









# THE ENGINEERING JOURNAL



VOLUME 25

JANUARY - DECEMBER, 1942



PUBLISHED BY  
THE ENGINEERING INSTITUTE OF CANADA  
2050 MANSFIELD STREET  
MONTREAL, QUE.

# THE ENGINEERING JOURNAL

## INDEX TO VOLUME XXV JANUARY TO DECEMBER, 1942

	Page		Page
Abstracts of Current Literature. . . . .	32, 99, 168, 243, 307, 376, 428, 471, 517, 574, 627, 694	Cabinet Committee on Reconstruction. . . . .	105, 317, 378, 465, 632
Accident Prevention Methods and Results, Wills Maclachlan. . . . .	9	Can Professional Education be Liberalized? Dean C. R. Young	554
Discussion. . . . .	459	Canadian Engineers in England. . . . .	639
Air Bombing and Structural Defence, Engineering Aspects of, D. C. Tennant. . . . .	674	Canadian Industry in the War, C. D. Howe. . . . .	147
Air-Locks, The Use of, G. O. Boulton. . . . .	563	Canadian Institute of Steel Construction. . . . .	264
Air Raid Precautions as Related to Building Design, S. D. Lash. . . . .	28	Carrière, Capt. J. P., Construction of a By-pass Highway in England by Royal Canadian Engineers. . . . .	15
Aircraft, Tactics and Unorthodox, Major Oliver Stewart. . . . .	13	Carruthers, A. L., Brothers of the Bridge. . . . .	625
Alaska Highway, J. M. Wardle. . . . .	136	Causes and Effects of Damage to Electrical Machinery and Switching, C. A. Laverty. . . . .	604
Algoma Steel Corporation, Ltd., Moving a Coal Bridge at the, D. C. Tennant. . . . .	615	Charcoal Has War-Time Use. . . . .	235
Allcut, E. A., Producer Gas For Motor Transport. . . . .	223	Civil Defence, Institute Committee on Engineering Features of. . . . .	379, 478, 578, 633, 700
Allcut, E. A., The Significance of Industrial Relations. . . . .	557	Civilian Defence, Some of the Engineering Implications of, Walter D. Binger. . . . .	238
Alternative Babbitts, I. I. Sylvester. . . . .	502	Civilization, We Are In It Together In The Defence of, H. J. Cody. . . . .	686
Alternative Bronzes, G. E. Tait. . . . .	504	Clarke, K. H. J., The Metal Situation. . . . .	498
American Engineering Societies, Publications. . . . .	316	Coal Bridge at Algoma Steel Corporation, Moving a, D. C. Tennant. . . . .	615
American Society of Civil Engineers, Niagara Falls Meeting. . . . .	523, 635	Cody, H. J., We Are In It Together In The Defence of Civilization. . . . .	686
American Institute of Electrical Engineers. . . . .	199	Committee on Engineering Features on Civil Defence. . . . .	379, 478, 578, 633
Annual General and Professional Meeting, Fifty-sixth. . . . .	154	Committee on Industrial Relations. . . . .	379, 479, 578
Programme. . . . .	36	Committee on Post-War Problems. . . . .	378, 478, 632
Papers. . . . .	37	Committee on Reconstruction, Dominion Government. . . . .	105, 378
Report of Meeting. . . . .	154	Committee on the Training and Welfare of the Young Engineer. . . . .	174, 583, 638
Said at the Banquet. . . . .	166	Conservation, Public Health and, A. E. Berry. . . . .	667
Annual General and Professional Meeting, Fifty-seventh. . . . .	523, 623, 699	Conservation of Natural Resources With Some Reference to Post-War Planning. . . . .	663
Annual Reunion, University of Toronto Alumni. . . . .	718	Construction Features on the Extension of the Santurce Steam Plant, Puerto Rico, J. T. Farmer and E. A. Goodwin. . . . .	454
Association of Professional Engineers of Ontario. . . . .	119, 199, 264	Construction Industry, Regulations Affecting the. . . . .	571
Association of Professional Engineers of Saskatchewan. . . . .	719	Construction of a By-Pass Highway in England by Royal Canadian Engineers, Capt. J. P. Carrière. . . . .	15
As the Year Ends, Deau C. R. Young. . . . .	661	Contractor's Claim For Extras, A. . . . .	515
Babbitts, Alternative, I. I. Sylvester. . . . .	502	Discussion. . . . .	639
Banks, S. R., The Lions' Gate Bridge, Part 1. . . . .	210	Control of Man-Power in Canada. . . . .	624
Part 2. . . . .	282	Control of Technical Man-Power. . . . .	241
Part 3. . . . .	347	Controller of Construction, Order No. 12, Regulations Affecting the Construction Industry. . . . .	571
Part 4. . . . .	414	Coote, J. A., The Significance of Industrial Relations. . . . .	557
Barrett Chute Development, A. I. Malcolm. . . . .	402	Correspondence. . . . .	175, 317, 434, 481, 525, 583, 639
Berry, A. E., Public Health and Conservation. . . . .	667	Council For The Year 1941, Report of. . . . .	80
Binger, Walter D., Some of the Engineering Implications of Civilian Defence. . . . .	238	Couper, Dr. W. J., Wages Stabilization. . . . .	406
Birch, L. W., Trolley Coach Overhead Materials and Design. . . . .	231	Coventry, A. F., The Water Situation in Southern Ontario. . . . .	664
Book Reviews. . . . .	199, 316	Damage of Plant Through Enemy Action, Proneness to, Hal Gutteridge. . . . .	559
Boulton, G. O., The Use of Air-Locks. . . . .	563	Davidson, A. E., Mechanical Features of 220-kv. Lines in Ontario, 1940 and 1941. . . . .	496
Branches, Membership and Financial Statements of. . . . .	94	Development of Ground Water Supply, J. W. Simard. . . . .	669
<i>Branches, News of—</i>		Diesel Engines, Supercharging of Two-Stroke, F. Oederlin. . . . .	618
Border Cities. . . . .	48, 257, 325, 440, 646	<i>Discussions—</i>	
Calgary. . . . .	258, 390, 647, 713	The Manufacture of the 25-pounder in Canada, W. F. Drysdale. . . . .	298
Edmonton. . . . .	49, 191, 259, 531, 713	The Justification and Control of the Limit Design Method, F. P. Shearwood. . . . .	303
Halifax. . . . .	49, 114, 191, 259, 391, 532, 647, 713	Rational Column Analysis, J. A. Van den Broek. . . . .	360
Hamilton. . . . .	49, 259, 326, 441, 592, 647, 714	Accident Prevention Methods and Results, Wills Maclachlan. . . . .	459
Kingston. . . . .	441	Doherty, Robert E., Professional Development and Responsibility. . . . .	469
Lakehead. . . . .	50, 191, 327, 486, 714	Drainage Areas of Ontario, Forests and, F. A. MacDougall. . . . .	663
London. . . . .	50, 114, 192, 328, 442, 592	Drysdale, W. F., The Manufacture of the 25-pounder in Canada. . . . .	5
Moncton. . . . .	50, 260, 329, 486, 532	Discussion. . . . .	298
Montreal. . . . .	51, 114, 192, 260, 329, 391, 648, 714	Effect of Wet Coal on Pulverizer and Boiler Performance, Murray D. Stewart. . . . .	609
Niagara Peninsula. . . . .	51, 194, 262, 330, 391, 442	Elections and Transfers. . . . .	43, 109, 179, 253, 320, 386, 437, 528, 586, 642, 707
Ottawa. . . . .	51, 115, 194, 262, 330, 392, 593, 649, 715	Electrical Machinery and Switching, Causes and Effects of Damage to, C. A. Laverty. . . . .	604
Peterborough. . . . .	52, 195, 392, 443	Engineer Looks at Music, An, S. T. Fisher. . . . .	548
Quebec. . . . .	117		
Saguenay. . . . .	55, 115, 195, 393, 443, 486, 534, 716		
Saint John. . . . .	54, 443, 535		
St. Maurice Valley. . . . .	54, 119, 330, 393, 536, 649, 716		
Saskatchewan. . . . .	55, 117, 196, 263, 393, 649, 716		
Sault Ste. Marie. . . . .	55, 263, 330, 394, 717		
Toronto. . . . .	56, 196, 331, 717		
Vancouver. . . . .	196, 394, 443, 593, 649, 717		
Victoria. . . . .	119		
Winnipeg. . . . .	56		
British Aeroplane, The Quality Underlying the, Lt.-Col. W. Lockwood Marsh. . . . .	71		
Bronzes, Alternative, G. E. Tait. . . . .	504		
Brothers of the Bridge, A. L. Carruthers. . . . .	625		
Brown, Dean Ernest, receives honorary degree. . . . .	39		
Building Design, Air Raid Precautions as Related to, S. D. Lash. . . . .	28		
Building Fund, Branch Contributions to. . . . .	39		
By-pass Highway in England, Construction of, by Royal Canadian Engineers, Capt. J. P. Carrière. . . . .	15		

Engineer, The Place of the, Dean C. R. Young . . . . .	684	Malcolm, A. L., Barrett Chute Development . . . . .	624
Engineering as a Career . . . . .	248	Man-Power Control in Canada . . . . .	
Engineering Aspects of Air Bombing in Structural Defence, D. C. Tennant . . . . .	674	Management-Employee Problem for Engineers, The, J. W. Parker . . . . .	236
Engineering Features of Civil Defence, Committee on . . . 379, 478, 578, 633, 700		Manufacture of the 25-pounder in Canada, W. F. Drysdale . . Discussion . . . . .	5 298
Engineering in Canada, The Profession of . . . . .	174	Marsh, Lt.-Col. W. Lockwood, The Quality Underlying The British Aeroplane . . . . .	71
Engineers' Council for Professional Development—		Maude, John H., The New Oil-Hydraulic Press in Munition Manufacture . . . . .	66
Annual Report for 1941 . . . . .	29	Mechanical Features of 220-kv. Lines in Ontario, 1940 and 1941, A. E. Davison . . . . .	496
Guidance Booklet . . . . .	248	Meetings of Council . . . . . 41, 107, 175, 251, 318, 380, 482, 525, 585, 640,	705
Tenth Annual Meeting . . . . .	638, 689	Membership of Branches . . . . .	94
Vocational Guidance Manual . . . . .	583	Message from the President, Dean C. R. Young . . . . .	127
Essential Work Regulations, 1942 . . . . .	241	Message to Canadian Engineers, Lieut.-General A. G. L. McNaughton . . . . .	145
Farmer, J. T., Construction Features on the Extension of the Santurce Steam Plant, Puerto Rico . . . . .	454	Metal Situation, K. H. J. Clarke . . . . .	498
Farmer, J. T., The Modernization of a Puerto Rico Steam Plant . . . . .	342	Modernization of a Puerto Rico Steam Plant, The, J. T. Farmer and E. A. Goodwin . . . . .	342
Fees of Members Overseas . . . . .	433	Moving a Coal Bridge at the Algoma Steel Corporation, Ltd., D. C. Tennant . . . . .	615
<i>Financial Statements—</i>		Munition Industries, Subcontracting in Canada's, F. L. Jeckell . . . . .	279
Of the Institute . . . . .	84	Munitions Manufacture, The New Oil-Hydraulic Press in, John H. Maude . . . . .	66
Of the Branches . . . . .	94	Music, An Engineer Looks at, S. T. Fisher . . . . .	548
Fisher, S. T., An Engineer Looks at Music . . . . .	548	Myers, Charles Samuel, Psychology as Applied to Engineering . . . . .	508
Foreign Correspondents . . . . .	104	National Research Council of Canada, War Activities of, Dean C. J. Mackenzie . . . . .	141
Forests and Drainage Areas of Ontario, F. A. MacDougall . . . . .	663	National Selective Service . . . . .	248, 624
Frampton, A. H., The 220,000-volt System of the Hydro-Electric Power Commission of Ontario . . . . .	21	National Service—A Challenge to the Engineer, E. M. Little . . . . .	151
Fullerton, J. S., Substitute Solders . . . . .	499	Natural Resources With Some Reference to Post-War Planning, The Conservation of . . . . .	663
Gaherty, G. A., Wartime National Efficiency . . . . .	621	New Brunswick Agreement . . . . .	38
Generators in the U.S.A., Water-Wheel Driven, C. M. Laffoon . . . . .	457	New Field and a New Emphasis, A, Dean C. R. Young . . . . .	127
Goodwin, E. A., Construction Features on the Extension of the Santurce Steam Plant, Puerto Rico . . . . .	454	New Oil-Hydraulic Press in Munitions Manufacture, The, John H. Maude . . . . .	66
Goodwin, E. A., The Modernization of a Puerto Rico Steam Plant . . . . .	342	Newly Elected Officers of The Institute, Biographies . . . . .	180
Ground Water Supply, Development of, J. W. Simard . . . . .	669	News of Other Societies . . . . . 47, 119, 199, 264,	718
Gutteridge, Hal, Proneness to Damage of Plant Through Enemy Action . . . . .	559	Niagara Falls Joint Meeting . . . . .	523, 635
Howe, C. D., Canadian Industry in the War . . . . .	147	<i>Obituaries—</i>	
Hydro-Electric Power Commission of Ontario, the 220,000-volt System, A. H. Frampton and E. M. Wood . . . . .	21	Andrewes, Lieut.-Colonel William Edward . . . . .	440
Industrial Relations, Institute Committee on . . . 379, 479, 578, 700		Armstrong, Thomas Stirryaker . . . . .	389
Industrial Relations, The Significance of, E. A. Allcut and J. A. Coote . . . . .	557	Baltzell, Willie Harry . . . . .	591
<i>Institute Prizes—</i>		Blanchard, Joseph Elie . . . . .	47
Prize Awards, 1942 . . . . .	435	Bang, Claus Marius . . . . .	711
For Juniors and Students . . . . .	578	Boyd, William Gamble . . . . .	257
Rules Governing Award of . . . . .	587	Byers, Archibald Fullarton . . . . .	189
Institute Prize Winners, Biographies . . . . .	185	Cregeen, Kenneth Thomas . . . . .	190
Jacobsen, E. R., Letter from Washington . . . 433, 480, 524, 582, 637		Dennis, Earle Munro . . . . .	711
James Committee . . . . .	105, 317, 378, 465, 632	Duckworth, Walter Ritchie . . . . .	113
James Watt International Medal . . . . .	432	Duncan, G. Rupert . . . . .	389
Jane, Dr. R. S., Synthetic Rubber . . . . .	274	Evans, John Maurice . . . . .	530
Jeckell, F. L., Subcontracting in Canada's Munition Industries . . . . .	279	Fuller, Royden John . . . . .	190
Johnson, Howard, Shipyard Production Methods . . . . .	73	Hawley, George Prince . . . . .	47
King vs. Paradis and Farley, Inc., A Contractor's Claim for Extras . . . . .	515	Jackson, Donald Alphonse . . . . .	711
Discussion, E. P. Muntz . . . . .	639	Johnson, Edward Preston . . . . .	257
Letters to Editor . . . . .	703	Johnson, Harold Stanley . . . . .	645
Laffoon, C. M., Water-Wheel Driven Generators in the U.S.A. Landmark Disappears . . . . .	457 249	Johnston, William Morrison . . . . .	113
Lash, S. D., Air Raid Precautions as Related to Building Design . . . . .	28	Kester, Fred Henry . . . . .	530
Laverty, C. A., Causes and Effects of Damage to Electrical Machinery and Switching . . . . .	604	Kirkpatrick, Alexander M. . . . .	531
Legget, R. F., Conservation of Natural Resources with some Reference to Post-War Planning . . . . .	663	MacDiarmid, Archibald Alexander . . . . .	113
Legget's Memorandum . . . . .	379	Macphail, William Matheson . . . . .	711
Library Notes . . . . . 58, 120, 199, 265, 332, 395, 444, 487, 537, 594, 650, 720		Mahon, Harry Wendell . . . . .	485
Lions' Gate Bridge, The, Part 1, S. R. Banks . . . . .	210	McCurdy, Lyall Radcliffe . . . . .	646
Part 2 . . . . .	282	McDowall, Robert . . . . .	325
Part 3 . . . . .	347	Mews, John Courtenay . . . . .	190
Part 4 . . . . .	414	Millidge, Edwin Reginald . . . . .	531
Little, E. M., National Service—A Challenge to the Engineer . . . . .	151	Morrisey, Lieut.-Colonel Henry Fairweather . . . . .	485
MacDougall, F. A., Forests and Drainage Areas of Ontario . . . . .	663	Murray, Robert Leslie . . . . .	113
Mackenzie, Dean C. J., New Year Message . . . . .	3	Palmer, John . . . . .	325
Mackenzie, Dean C. J., The War Activities of the National Research Council of Canada . . . . .	141	Parker, Thomas Wint Weir . . . . .	190
Maclachlan, Wills, Accident Prevention Methods and Results. Discussion . . . . .	9 459	Porter, John Earle . . . . .	485
McNaughton, Lieut.-General A. G. L., A Message to Canadian Engineers . . . . .	145	Porter, Lawson B. . . . .	591
		Reynolds, Philip . . . . .	591
		Robertson, A. Ross . . . . .	712
		Schlemm, Leonard Ernest . . . . .	390
		Smither, William James . . . . .	113
		Swingler, Russell Henry . . . . .	325
		Tempest, John Sugden . . . . .	190
		Townsend, Lieut.-Colonel Charles Rowlett . . . . .	646
		Webb, Harry Randall . . . . .	592
		White, Squadron Leader Joseph J. . . . .	712
		Oederlin, F., The Supercharging of Two-Stroke Diesel Engines. Officers of The Institute, Newly Elected, Biographies . . . . .	618 180
		Oil-Hydraulic Press in Munitions Manufacture, The New, John H. Maude . . . . .	66

	Page		Page
Ontario, Forests and Drainage Areas of, F. A. MacDougall . . . . .	663	Simard, J. W., Development of Ground Water Supply . . . . .	669
Ontario, Hydro-Electric Power Commission, The 220,000-Volt System, A. H. Frampton and E. M. Wood . . . . .	21	Size and the Aeroplane, Major Oliver Stewart . . . . .	412
Ontario, The Water Situation in Southern, A. F. Coventry . . . . .	664	Solders, Substitute, J. S. Fullerton . . . . .	499
Organization and Work of Research Enterprises, Ltd., Colonel W. E. Phillips . . . . .	129	Stewart, Major Oliver, Size and The Aeroplane . . . . .	412
Parker, James W., The Management-Employee Problem for Engineers . . . . .	236	Stewart, Major Oliver, Tactics and Unorthodox Aircraft . . . . .	13
Peace Worth Fighting For, A. William E. Wickenden . . . . .	408	Stewart, Murray D., The Effect of Wet Coal on Pulverizer and Boiler Performance . . . . .	609
Personals . . . . . 44, 110, 187, 254, 321, 386, 437, 483, 528, 589, 643		Structural Defence Against Bombing, A Reference Book on Civil Defence . . . . .	578, 632
Phillips, Colonel W. E., The Organization and Work of Research Enterprises Limited . . . . .	129	Structural Defence, Engineering Aspects of Air Bombing and D. C. Tennant . . . . .	674
Place of The Engineer, The, Dean C. R. Young . . . . .	684	Subcontracting in Canada's Munition Industries, F. L. Jeckell . . . . .	279
Polish Engineers in Canada . . . . .	104	Substitute Solders, J. S. Fullerton . . . . .	499
Post-War Problems, Institute Committee on . . . . .	378, 478, 632	Supercharging of Two-Stroke Diesel Engines, F. Oederlin . . . . .	618
Post-War Planning, The Conservation of Natural Resources With Some Reference to . . . . .	663	Sylvester, I. I., Alternative Babbitts . . . . .	502
Preliminary Notice . . . . . 61, 122, 204, 268, 336, 397, 448, 489, 541, 596, 653, 723		Synthetic Rubber, Dr. R. S. Jane . . . . .	274
President's New Year Message . . . . .	3	Tait, G. E., Alternative Bronzes . . . . .	504
President's Trip to Quebec and The Maritimes . . . . .	432, 522	Tactics and Unorthodox Aircraft, Major Oliver Stewart . . . . .	13
President's Trip to The West . . . . .	175, 312	Technical Man-Power, Control of . . . . .	241
Professional Development and Responsibility, Robert E. Doherty . . . . .	469	Technical Personnel Regulations, 1942 . . . . .	241
Professional Recognition in the Services . . . . .	522	Tennant, D. C., Engineering Aspects of Air Bombing and Structural Defence . . . . .	674
Prize Awards, 1942 . . . . .	435	Tennant, D. C., Moving a Coal Bridge at the Algoma Steel Corporation, Limited . . . . .	615
Prize Winners, Institute, Biographies . . . . .	185	Tenth Annual Meeting of E.C.P.D. . . . .	689
Producer Gas For Motor Transport, A. E. Allcut . . . . .	223	Tin Conservation . . . . .	498
Profession of Engineering in Canada, The . . . . .	174	Trolley Coach Overhead Materials and Design, L. W. Birch . . . . .	231
Professional Recognition in The Services . . . . .	522	25-Pounder in Canada, Manufacture of, W. F. Drysdale . . . . .	5
Proneness to Damage of Plant Through Enemy Action, Hal Gutteridge . . . . .	559	Discussion . . . . .	298
Psychology as Applied to Engineering, Charles Samuel Myers . . . . .	508	220-kv. Lines in Ontario, 1940 and 1941, Mechanical Features of, A. E. Davison . . . . .	496
Public Health and Conservation, A. E. Berry . . . . .	667	220,000-Volt System of the Hydro-Electric Power Commission of Ontario, A. H. Frampton and E. M. Wood . . . . .	21
Puerto Rico, Construction Features on the Extension of the Santurce Steam Plant, J. T. Farmer and E. A. Goodwin . . . . .	454	Use of Air-Locks, G. O. Boulton . . . . .	563
Puerto Rico Steam Plant, The Modernization of a, J. T. Farmer and E. A. Goodwin . . . . .	342	Vocational Guidance Manual, Engineers' Council for Professional Development . . . . .	583
Pulverizer and Boiler Performance, The Effect of Wet Coal on, Murray D. Stewart . . . . .	609	Warime National Efficiency, G. A. Gaherty . . . . .	621
Quality Underlying the British Aeroplane, The, Lt.-Colonel W. Lockwood Marsh . . . . .	71	Wages Stabilization, Dr. W. J. Couper . . . . .	406
Recent Graduates in Engineering . . . . .	435	War Activities of the National Research Council of Canada, Dean C. J. Mackenzie . . . . .	141
Reconstruction and Re-establishment . . . . .	465	Wardle, J. M., The Alaska Highway . . . . .	136
Reconstruction, Cabinet Committee on . . . . . 105, 317, 378, 465, 632		Warime Bureau of Technical Personnel . . . . . 41, 81, 174, 249, 241, 581	581
Regional Meetings of Council . . . . .	313, 316, 318	Washington Letter, E. R. Jacobsen . . . . . 433, 480, 524, 582, 637, 698	698
Registration in The Faculties of Applied Science or Engineering in Canadian Universities, Session 1941-1942 . . . . .	39	Water Situation in Southern Ontario, The, A. F. Coventry . . . . .	664
Session 1942-1943 . . . . .	699	Water-Wheel Driven Generators in the U.S.A., C. M. Laffoon . . . . .	457
Regulations Affecting The Construction Industry, Controller of Construction . . . . .	571	We are in it Together in the Defence of Civilization, H. J. Cody . . . . .	686
Report of Council for the Year 1941 . . . . .	80	Webster Lectures . . . . . 313, 383, 478, 523	523
Reports from Branches . . . . .	90	Wet Coal on Pulverizer and Boiler Performance, The Effect of, Murray D. Stewart . . . . .	609
Research Enterprises Limited, The Organization and Work of, Colonel W. E. Phillips . . . . .	129	Wickenden, William E., A Peace Worth Fighting For . . . . .	408
Royal Canadian Engineers, Construction of a By-pass Highway in England by, Capt. J. P. Carrière . . . . .	15	Wood, E. M., The 220,000-Volt System of the Hydro-Electric Power Commission of Ontario . . . . .	21
Rubber, Synthetic, R. S. Jane . . . . .	274	Work Regulations, 1942 . . . . .	241
Santurce Steam Plant, Puerto Rico, Construction Features on The Extension of the, J. T. Farmer and E. A. Goodwin . . . . .	454	Wright, L. Austin, Man-Power Control in Canada . . . . .	624
Santurce Steam Plant, Puerto Rico, The Modernization of, J. T. Farmer and E. A. Goodwin . . . . .	342	Young, Dean C. R., A New Field and a New Emphasis . . . . .	127
Shipyards Production Methods, Howard Johnson . . . . .	73	Young, Dean C. R., As the Year Ends . . . . .	661
Significance of Industrial Relations, E. A. Allcut and J. A. Coote . . . . .	557	Young, Dean C. R., Biography . . . . .	173
		Young, Dean C. R., Can Professional Education be Liberalized? . . . . .	554
		Young, Dean C. R., Industrial Relations a Legitimate Field for Institute Activities . . . . .	578
		Young, Dean C. R., Testimonial Dinner to . . . . .	314
		Young, C. R., The Place of The Engineer . . . . .	684
		Young Engineer, The Committee on the Training and Welfare of the . . . . . 174, 583, 638	638



# THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 25

MONTREAL, JANUARY 1942

NUMBER 1



"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

★ ★ ★

PUBLISHED MONTHLY BY  
THE ENGINEERING INSTITUTE  
OF CANADA

2050 MANSFIELD STREET - MONTREAL

L. AUSTIN WRIGHT, M.E.I.C.  
*Editor*

N. E. D. SHEPPARD, M.E.I.C.  
*Advertising Manager*

#### PUBLICATION COMMITTEE

C. K. McLEOD, M.E.I.C., *Chairman*  
R. DeL. FRENCH, M.E.I.C., *Vice-Chairman*  
A. C. D. BLANCHARD, M.E.I.C.  
H. F. FINNEMORE, M.E.I.C.  
T. J. LAFRENIÈRE, M.E.I.C.

## CONTENTS

MUZZLE OF 25-POUNDER BARREL . . . . .	Cover
<i>(Photo Courtesy Public Information)</i>	
PRESIDENT'S MESSAGE . . . . .	3
THE MANUFACTURE OF THE 25-POUNDER IN CANADA . . . . .	5
<i>W. F. Drysdale, M.E.I.C.</i>	
ACCIDENT PREVENTION METHODS AND RESULTS . . . . .	9
<i>Wills Maclachlan, M.E.I.C.</i>	
TACTICS AND UNORTHODOX AIRCRAFT . . . . .	13
<i>Major Oliver Stewart</i>	
CONSTRUCTION OF A BY-PASS HIGHWAY IN ENGLAND BY ROYAL CANADIAN ENGINEERS . . . . .	15
<i>Capt. J. P. Carrière, M.E.I.C.</i>	
THE 220,000-VOLT SYSTEM OF THE HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO . . . . .	21
<i>A. H. Frampton and E. M. Wood, M.E.I.C.</i>	
AIR RAID PRECAUTIONS AS RELATED TO BUILDING DESIGN . . . . .	28
<i>S. D. Lash, M.E.I.C.</i>	
ANNUAL REPORT FOR 1941 TO THE ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT . . . . .	29
ABSTRACTS OF CURRENT LITERATURE . . . . .	32
ANNUAL MEETING . . . . .	36-37
FROM MONTH TO MONTH . . . . .	38
PERSONALS . . . . .	44
Visitors to Headquarters . . . . .	46
Obituaries . . . . .	47
NEWS OF THE BRANCHES . . . . .	48
NEWS OF OTHER SOCIETIES . . . . .	47
LIBRARY NOTES . . . . .	58
PRELIMINARY NOTICE . . . . .	61
EMPLOYMENT SERVICE . . . . .	62

Price 50 cents a copy, \$3.00 a year: in Canada, British Possessions, United States and Mexico. \$4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, \$2.00 a year. —Entered at the Post Office, Montreal, as Second Class Matter.

THE INSTITUTE as a body is not responsible either for the statements made or for the opinions expressed in the following pages.

# THE ENGINEERING INSTITUTE OF CANADA

## MEMBERS OF COUNCIL

### PRESIDENT

C. J. MACKENZIE, Ottawa, Ont.

### VICE-PRESIDENTS

†A. L. CARRUTHERS, Victoria, B.C.  
\*McNEELY DuBOISE, Arvida, Que.

\*J. CLARK KEITH, Windsor, Ont.  
†DeGASPE BEAUBIEN, Montreal, Que.

†K. M. CAMERON, Ottawa, Ont.  
\*W. S. WILSON, Sydney, N.S.

### PAST-PRESIDENTS

\*J. B. CHALLIES, Montreal, Que.

†H. W. McKIEL, Sackville, N.B.

†T. H. HOGG, Toronto, Ont.

### COUNCILLORS

†A. E. BERRY, Toronto, Ont.  
\*G. P. F. BOESE, Calgary, Alta.  
\*I. W. BUCKLEY, Sydney, N.S.  
\*J. M. CAMPBELL, Lethbridge, Alta.  
\*A. L. CARRUTHERS, Victoria, B.C.  
†D. S. ELLIS, Kingston, Ont.  
†J. M. FLEMING, Port Arthur, Ont.  
†I. M. FRASER, Saskatoon, Sask.  
†J. H. FREGEAU, Three Rivers, Que.  
†J. GARRETT, Edmonton, Alta.  
†S. W. GRAY, Halifax, N.S.

†J. G. HALL, Montreal, Que.  
†W. G. HUNT, Montreal, Que.  
†E. M. KREBSER, Walkerville, Ont.  
\*J. L. LANG, Sault Ste. Marie, Ont.  
\*A. LARIVIERE, Quebec, Que.  
†H. N. MACPHERSON, Vancouver, B.C.  
\*W. R. MANOCK, Fort Erie North, Ont.  
\*H. MASSUE, Montreal, Que.  
†H. F. MORRISEY, Saint John, N.B.  
†W. H. MUNRO, Ottawa, Ont.  
\*W. L. McFAUL, Hamilton, Ont.

†C. K. McLEOD, Montreal, Que.  
\*J. H. PARKIN, Ottawa, Ont.  
\*B. R. PERRY, Montreal, Que.  
†G. McL. PITTS, Montreal, Que.  
\*J. W. SANGER, Winnipeg, Man.  
†M. G. SAUNDERS, Arvida, Que.  
\*H. R. SILLS, Peterborough, Ont.  
\*C. E. SISSON, Toronto, Ont.  
\*G. E. SMITH, Moncton, N.B.  
†J. A. VANCE, Woodstock, Ont.  
\*For 1941 †For 1941-42 †For 1941-42-43

### TREASURER

JOHN STADLER, Montreal, Que.

### GENERAL SECRETARY

L. AUSTIN WRIGHT, Montreal, Que.

### ASSISTANT GENERAL SECRETARY

LOUIS TRUDEL, Montreal, Que.

### SECRETARY-EMERITUS

R. J. DURLEY, Montreal, Que.

## STANDING COMMITTEES

### FINANCE

DeG. BEAUBIEN, *Chairman*  
J. E. ARMSTRONG  
G. A. GAHERTY  
J. A. McCRORY  
F. NEWELL  
J. STADLER, *Treasurer*

### LIBRARY AND HOUSE

BRIAN R. PERRY, *Chairman*

### LEGISLATION

E. M. KREBSER, *Chairman*  
R. L. DOBBIN  
R. J. DURLEY

### PAPERS

J. A. VANCE, *Chairman*  
DeG. BEAUBIEN  
K. M. CAMERON  
McN. DuBOISE  
J. C. KEITH  
W. S. WILSON

### PUBLICATION

C. K. McLEOD, *Chairman*  
R. DeL. FRENCH, *Vice-Chairman*  
A. C. D. BLANCHARD  
H. F. FINNEMORE  
T. J. LAFRENIERE

## SPECIAL COMMITTEES

### BOARD OF EXAMINERS AND EDUCATION

R. A. SPENCER, *Chairman*  
I. M. FRASER  
W. E. LOVELL  
A. P. LINTON  
H. R. MacKENZIE  
E. K. PHILLIPS

### PAST-PRESIDENTS' PRIZE

R. DeL. FRENCH, *Chairman*  
H. A. LUMSDEN  
H. R. MacKENZIE  
J. O. MARTINEAU  
R. W. McCOLOUGH

### GZOWSKI MEDAL

H. O. KEAY, *Chairman*  
H. V. ANDERSON  
W. H. POWELL  
H. J. VENNES  
A. O. WOLFF

### LEONARD MEDAL

A. D. CAMPBELL, *Chairman*  
L. L. BOLTON  
A. E. CAMERON  
G. E. COLE  
V. DOLMAGE

### DUGGAN MEDAL AND PRIZE

J. T. FARMER, *Chairman*  
J. M. FLEMING  
R. C. FLITTON

### PLUMMER MEDAL

J. F. HARKOM, *Chairman*  
F. G. GREEN  
R. E. GILMORE  
E. VIENS  
C. R. WHITTEMORE

### PROFESSIONAL INTERESTS

J. B. CHALLIES, *Chairman*  
G. A. GAHERTY  
O. O. LEFEBVRE  
H. W. McKIEL  
J. A. VANCE

### MEMBERSHIP

H. N. MACPHERSON, *Chairman*

### STUDENTS' AND JUNIORS' PRIZES

#### Zone A (Western Provinces)

H. N. Ruttan *Prize*

A. L. CARRUTHERS, *Chairman*  
J. M. CAMPBELL  
H. N. MACPHERSON

#### Zone B (Province of Ontario)

John Galbraith *Prize*

K. M. CAMERON, *Chairman*  
W. H. MUNRO  
J. H. PARKIN

#### Zone C (Province of Quebec)

Phelps Johnson *Prize (English)*

McN. DuBOISE, *Chairman*  
C. K. McLEOD  
H. J. VENNES

#### Ernest Marceau *Prize (French)*

DeG. BEAUBIEN, *Chairman*  
J. H. FREGEAU  
A. LARIVIERE

#### Zone D (Maritime Provinces)

Martin Murphy *Prize*

W. S. WILSON, *Chairman*  
I. W. BUCKLEY  
S. W. GRAY

### INTERNATIONAL RELATIONS

C. R. YOUNG, *Chairman*  
J. B. CHALLIES, *Vice-Chairman*  
E. A. ALLCUT  
R. W. ANGUS  
C. CAMSELL  
J. M. R. FAIRBAIRN  
O. O. LEFEBVRE  
M. J. McHENRY  
H. H. VAUGHAN

### RADIO, BROADCASTING

G. M. PITTS, *Chairman*  
R. J. DURLEY

### DETERIORATION OF CONCRETE STRUCTURES

R. B. YOUNG, *Chairman*  
E. VIENS, *Vice-Chairman*  
G. P. F. BOESE  
A. G. FLEMING  
W. G. GLIDDEN  
O. O. LEFEBVRE  
J. A. McCRORY  
C. J. MACKENZIE  
J. H. McKINNEY  
R. M. SMITH

### WESTERN WATER PROBLEMS

G. A. GAHERTY, *Chairman*  
C. H. ATTWOOD  
C. CAMSELL  
L. C. CHARLESWORTH  
A. GRIFFIN  
T. H. HOGG  
O. O. LEFEBVRE  
C. J. MACKENZIE  
F. H. PETERS  
S. G. PORTER  
J. M. WARDLE

### THE YOUNG ENGINEER

H. F. BENNETT, *Chairman*  
J. BENOIT  
D. S. ELLIS  
J. N. FINLAYSON  
R. DeL. FRENCH  
C. A. D. FOWLER  
R. E. HEARTZ  
C. C. KIRBY  
R. F. LEGGETT  
A. P. LINTON  
A. E. MACDONALD  
H. W. McKIEL  
R. M. SMITH  
H. R. WEBB

---

“To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public.”

---

## NEW YEAR MESSAGE

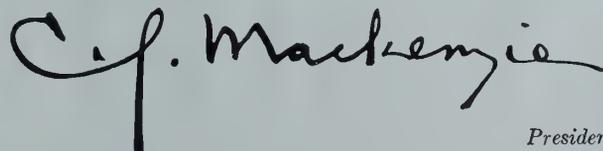
CONVENTIONAL messages of cordial greetings and good wishes for the coming year seem out of harmony with the realities of January 1st, 1942. We, as members of The Engineering Institute of Canada, are not ashamed of the part engineers have played to date in the war; it is not, however, with complacency that we face the third year of the war, but with a grim determination to increase not only our efforts but our effectiveness as engineers, as Canadians, as members of an awakened alliance of free peoples joined in deadly and perilous conflict with the most treacherous, unscrupulous and evil forces the world has ever known.

The dark hours through which we are bound to pass in 1942 will call for high courage; not only courage in combat but the courage which is needed to sustain judgement and a sense of proportion as the battle surges back and forth, presenting alternately disheartening defeats and encouraging victories, the courage which enables us to moderate emotional optimism and temper reverses, the courage which enables us to look squarely at our weaknesses and to recognize the strength and resources of our enemies.

It is not courage but folly to dismiss the possibility that before the year is out actual fighting may come to our shores. It is not courage but rather lack of it that makes for unpreparedness. It is nothing but nonsense at this time to think in terms of “national defence” instead of “total war.”

We as engineers have also, I suggest, a particular responsibility in this struggle of machines, power and technical devices. Not only must we as a body design, manufacture and operate innumerable engines of war but we must see to it that the industrial and technical resources of the country, both human and material, are utilized in the most effective way. We must avoid uninformed criticism of delays in “getting into production” for we know how inexorable is the time factor when new designs have to be prepared, new factories built and tooled for new processes, but on the other hand we must demand that there shall be no self satisfaction and that every week and every month efficiency and production must be greater and still greater. We are now entering that phase of the conflict when we must insist that nothing short of the most intelligent and effective utilization of our total human resources can be accepted.

We may take some satisfaction in the fact that for 1942 the lines of battle are clearly drawn. With the entry of the United States the world is now sharply divided into two camps, the time for talk is over, the issues are clear and a fight to the finish is on. To quote the stirring words of Churchill “Conquer we must, conquer we shall” for “without victory there is no survival.”



*President*

# THE ENGINEERING INSTITUTE OF CANADA

## OFFICERS OF BRANCHES

### BORDER CITIES

*Chairman*, H. L. JOHNSTON  
*Vice-Chair.*, G. G. HENDERSON  
*Executive*, W. P. AUGUSTINE  
 J. F. G. BLOWEY  
 W. R. STICKNEY  
*(Ex-Officio)*, E. M. KREBSER  
 G. E. MEDLAR  
*Sec.-Treas.*, J. B. DOWLER,  
 754 Chilver Road,  
 Walkerville, Ont.

### CALGARY

*Chairman*, J. B. DEHART  
*Vice-Chair.*, H. J. McEWEN  
*Executive*, F. J. HEUPERMAN  
 T. D. STANLEY  
 J. W. YOUNG  
*(Ex-Officio)*, G. P. F. BOESE  
 J. HADDIN  
 J. McMILLAN  
*Sec.-Treas.*, P. F. PEELE  
 248 Scarboro Avenue,  
 Calgary, Alta.

### CAPE BRETON

*Chairman*, J. A. MacLEOD  
*Executive*, J. A. RUSSELL M. F. COSSITT  
 A. P. THEUERKAUF  
*(Ex-Officio)*, I. W. BUCKLEY  
 W. S. WILSON  
*Ses.-Treas.*, S. C. MIFFLEN,  
 60 Whitney Ave., Sydney, N.S.

### EDMONTON

*Chairman*, R. M. HARDY  
*Vice-Chair.*, D. A. HANSEN  
*Executive*, J. A. CARRUTHERS  
 C. W. CARRY  
 D. HUTCHISON  
 B. W. PITFIELD  
 E. R. T. SKARIN  
 W. F. STEVENSON  
*(Ex-Officio)*, J. GARRETT  
 E. NELSON  
*Sec.-Treas.*, F. R. BURFIELD,  
 Water Resources Office,  
 Provincial Government,  
 Edmonton, Alta.

### HALIFAX

*Chairman*, P. A. LOVETT  
*Executive*, A. E. CAMERON  
 G. T. CLARKE G. J. CURRIE  
 A. E. FLYNN J. D. FRASER  
 D. G. DUNBAR J. A. MACKAY  
 J. F. F. MacKENZIE  
 J. W. MacDONALD  
 G. T. MEDFORTH  
*(Ex-Officio)*, S. L. FULTZ  
*Sec.-Treas.*, S. W. GRAY,  
 The Nova Scotia Power  
 Commission,  
 Halifax, N.S.

### HAMILTON

*Chairman*, W. A. T. GILMOUR  
*Vice-Chair.*, S. SHUPE  
*Executive*, C. H. HUTTON T. S. GLOVER  
 H. A. COOCH A. C. MACNAB  
*(Ex-Officio)*, ALEX. LOVE W. L. McFAUL  
*Sec.-Treas.*, A. R. HANNAFORD,  
 354 Herkimer Street,  
 Hamilton, Ont.

### KINGSTON

*Chairman*, T. A. McGINNIS  
*Vice-Chair.*, P. ROY  
*Executive*, V. R. DAVIES  
 K. H. McKIBBIN  
 K. M. WINSLOW  
*(Ex-Officio)*, A. H. MUNRO  
 G. G. M. CARR-HARRIS  
 D. S. ELLIS  
*Sec.-Treas.*, J. B. BATY,  
 Queen's University,  
 Kingston, Ont.

### LAKEHEAD

*Chairman*, B. A. CULPEPER  
*Vice-Chair.*, MISS E. M. G. MacGILL  
*Executive*, E. J. DAVIES  
 J. I. CARMICHAEL  
 S. E. FLOOK  
 S. T. McCAVOUR  
 R. B. CHANDLER  
 W. H. SMALL  
*(Ex-Officio)*, C. D. MACKINTOSH  
 H. G. O'LEARY  
 J. M. FLEMING  
*Sec.-Treas.*, W. C. BYERS,  
 c/o C. D. Howe Co. Ltd.,  
 Port Arthur, Ont.

### LETHBRIDGE

*Chairman*, C. S. DONALDSON  
*Vice-Chair.*, W. MELDRUM  
*Executive*, R. F. P. BOWMAN G. S. BROWN  
 N. H. BRADLEY  
 C. S. CLENDENING  
*(Ex-Officio)*, J. M. CAMPBELL  
 A. J. BRANCH J. T. WATSON  
*Sec.-Treas.*, R. B. McKENZIE,  
 McKenzie Electric Ltd.,  
 706, 3rd Ave. S., Lethbridge, Alta.

### LONDON

*Chairman*, R. W. GARRETT  
*Vice-Chair.*, F. T. JULIAN  
*Executive*, V. A. McKILLOP  
 F. C. BALL  
 F. BELL  
 T. L. McMANAMNA  
 R. S. CHARLES  
*(Ex-Officio)*, H. F. BENNETT  
 J. A. VANCE  
*Sec. Treas.*, H. G. STEAD,  
 60 Alexandra Street,  
 London, Ont.

### MONCTON

*Chairman*, F. O. CONDON  
*Vice-Chair.*, H. J. CRUDGE  
*Executive*, B. E. BAYNE E. R. EVANS  
 G. L. DICKSON E. B. MARTIN  
 T. H. DICKSON G. E. SMITH  
 R. H. EMMERSON  
*(Ex-Officio)*, H. W. McKIEL  
*Sec.-Treas.*, V. C. BLACKETT,  
 Engr. Dept., C.N.R.,  
 Moncton, N.B.

### MONTREAL

*Chairman*, R. E. HEARTZ  
*Vice-Chair.*, J. A. LALONDE  
*Executive*, E. V. GAGE  
 P. E. POITRAS  
 I. S. PATTERSON  
 J. B. STIRLING  
 J. M. CRAWFORD  
 J. COMEAU  
*(Ex-Officio)*, J. B. CHALLIES  
 DE G. BEAUBIEN  
 J. G. HALL  
 W. G. HUNT  
 H. MASSUE  
 C. K. McLEOD  
 B. R. PERRY  
 G. M. PITTS  
*Sec. Treas.*, L. A. DUCHASTEL  
 40 Kelvin Avenue,  
 Outremont, Que.

### NIAGARA PENINSULA

*Chairman*, A. L. McPHAIL  
*Vice-Chair.*, C. G. CLINE  
*Executive*, L. J. RUSSELL  
 J. H. TUCK  
 A. C. BLUE  
 G. F. VOLLMER  
 G. E. GRIFFITHS  
 D. W. BRACKEN  
 L. L. GIBBORNE  
*(Ex-Officio)*, W. R. MANOCK  
*Sec.-Treas.*, J. H. INGS,  
 1870 Ferry Street,  
 Niagara Falls, Ont.

### OTTAWA

*Chairman*, T. A. McELHANNEY  
*Executive*, J. H. IRVINE  
 W. G. C. GLIDDEN  
 A. A. SWINNERTON  
 W. H. NORRISH  
*(Ex-Officio)*, R. M. PRENDERGAST  
 C. J. MacKENZIE  
 J. H. PARKIN  
 W. H. MUNRO  
*Sec.-Treas.*, R. K. ODELL  
 Dept. of Mines and Resources,  
 Ottawa, Ont.

### PETERBOROUGH

*Chairman*, J. CAMERON  
*Executive*, A. J. GIRDWOOD I. F. McRAE  
 J. W. PIERCE F. R. POPE  
*(Ex-Officio)*, R. L. DOBBIN  
 H. R. SILLS  
*Sec.-Treas.*, A. L. MALBY  
 D. J. EMERY,  
 589 King Street,  
 Peterborough, Ont.

### QUEBEC

*Life Hon.-*  
*Chair.*, A. R. DECARY  
*Chairman*, L. C. DUPUIS  
*Vice-Chair.*, RENÉ DUPUIS  
*Executive*, O. DESJARDINS  
 R. SAUVAGE G. ST-JACQUES  
 S. PICARD L. GAGNON  
 G. W. WADDINGTON  
*(Ex-Officio)*, A. LARIVIÈRE  
 R. B. McDUNNOUGH P. MÉTHÉ  
*Sec.-Treas.*, PAUL VINCENT,  
 Colonization Department,  
 Room 333-A, Parliament Bldgs.,  
 Quebec, Que.

### SAGUENAY

*Chairman*, N. F. McCAGHEY  
*Vice-Chair.*, R. H. RIMMER  
*Executive*, B. BAUMAN  
 G. B. MOXON  
 A. I. CUNNINGHAM  
 W. J. THOMSON  
*(Ex-Officio)*, McN. DuBOISE  
 M. G. SAUNDERS  
 J. W. WARD  
*Sec.-Treas.*, D. S. ESTABROOKS,  
 Price Bros. & Co. Ltd.,  
 Riverbend, Que.

### SAINT JOHN

*Chairman*, F. A. PATRIQUEN  
*Vice-Chair.*, D. R. SMITH  
*Executive*, A. O. WOLFF  
 H. P. LINGLEY  
 W. B. AKERLEY  
*(Ex-Officio)*, J. P. MOONEY  
 H. F. MORRISEY  
*Sec.-Treas.*, V. S. CHESNUT,  
 P.O. Box 1393,  
 Saint John, N.B.

### ST. MAURICE VALLEY

*Chairman*, A. H. HEATLEY  
*Vice-Chair.*, H. G. TIMMIS  
*Executive*, A. C. ABBOTT J. M. MITCHELL  
 R. DORION G. RINFRET  
 V. JEPSEN H. J. WARD  
 J. JOYAL H. K. WYMAN  
 H. O. KEAY  
*(Ex-Officio)*, C. H. CHAMPION  
 J. H. FREGEAU  
*Sec.-Treas.*, C. G. deTONNANCOUR  
 Engineering Department,  
 Shawinigan Chemicals, Limited,  
 Shawinigan Falls, Que.

### SASKATCHEWAN

*Chairman*, R. A. McLELLAN  
*Vice-Chair.*, A. P. LINTON  
*Executive*, R. W. JICKLING  
 H. R. MacKENZIE  
 B. RUSSELL  
 G. L. MacKENZIE  
 C. J. McGAVIN  
 A. A. MURPHY  
*(Ex-Officio)*, I. M. FRASER  
*Sec.-Treas.*, STEWART YOUNG  
 P. O. Box 101,  
 Regina, Sask.

### SAULT STE. MARIE

*Chairman*, E. M. MacQUARRIE  
*Vice-Chair.*, L. R. BROWN  
*Executive*, R. A. CAMPBELL  
 N. C. COWIE  
 C. O. MADDOCK  
 C. R. MURDOCK  
*(Ex-Officio)*, J. L. LANG  
 A. E. PICKERING  
*Sec.-Treas.*, O. A. EVANS,  
 159 Upton Road,  
 Sault Ste. Marie, Ont.

### TORONTO

*Chairman*, H. E. BRANDON  
*Vice-Chair.*, W. S. WILSON  
*Executive*, F. J. BLAIR  
 W. H. M. LAUGHLIN  
 G. R. JACK  
 D. FORGAN  
 R. F. LEGGETT  
 S. R. FROST  
*(Ex-Officio)*, A. E. BERRY  
 N. MacNICOL  
 T. H. HOGG  
 C. E. SISSON  
*Sec.-Treas.*, J. J. SPENCE  
 Engineering Building  
 University of Toronto,  
 Toronto, Ont.

### VANCOUVER

*Chairman*, W. O. SCOTT  
*Vice-Chair.*, W. N. KELLY  
*Executive*, H. P. ARCHIBALD  
 I. C. BARTROP  
 H. C. FITZ-JAMES  
 H. J. MacLEOD  
 R. E. POTTER  
*(Ex-Officio)*, J. N. FINLAYSON  
 T. V. BERRY  
 H. N. MacPHERSON  
*Sec.-Treas.*, P. B. STROYAN  
 2099 Beach Avenue,  
 Vancouver, B.C.

### VICTORIA

*Chairman*, G. M. IRWIN  
*Vice-Chair.*, A. S. G. MUSGRAVE  
*Executive*, J. H. BLAKE  
 E. DAVIS  
 A. L. FORD  
 P. T. O'GRADY  
*(Ex-Officio)*, E. W. IZARD  
 A. L. CARRUTHERS  
*Sec.-Treas.*, K. REID,  
 1053 Pentrelew Place,  
 Victoria, B.C.

### WINNIPEG

*Chairman*, V. MICHIE  
*Vice-Chair.*, D. M. STEPHENS  
*Executive*, C. V. ANTENBRING  
 H. B. BREHAUT  
 J. T. DYMENT  
 H. W. McLEOD  
 T. E. STOREY  
*(Ex-Officio)*, H. L. BRIGGS  
 J. W. SANGER  
*Sec.-Treas.*, C. P. HALTALIN,  
 303 Winnipeg Electric Chambers,  
 Winnipeg, Man.

# THE MANUFACTURE OF THE 25-POUNDER IN CANADA

W. F. DRYSDALE, M.E.I.C.

Director-General of Industrial Planning, Department of Munitions and Supply, Ottawa, Ont.

Paper to be presented before the General Professional Meeting of The Engineering Institute of Canada, at Montreal, Que., on February 5th, 1942.

Among the projects with which the author has had to do during his services in Ottawa, one of the most interesting from a general and engineering point of view has been the production of the 25-pounder gun.

This weapon is now being manufactured by Sorel Industries at Sorel, Quebec, and the contents of this paper are based on close association with the work at Sorel for the past eighteen months.

Among the major difficulties encountered in building up this industry were the problems of personnel, housing, and the working out of plans to harmonize workers of many different trades from many different localities. The plant is located in a farming area bordering on an inland port, where few men were skilled in the arts which were called for.

The new 25-pdr. has replaced both the old 18-pdr. and the 4.5" howitzer. It was designed for use both as a field gun and a howitzer, and as its name implies, fires a shell weighing 25 lb.

Here it may not be out of place to mention that the 25-pdr. is a gun with separate ammunition; that is to say, the shell is loaded first, followed by the insertion of a brass cartridge case containing the propelling charge. The object of this separate loading is to permit the use of different charges, depending on whether the gun is being used as a field gun or a howitzer; a field gun has a comparatively low elevation and long range, whilst a howitzer generally has a high angle of elevation with a relatively short range, giving the projectile a high angle of descent.

The following brief description will give a general idea of the 25-pdr. gun and its accessories. Beginning at the ground level, the equipment comprises a firing platform, the axle unit and brake gear, the trail and carriage assembly, elevating, traversing and firing gear, the cradle and recuperator, the gun body and breech mechanism (See Fig. 1).

The *firing platform* is a circular fabricated ring, which, when the gun is in position, rests on the ground. The



Fig. 1—Minister of National Defence inspecting 25-pounder field gun at Sorel, Que.

carriage, which is fitted with rubber-tired wheels, has a trail which straddles the platform. On lifting the trail, it is easy to rotate the whole structure and meet the enemy from any direction, or prepare the gun for travelling (See Figs. 2 and 3).

The *carriage* is provided with two rubber-tired wheels, connected by an axle to which in turn is fitted a fabricated box-type *trail*, roughly 8 ft. long. To the end of the trail is fitted a spade which, when embedded in the ground, counteracts the shock of recoil on firing (See Fig. 4).

The *axle* passes through the lower part of a "U" fabri-

cated *top carriage*; on the top of each vertical side of the "U" is a bearing for the trunnion, or axis about which the gun moves in a vertical plane.

The *top carriage* carries a long, rectangular box, also fabricated, to the outside of which is riveted a trunnion band carrying a trunnion on each side.

Inside this long, rectangular box is fitted one of the most intricate parts of the equipment, viz.:—the recuperator.

The *recuperator* is the mechanism which absorbs the energy of the recoil when the gun is fired. Later in this paper this most important component will be further explained.

The top of the recuperator is machined to receive the



Fig. 2—Unlimbering 25-pounder gun ready for firing.

gun body which, when fitted into place, forms an integral part of it.

The *gun body* consists of a jacket, separate barrel, breech ring, breech block and breech mechanism.

From the above brief outline of the main parts of the 25-pdr. equipment, it will be realized that there are innumerable other components not specifically mentioned. Actually over 700 components are assembled to make up a single complete equipment, to which must be added other items, officially known as separately demandable stores, plus ancillary parts, which may include anything from a leather strap to a hand spike or set of drag ropes, or from a bucket to an oil-can.

It may be interesting to note the ways in which the 25-pdr. differs in design from previous field guns.

In the 18-pdr. gun of the last war the gun itself was built up; its inner tube was wound with high tension steel wire to give the necessary resistance to withstand the pressure of the discharge. On this inner, wire-wrapped tube was shrunk a cylindrical steel jacket.

This meant that as soon as the rifling was worn, the gun had to be taken out of service and replaced by a new one whilst the old one was being returned to the factory for repair.

This is where the new 25-pdr. gun has a great advantage, because it is made up of an inner tube or barrel and a separate outside jacket covering roughly half the length of the barrel.

To provide for easy replacement the barrel is fitted into the jacket with a small clearance on the diameter, roughly eight thousandths of an inch, while its breech end fits into a seat having a very slight taper. Thanks to this arrangement it is possible to unscrew the breech ring, withdraw the barrel and insert a new barrel secured by the same breech ring in about fifteen minutes. (See Fig. 5).

Coming now to the recuperator, formerly most field guns had mechanical recuperators whose springs took the recoil and returned the barrel to the firing position. During the last war the French and later the British, introduced the



Fig. 3—25-pounder gun travelling.

hydraulic type of recuperator along the lines of which the 25-pdr. recuperator has been developed.

The recuperator consists of a long steel block, the surfaces of which have been machined to very fine limits. Three or four holes which control the recoil and recuperator mechanism are bored through the entire length of the block, each with mirror-like finish.

Later it may be possible to give a few more details, but for the time being just imagine a block of steel roughly 10 by 5 in. cross section and 5 ft. long, bored and honed through its entire length to approximately  $2\frac{1}{2}$  in. diameter, each hole necessarily accurate in alignment to a thousandth of an inch.

The factory at Sorel which now covers more than 14 acres, is a joint venture between the Canadian Government and Messrs. Simard, who represent and own Marine Industries Limited at Sorel. It is not necessary to recite the details leading up to the formation of this company, nor all the vicissitudes we passed through before reaching the present state, but it may be said that at the present time the plant is producing 25-pdr. equipments at the rate of fifty per month. Incidentally, four-inch naval guns are also being manufactured and will shortly come into full production.

It is noteworthy that Sorel is the only factory on the North American continent manufacturing guns from the scrap metal stage to the finished article.

The buildings, of up-to-date design, consist of a laboratory, power house, steel-making plant, machine shop and fabricating shop.

The steel-making plant, with rolling-mill equipment, a forge shop with presses and hammers ranging from 2,000 tons downward, served by up-to-date heating furnaces, roughing out machinery, heat treating and annealing equipment and complete die-making shop, are housed in one building of three bays covering approximately 250,000 sq. ft.

Alongside this shop is a separate large machining and assembly shop and again adjacent is a steel plate fabricating establishment. It is proposed to span one of the gaps between two of the shops to accommodate increased production.

All necessary services, including oil, electricity, steam and compressed air, are supplied to the various units of the plant by a tunnel system over 2,200 ft. long.

Special attention has been given to that most important organization in any modern engineering production shop, the processing and planning department. Thanks to our good friends, the automobile manufacturers, a planning system has been set up along the lines used in their industry, i.e., the machine tools needed for each individual part to be machined have all been selected and placed together. For instance, in the machining of the recuperator block we have the following operations: planing, milling, slotting, boring, honing, rifling, threading and drilling. All the appropriate machines for the above operations have been gathered together and laid down in the sequence of the different operations.

This procedure has been carried out all through the shop for each component part.

One section of the planning department is responsible for the machining operations and design of jigs, fixtures and gauges, and keeps a constant record of the loading of each machine tool so that the work is continually fed through the shop in a balanced order.

Operation sheets for each individual part have been got out listing the surplus material to be removed, the tolerances to be observed, the appropriate tool or cutter to be used, the speed and feed at which the machine should be run and the jig, fixture or gauge to be used. Thus every process is systematised and all the foreman has to do is to supervise the work and assist his men in getting the best results.

Another section of the planning department is responsible for ordering, either in the shops or from outside sources, the appropriate material and an efficient follow-up organization sees to it that the required material is to hand at the right time.

All this presents a very different picture from the old days when a mechanic having finished his job, walked down the shop to pick up the next of his own choosing.

The steel foundry and rolling-mill shop is a long building, approximately 570 by 440 ft., which contains the three electric furnaces of 4, 8 and 20-tons capacity, respectively.

From these furnaces, fed with scrap and the necessary raw materials, are produced monthly some 3,000 tons of ingots for gun barrels, jackets, breech rings, recuperator blocks and their components. All these parts are of the highest grade steel; for example the gun barrel is manufactured from steel having a yield point in the neighbourhood of 40 to 45 tons per sq. in. A large proportion of this steel is made up of nickel-chrome-molybdenum alloy, but many other grades are being produced. The successful production of these steels requires close adherence to the specifications.

The laboratory being close at hand, tests are taken during the melting process and analysed, and the furnace charge adjusted according to requirements. In the log of each heat, careful records are kept of temperatures when starting and pouring, power consumption, weight of ingot and scrap, and other particulars, so that, should a defect be detected at a later stage, it can easily be traced.

In pouring the ingots from the steel every precaution is taken to prevent segregation. A pouring basin is used to reduce the pressure in the mould to keep inclusions out of the steel and to carefully control the rate of rise in the mould. In pouring, the temperature is controlled by an optical pyrometer and checked by a chill test.

From the ingots a large number of crop ends have to be cut. These ends are reduced to suitable sizes for rolling and thus the rolling mill turns what otherwise might be waste into steel bar of the highest quality.

The benefit of this rolling-mill installation has been such that a second rolling mill is at present being installed.



Fig. 4—Assembling 25-pounder gun, showing arrangement of firing platform, trail, spade, etc.

In the forge shop the ingots are pre-heated in oil-fired furnaces and then forged under the 2,000-ton hydraulic forging press.

In the case of a 25-pdr. the rough gun barrel forging is approximately 12 ft. long and from 8 to 9 inches in diameter.

The barrel is finish-forged on a 6-ton steam hammer, after which it is left to cool gradually in what is known as the soaking pit—really a very large bin of ashes. Throughout these processes great care has to be exercised and pyrometer control installed to govern the temperatures.

In order to produce the various gun components and drop forgings there are, in all, 18 other steam and pneumatic hammers ranging in size from 6 tons to 400 lb. with as many oil-fired heating furnaces.

The next bay of the shop houses the rough machining equipment and the equipment for heating and annealing and die making.

The rough-machining equipment comprises 14 roughing out machines including heavy rough-turning lathes, rough-boring machines, planing machines, milling machines and cut-off saws.

The heating and annealing equipment comprises three oil-fired furnaces, two small electric furnaces and ten vertical electric furnaces, all of the most modern design and fully equipped with the latest automatic control apparatus.

Here the barrel is first rough-turned and bored before being heat treated. The furnaces employed for the final heat treatment of the gun are of the vertical electric type, 4½ ft. in diameter and 27½ ft. deep. These vertical furnaces are equipped for accurate temperature control in five zones, making it possible to realize exact positions in heat treatment of the barrels.

After normalizing, the barrels are straightened if necessary on a horizontal hydraulic press.

Sufficient length of material is left on each end of the forging for the usual tensile, bending, and izod tests. Cylindrical slabs are sawn off from each end of the barrel and submitted for approval to the government inspectors.

Once the barrel tests have been certified and approved the barrel is ready for finish-machining.

Finish-machining includes two sets of operations; those preceding auto-frettage and those following auto-frettage.

Auto-frettage consists of expanding the tube radially by applying hydraulic pressure to the bore. The pressure used is sufficient to exceed the elastic limit of the metal in the bore. This causes the inner layers of metal in the bore to yield plastically and take a permanent set, whereas the metal near the outer surface of the tube has not been stretched beyond its elastic limit, and therefore attempts to return to its original dimensions.

The barrel is thus put into a condition of permanent circumferential stress, such that the inner layers are in



Fig. 6—Muzzle of 25-pounder barrel showing rifling.

compression and the outer metal in tension. This greatly reduces the maximum tensile stress which occurs when the gun is fired.

For the auto-frettage operation the two ends of the barrel are counter-bored, reamed and threaded so that the appropriate connections can be made. One end of the barrel is connected to a high pressure pump whilst the other is connected to a specially designed valve which releases the liquid used (a mixture of water and glycerine) through a pressure pump.

Before the gun is set up for auto-frettage a steel core bar is placed in the bore. This core bar is bored out for a short distance at both ends and at the inner end of each of these bores a radial hole is drilled.

The liquid thus passes through the core, then out through the first radial hole to the outside diameter where it passes along between the barrel and the core bar and re-enters the second radial hole at the opposite end. Thanks to this arrangement the quantity of liquid required is considerably reduced.

After the pipe connections have been made, indicators are placed at four points along the length to obtain readings on diameters 90 deg. apart.

The pressure is applied in four steps with readings taken at 20, 24, 28 and 32 tons per sq. in.

Before the barrel is set up for auto-frettage, it is carefully measured in the bore and on the outside at the four points previously mentioned.

Readings are taken by precision dial gauges while the pressure is being applied and plotted on charts. By this method it is possible to ascertain the amount by which the elastic limit has been exceeded.

After the 32 tons per sq. in. load, the pressure is released and the liquid drained out of the barrel. The barrel is then given a low temperature anneal in one of the vertical electric furnaces.

After annealing, the barrel is again returned to the auto-frettage set for a second test pressure, but this time the pressure is brought up to 32 tons per sq. in. in a single step.

The resulting increase in diameter is twelve to twenty thousandths of an inch in the bore, and six to ten thousandths on the outside. The difference between these two figures indicates the permanent set of the barrel.

Returning to the machining operations, the ends of the barrel, including the threaded portion, are then cut off.

The barrel is then bored out to 3.35 in. after which it is finish-turned on the outside diameter and finally bored out to 3.44 in. It is then honed and the final chambering operations performed.

The outside surface is then ground for receiving the jacket, the barrel being given a slight taper. Then follow two further lathe operations, finishing the breech end, turn-



Fig. 5—Fitting breech mechanisms to gun barrels.

ing the front core and facing the barrel to length. Finally, the barrel is rifled.

Honing and rifling are operations of importance in gun manufacture.

Honing is a surface-finishing operation which has been introduced into gun manufacture comparatively recently. It employs a head on which are mounted a number of carbondum strips. This head, in turn, is mounted on a revolving bar which has also a rapid, relative longitudinal traverse.

The rifling machine is another special tool used in gun manufacture. It consists of a long bar on which is mounted a head carrying a tool in the shape of the groove to be produced; the rifling bar is rotated by the action of rollers on a sine bar, thus controlling the twist of the rifling.

Recent development has greatly improved the method of rifling, because the single tool cutters formerly used have been replaced by cutters with as many teeth as there are grooves to be cut. By using a set of cutters, roughly thirty in number, each a shade larger in diameter than the previous one, and by pulling these 30 cutters through the bore, not only is the machining time reduced to about a fifth of the former time required, but greater accuracy in division of the grooves is obtained.

Time will not permit even a brief description of the different operations in the production of the other main components, namely the jacket, breech ring, breech block and recuperator. These however are practically all machined on general purpose machines.

As previously mentioned, the machine shop, covering roughly 500 by 245 ft. is laid out according to the flow of the various parts. Here we have horizontal boring machines, vertical boring machines, horizontal and vertical milling machines, plano milling machines, grinding machines, gear cutting machines, broaching machines, engine lathes, capstan and turret lathes, planing machines, slotting machines, shaping machines, plus the equipment of a very large, up-to-date tool room, including such special machines as jig borers and thread grinders.

The fitting and assembly lines are installed next to the production machines and here, as in the machine shop,

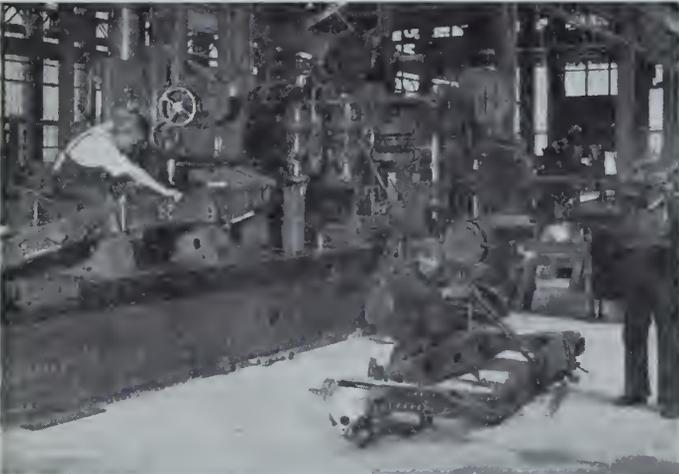


Fig. 7—Machining fabricated under-carriage on a giant multiple milling machine which makes eight cuts in one operation.

fitting and assembly gangs dealing with one component only are grouped together (See Fig. 4).

The last building is the plate fabricating shop, in which the firing platform, trail, top carriage and other components, in which plate work is the principal feature, are produced.

This shop is fully equipped with shears, guillotines, rollers, presses, pneumatic riveters, flame cutting apparatus and welding units.

After the pressings have been produced they are riveted or welded into position and machined where necessary, using jigs wherever possible for location.

In the final stage of production the work coming from the plate fabricating shop meets the machined components from the machine shop on the fitting and assembly floor. Here fitters, each skilled in finishing a certain part, work on a long assembly line of from seventy to a hundred guns.

An interesting feature is the effort that is being made to spread the work among other shops by sub-contracting different components. An outstanding example of this is the production of the carrier dial sight, a component comprising a large number of parts, which is now being produced by a Montreal firm in a satisfactory and creditable manner.

At the present time Sorel has about 80 sub-contractors manufacturing 700 different parts at the rate of 40,000 per



Fig. 8—Inspecting parts of breech mechanism.

month. All these firms have been carefully selected according to the type of work for which they are best suited. It is common practice, when contacting a firm for a specified production, to extend every possible help and part of this scheme is to arrange for a qualified master mechanic to follow up on the spot any manufacturing intricacies.

The results obtained by this sub-contracting branch are most gratifying and have been well worth the pains taken by Sorel Industries who have acted more or less as pioneers in this field.

Another feature worthy of mention is the special engineering department which has been set up by Sorel to take care of suggestions to be submitted to the inspector for passing alternative materials or machining methods; for example, replacing a forged steel entirely machined handle by a die casting requiring no machining at all.

Attention should be drawn to the invaluable help which the Chrysler Corporation have given Canada at Sorel. They came in at a critical time at the suggestion of the Government Control Committee to aid in supplying efficient management. Right nobly they have responded.

Praise is certainly due to the directors of Marine Industries who, by their enterprise, made such a project possible. In mentioning this company the author desires to compliment the Messrs. Simard Brothers personally. He wishes also to pay tribute to the men of Sorel for the wonderful part they have taken. At the present time Sorel Industries employ approximately 1700 to 1800 men of which roughly 85 per cent are French Canadians; it would be safe to say not more than ten per cent of this number had any mechanical training before joining the firm, which adds credit to their achievement.

Such matters as trade schools, the housing of workmen, the provision of hostels, etc., all form part of this vast scheme. Sorel Industries have not forgotten Napoleon's dictum that an army marches on its stomach, and in to-day's warfare when for every man at the front eighteen are needed at home, the word army applies just as much to the men in the shops as the men in the field.

# ACCIDENT PREVENTION METHODS AND RESULTS

WILLS MACLACHLAN, M.E.I.C.

*Secretary-Treasurer and Engineer, Electrical Employers' Association of Ontario, Toronto, Ont.*

Paper to be presented before the General Professional Meeting of The Engineering Institute of Canada, at Montreal, Que., on February 6th, 1942.

**SUMMARY**—An outline of the accident prevention work as carried out during the past twenty-five years for the Electrical Employers Association of Ontario, giving examples of some of the hazards and the results of prevention or remedial work. Statistics are shown in graphic form.

With the country at war it is of importance that men and material shall not be wasted but shall be used in the most effective manner. The wastage from accidents in industry and in war industry has disproportionately increased since the speed-up began.

The industries in Schedule 1 of the Ontario Compensation Act do not include the railways, the Bell Telephone Company, the Hydro-Electric Power Commission, many municipal and all governmental defence operations. Excluding these, the compensation cost of accidents in 1940 was \$8,370,000, a dead loss from our badly needed resources. This sum would have bought 14 corvettes but it represents only one-fifth of the loss because it has been proved repeatedly that "compensation payments constitute only one-fifth of the total employer accident cost." Where can effective ideas, methods and means be found to stop or reduce this loss?

The electrical public utilities of Ontario have been carrying out organized accident prevention work since 1915. Certain methods have been developed; certain objects have been achieved; a review of these may assist in solving the general problem.

The following notes refer chiefly to a group of public utilities in the province of Ontario. A large amount of accident prevention work has been done in other provinces and in industries other than the electrical public utilities, but this paper is based on facts and methods that have come under the author's personal observation.

In 1914 the Legislature of the Province of Ontario passed a Workmen's Compensation Act; this being the result of study by a Royal Commission headed by Sir William Meredith. The fundamental basis of most Workmen's Compensation Acts is the same, and, quoting from the Ontario Act, may be stated as follows:—

"Where in any employment . . . personal injury by accident arising out of and in the course of employment is caused to a workman, his employer shall be liable to provide or to pay compensation in the manner and to the extent hereinafter mentioned." . . .

There are various methods by which the employer can provide this compensation. In Ontario there are two: First, under Schedule 1 of the Act, by paying an assessment on payroll to the Compensation Board, the Board assuming the responsibility for the payment of all costs under the Act. Second, under Schedule 2, by the employers being individually liable for the payment of the said costs on direction of the Board. By far the greater part of employment is placed in Schedule 1. In certain other acts of this character provision is made for injured workmen's compensation by the employer taking out insurance with a regular insurance company; this is a more expensive method than that in effect in Ontario and Quebec.

The Ontario Act provides for the formation of associations of employers for the prevention of accidents, it being better to prevent an accident than to pay compensation. Classes and groups of employers are recognized, and these associations, usually embracing industries of a

like character, are managed by committees of employers in the respective classes. The Workmen's Compensation Board has authority to approve such an association if it believes that it sufficiently represents a class and in its assessment of the class obtains sufficient money so that it can make a grant to the association to carry out its work. Such a one is the Electrical Employers' Association of Ontario. It was brought into being in December, 1914; was approved by the Board and has been carrying out its functions since January 1st, 1915. It deals primarily with accident prevention among employees of the electrical public utilities and telephone systems, placed by the Workmen's Compensation Board under Schedule 1 of the Act, and now for the most part contained in groups 220 and 221. This Association is governed by a Managing Committee. Serving as presidents at different times have been some prominent members of the Engineering Institute of Canada, to mention but four: the late A. A. Dion, R. L. Dobbin, W. H. Munro and the present president, R. Harrison.

## THE PROBLEMS

What are the conditions in the electric public utility industry that increase liability to accidents? The first is scattered employment. In any public utility, the employees are dispersed over a city, town or a large part of the countryside, working for the most part in small groups, often without close supervision. The next condition is the constant hazard, particularly in the electric power industry, of electrical shock or electrical burns. There are many peculiar hazards that develop in the operation and maintenance of power houses and substations, due to the necessity of installing machinery in a confined space and also due to the fact that much of this equipment is energized. The overhead system of a public utility develops another type of hazard. Such a system has to be maintained in all weathers, the butts of poles being subject to rot and in cities the pole tops often being encumbered with cross arms and equipment. Adding to the hazard is the fact that it is important to maintain, as far as possible, continuity of service and hence the necessity at times of working close to or on either moving machinery or energized apparatus or lines. Analogous to this last mentioned hazard is the difficulty of removing apparatus or lines from service and returning them to service. To enlarge slightly on this: a transmission line operating at 44,000 volts needs some insulators removed because of broken petticoats; arrangements have been made to make the line dead so that the men can work on it. The risk is ever present that the line may inadvertently be put back into service prematurely.

Men are supervising, managing and operating public utilities; many machines are involved, but in addition the frailties of human nature are always present.

## HOW HAVE SOME OF THESE PROBLEMS BEEN MET?

### 1. ENGINEERING REVISION AND DESIGN

Consider an example. In 1915 and for some years after, it was common practice to install a number of disconnecting switches side by side on a switchboard or structure in a power house or substation. After the load was taken off a circuit by the oil switch being opened, the operator's problem was to open the disconnecting switches on each side of the oil switch or piece of appar-

atus. With a number of disconnecting switches on the switchboard or structure, there were times when he would open two blades of the circuit that was de-energized and then by mistake a blade in an adjacent live circuit, drawing an arc which at times enveloped the operator, resulting in severe burns or death. This problem was met first, by putting insulated baffle boards between the individual blades of the disconnecting switches of each circuit and, secondly, by clearly naming all disconnecting blades that constituted the disconnecting switch of the circuit. By this means even if the wrong blade was opened, the baffle board often prevented a short circuit arc from developing and the clear naming and designating of the switch was a constant indication to the operator of the blades constituting the circuit. This system of segregation, spacing and marking switches and apparatus and thus clearly designating them, was rapidly extended to the whole of the power house or substation equipment, including power transformers and other major equipment, and materially reduced accidents caused by employees straying into live apparatus.

Still another example of engineering revision: In earlier designs the fly-balls of a governor rotated in the air. Some of these fly-balls were at elbow height and operators' elbows have been fractured by being hit by the fly-balls, so that guards were installed. Later, more effective design was developed by enclosing the fly-balls, making for constant windage, better lubrication and a safe design.

Again, in the development of pole type transformer installations, a very considerable improvement has been made, not only in the service to the consumer but also in safety for the lineman, by creating more elbow room for the workman, perfecting the type of cut-out, re-arranging and improving the whole grounding system, particularly making provision for grounding of transformer cases, and in some later designs making it possible to entirely kill all wires and circuits below the line arm.

In all utility property, the exposed non-current carrying metal parts, such as frames of motors, are effectively grounded. This is to prevent the employee who places his hand on the motor frame from receiving a severe shock if the motor has broken down between coil and frame. This same hazard exists in motors in the manufacturing and other industries but many do not seem to realize the importance of grounding these frames.

## 2. TOOLS AND EQUIPMENT

Tools and equipment enter into many accidents in electric public utilities. One piece of equipment may be mentioned. Formerly there were many cases in which a lineman's belt broke, dropping the lineman, often resulting in serious injury and sometimes in fatal results. A study was carried out in connection with linemen's belts. The hardware had been adapted from horse harness hardware, but the snaps were malleable and at times had blow holes and broke. Drop-forged steel snaps were developed. The D rings in the earlier belt were sewed on the outside of the main body belt; if the stitching or rivets gave way, the man would fall. On redesigning, the body belt was placed through the D ring and the D rings made of drop-forged steel. Advice from leather manufacturers was obtained, a better grade of leather was developed and advice given to linemen for the maintenance of the belts. These details were worked out and the matter placed before a Canadian manufacturer who produced a very satisfactory belt.

In the early days the lineman supplied his own belt, but since, if the belt failed, the employer paid the cost of the accident, the practice developed of the employer providing the belt. This has resulted in a better belt more adequately maintained.

Since the perfected belt went into service some years ago, not one accident has occurred in Ontario to a lineman through failure of this belt. The same method of careful analysis of tools and equipment has been applied to rubber gloves, ladders, line hose, insulator caps, rubber blankets, and other items of equipment.

## 3. METHODS OF WORK

Various methods of doing work were investigated. As was pointed out earlier, one of the distinct hazards in electric public utility work arises in taking a piece of apparatus out of service for work and replacing it in service. This in the old days was guarded against by a clearance rule which with the more complicated systems, has developed into regulations filling many pages of the rule book. The essential features are:

That the foreman shall obtain permission to take the piece of apparatus out of service. This frequently necessitates the approval of a senior official. At the time that the work is to be done, the holder of this permit, usually the foreman, and the operator who receives the permit, see to it that the necessary switches or valves are put in such a position that the piece of apparatus is taken out of service and de-energized. If it is electrical apparatus it is thoroughly grounded and not until that time is it considered dead. Tags giving the name of the man holding the permit are placed on the valves or switches stating that the apparatus is out of service. These tags cannot be removed nor can the apparatus be put back into service without the holders' permission. In transmission line work, it is also necessary to place grounds on each side of the working space. Not until the foregoing is completed is work allowed to commence.

After the work is completed, the foreman makes sure that all working grounds are removed, every man under his supervision is clear and all possibility of contact with the apparatus or line is prevented. Not until this is done does he return his permit and turn it over to the operator.

Although this rule is enforced by all public utilities and is applicable to industry, in ammonia tanks, cranes, industrial substations, air lines, etc., it has not yet received the consideration that it should from those in charge of some manufacturing concerns.

Another simple but very important rule is that some one person should be in definite charge of a power house or substation or control desk at any instant. There should be no divided responsibility. For example at the time of a change of shift, there is danger of the operator and his relief being uncertain as to who is in charge of the power house. This point has been most clearly defined in rules. In one utility the relief does not take over until he has read and signed the log. Every utility man with long experience can remember cases where the lack of such a rule resulted in a near accident or a fatal accident.

## 4. HUMAN FACTOR

Up to the present we have been dealing with the correction of machines and methods of working. Men, however, are doing the operation and maintenance, and the psychological factor must not be overlooked. In certain kinds of work, habit training is of great value and is definitely indicated. This is important in connection with artificial respiration but it is equally applicable in many other phases of the work. For those who have investigated many accidents, the possibility that an experienced man may do something that one would never expect him to do under normal circumstances, is a very considerable worry. One example of this is that of an experienced employee, who while thinking of something entirely foreign

to his work, goes in on clearly marked and designated live apparatus, instead of dead apparatus. Methods have to be developed to assist the man in keeping his mind on the job at critical moments and in hazardous conditions. One simple method has been the instruction to a lineman in climbing a pole to stop 4-ft. below the lowest cross-arm or attachment, put his belt around the pole, have a good look at the pole top, figure out exactly what he is going to do and then go ahead and do his job.

The choice of the suitable man for each type of employment must not be overlooked. A man might be ideal in the operation of a substation but unfitted for the operation of a power plant. A man who would make a splendid lineman might be out of place on a patrol beat. It is not only the physical make-up of the man that is to be taken into consideration, but also his whole personality. If this is important in connection with the rank and file of employees, what of management? Employees must be impressed with the sincerity of management in its endeavour to prevent accidents. It is quite possible to get quick results for a very short period of time by publicity methods, but nothing will replace the mutual confidence between management and employee for the long pull in accident prevention work or for that matter in any phase of employment.

#### 5. METHODS OF CORRECTION AFTER THE ACCIDENT

Given that an accident has happened, the immediate effort becomes one to mitigate or reduce serious consequences, and secondly, an effort to prevent repetition.

Speaking first of mitigation, detailed first aid kits in line with the requirements of the Workmen's Compensation Board adapted for the use of public utilities have been recommended and training in the use of the kits and in simple first aid put forward. Extensive training in first aid has not been recommended, but that pertaining to the public utility field has been specified.

Because of the fact that electrical shock is such a major hazard in the electrical public utility field, a very large amount of time and effort has been expended on this factor. In the early days, methods were crude, so with the co-operation of medical associations and the universities, research into the effect of the passage of electrical current through the body was instituted. While this laboratory research was being done and detailed information of actual cases collected from the field, a careful study was made of all the engineering and medical literature available on this subject. As a result of this work, much information was gained and a practical system of remedial measures after electrical shock was developed.

As it was clear from the studies that these measures must be put into effect without delay after electrical shock, training of all employees in artificial respiration was taught, so that the man closest to the injured would know what to do. In view of the fact that after an accident there is a great tendency for people to lose their heads, constant practice in artificial respiration was required among employees, so that by habit training, these men would be prepared to carry on artificial respiration even though very much excited. Rescue methods were also taught. Co-operation of doctors and nurses was obtained by giving talks and demonstrations in universities and hospitals and before various medical bodies and preparing papers for the medical technical press. As a result of this, many lives have been saved. One case of outstanding character may be cited.

In 1927, about two o'clock one afternoon, a young lineman brought his head into contact with a high tension overhead wire. His feet and hands were in contact with conductors which were grounded. He received a very severe shock and was apparently lifeless, hanging back in

his belt. He was removed from the pole, artificial respiration was started at the foot of the pole, medical assistance called, and telephone communication established with headquarters. About 1½ hours later he was removed to hospital; artificial respiration was continued during transportation and was continuously applied in the hospital. All this was done by public utility men. About ten o'clock that night, they had the man breathing without assistance. This had required eight hours of continuous artificial respiration after electrical shock—the longest case on record.

After an accident, particularly of a serious character, an investigation is usually carried out, but much of the value of these investigations has been lost. If those holding an investigation would not only ascertain the facts but would learn what should be done to prevent repetition and see that such measures are put into effect, much of value would be obtained. Investigations merely to fix the blame are largely a waste of time as it will be found that what one is really discovering is an alibi. Real information has been driven under cover. If, however, the blame is fixed the next step usually is discipline. This develops fear and frequently results in more accidents. Nothing is gained. Time is wasted and valuable information that would have helped to prevent a recurrence is lost.

One phase of mitigation that should be touched upon is that of rehabilitation. At times a lineman is injured in such a way that he cannot continue to be a lineman. How can he be rehabilitated to become a useful citizen? Two approaches are at present in use: first by physio-electro and occupational therapy the man is assisted in overcoming the results of the accident; the injured muscles and nerves are made well and the mental outlook improved. A splendid curative clinic working to this end

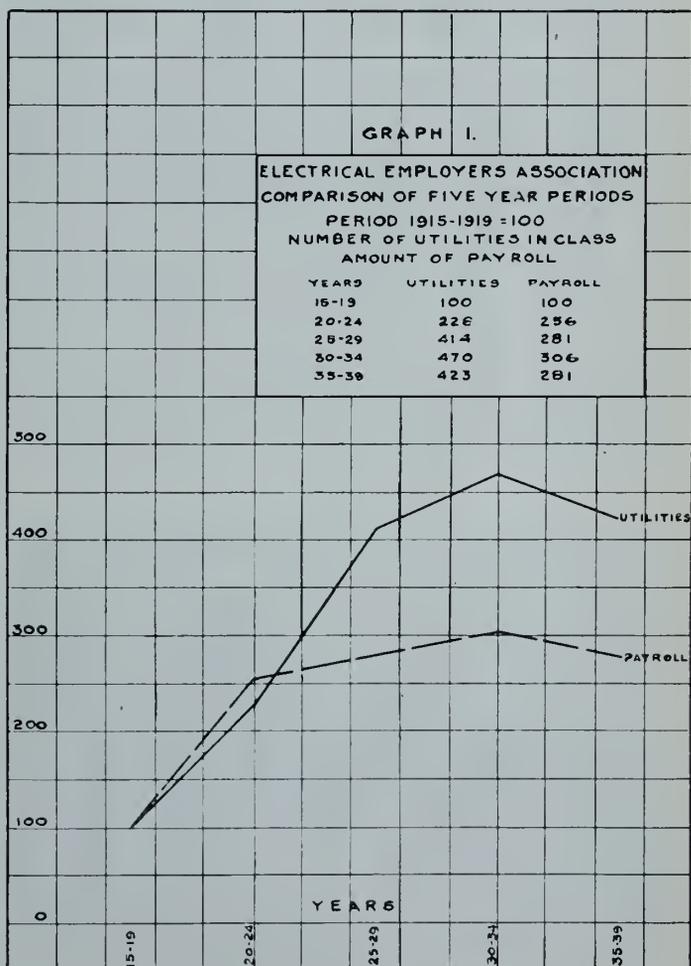


Fig. 1—Number of utilities and amount of payrolls

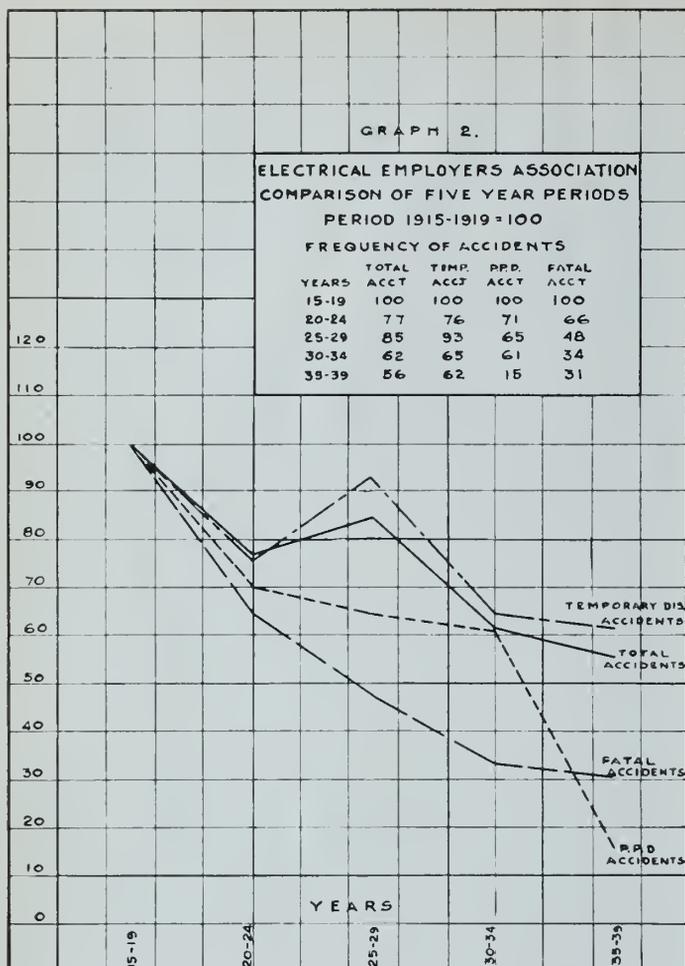


Fig. 2—Frequency of accidents per one million dollars payroll

is maintained by the Workmen's Compensation Board of Ontario. Secondly, by re-education and retraining in schools and industry, the man is prepared to take a new job suitable to his condition. Such rehabilitation is not easy to carry out but anyone assisting to forward the work, will be thoroughly recompensed in seeing some cases carried through to success.

It must not be assumed that this account covers all the various applications employed. Engineering revision and all of the other methods are used in many other ways but these are examples. In addition to this, talks with employees and management, letters and bulletins and the usual forms of approach have been tried, and where successful, proceeded with.

### RESULTS

What have been the results of accident prevention in the Electrical Employers' Association during the twenty-five years 1915 to 1939?

Records have been kept over this period. They have been checked by the statistical department of the Workmen's Compensation Board of Ontario and are in agreement with their records.

As the experience varies from year to year, it has been thought wise to take five-year periods and group the accidents, costs of accidents, and other information within these periods. As a means of comparison, the experience for the years 1915-1919 has been taken as a control and assumed to be 100.

### NUMBER OF UTILITIES AND AMOUNT OF PAYROLL

Figure 1 is a graph showing the increase in the number of utilities in the class and the payrolls for each five-year period taken as a percentage of the five-year period

1915-1919. It will be seen that there was a substantial increase in the number of utilities in the class up to the five-year period 1925-1929; it then shaded off and for the last five-year period there is reduction from the peak. This has been due to a number of different causes: the amalgamation of different utilities into one; some utilities being removed entirely from the utility field and other employers placed in the class for a few years, for example, construction industries were removed from the class, as their work is foreign to that normally done by public utilities. The payroll showed a sharp increase until the period 1920-1924, then a slight increase since that time. This is due to the fact that some of the larger utilities were bought out by those not in the class and to a very great extent in the latter years the utilities entering the class have been of a smaller character.

### FREQUENCY OF ACCIDENTS

In Fig. 2, is shown the frequency for,—  
Total lost time accidents  
Temporary disability accidents  
Permanent partial disability accidents and  
Fatal accidents

The frequency for this graph has been taken as so many accidents per million dollars payroll. It has not been possible to use the more usual comparison of accidents per so many man-hours. This again is for each five-year period, compared with the 1915-1919 period as 100. The sharp increase for the period 1925-1929 in the number of temporary disability accidents is due to the fact that during this period the construction companies were in the class and have since been removed. It will be noted that for the last five-year period under consideration, the fatal accidents per million dollars payroll were less

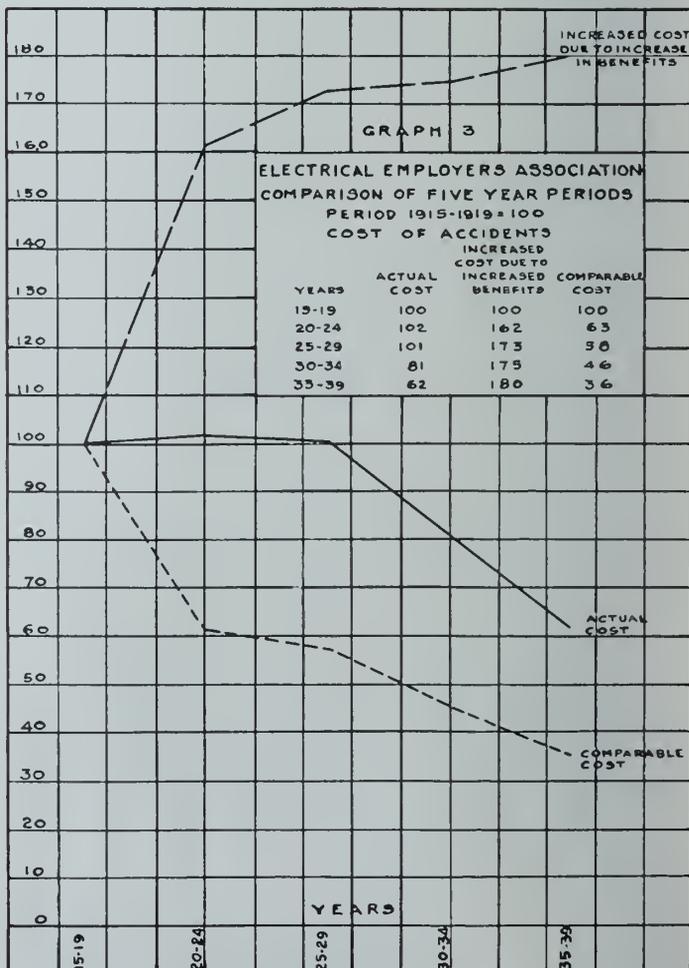


Fig. 3—Cost of accidents per one hundred dollars payroll

than one third of what they were in the period 1915-1919 and the permanent partial disability accidents were but 15 per cent of what they were in the earlier period.

#### COST OF ACCIDENTS

In Fig. 3, the cost of accidents has been compared on the basis of cost per \$100.00 payroll; the solid line shows the actual expenditure by the Board. It will be seen that this actual expenditure for accidents for the period 1920-1924 was slightly over that of 1915-1919 and in 1925-1929 there still was a slight increase; all this seems contrary to what could be inferred from Fig. 2. The last two five-year periods show a sharp reduction. However, when one remembers that amendments to the Act brought in from time to time made the benefits to the injured employee (and hence costs) greater than for the earlier years of the Act, the trend of this actual cost line is explained. With the co-operation of the statistician of the Workmen's Compensation Board of Ontario, a curve of the increased cost of comparable accidents due to increased cost in benefits was worked out and this is shown in the graph. By applying this curve of increased cost due to increased benefits to the actual cost of accidents,

a curve is obtained showing what the costs would have been had there been no increase in benefits. This latter curve is a true comparison of the five-year periods with one another and shows a very marked reduction in cost over each of the five-year periods. This reduction in cost, in part at least, can be attributed to accident prevention efforts.

#### CONCLUSION

In carrying out any accident prevention work, it is most important that a realistic approach be maintained. The prime object before anyone should be to get facts. If this is kept in mind, then naturally the object of any investigation of an accident is to learn the cause and provide measures to prevent a recurrence and not to find out who is to blame. Arising out of this, design of plant or equipment to be efficient must be such that it is safe to install, manufacture, operate and maintain. Rules and instructions should be simple, practical. They should be enforced or else removed. Even with these essentials the sincere leadership of management is vital to the whole matter. Canada needs every man on the job and not in a hospital bed.

## TACTICS AND UNORTHODOX AIRCRAFT

MAJOR OLIVER STEWART

*Editor of "Aeronautics" London, England.*

Unconventional aircraft designs do not often succeed in war. The amazing invention which appears so often in fiction and which—in fiction—wins so many wars seems to have no counterpart in real life. In aviation especially it is usually the orthodox, well-developed aeroplane that proves the best in service. An example is the Armstrong-Whitworth *Whitly*, a bombing aeroplane of perfectly normal conventional design built by conventional methods. At the outbreak of war in September, 1939, the *Whitly* was looked upon by many people as obsolescent if not obsolete. Yet a year later it was one of the mainstays of the British bombing fleet.

The *Whitly* was given a fresh lease of life by being slightly modified and re-engined and in this form it proved completely successful and showed itself capable of operating under difficult conditions.

#### BRITAIN WAS FIRST WITH POWER-OPERATED TURRETS

But although a conventional aeroplane appropriately developed and modified seems usually to play the leading part in war, there are occasions when unorthodox designs or constructional methods or novel equipment come into service with successful results.

If the operations of the Royal Air Force are studied, it will be seen that they owe their successes mainly to steady development of aircraft and aircraft equipment, but also to some extent to strikingly original thinking and to the introduction of unorthodox features.

The power-operated gun turret, which has been, since the beginning, a feature of the big British aircraft, and which is fitted to not only the heavy bombers but also to the medium bombers, is an example of a bold unconventional piece of design work.

No other country in the world thought it possible to introduce a power-operated turret, but British designers went forward with this component, developed it both for electrical operation and for hydraulic operation, and finally brought it to the stage of full efficiency.

At first many different theories were held about the method of operating such turrets, and one of the early Boulton Paul turrets was so arranged that the entire working of the rotatable part was brought about simply by the action of the gunner in aiming his gun. Thus, by swinging the gun to the right, power would be clutched in to the turret and the turret would turn to the right.

Our methods employed the twist grip similar to that found in some motor-bicycles. But all these methods were quickly sorted out under stress of war and the power-operated gun turret is now incorporated in vast numbers of British aircraft and has been responsible more than anything else for enabling Britain's biggest machines to beat off fighter attack.

#### WAR'S MOST SUCCESSFUL BOMBER

Here then is one example of original unconventional thinking brought to a highly successful conclusion in war. It is matched, so far as the structural side is concerned,



Fig. 1—The Wellington MKII



Fig. 2—The *Hurricane* II armed with twelve machine guns.

by the geodetic construction of the Vickers-Armstrong *Wellington*. This form of construction has frequently been described and it is not necessary to repeat the details. In essentials it consists of a basketwork of criss-crossing metal members which themselves give the aircraft not only its strength but also its shape. In other words, the geodetic construction places the strength of the machine where it is needed near the surfaces of the aerodynamic shapes. In this it contrasts with more conventional construction wherein the strength is imparted through girders and struts which are inside the wings or fuselage and which do nothing to impart to them their aerodynamic shape.

The *Wellington* has a right claim to be the most successful heavy bombing aircraft of the whole war. It has worked in many theatres and under difficult conditions. It has been employed on most of the very long range attacks that the Royal Air Force has made and it has invariably given the fullest satisfaction. Here is another case of unorthodoxy proving successful. Constructionally it is probably the most outstanding case of all.

#### WHY R.A.F. FIGHTERS HAVE THE ADVANTAGE

In armament the success achieved by the Royal Air Force fighters must be attributed more to the unorthodox tactical thinking than to any special design novelties. It was decided some time before the war that British fighters would be given the power of hitting harder than any other fighters in the world. The consequence was that guns were packed into them to an extent never before thought possible. One other point is worth noting, that these guns were packed in such a way as to enable them to be used without any synchronising or interruptor gear. In other words, they were so disposed as to be clear of the disc swept by the airscrew blades.

The Vickers-Armstrong *Spitfire* had eight guns mounted in its wings all fixed to fire forward in the line of flight and all outside the disc swept by the airscrew. Similarly, the Hawker *Hurricane* had eight guns mounted in



Fig. 3—A *Lysander* in flight. The rear gunner is strafing a convoy.

its wings. The later version of the *Hurricane* has no fewer than twelve machine guns, or alternatively, four 20-millimetre cannon.

This tremendously heavy armament for single seat fighters must be looked upon as unorthodox. It was not matched by anything in Germany or in any other country and it gave Royal Air Force fighter pilots a notable and lasting advantage over the enemy. The plan has been pushed even farther in the Bristol *Beaufighter* which carries four 20-millimetre cannon, and six machine-guns.

#### WORK OF THE LYSANDERS

When we turn to other classes of aircraft we find some notable unorthodox types, chief among them the Westland *Lysander* army co-operation machine. This aeroplane has had a long lease of useful life and has earned extremely high opinions from the pilots who have flown it. It has been used for innumerable different tasks, though most of them not of the kind that will see much publicity. It is still regarded as one of the best army co-operation aircraft in service to-day.

Its design is a brilliant piece of specialised work. For army co-operation purposes an aircraft must be able to take off from and land in a comparatively small area. Con-



Fig. 4—The Bell *Airacobra* in flight.

sequently the wing loading and the general wing arrangement of the *Lysander* is adapted to give a wide speed range. The aeroplane is capable of slow flying under full control yet it has a reasonably high top speed to enable it to meet all conditions under which it may be used. Partly this result is achieved by fitting the wings with Handley Page slots. These devices, by controlling the air flow over the wings, enable lift to be generated at lower speeds than would otherwise be possible.

The *Lysander* is also a masterpiece of internal planning. It packs into its fuselage a vast quantity of equipment. High wing arrangement has the obvious purpose of allowing the pilot to get a clear view downwards. *Lysanders* have been used for an enormous variety of different tasks including message dropping and picking up and the dropping of containers for re-equipping troops.

These aircraft are instances of successful departures from orthodox design. They have played a vital part in Royal Air Force operations from the start of the war and they show that although the scope is restricted there still is scope for the novelty and for unconventional feature. More recently the Royal Air Force has taken into service the United States single seat fighter of extremely unorthodox design, the Bell *Airacobra*. This will be watched with especial interest, for many people believe that it may point the way for useful future developments.

# CONSTRUCTION OF A BY-PASS HIGHWAY IN ENGLAND BY ROYAL CANADIAN ENGINEERS

CAPT. J. P. CARRIÈRE, M.E.I.C.

R.C.E. Headquarters, Canadian Corps Troops, Canadian Army, Overseas.\*

## GENERAL

The military engineers' operations, outside of actual fighting, often lead average members of the profession to believe that they consist mostly of carrying out engineering works of a pre-planned and standard type, and that all designs are empirical. The author himself confesses, without shame, that he was of this opinion before being initiated into this branch of the service.

The purpose of this paper is twofold:—

- (a) To offset this false impression.
- (b) To bring to the fore certain interesting technical points and statistics of road construction practice in England.

In the early fall of 1940, the General Officer Commanding Canadian Corps made plans to move his Army wherever and whenever needed. The author disclaims any knowledge of such plans, beyond the fact that certain roads had to be improved and certain by-passes constructed to accommodate the immense mechanical transport of this modern army.

The construction of one of these by-passes will be the subject of this paper.

In the case under consideration, the required by-pass had already been designed and planned in peace-time but its construction had been forcibly put off with the declaration of war. The problem, as regards location, consisted in building a road on the right-of-way of this proposed by-pass, and of such design as would not hinder the construction of the complete by-pass in the future. A scheme was finally agreed to by the Ministry of Transport, the County Council and the Canadian Corps whereby a 22-ft. concrete highway would be built on the exact site of one of the planned carriageways, except at a few sections where such a procedure was impracticable and where a tar-macadam wearing course overlying a "hard core" foundation was designed.

## DESIGN

(a) GENERAL—The by-pass connects two main highways; one is at Elevation 265 and the other at Elevation 135.

The by-pass is 6,500 ft. long and the topography of the ground between the two above mentioned highways con-

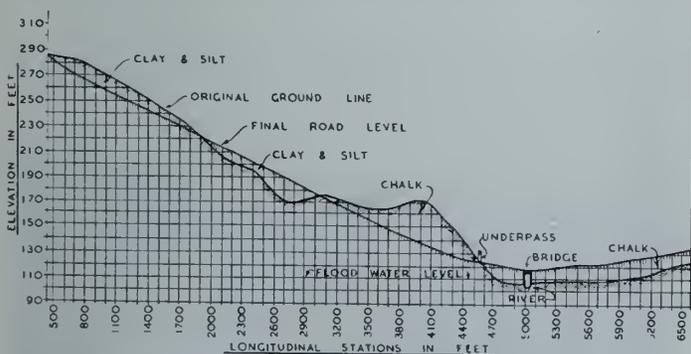


Fig. 1—Longitudinal elevation of road.

\*In civil life Mr. Carrière is Senior Assistant Engineer in the Montreal District office of the Department of Public Works of Canada.

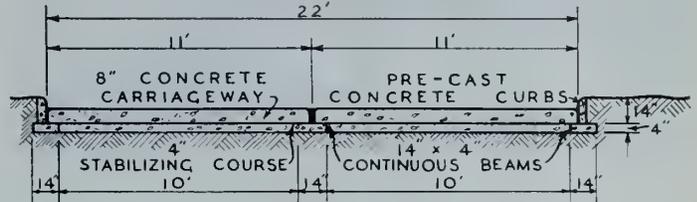


Fig. 2—Cross-section of concrete carriage way.

sists of a valley, with a temperamental river at the bottom and, to complete the modern pastoral scene, a main railroad on a 20-ft. embankment crossing at right angles.

(b) GRADING—The material required for grading consisted of 145,000 cu. yds. of balanced cut and fill. The soil to be excavated in the first 1,800 ft. consisted of a typical English clay and silt of a singularly sticky variety. The remainder consisted of material described as Upper Chalk with Flints (first named by W. Whitaker in 1865). The chalk is apparently fairly pure calcium carbonate composed of very fine granular particles held together by a weak calcarious cement which dissolves easily during rainy weather. This makes the handling of the chalk extremely difficult with consequent discomfort to all those engaged in the operation. The existence of flints in the material adds to the difficulties of handling it. These flints when struck by heavy road building machinery such as was used, break clean, presenting razor-like edges. The modern road building machinery employed on the job was naturally fitted with rubber tires which suffered considerably due to contact with broken flints.

(c) DRAINAGE—The design of the drainage system was a simple operation on paper. Its construction was quite another thing. One portion of the road had to be cut 39 ft. deep; the road bed in that cut has a 4 per cent grade; the bottom of the cut is 124 ft. wide and the 20-ft. railroad embankment lies at the lower portion of the grade. The width of the road is controlled by an underpass 12 ft. wide under the railroad. The drainage system was designed so that all surface water from the road above this point,

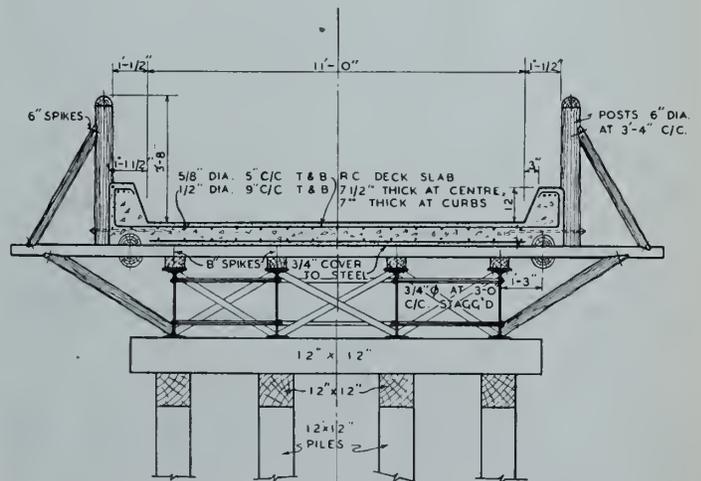


Fig. 3—Cross-section of bridge.



Fig. 4—Winter Flood.

together with surface water from part of the surrounding countryside, which partially drains in this artificial basin, could be collected and carried in sub-surface conduits through the underpass and eventually to the river. The only difficulty was that this work had to be carried out during the rainy season and consequently the site was normally in a very wet condition.

(d) CONSOLIDATION OF FILL:—No special machinery was supplied for consolidating the fills. It was proposed to place the soil in thin layers and depend on the continuous traffic of heavy road-building machinery for consolidation. This proved to be an excellent procedure and gave extremely good results.

(e) DESIGN OF CARRIAGE-WAYS:—The most interesting structural feature of the road is the foundation. This consists of three continuous longitudinal concrete beams 14 in. wide and 4 in. deep laid at 11 ft. centre to centre. Cross-beams of the same dimensions are built at every 80 ft. Where the grade is 4 per cent or more, the cross beams are supported on short concrete piles 2 ft., 6 in. long and 14 in. by 14 in. in cross section. Between this maze of beams is poured what is locally called a stabilizing course—this consists of a low grade concrete continuous slab 4 in. thick. Over this stabilizing course lies the carriage-way proper 8 in. thick; the carriage-way slab is completely isolated from the stabilizing course by a layer of special tar paper to prevent bond between the two courses. Expansion joints in the top slab are built at every 80 ft., except over portions of the fill where serious settlement is expected and where expansion joints are built at every 20 ft.

(f) UNDERPASS UNDER RAILWAY:—An underpass already existed under the railway; it was more in the nature of a cattle-pass. For reasons of economy and to ensure that railway traffic would not be interrupted, it was decided to improve the existing underpass rather than build a new one. In order to get sufficient headroom it was necessary to lower the existing ground line and this necessitated underpinning the foundations of the abutments. These abutments are of brick and have been in position for over 50 years, resting directly on a clay base, and no settlement has ever been recorded. The design of the underpinning consisted of mass concrete blocks, poured in sections. 7 ft. high and 4 ft. wide. Bond between the new concrete foundation and the existing brick piers was achieved through the use of sections of steel rails acting as dowels.

(g) BRIDGE OVER RIVER:—Borings along the banks of the river showed that a layer of chalk existed at a maximum depth of 12 ft. below bottom. This chalk layer was overlain with horizons of clay and gravel (locally called ballast). The location of the bridge to be built for military use was chosen outside the location of the eventual permanent bridge, which is to consist of a single concrete

arch. The gap to be bridged was 79 ft. The controlling loads on the bridge were those to be applied during construction and due mostly to the moving of soil, excavated from one side of the river and transported to the other side for fill. The maximum dynamic load to be applied was estimated at 45 tons, consisting of a train of two vehicles. Another important factor affecting the design was the availability of bridging materials. The material eventually employed consisted of 12-I beams 24 by 7½ in. at 90 lb., 8 of which were 24 ft. long and the remaining four, 31 ft. long; this allowed the construction of a three-span bridge, but the centre span had to be limited to a maximum of 27 ft. to keep the steel within safe working stresses. It is worth noting here that the above mentioned steel beams were by no means new and had been used over and over again. In view of this condition, a working stress of only 16,000 lb. was used for design purposes.

The work on the road having started in November, it was imperative that the bridge be erected without delay in order to keep the work of excavation and transportation of the soil moving. This factor affected the choice of foundations as the river under consideration is 10 ft. deep at the bridge site and it has the unpleasant habit of rising at a rate sometimes reaching 8 ft. in one day, was actually experienced during construction. All those factors led to the choice of mass concrete abutments at each end of the bridge and two intermediate timber pile piers. In order to limit the centre span to 27 ft., double bent pile piers were designed, bents to be 4 ft. centre to centre, and each bent to consist of four piles 12 by 12 in. in cross-section. The superstructure of the pile bents was designed of 12 by 12 in. timbers, cap sills being laid parallel to the length of the bridge and the bridge seats laid at right angles to the cap sills.

The unit working stresses in the bridging material under working loads were estimated as follows:—

- Piles—Max. load on a single pile 7 tons.
- Cap Sills—Max. tensile stress 973 lb. per sq. in.
- Cap Sills—Max. shear 81 lb. per sq. in.
- Bridge seats—Max. crushing stress 163 lb. per sq. in.
- R.S.J.s (I beam)—Max. tensile stress 15,110 per sq. in.

#### CONSTRUCTION:

(a) EARTH WORK:—The equipment employed for cut and fill consisted of eight-60 hp. tractors equipped with carryall scrapers; each tractor could be equipped with angle-dozer blades when required. One trailer type heavy roter was also used to loosen up the chalk before excavating it.

The job was started in early November 1940 and 20,000 cu. yds. of soil were moved by December 31st,—an average rate of 10,000 cu. yds., per month with an average haul of approximately 2,500 ft. From the 1st of January



Fig. 5—Working on wet fill.



Fig. 6—Home-made machine for testing shearing strength of soil.

to the end of March 1941, 21,000 cu. yds. were moved, averaging only 7,000 cu. yds. per month with a haul averaging only 2,000 ft. This lower rate of progress was due mostly to weather conditions. The remainder of the cut and fill, 104,000 cu. yds., was completed between April 1st and July 10th, 1941—an average of 30,000 cu. yds. a month with an average haul of 1,600 ft.

In all the above mentioned instances an average of six tractors and scrapers were being employed. These tractors and scrapers are of American design, and are a fairly common sight in Canada; their efficiency and all around usefulness is still being admired by all who have seen them at work on this job. It is worth mentioning that the sappers who operate these machines in Canadian Corps are the best that Canada can produce.

No trouble was encountered in excavating the clay and silt in dry weather nor in using it as a fill. Unfortunately a few attempts were made to work this type of soil during wet weather to gain time. The results obtained point out very definitely the inadvisability of this procedure. In each case the machines not only ruined the already built-up fill, but also churned up the undisturbed soil of the cut to such an extent that it took days for the soil to dry up sufficiently for operations to be resumed. This is not an original observation, but only an addition to the already established fact that it is economical in the long run not to disturb wet clay.

The chalk cuts and fills were comparatively easy to deal with. The flints played havoc with rubber tires at times and were effective in wearing down scraper blades and tractor treads quickly. However, taking everything into consideration, chalk proved no match for the equipment. During periods of dry weather, a heavy rooter was used to loosen up the undisturbed chalk ahead of the scrapers.

All material used for fill was spread in layers of a maximum thickness of four inches. The normal traffic of trac-

tors, heavy lorries, etc., was depended upon for consolidation. All chalk fill was consolidated to a consistency far beyond what was expected, and no settlement is likely to occur. Clay and silt fills, however, presented another picture, especially in view of the fact that they were disturbed while in a wet condition and that climatic conditions did not offer proper drying. Notwithstanding this condition, the road had to be pushed through over the fills. The critical sections of these fills were the slopes. The ultimate loading and the position of the loads being known it was decided to analyze the stability of the slopes before attempting to lay the carriage-way.

In view of the lack of soil testing equipment, most tests were carried out by "rule of thumb" methods; but the approximate internal shearing strength of the soil at various levels had to be estimated quite closely to give any value to the analysis. For that purpose, a machine was rigged up, consisting of one cross arm fitted with hooks to which were attached two spring balances, each calibrated to 40 lb. A piece of sheet iron 12 in. wide bent to a radius of 3 in. and connected to each spring balance completed the machine. Small trenches were dug at various levels along the worst portions of the fill, deep enough to reach a part of the fill unaffected by exposure. These trenches were so shaped as to allow full use of the testing machine and "bridges" of soil, 12 in. long and of various cross-sectional areas at each end, were carefully shaped in the undisturbed soil. The piece of sheet iron was then placed so as to bear evenly under each "bridge" and connected to the spring balances hanging from the cross arm. Upward forces were then applied at each end of the cross arm, as evenly as possible, until the specimen or "bridge" sheared from the parent mass, and the magnitude of each force, as registered on the balances, was recorded. The sum of the forces was considered as one force evenly distributed and equal to the ultimate shearing strength of the specimen, plus its weight. The unit weight of the soil was checked in place by weighing known volumes of it. The unit shearing strength of the soil was then arrived by weighing the specimens, subtracting this value from the total recorded force, and dividing the remaining value by the sum of the shearing areas, at each end of the specimens. The following values were obtained:—

Average weight: 115 lb. per cu. ft.

Shear strengths: Average for top 12 ft. of fill 384 lb. per sq. ft.

From 12 ft. to 13.5 ft. below top of fill: 156 lb. per sq. ft.

From 13.5 to 14.5 ft. below top of fill; 74 lb. per sq. ft.

At its most critical point, the fill under consideration was 20 ft. high. Between elevations 16 ft., and 14 ft. below the top, a two-ft. layer of chalk was placed during construction as an attempt to overcome part of the dam-

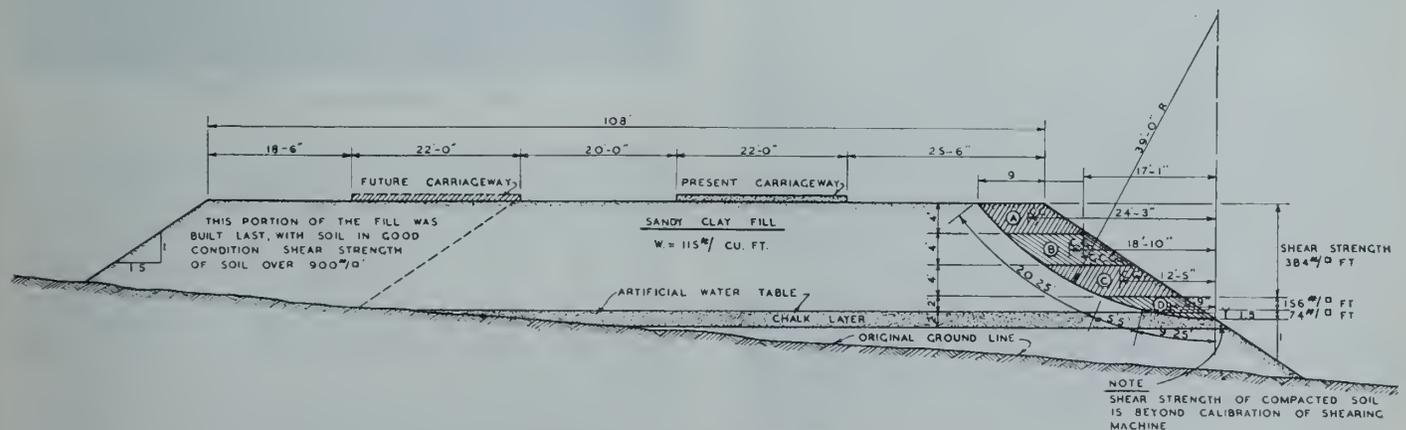


Fig. 7—Diagram of fill showing study of stability.



Fig. 8—Preparing to launch bridge girders.

age done by working the clay in wet weather and to give a foothold to the machinery. This layer consolidated and formed a very stiff horizon of material, apparently not easily soluble in water of infiltration and which acts as an artificial water-table, the top four inches of this layer remaining very wet while the remainder is dry and solid. This artificial water-table apparently limits the downward movement of water of infiltration and causes the overlying mass of clay to retain moisture to degrees varying in intensity from maximum at the chalk layer to minimum at the top of the fill. The variation in shear strength of the clay at the various levels is thus plausibly explainable as the magnitude of this characteristic of cohesive soils is proportional to their water content.

There is no doubt that settlement will occur in this fill; the extent of settlement will vary according to the height of the fill, and the magnitude could only be roughly estimated, due to lack of proper testing equipment. However, for the purpose of record, the County Council engineers set permanent brass plugs in the concrete slab at 20 ft. intervals in the highest fills to record the settlement over a period of years.

The characteristics and dimensions of the fill which presented the worst condition and appeared to have the weakest slopes, were used to make an analysis of stability of slopes. The soil composing the fill being plastic and cohesive, it was assumed (1) that failure of the slopes, should such occur, would take place along a cylindrical plane of rupture; (2) that the centre of this cylindrical plane would be located on the vertical projection of the toe of the estimated failure plane; (3) that the wedge or mass of fill above the plane of rupture would act as a solid body; (4) that this solid body would tend to break away from the parent mass in a circular motion; (5) that this tendency to motion would be resisted by internal cohesion and friction within the soil mass along the plane of rupture; (6) that the sum of the values of cohesion and friction could be translated as internal shear strength; (7) and finally, that the toe of the plane of rupture would not be lower than six inches below the top of the chalk layer described above.

The problem consisted therefore in finding the radius of a cylindrical plane to satisfy the following conditions:—

- (a) Maximum shear stress.
- (b) Minimum shear resistance.

By the method of trial and error, conditions were finally satisfied and the following values were obtained:

Shear stress: 7,245 lb.

Total shear strength along plane of rupture based on values obtained by tests: 9,320 lb.

The factor of safety of this slope against failure is therefore 1.27 and as this represents the worst condition on the job, all fills were assumed safe.

An attempt was made to estimate the rate of settlement, as follows:—

Plugs were driven into the fill at various points on which levels were to be taken at regular intervals. Time being the essence of this job, the road had to be pushed through before sufficient data had been assembled to determine the rate of settlement. The intention was to plot curves of settlement against time, estimate the formula for the average curve thus obtained, and then develop the curve for whatever periods of time were required. It remains to be proved whether such a procedure would have been accurate enough to be of use. However, in order to offset part of the effect of settlement on the concrete carriage-ways, it was decided to build these two inches higher than planned, at the highest fills in clay; as the road at these portions has a grade of 4 per cent, the drainage and other functions were not affected. It was also decided to build expansion joints at every 20 ft. in these portions.

(b) BRIDGE:—*Pile driving equipment*—There were only 16 piles to be driven, each being 24 ft. long and requiring to be driven to a penetration of 10 to 12 ft. To do this job, a timber pile-driving frame (of uncertain age) and a 25 cwt. monkey, were provided. In order to drive the piles in a reasonably short time, it was decided to operate the pile-driving hammer by mechanical means. The power was supplied by the power take-off of one of the tractors, one drum being used to lift the monkey and the other for pitching piles. By providing a makeshift weighted trip-gear at the monkey, a single action, automatic, drop-hammer was obtained.

Each pile was fitted with iron shoes and bands and was held in place during the driving by strong falsework. In most cases, there was a tendency for the piles to shift out of alignment and to twist about their vertical axis; this



Fig. 9—Side elevation of bridge.

latter defect would have been most objectionable in this case and extensive precautions had to be taken to overcome it. This points out the advisability of using round timber piles for this type of work.

All piles were driven to their full penetration. The set per blow on the last five blows averaged  $\frac{1}{4}$  in. with an average drop of 7 ft. This resistance to penetration approximates quite closely the maximum bearing capacity required.

The superstructure was erected by normal methods and presented no points of special interest.

The girders were launched by the derrick and preventer method, using the pile-driving frame as a derrick with a tractor as the power plant on one side of the river, and a second tractor as a preventer on the other. This proved a most efficient and quick method.

As the first function of the bridge was to allow the transportation of 78,000 cu. yds. of fill across the river, and bearing in mind the damaging effect of tractor treads on concrete, strong timber decking was laid to take that traffic. Upon completion of the fill, this timber decking was removed and a reinforced concrete slab was then built for permanent decking.

It is interesting to note that the bridge was submitted to greater loading and vibration before completing the decking than it will have to withstand under normal conditions and it is therefore reasonable to assume that no settlement or disturbance in the structure is likely to occur.

(c) UNDERPASS:—The underpinning of the abutments of the underpass did not present any difficulty and was carried out in a normal manner. The railway traffic was not affected by the work and the regular half hour train schedule was carried out by the railway authorities all through the operation.

(d) DRAINAGE:—The construction of the drainage system did not present any engineering difficulty, although it did involve many physical discomforts during the rainy season. Various makeshift implements were tried in attempts to increase the rate of progress of ditching, two of which are worthy of mention:—

The first consisted simply of a Fresno scraper rigged up fore and aft with steel wire ropes leading through blocks lashed to timber posts set solidly at each end of the proposed trench to the front and rear of a three-ton dump truck. Advancing and retiring the truck along a given line of travel actuated the scraper along the line of the trench causing it to dig, transport and dump soil, thereby reducing manual labour to a minimum.

One trench had to be excavated four to five ft. deep in the chalk along a distance of over 3,000 ft. A  $\frac{1}{2}$  cu. yd. self-propelled bucket excavator was used for this purpose. It was placed so as to straddle the trench, heavy timbers being placed under and at right angles to the tracks, in order to guard against the possibility of failure of the sides of the trench. A heavy rooter was used to loosen up the undisturbed chalk ahead of the excavator. As the excavated soil was being dumped along the sides of the trench, for back-filling, this method was found most satisfactory.

All pipes laid were of concrete and were surrounded with from four to six inches of concrete.

Some inspection chambers and catch basins consisted of precast concrete shapes which, once in place, functioned as the inner forms. They had to be surrounded with concrete so as to withstand the pressures of the soil deposited around them. Inspection chambers were also built of brick and were also surrounded with concrete.

(e) CARRIAGE-WAYS:

1. Concrete:

The three main operations in the pouring of the concrete carriage-ways consisted of:—

1. Pouring longitudinal and cross-beams, including stub piles.
2. Pouring stabilizing course.
3. Pouring carriage-ways proper.

These three operations were carried out by two groups. The leading group poured the beams and laid the forms on the beams for the carriage-way, and the second group poured the stabilizing course and the carriage-way.

The first operation was the longest, requiring the plac-



Fig. 10—Building the drainage system.

ing of forms for the beams, excavating and pouring concrete for stub piles, removing forms after two days setting period and placing and securing forms on the finished longitudinal beams; all this work had to be carried out by hand.

For the second and third operations, a mechanical concrete distributor and two vibrators were utilized, reducing manual labour to a minimum and making possible a fast rate of progress. One vibrator had a vibrating beam 10 ft. long, the other vibrator being equipped with an 11 ft. vibrating beam. This necessitated quite a bit of hand finishing but did not delay operations. This special equipment was supplied by the County Council.

The concrete was mixed at a central mixing plant of a capacity of two cu. yds. per batch. The water-cement ratio, the proportions, grading, volume and moisture content of the aggregates were under constant supervision.

For the carriage-way, and beams, the water-cement ratio was kept at between .44 and .50 and the mix averaged:—

Cement .....	1 part
Sand .....	2½ parts
Stone (5/8" max.) .....	5 parts

(measured by weight of dry aggregates).

For the stabilizing course, water-cement ratio remaining as above, the mix averaged:—

Cement .....	1 part
Sand .....	3½ parts
Stone .....	7 parts



Fig. 11—Inspection—showing also drainage conduit.

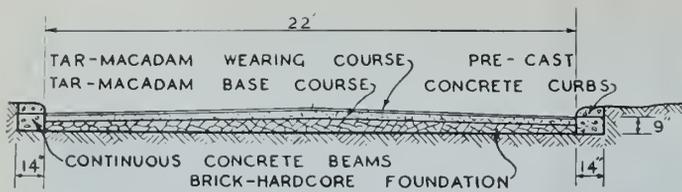


Fig. 12—Cross-section of tar-macadam carriage-way.

Only graded aggregates were employed.

The mixtures resulting from the above had no slump.

The average rates of progress were as follows:—

1. Beams and stub piles, 200 lin. ft. per day.
2. Stabilizing course, 480 lin. ft. per day (10 ft. wide).
3. Carriage-way—320 lin. ft. (11 ft. wide) per day.

Note that 5 days of operation No. 1 (1,000 lin. ft.) equals 2 days of operation No. 2 plus 3 days of operation No. 3.

The average compressive strengths of concrete were as follows:—

Stabilizing course—500 to 700 lb. per sq. in.

Carriage-ways—4,000 lb. per sq. in.

### 2. Tar-Macadam:

As mentioned previously, some portions of the road which are not of a permanent nature were built of tar-macadam overlying a hardcore base. In order to provide good shoulders against which to rest the road metal and to provide a base for curbs, concrete beams 14 in. wide and 9 in. deep were built along each side of the carriage-way.

Hardcore was then placed between these beams to a depth of 6 in. and rolled with a seven-ton road roller to provide a good base.

It is interesting to note that all the hardcore employed consisted of brick, concrete, and cut stone originating from the "ruins of London" and it might be stated here, without idle fancy, that many a relic lies buried under the tar-macadam.

The tar-macadam was laid in two courses; the base course, three in. thick was made with graded aggregates, mostly limestone slag, of a maximum size of two in., while the wearing coat  $\frac{1}{2}$  in. thick is made with graded aggregates up to  $\frac{3}{8}$  in.

The tar-macadam was mixed by the County Council at their plant and a few experts were also supplied by the County Council to finish the tar-macadam according to specifications.

3. *Curbs*:—All curbs were pre-cast in sections 30 in long. Along the concrete carriage-ways they were set upright on the projection of the concrete beams, while along the tar-macadam carriage-ways they were laid flat on top of the beams built for that purpose. In all cases, curbs were grouted in with a sand-cement grout.

4. *Farm Entrances*:—Accesses to a few farms along the



Fig. 13—Junction with existing road.

road had to be provided. The surfacing of these farm entrances consists of what is called locally "hogging" laid over a hardcore base. Hogging is a type of soil stabilization consisting of mixing clay, chalk and gravel in the right proportions and with the right amount of water to reach optimum moisture. This mixture is spread over a prepared base and smooth rolled. When completed, it presents a hard surface not unlike the better type of Canadian consolidated gravel roads.

### OFFICIAL OPENING OF ROAD

The road was officially opened on August 28th, 1941, by the Rt. Hon. William Lyon Mackenzie King, Prime Minister of Canada. He named it "Young Street" to commemorate the name of the Officer Commanding the company of Royal Canadian Engineers who built it, and then, (in a blinding rain), addressed the officers and men of the company. In his address, Mr. Mackenzie King brought out an interesting point, to wit: "War does not consist only of destruction but also of construction, often of a permanent nature and of general benefit to the advancement of civilization."

### ACKNOWLEDGMENTS

This paper would be incomplete without the following acknowledgments;

To (*censored*).....Chief Engineer Canadian Corps for permitting its publication, to (*censored*).....C.R.E. Canadian Corps Troops Engineers for posting the writer to the company of engineers employed on this construction, to Major E. J. Young, M.C., Officer Commanding the company of engineers to whom the task was allotted and to whom credit is due for the efficiency of the company, for allowing the writer free access to all records of the work and for supplying some of the photographs, and finally to the officers and men of the company for the efficient and exemplary way in which they carried out the work, and for the accurate records which they kept.

# THE 220,000-VOLT SYSTEM OF THE HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO

A. H. FRAMPTON and E. M. WOOD, M.E.I.C.

*Respectively Assistant Electrical Engineer and Planning Engineer, The Hydro-Electric Power Commission of Ontario, Toronto, Ont.*

Paper presented originally at the Summer Convention of the American Institute of Electrical Engineers at Toronto, Ont., June 1941, and delivered again before the Hamilton Branch of The Engineering Institute of Canada, on October 2nd, 1941, and before the Peterborough Branch, on November 6th, 1941.

## INTRODUCTION

At the Summer Convention of the American Institute of Electrical Engineers in 1930, Mr. E. T. J. Brandon presented a paper under this same title<sup>1</sup>, describing the design of the initial components of this system, which had then been in operation approximately one and one-half years. At that time, one and one-half circuits, having a combined length of 350 miles, were in service, transmitting approximately 110,000 k.w. to a receiving terminal station in the Toronto area of 180,000 kva. capacity. At the present time, the Commission is operating a total of 1,000 miles of single-circuit 220,000-volt construction, with one receiving terminal of 420,000 kva. rated capacity and is placing into service immediately 45 miles of double-circuit construction and a second receiving terminal of 150,000 kva. capacity.

This paper presents a brief history of the development of the system and places on record the experience gained in 8,400 circuit-mile-years of operation of the transmission circuits. Data are presented regarding lightning outages and the behaviour of the circuits under sleet and conductor vibration.

These data are then used to indicate the reasons for certain revisions made in the design of new single-circuit construction carried out during 1940-41, and to indicate the factors that influenced the design of a new 45-mile double-circuit extension. The paper concludes with a discussion of the relay protection system and the improvements now being incorporated therein.

## GENERAL SYSTEM ARRANGEMENT

The 220,000-volt system under discussion forms part of the Commission's 25-cycle Niagara System, Figure 1, which supplies a highly developed area of some 12,000 sq. mi. in the peninsula formed by Lakes Huron, Erie and Ontario. This system distributes power over approximately 1,350 mi. of 110,000-volt lines. The total primary load, which equalled 710,000 kw. in December 1929, reached nearly 1,125,000 kw. in December 1940.

This 220-kv. system has been the channel over which

all growth of load in the Niagara System has been supplied since 1928, from generating sources largely in the neighbouring province of Quebec. An initial 60,000 kw. was transmitted over the first circuit in October 1928, increasing to 515,000 kw. transmitted over three such circuits in December 1940.

Until this summer, this supply has been delivered at the Leaside receiving terminal, adjacent to the city of Toronto, which it will be noted lies at the easterly extremity of the main 110,000-volt system. This fact has in itself created problems of distribution, the solution of which will be materially aided by the placing in service of the new terminal shown at Burlington.

## DEVELOPMENT OF 220,000-VOLT SYSTEM

The 220,000-volt system was initially conceived as a two-circuit system, with a mid-point interswitching station, transmitting some 200,000 kw. purchased under contract from the Gatineau Power Company, from that Company's Pagan development some 230 miles east of Toronto. Later contractual undertakings and the construction of the Chats Falls development on the Ottawa River, brought the total capacity, available from eastern sources to approximately 615,000 kw.

The third 220-kv. circuit was constructed in 1931, when the Chats Falls development was first brought into service. The connection shown from Beauharnois to MacLaren to Chats Falls was built during the depression years, to deliver the power which became available from the former sources to Chats Falls for transmission over the three-circuit system. This was an expedient, adopted as the most economical means of effecting this delivery, following an analysis of the transmission capacity of these three circuits in the light of the then existing knowledge of stability problems. This analysis indicated that, even without a mid-point interswitching station, the dependable capacity of these circuits, given proper fault clearance times, could be increased from an earlier rating of 330,000 kw. to approximately 450,000 kw.

The terminal capacity at Leaside has been increased progressively, by the addition of four 45,000-kva. banks,

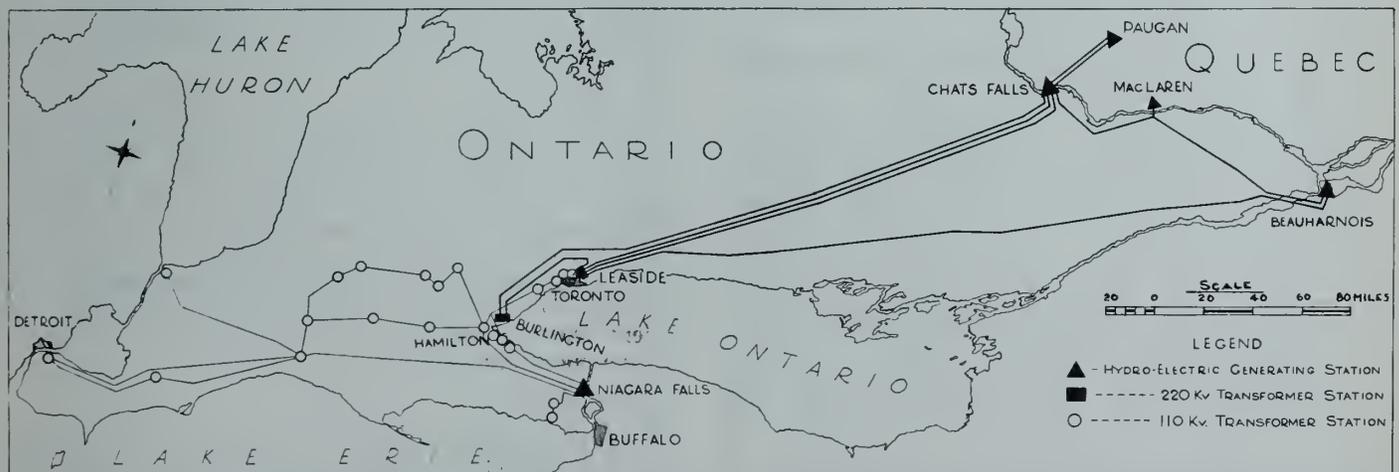


Fig. 1—The Niagara System of the Hydro-Electric Power Commission of Ontario, showing major generating and transformer stations and 220-kv. and 110-kv. lines.

duplicate of the two banks originally installed, and two 75,000-kva. banks, making a total installed rating of 420,000 kva.

Until the outbreak of hostilities in September 1939, it was planned that this system would need to be extended for service in the fall of 1942. The outbreak of hostilities, however, brought the expectation of rapidly accelerated power demands and the construction of a fourth circuit from the Beauharnois development of the Beauharnois Light, Heat and Power Company, in the Quebec section of the St. Lawrence River, was immediately undertaken. The selection of a westerly terminus for that line presented a problem upon which considerable time and study has been expended.

The Leaside terminal, being located in the metropolitan area of the city of Toronto, in which approximately 40 per cent of the total primary demand of the Niagara System occurs, provided a convenient point of distribution for the power delivered during the building-up years. In later years, however, Leaside has been expanded beyond the capacity originally contemplated, so as to make the most efficient use of the transmission system, thereby creating an increasing distribution problem.

Furthermore, as is obviously desirable, the power transmitted over this system was purchased under contracts which require high load-factor deliveries, much higher, in fact, than the load factor of the demands within the immediate vicinity of the receiving terminal.

For these reasons it has been necessary to distribute from Leaside, to gradually increasing distances, power and energy delivered in excess of the Toronto area demands. This distribution distance increases and decreases daily, with the variations of local demand, and is considerably greater in the summer than in the winter. During recent summer months power generated 250 miles east of Toronto has actually been delivered to the immediate vicinity of Niagara Falls.

It had been planned that the second 220-kv. terminal would also be in the Toronto area, but on its westerly outskirts. Further study, in the light of the increased capacity of Leaside, has resulted in the new terminal being located at Burlington, some thirty miles west of Toronto. At that point the new station is adjacent to the rapidly expanding load area of the city of Hamilton and also is situated where a number of existing 110-kv. circuits intersect.

This new terminal is supplied by diverting to it the shortest of the existing 220-kv. circuits, namely, one originating at the Chats Falls development, thus holding the

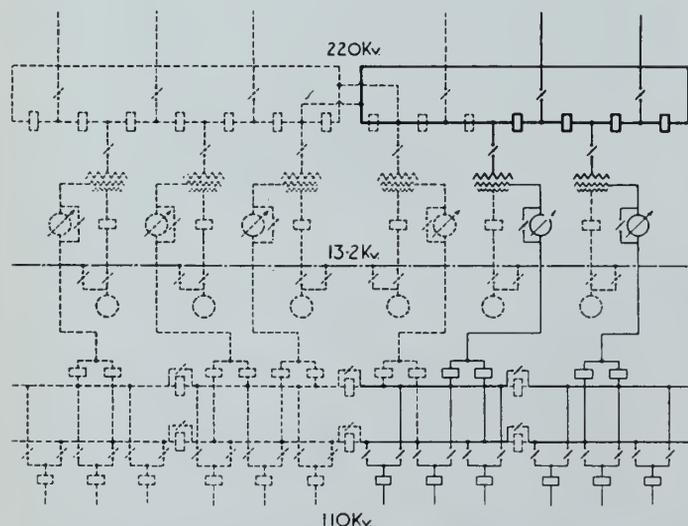


Fig. 2—Burlington 220-kv. receiving terminal. Proposed ultimate diagram for six-220-kv. circuits and six-75,000-kva. transformer banks. Initial (1941) installation in heavy lines.

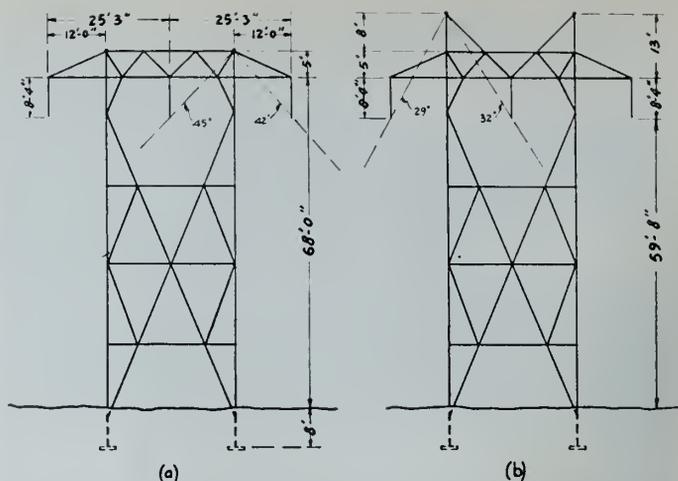


Fig. 3—(a) Outline of original single-circuit 220-kv. tower showing major dimensions and shielding angles. (b) Corresponding outline of revised 1940 tower.

longer Beauharnois circuit to its minimum length by terminating it at Leaside. In addition, a 220-kv. tie-circuit between Burlington and Leaside is provided, interconnecting the 220-kv. lines so that they operate as a four-circuit system. These two circuits are carried around the metropolitan area of Toronto and to Burlington on double-circuit structures, the first of such construction adopted by the Commission.

The Burlington transformer station is being constructed on a sixty-acre site, designed to accommodate ultimately six banks of three-25,000-kva., single-phase, 220/110/13.2-kv., forced-air-cooled transformers. Two banks totalling 150,000 kva. are being installed initially. A schematic diagram of the proposed ultimate station is shown in Fig. 2, on which the initial installation is indicated in heavy full lines. The addition of a third bank at this station will complete the existing phase of development, providing for the delivery of some 675,000 kw. over the four 220-kv. circuits. Beyond that point further delivery at Burlington will depend upon the development of new power resources, as for example, upon the Ottawa or St. Lawrence Rivers.

#### SUMMARY OF OPERATING EXPERIENCE

The first of these 220-kv. circuits was placed in service on October 1st, 1928, since when a total of 560 circuit-miles has been added, making a total of 790 circuit-miles in service as of March 31st, 1941. Of this mileage some 85 circuit-miles are not actually operated by the Commission, being located in the province of Quebec, but are included in the following record. The whole of this construction in general conforms to the designs described in the earlier paper, the standard suspension tower being shown in Fig. 3 (a).

In approximately thirteen years, 8,400 circuit-miles-years of operating experience has been secured and a total of 111 faults due to all causes have been experienced. Of these, four were occasioned by various construction hazards in the early years and eight were due to miscellaneous causes, chiefly external interference. Each of these faults involved only one wire and ground and, except in the period when only one circuit was in service, created no serious disturbance. It is of interest to discuss the salient features arising out of the remainder of this extensive operating record.

#### (a) LIGHTNING

Of the remaining 99 faults experienced in this period, 97 are attributed to lightning, equal to an average of 1.15 lightning outages per 100-circuit-miles per year, in a territory in which the thunderstorm frequency is between

thirty-five and forty storms per year. The classification of these lightning faults as to single-wire-to-ground, two-wire-to-ground and three-wire and as to those involving one, two or three circuits is given in Table I. The frequency of occurrence of such faults has varied tremendously; for example, three outages have been experienced within ten minutes; on another occasion, four within an hour and again five in one day and yet one period of eighteen months passed without a single outage.

TABLE I  
LIGHTNING OUTAGE RECORD

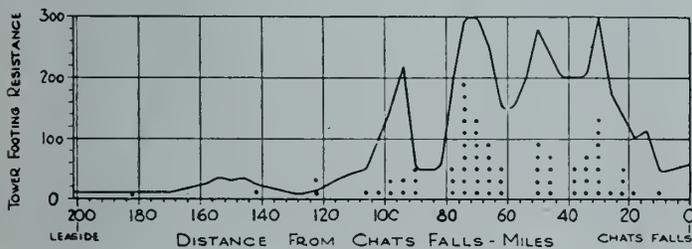
Classified according to the type of fault.

Involving one wire and ground.....	56	— 59%
Involving two wires and ground.....	25	— 26%
Involving three wires.....	14	— 15%
Total .....	95	—100%
Involving one circuit only.....	95	— 98%
Involving two circuits simultaneously..	1	— 1%
Involving three circuits simultaneously	1	— 1%
Total outages due to lightning....	97	—100%

These averaged data do not give a complete picture of the performance of these circuits. The three Chats Falls-Leaside circuits are constructed over terrain varying from rich farm land to rocky undeveloped bush country. The latter section, which extends almost continuously for a distance of about 90 miles, is characterized by surface rock formations with pockets of muskeg in the rock depressions. Towers are frequently erected on the rock outcrops. Low footing resistances are, therefore, difficult to obtain. In Fig. 4 an approximate footing-resistance profile for the Chats Falls-Leaside section is given, as compared to the known location of 70 of a total of 89 outages in this section attributed to lightning. It will be seen that some 90 per cent of the located lightning outages occurred in the section of high footing resistance.

In Table II is presented an attempt to co-relate the lightning outage record with footing resistance. The data are presented first for the 70 located faults in the Chats Falls-Leaside section and then for all 97 faults, based on locations for those not traced, as estimated from relay target and oscillograph records. It will be observed that, in the territory where footing resistances are considered to be below 25 ohms, the actual outage record approximates 0.2 outages per 100-circuit-miles per year.

Reference to Fig. 3 (a) shows that the tower design in these lines provides a shielding angle of 42 degrees and a ratio of "height of ground wire above power conductor to total height of ground wire" of 0.182. The experimental results of Wagner, McCann and MacLane<sup>2</sup> and the data presented by Waldorf<sup>3</sup> would indicate that good lightning performance could be expected and the record



• REPRESENTS ONE LIGHTNING FAULT IN THE RESPECTIVE FOUR MILE SECTION (5 TOWERS PER CIRCUIT PER MILE)  
TOWER FOOTING RESISTANCE FIGURES ARE AVERAGE VALUES FOR THE 60 TOWERS IN EACH FOUR MILE SECTION.

Fig. 4—Approximate footing resistance profile of three-220-kv. circuits, Chats Falls to Leaside, showing grouping of 70 located lightning outages.

proves that, given low-footing resistances, such has been the case.

Some crowfoot counterpoise work was done in the rock section along these three circuits during 1934-35. Short sections of highest footing resistance were so treated, with some success in lowering the measured values, but presumably the distances the crowfoot wires were carried to reach good grounds were too great to secure any considerable benefit.

TABLE II  
LIGHTNING OUTAGE RECORD

Classified according to tower footing resistance.

(a) For 70 located faults on the Leaside-Chats Falls Circuits.

Average Tower Footing Resistance—Ohms	Number of Outages	Circuit-mile—Years of Operation	Outages per 100 Circuit-mile-years
Under 25	3	2,150	0.14
25-50	6	1,950	0.31
50-200	16	2,000	0.8
Above 200	45	1,100	4.1
	70	7,200	0.97

(b) For all outages due to lightning.

Average Tower Footing Resistance—Ohms	Number of Outages	Circuit-mile—Years of Operation	Outages per 100 Circuit-mile-years
Under 25	5	2,600	0.19
25-50	9	2,200	0.41
50-200	27	2,500	1.08
Over 200	56	1,100	5.1
	97	8,400	1.15

(b) MECHANICAL—SLEET AND WIND

In the southern part of the province of Ontario sleet storms of varying intensity may be anticipated both in the early and late winter seasons. December and March are the two worst months, though infrequently sleet may occur in any month from November to April. Storms have been experienced which have disrupted communication circuits and taken down wood pole construction. The phenomenon of "galloping conductors" has been observed, at frequent intervals, on various sizes and spans of conductors up to 605,000 c.m., A.C.S.R. at a span of 880 ft. Consideration must therefore be given to sleet conditions for all lines designed or constructed in this territory.

Two outages in the period under review are attributed directly to sleet, and these, incidentally, occurred within a few minutes of one another. Heavy sleet had formed on both power conductors and ground cables on certain hill tops, but only lightly on an intervening long valley span. As a result, the power conductors in the long span were pulled up by the unbalanced loading on the two sides of the adjacent suspension insulation, so that the ground cables, sagged to their normal loaded positions, appeared below the plane of the power conductors at mid-span. Two flashovers occurred, the second of which burned down a ground cable, resulting, on account of inaccessibility, in 27-circuit-hours of outage. In two other similar cases, a condition of unbalanced sleet loading was set-up, greatly increasing the sag of the ground cables without compensating sag of the power conductors, resulting in inadequate clearances. Fortunately, in these cases, the conductors were not disturbed by wind.

(c) MECHANICAL—VIBRATION

At the time of the construction of the first of these circuits (1927-28), the then relatively recent adoption of much longer spans and higher conductor tensions had brought the problem of conductor vibration strongly to

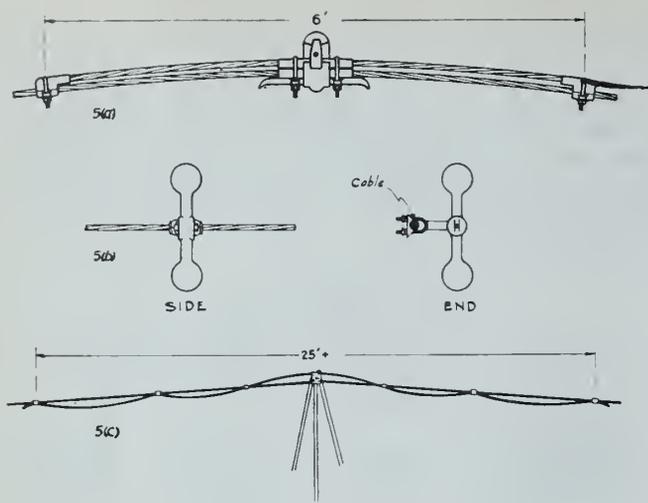


Fig. 5—(a) Conductor reinforcement on first (1927-28) construction.  
 (b) Torsional-type vibration absorber provided on one-half 1940-41 single-circuit construction; Stockbridge damper provided on remainder of such construction.  
 (c) Ground cable festoon used on 1940-41 construction.

the attention of transmission engineers. Remedial or palliative measures were as yet under investigation. In the original design this problem was recognized by providing, at suspension points, a reinforcement consisting of a 6-ft. length of the conductor fastened at its outer extremities and supported above the main conductor in a double-seated suspension clamp, Fig. 5(a). In the second and third circuits this form of reinforcement was replaced by the standard armour rods.

Each of these circuits was designed for a maximum conductor tension, at  $\frac{1}{2}$  in. ice, 8-lb. wind and 32 deg. F., of 10,000 lb., conductors being 795,000 m.c.m., A.C.S.R. having an ultimate strength of 28,500 lb. This represents a maximum tension of 35 per cent of ultimate and also represents a tension at 60 deg. F. of 16 per cent of ultimate. These figures will be recognized as indicating a design in which conductor fatigue due to vibration might be anticipated.

Actually a considerable record of vibration has accumulated in operation, though nothing approaching a serious condition has been observed to date. Quite early a loosening of tower members was experienced, but this was remedied by the use of locknuts or their equivalent at all one and two bolt positions. Careful periodic examination of the conductors has revealed a few broken strands though such damage does not indicate the need for any further palliative measures for some years.

#### REVISION IN DESIGN INCORPORATED IN THE 1940-41 SINGLE-CIRCUIT CONSTRUCTION

The recent extensive additions to this system were naturally not undertaken without re-consideration of the various design factors in the light of the experience enumerated above. It is of interest therefore to mention the revisions that were made and to discuss the reasons associated therewith. The discussion is perhaps best arranged under the previous headings, though it is difficult to separate those adopted for improved lightning design from those which aimed at improvement in the mechanical performance.

##### (a) LIGHTNING

The record indicates that good lightning performance can be expected of the original single-circuit tower, so long as footing resistances are kept sufficiently low. Perhaps, therefore, no change would have been made in the tower design were this the only factor, but as it was decided to raise the ground cables primarily for sleet operation,

this revision may also be taken as improving the expectation of good lightning performance.

As illustrated in Fig. 3(b), the two ground cables were raised eight ft. above their original location, to a point of support 21 ft. above the point of support of the power conductor in the suspension tower. This has had the result of decreasing the shielding angle to 29 deg., while increasing the ratio of "height of ground cable above power conductors to total height of ground cable" to 0.263.

Measurements made by the Meg-Earth tester shortly after tower erection indicated that, in the earth sections, after consolidation of the back-fill, tower footing resistances generally would not exceed 15 ohms. In these sections, no treatment beyond the occasional crowfoot is contemplated. In the rock section, it was decided to lay a continuous counterpoise, consisting of  $\frac{5}{16}$  steel conductors available in salvage stores. These cables are in general buried to an average depth of 18 in. under the out-phase wires. Occasionally, however, they are taken around rock outcrops, when by so doing they could be buried, and, in isolated cases, are actually carried over the top of the rock. The performance of this new circuit will be carefully compared to that of the existing circuits as such performance will largely dictate whether counterpoise should be added to the older construction.

##### (b) MECHANICAL—SLEET AND WIND

Our experience would seem to indicate that, under the operating conditions existing, sleet is more liable to form on the ground cables than on the power conductors, and under such conditions the vertical separation provided between ground cables and power conductors has proved insufficient. Mr. A. E. Davison, Transmission Engineer for the Commission, has actively studied this problem of conductor clearances. These studies are based on Lissajous figures<sup>4</sup> and the locus of motion of the conductor under "galloping" conditions is taken as the criterion. The axes of this motion have been determined empirically

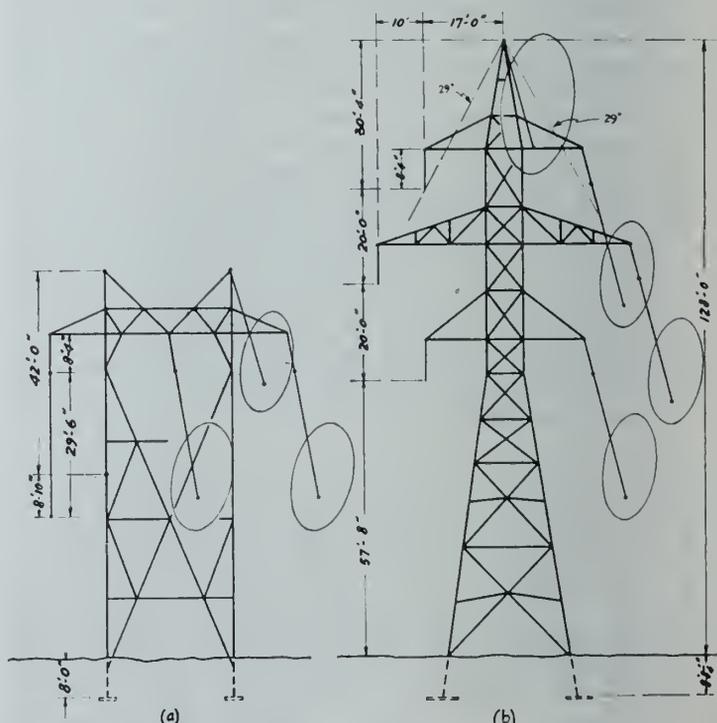


Fig. 6—(a) Clearance diagram (Lissajous figures) for 1940-41 single circuit construction. Loci based on half-loops, i.e., movement of quarter-point in suspension span. Note also mid-span positions of  $\frac{3}{4}$  in. ice-loaded ground cable and unloaded phase conductor.

(b) Corresponding diagram for 1941 double-circuit construction. Note full loop movement of ground wires assumed at 880 ft. span.

from recorded field observations and from analyses of motion picture records of a number of actual occurrences. It is possible to at least approximately delineate the various loci. A tower design in which these approximate loci indicate adequate clearance between all conductors is considered much more satisfactory than one in which overlapping loci occur.

However, the extent to which this method should be applied to heavy conductor, long-span construction is still somewhat of an open question, being largely based on the behaviour of smaller conductors and shorter span construction than is involved in this case. No conclusive data are available indicating that 795,000 c.m., A.C.S.R. at 1,056 ft. spans will "gallop" at all, and, even if it does, whether it will be in one continuous loop between the points of support or in something of a wave motion raising not more than one-half the span above its normal position at one time (that is, in half-loops). Messrs. Oldacre and Wollaston<sup>5</sup>, in describing the Powerton-Crawford line, illustrated the use of Lissajous figures and assumed the movement of the conductor in one loop.

In our case, however, a substantial mileage of towers was available in stock and much quicker deliveries could be obtained if the basic original design was not changed. This design was based on a longitudinal loading equivalent to  $\frac{1}{2}$  in. ice and 8-lb. wind, but with the transverse loading increased to  $\frac{3}{4}$  in. and 11-lb. wind, the latter increase an added factor of safety since considered unnecessary. It was decided that part of this excess strength could be utilized to provide greater vertical separation between ground cables and power conductors, though in designing this improvement it was considered sufficient to assume movement of the conductors in half-loops only. It will be noted in Fig. 6(a) that the re-design has removed the loci of motion of the ground cables from those of the phase conductors, providing adequate clearances under the assumed conditions. The ice-loaded mid-span position of the ground cable at rest, as compared to the corresponding position of the unloaded phase conductor, is also shown, indicating the maintenance of substantial clearances even with a  $\frac{3}{4}$  in. ice differential.

### (c) MECHANICAL—VIBRATION

The balance of the excess strength in the original tower design has been utilized to increase the ruling span from 1,056 ft. to 1,150 ft. In order to maintain the same ground clearance at this longer span, the higher strength 26x7 strand, 795,000 c.m., A.C.S.R. has been used, strung to a maximum designed tension of 12,000 lb. Based on an ultimate strength of 30,900 lb., the designed maximum and "60 degree" tensions therefore approximate 39 per cent and 17.6 per cent of ultimate strength respectively.

The lengthening of the span in the new circuit was based partly upon the vibration record of the existing circuits and partly upon the favourable results obtained from an extensive laboratory and field investigation of damper design and performance<sup>6</sup>. It is felt that the development in this field now safely permits securing the economy inherent in longer spans and higher conductor tensions. The full possibilities in this connection were not realized in this case, due to the decision to retain the basic original tower design, but had a completely new design been permitted, spans as great as those encountered in some other recent construction would have been given serious consideration.

Associated with this increased span length the application of vibration absorbers was decided upon, rather than the previously used armour rods. Approximately one-half the line is equipped with the Stockbridge damper and one-half with the torsional damper, Fig. 5(b), developed in the Commission's laboratory and described in a companion paper by Mr. G. B. Tebo<sup>6</sup>. Both dampers are

used singly, that is, two per span. Vibration of the ground wires is protected against by the use of festoons, Fig. 5 (c).

### DOUBLE CIRCUIT CONSTRUCTION—LEASIDE TO BURLINGTON

In considering the two-circuit extension of these 220-kv. lines, from the existing terminal at Leaside to the new terminal at Burlington, a number of factors were brought into consideration. Single-circuit construction was initially considered, the Commission not having previously operated any double-circuit construction at 220 kv. In fact, there had been evident in the Commission's engineering a tendency to avoid such construction at all voltages, in favour of various single-circuit configurations. However, as some twenty miles of the Burlington extension necessarily encircled the metropolitan area of Toronto, this viewpoint was brought sharply into conflict with the question of right-of-way costs. The final decision was in favour of the double-circuit construction, though it will be noted that a relatively conservative design has been adopted.

The initial decision was to adopt a span of 880 ft., utilizing 795,000 c.m., A.C.S.R. at a maximum designed tension of 10,000 lb. However, a change in this decision was

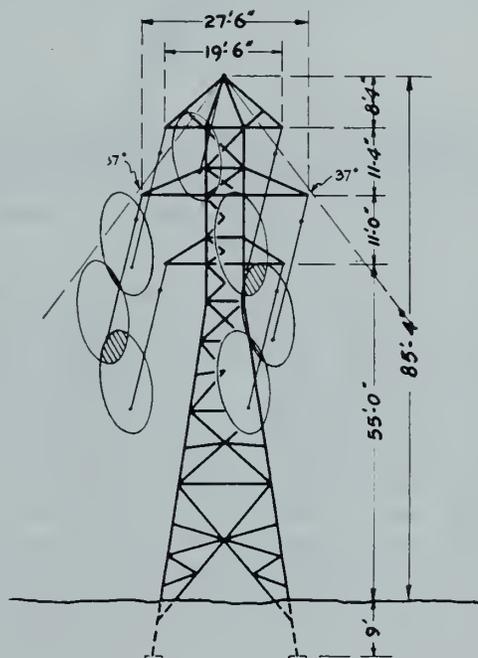


Fig. 7—Clearance diagram for 1920 type 110 kv. double-circuit construction—one-half loops only. Note overlapping loci indicating anticipation of sleet outages.

brought about by the exigencies of the present situation and the line is actually being constructed utilizing the type HH segmental, hollow-core, copper conductors, 500,000 c.m., 1.02 in. outside diameter, seven segments, having an ultimate strength of 21,200 lb. At the 880 ft. ruling span the maximum designed tension, at  $\frac{1}{2}$  in. ice, 8-lb. wind and 32 deg. F., is 9,500 lb., the 60 deg. tension being 4,700 lb., equivalent to 45 per cent and 22 per cent of ultimate respectively.

The tower design adopted is shown in Fig. 6(b). It will be noted that a single ground cable is used, located at the tower peak, 30 ft. above the point of support of the upper phase conductor in the suspension position. A shielding angle of 29 deg. and a ratio of "height of ground wire above power conductors to total height of ground wire" of 0.236 results. Footing resistance data on this construction are not yet available, but the line being all in good agricultural land it is not anticipated any particular treatment of the footings will be found necessary.

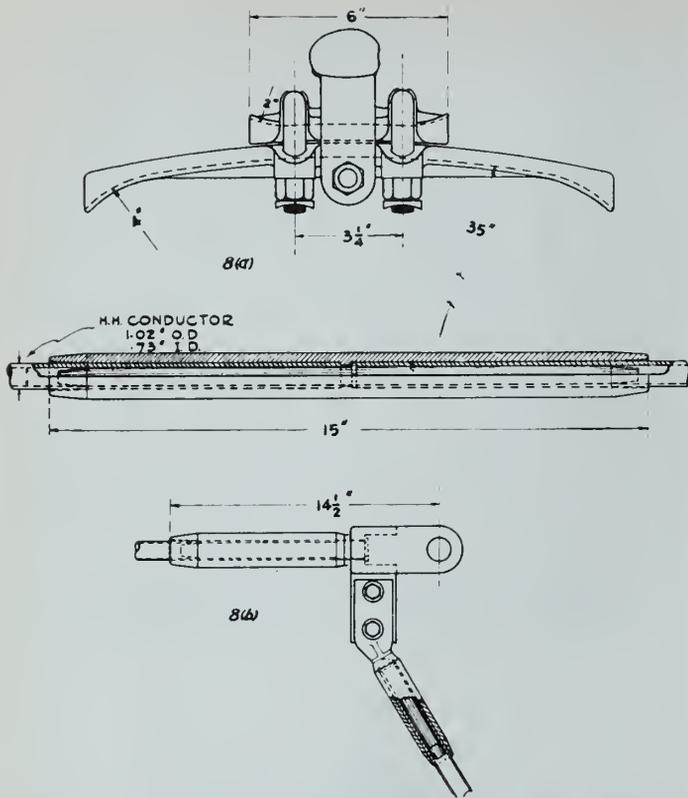


Fig. 8—(a) Suspension clamp adopted for type III segmental copper cable, 500,000 c.m., 1.02 in. outside diameter. Span 880 ft. maximum designed tension 9,500 lb. 45 per cent of ultimate strength.

(b) Jointing and dead-end assemblies for type III copper conductors.

Again in the new double-circuit construction the same principles of design for slect operation were used. It has been found more difficult to provide adequate clearances economically in this type of structure than in the single-circuit design. For example, in an earlier 110-kv. design, utilizing 605,000 c.m., A.C.S.R. conductors at 880 ft. spans and providing a 4-ft. offset of the centre phase wire, Fig. 7, actual outages due to "galloping" have been experienced. That these outages might be anticipated, however, is indicated when the design is analyzed by means of Lisajous figures, though it will be seen that rather extensive revisions will be needed to effect full clearances. The clearance diagram for the 220-kv. design finally adopted is shown in Fig. 6(b), based on half-loop movement of heavy copper power conductors but full loop movement of the relatively light ground cable.

No special precautions are being taken to protect this double-circuit construction against conductor vibration. The extensive studies reported by other authors are interpreted as indicating that, except perhaps in certain cases, no such precautions are necessary. Furthermore, it was decided that no particularly special provisions would be made in the suspension clamp, Fig. 8(a), and that copper compression joints, Fig. 8(b), would be used for both straight joints and dead-end assemblies. Time has not permitted complete investigation of this latter practice, which is at variance with the practice adopted in certain other lines utilizing this form of conductor<sup>7</sup>, but, as the full strength of the conductor is developed in these new joints and as the mass of all parts subject to possible vibratory stresses is reduced to a minimum, no objectionable operating experience is anticipated.

A structural revision incorporated in the double-circuit tower consists of designing the lower panel so that all diagonal connections are made above grade. In earlier designs, including the single-circuit 220-kv. construction, the point of connection of the lower diagonals and the

main legs is located below ground level. In this climate and particularly in clay soils, frost heaving has been found to occur which reacts against this below-grade diagonal, causing bending and in some cases actual failure.

#### RELAY PROTECTION AND SYSTEM STABILITY

It is finally of interest to describe briefly the relay protection provided on this 220-kv. system and to discuss the improvements being made, both in the existing protection and in the protection of the newer construction, associating these improvements with the operating record and with the data obtained from Network Calculator analysis of the system.

For "phase" faults, the earlier relaying consists of directional, two-stage, impedance distance type. The instantaneous range of such relays is set to cover 85 to 90 per cent of the line length, the overlapping second range set to cover the remainder of the line and being given a definite time delay of 0.6 to 0.8 seconds. This protection effects simultaneous clearance of all faults in the mid-section of any line, but results in delayed opening of the distant breaker for end-zone faults.

For "ground" faults, similar protection is used, except that the relays are supplied with line residual current and phase-to-ground voltage and the instantaneous range is set to cover the whole length of the line, with some margin if the remote end is open. This results in simultaneous clearance of mid-sections faults, though it also effects sequential clearance of faults in the end zones, that is, clearance without the delay associated with the timed second range.

Certain of the line sections terminate in breakers of earlier design, which originally gave a clearance time, with instantaneous tripping, as high as 0.5 to 0.6 seconds. The more modern equipment clears within 0.2 to 0.25 seconds. Improvements have been made from time to time,

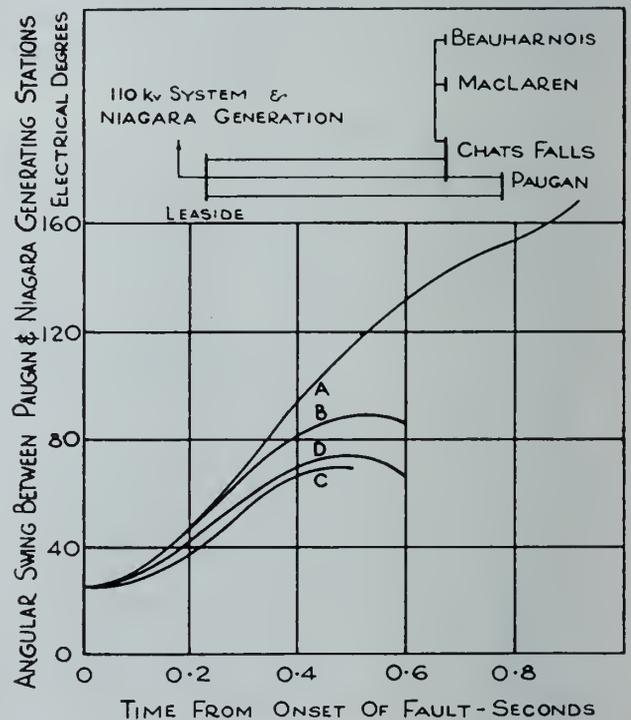


Fig. 9—Stability curves for three-circuit 220-kv. system at loadings of approximately 200,000 h.p. per circuit. (A) Three-phase fault at Chats Falls, cleared sequentially in 0.2-0.5 seconds—unstable. (B) Three-phase fault at Chats Falls, cleared simultaneously in 0.2 seconds—stable. (C) Three-phase fault 30 miles west of Chats Falls, cleared simultaneously in 0.25 seconds—stable. (D) Two-wire-to-ground fault at Chats Falls, cleared sequentially in 0.2-0.5 seconds—stable.

in the original relaying and in the older circuit breakers, so that total clearance times now vary from 4.5 to 10 cycles, with an average of about 6 cycles (based on 25 cycles) for all faults except those cleared by the second ranges.

This protection, though admittedly below present-day standards, has nevertheless given adequate service during the building-up period on this system. Fortunately, all but a very few of the 39 multi-phase faults have occurred in the high-footing-resistance territory in the mid-section of the Chats Falls-Leaside lines, where this protection effects simultaneous clearance.

Improvement necessary in the protective equipment, when operating at the higher recent loadings, has been the subject of several Network Calculator studies. These studies bring out quite clearly the inherent stability of a 25-cycle system. Assuming simultaneous clearance times of 0.2 to 0.25 seconds, as would be obtained with standard modern equipment, it is found that the three-phase fault may be adopted as the stability criterion, rather than the two-wire-to-ground fault usually adopted in 60-cycle systems.

In Fig. 9 is presented a family of curves obtained in such analysis, which indicate the relative severity of different types and locations of faults. At a loading of approximately 150,000 kw. per circuit, Curves A and B indicate that three-phase faults near the generating sources must be cleared simultaneously in approximately 0.2 seconds, if stability is to be maintained. If such faults occur away from the generating sources, Curve C indicates that the increased loading of generators thereby created is sufficient to maintain stability with simultaneous clearance at 0.25 seconds. Curve D shows the relatively lesser severity of the two-wire-to-ground fault, which does not disturb the system stability with sequential clearance as long as 0.2 and 0.5 seconds. These results are taken to indicate that, with protective equipment effecting simultaneous clearance of all faults in 0.2 to 0.25 seconds, loss of system stability at loadings of 150,000 kw. to 170,000 kw. per circuit need not be anticipated.

It is proposed to attain this aim by superimposing carrier pilot control on existing and on all new two-stage impedance relaying. With the exception of the new Leaside-Burlington line, where standard "transfer-block" carrier relaying is proposed, a system of transfer-trip carrier control is being developed. The first of this equipment is being installed on the Beauharnois-MacLaren-Chats Falls connection and on the new Beauharnois-

Leaside circuit. It consists of 400-watt carrier communication transmitters, single-frequency voice-actuated, the speech frequency range being limited to a band of 200 to 2,500 cycles. Tone generators will be used to transmit relay control signals, which operate to remove the time-delay feature of the distant-end second-range relays. Thus simultaneous clearance is obtained over the full line length, the speed of clearance being limited to that of the various terminal breaker equipments. This protection is as yet experimental and its performance in service will form an interesting study.

#### CONCLUSIONS

1. Operating experience with some 8,400 circuit-mile-years of 220-kv. single-circuit overhead line construction is submitted, which to a high degree confirms conclusions which may be drawn from the application to designs of published principles derived from theoretical and experimental analysis.
2. Changes made in the latest designs of towers to provide improved operation under sleet conditions also provide desirable improvements in design against lightning.
3. Counterpoise on towers of high-footing-resistance which has largely been omitted on earlier construction is being installed on 1940-41 lines.
4. Standard two-stage impedance type relay protection has given good satisfaction on these lines. To provide the best operation under heavy line loadings, carrier-current features are being superimposed on both new and old relaying to extend high-speed simultaneous fault clearance to cover the full length of each line.

#### REFERENCES

- ① "The 220,000-Volt System of the Hydro-Electric Power Commission of Ontario," E.T.J. Brandon; A.I.E.E. Transactions, Vol. 49, October 1930, pgs. 1400-1417.
- ② "Shielding of Transmission Lines," Messrs. Wagner, McCann and MacLaren, Jr.; A.I.E.E. Technical Paper 40-107, presented at the Summer Convention 1940.
- ③ "Experience with Prevention Lightning Protection on Transmission Lines," S. K. Waldorf; A.I.E.E. Technical Paper 41-36, presented at the Midwinter Convention 1941.
- ④ "Ice-Coated Electrical Conductors"—A. E. Davison; Technical Report No. 229, at the Conférence Internationale des Grands Réseaux Electriques à Haute Tension, at Paris, France, on July 1, 1939.  
*Note:* This paper is reprinted in the *Bulletin* of the Hydro-Elec. Power Com. of Ont., Sept. 1939, pgs. 271-80.
- ⑤ "Powerton-Crawford 220-Kv. Line Design and Construction Features"—M. S. Oldacre and F. O. Wollaston; A.I.E.E. Technical Paper 41-57, presented at the Midwinter Convention 1941.
- ⑥ "Measurement and Control of Conductor Vibration," G. B. Tebo; Hydro-Elec. Power Com. of Ont.; a paper submitted for presentation at the A.I.E.E. Summer Convention 1941.
- ⑦ "Engineering Features of the Boulder Dam-Los Angeles Lines," E. F. Scattergood; A.I.E.E. Transactions, Vol. 54, 1935, pgs. 494-512.

# AIR RAID PRECAUTIONS AS RELATED TO BUILDING DESIGN

S. D. LASH, M.E.I.C.

Lecturer, Department of Civil Engineering, Queen's University, Kingston, Ont.

**NOTE**—This article was prepared at the request of the Publication Committee of The Institute. It gives a general outline of the information contained in one piece of literature issued by the British authorities.

## INTRODUCTION

Considerable attention has been given in recent months to the problem of air raid precautions in Canada, particularly from the point of view of civilian defence organization. At the same time, many factory buildings have been built for use by war industries and it appears that, in its design of these, little or no thought has been given to the possibility that in the event of air raids such buildings will form important military targets. It is suggested therefore, that architects and engineers responsible for the design of buildings for defence industries, or other vital services, should consider carefully the question of passive protection against air attack.

Although much is yet to be learned, it has been clearly established that certain precautions can be taken which will greatly lessen the probable damage from air attack. Some of these results have been presented in the Wartime Building Bulletins published by the Department of Scientific and Industrial Research in Great Britain. Copies of these bulletins are on file in The Institute library. The following suggestions are largely based upon information contained in the Wartime Building Bulletins, particularly No. 10 "General Principles of Wartime Building."

## PLANNING

Certain buildings can be very easily detected from the air. This may result from the location of such buildings or from their design. For example, buildings should not be placed in close proximity to well-defined topographical features such as lakes or the junctions of railways or main roads. The film "Target for To-Night" provided an illustration of these points. The layout of the buildings and site should be such that a regular arrangement of buildings and roads is avoided, and the natural surface of the ground is disturbed as little as possible. Distinctive features such as traffic circles should also be avoided; road surfaces should be dark in colour; and it is desirable that hedges be planted alongside roads. The best orientation for buildings is with the longest side running east and west.

High buildings are more easily detected from the air than low buildings, and any buildings having inclined roof glazing are particularly difficult to camouflage. Thus the ordinary saw-tooth roof building should be avoided and it is fortunate that this type has never been as popular in Canada as elsewhere owing to problems resulting from the accumulation of snow in the valleys. On the other hand, flat roofs should have a sufficient slope to ensure a rapid run-off of rain water so as to avoid reflections.

## CONSTRUCTION

The precautions mentioned in the preceding paragraph are aimed at preventing the detection of the building from the air. In spite of all precautions a factory may be located by the enemy and bombs dropped in its vicinity. Its vulnerability will then depend greatly upon the construction.

Damage from bombs may result from a direct hit, from blast, or indirectly from fire. The following remarks refer chiefly to the effects of these on single storey factories.

With regard to direct hits, the British authorities state that "it is possible without extravagance to design a sin-

gle storey factory in which extensive collapse of the roof is unlikely, even under a direct hit from a very heavy bomb." This is accomplished by building the structure with a considerable degree of continuity. Thus, for example, steel roof trusses should not rest on masonry bearing walls but should be strongly connected to steel columns so as to produce a fully framed structure. Other things being equal, a building with closely spaced columns may be more vulnerable than one in which the columns are further apart since two or more adjacent columns may be destroyed by a single bomb. Particular care should be taken to prevent the collapse of a whole series of roof trusses through the collapse of one. This can be accomplished by providing suitable continuous beams or trusses at right angles to the planes containing the roof trusses. In general, design to limit damage from direct hits has many things in common with the design of earthquake resisting structures.

It has been shown quite clearly that the effect of blast is greatly increased if the explosion is confined in a small space. Thus when a bomb explodes in a building there is a considerable increase in pressure for a very short period of time and the impulsive forces thus created will shatter windows and possibly push out the walls and lift the roof.

Inclined roof glazing is bad from the point of view of vulnerability, as well as detection, since when the glass is shattered, the arrangement of temporary protection against weather and of blackout measures may be a matter of some difficulty. In fact it will be considerably more difficult to arrange blackout precautions in the first instance. On the other hand it has been pointed out that vertical glazing in walls, if close to the ground, is particularly liable to damage from near, or not so near, misses. Thus it is desirable that walls should have no window openings closer than say five or six feet to the ground and that the walls up to this height should be of sufficient thickness to provide protection against splinters. Such walls should not be anchored to the columns since they can then be blown out without causing collapse of the whole structure. On the other hand, the roof should be securely anchored down. The necessity for adequate roof anchorage against wind loads has been generally recognized since the Florida and New England hurricanes and the use of such anchorage will assist greatly in preventing the displacement of roofs by blast.

The British authorities state that the need for fire protection has been clearly shown. It is stated that for every ton of steel rendered unusable by the direct action of bombs ten tons have been destroyed by fire. Consequently it is strongly recommended that all steel be protected against fire. The amount of protection required in any particular case will depend upon the amount of combustible material in the building. In a great many instances, protection sufficient to provide a fire resistance of one hour, as determined by standard test, will be adequate. In some cases even one half-hour protection may be sufficient to prevent collapse. Many modern building codes include description of such protections. The British authorities refer to the use of sprayed asbestos and sprayed "slag wool" (rock wool and gypsum), in addition to the protections more commonly used; these processes would appear to be worth consideration in Canada.

Limitation of damage by fire is not merely a matter of protection of structural members, though such protection will go far in preventing structural collapse; all fire prevention methods which have proved to be valuable in

the past should be carefully considered. Such methods include the provision of adequate water supplies for fire-fighting, the use of automatic detecting and extinguishing systems, and the use of self-closing fire doors and other barriers to the spread of fire. In these matters the various associations of insurance underwriters can give expert advice. Occasionally wartime requirements differ from ordinary fire protection measures. Thus it has already been pointed out that the subdivision of floor space into comparatively small areas is considered undesirable, since the effect of blast may thereby be increased.

The protection of personnel comes under the general subject of civilian defence but there are one or two matters to which the attention of architects and engineers may be directed. The provision of proper exit facilities is of great importance. Since the primary exit may be blocked it is particularly important that a second exit be available from every floor area. Low walls three or four feet high, subdividing floor areas, are a useful means of protecting personnel and machinery from splinters and from the effects of blast. They will not confine the blast sufficiently to increase general structural damage.

## ANNUAL REPORT FOR 1941 TO THE ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT

ROBERT E. DOHERTY  
*Chairman of the Council*

Presented at the Annual Meeting of the Engineers' Council for Professional Development,  
at New York, U.S.A., on October 30th, 1941.

Before reporting specifically regarding the work of the Council I wish to make a few general observations. In the first place, it has seemed clear that before E.C.P.D. could accelerate its progress toward the objectives stated in the Charter it was essential that not only the officers and boards but also the rank and file of the constituent organizations understand much more fully than they have in the past what these objectives are and the importance of their achievement to the welfare of the country. An astonishing number of people, including some comparatively close to the work, have felt that the most important activity and the only significant achievement of E.C.P.D. have been in connection with the accrediting program. Yet the Charter clearly indicates other purposes and activities—relating to selection and guidance, professional training, professional recognition—and these are also actively pursued by standing committees. And from the point of view of further advancement of the profession, and more important still, the welfare of the country, these other purposes and activities are, in the long run, unquestionably of equal importance with accrediting. Good students are not less essential than good schools. Hence, at the beginning of the year I strongly urged an educational campaign among the constituent organizations as one of the most important projects the Council could undertake. And I am confident that as the constructive purposes and results of the Council's work become clear, all constituent bodies will appraise the situation as it exists today, forget misunderstandings of the past, and see their way clear to support the Council's work.

The chairman's views regarding this matter, after discussion in Executive Committee meetings, were presented in a report to the several boards of the constituent groups under the heading "E.C.P.D. Should Look Ahead." This report has been made available to the membership of several of the constituent organizations by publication in their respective journals<sup>1</sup>. It urged that, in the interest of national welfare as well as professional development, the organizations cultivate more effective methods of co-operation than they have had in the past.

The machinery for the cultivation of such co-operation exists in E.C.P.D. The projects represented by its standing committees and by other objectives *having to do with professional development* afford a basis on which the organizations can work together. But the effectiveness of this co-operation will depend, in my opinion, altogether upon the effectiveness of plans devised by the Council to make use of the machinery wisely set up by the sever-

al participating bodies when the Council was organized. These plans must, it seems to me, include a more active participation than in the past by the representatives of the constituent bodies; and to accomplish this, there naturally must be a definite and a constructive program in which they can find an active interest. It is hardly to be expected that each of twenty-four different delegates will, on his own responsibility, think out what his organization should do toward E.C.P.D. objectives or what E.C.P.D. might do to further them. Hence the officers and Committee chairmen of the Council must work with the delegates to formulate plans and procedures. Fostering co-operative effort has thus become one of our definite plans.

And finally, I would say a general word regarding financial responsibility for supporting the work of the Committee on Engineering Schools. From the beginning it has been the policy, and still is, that an engineering school should pay for the expense of the initial inspection to determine whether a curriculum should be accredited. Although all of the colleges have accepted this policy (some, however, under protest), there is nevertheless another side of the inspection plan on which the policy has not been so clear or so widely accepted. This relates to the question who should pay for *re-inspection* of curricula that have already been added to the accredited list. A number of the colleges are unalterably opposed to the principle that they should pay this *re-inspection* fee, and this opposition has made it extremely difficult for the officers of E.C.P.D. who administer the accrediting program. Hence this became a major question of policy. On the one side, such engineering colleges take the position that the E.C.P.D. and other accrediting agencies constitute an intolerable burden and nuisance in view of the combined expense in money and time of staff spent in preparing questionnaires and in looking after visiting delegations of inspection; that they were not responsible for the proposal to start the accrediting program in the first place, but rather it was the state boards and professional societies that wanted it; and that they now make sizeable contributions toward the program through the time their faculty members and their official staff take from academic work in order to carry out E.C.P.D. committee assignments in connection with inspection programs at other institutions and the preparation of reports for E.C.P.D. On the other hand, the argument is proposed by some representatives of the constituent organizations that the accrediting program is valuable to the colleges both on account of the advice and counsel that may come to them as a result of the inspection and *re-inspection* and

<sup>1</sup> *The Engineering Journal*, September 1941, p. 446.

through having their names appear on the accredited list. This matter was a question of extended debate at two meetings of the Executive Committee, since a decision to remove the burden of *re*-inspection fee from the colleges would make an additional appropriation necessary from the constituent organizations. As indicated in detail under finances, the decision of the Committee was in favor of relieving the colleges of this burden, and of asking the constituent organizations for increased appropriations.

#### NEW CHARTER FOR ENGINEERING EDUCATION

Engineering education in this country now has a charter to guide its development. In 1939 a special committee of the Society for the Promotion of Engineering Education undertook the statement of an educational philosophy and the formulation of definite objectives that might serve as the basis for the design of programs in engineering education. After extended work by the committee, representing a wide spread of points of view, the S.P.E.E. issued the report "Aims and Scope of Engineering Curricula."

In view of the fact that the recommendations of this report naturally had definite relationship to the question of accrediting, the report was submitted to the Engineers' Council for Professional Development at the October, 1940 meeting, at which President Donald B. Prentice of the S.P.E.E. made a statement regarding this relationship to the Council's work. The Council of course referred the matter to the Committee on Engineering Schools, and I am happy to note in the report of Chairman Potter of this Committee that the provisions in the S.P.E.E. document have been endorsed by this Committee.

For its educational leadership and the contribution thus made toward professional development by the Society for the Promotion of Engineering Education, the E.C.P.D. should be most grateful, and I here express such gratitude on behalf of the Council.

#### E.C.P.D. ACTIVITIES

The work of the several Committees is fully reported by the chairmen, but there are a few items that I also wish to mention.

In connection with Selection and Guidance, the Council was very appreciative of the proposal made by President Cullimore of Newark College of Engineering and sponsored by Dean Sackett's Committee. It related to a joint study of the E.C.P.D. and S.P.E.E. on "Aptitude Tests and Selective Devices" which have proved to be most effective in the selection of engineering students. The Council enthusiastically approved the project, which it was estimated would cost \$4,500, and expressed its gratitude to President Cullimore for his interest and his willingness to find the funds to finance the project.

Another item is the pamphlet "Engineering as a Career." After protracted study and repeated revisions, Chairman Sackett of the Committee on Selection and Guidance presented it in manuscript to the Council meeting in October, 1940. The Council expressed its gratitude to Dean Sackett for his untiring work in this connection and approved the manuscript for publication provided funds could be obtained for the purpose, and subject to review and approval by the Committee on Information. There was available from the sale of the old pamphlet a balance of approximately \$2,000, which was about one-half of the amount required for publication of a new pamphlet. The Chairman of E.C.P.D. explored without avail every possible source of financial assistance that had been suggested. Hence the only recourse seemed to be a revision of the pamphlet which would reduce its volume and expense to a level that could be financed by the funds that were available. This problem was reviewed by the Committee on Information, and its proposal to undertake the revision was later reviewed and approved by the Ex-

ecutive Committee, the revised manuscript subject to approval by the Executive Committee. The revision will be ready for review and approval at the October, 1941 meeting of the Executive Committee. It is to be hoped that the new pamphlet will promptly make its appearance after the October meeting, because there is great demand—about 10,000 copies per year—and the stock of the old pamphlet is exhausted.

The major effort of the Committee on Engineering Schools has of course been in connection with the accrediting program. The statesmanlike manner in which the numerous difficult problems of the Committee have been handled by Dean Potter and his colleagues has greatly enhanced the prestige of E.C.P.D. Dean Potter's second term on the Committee on Engineering Schools expires this year, and it is with sincere regret that the Council will lose his distinguished leadership. Needless to say, his contributions toward the work of E.C.P.D. were not confined alone to the activities of the Committee on Engineering Schools but spread over the whole program, including an extremely important role in connection with the financial support of the Council's work. And for all of this, I speak the gratitude of his colleagues on the Council.

The Committee on Professional Training also will lose the leadership of its present chairman. Mr. S. D. Kirkpatrick, who was vice-chairman during 1939-40 and chairman during the current year, will be obliged to give up the chairmanship next year on account of his accepting the honor and new responsibility of the presidency of the American Institute of Chemical Engineers. During his first term as a member and later as vice-chairman of the Committee on Professional Training, he had made important contributions to the Council's work, and in his brief term as chairman of the Committee he has carried forward the program with the same characteristic thought and vigor. We are grateful to him and reluctantly give him up to the leadership of his own profession.

Of all the problems with which E.C.P.D. has dealt, professional recognition has proved the most perplexing. The difficulty lies primarily and inherently in the fact that the profession of engineering is itself in a state of evolution and hence there has not yet been evolved a definite concept that would receive general acceptance as to what constitutes the profession. Without this, there is little promise of arriving at a consensus as to criteria of professional recognition. The persistent and unremitting work of Professor C. F. Scott, chairman of the Committee on Professional Recognition, is, I believe, bringing a gradual clarification of the elemental considerations that must be dealt with before a satisfactory solution of the problem can be achieved. With certain *de facto* forms of recognition in different areas and with slowly crystallizing concepts of what the profession is, Professor Scott and his Committee aim first to secure clarification of thought and views, recognizing that the reconciliation or adjustment of fundamentally different concepts calls not for precipitous action but for continuing long-range study and pursuit. Following E.C.P.D. methods it begins with youth, concentrating on the engineering student by aiming to arouse his interest in understanding the engineering profession and "Professional Recognition"—the goal he seeks. The Committee observes that the immediate objective of E.C.P.D.—"the development of the young engineer to professional standing"—concerns the individual; but its culminating aim—"greater effectiveness in dealing with technical, social, and economic problems"—calls for group action, a profession. The young engineer is but partially developed if he lacks the capability and the attitude for group action in a profession.

The work of the Committee on Ethics was inherited from the American Engineering Council when the latter dissolved. At its meeting in January, 1941, the Executive

Committee voted to take over the sponsorship of this work, and the Committee on Ethics under the chairmanship of Professor D. C. Jackson, and with a few additional members appointed by the Council, has continued the study and preparation of a code of ethics. The Committee has made a progress report including a preliminary tentative draft. I strongly recommend that the Council request the Committee to continue its study and look forward to having a final report at the Annual Meeting in 1942.

The educational campaign, to which I have already referred, is another Council activity that I wish to touch more specifically. There have been three lines. One was the Chairman's report to the Boards, "E.C.P.D. Should Look Ahead," which gave not only the Chairman's view as to the opportunities and responsibilities that lie before E.C.P.D. but also a brief report of the active work of the several committees. The second was the plan of the Committee on Information to prepare for the press, especially for the publications reaching members of the engineering profession, informative releases regarding the work of the Council. And finally a plan was made to encourage sessions at meetings of the constituent organizations at which the work of E.C.P.D. would be presented and discussed. There have been two such meetings and two more are scheduled, as reported by Professor Scott, chairman of the Committee on Professional Recognition, who has taken a leading interest in this plan.

In this latter connection, a report from Mr. J. F. Fairman, an American Institute of Electrical Engineers representative on the Council, includes an idea which I think is highly significant. It is that the way to achieve understanding of and active interest in the purposes of E.C.P.D. by the members of the constituent organizations is to have the local chapters take an active hand; and that the way to bring this about is to have the whole matter, including a plan, discussed at the regular Session of Officers, Delegates, and Members at the A.I.E.E. annual convention. These are the people responsible for section activities, and if they understand the plan and are convinced, something will come of it when they go back home. It is the conclusion of Mr. Fairman and his associates that the most likely of the Council's problems about which the local Sections might become active is that of Selection and Guidance. Their work might be patterned along the lines of the procedure already developed in certain metropolitan areas in connection with the work of the Committee on Selection and Guidance. Once this was under way, a second step taken by a section might be in relation to the work of the Committee on Professional Training in helping young graduates to become appropriately oriented and active in their own professional development. And so on. This general point of view and plan seem to me most promising, and the fact that the A.I.E.E., through the leadership of Mr. Fairman and his associates, is proceeding along these lines is most encouraging.

#### TECHNICAL INSTITUTES

The relationship of technical institutes to the whole scheme of technological education in this country has been a matter of continuing concern to the Council. In his annual report last year Chairman Perry outlined the beginning of active consideration of this problem under the sponsorship of E.C.P.D. President Parke Rexford Kolbe of Drexel Institute of Technology and Dean H. P. Hammond of Pennsylvania State College have undertaken the leadership in this important and difficult matter. President Kolbe called a meeting of officers of a number of technical institutes, and as a result a petition was submitted to E.C.P.D. that it consider the problem of accrediting of technical institutes. This was referred by

Chairman Perry to the Committee on Engineering Schools, but after consideration it became clear in this Committee that the question was too involved to allow a prompt decision to be reached; it was then recommended that a sub-committee including President Kolbe be appointed to continue study of the problem, and this was done.

#### CONSTITUENT MEMBERSHIP

Since the organization of E.C.P.D. the question has arisen from time to time as to whether the constituent membership should be increased. As reported by Chairman Perry last year, The Engineering Institute of Canada was welcomed as a new member of the Council, and this was done through the unanimous decision of the existing member organizations to recognize the common purposes and interests of engineers of the two great countries in connection with professional development. The international aspect of this move placed it in an altogether special category as regards institutional membership. There have been other problems in connection with engineering organizations in the United States, but the Council has not yet found it possible to dispose finally of the question of general policy here involved.

#### FINANCES

E.C.P.D. is solvent, but the financial situation is certainly not all that might be desired. As one indication of the limitations on its work I would mention that the funds available to the standing committees, excepting the Committee on Engineering Schools, for the important work they are expected to pursue, are limited in each case within the range of \$300 to \$600. One of the immediate problems before the Council is the provision of something approaching a reasonable appropriation in these cases.

The financing of the work of the Committee on Engineering Schools has had special aspects, as I have indicated earlier in this report. The problem of policy as to whether engineering schools should be assessed for re-inspection of curricula was determined by the Executive Committee at its meeting in March: the schools were not to be assessed. Accordingly, constituent bodies were approached by the Chairman with the request that they increase their appropriations to the work of the Council in order that this policy might be carried out. I am gratified to report that the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, and the American Institute of Chemical Engineers have doubled their appropriations, and that the American Society of Civil Engineers will act upon our request in December. Thus it seems clear that we shall be able to carry out the policy adopted by the Executive Committee, and I express the Council's gratitude to the organizations that are making this possible.

I would report one further action of the Executive Committee. After considerable deliberation as to responsibility for the securing of funds for the Council's work, the Executive Committee decided for the present year to expand the Ways and Means Committee to include one representative from each of the constituent groups. In the absence of any action by the Ways and Means Committee, the Chairman of E.C.P.D., with such assistance as he could find—and he found good assistance—has taken the initiative in raising funds, and he is very grateful to Messrs. Potter, Seabury, Fairman, Davies, Stevenson, Tyler, and Dodge.

I close this report with an expression of my great appreciation of the co-operative attitude and interest of the officers, committees, and members of the Council, and I feel sure that their work during the year has given new impetus to the Council's programs at a time when, for the welfare of the country, this is most important.

# Abstracts of Current Literature

## BRITAIN SCRAPS WHOLE RAILWAY

From Robert Williamson, London, Eng.

Britain is throwing a whole railway into the mobilization of iron and steel for the war. Although it is an old railway, its rails alone will add to the resources of Britain enough steel for no fewer than 384,000 rifles.

Until 1937 the trains of the Welsh Highland Railway chugged over some of the loveliest scenery in the Principality. But in that year it ceased to function and the grass began to grow along its 28 miles of permanent way.

Now the rails, which are modern, are being taken up, 1,200 tons of them. They will be relaid elsewhere on sidings needed for the war effort, so setting free steel-making capacity for armament manufacture.

The two old locomotives are for the dismantler's yard and metal from the rolling stock is for the same destination.

The railway is but an item in a nation-wide hunt for metal to turn into rifles, Tommy guns and tanks, into armour plate for battleships and armoured coastal defences.

A Doomsday Book of park, street and house railings, of ancient steam rollers, engines and boiler-house plant is being prepared and already on walls bills have been posted proclaiming the Government's requisitioning of them. Among the first to respond has been the King himself with many tons of the railings of Buckingham Palace for the collection.

## ALUMINIUM AFTER THE WAR

From *Trade & Engineering* (LONDON), OCTOBER, 1941.

The cessation of hostilities will release, for more peaceful purposes, vast quantities of aluminium and its alloys. Doubt has been expressed in many quarters as to whether the war-time output of the metal can, without artificial stimulus, be absorbed in times of peace, but those familiar with the trends of aluminium consumption before the war entertain no doubt but that the demand for light-weight products will be sufficient to absorb even the present large output.

In one field in particular, that of architecture, both structural and decorative, there will undoubtedly be a considerable increase in aluminium consumption over that experienced up to the outbreak of war. The experience which has been gained in forming or building up large components for the great aircraft and flying-boats now in use will be of direct value to architects and constructional engineers. Another factor which will contribute largely to the use of aluminium in building construction is the reduction in costs of handling and in the fatigue of personnel which is a result of the low weight of the material.

The high coefficient of thermal expansion of the metal has on occasion been advanced as an argument against its employment in large structures, but this can be readily overcome, as it has been in the past, by making the necessary provisions for expansion and contraction. When extruded sections are used it is possible to accomplish this by means of slip joints at junctions of the members, but where solid lengths or cast aluminium spandrels are placed between masonry jambs plastic caulking material will be necessary at the joints.

Many factors are likely to contribute to the extended use of aluminium. First must rank the fact that a substantial reduction in price will be effected immediately

## Abstracts of articles appearing in the current technical periodicals

war-time restrictions regarding price control are removed. This must inevitably follow as a natural consequence of the vast expansion of aluminium production and the rationalization which has occurred with regard to the economic use of the large supplies of high-quality scrap now available.

Improvements in technique resulting from the war-time programme of aircraft construction will also be potent factors in increasing consumption of aluminium for architectural purposes. In particular the advances made in extrusion technique, especially with regard to the production of bulky sections in long lengths, will prove to be of importance. Casting techniques have also been improved, particularly with regard to the production of gravity and pressure die castings. These processes are naturally of value in cases where large quantity production is contemplated. The machining of aluminium alloys has also been intensively investigated, particularly in connection with the use of recently developed hard metal and diamond tools.

## AMERICAN WAR INDUSTRY

From *Civil Engineering and Public Works Review* (LONDON), NOVEMBER, 1941

The rapid expansion of the American war effort in the factories is being reflected in the vast increase of the production of various component parts. The number of factories is being rapidly increased and the existing ones are being extended as rapidly as human ingenuity and labour can devise.

Few branches of the war industry have shown a greater degree of expansion than the manufacture of aeroplanes. This is well seen in the rapid development of the aluminium production industry, particularly of one company, the Aluminium Company of America. This company is fast bringing to completion the expansions of its plants at Los Angeles, California, and at Lafayette, Indiana.

In 1937, in order to serve the aeroplane industry more effectively, the company bought 15 acres of land in Vernon, Los Angeles, and erected on it a sand and permanent-mould foundry and forge plant. The works was completed early in 1938. At the start of the war, the Vernon works had a capacity of 100,000 lb. of aluminium alloy forgings, and 424,000 lb. of sand and permanent-mould castings a month.

In the spring of 1940, an expansion of the facilities in Vernon was announced. This expansion included the addition of an extrusion works and a rivet plant, as well as additions and betterments to the existing aluminium foundry and forge plant. To carry on this expansion, the company acquired an adjacent 30 acres of land.

The buildings necessary to house the additional manufacturing facilities in Los Angeles have now been completed and the equipment is rapidly being installed to handle the increased production, so that very shortly the sand and permanent-mould casting capacity will have been increased to 593,000 lb. a month (an increase of 40 per cent.), and the forging capacity to 450,000 lb. a month (an increase of 350 per cent.); while the new extrusion plant will be turning out extruded shapes at the rate of 1,019,000 lb. a month; and the new rivet plant, rivets at the rate of 70,000 lb. a month. By March, 1942, the forging capacity of the Vernon works will have been increased an additional 50,000 lb. a month.

## STRONG AS CAST IRON

From Robert Williamson, London, Eng.

After two years' continuous research, Great Britain is today able to introduce pottery into many new fields of British industry to take the place of metals, alloys, glass, rubber and wood, on the use of which restrictions have inevitably been placed in war time.

High grade chemical stoneware comparable with grey cast iron in mechanical strength can now be used in place of metal for pipe lines and also for packing purposes either in relatively small units or in bulk.

These novel ceramic wares have certain advantages over the materials in former use. They resist rust and contamination; they can be turned into an almost unlimited number of shapes and sizes, and they are proof against all corrosive chemicals except hydrofluoric acid and hot, strong caustic alkalis.

The new pottery is, moreover, prepared with such scientific thoroughness and fired in the kilns at such a high temperature, 1250 deg. C. or more, that, in compression strength it resembles metals rather than the fragile china or earthenware ornaments of the home.

New applications of ceramic materials have also been introduced in recent months to textiles, rayon, paper-making, printing, soap, perfumery, cosmetics, brewing and food manufacture industries and to many branches of the chemical, metallurgical and electrical industries.

## THE AUTOMATIC DETECTION OF INCENDIARY BOMBS

From *Engineering* (LONDON), SEPTEMBER 5TH, 1941

A brief reference was made in the issue of *Engineering* for June 6 of this year, page 448, to the employment of the light-sensitive selenium cell, known as the Radiovisor, in the detection of incendiary bombs, but some data resulting from a recent investigation are sufficient to justify a more detailed account. The investigation was made to determine to what extent serious fires have occurred in factories from undetected incendiary bombs. In nearly every case the fire-watching organization was efficient in the factory concerned and was able to get every bomb in sight under control without difficulty, it being the undiscovered bombs which had fallen on roofs or in such places as closed yards which were responsible for the subsequent damage. It is stated that in over 70 per cent. of the cases investigated the persons responsible for the safety of the factory stated that their organization would have been quite capable of getting all the fires under control had they known their whereabouts precisely. This does not imply that the patrolling was not efficient; the obvious reaction to an incendiary bomb attack is to put out those bombs, or the fires they may be starting, which are in the immediate vicinity of the patrols. It is possible, moreover, that some of these bombs may fall in positions in which they will do no damage and may thus be left for later attention or perhaps even left to burn themselves out. In the meantime a bomb on, say a roof, may escape notice until a fire difficult to control has been caused.

The primary requirement is, clearly, the indication of the location of every bomb and the grouping of the indications in a central position. This enables the persons in charge at the central position to send fire-fighting squads to the exact spot at which the bomb has fallen and, if the attack is heavy, to distribute these squads to the positions involving a heavy fire-risk; first, for example, to paint stores, pattern shops and woodworking shops, that is, assuming the personnel is not sufficient to deal with all the fires at once. The bombs which fall in localities involving little fire risk, such as yards, brick buildings containing stored metal and the like, should there be a shortage of personnel, may

be dealt with subsequently. The locating of all bomb sites should be accompanied by means for discrimination, should such discrimination be necessary. The system of detection by the selenium cell referred to in our previous note would seem to meet these requirements. It has, indeed, proved effective in factories in which it has already been installed. This system has been developed, as indicated in the previous note, by Messrs. Mortimer, Gall and Company, Limited, 115-117, Cannon-street, London, E.C.4.

In practice, the selenium detectors are installed in the works in positions which appear to be most suitable. Each detector will cover an area ranging from 8,000 sq. ft. to 10,000 sq. ft. of open workshop. Usually some are installed inside and some outside. A common and effective position for the outside detectors is on the ridges of the saw-tooth or north-light roof often adopted for shops of considerable area. A detector is not needed on every ridge, but on alternate ones only, as the valleys of the ridge without a detector are effectively covered by the detectors on the ridges on each side of it. The valleys of such roofs are particularly dangerous spots, since the roof purlins, when of wood, are easily ignited from bombs. The gutters into which a bomb might roll are best protected by a covering of expanded metal. The detectors are easily attached and on some sites on roofs are protected by a small canopy so that they will not respond to, say, a gunflash and so give a false alarm.

There is a set of electrical apparatus for each selenium detector, the wiring between the two usually carrying current at 50 volts. The supply to the apparatus may be at 100 volts, 200 volts, or 250 volts, and may be either alternating current or direct current. The terminals to which the detector is connected are seen at the bottom left-hand corner of the case. Above them is a sensitivity control knob, and to the right a reset switch. The other terminals are for the bell and indicator leads. An earthing terminal is provided. The electrical apparatus includes transformers. The current for the detector has already been mentioned; that for the bell and indicator circuit is supplied from an independent battery and varies from 4 volts to 24 volts, according to the lay-out. The electrical cases can be arranged in groups of three or four in any convenient place in the shops. The indicator panel and alarm bell are situated in the room of the works A.R.P. controller. Each dial of the indicator is labelled in accordance with the position of the detector actuating it, and the panels have generally a much larger number of windows than the demonstration set shown.

In the event of a number of incendiary bombs falling on a works, more than one of the detectors will most probably be actuated, when the warning bell will ring and the discs in the appropriate windows of the indicator will oscillate to show near which detector stations the bombs are lying. The vulnerability of the sections concerned can be immediately assessed and the fire-parties allocated accordingly. The allocation of men is, of course, a matter for the works concerned, but it may be of interest to cite an example in a works in which the selenium-cell detection system is fitted. In this works the controller is provided with a tabulated list of departments showing the minimum number of men that should be dispatched to that department in case an incendiary bomb should fall in it. The actual list is in the following form: pattern shop, 3 men; paint shop, 4 men; office block (west), 6 men; office block (east), 4 men; loading bank, 1 man, and so on. The problem of the undiscovered delayed-action incendiary bomb is also solved by the system above described.

An interesting development concerns the security of special offices and rooms to which access is permissible in cases of emergency only. This consists of a box attached to the door of the room and having a slot into which the door key is dropped when the door has been locked. The key remains inaccessible, but when normal access is required it can be caused to fall out into a tray at the front of the box by the operation of a switch on the control room. In an

emergency, as when incendiary bombs fall, it is delivered automatically, since the actuating mechanism is connected with the detector system.

## GATEWAY TO MIDDLE EAST

From Robert Williamson, London, England

The Turkish Government have given London engineers a contract, worth some £200,000, to reconstruct harbour works at Alexandretta, consisting of a jetty with screwed-cylinder foundation, sheds, railway lines and cranes.

It is understood that a similar contract is pending for the port of Mersin across the gulf, the base of a Turkish army corps. Both Alexandretta and Mersin are connected by rail with Aleppo. The fact that they are so near this vital railway link between Turkey and Iraq, dominating North Persia and the Middle East, gives both ports considerable military importance, apart from their value at the moment for trade between Turkey and Great Britain.

Alexandretta has 8,000 sq. metres of covered warehouses, but there are no quays or dry docks. The harbour is not protected by breakwaters, although it is sheltered and gives the safest anchorage all the year round in that part of the world. Ships anchored half a mile from the shore discharge their cargoes into lighters and other small craft for which there is a basin 80 ft. long.

## THE DESERT AND THE SOWN

From *Civil Engineering and Public Works Review* (LONDON),  
NOVEMBER, 1941

This aspect of the work of the engineer is of the greatest political and economic importance. Over vast regions of the surface of the globe there stretches desert conditions which render the human occupation of hundreds of thousands of square miles quite impossible. A glance at a map of the world shows that these arid places tend to girdle the earth as two zones lying just north and south of the humid equatorial regions. To the north and to the south lie the temperate zones of the earth, which have been the sites of human expansion and progress.

As the growth of population has produced an expanding need to bring fresh land under cultivation for the growth of an ever-increasing demand for foodstuff, there has been a tendency for the peoples of the humid, well-watered areas to spread towards the less well-watered arid regions. The advance into these areas has been spasmodic and has fluctuated according to the needs of the time.

No modern country illustrates to a greater degree this tendency than the United States. Every year sees the completion of one or more vast schemes for bringing the life-giving water to some arid area and so enabling man to encroach more and more into what would otherwise be inhospitable and uninhabitable lands.

This modern struggle to invade and occupy the desert fringes is no new phenomenon. Each year brings forth fresh evidence of the antiquity of this struggle.

Of ancient endeavours in this direction there is none more fascinating than that which took place over 2,500 years ago in the ancient land of Sheba.

To the layman the present-day engineering works for the conservation of water and its distribution to the desert lands seems a modern engineering triumph. Through the ages the engineer has played his part in the struggle for human expansion and betterment. Few sections of any community have made so great a contribution to human progress as the civil engineer.

Recent exploration work in the ancient land of Sheba, the modern Yemen, has disclosed the great part played by the civil engineer, though doubtless he was not known by that name in those days, in the development of the ancient Sabaeen Kingdom of South-West Arabia.

For long it has been a matter of speculation as to how so virile and energetic a people maintained and supported life in so inhospitable a region.

Najran, Marib and Janf were the most important centres of ancient Sabaeen culture. Najran has been described as the most beautiful oasis of Arabia, situated in a great valley of extensive palm groves. Just above the oasis the valley debouches in a great basin, from which escape its flood waters through a narrow straits between sheer walls barely 20 feet wide. Here in ancient times there was a dam, the marks of which still survive. The dam was apparently only 12 feet high, and at this height channels were cut on either side to take the impounded water when it rose to that level at the dam. The dam has been calculated to have had a capacity of 100,000,000 gallons of water.

Anything above this amount would have flowed out by the side canals. In the dry season the sluices of the dam could have been opened to allow the water to flow into the irrigation channels.

The other areas of irrigation in this Sabaeen area show remarkable skill in the conservation and distribution of water and are enduring monuments to the skill of these ancient engineers.

The importance of these ancient works is shown by the interpretation of certain inscriptions dating back to the 7th century B.C. These relate that on the first occasion when the great dam of Marib was destroyed—whether by seismic disturbance or the legendary rat which is supposed to have made a hole through it, they do not say—it was repaired; and for this purpose the Sabaeen ruler of that date mobilised all the people as if they were going to war and by their united effort repaired the damage. The inscription records some interesting details with regard to the number of oxen and the number of loads of dates and honey consumed on that occasion.

Truly man's struggle to improve his lot and increase his heritage goes far back into ancient history, and in that struggle the engineer and his skill have played their part.

## BLUEPRINTS GO WHITE

From our London Correspondent, Robert Williamson

The engineer's prints without which Britain could not produce a single battleship, tank, or aeroplane or even the smallest nut or bolt, are changing their colour. The traditional "blueprint" is gradually being replaced by papers giving diagrams in black, blue or brown on white instead of white diagrams on blue.

The new prints, made by the dyeline process, are positive instead of negative. They can not only be produced much more quickly and in a smaller space but they give a clearer background and a stronger line less subject to fading, so helping the thousands of women and other inexperienced recruits in war production. Moreover, the paper does not shrink, as does the "blueprint" or ferro paper, and the designs are therefore more true to scale, another advantage to the semi-skilled. A valuable feature is that the surface is particularly suitable for receiving ink lines or colour tints.

Dyeline prints are produced by two processes. In one, the dry process, the developer is incorporated in the paper itself, and when this is run over a light with the original tracing and subjected to ammonia gas, the drawings appear on the blank sheet as if by magic. In the other, the semi-dry process, a special solution is spread, by means of a simple machine, over the surface of the print. Here again development is instantaneous and the prints dry in a few seconds.

Dyeline papers have been manufactured in Britain for some years past, and in one London works the chemists have been experimenting continuously with them for the past fifteen years.

## RUSSIA'S AIR FORCE

From Robert Williamson, London, Eng.

When the German propaganda spokesmen loudly asserted at the start of the Russian campaign that the war would be won by 11th August on the Eastern Front, they gave public proof that they were guilty of several major miscalculations. And chief among them was their under-estimation of Russia's Air Force.

For years, the belief had been cleverly fostered abroad that the Soviet warplanes were, at best, semi-obsolete in type and poorly manned. But behind the veil of secrecy flung round the preparations for defence against the program so frankly outlined in "Mein Kampf" Stalin was building up an air force that gave the Luftwaffe the greatest shock it has known since the Battle of Britain.

Russia's fighters include six different types in her first line strength, five being single-seat and one, the "1 19 (X)", a two-seater. It is this last-named machine which played so notable a part in maintaining the stubborn resistance that amazed the world, for not only has the "1 19 (X)" great manoeuvrability allied to high speed, it is so heavily armed that the second member of the crew acts almost solely as a gun-loader.

This machine, like all others in the "1" class, is of Russian design and is the product of the Soviets' "number one" designer, H. N. Polikarpoff. With a ceiling of approximately 40,000 ft. and a reputed top speed in excess of 400 m.p.h., it is one of the finest fighters in the world. Indeed, the Russians themselves think so highly of it that it has been in full production in dozens of State aircraft factories for over a year.

A newcomer to this group is the MIG.3, which corresponds in design and performance with Britain's Hurricanes and Spitfires. In revealing the existence of this model, previously unknown to the German Air Staff, Lord Beaverbrook, broadcasting on his return from Moscow, has characterised it as more than a match for the Messerschmitt.

### BOMBERS CARRY 4-TON LOAD 3,000 MILES

Prominent in the news lately is a new Russian bomber, unknown to the world until mentioned in Lord Beaverbrook's broadcast. This is the Stormovik, a dive-bomber incorporating features of the Spitfire and ME109. It has proved an outstanding success in attacking troop concentrations and breaking up enemy formations.

The astute policy of hiding from the world the development of the Soviet Air Force was incidentally assisted by the fact that Russia's bombers were entirely designed by her own aeronautical engineers. In fact, of the ten standard bomber and two dive-bomber types employed, only two have been at all influenced constructionally by foreign machines. These are the "CKB 26," which is similar to the Martin, and the "TB3B" which is built on the principles of the Junkers.

Most of Russia's bomber types are designed for close co-operational work with her armies, but quite early on in the campaign two types specifically designed for long-range strategic bombing did much valuable work. Two long-range bombers of the "L" type in particular are machines of outstanding capabilities. They have a range of as many as 3,000 miles with a bomb load of almost four tons.

No nation at war will give figures of its first line strength, but even so, it is possible to arrive at an approximate figure based on pre-war reports.

A Russian Air Mission official, who visited England in the early days of the campaign, stated that the figure given by Marshal Voroshilov when he reported to the Central Committee of the U.S.S.R. in 1939 on Russia's first line strength, had been more than doubled since the war began. In his report, the Marshal stated that the total bomb load then carried on one flight was as high as 6,000 tons.

It may, therefore, be assumed that Russia entered the war with a 12,000-ton bomb load, which, allowing an average weight of two tons to every bomber, gives a figure of 6,000 first line bombers. Statistics derived from the same source gave Russia some three thousand first line fighters at the time of the Nazi invasion.

### SOVIET'S 1,100 PILOT SCHOOLS

Russia is fortunate in that all forms of raw materials required for aircraft construction can be found in her own country. And the fact that all her main aircraft factories were established beyond the range of Nazi bombers enable her to drive forward on the vital task of producing warplanes unhindered by day or night bombing.

Her aircraft production strength at the start of the war in the East is believed to have been actually higher than Germany's, and the Russians did all in their power to safeguard against any disruption. Thus, anti-aircraft units and day and night fighters were allotted the task of concentrating on the defence of her great aircraft factories.

Unlike many nations, Russia suffers from no bottleneck in the vitally important matter of output of flying personnel. In addition to her Air Force training schools, Russia established more than 1,100 pilot schools which young workers were encouraged to visit for free instruction.

Here they received a training equal to the passing-out standard of Britain's Royal Air Force Elementary Flying Training Schools. But in addition to these clubs there had existed for some time before the war a civilian training body known as *Ossviachim* numbering more than fifteen million members.

Indeed, so thorough was the national training scheme that every Russian pilot who went on active service when war started had done two hundred and fifty hours' flying.

# FIFTY-SIXTH ANNUAL GENERAL

## MONTREAL —

THURSDAY AND FRIDAY



R. S. EADIE  
Chairman of the Papers  
and Meetings Committee



GORDON D. HULME  
Chairman of the Hotel Arrangements  
and the Publicity Committee



W. MCG. GARDNER  
Chairman of the Reception  
and Registration Committee



K. G. CAMERON  
Chairman of the Plant Visits and  
Transportation Committee



WALTER G. HUNT  
General Chairman

### LADIES' PROGRAMME

A special programme of entertainment for the ladies is being arranged which includes a tea at the Montreal Badminton and Squash Club and a Bridge Party at the Engineers' Club. Visiting ladies will be the guests of the Branch at both luncheons.

### PROGRAMME

#### THURSDAY, FEBRUARY 5th

- 9.00 a.m.—Registration.  
10.00 a.m.—Annual Meeting and Address of Retiring President on the war work of the National Research Council.  
12.30 p.m.—Luncheon—Speaker: Hon. C. D. Howe, Hon. M.E.I.C., Minister of Munitions and Supply.  
2.30 p.m.—Professional Session.  
8.00 p.m.—Montreal Branch Annual Smoker.

#### FRIDAY, FEBRUARY 6th

- 9.30 a.m.—Professional Sessions.  
12.30 p.m.—Luncheon—Speaker: W. L. Batt, President, SKF Industries Inc., Philadelphia, Pa., and Director of Materials, Office of Production Management, Washington, D.C.  
2.30 p.m.—Professional Sessions.  
7.30 p.m.—Annual Banquet—Speaker: Leonard W. Brockington, K.C.  
10.30 p.m.—Dance.

Special return tickets will be supplied by the railways at the rate of one and a third of the regular on

# AND PROFESSIONAL MEETING

## WINDSOR HOTEL

FEBRUARY 5th AND 6th, 1942



RALPH C. FLITTON  
General Vice-Chairman and  
Chairman of the Programme Committee

### VISITS

Visits to war plants of the Mon-  
treal area are being arranged.



I. S. PATTERSON  
Chairman of the Special Arrangements  
Committee

### PAPERS

The Work of Research Enterprises Ltd., by Colonel  
W. E. Phillips, President, Research Enterprises  
Ltd., Toronto.

Manufacture of 25-Pounder Guns in Canada, by  
W. F. Drysdale, M.E.I.C., Director General of  
Industrial Planning, Department of Munitions  
and Supply, Ottawa.

The New "Oilraulic" Press in Munitions Manu-  
facture, by J. H. Maude, M.E.I.C., Chief  
Designer, Mining, Metals and Plastics Machin-  
ery Division, Dominion Engineering Co., Ltd.,  
Montreal.

Rational Column Analysis, by J. A. Van den  
Broek, Professor of Engineering Mechanics,  
University of Michigan, Ann Arbor, Mich.

Accident Prevention Methods and Results, by  
Wills Maclachlan, M.E.I.C., Secretary-Treas-  
urer and Engineer, Electrical Employers  
Association of Ontario, Toronto.

National Service—A Challenge to Engineers, by  
E. M. Little, Director, Wartime Bureau of  
Technical Personnel, Ottawa.

Some of the Engineering Implications of Civilian  
Defence, by Walter D. Binger, Commissioner  
of Borough Works, City of New York, and  
Chairman, National Technological Civil Pro-  
tection Committee of the United States.



MRS. F. W. TAYLOR-BAILEY  
Convenor Ladies' Committee



A. G. MOORE  
Treasurer and Chairman of  
Finance Committee



L. A. DUCHASTEL  
Secretary

fare. Necessary certificates will be mailed shortly along with a programme of the entire meeting.

# From Month to Month

## PRESIDENT'S MESSAGE

A feature of each January number of *The Journal* is the New Year Message from the President. This year the message is more than usually significant. It should be read carefully by every engineer. It will be found on page three of this number.

## NEW BRUNSWICK AGREEMENT

The December Journal reported a successful ballot on the proposal for further co-operation between the Association of Professional Engineers of New Brunswick and The Engineering Institute of Canada. Since this, arrangements have been made for the ceremony of signing the agreement and the inauguration of its benefits.

The ceremony will take place in Saint John on the evening of January 12th. This corresponds with the annual meeting of the Association, and the combination of important events should draw an unusually large attendance. It is planned that the president and general secretary will sign on behalf of The Institute, and that other officers from Quebec and Ontario will also be present.

This becomes the fourth province in which the provincial body and The Institute have devised a working arrangement whereby the benefits of each will become more readily available to the other. Not only are the privileges increased, but the costs are decreased. The benefits of common membership are apparent to all, and beyond a doubt the profession of engineering has taken a step forward in New Brunswick by this latest decision.

The officers of The Institute look forward with great pleasure to this opportunity of working in close harmony with the officers and members of the Association, and see in this new agreement another and substantial step toward the long hoped-for complete co-operation between engineers throughout Canada.

## GREETINGS FROM ENGLAND

The general secretary, under instructions of Council, sent the following messages of greetings to the secretaries of the five leading British engineering institutions:

"The President and Council of The Engineering Institute of Canada have asked me to present, through you, the season's greetings to the President and other officers of your Institution.

"We appreciate that conditions in your country are far from ideal for the celebration of the holiday season, but are confident that in spite of them you will derive a good measure of Christmas cheer.

"It is our wish that the coming year will bring to the members of your great society strength and encouragement to fight the great fight and that at an early date a just reward may be yours. Our thoughts and our sympathies are with you."

Replies have been received in which all members of The Institute will be interested:

"The President and Council of the Institution of Civil Engineers much appreciate Christmas and New Year greetings received from Engineering Institute of Canada which are heartily reciprocated. Celebrations here will be in a more cheerful atmosphere than last year when air raids were a nightly feature. Furthermore present news instils a spirit of quiet optimism. Warm personal greetings to you from

GRAHAM CLARK, *Secretary*,  
Institution of Civil Engineers."

## News of the Institute and other Societies. Comments and Correspondence, Elections and Transfers

"Many thanks your cable conveying season's greetings to myself, the members of council and the Institution. Generally we much appreciate your kindly thought and heartily reciprocate your good wishes. With you we all hope that New Year will bring with it that reward of just peace for which all members of British Commonwealth and indeed all free peoples are working.

W. A. STADIER, *President*,  
Institution of Mechanical Engineers."

"President and Council much appreciate your kind and encouraging message. They heartily reciprocate your sentiments and pray that your Institute may grow from strength to strength.

W. K. BRASHER, *Secretary*,  
Institution of Electrical Engineers."

"President and Council of Royal Aeronautical Society wish me to thank you for your seasons greetings and to reciprocate them to all the officers and members of The Institute. They are acutely conscious of the great part Canada and Canadian engineers are playing to bring about a world peace. They wish me to add how much they appreciate the close friendship between the two engineering institutions and to hope that the time is not far distant when normal contacts can be resumed.

J. L. PRITCHARD, *Secretary*,  
The Royal Aeronautical Society."

"The President and Council of the Institution of Structural Engineers desire me to express through you their very grateful thanks to your President and all officers of your institution for the kindly thought which prompted the despatch of Christmas greetings and wishes of good cheer. We are immeasurably strengthened by the message of sympathy and support which you send. My President and Council transmit to you all their greetings for 1942 with the hope that the relations of the two institutions may be further cemented and that they may be found working side by side for the benefit of all free peoples during the period of reconstruction.

R. F. MAITLAND, *Secretary*,  
Institution of Structural Engineers."

## TO AVOID CONFUSION

In the December *Journal* attention was called to an organization operating under the name "Canadian Institute of Engineering Technology," pointing out that this was a "spurious" organization.

A letter has been received at Headquarters from the Canadian Institute of Science and Technology Limited, calling our attention to the similarity of names and requesting that we draw our readers' attention to the fact that they are in no way associated with the other organization. This we are glad to do. The Canadian Institute of Science and Technology Limited is a well established business operating as the Canadian Branch of the British Institute of Engineering Technology Limited. We hope that they do not suffer from the publicity which was necessarily given to the spurious outfit.

## REGISTRATION AT UNIVERSITIES

Herewith is shown the registration in engineering at all Canadian universities. This tabulation has been an interesting feature of the *Journal* for several years. The 1941 figures are somewhat different than previous years, but the variations do not seem to establish any particular trend.

At British Columbia, Toronto, Queen's and Ecole Polytechnique, the freshman registration is substantially increased, but at the other universities it is smaller. On the whole the total is 151 more than last year. There has been little change in the order of specialization. Chemical engineering continues to be the best patronized course but mechanical has gained substantially on it, and probably will continue to do so from now on.

## BRANCH CONTRIBUTIONS TO BUILDING FUND

It is with a great deal of satisfaction that the following statement of contributions is distributed to the membership. When President Hogg and President-Elect Mackenzie first requested the assistance of the branches in meeting the costs of repairs to the Headquarters building it was not thought that so substantial a sum would be realized.

All branches have done exceedingly well; but the work of the Montreal Branch committee has been particularly productive. The chairman, R. E. Heartz, and his committee set a high objective and they ran well beyond it. It is gratifying to know that the members were willing to support the cause to the extent of an average of \$5.00 per member, or a total of \$6,000.00.

A special message of appreciation is going from the president to each branch. It is hoped that every member will see this statement and realize the strength that lies in a group of the type of those who make up The Institute membership.

Border Cities Branch .....	\$ 62.00
Calgary .....	125.00
Cape Breton .....	25.00
Edmonton .....	52.00
Halifax .....	96.00
Hamilton .....	147.00
Kingston .....	70.00
Lakehead .....	49.00
Lethbridge .....	26.00
London .....	75.00
Moncton .....	31.00
Montreal .....	6,000.00
Niagara Peninsula .....	48.00
Ottawa .....	394.00
Peterborough .....	75.00
Quebec .....	75.00
Saguenay .....	61.00
Saint John .....	41.85
St. Maurice Valley .....	30.00
Sault Ste. Marie .....	100.00
Toronto .....	201.25
Vancouver .....	101.00
Victoria .....	60.00
Winnipeg .....	64.00

\$8,009.10

UNIVERSITY	Year	General Course	Agriculture	Architectural	Ceramic	Chemical Engrg. and Chemistry	Civil	Electrical	Electro-Mechanics	Forestry	Geology and Mineralogy	Mechanical	Metalurgy	Mining	Physics, Engrg.	Total
Nova Scotia Technical College	1st	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	2nd	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	3rd	..	..	..	..	..	4	10	..	..	..	16	..	6	..	36
	4th	..	..	..	..	..	5	7	..	..	..	11	..	..	..	23*
	Total	..	..	..	..	..	9	17	..	..	..	27	..	6	..	59
New Brunswick	1st	4	..	..	..	..	14	22	..	10	..	..	..	..	..	50
	2nd	..	..	..	..	..	7	24	..	15	..	..	..	..	..	46
	3rd	..	..	..	..	..	11	13	..	12	..	..	..	..	..	36
	4th	..	..	..	..	..	6	16	..	12	..	..	..	..	..	34*
	Total	4	..	..	..	..	38	75	..	49	..	..	..	..	..	166
Ecole Polytechnique de Montreal	1st	121	..	..	..	..	..	..	..	..	..	..	..	..	..	121
	2nd	74	..	..	..	..	..	..	..	..	..	..	..	..	..	74
	3rd	48	..	..	..	..	..	..	..	..	..	..	..	..	..	48
	4th	..	..	..	..	6	7	..	22	..	..	..	..	..	..	35
	5th	44	..	..	..	..	..	..	..	..	..	..	..	..	..	44*
Total	287	..	..	..	6	7	..	22	..	..	..	..	..	..	322	
McGill	1st	141	..	9	..	..	..	..	..	..	..	..	..	..	..	150
	2nd	73	..	11	18	..	..	..	..	..	..	..	10	..	..	112
	3rd	..	..	3	26	11	17	..	..	..	45	7	12	..	..	121
	4th	..	..	3	21	8	21	..	..	..	28	9	14	..	..	104*
	5th	..	..	1	..	..	..	..	..	..	..	..	..	..	..	1*
Total	214	27	65	19	38	..	..	..	..	73	26	26	..	..	488	
Queens	1st	200	..	..	..	..	..	..	..	..	..	..	..	..	..	200
	2nd	137	..	..	..	..	..	..	..	..	..	..	..	..	..	137
	3rd	..	..	..	26	16	23	..	..	..	1	30	14	15	3	128
	4th	..	..	..	26	8	13	..	..	..	1	26	17	17	1	109*
	Total	337	..	..	52	24	36	..	..	..	2	56	31	32	4	574
Toronto	1st	..	..	8	14	101	87	73	..	..	3	97	27	24	36	470
	2nd	..	..	7	3	67	36	37	..	..	1	60	13	15	22	261
	3rd	..	..	9	2	53	26	47	..	..	5	44	16	21	12	235
	4th	..	..	8	2	39	19	21	..	..	4	39	21	17	9	179*
	5th	..	..	2	..	..	..	..	..	..	..	..	..	..	..	2*
Total	..	34	21	260	168	178	..	..	..	13	240	77	77	79	1147	
Manitoba	1st	80	..	..	..	..	..	..	..	..	..	..	..	..	..	80
	2nd	53	..	..	..	..	..	..	..	..	..	..	..	..	..	53
	3rd	..	..	..	..	18	25	..	..	..	..	..	..	..	..	43
	4th	..	..	..	..	16	15	..	..	..	2	..	..	..	..	33*
Total	133	..	..	..	34	40	..	..	..	2	..	..	..	..	209	
Saskatchewan	1st	166	..	..	..	..	..	..	..	..	..	..	..	..	..	166
	2nd	111	..	..	..	..	..	..	..	..	..	..	..	..	..	111
	3rd	..	4	..	3	11	14	..	..	..	6	40	..	..	6	84
	4th	..	7	..	2	15	13	..	..	..	3	36	..	..	1	77*
Total	277	11	..	5	26	27	..	..	..	9	76	..	..	7	438	
Alberta	1st	107	..	..	..	..	..	..	..	..	..	..	..	..	..	107
	2nd	..	..	..	..	35	14	30	..	..	..	..	..	13	..	92
	3rd	..	..	..	..	21	16	18	..	..	..	..	..	6	1	62
	4th	..	..	..	..	15	14	5	..	..	..	..	..	10	4	48*
Total	107	..	..	71	44	53	..	..	..	..	..	..	29	5	309	
British Columbia	2nd	190	..	..	..	..	..	..	..	..	..	..	..	..	..	190
	3rd	99	..	..	..	..	..	..	..	..	..	..	..	..	..	99
	4th	..	..	..	..	29	4	21	..	4	6	30	4	6	..	104
	5th	..	..	..	..	24	6	12	..	13	11	13	3	10	..	92*
Total	289	..	..	53	10	33	..	17	17	17	43	7	16	..	485	
Grand Total	1648	11	61	26	533	380	470	22	66	43	515	141	186	95	4197	

\*Indicates those graduating in the spring of 1942—Total 746.

## DEAN BROWN RECEIVES HONORARY DEGREE

Ernest Brown, M.E.I.C., dean of engineering at McGill University, was given an honorary degree of Doctor of Engineering by the University of Toronto at a special convocation held in Convocation Hall, December 15th, 1941. Herewith is the citation read by Dr. Cody, president of the university, and Dean Brown's response:

### PRESIDENT CODY'S CITATION

Engineers have largely helped in the material development of Canada. They are of vital importance in the creation, adaptation and growth of our industries in the mechanized war of to-day. They are among the most constructive and useful of our citizens. The universities do well to recognize their services and to honour them for their amazing achievements. If engineers are to be praised, how much more the men who teach and train them!

In the field of engineering education in Canada, McGill University has for many years played a distinguished role. The University of Toronto with pleasure and high satisfaction wishes to-night to recognize this service of a great sister-institution, and at the same time to honour for his own sake, the Dean of its Faculty of Engineering.

Ernest Brown, who in his time was an 1851 Exhibition Scholar, graduated from University College, Liverpool, with the degrees of Master of Science and Master of Engineering. Following some years of service as a Lecturer in Engineering at Liverpool, he came to Canada in 1905, to become Assistant and then Associate Professor in Applied Mechanics at McGill University. In 1911, he became Professor of Applied Mechanics and Hydraulics, a chair he still retains.

Succeeding the late Dean H. M. MacKay, in 1931, Dean Brown has guided with distinction the fortunes of his Faculty in times that have often been difficult both for the engineer and for higher education. While carrying a heavy load of teaching and administration, he has contributed much to engineering knowledge. His investiga-



Dean Ernest Brown, M.E.I.C.

tions in the field of reinforced concrete are classic. He had an important share in the difficult special studies carried out in connection with the design of the Quebec bridge, and his experiments and researches on the strength of ice have added greatly to the knowledge of the engineer concerning the action of this troublesome substance on his structures and machines. Of notable importance have been his studies, pursued over many years, on model turbine runners. Through these and related engineering investigations, he has made an outstanding contribution to the economical development of the hydraulic resources of the Dominion.

By his old students, Dean Brown has long been acclaimed as a clear and forceful teacher. It is a McGill tradition that those who had the privilege of sitting under him very soon came to regard that period of instruction and personal contact as one of the most fruitful experiences of their lives.

I have the honour to present to you, Mr. Chancellor, for the degree of Doctor of Engineering, *honoris causa*, Ernest Brown, Dean of the Faculty of Engineering of McGill University.

#### DEAN BROWN'S RESPONSE

Your Honour, Mr. Chancellor, President Cody, Members of Convocation, Ladies and Gentlemen:

An old friend of mine, a distinguished graduate of this University, in referring to the lack of the gift of oratory characteristic of my tribe, used to say that the language of the engineer is a blueprint and a grunt. A lecturer on public speaking, seeking to engage the interest of a group of students in engineering, is reported to have begun his first talk as follows: "Some day, speaking as a contractor, you will want to give hell to a city council, and to do it in the nice way." To-night my fear is that my grunt of appreciation of the great honour you have paid me will

fall far short of what it is in my heart to convey. I had never thought to exchange my humble overalls for the brilliant garb of an honorary graduate. I wish to thank you, Dr. Cody, for the gracious, but over-generous terms in which you set forth the reasons for the granting of this degree, and to express my deep sense of the great honour conferred upon me. It is a form of recognition which, to me, outweighs all others. I regard it not only as a tribute to whatever I may have been able to accomplish personally in the field of engineering education and in various professional activities, but also as an expression of goodwill towards an important faculty in a sister-university. All engineering activity is a co-operative undertaking. Without the devotion and support of my colleagues I could have accomplished little, and I feel that much credit is due to them for the great honour you have paid me. It has also been my privilege for over 30 years to number among my good friends many members of this University, and to be associated with them not only in academic and professional affairs, but in fostering and controlling intercollegiate sport and competition. These happy memories add greatly to my pleasure in receiving the degree which has been conferred on me. It has not escaped my notice that you have chosen a time when intercollegiate competition is suspended to make me one of your own, by admitting me into the select company of your honorary graduates. I am thus relieved of the severe strain which feelings of divided loyalty might otherwise have imposed on me. This I regard as showing really great consideration. I am profoundly conscious of the value of all good clean sport, and of the loyalties and abiding friendships which it fosters. Nowhere is the saying that all work and no play makes Jack a dull boy more true than in the universities. Some clever modern cynic defined education as "the inculcation of the incomprehensible into the minds of the ignorant by the incompetent." While this is clever, it is not profound. Aristotle knew better when he said: "The purpose of education is to enable us to enjoy leisure beautifully." To-day life is stern and hard, but it may be good for us even during our greatest trials, to reflect a little on the benefits of properly applied leisure. We *exist*—one cannot call it *living* in the true sense—amid a medley of restraints and controls, under ceilings, and in basements, and many of the worth-while things of life seem far away. They will, I hope, be recaptured when, after many grim trials, our hard discipline has brought us out of the deep shadows of the valleys into the pure sunlight of the uplands. And so, even in these hectic days, I like to reflect on the lasting joy and satisfaction derived from the many hours of freedom afforded by academic life, and to hope that in a re-constructed world the advantages of leisure as a factor in the art of living may be realized for all people.

Stevenson in one of his essays—"An Apology for Idlers"—reminds us that idleness, so-called, does not consist in doing nothing, but in doing a great deal not recognized in the dogmatic formularies of a ruling class, and that it has as good a right to state its position as industry itself. "It is surely beyond a doubt," he says, "that people should be a good deal idle in youth. For though here and there a Lord Macaulay may escape from school honours with all his wits about him, most boys pay so dear for their medals that they never afterwards have a shot in their locker, and begin the world bankrupt. And the same holds true during all the time a lad is educating himself, or suffering others to educate him." And again he says: "Extreme busyness, whether at school or college, kirk or market, is a symptom of deficient vitality; and a faculty for idleness implies a catholic appetite and a strong sense of personal identity. There is a sort of dead-alive, hackneyed people about, who are scarcely conscious of living except in the exercise of some

conventional occupation. Bring these fellows into the country or set them aboard ship, and you will see how they pine for their desk or their study. They have no curiosity; they cannot give themselves over to random provocations; they do not take pleasure in the exercise of their faculties for its own sake; and unless Necessity lays about them with a stick, they will even stand still. It is no good speaking to such folk: they cannot be idle, their nature is not generous enough; and they pass those hours in a sort of coma, which are not dedicated to furious moiling in the gold-mill." This is part of Stevenson's plea for a well ordered leisure, for relief from the rush and turmoil of mere existence.

In looking back over our experiences, few of us older folk regret the full satisfaction of the hours of truantry. Unhappily to-day, people in every walk of life must give up leisure and regiment their lives, devoting all their time and thought to the overthrow of those whose principles would otherwise enslave them. May it not be good for us, even though we can now look forward but dimly,—sometimes hardly daring to hope,—may it not be good for us to dream of happier days when as part of the reward of labour all men may enjoy leisure beautifully. The truant, says Stevenson, need not be always in the streets "for if he prefers he may go out by the gardened suburbs into the country. He may pitch on some tuft of lilies over a burn, and smoke innumerable pipes to the tune of the water on the stones. A bird will sing in the thicket. And there he may fall into a vein of kindly thought, and see things in a new perspective. Why, if this be not education, what is it?"

This brings me to the end of the engineer's "grunt" to which I referred a few minutes ago. There is no blueprint to accompany it. The dream I have spoken of can only come true in the hearts and minds of men. I wish to thank you, Mr. Chancellor, and Dr. Cody, for giving me this opportunity to say a few words at this Convocation. Let me renew my most grateful thanks for the high honour you have conferred on me.

## WARTIME BUREAU OF TECHNICAL PERSONNEL

### MONTHLY BULLETIN

The demand for engineers continues. The need for chemists is increasing. The intensive study of the Bureau records is disclosing a greater number of such persons who are not occupied wholly in war work. The Bureau is now closely engaged in endeavours to transfer such persons to new work where their services may be used to greater advantage.

Such negotiations cannot be concluded quickly. It is necessary to consult the wishes of the individual, and to give proper consideration to the needs of the present employer. There is no form of legal compulsion that can be used, and consequently each case becomes a special affair in which the needs of the country are not always the only consideration. In most cases highly specialized persons are involved, and positions of considerable importance are at issue.

\* \* \* \* \*

The Bureau has just completed a special assignment. The British Ministry of Aircraft Production (M.A.P.) urgently needed twenty-five or more civil engineers and draughtsmen for civilian emergency work in England. A trans-Atlantic telephone call placed the inquiry with the Bureau, and after hurried consultations with government officials in Ottawa to get authorization for the "export" of these men, the work was taken in hand.

Advertisements were run in ten newspapers covering Toronto, Ottawa and Montreal, and other names were selected from the Bureau records. Representatives of the Bureau interviewed all applicants whose written records

indicated some degree of suitability. These interviews were held in Toronto, Ottawa and Montreal.

Eventually about thirty-five men were selected from the one hundred and forty applicants. A representative of M.A.P. came to Canada to make the final selection in company of a representative of the Bureau, and accepted every individual previously selected by the Bureau.

Some of the conditions laid down by M.A.P., involving income tax and the portion of salary that could be returned to Canada, reduced the number of applicants, but eventually the required number were signed up and arrangements made for their transportation.

It is likely that the changes in the international situation will delay the departure of some of these men, but the need for them in the Old Country will become more urgent than ever. It is hoped that the original plans will not be delayed seriously.

\* \* \* \* \*

The Bureau proposes to have a representative at the annual meetings of those organizations whose membership includes technical personnel. It will be the representative's mission to explain the purposes and methods of the Bureau and to answer questions. A supply of questionnaires will also be on hand in case anyone who has been missed previously desires to record his qualifications with the other members of his profession.

Doubtless there will be other matters that can be attended to at the same time, all having a bearing on the Bureau's policy of giving service to the engineer and the employer, to the end that Canada's war effort may be increased.

## MEETING OF COUNCIL

A meeting of the Council of The Institute was held at Headquarters on Saturday, December 13th, 1941, at ten thirty a.m.

Present: Vice-President deGaspé Beaubien in the chair; Past President J. B. Challies; Vice-President K. M. Cameron; Councillors J. H. Fregeau, W. G. Hunt, A. Larivière, H. Massue, C. K. McLeod and G. M. Pitts; Secretary Emeritus R. J. Durley, General Secretary L. Austin Wright and Assistant General Secretary Louis Trudel.

The president-elect, Dean C. R. Young, was also present and Mr. Beaubien extended to him, and to Mr. Hunt, the newly appointed councillor for the Montreal Branch, a very cordial welcome to the meeting.

It was noted that since the last meeting contributions had been received from six more branches, bringing the total up to \$7,324.60. Reporting for the Quebec Branch, Mr. Larivière advised that they had a certain amount collected, but had delayed sending it in as they had hoped to be able to send at least \$100.00 as their contribution. He undertook to ask the branch to send in the amount already collected so that the books could be closed at the end of the year.

Mr. Beaubien stated that the Finance Committee particularly appreciated the co-operation of the branches in this matter, and the secretary was directed to thank them all for the splendid effort which has been made on behalf of the building fund.

At the last meeting of Council it had been decided to take advantage of certain opportunities made available through the National Research Council and the Department of Public Works whereby a member of The Institute could be sent to England to secure information regarding the protection and repair of public buildings and utilities subject to attack by bombing or gun fire.

The general secretary reported that he had recently been in touch with the president who, in view of the changed international situation, felt that it would be unwise to send a man to England at the present time. He

pointed out that in the library at the Research Council here are copies of practically everything that has been written on this subject, all of which could be made available to The Institute, and in view of the added risk, and uncertainty regarding transportation, he doubted whether The Institute would be justified in sending a representative for such an investigation at this time. He recommended that the idea be postponed indefinitely.

While realising the advantage of having some person go over and bring back first-hand information, Mr. Cameron doubted whether the desired results would be obtained under present circumstances. Mr. Doncaster, who had been selected to go over, would be willing to take the risk, but he might be stranded in England and be unable to return with the desired information in time for the Annual Meeting as planned.

Mr. Wright stated that the president has agreed to have the member of his staff who is reading all the literature on this subject, prepare a paper for the Annual Meeting. It was also hoped that it would be possible to get Mr. W. D. Binger, Borough Engineer of New York, to come to the meeting and tell about his recent visit to England. Mr. Binger headed a mission sent over by the United States to obtain similar information.

Mr. Pitts thought that some paid official should be made technically responsible for centralizing the work of various organizations making investigations along this line. Mr. Beaubien suggested that since Mr. Doncaster's services had been made available by the Government, it might be possible to put him on this work.

After further discussion it was agreed that Mr. Doncaster's visit to England should be postponed for the time being, and that the matter be left in the hands of the president and Vice-President Cameron for further action.

Mr. Wright gave a brief description of the various papers to be presented to the annual meeting, the general theme of which will be along the line of Canada's war effort, with particular reference to the work of the engineer and scientist. Plans were also progressing for an exhibit of war materials.

Mr. Hunt, chairman of the Annual Meeting Committee, reported briefly on the general programme. All committees are now organized and are working out the various detailed arrangements. For those members who are interested, it is hoped to arrange visits to certain plants on the Saturday morning.

The report of the scrutineers appointed to open the ballots on the New Brunswick agreement was presented.

The general secretary reported that the results of the ballot of members of the Association of Professional Engineers of New Brunswick showed that eighty members had voted in favour of the agreement and seven against. Seventy-eight members had indicated their willingness to take advantage of joint membership under the terms of the agreement.

These results were noted with considerable satisfaction, and on the motion of Mr. Massue, seconded by Mr. McLeod, it was unanimously resolved that the president, or an alternate appointed by him, and the general secretary be duly authorized to sign the agreement between The Engineering Institute of Canada and the Association of Professional Engineers of the Province of New Brunswick. It was also unanimously resolved that the agreement be put into effect as soon as it is signed.

The general secretary was directed to write to the president of the Association expressing Council's pleasure at the results and their appreciation of the splendid work which had been done by the engineers in New Brunswick in negotiating this agreement. It was left with the general secretary to make the necessary arrangements for the signing ceremony, which would probably be held early in January.

Mr. Beaubien reported that the financial statement to the end of November had been examined and found in a very satisfactory condition. Expenses are a little under and revenue is considerably over the budget.

The recommendation of the Finance Committee that *The Engineering Journal* be sent complimentary for the year 1942 to the engineers from other countries now in Canada on war work was unanimously approved.

Dean Young was particularly pleased with this decision. He stated that there are about twenty Polish engineers in Toronto who are very much interested in Institute affairs, and they will greatly appreciate this gesture on the part of Council.

Mr. Beaubien reported that as a result of correspondence with the Director of the Wartime Bureau of Technical Personnel it had been arranged that the Bureau would reimburse The Institute to the extent of \$150.00 a month to cover part of the additional costs to which The Institute was subjected due to the absence of the general secretary in Ottawa, and activities which were undertaken on behalf of the Bureau. This was a great help to the Finance Committee, and Mr. Beaubien felt that The Institute should express its appreciation to the Bureau.

The secretary presented a revised version of the by-laws of the Calgary Branch, which had been examined and found to be in agreement with The Institute by-laws. On the motion of Mr. Challies, seconded by Mr. Massue, it was unanimously resolved that the by-laws as submitted be approved.

The general secretary read two letters from a member, of Hamilton, Ontario, regarding the interpretation of the by-laws governing the qualifications for membership in The Institute, with particular reference to the requirement for full membership of two years of professional responsibility in charge of work as principal or assistant. There seemed to be some diversity of opinion among members of The Institute with whom he had come in contact as to just how this particular qualification is to be interpreted. He suggested that immediate steps be taken to advise the members, and particularly branch executives, regarding their responsibility in making recommendations for membership, pointing out particularly the difference between executive responsibility not involving engineering work, and engineering or professional responsibility.

A full discussion followed, during which it was suggested that the branches might be advised that representations had been made to Council indicating that in some instances enough consideration had not been given to the question of professional responsibility.

Mr. Cameron suggested that it should be made clear to the author of the letters that each application for membership receives individual consideration by Council, and that very frequently certain cases are referred back to the branch executive for further consideration and inquiry.

Further discussion took place, and it was decided to leave the matter in the hands of the general secretary to take whatever action seemed advisable in order to keep branch executives fully informed.

The general secretary read a letter from the secretary of the Hamilton Branch, pointing out the desirability of giving students, as they join The Institute, full information about the advantages of membership in The Institute and the requirements for their eventual transfer to a higher class of membership.

Mr. Challies thought this was a very important question. In his opinion, every student, upon entering The Institute should be given some sort of a brochure indicating just what The Institute stands for. This was a matter which might very well be referred to Mr. Bennett's Committee on the Young Engineer.

Mr. Cameron suggested that the general secretary, when notifying Students of their admission, should write

a letter to each one encouraging them to continue their membership, sending a copy of the letter to the branch executive. Mr. Pitts thought a brochure such as had been suggested by Mr. Challies would be more helpful.

Mr. Massue thought it should be the responsibility of branch membership committees to keep in touch with the Students and encourage them to transfer as soon as they are eligible, instead of dropping out as a great many do, apparently from lack of knowledge of the advantages of Institute membership.

Dean Young also believed that the branches should be encouraged to follow up on all Student members. A general follow-up under the direction of Mr. Bennett's committee, perhaps through the branches, would be very beneficial.

It was unanimously agreed that special contact should be maintained with Student members to the end that they will transfer to a higher class of membership. It was left with the general secretary to discuss this with Mr. Bennett and see what could be done in addition to the policy already being followed.

A number of applications were considered and the following elections and transfers were effected:

ADMISSION	
Members .....	8
Juniors .....	4
Students .....	24
Affiliate .....	1
TRANSFERS	
Junior to Member .....	3
Student to Junior .....	2
Student to Member .....	1

Mr. Challies drew attention to the fact that Miss Caroline Haslett, President of the Women's Engineering Society of Great Britain, had been visiting the United States, and was spending two days in Canada. He felt that her visit should be recognized in some way by The Institute, and it was left with the general secretary to see what could be done.

Mr. Challies reported that a meeting of the executive of the Engineers' Council for Professional Development was being held in New York on December 18th. It would be impossible for him to attend, and as neither Dr. Fairbairn nor Dr. Surveyer could go, he suggested that Council authorize the general secretary to attend and represent The Institute at that meeting. This was unanimously approved.

Council noted with sincere regret the death of Mr. J. B. Hunter, Deputy Minister of the Department of Public Works, Ottawa, and it was unanimously resolved that the following resolution be recorded in the minutes and that a copy be sent to Mrs. Hunter and to the Department.

"The Council of The Engineering Institute has been greatly shocked to hear of the death of Mr. J. B. Hunter, Deputy Minister of the Department of Public Works at Ottawa, and desires to express to Mrs. Hunter some measure of the sympathy which they feel at her loss.

"The Engineering Institute has had very pleasant relations with Mr. Hunter throughout the entire period of his office, and has received frequent and important favours from him. Among the government officials not many have shown a greater sympathy for the work and the needs of the engineer, and his loss will be felt by members of the profession in all parts of Canada."

Mr. Challies commented on the large number of students from the Ecole Polytechnique who were joining The Institute, for which a great deal of credit was no doubt due to Mr. Trudel.

It was left with the president and the general secretary to decide upon the date for the January meeting of Council.

The Council rose at one o'clock p.m.

## ELECTIONS AND TRANSFERS

At the meeting of Council held on December 13th, 1941, the following elections and transfers were effected:

### Members

- Brekke**, Hans Krishan Andreas, Civil Engr., (Prague Univ.), hydraulic engr., City of Winnipeg Hydro Electric System, Winnipeg, Man.
- Duncan**, John Martin, B.A.Sc. (Univ. of Toronto), plant mgr., Canadian Liquid Air Co. Ltd., Hamilton, Ont.
- Howse**, George Wesley, district inspector, Hydro-electric Power Commission of Ontario, Hamilton, Ont.
- McNeil**, John Newson, B.Sc.(C.E.), (Univ. of Man.), engr. i/c field constrn., C. D. Howe Co. Ltd., Port Arthur, Ont.
- Stark**, John Edward, constrn. supt., Hydro-Electric Power Commission of Ontario, Toronto, Ont.
- Westman**, LeRoy Egerton, B.A., M.A. (Univ. of Toronto), president, Westman Publications Limited, Toronto, Ont.
- Wingfield**, Harold Ernest, B.A.Sc. (Univ. of Toronto), director of sales, advertising & purchasing, Imperial Rattan Co. Ltd., Stratford, Ont.
- Wood**, Wells Arthur, B.A.Sc. (Univ. of B.C.), design engr., Harrington Tool & Die Company, Lachine, Que.

### Juniors

- Davis**, Frederick Allan, B.Sc. (Chem.), (Queen's Univ.), asst. refinery engr., British American Oil Co. Ltd., Montreal East, Que.
- Kennedy**, Samuel McNeer, B.A.Sc. (Univ. of Toronto), engr. dept., Defence Industries Ltd., Montreal, Que.
- Mann**, Neville Whitney Davis, B.Sc. (C.E.), (Univ. of N.B.), junior engr., Atlas Construction Co. Ltd., Gander, Nfld.
- Teskey**, Arthur G., B.Sc. (E.E.), (Univ. of Man.), sales engr., Canadian Westinghouse Co. Ltd., Winnipeg, Man.

### Affiliate

- Jones**, Douglas, (McGill Univ.), secretary-engineer, technical section, Canadian Pulp & Paper Association, Montreal, Que.

### *Transferred from the class of Junior to that of Member*

- Nathanson**, Max, B.Sc. (McGill Univ.), owner and engr., Canadian Armature Works, Montreal, Que.
- Pope**, Joseph Morley, B.Sc. (McGill Univ.), Flt.-Lieut., R.C.A.F. (A.M.A.E. Divn.), Ottawa, Ont.
- Tuck**, Joseph Howard, B.Sc. (Queen's Univ.), supt., monel dept., International Nickel Company, Port Colborne, Ont.

### *Transferred from the class of Student to that of Member*

- Baggs**, William Clyde, B.ENG. (McGill Univ.), asst. to the mgr., Bathurst Power & Paper Co. Ltd., Bathurst, N.B.

### *Transferred from the class of Student to that of Junior*

- Laird**, Alan Douglas Kenneth, B.A.Sc. (Univ. of B.C.), material engr., Fraser Brace Engineering Co. Ltd., Winnipeg, Man.
- Thompson**, Arthur McCall, B.Sc. (Univ. of Alta.), apparatus sales engr., Canadian General Electric Co. Ltd., Winnipeg, Man.

### Students Admitted

- Bell**, Frederick Arthur, (Univ. of Toronto), 91 St. George St., Toronto, Ont.
- Bradley**, Whitney Lloyd, (Univ. of Toronto), 31 Welland St., Thorold, Ont.
- Carrothers**, Percival John Godber, (Univ. of B.C.), 1549 Western Crescent, Vancouver, B.C.
- Chinn**, Norman William, (McGill Univ.), 4639 Melrose Ave., Montreal, Que.
- Cohen**, Peter Zelig, (McGill Univ.), 20 Lavolette Ave., Outremont, Que.
- Cross**, Ivor Frederick, (Univ. of Man.), 82 Rosseau Ave. W., Transcona, Man.
- Diamond**, George Bernard, (McGill Univ.), 48 Joyce Ave., Outremont, Que.
- Galli**, Joseph Nicholas, (Univ. of Man.), 749 Ross Ave., Winnipeg, Man.
- Grimble**, Wilf George, (Univ. of B.C.), 3806 West 35th Ave., Vancouver, B.C.
- Hartwig**, Elmer Herman William, 11 Barons Ave. So., Hamilton, Ont.
- Hlibchuk**, Walter (McGill Univ.), 3 Popliger Ave., Montreal, Que.
- Joy**, Richard Joseph, (McGill Univ.), 341 Metcalfe Ave., Westmount, Que.
- Keay**, William Logan, (Univ. of Man.), 464 Bowman Ave., Winnipeg, Man.

**Luscombe**, William Charles Murray, B.Sc. (Queen's Univ.), 126 Fenimore Ave., Ottawa, Ont.  
**Lefebvre**, Marcel, (Ecole Polytechnique), 5025 St. Urbain St., Montreal, Que.  
**Morris**, Wallace Victor, (Univ. of Man.), 688 Jubilee Ave., Winnipeg, Man.  
**Milot**, Raymond, (McGill Univ.), 3539 St. Famille St., Montreal, Que.  
**McDermott**, Arthur G., (Univ. of N.B.), 242 Charlotte St., Saint John, N.B.  
**McLaughlin**, Robert Hugh Benson, (Univ. of N.B.), Beaverbrook Residence, Fredericton, N.B.  
**McNiven**, Hugh Donald, (Univ. of Toronto), Islington, Ont.  
**Orloff**, Irving, (Univ. of Man.), 302 Redwood Ave., Winnipeg, Man.  
**Pichette**, Jacques, (McGill Univ.), 3539 St. Famille St., Montreal, Que.  
**Prideaux**, Norman Llewellyn, (Univ. of Toronto), 33 Monarch Park Ave., Toronto, Ont.  
**Rossetti**, Anthony Bruce, (N.S. Tech. Coll.), 33 Cherry St., Halifax, N.S.

## COMING MEETINGS

**Association of Professional Engineers of Ontario**—Annual Meeting and Dinner, Royal York Hotel, Toronto, Ont., on January 17th, 1942. Walter McKay, Secretary-Treasurer, 350 Bay Street, Toronto, Ont.

**Canadian Electrical Association, Inc.**—Ninth Annual Winter Conference, Mount Royal Hotel, Montreal, Que., January 19th and 20th, 1942. B. C. Fairchild, Secretary, Room 804, Tramways Building, Montreal, Que.

**The Engineering Institute of Canada**—Sixty-sixth Annual General and General Professional Meeting, Windsor Hotel, Montreal, Que., February 5th-6th, 1942. L. Austin Wright, General Secretary, 2050 Mansfield Street, Montreal, Que.

## Personals

**Léo Brossard**, M.E.I.C., has entered private practice in Montreal as a consulting engineer and land surveyor. He graduated from the Ecole Polytechnique in civil engineering in 1936 and after post graduate work obtained a degree of Master of Science in geology from McGill University in 1940.

He has spent some time in the northern mining district of Quebec as a geologist with the Cournot Mining Company and has also done some work for the Department of Mines of the Province of Quebec. Lately he has been connected with dredging work for drainage purposes in the Napierville district in Quebec. Mr. Brossard is a member of the Corporation of Land Surveyors of the Province of Quebec.

**Pilot Officer L. M. Clarke**, M.E.I.C., has recently completed a course at the School of Aeronautical Engineering of the Royal Canadian Air Force at Montreal and has been posted at R.C.A.F. Headquarters, Ottawa.

**Pilot Officer S. V. Antenbring, Jr.**, E.I.C., was also in the class who completed their course at the School of Aeronautical Engineering of the Royal Canadian Air Force in Montreal, and has been posted to R.C.A.F. Headquarters in Ottawa.

**I. D. Mackenzie**, Jr., E.I.C., has been transferred from Shawinigan Falls to the Montreal office of Shawinigan Engineering Company. He graduated from Queen's University in 1940.

**R. C. Robson**, Jr., E.I.C., has recently accepted a position with Bloedel, Stewart and Welch Limited of Vancouver as engineer. He was previously connected with the Consolidated Mining and Smelting Company at Trail, B.C.

**G. O. Sanders**, Jr., E.I.C., is at present stationed at Providence, R.I., U.S.A., as assistant inspector of Naval Ordnance for the British Admiralty. He graduated from Queen's University in 1937 and up until recently was on the staff of Howard Smith Paper Mills Limited at Cornwall, Ont., as maintenance engineer.

**W. C. Weir**, Jr., E.I.C., is now stationed at Brantford, Ont., as engineer officer with the Royal Canadian Air Force. He graduated from the University of Saskatchewan in 1936 and for some time was connected with the Hudson Bay Mining and Smelting Company at Flin Flon, Man.

**Pierre A. Duchastel**, Jr., E.I.C., has recently accepted an appointment with the physics and electrical engineering

## News of the Personal Activities of members of the Institute, and visitors to Headquarters

department of the National Research Council at Ottawa. He graduated in electrical engineering from McGill University in 1938, and since graduation has been connected with the Ferranti Electric Limited, Montreal.

**Squadron Leader Baxter Richer**, S.E.I.C., has recently been appointed to command a squadron at No. 13 Service Flying Training School of the Royal Canadian Air Force at St. Hubert, Que. Squadron-Leader Richer graduated from the Ecole Polytechnique in 1937 and enlisted in the service of the R.C.A.F. in the same year. In December, 1938, he was promoted to the rank of Flying Officer and was made a Flight Lieutenant in May, 1940. Lately he had been stationed at McLeod, Alta., and previously at Regina, Sask.

**Pilot Officer R. J. Doehler**, S.E.I.C., has recently completed a course at the School of Aeronautical Engineering of the Royal Canadian Air Force at Montreal and has been posted at Summerside airport, P.E.I.

**W. H. MacGowan**, S.E.I.C., has accepted a commission in the Royal Canadian Air Force and is at present posted at No. 3 Wireless School, Winnipeg, Man. He graduated from McGill University in 1929.

**Pilot Officer Marcel Papineau**, S.E.I.C., has recently completed his course at the School of Aeronautical Engineering of the Royal Canadian Air Force, Montreal, and has been posted at No. 6 Repair Depot, Trenton, Ont. He graduated from the Ecole Polytechnique in 1940 and was on the staff of the Noranda Mines Limited at Noranda until he joined the air force a few months ago.

**R. M. Morris**, S.E.I.C., has joined the staff of the National Research Council in the Department of Physics and Electrical Engineering at Ottawa. He was previously on the staff of the Shawinigan Engineering Company at Montreal. He graduated from Nova Scotia Technical College in 1940.

**Pilot Officer Bernard Lavigne**, S.E.I.C., has completed his course at the School of Aeronautical Engineering of the Royal Canadian Air Force, Montreal, and has been posted at No. 11 Technical Detachment, R.C.A.F., at Montreal. He graduated from the Ecole Polytechnique in 1941.

**Richard Noonan**, S.E.I.C., has joined the staff of the English Electric Company, transformer department, at St. Catharines, Ont. He was formerly connected with the electrical department of the Canadian National Railways at Montreal.

**Georges Archambault**, S.E.I.C., has joined the staff of the Aluminum Company of Canada Limited at Arvida, Que. He graduated in mechanical engineering from McGill in 1939 and joined the staff of Minneapolis Honeywell Regulator Company at Montreal. Lately he had been connected with Peacock Bros. Limited, at Montreal.

**J. A. Lalonde**, M.E.I.C., was elected this month chairman of the Montreal Branch of The Institute. He was born at Au Sable, Mich., U.S.A., in 1891 and was educated at the Ecole Polytechnique of Montreal, where he graduated in 1912.

Upon graduation he spent a few months on railway work with the North Railway Company at Hudson Bay. In 1913 he joined the staff of the City of Outremont as assistant



**J. A. Lalonde, M.E.I.C.**

engineer. In 1920 he went with the City of Montreal as assistant superintendent of streets, a position which he left in 1924 to join the staff of Quinlan, Robertson and Janin, Montreal, as manager of the paving department. In addition to these duties he was chief engineer of A. Janin and Company from 1930 to 1939. At that time he became manager and chief engineer of the Quebec Paving Company, Montreal, and associated companies, a position which he holds at present.

Mr. Lalonde has been Professor in Municipal Engineering at Ecole Polytechnique since 1926.

**Colonel H. G. Thompson**, D.F.C., M.E.I.C., is among the three Canadian officers who were recently despatched to the middle East as observers with the British 8th and 9th Armies. Col. Thompson is well known to members of The Institute, having held for over two years the position of editors of indices of The Engineering Catalogue at Headquarters. Since his graduation from the University of Toronto in 1922, he has been engaged in mechanical sales engineering with various firms. In 1934 he joined the staff of Canadian Vickers Limited and in 1935 he was appointed manager of the Toronto office of the Company.

In 1940 he was in England as officer commanding No. 2 Army Field Workshop, R.C.O.C. Upon his return to Canada last year, he was appointed chief ordnance mechanical engineer, Department of National Defence, at Ottawa.

**W. O. Scott**, M.E.I.C., is the newly elected chairman of the Vancouver Branch of The Institute. He graduated from the University of British Columbia with the degree of Master of Applied Science in 1923. Following graduation,

Mr. Scott became connected with J. W. Thompson and Company of Vancouver, and in 1924 he entered the employ of the City of Vancouver as assistant in the water works survey, later becoming smoke inspector. In 1926 he went with Scott Foster and Company as mechanical engineer and later was on the staff of Canadian Utilities Limited at Calgary, Alta. He is at present assistant plant superintendent of the Dominion Bridge Company at Vancouver, a firm with which he became connected in 1933.

**John M. Evans**, M.E.I.C., has been appointed chairman of the newly created Export Control Committee of the Federal Government at Ottawa. Mr. Evans' duties will be to administer control of Canada's export trade in order to protect the Canadian public and manufacturers against serious loss of export markets and to insure that no materials or commodities essential to the Dominion's war effort are manufactured or processed for export trade until the full requirements of the country for war purposes have been filled. The membership will include representatives from the various wartime boards.



**John M. Evans, M.E.I.C.**

Mr. Evans was born in England in 1905. He was educated in public and commercial and technical high schools in Montreal and graduated from McGill University in May, 1929, with a degree of B.Eng., in electrical engineering. He joined the Shawinigan Water & Power Company June 1st, 1929, and after spending two years on system planning, design of pole lines, transformers, and other equipment, he transferred to the department of development and devoted his attention to industrial location studies and the development of new loads. He is at present assistant manager of the department of development of the Company.

**E. M. Proctor**, M.E.I.C., is at present located at Washington, D.C., where he is representing the Canadian Government on the Bureau of Industrial Conservation, which is a branch of the Office of Production Management of the United States. Mr. Proctor is president of James, Proctor and Redfern Limited, Toronto.

**Sub-Lieutenant C. K. Hurst**, M.E.I.C., has been posted to the Naval College at Halifax for training. Previous to his enlistment he was on the hydraulic staff of the canals branch of the Department of Transport, Ottawa.

**Jean P. Carrière**, M.E.I.C., whose paper on "Construction of a By-Pass Highway in England by Royal Canadian Engineers" is printed in this issue of the Journal, is at present serving as a captain with the Royal Canadian Engineers in England. In civil life, Mr. Carrière is senior assistant engineer in the Montreal office of the Department of Public Works of Canada and previous to his enlistment he had been for some time attached to the London, Ont., district office.

**H. A. Gibeau, M.E.I.C.**, has been appointed director of the Department of Public Works of the city of Montreal to succeed the late J. E. Blanchard, M.E.I.C. Mr. Gibeau, who has held the office of assistant director for the past year, was born in Montreal. He took a science course at the Rensselaer Polytechnic Institute in Troy, N.Y., where his brilliant studies won him the chair of applied mechanics at the Villa Nova Institute in Philadelphia.



**H. A. Gibeau, M.E.I.C.**

After teaching for five years in the Philadelphia institute he returned to Canada and was appointed chief examiner of the Montreal Municipal Service Commission, in 1920. Two years later he joined the Public Works Department, and in 1937 he was appointed assistant chief engineer of the city.

**C. Neufeld, M.E.I.C.**, has been transferred to the staff of the Dominion Bridge Company at Calgary as designing engineer. He was previously connected with the Sault Structural Steel Company at Sault Ste. Marie. Mr. Neufeld, who graduated from the University of Saskatchewan in the class of 1935, was the winner of the H. N. Ruttan prize of The Institute in 1938.

**Flying Officer W. Shuttleworth, M.E.I.C.**, has joined the works and buildings branch of the Royal Canadian Air Force and is at present stationed at Newfoundland.



**Americans Honour Canadian Engineer**

At the Annual Meeting of the American Society of Mechanical Engineers in New York, the Hon. C. D. Howe, M.E.I.C., was given an Honorary Membership in the Society. Here he is shown between two other distinguished gentlemen who received a similar honour on the same occasion. On the left is Major General Charles Macon Wesson, Chief of Ordnance of the United States Army, and on the right is Rear Admiral Samuel Murray Robinson, Chief of the Bureau of Ships.



**W. F. Drysdale Participates in Quiz**

At the Annual Meeting of the American Society of Mechanical Engineers held in New York, a special feature was a "clinic" devoted to questions and answers on Conservation and Reclamation of Materials in Industry. On the board of experts was W. F. Drysdale, a Member of The Institute. The above photograph shows other experts who also assisted in answering the many questions.

Back Row: left to right, D. R. Kellogg, Assistant to Manager, Engineering Laboratories and Standards, Westinghouse Electric; W. W. Finlay, Manager, Cincinnati Div'n., Wright Aeronautical Corp'n.

Front Row: W. F. Drysdale, M.E.I.C., Director-General of Industrial Planning and Engineering, Ottawa; John C. Parker, President A.S.M.E., Vice-President Consolidated Edison Co.; C. E. Smith, Vice-President N.Y., N.H. & H. Railroad.

#### VISITORS TO HEADQUARTERS

**Lieut.-Colonel G. E. Cole, M.E.I.C.**, Wartime Bureau of Technical Personnel, Ottawa, Ont., on November 27th.

**R. I. McCabe, M.E.I.C.**, office manager, Sherbrooke Machineries Limited, Sherbrooke, Que., on November 27th.

**G. St. Jacques, M.E.I.C.**, engineer, Public Service Board, Quebec, Que., on November 28th.

**A. C. R. Yuille, M.E.I.C.**, consulting engineer, Vancouver, B.C., on November 28th.

**T. S. McMillan, Jr., E.I.C.**, maintenance engineer, Plastic Division, Canadian Industries Limited, Brownsburg, Que., on December 3rd.

**E. M. Nason, Jr., E.I.C.**, No. 3 Training Command, R.C.A.F., Moncton, N.B., on December 4th.

**B. Gray, M.E.I.C.**, mechanical and resident engineer, Canadian International Paper Company, Temiskaming, Que., on December 6th.

**R. H. Findlater, M.E.I.C.**, Inspection Board of the United Kingdom and Canada, Ottawa, Ont., on December 6th.

**M. G. Saunders, M.E.I.C.**, Councillor of The Institute, mechanical superintendent, Aluminum Company of Canada Limited, Arvida, Que., on December 9th.

**Roger Lord, S.E.I.C.**, Beauharnois Light, Heat & Power Company, Beauharnois, Que., on December 11th.

**Major C. B. Bate, R.C.E., M.E.I.C.**, St. Johns, Newfoundland, on December 18th.

**Sergeant Eric Grant, M.E.I.C.**, Department of Works and Buildings, R.C.A.F. Headquarters, Eastern Command, Halifax, N.S., on December 22nd.

**Professor R. F. Legget, M.E.I.C.**, Department of Civil Engineering, University of Toronto, Toronto, Ont., on December 24th.

**T. M. Moran, M.E.I.C.**, Vice-President, Stevenson and Kellogg Limited, Toronto, Ont., on December 29th.

**J. H. Bradley, M.E.I.C.**, engineer with Holcroft and Company, Detroit, Mich., on December 31st.

**Geoffrey Stead, M.E.I.C.**, Saint John, N.B., on January 2nd.

# Obituaries

*The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.*

**Joseph Elie Blanchard**, M.E.I.C., died in the hospital at Montreal on December 12, 1941. He was born at Montreal on August 3rd, 1881. He received his early education at the Plateau Academy and his engineering training at the



J. Elie Blanchard, M.E.I.C.

Ecole Polytechnique of Montreal, where he graduated in 1902. He worked for some time with F. C. Laberge, consulting engineer of Montreal, and in 1904 he was engineer in charge of the construction of the waterworks at St.

Boniface, Man. In 1905 he became chief engineer of the City of St. Henry and when this latter was annexed to Montreal, he remained on the public works personnel. In 1915 he was appointed in charge of the roads and sewers division of the City of Montreal. In 1918 he was made engineering superintendent of the roads department of the city, a position which he occupied until 1930 when he became director of the Department of Public Works of Montreal. The department underwent marked improvements under the direction of Mr. Blanchard and the recent reorganization had been carried out under his supervision and that of the Quebec Municipal Commission.

Mr. Blanchard joined The Institute as a member in 1920.

**George Prince Hawley**, M.E.I.C., died at Santa Monica, Cal., on November 26th, 1941. He was born at Niagara Falls, N.Y., on August 22nd, 1872, and was educated at the University of Wisconsin. After spending a few years in municipal and railroad work, he joined the staff of Wallace C. Johnson at Niagara Falls in 1900 and was engaged on the design and construction of hydro-electric power plants, particularly at Shawinigan Falls, Que. From 1905 to 1911 he was city engineer at Depere, Wis. He returned to Canada in 1911 with the Shawinigan Water and Power Company and in 1912 he joined the staff of the Montreal Light, Heat and Power Consolidated as resident engineer in charge of the construction of the Cedar Rapids plant on the St. Lawrence river near Montreal. Later he was engaged on the construction of the Rivière-des-Prairies plant of the Montreal Island Power Company, a subsidiary of the Montreal Light, Heat and Power Consolidated. He remained at this plant as resident engineer until four years ago when he retired. He had since visited Florida and many other states, finally establishing his home at Santa Monica, Cal.

Mr. Hawley joined The Institute as a member in 1920.

## News of Other Societies

### BRANTFORD GROUP

Vice-President K. M. Cameron of The Institute visited the Brantford group of engineers on Saturday, November 22nd. He was the guest speaker at the monthly dinner and told an interesting story of the work done in and around Brantford by the Department of Public Works. His knowledge of the history and geography of the locality doubtless was a surprise to many, and indicated that civil engineering is a broad calling by which one learns much about the country in which he works. As chief engineer of his Department, Mr. Cameron is never in a strange land in any part of Canada.

Many questions were asked which, along with the

### Items of interest regarding activities of other engineering societies or associations

informal friendly style of the talk, made the whole evening a delightful affair. The president of the group, Frank Westaway, was in the chair, and had as other head table guests, W. A. T. Gilmour, chairman of the Hamilton Branch of The Institute, General Secretary L. Austin Wright, and a past-president of the group, E. T. Sterne, now of Montreal. Mr. Wright spoke briefly on the work of the Wartime Bureau of Technical Personnel.

James A. Vance was present to represent the London Branch of The Institute, and besides the chairman, the Hamilton Branch was represented by the chairman-elect, Stanley Shupe, of Kitchener, and the secretary-treasurer, A. R. Hannaford.

### PROFESSIONAL ENGINEERS OF ONTARIO

The Association of Professional Engineers of Ontario have announced that Flt.-Lieut. Henry Cotton, Padre of the Technical Training Centre, R.C.A.F., St. Thomas, will be the guest speaker at the dinner of the Association which is being held in the Royal York Hotel, Toronto on January 17th. He will speak on the subject, "The Battle of Brains."

Flt.-Lieut. Cotton who was attending McGill University when the last war broke out, enlisted as a Private and finished as Captain in the old Royal Flying Corps. He was in dog-fights with Richthofen and Voss, the celebrated German war aces. Shot down on his fortieth flight to Germany, he was for two years a prisoner of war. He was cited in the London Gazette "for gallant and distinguished service," his copy being signed on the King's behalf by Winston Churchill, then Secretary of State for Air.

(News of Other Societies continued on page 57)



K. M. Cameron speaks to the Brantford Group of Engineers. On the left is Chairman W. A. T. Gilmour of the Hamilton Branch of The Institute and on the right is President Frank Westaway of the Group.

## BORDER CITIES BRANCH

W. P. AUGUSTINE, M.E.I.C. - *Secretary-Treasurer*  
J. B. DOWLER, M.E.I.C. - *Branch News Editor*

The November meeting of the Border Cities Branch was held on Friday, November 14th, at the Prince Edward Hotel, Windsor. In the absence of the branch chairman, G. M. Medlar, the Branch was honoured by having Councillor E. M. Krebsler in the chair. After dinner, the speaker, Mr. Donald Ramseyer, was introduced by Mr. J. Blowey.

Mr. Ramseyer is superintendent of the soy bean plant of the Ford Motor Company at Dearborn, Mich. He has been associated with soy bean work at the Ford Motor Company since its inception in 1930. The subject of his talk was **Soy Beans in Industry**.

In order to introduce his subject, Mr. Ramseyer first showed a slide film entitled **Farms of the Future**. It has long been one of Mr. Henry Ford's principles that there must be the utmost co-operation between the American farmer and industry before we can obtain true prosperity on this continent. Industry must absorb the products of the farmer in order that the farmer may absorb the products of industry.

With this in mind, Mr. Ford started research to find products of the farm most useful to industry. Many products were experimented with—corn stalks, wheat straw, vegetables, sunflower seeds, weeds and many others. Finally the soy bean was chosen as having the greatest possibilities. This is because of the high protein content.

The soy bean was introduced into America about 1800, but very little was done with it until about 1914. Its chief uses were as a silage crop and the oil was used as a substitute for cotton seed oil.

One of the difficulties with early methods for utilization of soy beans was that all the oil could not be removed from the meal and this was the first problem attacked by Mr. Ford's research laboratory. They developed a method by which 100 per cent of the oil can be absorbed from the crushed beans leaving a meal not unlike some prepared breakfast foods. The soy bean oil can then be recovered from the solvent and the solvent used over and over again. The meal can be dried and converted into many different products.

The oil is now used in the enamels for the Ford car. The enamels now contain up to 50 per cent of soy bean oil.

A new process has been the hydrogenation of the oil to produce glycerine and stearic acid, both very necessary for war-time production.

The original product developed by Ford research laboratory was the combination of the meal and bakelite to mould the gear shifter knob. Practically all the buttons, handles and ignition parts are now being moulded from this material.

Soy bean water paint has been developed from the meal. This is a very cheap paint for factory work, excellent for stonework and cement, retaining its whiteness longer than other paints. It can be washed but is rather porous and therefore is not suitable for painting steel. It can be mixed with pigment to give different colours.

The Ford research laboratory is also experimenting with gaskets made of fabric impregnated with the soy bean protein. This is a very severe application and large scale tests are now under way. The tests look very promising but it has not yet been applied commercially.

The soy bean meal is also used in the Ford steel mill as a substitute for corn flower as a core binder. Replaceable hot pops for steel ingot casting is another use.

One of the most amazing of the Ford developments is protein wool made from the soy meal. This wool has a texture and quality very similar to sheep's wool. It is equal in strength when dry to 80 per cent of strength when wet,

## Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

and has 20 per cent more stretch. As a comparison it requires two acres of land per sheep to produce 12 lb. of wool, whereas two acres of land will produce 200 lb. of soy bean wool. This material has been used to make automobile upholstery of 30 per cent soy bean fibre and 70 per cent sheep's wool. It has been used very satisfactorily. Even suits have been made and felt for hats, successfully. Mr. Ford is now building a plant to produce this wool.

Mr. Ramseyer was asked whether plastics would greatly affect the production of aeroplanes and other articles during the war-time rush. He stated that at the present time there were not nearly enough soy beans grown to meet the demand. This year production was about 110,000,000 bushels of beans and next year it is expected to reach 125,000,000 bushels. Even this would not meet the demand. However, after the war, he predicted, there would be huge developments along this line.



The Border Cities group at the dinner held in honour of the president.

One other great advantage of soy beans is that the plant adds great quantities of nitrogen to the soil and is therefore of great benefit to the soil.

A special meeting of the Border Cities Branch was held on Wednesday, November 26, at the Prince Edward Hotel, Windsor. The occasion was the visit to the branch of the present, Dean C. J. Mackenzie, accompanied by Vice-President K. M. Cameron from Ottawa. The president was also accompanied by Mr. J. A. Vance and Mr. H. F. Bennett of the London Branch.

A dinner meeting was held with Mr. George E. Medlar in the chair. After the dinner, the chairman welcomed the president and his party on behalf of the branch, and turned the meeting over to Vice-President J. Clark Keith. Mr. Keith gave a brief review of President Mackenzie's career leading up to his present work as acting president of the National Research Council and chairman of the Federal Board of Inventions.

President Mackenzie spoke of his visits to the various branches throughout Canada, and his appreciation of the opportunity to be president. He spoke of the prominent part being played by engineers in Canada to-day, especially in the Department of Munitions and Supply, and the increasing importance of engineering as a profession.

President Mackenzie then reviewed the work of the Research Council. The work to-day is probably more development engineering than long term research but the work requires the same type of mind and in either case extensive training for the job.

As an outstanding example of the value of research, it may be said that scientific research saved Britain in 1940 as it gave them the Spitfire and Hurricane aeroplanes and their equipment. The air force was quite small but superbly trained and with superior equipment they saved Britain.



President's visit to Windsor. From left to right: J. A. Vance, J. Clark Keith, President Mackenzie, K. M. Cameron and H. F. Bennett.

Without this equipment in the air and on the sea nothing else could have stopped the Germans.

The war will not be won by any spectacular or new weapons but will be won by careful, consistent and continual attention to detail and constant attention to research and development of men and equipment.

After President Mackenzie's address, Chairman George Medlar asked Councillor E. M. Krebsler to introduce Vice-President K. M. Cameron.

Mr. Cameron paid tribute to the speaker of the evening and said that it was exceedingly fortunate that Canada was able to call on a man of President Mackenzie's calibre to take over the duties at the National Research Council.

Mr. Cameron then discussed several Institute affairs of great interest to the members, particularly the papers presented for the John Galbraith prize. One of our members, Mr. A. H. Pask, has presented a paper for this prize.

Councillor J. A. Vance then spoke briefly and praised the work of President Mackenzie and past presidents in visiting the different branches and bringing them more closely together.

Mr. H. F. Bennett of London spoke briefly on the work of the Committee on the Welfare of the Young Engineer and spoke of the booklet which is being prepared for early distribution to Canadian high schools giving information regarding the engineering profession.

At the close of the meeting, Mr. T. H. Jenkins, on behalf of all the members, moved a hearty vote of thanks to our president for his visit and extremely interesting address. Mr. J. F. Bridge seconded this motion.

#### EDMONTON BRANCH

F. R. BURFIELD, M.E.I.C. - *Secretary-Treasurer*  
L. A. THORSSSEN, Jr.E.I.C. - *Branch News Editor*

The second general meeting for the year of the Edmonton Branch was held in the Electrical Engineering Laboratories of the University of Alberta, on November 18th. A paper was given in connection with a visit to the new Broadcasting Station, CKUA, of the University of Alberta by Mr. J. W. Porteous, of the department of electrical engineering, who was chief engineer and designer of the new installation.

Prior to the visit Mr. Porteous outlined the problems confronting the designer of a broadcasting station and very clearly showed the various steps from the source of sounds to the antenna into the air and finally to the radio receiver. These various steps were illustrated by a laboratory set-up in which he explained the transfer of sound into electric currents by the microphone, how these currents were stepped-up by radio tubes, then showing the combination of these currents and voltages, known as audio frequencies, with the radio frequency wave, in order to produce a wave that can travel out from the antenna for great distances. With the laboratory set-up, Mr. Porteous actually broad-

cast various sounds showing the combination of the audio and radio frequencies by the use of an oscillograph. These sounds were picked up by an ordinary radio receiving set in the far end of the laboratory.

After the paper, Mr. Porteous conducted the members around the transmitter and antenna tower of the new station, pointing out the various steps described in his paper.

With an excellent turn-out of members and guests, it was a very interesting and enjoyable evening.

#### HALIFAX BRANCH

S. W. GRAY, M.E.I.C. - *Secretary-Treasurer*  
G. V. ROSS, M.E.I.C. - *Branch News Editor*

Mr. M. Walsh, chief engineer of the Gunitite and Waterproofing Co. Ltd., was speaker at the November 27th dinner meeting of the Branch. Seventy-seven members and guests were present.

Mr. Walsh described the **Pre-stressed Concrete** process used by his company in the construction of water and oil tanks, a topic of special interest here as several tanks of this type are soon to be built in the vicinity of Halifax. Mr. Walsh spoke of the causes of failure due to cracking and separation of concrete from steel in tanks of conventional design. He then dealt with the pre-loaded concrete design, which overcomes these causes of failure, and explained the method of placing and pre-stressing the reinforcing steel, and illustrated his talk with a motion picture of tanks under construction.

Mr. R. L. Dunsmore, of the Imperial Oil Company, extended an invitation to the Branch members to visit the site when construction gets under way.

The tanks to be erected are 130 ft. in diameter, 42 ft. wall height with domes bringing the total height to 58 ft. and with a capacity of 100,000 barrels.

S. L. Fultz was chairman of the meeting.

#### HAMILTON BRANCH

A. R. HANNAFORD, M.E.I.C. - *Secretary-Treasurer*  
W. E. BROWN, Jr.E.I.C. - *Branch News Editor*

The December meeting of the Branch was held at McMaster University on the 16th, with an attendance of 40. Since the meeting was to be one on tool steels, a Tool Steel Quiz was held prior to the meeting. This proved very interesting and the prize was won by a visitor, Mr. Trane.

T. S. Glover introduced the speaker, Mr. H. B. Chambers, metallurgist of Atlas Steels Limited, of Welland, Ont.

Mr. Chambers, in speaking on **Tool Steels for Engineers** explained that generally the engineer had a very poor conception of tool steels and their proper application.

Basically tool steel is a mixture of iron, carbon varying from 0.7 to 1½ per cent, silicon ¼ per cent for soundness of steel, and manganese ¼ per cent for workability. These are water-hardening steels and can be divided into four groupings, according to a 20 point carbon range, as follows:

1.30 to 1.50 carbon  
1.10 to 1.30 carbon  
0.90 to 1.10 carbon  
0.70 to 0.90 carbon

The higher carbon steels have a maximum of wear resistance and the lower carbon steels a maximum of toughness or resistance to shock load. It must always be remembered that as the resistance to wear is increased, the toughness of the steel must be sacrificed and vice-versa. The intermediate groups give a combination of these two properties.

But it is necessary to have tool steels which can be hardened without any appreciable change in section. Therefore, by the addition of chromium, molybdenum and in some cases manganese, the oil-hardening steels are obtained but still with same carbon range and groupings, so that the oil-hardening steels add four more groups.

But in applications such as forging or high speed lathe work the die or tool must resist heat. Therefore, there

arises the need for high speed tool steels or in other words, heat-resisting tool steels and these are obtained by the addition of tungsten and in some cases additional molybdenum. The same carbon range is maintained and thus four more main groups of tool steels are added to the available tool steels.

To recapitulate, we have:

Water-hardening steels—4 groups.

Oil-hardening steels—4 groups.

Heat-resisting steels—4 groups.

It should be remembered that each of these three classifications maintains the range from maximum wear resistance to maximum toughness. Thus the whole tool steel picture can be given in 12 groups.

Mr. Chambers also pointed out the dangers of poor die design, showing how the use of fillets and an attempt to keep dies of irregular cross-section to a balanced cross-section will avoid the strains and resultant cracks sometimes experienced in the heat-treating of dies.

Mr. Chambers went on to deal with some specific applications of tool steels and also answered many questions.

E. M. Coles moved the vote of thanks, expressing the appreciation of the meeting for the very clear picture of tool steels presented by the speaker.

The meeting adjourned for the usual refreshments.

### LAKEHEAD BRANCH

W. C. BYERS, M.E.I.C. - *Secretary-Treasurer*  
A. L. PIERCE, M.E.I.C. - *Branch News Editor*

The regular monthly meeting of the Lakehead Branch was held on Wednesday, November 19th, at 8 p.m. The members gathered at the new Shell Plant at Fort William for an inspection trip.

Later in the evening the members re-assembled at the New York Lunch in Fort William, where a short general meeting was held and lunch was served. The scheduled speaker of the evening, Mr. J. M. Paton, general manager of the Shell plant was unable to be present. In his absence, Mr. J. Heald, production manager of the plant, spoke a few words of welcome.

Mr. Krzywoblocki, a Polish engineer now resident at the Lakehead, attended the meeting and was warmly welcomed and invited to attend all future meetings of the Branch.

A short discussion took place during which some of the members expressed their pleasure upon having been given the opportunity of visiting the Shell plant. A vote of thanks from the membership was extended to Mr. J. M. Paton, who had made the visit possible.

The Lakehead Branch held its monthly meeting on December 3rd at the New York Lunch in Fort William. Following dinner, the members were shown two moving pictures. The first of these was the **Tacoma Narrows Bridge**. Mr. P. E. Doncaster, who had previously seen the film, then gave a few statistics regarding the structure and a lively discussion followed. A film called **Photo-elastic Stress Analysis**, filmed at the University of Manitoba, was next shown and was followed with a great deal of interest by the members. Mr. J. M. Fleming led the discussion which followed.

Both pictures were thoroughly enjoyed by the members and guests. Mr. G. R. Duncan was tendered an expression of thanks by the chairman for the use of his projector.

B. A. Culpeper, the chairman, presided. Thirty-nine members and guests were present.

### LONDON BRANCH

H. A. STEAD, M.E.I.C. - *Secretary-Treasurer*  
A. L. FURANNA, M.E.I.C. - *Branch News Editor*

On Wednesday, November 26th, the London Branch held its monthly meeting jointly with the Canadian Club to welcome The Engineering Institute's president, Dean C. J. Mackenzie. The meeting took the form of a dinner in the Crystal Ball Room of the Hotel London.

Introduced by Mr. H. F. Bennett, the president spoke on **Research and War**. Dean Mackenzie in his capacity as acting president of the National Research Council outlined the purpose, functions and organization of research in Canada at war.

As for the importance of research in war, he said, it need only be stated that it is highly endorsed by Major General A. G. L. McNaughton. Before the war, scientific work in Canada was well organized and the change-over from peace to war was made with high efficiency. He said that the purpose of research in war is to develop the equipment to be placed in the hands of the fighting forces. To give some idea of the vastness of this undertaking, it is only necessary to realize that one division carries power equipment totalling a capacity equal to that required by the city of Toronto.

Dean Mackenzie stated that in this war of mass production there are four distinct phases: development, design, tooling-up and training. But time is the predominating factor throughout, and this limits what can be done in research. While it is impossible to design new battleships or even big guns, much is being done in the middle-class projects such as small guns and improvements on aeroplane parts. However, most of the work is being done in the small appliance class including radio, medical apparatus and optical instruments. Thus there are three prime considerations in any problem. Is it scientifically sound? Is it tactically sound? Can you make it?

Organized research in Canada is carried out by the National Research Council. The most important function of this body is to coordinate and supervise research across the country. Originally there were no laboratories; however, there are now several laboratories in Ottawa.

Research is carried on under four classifications: mechanical engineering, electrical engineering, chemistry and biology with associate interests in medicine, field conservation and forestry. The Council has mobilized across Canada so that now there are 70 projects under study in 15 universities throughout the Dominion.

Constant liaison is maintained with England and the United States, the object being not to repeat any work already done elsewhere nor to do anything which cannot be carried through.

Finally, the president warned that we must do away with wishful thinking. This war will not be won by any miracle of science. We must be prepared to make real sacrifices and do away with petty criticisms. He said the reason we feel so futile about this war is that although we have been trying, we are not doing our best. Something is lacking—sacrifice.

After the meeting two tours were conducted. The first trip was to the Ordnance Mechanics Training School at Queens Park and was arranged by Lt.-Col. W. M. Veitch.

The second trip was to the Fleet Aircraft plant at Crumlin, under the direction of the architect, Mr. Loreen Oxley.

### MONCTON BRANCH

V. C. BLACKETT, M.E.I.C. - *Secretary-Treasurer*

**Centralized Traffic Control** was the subject of an address delivered before a branch meeting on November 28th, by R. M. Phinney, S.B., engineer of train operation, General Railway Signal Co., Rochester, N.Y. The meeting was open to the public and in addition to branch members, a large number of railway men were present. F. O. Condon, chairman of the branch, presided.

Mr. Phinney's paper dealt with the despatching of trains. He compared the present method of written train orders, time-table authority and hand-operated switches, with the newer mechanized system whereby trains move under the instruction of way-side signals, which together with the operation of important track switches are under the control of a single operator located in a central office. Mr. Phinney's remarks were illustrated with motion pictures.

A vote of thanks to the speaker was moved by T. H. Dickson and seconded by E. R. Evans.

#### SACKVILLE MEETING

On November 29th, the Moncton Branch combined with the Engineering Society of Mount Allison to hold a meeting in the Science building of the University at Sackville. There was a large attendance of engineering students together with members of the branch, and also of the technical staffs of the Robb Engineering Company and the Canadian Car and Foundry Company at Amherst. Laine Jamieson, president of the Engineering Society, was in the chair. The speaker was R. M. Phinney, who gave an illustrated address on **Centralized Traffic Control**. A vote of thanks was extended Mr. Phinney by Dean H. W. McKiel.

#### MONTREAL BRANCH

L. A. DUCHASTEL, M.E.I.C. - *Secretary Treasurer*  
G. G. WANLESS, JR.E.I.C. - *Branch News Editor*

Dr. R. R. Williams addressed the Montreal Branch on December 11th, on the subject of **The Chemical Descent of Man**.

Dr. Williams, who is Chemical Director of the Bell Telephone Laboratories, has specialized in the field of vitamin chemistry. He was born in 1886 at Rampatnam, India, where he had ample opportunity to become acquainted with the scourge of beriberi. After receiving his m.sc. degree from the University of Chicago in 1908, he returned to the far east and began work in the Bureau of Science at Manila on this same problem of beriberi. Not until 1933 did he succeed in isolating pure vitamin B<sub>1</sub> (thiamin) from rice polishings, and in proving that this was the specific substance whose absence from polished rice causes beriberi in oriental peoples. By 1936 he had accomplished the synthesis of thiamin. This great work was carried on, for the most part, in addition to his regular duties at the Bell Laboratories.

Although we seldom hear of beriberi in this hemisphere, moderate deficiency of B<sub>1</sub> in our diet can be responsible for an impairment of physical and mental efficiency. This is of especial interest to the armed forces. Dr. Williams has been awarded the Willard Gibbs medal for his brilliant work.

By comparing the behaviour of certain vitamins in the physiology of man, animals and plants, Dr. Williams was able to show how closely related are their basic living functions. Such examples are accepted as evidence in support of the theory of man's evolution. It is much more precise evidence than physical and character resemblances which formed the basis of Darwin's famous book of 1870. Some chemical illustrations of the interdependence and similarities of man, animals and plants are:—

(1) Plants synthesize carbon dioxide and water into starches, sugars and celluloses, which become the basic plant structures. Man and animals consume these products, producing energy and causing a reversion of the process.

(2) Exactly the same vitamins, amino-acids and other functional chemicals are found in man and other higher animals.

(3) It is of interest to note that the physiological behaviour of food and drug on man can be predicted from laboratory tests performed on animals.

(4) The hormones, stimulating agents of human endocrine glands, have the same effects on behaviour in other animals.

(5) The functioning of the nervous systems in men and animals are known to be actuated by electrical impulses, which resemble chemical chain reactions. Their temperature coefficients are the same as those of wired electrical circuits.

(6) All the vertebrates have similar visual systems which function by the reversible oxidation and reduction

of certain carotinoid pigments in conjunction with one of the vitamins. The light filters of chickens' eyes contain the same chlorophyll and xanthophyll found in the plant world, and vitamin A. Lack of this same vitamin contributes to night blindness in humans.

(7) The principal substances in the blood stream of man (haemoglobin) and that of the plant circulatory systems (chlorophyll) were shown to have comparable chemical space structures.

(8) Some evidence is reported which indicates that both man and animals exhibit some instinctive craving for vitamins in which their bodies may be deficient. It is now suspected that all of the vitamins may prove to be essential chemicals in plants and animals, as are the hormones in man.

Dr. Williams presented his complicated subject in clear and understandable terms. The broad interest of his engineer audience was indicated by the extensive discussion which followed. In moving the vote of thanks, Dr. Struthers paid tribute to the brilliant investigations of this world-renowned scientist.

Dr. Williams delivered a classical lecture, and it was a rare opportunity to hear it.

#### NIAGARA PENINSULA BRANCH

J. H. INGS, M.E.I.C. - *Secretary-Treasurer*  
C. G. CLINE, M.E.I.C. - *Branch News Editor*

A joint meeting of the Niagara Peninsula Branches of The Engineering Institute of Canada and the American Institute of Electrical Engineers was held on November 20th at the Welland House, St. Catharines, with an attendance of 60. Mr. A. L. McPhail, chairman of the local branch of The Engineering Institute, presided. Mr. Norman Franks introduced the speaker, Mr. J. W. Bateman, manager of the lighting service department of the Canadian General Electric Company Limited, whose subject was **Some Interesting Applications of Light, Ultra-Violet and Infra-Red Radiations**. Mr. Bateman had with him a large amount of electrical equipment with which he illustrated his subject in a most interesting manner. He also used lantern slides to show various types of lighting installations. The vote of thanks was proposed by Mr. George Morrison, chairman of the local branch of the American Institute of Electrical Engineers.

#### OTTAWA BRANCH

R. K. ODELL, M.E.I.C. - *Secretary-Treasurer*

At the noon luncheon on November 20, Commander H. N. Lay, R.C.N., Director, Operations Division, Naval Service Headquarters, Ottawa, addressed the Branch on **The Royal Canadian Navy**. He traced briefly the history of the Royal Canadian Navy from its inauspicious beginning in 1910 to its present importance as a vital part of Canada's war effort.

G. J. Desbarats, C.M.G., who was deputy minister of the Naval Service at the time of the Navy's inception, was at the head table. For this reason the Commander hesitated to go into details too deeply. "Mr. Desbarats would be able to correct me if I made a mistake" he said.

The commencement of the Canadian Navy dates from 1910 when the Canadian Government officially took over the Royal dockyards at Halifax and Esquimalt and purchased two fairly old cruisers, the *Niobe* and the *Rainbow*. The former was stationed in eastern waters and the latter in western waters. The next year the Royal Naval College was started at Halifax.

During the first great war the Navy did its part and in 1917 Halifax became the first convoy assembly point on this side of the Atlantic. In 1918, after the close of the war, the personnel was reduced from 6,000 officers and men to 1,000 and subsequent cries for economy reduced the number in 1923 to less than 400 officers and men with estimates at one time as low as two million dollars.

In 1928 the Navy began to be built up again so that at

the commencement of the present war there were six destroyers and four mine sweepers. Naval personnel totalled 1,700 which was soon stepped up to 20,000. This great increase was enlisted during the first few months of the war and taxed to the utmost the facilities of Halifax and Esquimalt.

Discipline in the Royal Canadian Navy and the Royal Australian Navy, stated the speaker, is patterned after that of the Royal Navy. Officers go to England for instruction and there obtain "wonderful experience."

Canadian shipyards started building and in 1940 undertook an extensive building programme. As convoys were started immediately war was declared some sort of ships had to be commissioned at once for anti-submarine work as a stop gap, such as converted yachts of 400 to 500 tons. Three *Prince* class liners were converted to auxiliary cruisers and have been very successful, serving and making captures all over the world. Canadian destroyers also assisted at the evacuation of Dunkerque.

The corvettes, he characterized as "marvellous little ships, by far the cheapest and quickest to build for use against submarines." Tremendous credit must be given to Canadian shipyards for the facility with which they can now turn them out. In the short period of eleven months, he said, they can be laid down, completed, do their trials, cross the Atlantic and be placed in commission against the enemy. Within the next month it is expected that from 30 to 40 ships of various categories will be accepted by the Royal Canadian Navy.

The Royal Canadian Navy has gone through 31 years of pretty doubtful existence, stated the Commander, and it is to be hoped that the service is firmly established. Canada can no longer entirely depend upon the British Government for protection. On account of her extensive sea-borne trade, as long as there are any foreign navies in existence that might attack this traffic, there must be a Canadian Navy, he declared.

A talk on **Air Co-operation** was given at the noon luncheon of the Ottawa Branch at the Chateau Laurier on December 4. Squadron Leader W. W. Ross of the R.C.A.F., commanding the School of Army Co-operation and stationed at Rockcliffe, was the speaker. Chairman of the Branch, T. A. McElhanney presided.

Operations in modern warfare often call for the closest kind of co-operation between units of the army, the navy, and the air force, with the last-mentioned occupying a most important place in that co-operation. The speaker outlined the manner in which such co-operation may be maintained. He stated that the present-day pilot, whether engaged in fighter, bomber, reconnaissance or army co-operation manoeuvres must have plenty of initiative and self confidence. Frequently they are definitely on their own when the success of the job in hand is entirely up to the individual.

Squadron Leader Ross went over to England in February, 1940, with the 110 Army Co-operation Squadron, went through the September attack of that year and returned to Canada in March, 1941. "I really had a grandstand seat at the blitzkrieg on London," he commented, referring to a visit he made to that city while on leave during which time enemy attacks were at their worst.

He paid tribute to the remarkable bravery exhibited during these attacks by the English population. "Just about the bravest thing that I ever saw" he stated, "was the manner in which two young girls drove an ambulance through the burning city of London one night when the enemy really tried to set it on fire. They rumbled over the rubble of the streets, picking up the casualties here and there whenever they heard anyone yelling for help. Before the night was over the cover of their ambulance was burned away but they thought nothing of that and simply took it all in their stride. I undertook to assist them and accompanied them for several hours although I did not even learn their names. I am willing to admit that all the time I was with them I was just about scared to death."

## PETERBOROUGH BRANCH

D. J. EMERY, M.E.I.C. - *Secretary-Treasurer*  
E. WHITELEY, Jr. E.I.C. - *Branch News Editor*

The twenty-third Annual Dinner of the Peterborough Branch was held at the Kawartha Club on November 19th, and was attended by about ninety engineers. The meeting was addressed by four notables of the engineering world in the persons of Dean C. J. Mackenzie, president of The Institute and acting president of the National Research Council of Canada; K. M. Cameron, Vice-President of The Institute and Chief Engineer of the Department of Public Works, Ottawa; deGaspé Beaubien, Vice-President of The Institute, Joint National Chairman for War Savings, and Consulting Engineer, Montreal, and L. Austin Wright, General Secretary of The Institute, Montreal, and Assistant Director of the Wartime Bureau of Technical Personnel, Ottawa.

The theme carried throughout the addresses urged engineers to make plans now to avoid post-war dislocations. It is becoming apparent that engineers must face a two-fold challenge—to win the war, and to organize a plan to avoid its aftermath of destructive dislocation.

The first appeal to make this a total war came from L. Austin Wright. He claimed it was the duty of the engineers of Canada to give leadership on the subject of air-raid precaution work, and, he added, with this in view,



The Headquarters party. President Mackenzie, Vice-Presidents Cameron and Beaubien, and General-Secretary Wright.

arrangements had been completed to send a competent engineer to Britain to study and investigate the work being done, that is from a structural and engineering standpoint, and to report back at the annual meeting to be held next February. The study will include defence from bombs, repairs from damage, restoration of public utilities, and the many other phases of this work.

Mr. Wright said The Institute was in a healthy condition, both in membership and financially, but, he added, the war had brought manifold problems.

He spoke, too, of the problems of the Wartime Bureau of Technical Personnel, and explained that an attempt was being made to catalogue and organize the engineers of Canada so that they would be able to tackle every problem in all fields of engineering during the war.

The second appeal to organize and avoid post-war dislocation and depression came from G. R. Langley, chief engineer at the local plant of the Canadian General Electric Company, Limited.

"This is an appeal for action on a matter that vitally concerns everyone in Canada. No one here to-night would dispute that our job is to win the war. Too many of us, however, think of this job solely as a matter of production of tanks, ships and guns, the training of men and the complete defeat of Hitler and his armies. We can win that



The scenic entry of the roast. From right to left: the carvers are G. R. Langley, S. O. Shields, A. L. Killaly, D. A. Drynan and V. S. Foster. Seated are R. L. Dobbin, H. E. Brandon, W. E. Ross, Colonel LeR. F. Grant.



W. E. Ross (Toronto), J. E. Girven, A. E. Berry (Toronto) and M. H. Smith.



A. L. Killaly carves the roast.



Above: T. E. Gilchrist and H. R. Sills.



At left: Chairman J. Cameron presents his report.



The head table. From left to right: G. R. Langley, President C. J. Mackenzie, Chairman J. Cameron, Vice-president K. M. Cameron, Councillor Dr. A. E. Berry and Vice-President de Gaspé Beaubien. In front, J. E. Girven.



From left to right: Miss N. Brown, Mr. A. M. McQuarrie, Misses J. Forest, E. Newman and E. Rabkin; Messrs. S. Barkell and G. R. Langley.

phase of the war and still meet defeat if we fail to adequately plan to avoid post war dislocations that may destroy the things we are really fighting for, our standards of culture, and living and our democratic institutions.

"At the close of hostilities, Canada will probably have her wealth-producing facilities (factory building and machinery, transportation, power supply, mines, farms, forests, and trained personnel) in better shape than ever before in her history, most of them not merely unimpaired by the war effort, but actually improved. There is no theoretical or practical reason why these facilities cannot be used to give a higher standard of living for everyone, than has ever been reached in the past. This happy result can only be achieved by adequate planning. Lacking such planning there is good reason to fear a business recession of terrific proportions."

A stirring appeal for more support in the form of War Savings Certificates, coupled with the assurance that the citizens of Quebec are striving with all Canada for a national unity and an early peace through victory, was brought to members of the Branch by deGaspé Beaubien.

"You need not worry about the great race I represent, when you think of national unity. If we can get Quebec to know the other provinces better, and the other provinces to know Quebec as she is, then everything will be better."

"The great task ahead of us will require more production, and greater production requires money. More War Savings Certificates must be sold, and I would urge that you renew your effort if at all possible, and this appeal comes from your country."

The guest speaker of the evening, Dean C. J. Mackenzie, was introduced by Hubert R. Sills of the Peterborough Branch.

Dean Mackenzie spoke on the part scientific workers are playing in this war and he prefaced his talk with a few remarks to show the great difference in the World War I of 1914-18 and the present struggle. For example, he stated that one division alone has 500,000 horse power, as much as is used in the city of Toronto.

"Our science and technology was adequate when this war began, but we lacked quantity of war weapons. What we had was of good quality, but we had little. In 1916 the National Research Council had been formed and it has gone on ever since in a modest way.

"To-day, this Research Council is in high gear with four branches, and 30 associate committees, of these latter the one perhaps making the greatest progress is the committee engaged in medical research.

"Our job is to co-operate, co-ordinate and stimulate the country's effort towards winning the war."

Jack Cameron, president of the branch, was chairman during the dinner meeting, which was attended by 90 people including engineers from Hamilton, Toronto, Ottawa and Montreal, and also including ten girls, graduates of different universities who are being trained as inspectors at the C.G.E. plant. The thanks of the gathering to the speakers was voiced by Stanley O. Shields, of the branch. Entertainment was provided by Rex Slocombe of Toronto, a magician and a musician.

### SAINT JOHN BRANCH

V. S. CHESTNUT, M.E.I.C. - *Secretary-Treasurer*

Thirty-three members and guests attended a supper meeting of the Saint John Branch held in the Admiral Beatty Hotel on Thursday, December 11th. The Branch chairman, F. A. Patriquen, presided. Mr. C. C. Kirby reported that the professional engineers of the province voted strongly in favour of co-operation with The Engineering Institute. Mr. Kirby also outlined the progress being made in the formation of a Demolition Committee for the city of Saint John and in which the Saint John Branch is taking such a leading part.

Mr. G. W. Berry, Saint John manager of Ford Company of Canada, Ltd., the guest speaker of the evening, was

introduced by the chairman, Mr. Patriquen. Mr. Berry outlined to his audience the vast strides made in Canada's industrial contribution to the war effort. In the last war, an infantry battalion unopposed by the enemy could travel fifteen miles per day, while to-day the same battalion could travel 150-200 miles in the same period. There is more horse power in an armoured division of to-day than in the whole of the maritime provinces. The motor car industry of Canada had naturally specialized in army trucks and carriers of all kinds, and had supplied thousands of these machines to numerous battlefronts of the world. If necessary, Canada could supply 25,000 of these machines per month.

In the field of tanks, Canada was building the light infantry and the medium cruiser tank. An additional fighting unit, the light destroyer tank, is still in the hands of the designers.

At the conclusion of his address, Mr. Berry showed films outlining the manufacture and testing of the equipment manufactured at the Ford plant. From these tests it was apparent that any defects would be discovered before export to the various fields of battle and that Canada should be proud of the equipment she is supplying in "providing the tools to finish the job."

### ST. MAURICE VALLEY BRANCH

C. G. DE TONNANCOUR, S.E.I.C. - *Secretary-Treasurer*

The fall activities of the branch were resumed on September 4th when the branch and the Shawinigan Chemical Association were invited to participate in a joint dinner meeting sponsored by the Canadian Club, at the Cascade Inn.

The guest speaker was Sir W. Lawrence Brogg, noted for his work on X-ray analysis of crystal structure, and one of the world's leading scientists, specializing in the structure of metals.

Sir Lawrence, acting in Canada as liaison officer with the National Research Council, spoke on **Canadians are British Scientists in the War.**

The meeting was very well attended, and the Canadian Club must be thanked for the initiative in sharing their distinguished guest with the engineers and the chemists.

Sir Lawrence stressed the evident preparedness of Germany long before the invasion of Poland and explained by means of examples the part played by chemists and



Mr. George Long speaks to the St. Maurice Valley Branch. Next to him are Chairman A. H. Heatley and H. G. Timmis.

physicists in gearing British industries to war production; he mentioned that their contribution was more on solving the problems of development and expansion of known processes than on last minute inventions.

The next event was a dinner meeting at the Château de Blois, in Trois-Rivières, presided over by Dr. H. Heatley, branch chairman. Mr. George Long, historian of the Bell Telephone Company of Canada, spoke on **Wartime Communications**. Amidst an impressive array of electrical equipment illustrating the development of the telephone from A. Graham Bell to our times, Mr. Long gave his audience a vivid picture of the part played by the Bell Laboratories, the Bell network and equipment manufacturers in World Wars I and II. Mr. Long was presented by Mr. J. M. Mitchell, and thanked by Mr. H. G. Timmis.

On November 3rd, at the Laurentide Inn, in Grand'Mère, Mr. Jean Flahault, S.E.I.C., made a successful escape from work at Arvida to address the branch on **Some Engineering Aspects of the German Army**, gathered from his personal experience with the Germans in France, his capture and subsequent escape to Canada. Mr. Flahault submitted willingly to a bombardment of questions and ended by giving the World War I veterans among his audience an eagerness to be "over there" once more, not to talk of the younger members' reaction. Mr. Flahault was introduced by Mr. Alphonse Trudel, and thanked by Mr. R. Dorion.

### SAGUENAY BRANCH

D. S. ESTABROOKS, M.E.I.C. - *Secretary-Treasurer*  
J. P. ESTABROOK, JR., E.I.C. - *Branch News Editor*

A meeting of the Saguenay Branch of The Institute was held on Tuesday, November 25th, in the Arvida school.

Previous to hearing the guest speaker on this occasion, the members were shown a film depicting the placing of the "obelisk," used to turn the water into the diversion canal of the present Chute-à-Caron power development. The "obelisk" was a concrete structure in the shape of a block 40 ft. square in cross-section and 92 ft. long made to fit the contour of the river bed and first supported in an almost upright position by a thin concrete column, placed to prevent it from tipping. When all was ready this thin column was blasted away and the massive obelisk fell into place in the river, leaving an eight foot gap at each end that was later sealed with stop logs. By means of instruments used to study the fall, it was learned that 99.6 per cent. of the energy had been absorbed by the water.

The speaker, Mr. C. D. McCoy of the refining division of the Foster Wheeler Corp., New York City, was introduced by our chairman, Mr. N. F. McCaghey.

Choosing as his topic, **The General Principles of Petroleum Refining**, Mr. McCoy first dwelt on the various products available from crude petroleum: toluene, acetone, alcohols, rubber, ammonia, and hydrogen, later stressing the part played in the war by lubricants and high octane gasoline. In a review of Canadian production facilities, the Athabaska oil shales were mentioned and also the fact that Canadian refineries have five times the capacity that would be required if they were handling only Canadian crude.

The refining of petroleum is essentially a distillation process with a fractionating action enabling the operators to obtain the different grades of distillate at definite levels in the fractionating tower.

The exact treatment depends on the type of crude being treated and each refinery has its own characteristic operations. However, the general design of the equipment used is similar. The crude oil is preheated, enters the tubes of a furnace and thence goes to the bubble tower where fractionation takes place. Gasoline vapours are taken off overhead and naphtha, kerosene and fuel oils, etc., at a lower level. Wax distillate is drawn off at the bottom. Other special equipment such as stripping columns and coke units enter the process.

As gasoline is now the most useful constituent, the present policy is to increase this cut as much as possible. This is done by cracking and polymerization of the heavy fraction and the lighter gaseous fractions respectively.

Catalytic hydrogenation, using an aluminum chloride catalyst is playing its part in this aim to produce more gasoline.

In conclusion, Mr. McCoy explained the use of the octane rating system and the importance of high octane gasoline in our present day world. The keen interest aroused by the speaker was shown by the large number of questions that followed in the discussion period.

### SASKATCHEWAN BRANCH

STEWART YOUNG, M.E.I.C. - *Secretary-Treasurer*

A meeting of the Saskatchewan Branch was held in the Kitchener Hotel, Regina, on November 21st, jointly with the Association of Professional Engineers and the Saskatchewan Section of the American Institute of Electrical Engineering. The attendance was 45.

For a short period after dinner the meeting was conducted as a meeting of the Association of Professional Engineers to consider certain proposed amendments to the by-laws. These were put to a vote and adopted.

Mr. H. I. Nicholl called attention to the departure for Bolivia in the near future of one of our members, Mr. L. M. Howe, active during the past several months on the papers and meetings committee. Mr. Howe replied in a few appropriate words.

The showing of a two-reel silent film, the **Tacoma Narrows Bridge**, occupied the balance of the evening and proved of more than usual interest.

### SAULT STE. MARIE BRANCH

O. A. EVANS, M.E.I.C. - *Secretary-Treasurer*

The sixth general meeting for the year 1941 was held in the Grill Room of the Windsor Hotel on Friday, November 28th, 1941. Nineteen members and guests sat down to dinner at 6.45 p.m.

The chairman called upon David L. Mekeel, Steel Mill Consultant, to address the meeting. Mr. Mekeel had for his topic **The Steel Industry**.

The speaker dealt with the steel industry from its birth as small isolated furnaces to the present gigantic groupings in strategic centres. He also sketched briefly the rise of the American steel industry. The first cargo of ore that was shipped from the Lake Superior Mines was in the 1850's. Not much hope was held at that time for the iron mines of the lake district. The speaker held the interest of the audience with stories on the human side of the steel industry, relating the personal touch that men such as Bessemer, Jones, Carnegie, Schwab have given to the industry. The speaker then gave a brief review of the steel industry in Canada, paying particular emphasis to the Algoma Steel Corporation and its possibilities.

At the conclusion of his speech the meeting was thrown open for discussion. The speaker was deluged with a flood of questions on all phases of the industry. The discussion kept up for quite some time.

A. E. Pickering moved a vote of thanks to the speaker, H. W. Adams seconded it.

The annual meeting for the year 1941 was held in the Grill Room of the Windsor Hotel at 6.45 p.m. on Friday, December 12, 1941. Twenty-one members and guests sat down to dinner.

The business portion of the meeting began at 8.00 p.m. with L. R. Brown, vice-chairman, presiding.

The secretary presented his report. The highlights were a successful year as regards papers and meetings but a loss of membership and a financial loss of \$36.27. J. L. Lang, M.E.I.C., and G. W. MacLeod, M.E.I.C., moved that the secretary's report be adopted.

The chairmen of the various committees then brought in their reports. They were as follows:

N. C. Cowie, Junior Engineers' Committee;  
R. A. Campbell, Legislation and Remuneration;  
A. E. Pickering, Papers and Publicity;  
J. L. Lang, Entertainment;  
A. M. Wilson, Membership.

A. E. Pickering paid tribute to J. S. Macleod, the chairman of the Papers Committee, who was absent from the meeting but had done splendid work throughout the year. A. M. Wilson told the branch that there was a great field for the incoming membership committee, as many engineers were moving into town.

A. H. Meldrum and N. C. Cowie were then appointed auditors for the year 1941 on motion of R. S. McCormick and C. Stenbol.

Before accepting the chair for the year, L. R. Brown called for further nominations. After some time G. W. MacLeod and A. M. Wilson moved that nominations be closed. The chairman then called for co-operation for the year 1942.

The chairman then called upon F. W. Fraser to give a short summary on the causes of the failure of the Tacoma Bridge, which was done in a very capable manner, G. W. MacLeod acted as the projectionist for the film. The rest of the evening was spent in a social way.

### TORONTO BRANCH

J. J. SPENCE, M.E.I.C. - *Secretary-Treasurer*  
D. FORGAN, M.E.I.C. - *Branch News Editor*

On November 29th the Toronto Branch of The Engineering Institute participated in a joint meeting with the Royal Canadian Institute in Convocation Hall to hear Dr. H. Ries, A.M.Ph.D., professor of geology, Cornell University, present his views on **What Use the Engineer Makes of Geology**.

The branch chairman, Mr. H. E. Brandon, following the chairman of the R.C.I., welcomed the speaker on behalf of The Engineering Institute, a considerable number of our members attending.

Professor Ries' lecture was profusely illustrated with lantern slides and motion pictures of his own taking. His references to the part which the geologist should play in the siting and design of engineering structures and the use which engineers have made of such available knowledge and experience, were provocative of considerable comment and given proper appreciation by those engineers fortunate enough to hear them.

The regular meeting of the branch was held in the theatre of the Royal Ontario Museum at 8.00 p.m. on December 4th. It had been felt that the subject for the evening was of sufficiently wide and popular interest to warrant the branch engaging this accommodation, and inviting the public and other interested organizations. These expectations were fully realized, some 350 people attending the meeting. All expressed opinion testified to the very great general interest which the meeting held, and it was felt that the evening's programme more than maintained the high level which has characterized the branch meetings this season. It is impossible to escape the conclusion that even a few meetings of this type, presented where the general public could share in them, would do much to further the standing and usefulness of the engineering societies.

The subject of the meeting was **Conservation of Natural Resources, with Special Reference to Post-War Planning**. In his opening remarks the branch chairman, Mr. H. E. Brandon, pointed to the steadily mounting public interest in the subject, which though frequently thought of as being associated with tree planting, wild life, and soil erosion, actually is a matter which intimately affects many more phases of life and community activities. Many activities of the engineer are affected and so the interest of the engineer in conservation is important. The chairman welcomed those members of other bodies present, among

whom were: the Ontario Federation of Naturalists; the Southern Ontario Section of the Canadian Society of Forest Engineers; the Toronto Field Naturalists Club; the Society of Biologists, Toronto Branch; the Toronto Hunters' and Anglers' Association; the Toronto Branch of the Canadian Society of Scientific Agriculturists.

The programme was conducted by Mr. R. F. Legget, assistant professor of civil engineering, University of Toronto, to whose efforts much of the success of the meeting was due. Three speakers participated, each one an authority on his particular phase of the subject. As each took up his theme he was introduced by Professor Legget who briefly outlined the field to be covered. The first speaker was Mr. F. A. MacDougall, Deputy Minister of Lands and Forests for Ontario, who presented a comprehensive illustrated talk on the **Forests and Drainage Areas of Ontario**. The second speaker, Professor A. F. Coventry, department of biology, University of Toronto, spoke on the **Water Situation in Southern Ontario**. His lecture, also illustrated, was most startling and effective in the information he presented, and vividly drew attention to the effect of indiscriminate clearing and drainage, and the consequent serious results on farming operations in southern Ontario.

Dr. A. E. Berry, chief sanitary engineer, Ontario Department of Health, followed. He spoke on **Public Health in Ontario** and its relation to conservation and, illustrating his lecture with numerous slides, forcefully brought before the audience the effects of floods and droughts on the nation's health problem.

The fourth item on the programme was a documentary film entitled **The River**. Kindly loaned by the United States Soil Conservation Service, the film deals with the Mississippi River, what it has done and what man has done to it. It depicts vividly the vital part that this river has played in the development of the United States and shows how man, by abusing natural conditions, has in many cases turned the river from a natural blessing into an uncontrollable menace. It goes one step further and points out how through agricultural practices and engineering projects, which in themselves are beneficial to the country as a whole, control of the river can be regained. It is a conscious attempt to present a fundamental problem so factually and so dramatically that those who see the picture will be moved to action. The film was a fitting climax to the three addresses, and left everyone in the meeting faced with the impression that something must be done before it is too late, if it is not already so, to preserve the natural resources of our Dominion, especially the part each one lives in.

On Monday, December 8th, as arranged by the Institute of Radio Engineers, Toronto Section, a joint meeting was held in the Physics Building of the University of Toronto of the following societies: Institute of Radio Engineers (Toronto Section); Engineering Institute of Canada (Toronto Branch); Illuminating Engineering Society (Toronto Chapter); American Institute of Electrical Engineers (Toronto Section).

The speaker, Mr. Harris Reinhardt of the Hygrade Sylvania Corporation of Salem, Mass., gave to the meeting a wealth of information on **Fluorescent Lighting and Equipment** well demonstrated by slides and apparatus. There was keen interest shown by all engineers in this well-delivered address on a comparatively new development in lighting practice.

About 350 engineers were present.

### WINNIPEG BRANCH

C. P. HALTAIN, M.E.I.C. - *Secretary-Treasurer*  
T. A. LINDSAY, M.E.I.C. - *Branch News Editor*

On November 6th, one hundred and three members of the Winnipeg Branch visited the offices and repair base of Trans-Canada Air Lines at Stevenson Field. Mr. J. T. Dymont, Chief Engineer of T.C.A., addressed the gathering and outlined the functions of the various specialized shops

which comprise the repair base. He also described the various aircraft used by the system and gave an interesting comparison of their performance characteristics.

Trans-Canada Air Lines maintains a fleet of twenty Lockheed twin-engined aircraft, six of which are Lockheed 18's. These ships have seating accommodation for 14 passengers, and can carry a total load of 5,500 lb. The Lockheed 14, of which T.C.A. has twelve in operation, carries ten passengers, and the same total load as the 18, but its maximum speed is only 244 m.p.h. as compared with 263 m.p.h. for the larger ship.

Mr. Dymont gave some very interesting figures on air system transportation. During the month of September, T.C.A. carried an average of 305 passengers daily, an average distance of 499.5 miles each. In the same period 99.3 per cent. of all scheduled flights were made. This fact alone speaks for the efficiency of the organization when one considers that the T.C.A. fleet flies 20,500 miles per day.

At the conclusion of Mr. Dymont's remarks, the membership inspected the shops and hangars of the base, under the guidance of T.C.A. personnel.

The Repair Base has fourteen shops, fully equipped to handle all the multitudinous details connected with the maintenance and operation of one of the world's finest airlines. Of particular interest to the members was the instrument repair shop, and the engine testing shop.

The inspection over, members of the branch adjourned to the recreation room where refreshments were served through the courtesy of T.C.A.

On November 20th the Winnipeg Branch met in the business offices of the City of Winnipeg Hydro-Electric System.

Gathering figures, printing bills and keeping accounts by punching holes in cards was the theme of an address given by Mr. F. J. Malby, Business Manager. Analysis of

electric sales to produce the revenue in each class of business, the number of minimum bills, empty houses, water heaters of different sizes and whether in use or not, the electric consumption in homes of different sizes, average rates, etc., are just a few samples of the mass of detailed information obtainable from the electric tabulation of punched cards. These cards are also used to automatically print the customers bills and finally are used as a ledger card system. Although there are 80 columns of figures on the card, only approximately 15 holes have to be manually punched thus reducing the possibility of error to a minimum. All the other holes are either automatically pre-punched from the previous month's card, where standard information is transferred or from master cards which represent every possible bill that is sent out. The latter is based on the fact that all persons using the same amount of electricity under the same base rate will have identical bills.

The master card is sorted into the groups with the same consumption and automatically reproduces the figures for the complete bill on all cards following. The key to the whole electric tabulating system is the sorting machine which separates the cards into their respective groups by electric contact through the hole punched for code purposes. During Mr. Malby's talk, the card punching and sorting machines were demonstrated, and finally the members present spent a considerable time watching and marvelling at the intricacies of the various machines. Moving picture films showing the same machines handling 30 million cards for the United States Social Security Act were exhibited. During his address the speaker paid tribute to the engineering profession for their contribution to the emancipation of office workers, by removing the drudgery from accounting, through the scientific application of machine methods. A very educational and entertaining meeting was closed with the serving of a buffet supper.

## News of Other Societies *(Continued from page 47)*

After the war, he graduated from Victoria University in Theology and the University of Toronto in Social Science. He had done considerable lecturing in Canada, United States and Germany. He is a very pleasing speaker and has a real message for the members of the Association.

The General Meeting of the Association will be held at the Royal York Hotel, Toronto, on Saturday afternoon, January 17th, 1942, at 2.30 p.m. (D.S.T.) The dinner will be held at 7 p.m. (D.S.T.) in the Roof Garden, Royal York Hotel. Reception for members at 6.30 p.m.

### ANNUAL DINNER OF U. OF T. ENGINEERING ALUMNI

The Annual Meeting of the Engineering Alumni of the University of Toronto took place on November 26th. As usual, the graduating class was featured, and H. E. Wingfield, president of the Alumni, presented the traditional gavel to J. P. D. Rogers, president of the class. Another interesting feature was the presentation of a life membership to Dr. J. L. Morris, the first graduate of the "School,"

who is now celebrating the sixtieth anniversary of his graduation.

Similar "Toike Oike" nights were held in many cities from coast to coast, and telegraphic greetings from all of them were read to the meeting by M. B. Hastings, vice-president of the Engineering Alumni and president of the University of Toronto Alumni Federation.



One side of a table of distinguished graduates. From left to right: Professor Treadgold, Professor Haultain and past-president Dr. T. H. Hogg.



The speaker of the evening was C. R. Young, Dean of Engineering, and president-elect of The Engineering Institute.

The special guest and speaker of the evening was C. R. Young, recently appointed Dean of Engineering at Toronto. Dean Young reported that this year's registration in engineering had made a new record—1,148 students, and over four hundred in the freshman year.

Referring to the recent survey made at Toronto, the speaker pointed out changes in the curriculum which had been made, based on the recommendation of the report. Now 83 per cent of first year time is spent in studies common to all departments. Class room hours have been reduced to 33 a week, and instruction in English and economics has been doubled.

Dean Young spoke of the decision to continue the work at the professional level, although because of the war, proposals had been made to offer courses of a technical type. He thought this work could be done better by the secondary schools.

He also referred to the possibility of shortening courses to hasten graduation, in order to meet the demands of the active service forces and industry. The Wartime Bureau of Technical Personnel, after an investigation, had advised that teaching should be carried on as normally as possible, at least for the present, and the university was following this course.

He asked for the assistance of graduates in establishing prizes and scholarships particularly for post-graduate work, and in obtaining additional accommodation for the greatly expanded enrolment.

H. E. Wingfield, M.E.I.C., president, was chairman. The speaker was introduced by Dr. Cody, president of the University, and was thanked by Austin Wright, M.E.I.C., Ross Robertson, M.E.I.C., immediate past-president, pre-

sented the fourth year men to the chairman. An interesting feature was the regular news commentary of Wilson Woodside, which was broadcast from the head table. Mr. Woodside is a graduate of the "School." About 450 were in attendance.



President H. E. Wingfield, M.E.I.C., presents a Life Membership to Dr. J. L. Morris, M.E.I.C., the first graduate.

## Library Notes

### ADDITIONS TO THE LIBRARY

#### TECHNICAL BOOKS

##### Hydraulics:

4th ed., by Horace W. King, Chester O. Wisler and James G. Woodburn. N.Y., John Wiley and Sons, Inc., 1941. 6 x 9 1/4 in. \$2.75.

##### Hydraulics of Steady Flow in Open Channels

By Sherman M. Woodward and Chesley J. Posey, N.Y., John Wiley and Sons, Inc., 1941. 6 x 9 1/4 in. \$2.75.

#### PROCEEDINGS

##### Society for the Promotion of Engineering Education:

Proceedings of the 48th Annual Meeting held in June, 1940, and papers, reports, discussions, etc., printed in the Journal of Engineering Education, Vol. 31, 1940-41. Office of the Secretary, Pittsburgh, Pa., 1941.

#### REPORTS

##### Smithsonian Institution:

Annual report of the Board of Regents for the year ending June 30, 1940. Wash., U.S. Govt. Printing Office, 1941. \$1.50 (cloth cover).

##### Canada, Bureau of Statistics:

Census of the Prairie Provinces, 1936, Vol. 1: Population and Agriculture; Vol. 2 Occupations, unemployment, earnings and employment, households and families. Ottawa, 1938. \$1.00 per Vol.

##### U.S. Bureau of Standards:

Buildings Materials and Structures—Report BMS76—Effect of outdoor exposure on the water permeability of masonry walls. Report BMS77—Properties and performance of fiber tile boards.

### Book notes, Additions to the Library of the Engineering Institute, Reviews of New Books and Publications

##### U.S. Bureau of Standards:

Handbook H26, supersedes Handbook H11; Weights and Measures. Administration by Ralph W. Smith. Issued August 29, 1941. Wash., U.S. Government Printing Office, 1941. 75 cents.

##### Canadian Government Purchasing Standards Committee—Specifications:

Paste floor wax, No. 1-GP-18; Emergency specifications for paste floor wax, No. 1-GP-13e; Exterior varnish, No. 1-GP-18; Varnish vehicle for aluminium paint (type 3 for high temperature use), No. 1-GP-21; Aviation fuel, No. 3-GP-5.

##### American Society for Testing Materials:

Index to A.S.T.M. standards including tentative standards. Free on written request to the Society, 260 Broad St., Phil., Pa.

##### Ontario, Association of Professional Engineers:

Act of incorporation; by-laws; code of ethics; list of members as of November, 1941.

##### Electrochemical Society—Preprint:

X-ray studies of storage battery pastes. Preprint 81-1.

##### American Institute of Steel Construction:

Annual report for the year ending September, 1941.

##### Quebec, La Commission des Eaux Courantes:

Vingt-cinquième rapport, 1936. Published 1941.

##### Canada, Department of Labour:

30th annual report on labour organization in Canada for the year 1940. Ottawa, 1941. 50 cents.

##### U.S. Department of the Interior—Geological Survey Bulletins:

Subsurface geology and oil and gas resources of Osage County, Oklahoma pt. 7, 8, 9-900-G,H,I; Past lode-gold production from Alaska, 917-C; Geology and oil and coal resources of the region south of Cody, Park County, Wyoming, 921-B; Tin-bearing pegmatites of the Tinton District, Lawrence County, South Dakota, 922-T; Geophysical abstracts 103, October-December, 1940, 925-D; Superposition in the interpretation of two-layer earth-resistivity curves, 927-A; Geophysical abstracts 104, January-March, 1941, 932-A.

##### U.S. Department of the Interior—Geological Survey Professional Papers:

Transgressive and regressive cretaceous deposits in Southern San Juan Basin, New Mexico, 193-F; Titanium deposits of Nelson and Amherst Counties, Virginia, 198.

##### U.S. Department of the Interior—Geological Survey Water-Supply Papers:

Geology and Ground Water resources of the Balnearia Area Western Texas, 849-C; Underground leakage from Artesian Wells in the Las Vegas area, Nevada, 849-D; Geology of Dam Sites on the Upper tributaries of the Columbia River in Idaho and Montana, 866-A; Investigations of methods and equipment used in stream gaging, 2 parts, 868A and B. Surface water supply of the United States 1939; pt. 1 North Atlantic slope basins, 871.

##### Province of Quebec—Bureau of Mines—Geological Report:

Hallivell mine map-area by G. S. MacKenzie, report No. 7; Eustis-Mine area Ascot township by G. Vibert Douglas report Na. 8.

**Canada, Department of Mines and Resources—Geological Survey:**

*Palaeozoic geology of the Brantford area, Ontario*, by J. F. Caley, *Memoir No. 226*; *Jacquet River and Tetagouche River map-areas, New Brunswick* by F. J. Alcock, *Memoir No. 227*; *Mineral industry of the Northwest Territories* by C. S. Lord, *Memoir No. 230*; *Bousquet-Joannes area, Quebec*, by H. C. Gunning, *Memoir No. 231*; *Mining industry of Yukon, 1939 and 1940* by H. S. Bostock, *Memoir No. 234*.

**BOOK NOTES**

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet the books are not in The Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

**AMERICAN MINERS' ASSOCIATION**

By E. A. Wieck. *Russell Sage Foundation, New York, 1940. 330 pp., illus., 9½ x 6½ in., cloth, \$2.00.*

A record of the origin of coal miners' unions in the United States is presented in this volume. The two main sections deal respectively with the origin and backgrounds and with the development of organization. A large section containing contemporary records is appended, and there is a bibliography.

**ANYBODY'S GOLD, The Story of California's Mining Towns**

By J. H. Jackson. *D. Appleton-Century Co., New York and London, 1941. 467 pp., illus., 9 x 6½ in., cloth, \$5.00.*

In narrative form, the author tells first of the California gold rush, with special emphasis on the life of the usual miner, but highlighted with tales of the more colorful personalities. The second section of the book deals with the mining towns as they are to-day, many of which are now merely ghost towns. In this manner the absorbing history of the earlier days is continued into the present. The drawings of these towns as they are to-day, by E. H. Suydam, are most attractive.

**BUILDING INSULATION**

By P. D. Close. *American Technical Society, Chicago, Ill., 1941. 238 pp., illus., diags., charts, tables, 8½ x 5½ in., cloth, \$3.00.*

The principles and applications of insulation are described as used to retard heat losses and heat gains, and to guard against fire, sound, vibration and condensation in buildings. Considerable reference data and many practical examples of calculation procedures are included. A set of review questions is appended.

**DIFFUSION IN AND THROUGH SOLIDS**

By R. M. Barrer. *Macmillan Co., New York; University Press, Cambridge, England, 1941. 464 pp., illus., diags., charts, tables, 9 x 5½ in., cloth, \$6.50.*

This book presents a study of the permeability of materials to solutes, and of the diffusion constants of solutes within them. The author's aims are: to keep a balance between experimental methods and their mathematical and physical interpretations; to provide lists of permeability and diffusion constants for ready reference; and to outline current theories of processes of permeation, solution and diffusion.

**ELECTRICITY AND MAGNETISM, Theory and Applications**

By N. E. Gilbert, rev. ed. *Macmillan Co., New York, 1941, 585 pp., diags., charts, tables, 8½ x 5½ in., cloth, \$4.50.*

Fundamental principles are covered in this textbook for non-technical students, with illustrative applications to engineering and to appliances in common use. Not intended as an

introduction to electrical engineering or an exposition of the mathematical theory of electricity, the book simply presents a thorough survey of the topics considered, with physics in the foreground.

**FIRE ENGINEERING HYDRAULICS**

By G. O. Stephenson. *Emmott & Co., Ltd., Manchester and London, England, 1941. 20 pp., illus., charts, 7½ x 5 in., paper, 1s.*

This little pamphlet contains graphic charts from which can be quickly obtained the discharge from nozzles, the loss of pressure because of friction in hose, and the height and reach of jets. These charts are based on John R. Freeman's experiments.

**FLIGHT, Aircraft Engines, a General Survey of Fundamentals of Aviation**

By R. F. Kuns. *American Technical Society, Chicago, 1942, pagged in sections, illus., diags., charts, tables, 9½ x 6 in., cloth, \$3.25.*

A discussion of elementary engines precedes chapters on light plane engines and radial aircraft engines. Other chapters provide practical information on engine fuels and fuel systems, electrical equipment, lubrication, and valve and ignition timing. There are many photographs and cross sectional diagrams, and a section of review-questions with answers is included.

**FLIGHT, Meteorology and Aircraft Instruments, a General Survey of Fundamentals of Aviation**

By B. Wright, W. E. Dyer and R. Martin. *American Technical Society, Chicago, 1942, pagged in sections, illus., diags., charts, maps, tables, 9½ x 6 in., cloth, \$3.25.*

Beginning with a general chapter on the atmosphere, this practical book discusses atmospheric circulation and weather forecasting. It covers weather maps, airway weather service and airway marking, and describes aviation radio and other instruments made necessary by atmospheric conditions. There is a question and answer section for review purposes.

**FLUID MECHANICS AND STATISTICAL METHODS IN ENGINEERING (University of Pennsylvania Bicentennial Conference)**

By H. L. Dryden, T. von Kármán and others. *University of Pennsylvania Press, Phila., 1941. 146 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$1.75.*

The eight papers by recognized authorities contained in this work are divided into two groups. Four of them deal with turbulence and related topics in the field of fluid mechanics. The other four, grouped under the heading of statistical methods in engineering, range from the contribution of statistics to purchasing specifications to the application of the statistical method in legislation.

**HANDBOOK OF SLEEVE BEARINGS**

By A. B. Willi. *Federal-Mogul Corporation, Detroit, Mich., 1941, illus., diags., charts, tables, 9½ x 6 in., cloth, (available only to those directly concerned with sleeve bearing installations).*

This practical guide for the engineer, designer and draftsman deals with the selection, design and application of sleeve bearings. It discusses, for example, the effect of design, materials and manufacturing methods upon sleeve-bearing efficiency and other special topics of major importance in setting up bearing specifications. There is a large reference section listing many sizes and types of bearings for which major manufacturing tools are now available.

**HIGH POLYMERIC REACTIONS, Their Theory and Practice. (High Polymers, Vol. 3)**

By H. Mark and R. Raff, translated from the manuscript by L. H. Weissberger and

I. P. Irany. *Interscience Publishers, New York, 1941. 476 pp., diags., charts, tables, 9½ x 6 in., cloth, \$6.50.*

The object of this volume is to describe the present state of our knowledge concerning the mechanism of chemical processes during which high polymers are formed. It is divided into two parts: the general part, which presents important general relationships in a quantitative manner; and the special part, which collects the literature on the subject, arranging the material according to the classification which is usual in organic chemistry.

**HIGHER MATHEMATICS FOR ENGINEERS AND PHYSICISTS**

By I. S. Sokolnikoff and E. S. Sokolnikoff, 2 ed. *McGraw-Hill Book Co., New York and London, 1941. 587 pp., diags., charts, tables, 9½ x 6 in., cloth, \$4.50.*

The purpose of this book is to give students of engineering and other applied sciences a bird's-eye view of those mathematical topics beyond the elementary calculus which are indispensable in the study of physical sciences. Underlying principles are emphasized, rather than direct application to specific problems, so as to provide an introduction to advanced mathematical treatises. The new edition has been considerably revised and enlarged.

**INDUSTRIAL ACCIDENT PREVENTION, a Scientific Approach**

By H. W. Heinrich. 2 ed. *McGraw-Hill Book Co., New York and London, 1941. 448 pp., illus., diags., charts, tables, 8½ x 5½ in., cloth, \$3.00.*

The essential principles and basic philosophy of accident prevention are presented in the first two chapters. The next three are devoted to an explanation of the practical application of these principles in industry. Further development of various phases of the subject and specific illustrative examples are found in succeeding chapters. Historical and statistical data are appended.

**INDUSTRIAL INSTRUMENTS FOR MEASUREMENT AND CONTROL. (Chemical Engineering Series)**

By T. J. Rhodes. *McGraw-Hill Book Co., New York and London, 1941. 573 pp., diags., charts, tables, 9 x 6 in., cloth, \$6.00.*

This new text is designed to provide a theoretical and practical treatment of the measurement and control of the four fundamental physical factors encountered in industrial processing and manufacturing: temperature, pressure, fluid flow and liquid level. Automatically controlled continuous processes are thoroughly analyzed, and practical rules are established for the design and maintenance of controlling instruments.

**INTRODUCTION TO PHYSICAL STATISTICS**

By R. B. Lindsay. *John Wiley & Sons, New York; Chapman & Hall, London, 1941. 306 pp., diags., charts, tables, 9½ x 6 in., cloth, \$3.75.*

This work is intended for the graduate student who wishes a thorough but not too lengthy introduction to the method of statistical physics. It calls for a background of theoretical physics. It presents a survey of the various ways in which statistical reasoning has been used in physics, from the classical applications to fluctuation phenomena, kinetic theory and statistical mechanics to the contemporary quantum mechanical statistics. Emphasis has been laid on methodology and numerous illustrative problems are included.

**LINCOLN'S INDUSTRIAL-COMMER-CIAL ELECTRICAL REFERENCE,**

*Edited by E. S. Lincoln. First edition. Electrical Modernization Bureau, 60 East 42nd St., New York, 1941, pagged in sections, illus., diags., charts, tables, 11 x 8½ in., cloth, \$15.00.*

The entire field of industrial electric operations, from service entrance through utilization equipment, is covered in this reference book. The material is divided into sections containing tables, diagrams, illustrations and descriptions of typical equipment in the respective fields, and other practical information. Special sections cover electrical and other related associations, safety precautions and the National Electrical Code provisions.

#### MacRAE'S BLUE BOOK, 49th Annual Edition, 1941-42

MacRae's Blue Book Co., Chicago and New York, 1941. 3,728 pp., illus., 11 x 8 in., cloth, \$15.00.

The new edition of this well-known and useful directory follows the plan of preceding ones. It includes an alphabetical list of manufacturers, producers and wholesalers, with the addresses of branch offices; a minutely classified list of products, with an extensive index; a list of towns of one thousand or more population; with their trade facilities and railroad connections; and a list of trade names.

#### (The) MECHANISM OF THE ELECTRIC SPARK

By L. B. Loeb and J. M. Meek. Stanford University Press, Stanford University, California; Humphrey Milford, Oxford University Press, London, 1941. 188 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$3.50.

This work analyzes the status of the theory of the mechanism of the electric spark in air at this time and, on the basis of this analysis, the streamer theory of spark discharge is developed. The three chapters deal respectively with the Townsend theory of the spark, with the development of the streamer theory, and with the calculation of breakdown in various types of gaps. Bibliographies are included.

#### MUNICIPAL AFFAIRS

By E. W. Steel. International Textbook Co., Scranton, Pa., 1941. 389 pp., diags., charts, tables, 8½ x 5 in., cloth, \$3.50.

Intended both as a textbook for college students and a source of information for those interested in municipal affairs, this book covers two fields. The first section is devoted to the development and forms of municipal government and its relation to state and federal authority. Administrative principles are treated in the latter part of the book including discussions of departmental work city financing methods, etc.

#### OUTLINES OF GEOLOGY

Outlines of Physical Geology, by C. R. Longwell, A. Knopf and R. F. Flint, 381 pp.

Outlines of Historical Geology, by C. Schuchert and C. O. Dunbar, 291 pp. 2. ed., John Wiley & Sons, New York; Chapman & Hall, London, 1941. illus., diags., charts, tables, maps, 9 x 6 in., cloth, \$4.00.

Combining two well-known elementary texts on physical and historical geology, the present volume was developed to furnish a brief treatise covering the salient features of the entire subject. In the first part, the principles of physical geography are explained as a key to the reading of geologic history, and the relation of these principles to practical human affairs is emphasized. The historical geology section presents a concise, general survey of the past history of the earth.

#### PHOTOMICROGRAPHY

By R. M. Allan. D. Van Nostrand Co., New York, 1941. 365 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$5.50.

The process of photographing minute objects through a microscope is comprehensively covered. Essential information concerning microscopic technique is provided for

those unfamiliar with such work, although the emphasis is upon photographic equipment and methods, which are described in detail. Excellent examples of various kinds of photomicrography are included, with explanatory paragraphs.

#### PIPING FLEXIBILITY AND STRESSES

By S. D. Vineratos and D. R. Zeno. Cornell Maritime Press, New York, 1941. 85 pp., diags., charts, tables, 10 x 7½ in., paper, \$3.00.

The grapho-analytical method of determining flexibility and stress from an examination of bending-moment diagrams is presented in this book for the design of piping systems, particularly steam piping in marine service. The fundamentals of the method are first briefly described, and its application is then explained, working from simple cases to problems with pipes intersecting in space.

#### PRINCIPLES OF ELECTRON TUBES

By H. J. Reich. McGraw-Hill Book Co., New York and London, 1941. 398 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$3.50.

Essentially an abridgment of the author's "Theory and application of electron tubes," the present volume is designed to meet the need for a text suitable for students not specializing in communication. In this edition some of the material has been deleted and the rest modified to give unity and coherence. New material includes a brief treatment of electron dynamics and an introductory treatment of frequency modulation.

#### RAILROADIANS OF AMERICA, New York, Book No. 3

Apply to W. A. Lucas, Editor and Chairman, Publication Committee, Railroadians of America, 56 Tuxedo Ave., Hawthorne, New Jersey, 1941. 128 pp., illus., diags., charts, tables, maps, 11 x 7½ in., paper, \$2.50.

Number 3 of this series presents an illustrated record of the motive power and growth of the Delaware and Hudson railroad. Originally printed in two sections by the Delaware and Hudson Railroad Corporation, additional material has been included to bring the information up to date.

#### (The) REFERENCE LIBRARY OF THE WELDING RESEARCH COUNCIL, Section I, Classified Library Catalogue, June, 1941

Published by Institute of Welding, 2 Buckingham Palace Gardens, London, S.W.1, England. 136 pp., 8½ x 5½ in., paper, 2s.

The major part of this publication is devoted to a catalogue of the reference library of the Welding Research Council, containing both author and subject entries in one alphabetical list. Additional information concerning the organization, staff, services and publications of the Institute of Welding is also included.

#### SHOP MANAGEMENT FOR THE SHOP SUPERVISOR

By R. C. Davis. Harper & Brothers, New York and London, 1941. 333 pp., diags., charts, tables, 8½ x 5½ in., cloth, \$2.00.

This book is concerned with the problems which confront the shop supervisor in all phases of production control. Topics covered include organization, plant and equipment, production and quality control in various types of shops, motion and time study, materials control, stores, and labor management.

#### THEORY OF GASEOUS CONDUCTION AND ELECTRONICS

By F. A. Maxfield and R. R. Benedict. McGraw-Hill Book Co., New York and

London, 1941. 483 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$4.50.

The fundamental theory of high-vacuum electronic equipment is presented with a systematic interpretation of the underlying phenomena upon which the properties of all types of gaseous-conduction devices depend. The discussion covers not only high vacuum conduction as found in electron tubes, but also the theory and application of corona, sparking, glows and arcs. Stress is placed upon scientific principles rather than upon specific apparatus and applications.

#### TRAFFIC ACCIDENTS AND CONGESTION

By M. Halsey. John Wiley & Sons, New York; Chapman & Hall, London, 1941. 408 pp., illus., diags., charts, tables, 10 x 7 in., cloth, \$4.00.

This volume sets forth the principles which underlie the scientific methods currently being developed to reduce traffic accidents and congestion. It is an engineering approach to these problems as they affect the movement of persons and merchandise. Application of the principles here outlined presents a basis for evaluating all elements of the traffic problem. There is a large bibliography.

#### TRUE STEEL, the Story of George Matthew Verity and His Associates.

By C. Borth. Bobbs-Merrill Co., Indianapolis and New York, 1941. 319 pp., illus., 9 x 6 in., cloth, \$3.00.

Mainly a biography of George Matthew Verity, the directing genius of the American Rolling Mill Company, this book is also a history of the Company and an exposition of the development of the steel industry. Both the technological and sociological aspects of the man and his work are presented.

#### UNIVERSITY PHYSICS, Part 3, LIGHT

By F. C. Champion. Interscience Publishers, New York; Blackie & Son, London and Glasgow, 1941. 172 pp., diags., charts, tables, 9 x 6 in., cloth, \$1.50.

One of a group of books on the several major divisions of physics, this particular volume covers the subject of light for intermediate students who have previously studied the elements of physics. The text is supplemented by numerous clear and helpful diagrams, and exercises and problems are supplied for review purposes.

#### WAVES, a Mathematical Account of the Common Types of Wave Motion

By C. A. Coulson. Oliver & Boyd, London, England, and Edinburgh, Scotland, 1941. 156 pp., diags., charts, tables, 7½ x 5 in., cloth, 5s.

The subject of waves is usually treated in separate branches of applied mathematics. In this book, as many different kinds of wave motion as possible are discussed as one whole, in an elementary way. Starting from the standard equation of wave motion, the author investigates waves on strings, in membranes, bars and springs, and in liquids, sound waves and electric waves; concluding with a chapter on some general properties of waves.

#### WELDING AND ITS APPLICATION

By B. E. Rossi. McGraw-Hill Book Co., New York and London, 1941. 343 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$2.50.

Welding and cutting processes, with the emphasis on electric-arc welding, are comprehensively covered, with their related phenomena, their techniques and their general application in industry. The intention is to present fundamental facts for the beginner, give the experienced operator a wider understanding of the welding process, and provide a source of reference for draftsmen, designers, engineers and any others interested in the subject.

# PRELIMINARY NOTICE

of Applications for Admission and for Transfer

FOR ADMISSION

December 31st, 1941.

The By-laws provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

**Communications relating to applicants are considered by the Council as strictly confidential.**

The Council will consider the applications herein described at the February meeting.

L. AUSTIN WRIGHT, General Secretary.

\*The professional requirements are as follows:—

A Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science or engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainment or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

GEDDES—ALVIN BROOKS, of Calgary, Alta. Born at Calgary, March 7th, 1904; Educ.: B.Sc., Iowa State College, 1927; 1927-28, motor test dept., 1928-29, correspondence dept., 1929-30, sales dept., and 1930 to date, sales engr., Canadian Westinghouse Company, Calgary, Alta.

References: H. J. McEwen, W. S. Fraser, J. McMillan, H. B. LeBourveau.

HALE—FREDERICK JOHN, of Roseau, Dominica, B.W.I. Born at Letchworth, Herts., England, Jan. 13th, 1891; Educ.: 1929-33, articled pupil to G. T. Hill, B.Sc., surveyor to the Letchworth Urban District Council. Assoc. Member Exam. of the Inst. C.E.; 1941; 1933-34, engr. asst., Letchworth U.D.C.; 1934-36, engr. asst. to the Hitchin Rural District Council; 1936-37, engr. asst., Corp'n. of the City of Peterborough, England; 1937-39, senior asst. to the Borough of Guildford, reinforced concrete work, roadworks, sewerage scheme, etc.; 1939-41, chief engr. asst., City of Winchester, roadworks, sewerage disposal, & 1/c of all works; At present, Asst. Colonial Engr., Public Works Dept., Roseau, Dominica. (By special ruling of Council references from members of Inst. of the Civil Engrs. (London) have been accepted).

References: A. C. O'Farrell, N. C. C. Barrell, W. S. Edwards, F. J. Smith, J. W. Hipwood.

HARISAY—VINO, of 262 Wood Ave., Westmount, Que. Born at Budapest, Hungary, Jan. 16th, 1882; (Naturalized British Subject, 1932). Educ.: B.Sc. (Mech. Engrg.), Royal Hungarian Joseph Polytechnicum, 1904, 1904-23, chief engr., Royal Hungarian Telephones & Telegraphs (went voluntarily on pension with title "Royal Technical Counsellor"); 1920-26, managing own cartonnage factory; 1937-39, designer, Canadian Marconi Company, Montreal; 1939-40, Aluminum Company of Canada, Montreal; 1940-41, designer, Allied Brass Company, Montreal; 1941 to date, mech. designer, Dominion Engineering Works Ltd., Longueuil, Que.

References: M. E. Hornback, A. W. Whitaker, H. M. Black, W. B. Scouler, E. M. G. MacGill.

JOHNSON—HOWARD, of Midland, Ont. Born at South Shields, England, Jan. 11th, 1903; Educ.: 1918-21, Marine School, South Shields; 1921-24, Kings College, Durham Univ., Diploma in Naval Architecture, 1924; (Member, Inst. Naval Architects.); 1918-24, ap'ticeship, J. Readhead & Sons, Engrs. & Shipbuilders; 1924-27, on technical staff, Messrs. R. Thompson, Shipbuilders, and Swan, Hunter & Wigham Richardson; 1927-29, asst. dry dock mgr., Wallsend Shipway & Engrg. Co., 1930-38, gen. mgr. & director, Burtinsland Ship Co. Ltd., and 1938-40, gen. mgr. & director, Bartrams Ship. Co. Ltd., all in Great Britain; 1940 to date, gen. mgr., Midland Shipyards Ltd., Midland, Ont.

References: C. K. McLeod, G. H. Midgley, R. E. Hertz, J. E. Dion, I. J. Tait, J. R. Groundwater.

JOSSLIN—JAMES ALEXANDER, of 915 St. Clair Ave. West, Toronto, Ont. Born at Bexhill-on-Sea, Sussex, England, Oct. 24th, 1893; Educ.: I.C.S. Diploma in Struct'l Engrg., 1916. Prelim. Civil Service Exam.; 1916, gen. dtng., R. Simpson Co., bldg. constr.; 1917-19, struct'l. steel detailing & checking, with various companies; 1919-31, checker & squad leader in drafting room, on struct'l. steel bldgs., bridges, etc., Dominion Bridge Company, Ltd., and from 1935 to date, asst. chief dtfsmn., Ontario Divn. for same company.

References: G. P. Wilbur, D. C. Tennant, A. R. Robertson, D. E. Perriton, A. H. Harkness.

MEKEEL—DAVID LANE, of Pittsburgh, Pa. Born at Westchester County, New York, June 30th, 1869; Educ.: B.Sc., 1891, Mech. Engr., 1892, Haverford College, Penna.; R.P.E., State of Penna. Up to 1912, dtfsmn. with various companies, and from 1912 to 1940, chief engr. and constgt. engr., Jones & Laughlin Steel Corp.; At present, steel mill consultant to the Algoma Steel Corporation, Sault Ste. Marie, Ont.

References: A. E. Pickering, C. Stenbol, L. R. Brown, K. G. Ross, J. L. Lang.

PRADL—GEORGE, of 4396 Coolbrooke Ave., Montreal, Que. Born at New York, N.Y., April 6th, 1907; Educ.: B.Sc. in Mech. Engr., 1930, Mech. Engr., 1936, C.O.P. Union; 1924-30, dtfsmn., field engr. and designer on furnaces, casting equipment, etc., Nichols Copper Co., Laurel Hill, N.Y.; 1930-32, asst. engr. on design & constr. of Montreal Refinery, for Canadian Copper Refiners Ltd., Montreal East; 1932 to date, chief designing engr. for same company, with complete responsibility for design of various plants, misc. equipment, and preparation of estimates and reports on various projects.

References: C. K. McLeod, A. D. Ross, H. T. Doran, G. H. Midgley, R. H. Findlay.

RENNIE—ROBERT, of 4410 Cypress St., Vancouver, B.C. Born at Linacre, Lancs., England, May 19th, 1894; Educ.: 1911-14, Technical Schools, Birkenhead and Liverpool, England; 1910-14, ap'tice (works and drawing office), shipbldg. and marine engr., Cammell Laird & Co. Ltd., and Clover, Clayton & Co. Ltd., Birkenhead; 1914-18, war service with Royal Engrs.; 1919-24, marine engr., F. Leyland & Co. Ltd., Liverpool; 1924-25, engr. inspr., National Boiler & General Insurance Co. Ltd., Manchester; 1925-26, lecturer in marine engrg., Central Technical School, Liverpool; ship & Engineer Surveyor to Lloyd's Register of Shipping as follows: 1926-27, London, England, 1927-30, Dunkirk, France, 1930-31, Leith, Scotland, 1931-34, Bordeaux, France, 1934-36, Barcelona, Spain, 1936-37, London, Newcastle, Sunderland, Grimsby, 1938-39, Liverpool, 1939, appointed Senior Surveyor at Vancouver, and at present in full charge of surveying duties for British Columbia with staff of eleven surveyors engaged in survey for classification of all cargo ships and steel naval ships.

References: J. N. Finlayson, J. Robertson, W. N. Kelly, W. O. Scott, H. N. Macpherson.

ROSSEN—ALEXANDER ALLYN, of 85 Cathedral Ave., Winnipeg, Man; Born at Winnipeg, Dec. 1st, 1911; Educ.: Senior Matric.; 1927-28, supervising reinforced concrete work on apartment block; 1928-29, field supt., engrg. dept., Aronovitch & Leipsic, Winnipeg; 1929-30, tracer, detailer, designer, Hudson's Bay Mining & Smelting Co., Winnipeg; 1930, instrman., etc., Carter Halls-Aldinger Co.; 1931, went into business for self—design of houses, warehouses, etc., from 1933, general salvage and wrecking business, and at present, owner and manager, Rossen Engineering and Construction Co., Winnipeg, Man.

References: J. H. Edgar, E. S. Kent, W. D. Hurst, K. A. Dunphy.

SANDERS—LIONEL JOHN REDVERS, of Montreal, Que. Born at Chippenham, England, July 11th, 1900; Educ.: 1919-22, Loughborough College, England; 1926-27, Cornell Univ.; Assoc. Member (by exam.), Inst. Mech. Engrs. (London); R.P.E. of Ont.; 1915-18, ap'ticeship, Westinghouse Brake Saxby Signal Co.; 1918-19, Royal Naval Air Service; 1922-24, with Herbert Morris Company, Loughborough; 1924-26, technical asst. to George Constantinescu, constgt. engr., London, England; 1927-29, asst. to chief engr., Lake Shore Mines, Kirkland Lake, Ont.; 1929-34, with Aluminium Limited—asst. chief engr., Aluminium Co. of Canada, divnl. supt., Toronto plant, and plant engr., Northern Aluminium Co., England; 1934-37, senior staff engr., George S. May, Industrial Engrs.; 1937-40, supt. of shops, Algoma Steel Corporation, Sault Ste. Marie, Ont.; 1941 to date, manager, Quebec-St. Lawrence Divn., Wartime Merchant Shipping Ltd., Montreal, Que.

References: G. O. Vogan, R. E. Hertz, G. H. Midgley, H. J. Leitch, J. R. Groundwater.

SCHMELZER—HANS, of 762 Sherbrooke St. West, Montreal, Que. Born at St. Ingbert, Bavarian Palatinate, April 26th, 1902 (Naturalized British subject 1933); Educ.: 1921-25, Staatl. Technische Hochschule, Karlsruhe, (Tech. Coll. of the German State), Mech. Engr., 1925; 1920-24, ap'ticeship during vacation periods with J. Dahlem Lumbermills, St. Ingbert; 1925-27, mtce. & production engr., Ligna Werke, G.m.b.H., Homburg, Saar; 1928-29, dtfsmn., Northern Electric Co., Montreal; 1929-34, dtfsmn., 1934-37, designer, hydraulic dept., Dominion Engrg. Works Ltd.;

(Continued on next page)

# Employment Service Bureau

## SITUATIONS VACANT

**MECHANICAL DESIGNING DRAUGHTSMAN**, Graduate preferred, urgently needed for work in Arvida for specification drawings for plate work, elevators, conveyors, etc., equipment layouts, pipe layouts and details. Apply to Box No. 2375-V.

**MECHANICAL GRADUATE ENGINEER** with machine shop experience required for work in Mackenzie, British Guiana, on essential war work. Apply to Box No. 2441-V.

**ENGINEERING DRAUGHTSMAN** with experience in machine and structural design, proficient in steel design calculation, and having ability for estimating. We require a man with at least five years' industrial experience, preferably in the paper mill field. Position is permanent. State experience and give physical description. Include small photograph and a sample of draughtsmanship. Apply to Box No. 2458-V.

**MECHANICAL DRAUGHTSMAN**, experienced in making layouts for various installations, piping, etc., around a paper mill. Applicant must be a college graduate. State previous experience, wages expected, etc. Apply to Box No. 2461-V.

**MECHANICAL DRAUGHTSMAN** preferably with pulp and paper experience. Good salary and permanent position. Apply giving details of experience to Box No. 2480-V.

**GRADUATE MECHANICAL ENGINEER** required for Mackenzie, B.G., immediately on work of plant and mining equipment maintenance. We are prepared to do necessary training which will give exceptional opportunity for experience. Apply to Box No. 2481-V.

**MECHANICAL ENGINEER** preferred with experience on diesels and tractors, for work in Mackenzie, B.G. Apply to Box No. 2482-V.

**MECHANICAL DRAUGHTSMEN** and engineers for pulp and paper mill work. Experienced men preferred. Good salary to qualified candidates. Apply to Box No. 2483-V.

**ELECTRICAL ENGINEER**, young French Canadian graduate engineer to be trained on work involving hydro-electric plant operation, transmission lines and

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.

construction, meter testing and inspection. Good opportunity to acquire first-hand electrical power experience. Apply to Box No. 2487-V.

## ENGINEER OFFICERS WANTED

Applications are invited for Commissions in the Royal Canadian Ordnance Corps for service both overseas and in Canada as Ordnance Mechanical Engineers. Since it is probable that several new units will be organized in the near future, a number of senior appointments may be open, and applications from engineers with a good background of military experience would be welcomed in this connection. Applications should be submitted on the regular Royal Canadian Ordnance Corps application forms, which can be obtained from the District Ordnance Officers of the respective Military Districts.

## SITUATIONS WANTED

**ELECTRICAL ENGINEER**, B.E. in electrical engineering, McGill University, Age 24, married, available on two weeks notice. Undergraduate experience, cable testing and cathode ray oscillography. Since graduation, five months on construction of large and small electrical equipment in plant and sub-station. One year operating electrical engineer in medium size central steam station paralleled with large Hydro system. At present employed, but is interested in research or teaching. Associate member of the American Institute of Electrical Engineers. Apply to Box No. 2419-W.

**CIVIL AND STRUCTURAL ENGINEER**, M.E.I.C., R.P.E. (Ont.), Age 49. Married. Home in To-

ronto. Experience in Britain, Africa, Canada, Turkey. Chief engineer reinforced concrete design offices, steelworks construction. Resident engineer design and construction munitions plants, and general civil engineering work. Extensive surveys, draughting, harbour and municipal work. Location immaterial. Available now. Apply Box No. 2425-W.

**ELECTRICAL, MECHANICAL ENGINEER**, age 35. Dip. and Assoc. R.T.C., Glasgow, A.M.I.E.E., (Students Premium) G.I. mech.E., M.E.I.C., Assoc. Am.I.E.E. Married. Available after December 22nd. Seventeen years experience covering machine shop apprenticeship, A.C. and D.C. motors, transformers, steel and glass bulb arc rectifiers, design, testing and erection sectional electric news and fineprints paper machine drives, experience tap changers H.V., L.V and marine switchgear. Apply to Box No. 2426-W.

**MECHANICAL ENGINEER** age 55 years. Married. Available at once. Thirty years experience in draughting and general machine shop and foundry work. Fifteen years as works manager. Considerable experience in pump work, including estimating and inspection. Apply to Box 2427-W.

**ELECTRICAL ENGINEERING** student in third year, age 27, desires summer position starting in April, with view to permanency on graduation. Two summers on design of shop equipment and electrical apparatus. Three years experience on test and experimental work for relays and control equipment. Student E.I.C., and Associate member American Institute of Electrical Engineers. Location immaterial. Apply to Box No. 2428-W.

## PRELIMINARY NOTICE (Continued from previous page)

Montreal; 1937-41, engr. & research engr., Canadian Car & Foundry Co. Ltd., Montreal; 1941 to date, mech. engr., Robert A. Rankin & Co., Industrial Engrs., Montreal, Que.

References: C. E. Herd, R. J. Mattson, R. A. Rankin, W. S. McIlquham, H. S. Van Patter.

**SCOTT—ROBERT GOVENLOCK**, of Winnipeg, Man. Born at Listowel, Ont., Nov. 28th, 1911; Educ.: B.Sc. (Elec.), Univ. of Alta., 1934; 1931-32-34 (summers) on survey parties for Dept. of Public Works, Alta.; 1935-36, test course, Can. Gen. Elect. Co. Ltd.; 1936, distribution transformer design and lighting service dept., C.G.E., Toronto; 1936-41, lighting service engr., and 1941 to date, sales engr., Winnipeg Electric Company, Winnipeg, Man.

References: E. V. Caton, C. T. Eyford, C. P. Haltalin, H. J. MacLeod, W. E. Cornish, W. A. Trott, E. S. Braddell, H. L. Briggs.

**SEED—CHARLES EDWARD**, of 32 Westmount Ave., Ottawa, Ont. Born at Ottawa, May 22nd, 1911; Educ.: Ottawa Technical School; 1929, Geodetic surveys; 1930-39, instr'man. & instrpr., sewer dept., Corp'n. of Ottawa; 1939-41, with Dept. of Public Works, as instrpr. (clerk of works) on bldgs. & sewers, roads & water, etc., also instr'man, laying out above. At present, asst. engr. with Angus Robertson Construction Co., i/c of sewers & laying out of hangers & bldgs., also water & roads.

References: W. F. M. Bryce, N. B. MacRostie, E. H. Beck.

**WAGNER—HERBERT LOUIS**, of Toronto, Ont. Born at Toronto, Nov. 10th, 1882; Educ.: B.A.Sc., Univ. of Toronto (S.P.S.) 1905; R.P.E. of Ont.; 1907-09, designer, McClinton Marshall Constrn. Co.; 1909-10, dftsmn., Hamilton Bridge Co.; 1910-12, checker, Canada Foundry Co., Toronto; 1912-21, chief dftsmn., Toronto Steel Constrn. Co.; 1921 to date, asst. engr., H.E.P.C. of Ontario, supervising design of power house superstructures, transformer stations, operators' colonies, etc.

References: H. E. Brandon, O. Holden, J. W. Falkner, R. C. McMordie.

## FOR TRANSFER FROM THE CLASS OF STUDENT

**JOHNSTON—WILLIAM DAVID**, of Toronto, Ont. Born at Toronto, Sept. 21st, 1913; Educ.: B.A.Sc., Univ. of Toronto, 1935; 1935 to date, sales engr., McGregor-McIntyre Divn., Dominion Bridge Co. Ltd., Toronto, Ont. (St. 1935).

References: A. R. Robertson, D. E. Perriton, D. C. Tennant, C. R. Young, W. H. M. Laughlin, G. P. Wilbur, C. F. Morrison.

**SARCHUK—LEON A.**, of 296 Hampton St., St. James, Man. Born at Sokal, Sask., Sept. 28th, 1914; Educ.: B.Eng. (Mech.), Univ. of Sask., 1940; 1940 to date, aircraft instrpr., A.I.D., MacDonal Bros. Aircraft, Winnipeg, Man. (St. 1940).

References: I. M. Fraser, C. J. Mackenzie, E. K. Phillips, W. E. Lovell, R. A. Spencer, G. M. Williams.

**WIGDOR—EDWARD IRVING**, of 2183 Maplewood Ave., Montreal, Que. Born at Montreal, March 12th, 1913; Educ.: B.Eng. (Elec.), McGill Univ., 1935. M.Eng. (Elec.), Renss. Poly. Inst., 1936; 1936-38, research asst., dept. of mech. engrg., National Research Council, Ottawa; 1938-39, engr., production dept., Fairchild Aviation, Montreal; 1939, engr., production dept. (Aviation), Cand. Car & Foundry Co. Ltd.; 1939-40, aeronautical engr., R.C.A.F. Tech. Detachment No. 11; 1940 to date, aeronautical engr., British Air Commission, at present, resident technical officer, at Vultee Aircraft, Nashville, Tenn. (St. 1934).

References: J. H. Parkin, C. M. McKergow, C. V. Christie, E. Brown, G. A. Wallace.

## PUBLICATIONS OF ENEMY ORIGIN

At the request of Mr. S. J. Cook, officer in charge, Research Plans and Publications Section, National Research Council, we are pleased to reproduce the following letter addressed by the acting president of the Council to presidents of universities and other research organizations in Canada.

In view of the restrictions on the importation of scientific

books and periodicals of enemy origin into Canada since the outbreak of war, there has been an increasing demand for photostats or other reproductions of specific articles appearing in such publications which are known to be available in United States libraries.

The National Research Council has been informed by the Department of the Secretary of State that educational institutions and industrial or research organizations in Canada are now permitted to order direct from United States libraries photostat copies of articles appearing in scientific journals which are known to be in such libraries but which are not in circulation in Canada.

The Commissioner of Customs and the Postal Censors have been asked to place no restrictions on the importation and safe delivery of photostats or other reproductions of this kind direct to university and other responsible scientific bodies in Canada when such importations are made from recognized and responsible United States libraries.

It is to be noted that the foregoing procedure applies only to photostats or other copies of articles from journals in the United States. Universities and other institutions that wish to secure scientific books or periodicals of enemy origin must still conform with the procedure authorized by the Secretary of State, which is briefly that—

(i) A certificate must be furnished to the National Research Council stating that the publications wanted are essential to the conduct of scientific work in Canada during the war;

(ii) A copy of the order must be filed with the National Research Council;

(iii) Orders must be placed with an organization in a neutral or allied country;

(iv) The shipper must be instructed to send the book or periodical in care of the National Research Council at Ottawa for Customs and Censorship clearance;

(v) Payment for such publications must be arranged between the concern placing the order and the firm with which the order is placed, and the regulations of the Foreign Exchange Control Board must be observed in such transactions.

# THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 25

MONTREAL, FEBRUARY 1942

NUMBER 2



"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

★ ★ ★

PUBLISHED MONTHLY BY  
THE ENGINEERING INSTITUTE  
OF CANADA

2050 MANSFIELD STREET - MONTREAL

L. AUSTIN WRIGHT, M.E.I.C.  
*Editor*

N. E. D. SHEPPARD, M.E.I.C.  
*Advertising Manager*

#### PUBLICATION COMMITTEE

C. K. McLEOD, M.E.I.C., *Chairman*  
R. DeL. FRENCH, M.E.I.C., *Vice-Chairman*  
A. C. D. BLANCHARD, M.E.I.C.  
H. F. FINNEMORE, M.E.I.C.  
T. J. LAFRENIÈRE, M.E.I.C.

## CONTENTS

ON THE LOOKOUT FOR ENEMY SUBMARINES . . . . .	Cover
<i>(Photo Courtesy Public Information, Ottawa)</i>	
THE NEW OIL-HYDRAULIC PRESS IN MUNITIONS MANUFACTURE . . . . .	66
<i>John H. Maude, M.E.I.C.</i>	
THE QUALITY UNDERLYING THE BRITISH AEROPLANE . . . . .	71
<i>Lt. Col. W. Lockwood Marsh</i>	
SHIPYARD PRODUCTION METHODS . . . . .	73
<i>Howard Johnson, M.E.I.C.</i>	
REPORT OF COUNCIL FOR 1941 . . . . .	80
ABSTRACTS OF CURRENT LITERATURE . . . . .	99
FROM MONTH TO MONTH . . . . .	104
PERSONALS . . . . .	110
<i>Visitors to Headquarters</i> . . . . .	112
<i>Obituaries</i> . . . . .	113
NEWS OF THE BRANCHES . . . . .	114
NEWS OF OTHER SOCIETIES . . . . .	119
LIBRARY NOTES . . . . .	120
PRELIMINARY NOTICE . . . . .	122
EMPLOYMENT SERVICE . . . . .	123

Price 50 cents a copy, \$3.00 a year: in Canada, British Possessions, United States and Mexico. \$4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, \$2.00 a year. —Entered at the Post Office, Montreal, as Second Class Matter.

THE INSTITUTE as a body is not responsible either for the statements made or for the opinions expressed in the following pages.

# THE ENGINEERING INSTITUTE OF CANADA

## MEMBERS OF COUNCIL

### PRESIDENT

C. J. MACKENZIE, Ottawa, Ont.

### VICE-PRESIDENTS

\*J. CLARK KEITH, Windsor, Ont.  
†DE GASPE BEAUBIEN, Montreal, Que.

†K. M. CAMERON, Ottawa, Ont.  
\*W. S. WILSON, Sydney, N.S.

### PAST-PRESIDENTS

†H. W. McKIEL, Sackville, N.B.

†T. H. HOGG, Toronto, Ont.

### COUNCILLORS

†A. E. BERRY, Toronto, Ont.  
\*G. P. F. BOESE, Calgary, Alta.  
\*I. W. BUCKLEY, Sydney, N.S.  
\*J. M. CAMPBELL, Lethbridge, Alta.  
\*A. L. CARRUTHERS, Victoria, B.C.  
†D. S. ELLIS, Kingston, Ont.  
†J. M. FLEMING, Port Arthur, Ont.  
†I. M. FRASER, Saskatoon, Sask.  
†J. H. FREGEAU, Three Rivers, Que.  
†J. GARRETT, Edmonton, Alta.  
†S. W. GRAY, Halifax, N.S.

†J. G. HALL, Montreal, Que.  
†W. G. HUNT, Montreal, Que.  
†J. R. KAYE, Halifax, N.S.  
†E. M. KREBSER, Walkerville, Ont.  
\*J. L. LANG, Sault Ste. Marie, Ont.  
\*A. LARIVIERE, Quebec, Que.  
†H. N. MACPHERSON, Vancouver, B.C.  
\*W. R. MANOCK, Fort Erie North, Ont.  
\*H. MASSUE, Montreal, Que.  
†H. F. MORRISEY, Saint John, N.B.  
†W. H. MUNRO, Ottawa, Ont.

\*W. L. McFAUL, Hamilton, Ont.  
†C. K. McLEOD, Montreal, Que.  
\*J. H. PARKIN, Ottawa, Ont.  
\*B. R. PERRY, Montreal, Que.  
†G. McL. PITTS, Montreal, Que.  
\*J. W. SANGER, Winnipeg, Man.  
†M. G. SAUNDERS, Arvida, Que.  
\*H. R. SILLS, Peterborough, Ont.  
\*C. E. SISSON, Toronto, Ont.  
\*G. E. SMITH, Moncton, N.B.  
†J. A. VANCE, Woodstock, Ont.  
\*For 1941    †For 1941-42    †For 1941-42-43

### TREASURER

JOHN STADLER, Montreal, Que.

### GENERAL SECRETARY

L. AUSTIN WRIGHT, Montreal, Que.

### ASSISTANT GENERAL SECRETARY

LOUIS TRUDEL, Montreal, Que.

### SECRETARY-EMERITUS

R. J. DURLEY, Montreal, Que.

## STANDING COMMITTEES

### FINANCE

DEG. BEAUBIEN, *Chairman*  
J. E. ARMSTRONG  
G. A. GAHERTY  
J. A. McCORRY  
F. NEWELL  
J. STADLER, *Treasurer*

### LEGISLATION

E. M. KREBSER, *Chairman*  
R. L. DOBBIN  
R. J. DURLEY

### PAPERS

J. A. VANCE, *Chairman*  
DEG. BEAUBIEN  
K. M. CAMERON  
McN. DuBOISE  
J. C. KEITH  
W. S. WILSON

### LIBRARY AND HOUSE

BRIAN R. PERRY, *Chairman*

### PUBLICATION

C. K. McLEOD, *Chairman*  
R. DeL. FRENCH, *Vice-Chairman*  
A. C. D. BLANCHARD  
H. F. FINNEMORE  
T. J. LAPRENIERE

## SPECIAL COMMITTEES

### BOARD OF EXAMINERS AND EDUCATION

R. A. SPENCER, *Chairman*  
I. M. FRASER  
W. E. LOVELL  
A. P. LINTON  
H. R. MACKENZIE  
E. K. PHILLIPS

### PAST-PRESIDENTS' PRIZE

R. DeL. FRENCH, *Chairman*  
H. A. LUMSDEN  
H. R. MACKENZIE  
J. O. MARTINEAU  
R. W. MCCOLOUGH

### GZOWSKI MEDAL

H. O. KEAY, *Chairman*  
H. V. ANDERSON  
W. H. POWELL  
H. J. VENNES  
A. O. WOLFF

### LEONARD MEDAL

A. D. CAMPBELL, *Chairman*  
L. L. BOLTON  
A. E. CAMERON  
G. E. COLE  
V. DOLMAGE

### DUGGAN MEDAL AND PRIZE

J. T. FARMER, *Chairman*  
J. M. FLEMING  
R. C. FLITTON

### PLUMMER MEDAL

J. F. HARKOM, *Chairman*  
F. G. GREEN  
R. E. GILMORE  
E. VIENS  
C. R. WHITTEMORE

### PROFESSIONAL INTERESTS

J. B. CHALLIES, *Chairman*  
G. A. GAHERTY  
O. O. LEFEBVRE  
H. W. McKIEL  
J. A. VANCE

### MEMBERSHIP

H. N. MACPHERSON, *Chairman*

### STUDENTS' AND JUNIORS' PRIZES

#### Zone A (Western Provinces)

##### H. N. Ruttan Prize

A. L. CARRUTHERS, *Chairman*  
J. M. CAMPBELL  
H. N. MACPHERSON

#### Zone B (Province of Ontario)

##### John Galbraith Prize

K. M. CAMERON, *Chairman*  
W. H. MUNRO  
J. H. PARKIN

#### Zone C (Province of Quebec)

##### Phelps Johnson Prize (English)

McN. DuBOISE, *Chairman*  
C. K. McLEOD  
H. J. VENNES

##### Ernest Marceau Prize (French)

DEG. BEAUBIEN, *Chairman*  
J. H. FREGEAU  
A. LARIVIERE

#### Zone D (Maritime Provinces)

##### Martin Murphy Prize

W. S. WILSON, *Chairman*  
I. W. BUCKLEY  
S. W. GRAY

### INTERNATIONAL RELATIONS

C. R. YOUNG, *Chairman*  
J. B. CHALLIES, *Vice-Chairman*  
E. A. ALLCUT  
R. W. ANGUS  
C. CAMSELL  
J. M. R. FAIRBAIRN  
O. O. LEFEBVRE  
M. J. McHENRY  
H. H. VAUGHAN

### RADIO BROADCASTING

G. M. PITTS, *Chairman*  
R. J. DURLEY

### DETERIORATION OF CONCRETE STRUCTURES

R. B. YOUNG, *Chairman*  
E. VIENS, *Vice-Chairman*  
G. P. F. BOESE  
A. G. FLEMING  
W. G. GLIDDON  
O. O. LEFEBVRE  
J. A. McCORRY  
C. J. MACKENZIE  
J. H. McKINNEY  
R. M. SMITH

### WESTERN WATER PROBLEMS

G. A. GAHERTY, *Chairman*  
C. H. ATTWOOD  
C. CAMSELL  
L. C. CHARLESWORTH  
A. GRIFFIN  
T. H. HOGG  
O. O. LEFEBVRE  
C. J. MACKENZIE  
F. H. PETERS  
S. G. PORTER  
J. M. WARDLE

### THE YOUNG ENGINEER

H. F. BENNETT, *Chairman*  
J. BENOIT  
D. S. ELLIS  
J. N. FINLAYSON  
R. DeL. FRENCH  
C. A. D. FOWLER  
R. E. HEARTZ  
C. C. KIRBY  
R. F. LEGGET  
A. P. LINTON  
A. E. MACDONALD  
H. W. McKIEL  
R. M. SMITH  
H. R. WEBB

# THE ENGINEERING INSTITUTE OF CANADA

## OFFICERS OF BRANCHES

### BORDER CITIES

*Chairman*, H. L. JOHNSTON  
*Vice-Chair.*, G. G. HENDERSON  
*Executive*, W. P. AUGUSTINE  
 J. F. G. BLOWEY  
 W. R. STICKNEY  
*(Ex-Officio)*, E. M. KREBSER  
 G. E. MEDLAR  
*Sec.-Treas.*, J. B. DOWLER,  
 754 Chilver Road,  
 Walkerville, Ont.

### CALGARY

*Chairman*, J. B. DEHART  
*Vice-Chair.*, H. J. McEWEN  
*Executive*, F. J. HEUPERMAN  
 T. D. STANLEY  
 J. W. YOUNG  
*(Ex-Officio)*, G. P. F. BOESE  
 J. HADDIN  
 J. McMILLAN  
*Sec.-Treas.*, P. F. PEELE  
 248 Scarboro Avenue,  
 Calgary, Alta.

### CAPE BRETON

*Chairman*, J. A. MacLEOD  
*Executive*, J. A. RUSSELL M. F. COSSITT  
 A. P. THEUPERKAUF  
*(Ex-Officio)*, I. W. BUCKLEY  
 W. S. WILSON  
*Sec.-Treas.*, S. C. MIFFLEN,  
 60 Whitney Ave., Sydney, N.S.

### EDMONTON

*Chairman*, R. M. HARDY  
*Vice-Chair.*, D. A. HANSEN  
*Executive*, J. A. CARRUTHERS  
 C. W. CARRY  
 D. HUTCHISON  
 B. W. PITFIELD  
 E. R. T. SKARIN  
 W. F. STEVENSON  
*(Ex-Officio)*, J. GARRETT  
 E. NELSON  
*Sec.-Treas.*, F. R. BURFIELD,  
 Water Resources Office,  
 Provincial Government,  
 Edmonton, Alta.

### HALIFAX

*Chairman*, P. A. LOVETT  
*Executive*, A. E. CAMERON  
 G. T. CLARKE G. J. CURRIE  
 A. E. FLYNN J. D. FRASER  
 D. G. DUNBAR J. A. MacKAY  
 J. F. F. MacKENZIE  
 J. W. MacDONALD  
 G. T. MEDFORTH  
*(Ex-Officio)*, S. L. FULTZ J. R. KAYE  
*Sec.-Treas.*, S. W. GRAY,  
 The Nova Scotia Power  
 Commission,  
 Halifax, N.S.

### HAMILTON

*Chairman*, STANLEY SHUPE  
*Vice-Chair.*, T. S. GLOVER  
*Executive*, H. A. COOCH  
 NORMAN EAGER  
 A. C. MacNAB  
 A. H. WINGFIELD  
*(Ex-Officio)*, W. J. W. REID  
 W. A. T. GILMOUR  
*Sec.-Treas.*, A. R. HANNAFORD,  
 354 Herkimer Street,  
 Hamilton, Ont.

### KINGSTON

*Chairman*, T. A. McGINNIS  
*Vice-Chair.*, P. ROY  
*Executive*, V. R. DAVIES  
 K. H. McKIBBIN  
 K. M. WINSLOW  
 A. H. MUNRO  
*(Ex-Officio)*, G. M. CARR-HARRIS  
 D. S. ELLIS  
*Sec.-Treas.*, J. B. BATY,  
 Queen's University,  
 Kingston, Ont.

### LAKEHEAD

*Chairman*, B. A. CULPEPER  
*Vice-Chair.*, MISS E. M. G. MacGILL  
*Executive*, E. J. DAVIES  
 J. I. CARMICHAEL  
 S. E. FLOOK  
 S. T. McCAVOUR  
 R. B. CHANDLER  
 W. H. SMALL  
*(Ex-Officio)*, C. D. MACKINTOSH  
 H. G. O'LEARY  
 J. M. FLEMING  
*Sec.-Treas.*, W. C. BYERS,  
 c/o C. D. Howe Co. Ltd.,  
 Port Arthur, Ont.

### LETHBRIDGE

*Chairman*, C. S. DONALDSON  
*Vice-Chair.*, W. MELDRUM  
*Executive*, R. F. P. BOWMAN G. S. BROWN  
 N. H. BRADLEY  
 C. S. CLENDENING  
*(Ex-Officio)*, J. M. CAMPBELL  
 A. J. BRANCH J. T. WATSON  
*Sec.-Treas.*, R. B. MacKENZIE,  
 McKenzie Electric Ltd.,  
 706, 3rd Ave. S., Lethbridge, Alta.

### LONDON

*Chairman*, R. W. GARRETT  
*Vice-Chair.*, F. T. JULIAN  
*Executive*, V. A. McKILLOP  
 F. C. BALL  
 F. BELL  
 T. L. McMANAMNA  
 R. S. CHARLES  
*(Ex-Officio)*, H. F. BENNETT  
 J. A. VANCE  
*Sec. Treas.*, H. G. STEAD,  
 60 Alexandra Street,  
 London, Ont.

### MONCTON

*Chairman*, F. O. CONDON  
*Vice-Chair.*, H. J. CRUDGE  
*Executive*, B. E. BAYNE E. R. EVANS  
 G. L. DICKSON E. B. MARTIN  
 T. H. DICKSON G. E. SMITH  
 R. H. EMMERSON  
*(Ex-Officio)*, H. W. McKIEL  
*Sec.-Treas.*, V. C. BLACKETT,  
 Engr. Dept., C.N.R.,  
 Moncton, N.B.

### MONTREAL

*Chairman*, R. E. HEARTZ  
*Vice-Chair.*, J. A. LALONDE  
*Executive*, E. V. GAGE  
 P. E. POITRAS  
 I. S. PATTERSON  
 J. B. STIRLING  
 J. M. CRAWFORD  
 J. COMEAU  
*(Ex-Officio)*, J. B. CHALLIES  
 DE G. BEAUBIEN  
 J. G. HALL  
 W. G. HUNT  
 H. MASSUE  
 C. K. McLEOD  
 B. R. PERRY  
 G. M. PITTS  
*Sec. Treas.*, L. A. DUCHASTEL  
 40 Kelvin Avenue,  
 Outremont, Que.

### NIAGARA PENINSULA

*Chairman*, A. L. McPHAIL  
*Vice-Chair.*, C. G. CLINE  
*Executive*, L. J. RUSSELL  
 J. H. TUCK  
 A. C. BLUE  
 G. F. VOLLMER  
 G. E. GRIFFITHS  
 D. W. BRACKEN  
 L. L. GISBORNE  
*(Ex-Officio)*, W. R. MANOCK  
*Sec.-Treas.*, J. H. INGS,  
 1870 Ferry Street,  
 Niagara Falls, Ont.

### OTTAWA

*Chairman*, N. B. MacROSTIE  
*Executive*, W. G. C. GLIDDON  
 R. M. PRENDERGAST  
 W. H. G. FLAY  
 G. A. LINDSAY  
 R. YULL  
*(Ex-Officio)*, K. M. CAMERON  
 W. H. MUNRO  
 T. A. McELHANNEY  
 R. K. ODELL  
*Sec.-Treas.*, A. A. SWINNERTON,  
 Dept. of Mines and Resources,  
 Ottawa, Ont.

### PETERBOROUGH

*Chairman*, J. CAMERON  
*Executive*, A. J. GIRDWOOD I. F. McRAE  
 J. W. PIERCE F. R. POPE  
*(Ex-Officio)*, R. L. DOBBIN  
 H. R. SILLS  
 A. L. MALBY  
*Sec.-Treas.*, D. J. EMERY,  
 589 King Street,  
 Peterborough, Ont.

### QUEBEC

*Life Hon.-*  
*Chair.*, A. R. DECARY  
*Chairman*, L. C. DUPUIS  
*Vice-Chair.*, RENE DUPUIS  
*Executive*, O. DESJARDINS G. ST-JACQUES  
 R. SAUVAGE L. GAGNON  
 S. PICARD G. W. WADDINGTON  
*(Ex-Officio)*, A. LARIVIERE  
 R. B. McDUNNOUGH P. METHÉ  
*Sec.-Treas.*, PAUL VINCENT,  
 Colonization Department,  
 Room 333-A, Parliament Bldgs.,  
 Quebec, Que.

### SAGUENAY

*Chairman*, N. F. McCAGHEY  
*Vice-Chair.*, R. H. RIMMER  
*Executive*, B. BAUMAN  
 G. B. MOXON  
 A. I. CUNNINGHAM  
 W. J. THOMSON  
*(Ex-Officio)*, McN. DuBOISE  
 M. G. SAUNDERS  
 J. W. WARD  
*Sec.-Treas.*, D. S. ESTABROOKS,  
 Price Bros. & Co. Ltd.  
 Riverbend, Que.

### SAINT JOHN

*Chairman*, F. A. PATRIQUEN  
*Vice-Chair.*, D. R. SMITH  
*Executive*, A. O. WOLFF  
 H. P. LINGLEY  
 W. B. AKERLEY  
*(Ex-Officio)*, J. P. MOONEY  
 H. F. MORRISSEY  
*Sec.-Treas.*, V. S. CHESNUT,  
 P.O. Box 1393,  
 Saint John, N.B.

### ST. MAURICE VALLEY

*Chairman*, A. H. HEATLEY  
*Vice-Chair.*, H. G. TIMMIS  
*Executive*, A. C. ABBOTT J. M. MITCHELL  
 R. DORION G. RINFRET  
 V. JEPSEN H. J. WARD  
 J. JOYAL H. K. WYMAN  
 H. O. KEAY  
*(Ex-Officio)*, C. H. CHAMPION  
 J. H. FREGEAU  
*Sec.-Treas.*, C. G. DETONNANCOUR  
 Engineering Department,  
 Shawinigan Chemicals, Limited,  
 Shawinigan Falls, Que.

### SASKATCHEWAN

*Chairman*, R. A. McLELLAN  
*Vice-Chair.*, A. P. LINTON  
*Executive*, R. W. JICKLING  
 H. R. MacKENZIE  
 B. RUSSELL  
 G. L. MacKENZIE  
 C. J. McGAVIN  
 A. A. MURPHY  
*(Ex-Officio)*, I. M. FRASER  
*Sec.-Treas.*, STEWART YOUNG  
 P. O. Box 101,  
 Regina, Sask.

### SAULT STE. MARIE

*Chairman*, E. M. MacQUARRIE  
*Vice-Chair.*, L. R. BROWN  
*Executive*, R. A. CAMPBELL  
 N. C. COWIE  
 C. O. MADDOCK  
 C. R. MURDOCK  
*(Ex-Officio)*, J. L. LANG  
 A. E. PICKERING  
*Sec.-Treas.*, O. A. EVANS,  
 159 Upton Road,  
 Sault Ste. Marie, Ont

### TORONTO

*Chairman*, H. E. BRANDON  
*Vice-Chair.*, W. S. WILSON  
*Executive*, F. J. BLAIR  
 W. H. M. LAUGHLIN  
 G. R. JACK  
 D. FORGAN  
 R. F. LEGGET  
 S. R. FROST  
*(Ex-Officio)*, A. E. BERRY  
 N. MacNICOL  
 T. H. HOGG  
 C. E. SISSON  
*Sec.-Treas.*, J. J. SPENCE  
 Engineering Building  
 University of Toronto,  
 Toronto, Ont.

### VANCOUVER

*Chairman*, W. O. SCOTT  
*Vice-Chair.*, W. N. KELLY  
*Executive*, H. P. ARCHIBALD  
 I. C. BARLTROP  
 H. C. FITZ-JAMES  
 H. J. MacLEOD  
 R. E. POTTER  
*(Ex-Officio)*, J. N. FINLAYSON  
 T. V. BERRY  
 H. N. MacPHERSON  
*Sec.-Treas.*, P. B. STROYAN  
 2099 Beach Avenue,  
 Vancouver, B.C.

### VICTORIA

*Chairman*, A. S. G. MUSGRAVE  
*Vice-Chair.*, KENNETH REID  
*Executive*, A. L. FORD  
 B. T. O'GRADY  
 J. B. PARHAM  
 R. BOWERING  
*(Ex-Officio)*, A. L. CARRUTHERS  
 G. M. IRWIN  
 E. W. IZARD  
*Sec.-Treas.*, J. H. BLAKE,  
 605 Victoria Avenue,  
 Victoria, B.C.

### WINNIPEG

*Chairman*, V. MICHIE  
*Vice-Chair.*, D. M. STEPHENS  
*Executive*, C. V. ANTENBRING  
 H. B. BREHAUT  
 J. T. DYMENT  
 H. W. McLEOD  
 T. E. STOREY  
*(Ex-Officio)*, H. L. BRIGGS  
 J. W. SANGER  
*Sec.-Treas.*, C. P. HALTALIN,  
 303 Winnipeg Electric Chambers,  
 Winnipeg, Man.

# THE NEW OIL-HYDRAULIC PRESS IN MUNITIONS MANUFACTURE

JOHN H. MAUDE, M.E.I.C.

Chief Designer, Mining, Metals and Plastics Machinery Department, Dominion Engineering Company Limited, Lachine, Que.

Paper presented before the General Professional Meeting of The Engineering Institute of Canada, at Montreal, Que., on February 6th, 1942.

During the last world war, the hydraulic press was a slow, powerful, ponderous machine, and considered from both a theoretical and practical aspect it was a crude instrument for applying controlled severe stress to metal. It was affected by a multitude of maintenance troubles, caused by a water system with triplex pumps, weight loaded accumulators, long downshop pipe lines and shock alleviators, and in consequence it did not give entire satisfaction when employed in modern mass production.

Since then, however, the automobile and other allied industries have demanded and obtained radical improvements in machinery available for the fabrication of their various components, and one of the most progressive developments has been the design of an entirely new type of press, which has given much better results.

This press employs oil as the pressure medium, and is entirely self-contained with a circulatory system. A high pressure radial piston pump is used as the power unit, direct coupled to its motor, and the whole with suitable starting equipment and oil tanks is carried on the press proper. Extreme rigidity is provided by side housings. The machine of this type manufactured by the Dominion Engineering Company is known as the Speed-Hy-Matic press; its main features are indicated in Fig. 1. The fundamentals of its working are indicated diagrammatically in

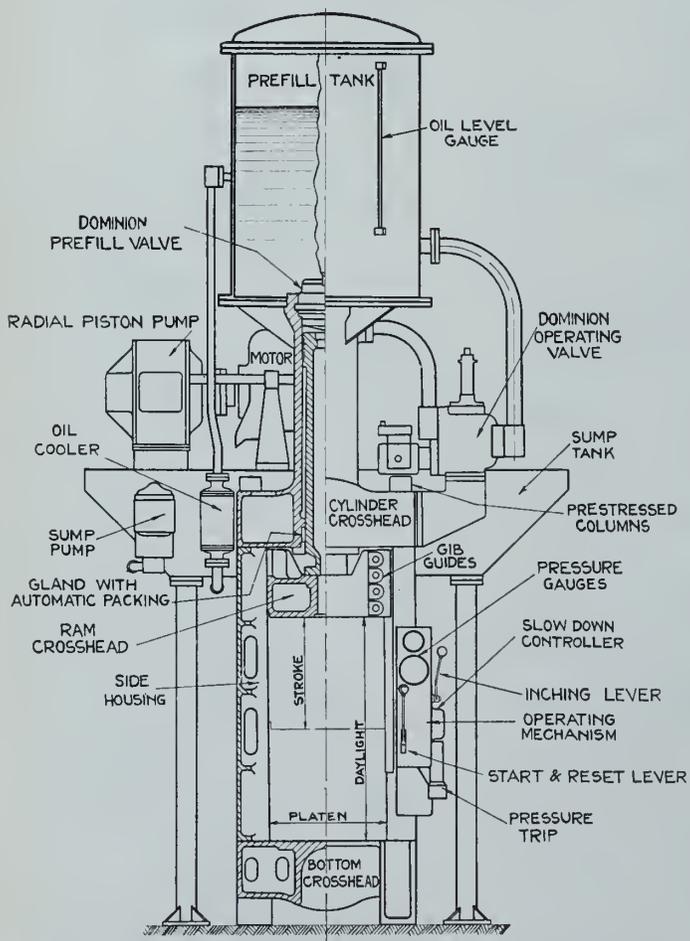


Fig. 1—Principal features of Speed-Hy-Matic press.

the circuit shown in Fig. 2 which particularly applies to a drawing press. The oil supply is carried overhead in the prefill tank with a filling check of special design in the centre of the top head. During the approach or prefill part of the stroke, when the ram and slide advance by gravity, the prefill valve opens and pump discharge at no pressure augments the flow into the cylinder. This prefill valve is a development of the filling check valve, streamlined for flow in both directions. As soon as the work piece is contacted, the prefill valve closes automatically, and the pumps take hold to develop pressure. It is essential that the filling of the main cylinder should occur without turbulence or cavitation, or there will be time lag before the pressure develops. With this streamlined prefill valve, approach

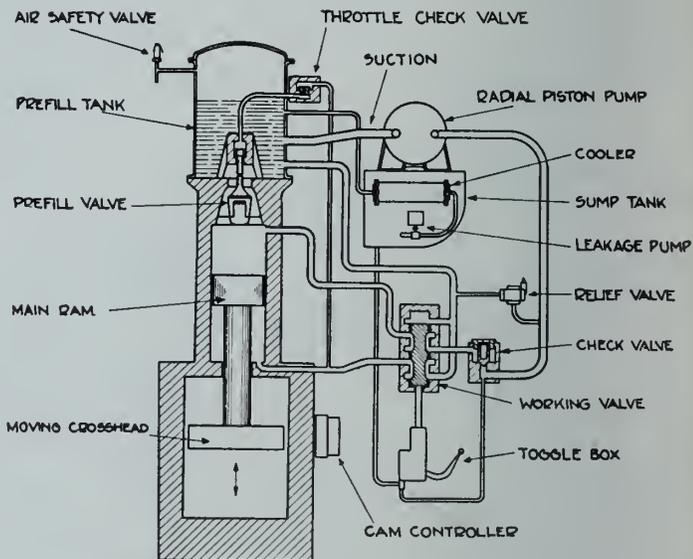


Fig. 2—Working circuit of drawing press.

speeds of 20 inches per second are obtained without cavitation. It is seen that the pumps develop pressure immediately against the work resistance to complete the work stroke and this occurs at absolutely uniform speed. Devices are provided, such that at the end of the work stroke the machine is tripped automatically, either on the attainment of a certain predetermined adjustable pressure, or by distance in any portion of the stroke, and the press then automatically returns to its upper position. This top position is also adjustable at the will of the operator, so that the daylight\* is variable as well as the length of the pressure stroke. When the slide or moving crosshead reaches the desired upper position limit, the pumps, which run continuously, are stroke neutralized so as to pump only as much fluid as will make up for the leakage content of the system, and also so as to develop no more pressure than is essential to hold up the moving mass. It is readily seen that a most economical work cycle is thus obtained.

The heart of the press is the high pressure radial piston pump, of positive displacement type, which is direct coupled to the motor and supplies the oil under pressure to the press cylinders. This pump is shown in Fig. 3 and

\* "Daylight" means the maximum distance between the upper face of the bottom crosshead and the under face of the ram crosshead when at the top of its stroke.

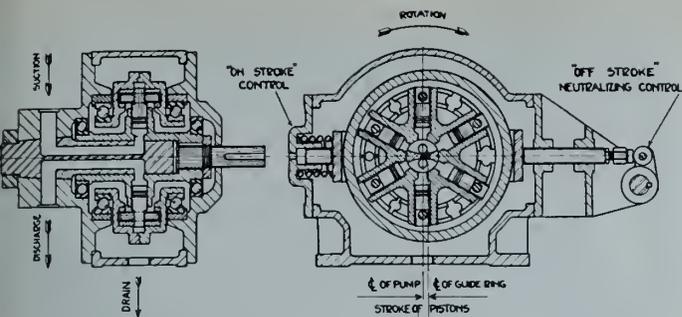


Fig. 3—Working parts of radial piston pump.

consists essentially of a cylinder assembly mounted in ball bearings, fitted with a number of radial plungers and driven by a spindle. The cylinder assembly rotates so as to carry the plungers with it. These plungers are ground and lapped in the cylinder, and have their outer ends pivoted in slippers, the thrust of each being taken in the floating ring assembly. The floating ring is moved by one of several devices in a lateral direction with respect to the shaft. The ported valve pintle in the centre is fixed to the "fluid end" cover. It is seen that rotation of the pump shaft and cylinder block will rotate the pistons also. If the axis of the floating ring coincides with that of the shaft, there is no pumping action because the pistons have not any stroke, but when the floating ring is moved off centre, piston displacement occurs, the discharge of the pump will be proportional to the shift of this ring, and the plunger stroke will be twice the ring movement. The multiplicity of plungers develops an overlapping discharge which is without noticeable pulsation, e.g., a seven cylinder pump rotating at 840 r.p.m. will develop 5880 small pressure crests per minute or 98 per second.

The pump or pumps are equipped with a special dual automatic stroke control as shown in the figure. One side has a "stroke holding cylinder," while the other side has a "cam lever stroke neutralizing control."

As previously stated, the system fluid is lubricating oil, approximately SAE. 45, having a viscosity approximately 920 SUV\* at 100 deg. F., and highly temperature-stable so as to retain a viscosity better than 340 SUV at 132 deg. F.

The fluid medium being lubricating oil, permits the use of a simple balanced piston valve, with the beat lapped into the body. Since it is entirely submerged in oil, wear and maintenance are practically eliminated.

Mention has already been made of semi-automatic operation from a single hand lever for the start only, and a patented simple mechanism has been developed whereby all the essential automatic motions may then be obtained.

Manual operation may also be employed, in which case press movement will follow the hand of the operator. Manual inching at creepage speeds for die setting is provided for by the insertion of a reduction gear. For semi-automatic operation, a full lever stroke will lock the toggles so that the valve is in the work stroke position, and either after pressure development or alternatively after a certain length of stroke, the toggles are automatically broken so as to reverse the valve, when the press immediately returns to the open position.

#### AN ANALYSIS OF VARIOUS PRESSES EMPLOYED

In the selection of a press required to perform a prescribed duty in cartridge case manufacture, one should choose a machine which is designed to suit the nature of the work, and if possible it should be capable of handling another allied operation just as efficiently when another machine in line is temporarily shut down for adjustment or repair. At first sight this requirement of double duty in

emergency, with maximum efficiency for both cycles, appears to be almost impossible. An examination of the leading characteristics of available machines indicates that this is not the case, and that they may be fitted into either of two most important classifications:

1. The fixed stroke type with fixed daylight.
2. The variable stroke machine with variable daylight.

The two groups are so fundamentally different, that a comparison of the leading characteristics shows that the former lacks certain desirable features. A fixed stroke press may be described as a machine whose mechanism, such as slider crank and crank toggle, will employ a low force or effort over a long distance to produce a higher effort through a shorter distance, and thus develop mechanical advantage. In this kind of machine, the opening, gap, or daylight is a fixed dimension except for a minor essential adjustment, and the stroke of the machine is definitely fixed by the throw of crank. Once a mechanical press of this kind is set up for a certain operation, and the crank speed decided upon, the maximum drawing speed becomes fixed, and this is not a desirable feature.

Experiments in a certain arsenal, where special tools and carboly dies were employed, indicate a limit draw speed for cartridge case brass as follows in connection with 75 MM. cases:—

1st and 2nd draw	—35 feet per minute
3rd draw	30 feet per minute
4th draw	25 feet per minute

and this under favourable conditions, with a laboratory atmosphere, accurate annealing control, with trained workmen and first class technical supervision.

In Canadian factories, with the new oil-hydraulic press, raw labour, and standard commercial high carbon steel tools, we regularly draw at speeds of 27 feet per minute and this on the 4th draw operation of the 25 pdr. case.

A 60-ton Speed-Hy-Matic press with an adept operator has regularly produced 1,450 first-draw pieces per hour for the 25 pdr. cartridge case.

Figure 4 shows the velocity-stroke diagrams of a crank press compared with the modern oil-hydraulic press, with the tooling employed in the 4th draw of a 25 pdr. cartridge case. Cyclic times for the operations are also given.

It is axiomatic that the velocity diagram is a sine curve, and it is seen that the tool must strike the work with a very considerable impact, for at the instant of contact the speed is 70 feet per minute, which diminishes to 27 feet per minute throughout the stroke according to the law of simple harmonic motion. This means that as the draw punch proceeds, the metal is constrained to move at a speed which varies greatly; this is not the best practice for drawn work. Present evidence borne out in practice indicates that this

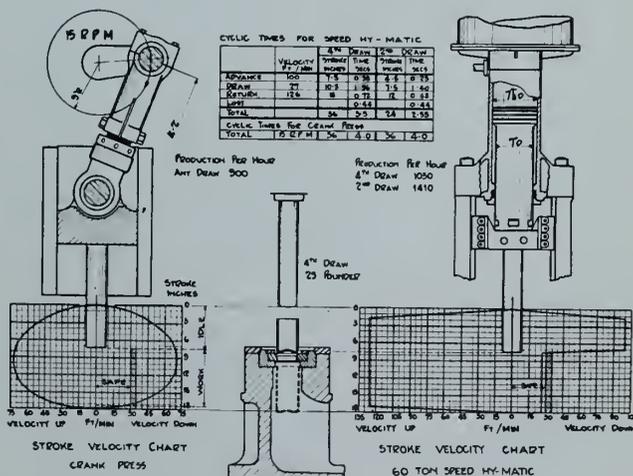


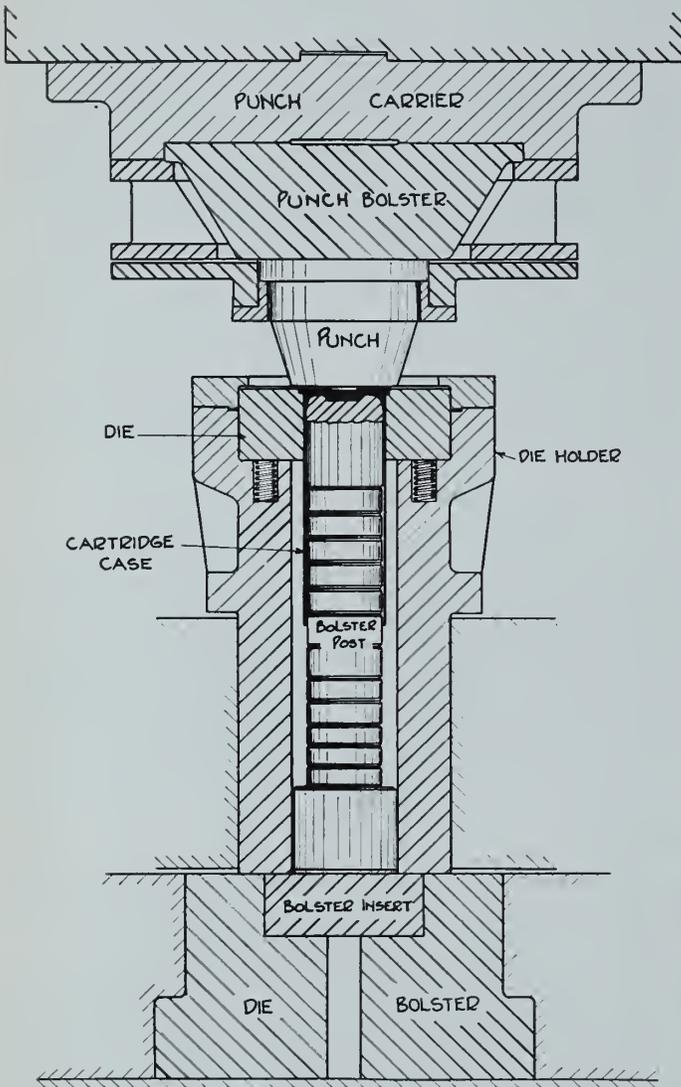
Fig. 4—Velocity-stroke diagrams of crank press and Speed-Hy-Matic press.

\* Saybolt Universal Viscosity.

rapidly changing velocity prevents full advantage being taken of the metal's capacity to suffer plastic deformation, and rupture may occur.

### INDENTING AND HEADING CARTRIDGE CASES

Indenting is the operation of making the pressed depression in the head of the case which is subsequently machined to take the primer.



TOOLING FOR HEADING OPERATION  
25 PDR. CARTRIDGE CASE

Fig. 5—Tooling for heading operation on cartridge cases.

Heading is the term used to describe the pressing operation to increase the hardness of the head and form the retaining flange. Automatic variable-tonnage\* heading and indenting is now accepted as standard practice. In both of these operations the press must necessarily operate against solid resistance in the form of a tool post. With mechanical presses it is essential that the tool post be set accurately as regards height, but a gradual reduction of tool post height occurs by repeated operation due to the ironing and work hardening of this member which must necessarily occur, and the effect is expressed in reduced tonnage on the work so that adjustments become necessary. Whenever a tool post is replaced due to breakage or undue wear the tonnage adjustment on a mechanical press must be repeated, for without this there is risk of mechanical failure due to excess tonnage developed at the end of stroke.

\* "Tonnage" means the total load in tons applied by the press to the work piece.

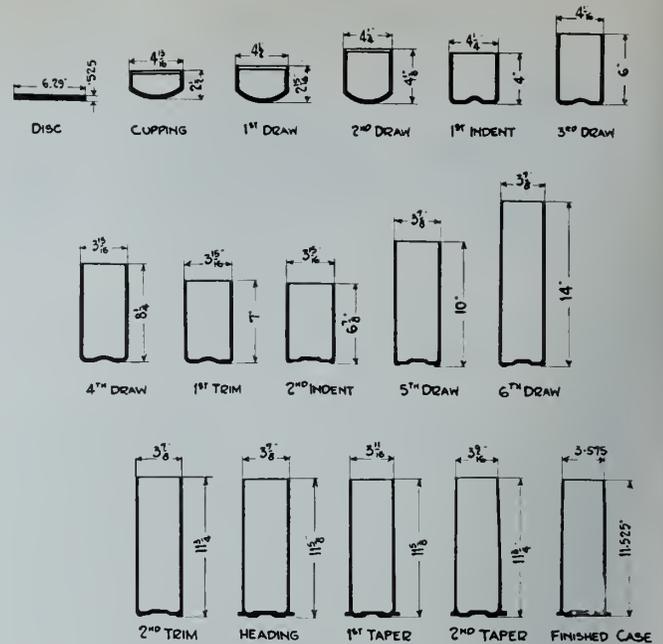


Fig. 6—Stages in manufacture of cartridge case.

In the new oil-hydraulic press it is stressed that the stroke and daylight may be varied so that variation in tool post height does not affect either the safety or the life of the press or of the dies themselves.

Figure 5 shows the typical tooling employed in either of these operations. In an oil-hydraulic press, overloading is impossible, first due to a pressure trip which is adjustable up to the maximum tonnage of the press, and also because of relief valve protection.

Heading and indenting generally have to be done in two stages, and it is possible to employ two separate selected tonnages each as best suited for either stage of the work.



Fig. 7—Cupping 4-inch cartridge case on 300-ton press.

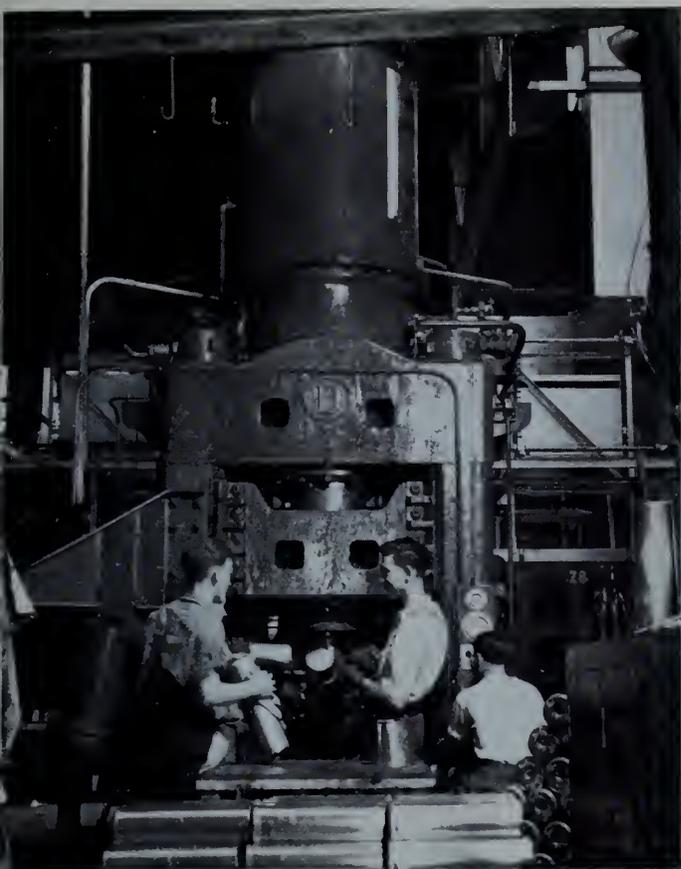


Fig. 8—Indenting 4-inch cartridge case on 800-ton press.

In a toggle operated press there is no slowdown at work contact, whereas in an oil-hydraulic press this feature is normal design so as to eliminate the impact on the work piece, and in addition on work contact the pressure is gradually built up hydraulically against resistance until the desired maximum is exerted. This gradual pressure build-up means that in heading some cases, such as in 75 MM. cases, double stage heading has been found unnecessary.

#### THE MANUFACTURE OF CARTRIDGE CASES

In order to withstand the increased charge of propellant, improvements in the manufacture of cartridge cases for fixed ammunition were found necessary. A number of plants are now in full production in the manufacture of cases of different sizes including 2 pdr., 40 MM., 75 MM.,



Fig. 9—Heading 4-inch cartridge case on 2000-ton press.

25 pdr., 4.5 in., 3.7 in. and 4 in. with arrangements to manufacture up to the 6 in. case when deemed necessary. Millions have already been shipped overseas and additional plants will soon be in operation. The brass is obtained from the brass manufacturer in the form of discs, as this holds the necessary scrap at its source of supply.

It may be of interest to give particulars of the manufacturing methods employed on two widely different examples, namely the 25 pdr. 3.45 in. cartridge case which is for the field gun replacing the old 18 pdr., and also the one necessitating the longest draw in practice to-day, namely the 4 in. naval case. The first operation is one known as cupping, after which follow certain draws, indents, heading and tapering operations substantially in the order as stated, with annealing necessarily placed between certain operations. The various stages for the 25 pdr. case are shown in Fig. 6.

#### OPERATIONS ON THE 25 PDR. 3.45 IN. CARTRIDGE CASE

In all, this requires 34 operations, as listed below:—

- |               |                |                    |
|---------------|----------------|--------------------|
| 1. Cup        | 13. Clean      | 25. Heading        |
| 2. Anneal     | 14. 4th draw   | 26. Wall Anneal    |
| 3. Clean      | 15. 1st trim   | 27. 1st taper      |
| 4. 1st draw   | 16. 2nd indent | 28. 2nd taper      |
| 5. Anneal     | 17. Anneal     | 29. Bullard Lathes |
| 6. Clean      | 18. Clean      | 30. Oakite Clean   |
| 7. 2nd draw   | 19. 5th draw   | 31. Stress Relieve |
| 8. 1st indent | 20. Anneal     | 32. Buffers        |
| 9. Anneal     | 21. Clean      | 33. Inspection     |
| 10. Clean     | 22. 6th draw   | 34. Stamping       |
| 11. 3rd draw  | 23. 2nd trim   |                    |
| 12. Anneal    | 24. Steam Heat |                    |

In the selection of a suitable press to perform a set operation it is advisable to have excess tonnage available so that any imperfections in annealing will not cause the work piece to stall in the machine.

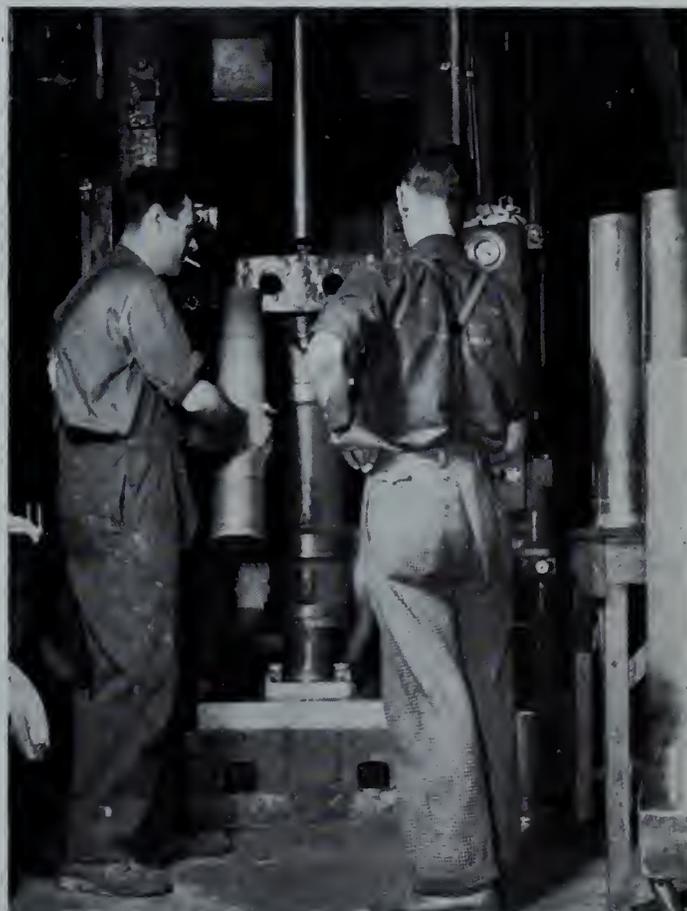


Fig. 10—Necking 4-inch cartridge case on 60-ton press.

This case probably represents one of Canada's biggest achievements in this field of endeavour, because it requires the longest draws, extremely difficult hardness graduation over a large area, and the highest tonnage for heading.

There are 39 separate operations required in the manufacture of a 4 in. cartridge case from the brass disc.

OPERATIONS ON 4-IN. NAVAL CASES

- |                |                 |                      |
|----------------|-----------------|----------------------|
| 1. Cup         | 16. Anneal      | 29. Wall Anneal      |
| 2. Anneal      | 17. Pickle      | 30. Pickle           |
| 3. Pickle      | 18. 5th draw    | 31. 2nd taper        |
| 4. First draw  | 19. 2nd trim    | 1st operation        |
| 5. Anneal      | 20. 2nd indent  | 32. 2nd taper        |
| 6. Pickle      | 1st operation   | 2nd operation        |
| 7. 2nd draw    | 2nd operation   | or necking           |
| 8. Anneal      | 21. Anneal      | 33. Mouth anneal     |
| 9. Pickle      | 22. Pickle      | 34. Base turn        |
| 10. 3rd draw   | 23. 6th draw    | 35. Drill clip holes |
| 11. Anneal     | 24. 3rd trim    | 36. Marking          |
| 12. Pickle     | 25. Heading     | 37. Stress relieve   |
| 13. 4th draw   | 26. Wall anneal | 38. Buffing          |
| 14. 1st trim   | 27. Pickle      | 39. Inspection       |
| 15. 1st indent | 28. 1st taper   |                      |

A number of these operations are illustrated in Figs. 7 to 11, as follows:

300-ton press engaged in cupping (Fig. 7).

Indenting on 800-ton press. A two-position shuffle feed is employed. (Fig. 8).

2,000-ton press engaged in heading, (Fig. 9), work going in and product coming out.

Necking on a 60-ton press. Tapered cases are on the right; a case is in the press, and the product is held by the operator on the left (Fig. 10).

Mouth annealing after necking (Fig. 11). This is done in a continuous furnace.

SHELL FORGING PRESSES

Whereas in the last war and with previous manufacturing methods the shell cavity was finish-machined, a finish-forged cavity to fine finish and tolerance is now prescribed.

The punch and draw method was usual, and to-day we



Fig. 11—Mouth annealing 4-inch cartridge case after necking.

find plants still using this same technique except that the draw rings are replaced by draw rollers. This process necessitates two machines, one punch and one draw. There is also a single machine on the market which is of the multiple progressive punch type, and as many as five or six separate operations must occur successively on the billet. In general the forging technique of the last war caused the metal to flow in the direction opposed to punch travel. This involved extrusion of the metal, resulting in rapid wear of both punch and die liner. It is thus seen that any forging process for the manufacture of shells which employs this

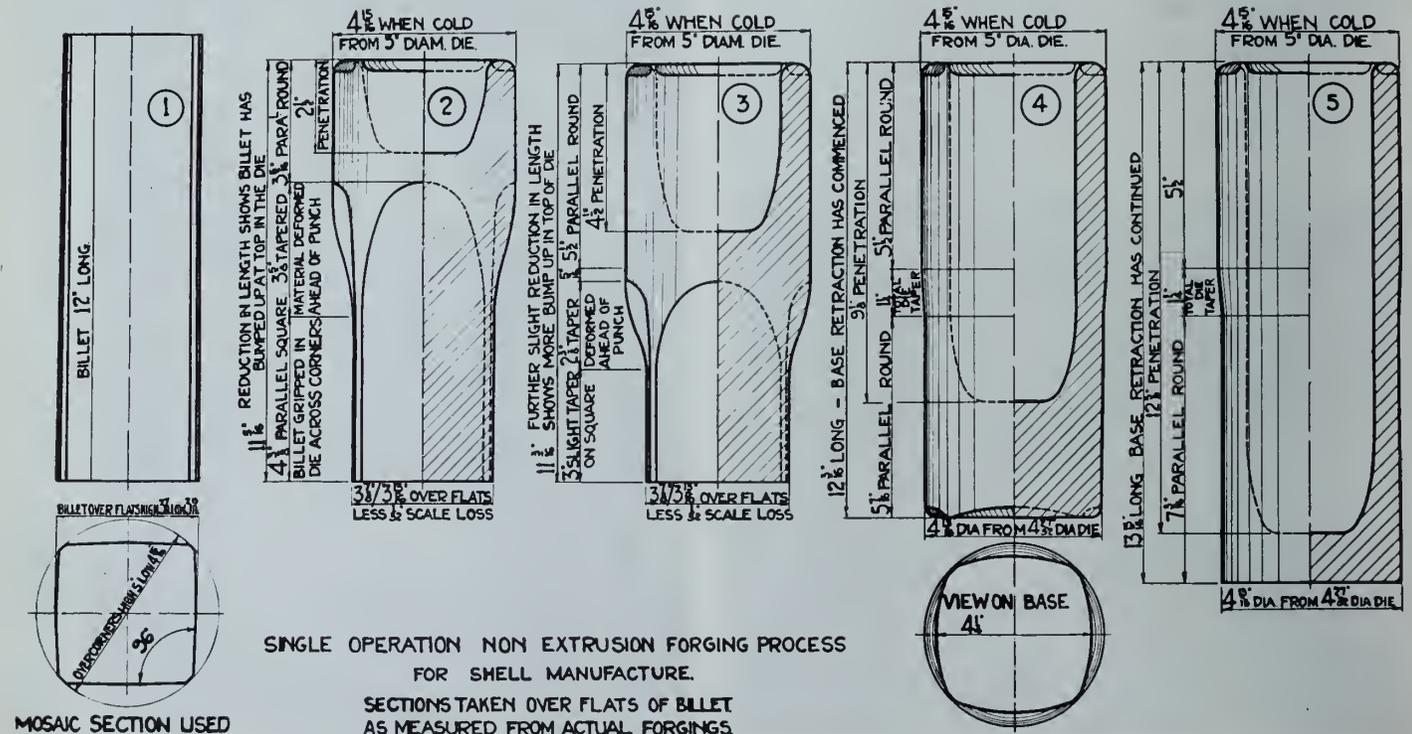


Fig. 12—Diagram of various stages in the single operation non-extension forging process for 4 and 5-inch shell.

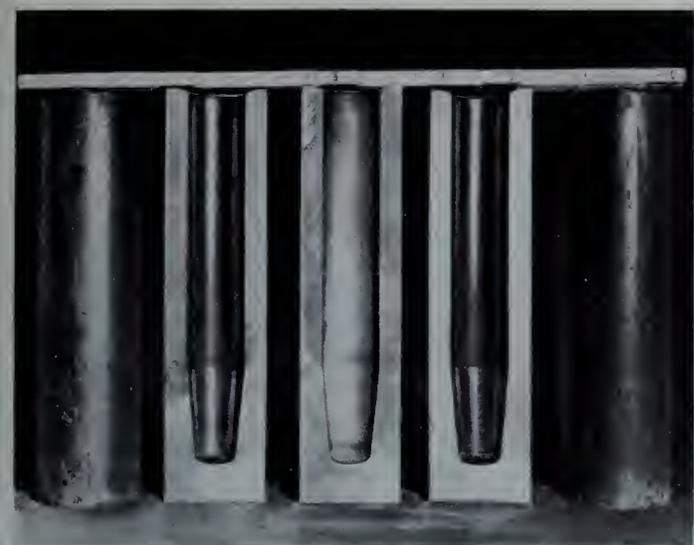


Fig. 13—Finish-forged cavity forgings for 25-pounder shell.

extrusion method must show a relatively high tool cost if accurate forgings with a finish-forged cavity are to be produced. After an extensive study of the various shell forging methods an entirely new protected one-operation process for forging shells with finish-forged cavity was evolved. The press, which has a three-station turret on the moving crosshead, employs but a single stroke of the punch into the billet with a special self-opening hydraulically cushioned die, and uses a non-extrusion process of forging.

Figure 12 shows the way in which the billet for a 4.5-in. shell becomes a finish-forged cavity forging. See also Fig. 13 and note.

As was anticipated, the forging pressure required has proved to be about half of that required for the straight punch method, thus permitting the use of a refined cast iron punch tip instead of tips of heat-treated tool steel. The overall tool cost has thus been considerably reduced, for cast iron die liners are also employed, and the average tool cost including all components works out at about  $9\frac{1}{2}$  c. per shell. It is seen that the metal is constrained to move downwards in the same direction of motion as the punch, but in advance of it as illustrated in Fig. 12. This better metal flow gives a more desirable form of grain structure without any evidence of the button

which was so prevalent in previous processes. The principal advantages of this new process include substantial savings in material cost, base thickness is reduced to a minimum and eccentricity is remarkably small; more rapid production of forgings is permitted to closer tolerances; an extremely low tool cost which has hitherto been unattainable; savings in forging labour; substantial reduction in rejected forgings and better material as regards grain structure in the forging itself.

Eccentricity in a piercing operation is one of the first troubles which must be overcome. It will be observed that in order to avoid this, a press has been designed having very rigid construction with side housings and prestressed columns and adequate guides to the moving crosshead. Again it was found that in the last war it was practically impossible to punch a hole whose length exceeded four



Fig. 14—Tools for 4-inch naval shell forging.

punch diameters. With this new process we are able to punch a finished cavity to perfection with a six-to-one ratio of punch length to diameter. Another important improvement embodied in the machine is the very good guide provided for the punch itself, which not only makes the punch start in the centre of the billet, but tends to hold it along this line of action. Again it will be noted that a billet of square or mosaic form is employed, and by the use of a split die it is positively gripped in position, because the distance across the corners of this billet is greater than the diameter of the die itself. The punch, tips, dies, and guide bushings for 4-in. naval shell forgings are shown in Fig. 14.

## THE QUALITY UNDERLYING THE BRITISH AEROPLANE

LT. COL. W. LOCKWOOD MARSH  
EDITOR OF "Aircraft Engineering"

The 'Battle of Britain' proved beyond all cavil the superiority in performance and fighting qualities of British aeroplanes of the fighter class, but numerous cases of the safe return to their bases of bombers (flying in some instances, hundreds of miles in a badly shot-about condition) have, though in a less spectacular way, equally demonstrated the excellence of the materials incorporated and the high standard of workmanship used in their production.

This is, in the first place, the result of years of research work and technical development in the gradual evolution of new materials. It has been estimated that it has, on occasion, taken fifteen years to develop, to the stage of being a commercial product suitable for introduction into some part of an aeroplane or aero-engine, a light alloy from the time when the first stages in the process were begun in the laboratory—at the Government National

Physical Laboratory or, it may be, in the works of some private firm.

It, is perhaps, interesting to examine this process and follow the stages by which the new material is developed in this way. Owing to the growing claims arising from rapid progress in aeroplane design, the need sooner or later arises, let us say, for a material which will stand up to more strenuous conditions of operation than those which have hitherto proved satisfactory. The chemist and the metallurgist consider the physical properties that will be necessary in the material to meet these fresh demands and investigate the precise effects that various changes in the composition—by the introduction of new elements, or variation in the quantities of existing ones—will have on these properties. The 'perfect' composition may then be found to produce a material which is ideal for the purpose so far as one strength characteristic is concerned but

fails to give satisfaction in other respects; owing, possibly, to its being too brittle, or possessing some other defect. This difficulty may be overcome by close study and patient experiment in the heat treatment, or some other process to which the material is subjected during the various stages of working it up into the finished part. This may necessitate a long series of experiments lasting over a considerable period of time; until eventually, a satisfactory 'laboratory' product is produced which fulfils the requirements that have originally been put before the research workers. Even then, however, there is still much to be done, because it is a commonplace in the materials world that something which can be produced time after time by the leisurely and closely-controlled methods of the laboratory to give the same results under tests, is not by any means always suitable at first for rapid turning out in quantity by the more rough and ready means which only are possible in a factory. Bars of the material are, therefore, tried out and produced by ordinary commercial processes. This again is a matter of trial and error involving alteration of existing methods, tried and proved, and, frequently, the installation of new and improved machinery and equipment.

All this procedure naturally takes time and requires much patient thought and experiment. Suppose the material has passed all the tests, and is shown to be satisfactory for the purpose for which it is designed, it then has to receive approval before it can be used in an aeroplane to be built for the Royal Air Force so that there is no fear of it lowering the standard of strength insisted on in every part of a machine.

All the principal British aeroplane firms, including of course aero-engine firms, are scheduled by the Ministry of Aircraft Production as 'approved for design and construction', which means that such a firm is authorized to use a new material once it is manufactured and provided that it conforms to the specification drawn up by the firm. This covers its use so far as the types of aeroplane designed by this individual firm are concerned. But it may be that the utility of the material is such that it is desired to use it more widely. In this case the specification is taken up by the Directorate of Technical Development

and is issued as a draft specification. This is a preliminary step to a still wider adoption, which will be explained in a moment. During this stage, the specification is circulated in the Aircraft Industry, and to the technical staffs of any other engineering firms concerned with the production of the material, for criticism and comment. These are examined by the Directorate of Technical Development, amendments incorporated, and it is then issued as a 'D.T.D. Specification' with a number. Even this is still only a preliminary stage in the journey of the new material on its long road to becoming a fully approved 'British Standard'. It frequently happens that it does not achieve popularity, or for some reason is found only to have a limited application—in which case it remains a D.T.D. Specification throughout its career. If, however, it proves to be a material of widespread utility for which there is a considerable demand, it goes a stage further and becomes a 'B.S. (British Standard) Specification'. To achieve this final distinction, it is handed over to the British Standards Institution, a semi-official body supported by all the various branches of the engineering industry of this Country, and is exhaustively examined and considered anew by one of the Institution's technical committees, which are composed of individuals, either in Government establishments or firms, with special experience and knowledge of the particular subject concerned; who give up part of their busy lives entirely free and voluntarily to this most important work. If the material passes this final scrutiny, it is issued by the Institution as a new 'British Standard'; than which there can be no higher hall-mark.

Even after this, however, the material itself is still subject to constant and repeated examination and test by inspectors on the staffs of the 'approved' firms, or by A.I.D. (Aircraft Inspection Directorate) inspectors, all through its career, from its first start as a bar or billet or what-not until it at last takes its place as a vital part, or fitting, in the complete aeroplane—when it carries for all to see the indentation made by the final inspection stamp showing that it has passed the vigilant eyes which have carefully scrutinized it at each stage in its evolution to the finished product.

COMPARISON OF FIRE POWER OF LEADING GERMAN, BRITISH AND U.S. FIGHTERS (1)

Country	Type	Armament	Rounds per Minute	Lb. per Minute	Duration of Fire
British.....	<i>Spitfire I</i> .....	8 x .303 in.m.g.....	9,600	240	—
German.....	<i>Me. 109 E</i> .....	2 x .308 in.m.g.(2)..... 2 x 20 mm. cannon.....	2,400 } 1,200 } 3,600	60 } 300 } 360	—
British.....	<i>Spitfire V</i> .....	4 x .303 in.m.g..... 2 x 20 mm. cannon.....	4,800 } 1,200 } 6,000	120 } 300 } 420	2½ mins.
German.....	<i>Me. 109 F.I.</i> .....	2 x .308 in.m.g.(2)..... 1 x 20 mm. Mauser Cannon.....	2,400 } 900 } 3,300	60 } 225 } 285	30 secs. 13 "
British.....	<i>Hurricane II B</i> .....	12 x .303 in.m.g.....	14,400	380	—
British.....	<i>Hurricane II C</i> .....	4 x 20 mm. cannon.....	2,400	600	—
U.S.....	<i>Airacobra</i> .....	1 x 37 mm. cannon (3)..... 2 x .50 in.m.g..... 4 x .30 in.m.g.....	120 } 1,500 } 4,800 } 6,420	—	15 secs. 22 " 50 "

(1) The figures are based on the following rates of fire: .303 in. machine guns, 1,200 rounds per minute, weighing 40 rounds per lb.; 20 mm. cannon, 600 rounds per minute, weighing 4 rounds per lb.; 20 mm. Mauser cannon, 900 rounds per minute, weighing 4 rounds per lbs.; 37 mm. cannon, 120 rounds per minute; .50 in. machine gun, 750 rounds per minute. The weights of the projectiles of the two latter (U.S.) guns are not known.

(2) Interrupted. Firing through airscrew disk.

(3) *Airacobras* supplied to the R.A.F. are fitted with a 20 mm., in place of the 37 mm., cannon.

# SHIPYARD PRODUCTION METHODS

HOWARD JOHNSON, M.I.N.A. (London), M.E.I.C.  
*General Manager, Midland Shipyards Limited, Midland, Ont.*

Paper presented before the Montreal Branch of The Engineering Institute of Canada, on January 8th, 1942

**SUMMARY**—An outline of building operations for steel vessels, giving the proper sequence of erection phases in order to obtain a maximum output. Charts are used to illustrate the progress of the work and to determine and correct the causes of delay.

Prime Minister Churchill has stated that the key to winning the war is ships and still more ships.

The lay mind has little knowledge of the tremendous effort necessary to accomplish the building of the great number of vessels required. Obviously no more ships can be brought into service than those which can be supplied with the essential equipment to run them. Looking at a modern standard specification, such as that of a 10,000-ton deadweight cargo vessel, we may well reconsider our attitude towards the battles of the Atlantic and Pacific and redouble our efforts in the face of such complexity.

## PLANT LAYOUT

The importance of shipyard layout and lifting and handling equipment cannot be overstressed. When it is considered that the general cargo vessel of, say, 10,000 tons deadweight requires about 3,000 tons of steel to build the hull, the necessity of careful layout is apparent. As the costs of labour rise, more careful planning must be applied to the mechanical handling of this steel from the freight car, through the various operations, until it becomes part of the structure. Transport must be reduced to a minimum from punch and welding sheds to erection at ship.

To attain rapidity of erection on the berth, in recent years, great improvements have been made in crange facilities. Formerly the old "sling pole" was the prime means of lifting; today, tower cranes, jib revolvers, gantries and lattice racking and slewing derricks are in use according to the layout of plant, type and size of ship to be built; economical, mechanical power supplanting manpower and so speeding up erection. The wood staging, generally shutting out the layman's view of a ship until she is almost ready for launching, is now largely superseded by steel uprights on special bases, quickly adjustable to breadths of various ships. Assuming that supplies are available to pre-fabricate large portions of the vessel, ample storage space near the berths is very important so that the number and travel of lifts is a minimum.

If pre-assembly work is well organized, two efficient cranes are capable of easily erecting the entire hull of the present standard cargo vessel in under 14 ordinary working weeks whilst, at the same time, liberally serving adjacent berths. It is essential, too, that ample road area be arranged to feed the erection cranes. Experience has actually shown that in some yards an improved output can be attained by reducing the number of berths but arranging better access roads and lifting facilities.

In laying out a new shipyard the method of estimating the amount of heavy equipment required is not difficult. Having surveyed the available site and decided on the largest type of ship to be built, the launching frontage or waterfront is measured and the number of berths settled. Given reasonably skilled labour and technique, it is mere arithmetic to arrive at the annual potential output for all complete hulls and the plant and equipment necessary to feed these berths. Balance between production, equipment and berth facilities is essential; this implies an intimate knowledge of the output capacity of every machine.

In earlier shipbuilding most of the heavy, external

transport was provided by steam locomotive cranes whilst the lighter materials were hauled by manual power on small bogies or trucks, the ground being graded but untreated. To-day there is a growing tendency towards the use of concrete over the site and on the berths, while rubber-tired motor cranes and low trucks are in use for all general transport. No matter what means of transport is employed, the modern shipyard has adopted the factory principle of routing. That is to say, from receipt of steel from the mills until its erection in the ship, the layout should be such that materials pass along a straight-line route through the various machines to the berths. The best exponents of such methods have been the Dutch, although yards in other countries are developing along similar lines: the increasing use of electric welding has helped in this connection.

The advance of shipbuilding has developed in three general stages.

- (a) Elimination of manual labour in haulage and erection,
- (b) Elimination of skilled labour by the extension of the use of moulds, and,
- (c) Elimination of unskilled labour through the use of improved tools and appliances.

There is also the tendency to build specific types of vessels in particular yards, rather than for each firm to develop its plant to cope with every class of ship. The economical advantages of such a development are obvious, as a different layout, from balance-sheet considerations—the acid test of efficiency—is required for the building of passenger vessels from that needed for merchant vessels.

## PLANNING

Attention can now be focussed on the processes of production. Under to-day's conditions, when builders need not haunt ship-owners' offices and when repeat orders are flowing fairly freely, even though in a somewhat jerky manner, from Government departments, every one will



Fig. 1—Typical 10,000-ton deadweight cargo vessel just launched.

PROGRAMME																		
BERTH NO	1942												1943					
	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	
1		YARD NO																
2			YARD NO															
3				YARD NO														
4					YARD NO													

Fig. 2—Master chart or programme.

agree that shipbuilding can, and indeed must, be systematically planned and intensively organized to obtain those results essential to the winning of our oceanic battles.

The facts of the war at sea should be prominently displayed on every vacant space in all shipyards, supply-fields, and allied spheres; for only those who have, in some manner or other, been in direct contact with that war, either on the high seas or in the repair yards, have any real conception of its intensity.

The author will try to sketch the procedure in planning and building typical 10,000-ton cargo vessels, assuming that all drawings are available and orders forthcoming as berths become vacated. A ship of this type is shown in Fig. 1.

A shipyard to be capable of building such ocean-going vessels efficiently must have the necessary equipment to process materials within reasonable time. For this size of ship, 20 weeks on the berth, from laying of keel to the launch, is a fair period for building; five weeks after the launch she should be on trial trip, and then ready to take her place at the loading berth to await convoy.

We shall assume this is a four-berth shipyard. The first sheet prepared is the Master Chart, shown in Fig. 2. commonly known as the Programme. On this is marked a period roughly equal to five months or 20 working weeks. As yet no dates are inserted; for the purchasing department is hard at work contacting the various supply controllers, steel mills, and priority experts in an endeavour to secure a smooth and ample supply of steel.

It is essential that the technical staff should be familiar with the sequence of works operations and the time occupied on key operations, such as frame bending, pre-fabricating bulkheads and other large parts of the hull structure. If this planned series is not understood, considerable time-lag and much disorder can arise in the works because these operations form the basis on which steel must be ordered for mass-production methods to be in any way effective. A chart is drawn up indicating the groupings of steel for various operations ensuring that each section shall be complete with all its attachments.

Standard instructions must be issued to the mould loft, as well as to each department, indicating the entire system of erection, so that moulds and templates will be prepared in correct sequence in parallel with speed of production in the shops.

As the drawings are, in the main, already available a large amount of the mould loft work will be completed ahead of steel deliveries. Should there be any prospect of this loft work not being in advance, overtime or other means should be worked to avoid the expense of slowing down production.

When the date for steel deliveries is decided, the time required to manufacture the frames and floors over half-length amidships is added: this fixes the date of laying the keel; processing of keel, centre girder and bottom shell takes about the same time as the framing for the half length amidships.

As regards questions of production, not finance, it is a waste of process time to lay the keel before sufficient material is prepared to ensure continuity in erection. Once erection starts this should be a continuous process, each step tying-up the preceding one in correct sequence.

The same process by which the date of laying the keel was decided is repeated for each berth until the programme is filled and all berths occupied; dates are then inserted on the programme. Simply by adding 20 weeks to the keel dates the approximate launch dates are established for the first four vessels. The period of 20 weeks is hypothetical and will vary in relation to the layout. These dates might not be final, and might have to be modified when the erection chart is drawn up.

Even greater co-operation will be given by the mills regarding deliveries of steel, when the multiplicity of shapes used in the vessels are grouped into as few sizes as possible and ordered *en bloc*. The same applies to steel plates. The erection programme, however, must not be forgotten in the interests of bulk tonnage delivered; sequence is essential: a point regularly overlooked by the inexperienced.

The purchasing department will be working at high pressure ordering the thousand-and-one items called for by the specification. Remember, we are working to a production schedule; every part of a ship has immediate relationship to some other, therefore the outfitting bears closely on the hull. The purchasing agent must have before him a complete list of items to be fitted, on which the required dates for delivery are clearly shown.

As the buying market to-day is exceedingly limited, price is for the time being of secondary importance to that of delivery. It has often been a practice of purchasing agents to plan their delivery requirements on the basis of so many weeks after laying of keel. Modern methods of construction, however, leave that method open to question. For instance, many fittings for various piping systems throughout the vessel are now fitted direct to bulkheads during welding or riveting on the fabricating skids of these parts of the structure, even before the keel is laid. Rather than relating deliveries to one particular part of the hull such as the keel, it is preferable to relate them to the method of production. To think in terms that this, that, or the other will not be needed until after the launch is definitely wrong. There is only one time for fitting anything—that time is the moment the hull, or any portion of the hull is sufficiently far advanced to receive it. For instance, the steering engine cannot be bedded until the quadrant is fitted, but telemotor piping can be fitted, except for small ends, as soon as the upper deck is riveted or welded. The object is to have every department working as early as possible on the ship and so avoid, on the day of delivery, that all too common sight of profane humanity unable to extricate itself.

#### PROCESSING

The output of every machine in the punch shed must be accurately determined. Before any particular job is commenced, all material for that job should be located and placed so that it can proceed without interruption until ready for assembly at the riveting or welding skids. Finished material should not be allowed to lie in the shed but immediately removed to the skids. Only in this way can the humps and hollows of labour curves be smoothed out. In cases where all the material for a particular job is not available, the job should still proceed unobstructed on its path to the ship. Temporary parts can be fitted to

facilitate erection. The non-delivery of apparently insignificant items can do more than any other factor to break-down erection output.

Some parts of the structure require longer periods to manufacture or assemble than others, and care must be taken so that these are advanced and available at their appropriate erection time.

It is often found that congestion arises at certain machines, such as plate edge-planing machines, counter-sinkers and scarpers. There are many ways of overcoming this, either by working shifts or adopting alternatives; but the best way is to make an independent programme for that particular machine and observe the results. It is surprising how often unnecessary work is applied, and how often an operator puts through material without any relation whatever to sequence. As a result, urgently required materials are buried under piles of steel not at present needed. Weak links in the production chain must be carefully nursed, but deviations from programme should not be countenanced without previous adequate discussion.

Of great importance is the disposition of the machines in the shops. A brief survey of the route of materials, from stockyard through the shops to the skids, frequently reveals a most erratic course; from the skids to the ship may be similar to going from Montreal to Vancouver via Cape Horn. A study of the problem and redistribution of, perhaps, one or two machines in the first case, or the removal of some small obstacles from the path on leaving the skids in the second instance, will be found to pay handsome dividends by way of easier flow.

Considering the movement, lifting and transporting of these 3,000 tons of steel, for every ship through all its processes, it will be agreed that correct routing saves tremendous time and expense. The ideal is to reduce routing to a straight line path from stockyard to ship, with a minimum of transit paths.

### ERECTION

We have seen how the programme was drawn up with provisional keel-laying and launching dates inserted. The Erection Chart is now needed. (See Fig. 3).

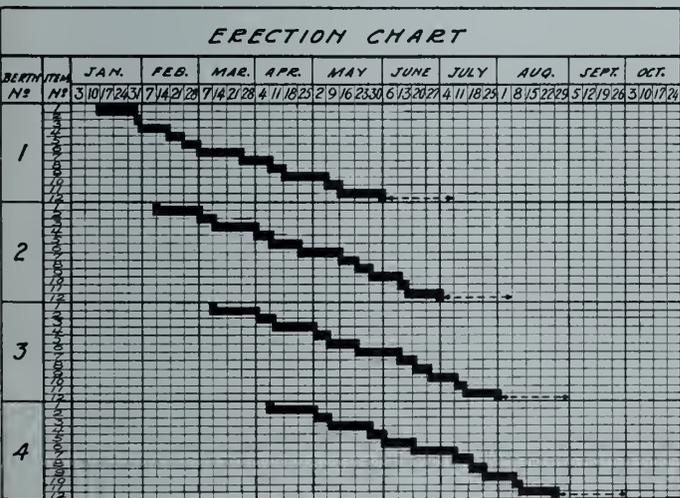


Fig. 3—Erection chart.

This is an elaboration of the programme chart, based on the assumption that the required periods for various operations are known, from either previous data or experience. A midship section and perspective of the hull of a cargo ship is given in Fig. 4, and indicates various parts of the structure.

In planning anything, there is a tendency to over-elaboration. It is easy to become bogged in detail. The erection chart has 12 key periods and in practice these

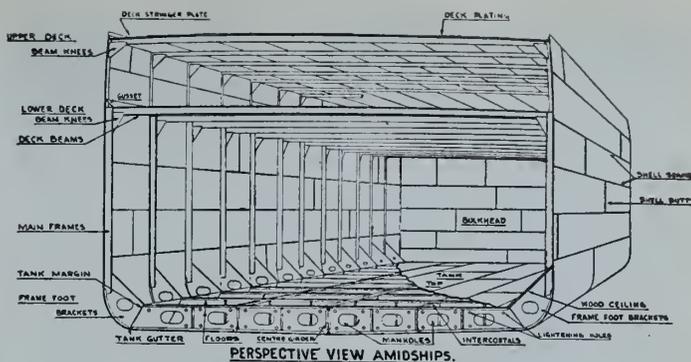


Fig. 4—Midship section and perspective of hull.

have been found to cover all the needs of erection planning in the building of ten-thousand-tonners as well as almost all other types of ocean-going vessels.

**No. 1 Erect Keel to Margin Bars Riveted.** This period covers the erection of keel, centre girders, floors, side girders, bottom developed shell, tank margins, outside and inside margin lugs and margin bars, also the amidships part of tank top.

It is recommended that all riveting or welding work on margins be kept well in advance before erection of frames is commenced.

**No. 2 Erect Tank Top.** This covers all tank top other than between the engine and boiler room bulkheads.

**No. 3 Erect Frames, Bulkheads and Forgings.** By forgings is meant stem bar and stern frame whether cast, forged, or fabricated. Bulkheads include shaft tunnel, centre line, and transverse and bunker bulkheads, also pillars up to lower deck. Frames cover all frames throughout between forgings.

**No. 4 Lower Deck, Hatches and Casings.** Lower deck covers entire deck plating, beams, hatch-end beams, deck girders and doubling plates. Hatches represent coamings, lugs, and bridles. Casings include casing trunk, coal shoots and saddle backs, from the lower deck to the casing top.

Tween deck centre-line bulkheads and pillars are also within this group.

**No. 5 Shell Stern and Bulwarks** embraces every shell plate, developed or lifted, (except bottom shell laid with the keel,) including stern plating and bulwarks.

**No. 6 Upper Deck, Hatches and Deck Houses** covers beams, deck plating and doublings. Hatches includes all coaming around deck openings complete with stays and stiffeners. Deck houses covers officers', engineers' and other deck houses, also navigating bridges.

**No. 7 Tank Testing** includes all hydraulically tested tanks; double bottom, deep tanks, peak tanks and hosing of the shell.

**No. 8 Wood Decks and Accommodation Soles.** To-day, wood decks and soles are disappearing in favour of patent compositions or linos. This implies all deck coverings.

**No. 9 Joiners on Ship.** Under this section comes the period from joiners commencing until accommodation is ready for soft furnishings.

**No. 10 Lining Up to Propeller Fitted.** This covers time from first sighting the boss until the cone and nut are fitted. Sea valves and openings must be finished during the same period.

**No. 11 Launch Way to Launch** is the period required to set up the launch-ways and launch the vessel.

**No. 12 Launch to Trial Trip.** By this is implied handing over the vessel.

In shipyards where several types and sizes of vessels follow one another on the same berths, similar charts are used: but, naturally, the periods for each operation will



Fig. 5—Tank top showing centre strake, margin and floors.

differ according to the amount of work involved. Under these conditions it then becomes necessary to draw up a cross-sectional chart of any one operation for all vessels. This is simply to a base of weeks, as in the erection chart, on which is laid down the period of, say, the shell erection for each vessel. At a glance it is seen, well in advance, whether a particular operation is going to be applied to too many ships at the same time. The yard may not possess the capacity for swelling plant and labour to meet the increased load. At once this would indicate the need for a spreading out of the programme or preparations put in hand to install equipment in time to forestall trouble. To cross-check is a wise precaution, even when the type is standardized, so that operations are nicely balanced. Peaks in the labour curve are thus avoided at times when labour is frequently difficult to obtain.

The cross-sectional method should be tested on any of the jobs where it is felt that weakness may exist and the programme and erection chart immediately amended if real benefits of planning are to be forthcoming.

We can now expand a few points on these twelve stages of the erection chart.

*Item 1.* For approximately four weeks prior to laying the keel the punch shed and riveting skids should be had at work on all double bottom steel. Centre girder, floors, bottom and reverse frames should be assembled and riveted; developed keel and bottom shell will be coming through together with tank margins. During this time the centre-line of keel will be sighted on the berth and keel and bilge blocks in course of preparation for the date of laying keel. As these items are completed, they are transported and placed as near to the berth as practicable, ready for erection. Where it is necessary to stack finished and partially fabricated materials, they must be placed in correct sequence. Stacks should never be built to the height when top-weight can distort buried portions or when the stack is then liable to slip.

On the planned date, work is commenced on erecting the keel and centre girder. It is not advisable, in multi-berth yards, to commence erection before fixed dates for keel, as this quickly puts craneage out of balance and foremen have the tendency to throw men on a job before it is absolutely necessary. This will be clearly shown on the labour chart, mentioned later.

The bottom shell is next laid, and then follows the erection of floors, tank-end floors and girders. These floors are then faired up and all longitudinal girders immediately put in place and thoroughly screwed up. The tank top centre strake is then fitted, tying up the floors and correcting them to their true distances on each side of the centre girder. The tank margins over the vessel's flat amidships are now erected and loosely bolted. All the amidships tank top, between the engine and boiler room bulkheads is then laid and tested. This is usually all developed plating and the purpose of erecting only the

amidships portion is to be certain of the plating meeting and fitting squarely across the ship from margin plate to margin plate. Actually this process is the first principle of fairing the structure. Any previous fairing is but tentative. Should discrepancies be found, such as the floors lying on a slightly diagonal line across the centre line of the vessels, and this is by no means as unusual as one would imagine, the work has not proceeded too far to render corrections costly. When it is clear that the amidship tank top plates are fitting, from bilge to bilge, squarely to the centre girder, they are thoroughly bolted up, the margins secured and run out to meet the fore and after peak bulkheads. The tank top (see Item 2) can now be laid throughout the vessel. While this is being done all foundation bars for centre line bulkheads, bulkheads and bulkhead stiffener brackets, shaft tunnel, shaft stools, auxiliary and boiler seats, etc., are at once laid down in preparation for the next stage in erection. The margin plates and bars are riveted or welded, commencing always amidships and working from this point towards the ends as soon as possible after the amidship tank top is squared. The tank margin bar, if riveted, is caulked immediately on the heels of the riveters and carried straight through to conclusion.

*Item 2.* This item covers all the tank top except the amidship fairing belt. It should be spread and riveted or welded up as early as possible to prevent dirt, moisture and other foreign matter from accumulating on the bottom shell on which riveting has not yet commenced. Once the amidship belt has been faired, there is no valid objection to riveting the bottom shell in the vicinity, even before or at the same time as the tank top. But in no case should the shell bottom be riveted before the tank top above it is squared, because skeleton floors, unless carefully watched, are at times out of alignment, causing bad rivet holes in either the tank top or the shell. (See Fig. 5.)

*Item 3.* When the stacks of pre-assembled material for the double bottom dwindle, or sooner if ground is available, the bulkheads and centre-line bulkheads should be making their appearance, pre-assembled, to be stacked in two piles; one pile with the after peak bulkhead at the bottom, covered by the after-main and engine room bulkhead; the other having the fore peak bulkhead at the bottom followed by the fore main and boiler room bulkheads. It may, however, be possible to lay each bulkhead opposite its appropriate place in the ship. In between these stacks the side bunker bulkheads are placed. During this time riveters should be at work on the skids, riveting beam knees and frame brackets to the side frames assembled there. As soon as a reasonable number are riveted they are collected and laid in correct sequence alongside the berth, port and starboard.

Now the gunwale staging should be up and the gunwale ribband resting on it, awaiting the frames. Erection of the shaft tunnel can commence as soon as the foundation bars are riveted and caulked. (See Fig. 6.)

The first frame to be erected is that forming the boundary bar of the boiler room bulkhead and is erected together with that bulkhead. Immediately following this is the centre line bulkhead connecting with it. This done, the two portions will stand rigid without additional support. The process is repeated with the engine room bulkhead and its related portion of centre-line bulkhead above the thrust recess already erected with the tunnel.

Side bunker bulkheads are now dropped into place and bolted up. These will also act as further supports to, and assist in, the truing up of the boiler room bulkheads. When this is completed the erection of the side frames commences. At this stage, tie wires are run fore and aft from the boiler room bulkhead frame and side shores are applied, so that the bulkhead is trued up, plumb and square.

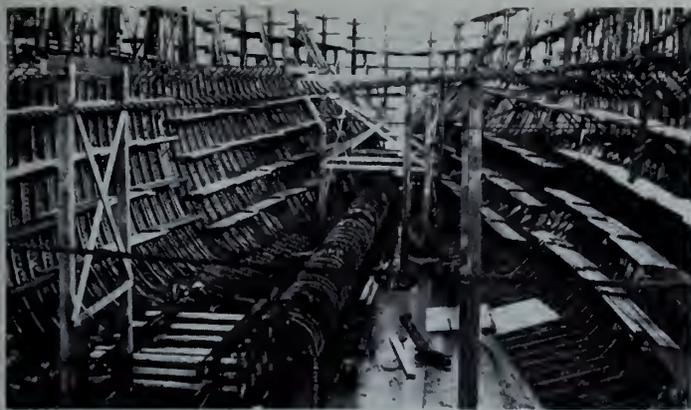


Fig. 6—After end of vessel showing tank top, frames and shaft tunnel being erected.

The gunwale ribband is at once attached to the bulkhead frame. From this point develops all subsequent fairing.

The side frames erection proceeds, but a halt is called at the forward hatch, the end of the after main hatch and at the after beam of the cross bunker hatch. The reason for this will soon be evident. When these frames are reached, all beams and half beams over this area are erected together with the appropriate deck girders and Item No. 4 on the erection chart commences.

Attention might be called, at this stage, to the fact that no operation actually stops; subsequent operations merely overlap their predecessors. Emphasis, however, must be laid on the reasons underlying each stage in the operations. It will be understood, too, that the execution of each operation so far described will be proceeding for both ends of the ship at the same time. A very important point is to be certain the next operation follows at the critical moment, so as to ensure fairness in the whole; and, furthermore, to be confident that pre-fabricated structures, developed in the mould loft, will fit accurately in their appointed places. Ships have an unfortunate habit of creeping and spreading, particularly in a downhill direction.

*Item 4.* It has been noted that the developed tank top is used to square the tank margins athwartships and to keep true relationship with the centre girder. The lower deck plating is now used for the same purpose in relation to the centre line bulkheads and the two main amidship transverse bulkheads. Between the two hatch-end beams above mentioned, the whole of the deck area is covered in and all casing sides and deck girders thoroughly faired up and squared, casing trunks being tested by diagonals in case of distortion. A good precaution at this stage is to shore up both casing and hatch corners one inch high. These corners are notorious for sagging before they are riveted. By so shoring, a lot of heartbreaking later work is avoided. Before the deck and its attachments are finally bolted up for welding or riveting, Item No. 5 commences.

*Item 5.* The developed shell plating, from lower deck gunwale to bottom shell, is next completely erected between, and overlapping, the engine and boiler room bulkheads. Checked and squared, this acts, in the vertical plane, in precisely the same manner as do the horizontal planes at tank top and deck.

There is now a complete, boxlike form, like the middle cut of a salmon, which is true and fair in every way. It is now safe to proceed with the previous items to conclusion as the fairing and checking act almost automatically onwards from this stage. The great advantage of this amidships fairing is that both ends of the ship proceed simultaneously. At all stages of erection great attention must be paid to a thorough shoring of the vessel. The increasing weight of the top structure, during erection, tends

to sag the frames, beams and bulkheads, until they are sufficiently strengthened to resist by riveting the connections. It is unpleasant to see that some lugs and brackets, which should have fitted, must be burned off and discarded because of inadequate shoring. The usual practice merely to put two holes in the beam knees and drill the remainder is not necessary if this attention to shoring is given. Should the material, moulded from the loft, fail to fit in place, some flaw is evident in the yard method. These faults can be eliminated.

*Item 6.* A point not yet mentioned is the advantage of attaching the 'tween deck frames to the main frames before erection. This saves double craning and further allows the work of erecting the upper deck to proceed as soon as Item 4 is sufficiently advanced to permit of it. Work on the upper deck follows the same pattern as laid down in Item 4 for the lower deck. When the centre line bulkheads, if fitted, are in place, the beams are dropped into position followed by the deck girders and deck plating over the amidships area.

Where no 'tween deck centre line bulkheads are fitted, the centre line deck runners, with their pillars, are erected. In this case, the beams are erected first and supported by longitudinal planking shored just off the centre line to allow for easy runner and pillar erection. After the amidship squaring is completed, the deck forward and aft is run out and hatch coamings, deck houses, and so on are forthwith placed. It should be noted that on both decks, as in the case of the tank top, foundation bars for all further erection should be laid immediately, from loft moulds, and riveted or welded together with the decks. It is, perhaps, difficult to establish this as standard practice; but the effort is worth making, if only for the purpose of reducing the number of odd rivets to be cleaned up and, more important, to prevent men having to come back on unfinished jobs. The greatest advantage, however, is that deck house erection can immediately commence as soon as the amidship belt is squared.

*Item 7.* Tank testing, on ships of the type under discussion, generally commences about the time the running of the upper deck plating is almost completed. Under this system the first tank generally is that under the engine room. This is natural, because in this vicinity the tank top is part of the amidship fairing process and so will be first completed. Often there is some difficulty in getting the small work around the auxiliary seats and side bunkers cleaned up; but if a tank testing chart is prepared, indicating the sequence of testing, this tardiness can be overcome. Most firms already adopt this as standard. It is an advantage also, if machinists have the supplies, to have all fittings connected to the tank top in place before the test. Ballast suction passing through tank ends should also, by this time, be in place. Indeed double bottom suction should be inserted while the floors are being erected. It might seem that tank testing could begin much earlier than the time indicated. It is suggested that, if the situation is carefully surveyed, no useful purpose is served by an earlier start. This method of construction allows of one tank being caulked as the next is being filled, in simple progression until the ship has been fully tested. Furthermore a smaller number of caulkers are in continuous working attendance from start to finish.

It is imperative that the fitters give early and adequate attention to the after peak tank. Frequently, accommodation and steering gear are directly above this tank and delay in testing, arising from small omissions, can have serious results on the launch and even on final delivery. Another point concerning the after peak is discussed under Item 10.

*Item 8.* As little of the joiner, electrical, piping, and other work around accommodation can commence before wood or patent decks are laid, this is the touchstone to

releasing a great deal of work. The advantage of laying foundation bars for deck houses with the deck plating will now be observed in relation to the laying of wood decks. Where 6 x 3 in. foundation bars are used, it is frequently possible, during dry spells, to commence laying accommodation soles before the deck houses are erected, for deck house plating, being of light material, is often delayed in delivery.

*Item 9.* This item needs no further elaboration than to say that charting it indicates a given time in which steelwork, in way of accommodation, is to be well advanced and painted before joiners commence. Sidelights must also be fitted as soon as the steel is erected.

*Item 10.* Experience over many ships has demonstrated the advantage of boring out the stern frame for fitting the stern tube before the boss plates are fitted. Probably there are many who will disagree; but the advantage lies in having light and access directly on both sides of the boss. Boring-out can commence as soon as the stern frame is adequately attached to the structure to prevent subsequent movement. The tube should, if possible, be fitted before the after peak test but this is not important if to do so delays the test. Nor is it a serious or expensive matter to pump up the after peak and test the tube when the ship is afloat. A little judgment has to be exercised



Fig. 7—Ready for launching.

at this stage in relation to the available time before launching. As the shipping of the rudder stock can take place only after the peak test,—unless the after peak is designed to suit—the question as to which operation, boring out or testing, should take precedence is often debatable. Only the particular circumstances can decide this. In any case, whatever result deliberation may bring, the time necessary to strip the after end staging should not be forgotten.

*Item 11.* This period of launch-ways to launch will vary in most yards, but three weeks is more than ample to avoid overtime, except for one tide before the launch. Figure 7 shows the ship ready for launching.

*Item 12.* From the launch to the trial trip is probably the worst period in the building of a ship. This is when

## LABOUR CHART



Fig. 8—Labour chart.

all concerned would swear that a conspiracy existed to prevent the ship from sailing. In the middle of cleaning up the thousand-and-one items the dock trial takes place, bringing to light various minor omissions. Just as this atmosphere is lifting, the crew arrives whose officers immediately demand every thing to be re-arranged. After each is supplied with some unspecified personal comfort, they accept the ship, though always retaining a feeling that she is not quite as good as the one just left! It is good policy to have a list prepared of the various jobs connected with dock trials, trial trips and such items as derrick and lifeboat tests. Attention to details can then be given well in advance.

### GENERAL

Should a break down occur during erection, or delay arise resulting in an undue extension of any allowed period, the erection chart must be scrutinized and cross-checked to see the effect of the stoppage on the programme. Steps must then be taken to restore the position and make any necessary amendments.

If the delay cannot be retrieved, departments concerned, and also suppliers, should be informed at once of the new dates. Suppliers will be grateful that a little of the pressure on them is relieved. By early advice, confidence and goodwill is established. Departments may not be quite so grateful but at least they know where they stand and are in a position, in ample time, to make amendments to their plans.

### LABOUR CHART

This chart (shown in Fig. 8) is a fairly sound indication of the disposition of the men employed on the various ships when used in conjunction with the erection chart. It is not uncommon in shipyards to find one vessel receiving more than its allotted share of attention. By the time this is discovered, overtime will be probably required on some other vessel to restore balance. The simplest method of establishing the contour of the curve is by closely following its application to a particular vessel which is known to have held smoothly to programme. Each yard will, of course, have its own specific contour. Yard facilities have great influence over it. The sketch shown is for only one ship; an estimated curve of labour required can be laid down for any ship at any time by lifting the dates of various operations from the erection chart and superimposing the outline of the labour curve over the new base line.

All charts, of course, should have this weekly base registering the same day of the week.

The curve for each ship is started as soon as labour is employed on the contract, the time office entering the weekly totals. Squared paper should be long enough to

cover a two-year programme allowing comparisons to be made at a glance.

It is astonishing how, immediately following launches, or some other psychological date, wholesale migrations of labour develop; they should be carefully guarded against and checked in good time.

The curve shown is an actual curve of a standard vessel similar to those under discussion, built in a four-berth yard with all berths full.

#### RIVETING CHART: PROGRESS

As a means of measuring progress from keel to launch the author would strongly recommend a Riveting Chart, like that shown in Fig. 9. Many shipyards use it. It is simple and remarkably accurate for vessels the structure of which is largely riveted. An estimate is made of the total number of rivets in the ship. The cumulative total of rivets driven each week is then calculated as a percentage of the total number to be driven and entered opposite its date.

The curve has a fairly regular contour and, once established for a particular ship, can be used by marking its dotted contour on the chart for the new vessel over the appropriate period of time she will be on the berth. As the work proceeds a full line is drawn in. Generally the full line should coincide with the dotted one. If un-

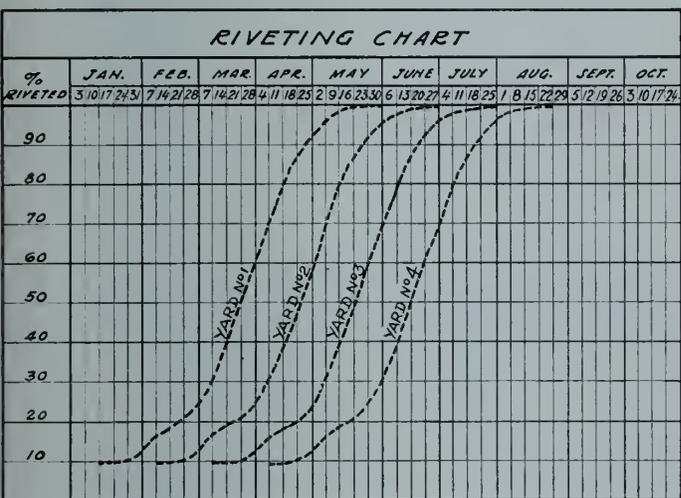


Fig. 9—Riveting chart.

usual circumstances arise, causing a marked deviation from its path, this would call for an investigation at once. Either totals have been miscalculated or a serious breakdown has occurred in the plant. Steps should be taken by introducing overtime, double banking or otherwise to bring the curve back to normal. If such a deviation occurs it is useful to scrutinize the labour chart for the same period. On most occasions it has been found that some of the birds had flown south; one of those labour migrations had taken place. This is easily rectified.

#### SUPPLY

In these days when the supply field stands aloof from the pathetic appeals of shipyards and where government departments control much of the manufacturing programmes, perhaps it will be pertinent to suggest that too many people are guessing at what they can deliver. This applies equally to shipbuilders.

Output should never be based on either guesses or hopes. In times like these, output estimates should be based, in the first instance, on the established capacity of the plant, after taking into consideration factors such as



Fig. 10—The ship leaves the ways.

available labour, and then acting on those estimates. Programmes of consumption based on facts project the true picture on which the supply field can be properly organized; similarly if suppliers also would simply state the facts, consumers in their turn would know the basis on which to plan.

Once it is established that a firm can and does act up to its promises, every assistance should be given to that firm, whether they are suppliers or consumers, so that their organization already functioning well under difficulties, can have some of those difficulties eased by way of encouragement. With such assistance firms can intensify their production at less cost to the country. Properly planned effort is essential to winning the war.

Consumers who give comprehensive, detailed and accurate forecasts of their requirements immediately on receipt of contracts are helping the supply field to organize. But the vicious practice of demanding deliveries well in advance of requirements, in the hope that they may mature somewhere near the mark, merely causes chaos. Nothing is more demoralizing to planned effort than to be kept dangling at the end of false promises.

When talking of mass production of ships, we must think in terms of every component part; not merely of hulls and propelling machinery. Successful accomplishment of large scale production depends on an adequate survey of the supply field and an intimate knowledge of consumption, capacity and requirements. Programmes, to be real, must be based, in the first instance, on the worst feature of the field. Attention must then be focused on that feature until the bottleneck is broadened and removed. Although acceleration is the aim, balance must always be borne in mind. Wherever improvement appears in any particular field, at once steps should be taken to swell all others to that same high level.

#### CONCLUSION

It has been necessary to omit many details of both organization and method; the author would plead the vastness of the subject and the few leisure hours left to a shipbuilder to-day. The points put forward will arouse interest; test them out in practice. The adoption of these methods has served well in recent years—to-day the need is paramount.

The shipbuilding resources of the Axis Powers are tremendous; their organization superb. Few with knowledge doubt their efficiency or unity of purpose. By this we must measure the magnitude of our task. Shipping in the Pacific can now no longer await a decision in the Atlantic Ocean; this is a two-ocean war; the conflict is world wide. To imagine we are doing our best is idle and dangerous; efforts must be doubled, intensified.

Effort itself is not enough. Effort applied and directed; that alone can bring victory.

# REPORT OF COUNCIL FOR THE YEAR 1941

## TOGETHER WITH COMMITTEE AND BRANCH REPORTS

Another year of war has come and gone, and through it all The Institute has continued to function in all its departments. Emphasis has been placed on certain activities and others have been allowed to subside, but on the whole it has been a year of greater activity. Increases in membership, and a substantial financial statement indicate that even under the disturbed conditions of to-day the engineers still look on The Institute as a vital part of the life of Canada, and an integral part of the war effort.

Members in all parts of the world are taking a leading part in the prosecution of the war. Information coming to Headquarters shows such persons in the active service units in Hong Kong, Singapore, South Africa, Australia, Libya, and almost every part of the Empire that is mentioned in the despatches, and in the countries of our allies as well. When the time comes that it can all be told, our members will be shown to have written brilliant pages in the book of history, adding lustre to themselves and to their profession.

The participation of members in civilian war activity is also great. The lists of personnel in almost all those departments of government which are most concerned with the war are full of the names of members. This is particularly true of the Department of Munitions and Supply, which operates under the competent guidance of the Hon. C. D. Howe, HON. M.E.I.C. In private industry, as well, members are found in positions of executive control, down to the more modest but yet important places filled by Students and Juniors. It is certainly an engineers' war and surely a vital activity of The Institute.

### BRANCH ACTIVITIES

From the branch reports which accompany this Report of Council and from the information which is reported regularly to Headquarters it is apparent that the branches have carried out a programme which compares favourably with their activities of previous years. Some branches have had an influx of new members or of old members transferred from other branches due to war activities. This interchange of members has brought new interests and even though these members all return to their normal locations after the war the branches will have benefited from the development. The experience of the Ottawa Branch is particularly noticeable. With the tremendous increase in the government staff and in the active service units the branch has experienced increased attendance at all meetings. There have been also many visitors from other countries who are members of sister societies.

### VISITS TO BRANCHES

The president visited the branches in all the zones, although unfortunately he could not attend meetings at all branches. In view of the importance of the president's position on the National Research Council The Institute is fortunate in having had him visit seventeen different branches, including Halifax and Vancouver. Necessarily, the trips have been hurried as it was not possible for him to be absent from his office for any great period of time.

On all trips he was accompanied by other officers of The Institute. On the trip to the Maritimes he was accompanied by Vice-President K. M. Cameron, Past-President J. B. Challies, Councillor J. A. Vance, R. L. Dobbin, G. A. Gaherty, and the general secretary. On his western trip he was accompanied part of the way by Vice-President Cameron and the general secretary.

The general secretary made 16 branch visits.

### COUNCIL MEETINGS

During the year Council held eleven meetings, six of them being regional meetings held at branches. This makes a new record for meetings held away from Headquarters. The attendance, including guests, was as follows: Hamilton (40) and (24), Toronto (34), Saint John (23), Kingston (26), Quebec (26). It is apparent that regional meetings contribute a great deal to the activities of the branches, and at the same time increase the interest in Council.

### FINANCES

It is a pleasure to record another successful year from the point of view of the Finance Committee. A substantial increase in revenue has made it possible to meet a large part of the costs of repairing the Headquarters premises and still show a satisfactory balance.

The steady increase in membership and the continued success of *The Journal* explain the increase in revenue. The Finance Committee had expected some loss of income by virtue of the remission of fees of members on active service overseas and other members resident in combatant areas. It is gratifying to know that even with this loss of income the net result is an increase.

Once again, the amount collected for arrears of fees is surprisingly great. This has been an important factor in the year's financing. The figures are shown on the accompanying statement.

### REPAIRS TO HEADQUARTERS PREMISES

The necessity of underpinning the main portion of the Headquarters premises resulted in an extraordinary expenditure of \$10,000.00. To meet this expense Past-President Hogg and President Mackenzie sent out a joint appeal to all branches for contributions. This has resulted in the collection of over \$8,000.00. The branches are all to be congratulated on the splendid manner in which they took up the appeal. It is encouraging to know that such excellent support can be obtained from the membership from coast to coast. The work of the Montreal Branch should be noted particularly. Under the stimulus of the chairman, R. E. Heartz, the committee collected \$6,000.00.

### ANNUAL MEETING

All those who attended the 1941 annual meeting at Hamilton carry very pleasant recollections of that function. It is doubtful if a more enjoyable meeting has ever been experienced. The Hamilton Branch arranged everything in great detail and extended a very heartfelt welcome to all who came from out-of-town. There were some unusual social features which added much to the success, and the attendance at the professional sessions was extremely encouraging.

The method of financing the meeting was particularly gratifying to Council. It is a long time since an annual meeting has been carried out with so little expense to Council.

### BY-LAW CHANGES

A new edition of the booklet describing the charter and by-laws was issued in June of this year. There have been some changes in the wording and in the arrangement of the by-laws but no changes in the by-laws themselves. A new index has also been established and several matters cleared up which were somewhat confusing in the previous edition. The preparation of the booklet and the re-

arrangement of the contents involved a great deal of work. This was very ably carried out by Secretary Emeritus R. J. Durley.

#### CO-OPERATION

Negotiations between the two branches of The Institute and the Association of Professional Engineers in New Brunswick resulted in an almost unanimous approval of the proposed co-operative agreement. As a consequence the agreement will come into effect at the first of January, 1942. The preliminary canvas indicates that joint membership will be applied for by the great majority of engineers.

This makes four provinces in which The Institute has a co-operative agreement with the Association. In the three provinces where co-operation has already been in force, very satisfactory results have been obtained. Officers of the associations and of the branches have reported themselves as well satisfied. It is expected that the same results will be obtained in New Brunswick, and it is hoped that a continuation of negotiations may result in similar agreements being adopted in other provinces.

The adoption of the agreement in New Brunswick requires members of the Association to pay a much higher fee for the joint membership. Previously they have enjoyed extremely modest dues. It is gratifying to see the agreement accepted by such a splendid majority in spite of this increased financial obligation. The officers of the Association are to be congratulated on the splendid manner in which they have guarded the interests of their members and at the same time promoted the advancement of co-operation within the profession.

The principal point of contact between The Institute and sister societies in Canada continues to be the Wartime Bureau of Technical Personnel. Such joint efforts do much towards pointing out the common interests and provide opportunities for better understanding of each other's problems and ambitions. The Institute is very pleased to work closely with these bodies and hopes for an ever increasing activity in such things.

#### INTERNATIONAL RELATIONS

The splendid co-operative relationships which have always existed between The Institute and sister societies in other parts of the world have continued. There has been a substantial exchange of correspondence with the British organizations and arrangements have been completed whereby their members who are in Canada on war work are given the privileges of The Engineering Institute, and whereby members of The Institute who are in the Old Country may make use of the British institutions without fee.

The officers and members of the American societies continue to be most helpful and cordial. It is a real pleasure and an inspiration to know that these societies are interested in our progress and are willing to contribute to it in whatever manner we may require. The presence of officers of these organizations at our annual meeting is a source of great pleasure. Frequently, officers of The Institute attend the American societies' meetings, and it is through such contacts that the excellent relationships continued to expand.

Beyond a doubt the advent of war in the United States will bring about a further development in the co-operative relationships with these American societies. Ever since the outbreak of war in 1939 the engineers of the United States have expressed sympathy and support for the ideals of their fellow engineers in Canada. It will be a source of much satisfaction and gratification to Canadian engineers to work side by side with their friends south of the border.

#### ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT

1941 marked the first full year of The Institute's participation in the activities of this Council. It has demonstrated the value of such affiliation and has indicated further channels through which The Institute may assist the profession.

At the annual meeting held in New York in October The Institute's representatives on E.C.P.D. were in attendance in full strength. In addition, President Mackenzie and Past-President Cleveland, of Vancouver, were in the group.

The plans of E.C.P.D. are comprehensive and will have an important bearing on the welfare of engineers both in Canada and in the United States. The membership of E.C.P.D. consists of—American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers, American Institute of Electrical Engineers, The Society for the Promotion of Engineering Education, American Institute of Chemical Engineers, National Council of State Boards of Engineering Examiners, The Engineering Institute of Canada.

#### WARTIME BUREAU OF TECHNICAL PERSONNEL

The Bureau is being operated by The Engineering Institute of Canada, The Canadian Institute of Mining and Metallurgy, The Canadian Institute of Chemistry, and the eight provincial associations of professional engineers. The head office is at Ottawa. The object is to locate all technical personnel in Canada so that the war activities of the government and of industry may be assisted.

Forty-eight thousand questionnaires have been circulated, and from the completed forms a very elaborate filing system has been established so that engineers of any particular classification or experience can be found without delay. The records indicate not only a person's qualifications but his availability for war work. From this information it has been possible to obtain for war work several hundreds of persons who were not previously so engaged. The demands upon the Bureau are increasing but with the records practically complete and the staff now thoroughly experienced it is possible to locate the required persons in a minimum of time.

Hundreds of industries, departments of government, and the active service forces have used the Bureau's facilities. The wisdom of such a system is being proven every day, and it is expected that the facilities of the Bureau will be more and more in demand for the duration.

The Institute's interests in this development are that the general secretary has been loaned to the Bureau to act in the capacity of assistant director, and that many members throughout the country have used the Bureau either to secure engineers or to find more suitable work for themselves. Beyond a doubt the Bureau renders a real service to the entire profession and The Institute is well justified in supporting it.

#### BAND INSTRUMENTS FOR THE ROYAL CANADIAN ENGINEERS

During the course of the annual meeting at Hamilton, a collection was made to raise a sum of money as a contribution towards the purchase of band instruments for the Royal Canadian Engineers at Petawawa. An amount of \$160.00 was raised and transmitted to Lieut.-Colonel J. P. Richards, Officer Commanding. A grateful acknowledgment has been received, accompanied by an invitation for members of The Institute to visit the camp any time that they might be in the locality.

#### CHRISTMAS CARDS

On account of the additional activities brought about by the war, Council decided to discontinue for the year the practice of issuing Institute Christmas cards. In pre-

vious years these have been distributed up to a quantity of over two thousand. Special greetings were sent by mail and cable to the officers of sister societies in different parts of the world.

#### ROLL OF THE INSTITUTE

The membership of all classes now totals 5,373, which appears to be the highest figure ever attained in The Institute's history. This number does not include new members who will come into The Institute at the first of January, 1942, by reason of the New Brunswick co-operative agreement. New names added to the roll for the year 1941 amounted to 451, but deaths, resignations and removals reduce the net figure to a gain of 253. This new figure will be very gratifying to all members of The Institute, particularly when it is understood that the number of members in arrears of fees is smaller now than it has been for many years. Special efforts were made to collect arrears, and the Finance Committee has taken a firm stand with those members who have failed to keep reasonably up to date. Consequently, the figure representing to-day's membership is indicative of a healthy condition.

During the year 1941, four hundred and thirty-nine candidates were elected to various grades in The Institute. These were classified as follows: One hundred and twenty-three Members; thirty-three Juniors; two hundred and seventy-one Students, and twelve Affiliates. The elections during the year 1940 totalled four hundred and thirty-six.

Transfers from one grade to another were as follows: Junior to Member, twenty-eight; Student to Member, twenty-eight; Student to Junior, seventy-one; Affiliate to Junior, one, a total of one hundred and twenty-eight.

The names of those elected or transferred are published in *The Journal* each month immediately following the election.

#### REMOVALS FROM THE ROLL

There have been removed from the roll during the year 1941, for non-payment of dues and by resignation, seventy-one Members; eighteen Juniors; sixty-six Students, and two Affiliates, a total of one hundred and fifty-seven. Twelve reinstatements were effected and sixteen Life Memberships were granted.

#### DECEASED MEMBERS

During the year 1941 the deaths of forty-one members of The Institute have been reported as follows:

##### MEMBERS

Adams, Francis Porter	Lumbers, William Cooper
Bishop, William Israel	Mitchell, Charles Hamilton
Blanchard, Joseph Elie	Moloney, James Grant
Bloomfield, James Munro	Morrison, John William
Brandon, Edgar Thomas John	Perrin, Vincent
Coke-Hill, Lionel	Philip, Patrick
Cook, Archibald Sinclair	Phillips, George
Cross, Frederick George	O'Reilly, Francis Joseph
Dawson, Alexander Scott	Ramsay, Robert
DuCane, Charles George	Sandwell, Percy
Fripp, Frederick Bowles	Silliman, Justus Mitchell
Gray, John Hamilton	Sinclair, Malcolm
Harry, Wilnot Earl	Stewart, William Lewis Reford
Hawley, George Prince	Sullivan, William Henry
Hill, Edgar Murray MacCheyne	Uniacke, Robert Fitzgerald
Holt, Sir Herbert Samuel	Vermette, Joseph A.
Johnstone, William Morrison	Weir, James
Kipp, Theodore	Wright, Athol Choate
Lamoureux, Joseph Arthur	

##### JUNIOR

Benny, Walter Robert

##### STUDENTS

Lalonde, A. Gaston  
McClung, Joseph Eldon  
Murray, Robert Leslie

#### TOTAL MEMBERSHIP

The membership of The Institute as at December 31st, 1941, totals five thousand, three hundred and seventy-three. The corresponding number for the year 1940 was five thousand, one hundred and twenty.

1940	
Honorary Members .....	15
Members .....	3,465
Juniors .....	588
Students .....	985
Affiliates .....	67
	5,120
1941	
Honorary Members .....	16
Members .....	3,560
Juniors .....	638
Students .....	1,084
Affiliates .....	75
	5,373

Respectfully submitted on behalf of the Council,

C. J. MACKENZIE, M.E.I.C., *President*,

L. AUSTIN WRIGHT, M.E.I.C., *General Secretary*.

#### TREASURER'S REPORT

The President and Council:

It gives me great satisfaction to report that in spite of the heavy expenditures for repairs to the Institute building, the Financial Statement again shows an improvement over the preceding year.

The contributions made towards the repairs undertaken have permitted to show an increase of \$1,771.99 in the surplus account.

Investments are shown at cost, which is \$1,006.49 less than the present market value.

In spite of this condition, it is urged that all possible means should be exercised to conserve the resources of the Institute.

Respectfully submitted,

JOHN STADLER, M.E.I.C., *Treasurer*.

#### FINANCE COMMITTEE

The President and Council:

The auditors' report of the finances of The Engineering Institute shows that they are in sound condition.

There is a surplus of \$1,771.99, after allocating \$3,120.05 to building repairs. The repairs to the building cost \$10,441.63 towards which special subscriptions were raised by the branches, amounting to \$7,321.60 (on December 31st last, with more coming), leaving a balance to be made up from general funds of \$3,120.05.

The Finance Committee takes the opportunity of congratulating the Montreal Branch which has subscribed more than \$6,000. to this fund.

The report has been drawn up in the usual manner, with the exception that the land and buildings of the Institute were carried in the auditors' statement, at cost, which is \$91,495.22. As this amount is in excess of the true value, the land and buildings are henceforth carried at their assessed value by the City of Montreal, which is \$36,000, and the balance of the cost, or \$55,495.22, is written off as depreciation. This will have the effect of very substantially decreasing the surplus account which stood before this change at \$110,459.44. The surplus ac-

count now stands at \$54,964.22, an amount very much closer to its true value.

Respectfully submitted,

DEGASPE BEAUBIEN, M.E.I.C., *Chairman.*

### PUBLICATION COMMITTEE

The President and Council:

The principal duty of your Committee is, of course, the supervision of the publication of the *Journal*, and while no major changes have been made in policy or in arrangement of it, a number of problems have been presented to us.

Several members have sent in suggestions for changes, and to them we wish to express our appreciation, as the criticisms have all been of a constructive nature. If we have not complied with their requests, it is because a canvass of other members has indicated that no change, or an alternative change, was desirable.

There has, at times, been a scarcity of good papers for publication, but we feel that the standard has been well maintained. Occasionally, papers are presented of such length that, if printed in the *Journal*, they would increase the cost too greatly. For this reason we have at times had to ask authors to abbreviate their articles, and in other instances have had to decline the paper.

One large paper of outstanding merit is that by S. R. Banks, on the Lion's Gate Bridge, and it has been decided to publish it in full. Fortunately, this work divides itself quite readily into three sections, and it will shortly be published in three successive issues of the *Journal*. For this paper Mr. Banks has been awarded the Gzowski medal.

One of the duties of this Committee is, in conjunction with the general secretary, to approve all publications issued in the Institute's name. Consequently, Mr. Bennett's Committee submitted the manuscript for the new booklet "The Profession of Engineering in Canada", and the committee spent considerable time in a careful study of it. The Committee has felt that as this is one of the most important publications ever issued by the Institute particular care should be taken in the preparation of the material. Mr. Bennett and his Committee have completed a tremendous task and their work should be of considerable benefit to prospective students of engineering throughout Canada. The Committee hopes that its comments and suggestions have been of some assistance to Mr. Bennett.

We again wish to thank those who have offered suggestions for improvement of the *Journal*, and we hope members will continue to take an active interest in this publication.

Respectfully submitted,

C. K. McLEOD, M.E.I.C., *Chairman.*

### PAPERS COMMITTEE

The President and Council:

During the year the activities of the Papers Committee have not been as extensive as desired. Owing to the pressure of war it has been difficult for engineers to find time to arrange an itinerary to visit and speak at branch meetings. However, the branch programmes have been greatly assisted by the visit of the president who was often accompanied by past-presidents, vice-presidents, the general secretary and other officers of The Institute.

The increased number of regional meetings of Council and the more frequent visits of officers and members at other branches is a good development in The Institute. It stimulates the branch activities and promotes greater co-operation among all engineers.

Co-operation between branches is steadily improving. This has proved to be a benefit in arranging programmes. Notices of meetings indicate that where a branch has a particularly good meeting, the speaker is soon found addressing another branch.

There is increasing evidence of the desirability of Headquarters becoming a clearing house for papers and films to a greater extent. When a good film is secured and the branches advised, there is a demand for its showing at branch meetings.

In this connection, the film showing the Tacoma Bridge Disaster has helped considerably in completing programmes for branch meetings. The film has been routed from Halifax to Victoria; in several branches special meetings had been arranged and the showing accompanied by commentaries from a member specialized in bridge engineering. The film was also shown in most of the engineering colleges under the auspices of the local branches.

The unanimous satisfaction expressed by those who have had the opportunity of seeing the Tacoma Bridge film indicates that it was well worth the small disbursement made for its purchase.

Through the courtesy of the University of Manitoba it has been possible to borrow another film entitled, "Photoelastic Stress Analysis." It has already been shown to some of the branches and it is expected that the others will be given the same opportunity.

There is a broad field for this committee in assisting the branches with papers and films. Some assistance can be given by officers and members by taking every opportunity to attend meetings of their own and other branches.

Respectfully submitted,

JAMES A. VANCE, M.E.I.C., *Chairman.*

### COMMITTEE ON THE TRAINING AND WELFARE OF THE YOUNG ENGINEER

The President and Council:

Subsequent to the submission of the last annual report as published on pages 69 and 70 of the February, 1941, *Journal*, five members of the committee, Messrs. Hartz, Ellis, Macdonald, Legget and the chairman, together with Mr. Murray, representing Mr. R. M. Smith, met at Hamilton to review the work of the committee and to determine the future activities.

The committee discussed pre-college training and entrance requirements, student selection and guidance, engineering curricula, scholarships, summer employment for engineering students, extra-mural studies and branch activities for younger members.

It was decided to ask authority of Council to proceed with the publication of a brochure on student guidance as the first extensive activity of the committee and to supplement this with a pamphlet on counselling for distribution to The Institute branches. This was approved by Council.

A draft of the proposed brochure was distributed to the committee members and to the members of Council in the early summer of 1941, and after much correspondence and discussion it was finally approved by Council and is now in the hands of the printers. It is hoped that distribution to all secondary schools in Canada will be made during February and March, 1942.

When this brochure is distributed, each branch will be asked to co-operate by naming a Student Counselling Committee so that all secondary schools in Canada may have the benefit of the advice of practicing engineers in the matter of student guidance.

During the year we have maintained close contact with the several committees of the E.C.P.D., and we value very highly the opportunities offered to meet with their members and to discuss our common problems.

We have noted the increased interest in the younger members by our several branches, and we hope to be able to stimulate this interest by the distribution of information covering the several fields of activity of this committee.

Respectfully submitted,

HARRY F. BENNETT, M.E.I.C., *Chairman.*

### LIBRARY AND HOUSE COMMITTEE

The President and Council:

Your committee carried on with the same membership as last year because of the major repairs to headquarters building which had been recommended and authorized. It was agreed by Council that a separate Library Committee would be appointed this year to study the requirements and possibilities of establishing the library on a satisfactory and adequate basis, in keeping with the status of The Institute. The unique opportunity of a fresh start had been presented by the elimination of a tremendous

accumulation of obsolete files and records due to the building renovation.

Unfortunately pressure of other activities has prevented Council from taking the necessary steps to provide the proper support for such a committee, and no appointment was made. It is the strong recommendation of your chairman, voicing the opinion, previously expressed, of the committee, that action be taken as soon as possible.

Tabulated below is a summary of the accessions to the library in the past year together with the number of requests for information received by the librarian:

Accessions (for the most part Reports, etc.).....	440
Books Borrowed.....	234
Bibliographies prepared (a total of 66 pages)...	24
Photostats furnished (a total of 70 pages).....	6
Requests for information.....	1,021
by telephone.....	413
by letter.....	364
in person.....	244
Books presented for review by publishers.....	44

### COMPARATIVE STATEMENT OF REVENUE AND EXPENDITURE FOR THE YEAR ENDED 31ST DECEMBER, 1941

REVENUE		EXPENDITURE	
	1941	1940	
<b>MEMBERSHIP FEES:</b>			
Arrears.....	\$ 3,557.00	\$ 3,332.75	
Current.....	26,686.75	26,295.10	
Advance.....	569.44	505.21	
Entrance.....	1,632.00	2,238.00	
	<u>32,445.19</u>	<u>32,371.06</u>	
<b>PUBLICATIONS:</b>			
Journal Subscriptions.....	\$ 7,698.65	\$ 7,495.51	
Journal Sales.....	36.72	43.88	
Journal Advertising.....	15,723.32	13,566.35	
	<u>\$23,458.69</u>	<u>\$21,105.74</u>	
INCOME FROM INVESTMENTS.....	\$ 505.10	\$ 458.93	
REFUND OF HALL EXPENSE.....	450.00	465.00	
SUNDRY REVENUE.....	102.16	66.80	
	<u>\$24,515.95</u>	<u>\$22,036.46</u>	
<b>BUILDING EXPENSE:</b>			
Property and Water Taxes.....	\$ 1,995.48	\$ 2,074.28	
Fuel.....	578.68	557.28	
Insurance.....	154.78	120.36	
Light, Gas and Power.....	339.05	329.15	
Caretaker's Wages and Services.....	976.00	878.00	
House Expense and Repairs.....	385.52	35.74	
Building Repairs—Cost.....	\$10,441.63		
Collected.....	7,321.60		
	<u>3,120.03</u>	<u>1,350.00</u>	
	<u>\$ 7,549.54</u>	<u>\$ 5,344.81</u>	
<b>PUBLICATIONS:</b>			
Journal Salaries and Expense.....	\$17,639.26	\$16,251.63	
Provincial Sales Tax.....	357.34	231.84	
Sundry Printing.....	589.80	494.23	
	<u>\$18,586.40</u>	<u>\$16,977.70</u>	
<b>OFFICE EXPENSE:</b>			
Office Salaries.....	\$13,825.79	\$12,420.57	
Postage, Telegraph and Excise.....	1,290.12	1,296.72	
Telephone.....	598.55	604.32	
Office Supplies and Stationery.....	1,663.48	1,557.36	
Audit Fees and Legal Expenses.....	315.00	290.00	
Messenger and Express.....	141.54	89.59	
Miscellaneous Expense.....	449.51	430.25	
Depreciation—Furniture.....	368.63	370.87	
	<u>\$18,652.62</u>	<u>\$17,059.68</u>	
<b>GENERAL EXPENSE:</b>			
Annual and Professional Meetings.....	764.20	1,284.39	
Meetings of Council.....	292.57	612.32	
Travelling.....	785.83	1,693.51	
Branch Stationery.....	148.90	194.58	
Prizes.....	350.32	343.21	
Library Expense.....	1,079.49	999.92	
Bank Exchange.....	107.48	149.57	
Examinations and Certificates.....	7.32	84.42	
Committee Expenses.....	558.02	255.65	
National Construction Council.....	100.00	50.00	
Sundry.....	110.07	61.00	
	<u>\$ 4,289.56</u>	<u>\$ 5,559.73</u>	
REBATES TO BRANCHES.....	\$ 6,111.03	\$ 6,304.00	
TOTAL EXPENDITURE FOR YEAR.....	55,189.15	51,245.92	
SURPLUS FOR YEAR.....	1,771.99	3,221.61	
	<u>\$56,961.14</u>	<u>\$54,467.53</u>	

The foregoing figures show that the library continues to be of great use to the members and proves one of the most valuable services provided by The Institute.

The removal of the periodicals files in the basement, occasioned by the repairs made early in the year, has provided an opportunity for establishing a more convenient classification. This is under way and should be completed soon.

The only activities of your committee during the year were connected with the repairs to headquarters. This work was fully reported in *The Journal*, but for purposes of this record the following details are repeated.

The whole of the auditorium section was underpinned with concrete piers to hardpan. The work was done by A. F. Byers & Company, Limited, at a contract sum after calling for competitive bids. The total cost of the repair, including minor patching of plaster and redecoration, was \$10,441.63. The front section of the building was not underpinned. It shows signs of post settlement but this was not connected with the evidence of current trouble

in the newer auditorium section built in 1913. It was agreed that the front building, an old remodelled residence, was not of sufficient value and not of the proper layout to warrant the expense of underpinning.

In studying and carrying out this work Messrs. J. A. McCrory and J. A. Lalonde were added to the committee because of their experience in construction matters.

During the year the caretakers' quarters were completely redecorated and some repairs made to roof, skylights, etc. Hardwood floors were laid in most rooms.

Respectfully submitted,

BRIAN R. PERRY, M.E.I.C., *Chairman.*

### LEGISLATION COMMITTEE

The President and Council:

During the year 1941, your committee was not presented with any business or problems concerning Institute legislation.

The committee has been ready at all times to be of

### COMPARATIVE STATEMENT OF ASSETS AND LIABILITIES

AS AT 31ST DECEMBER, 1941

ASSETS		1941	1940	LIABILITIES		1941	1940
<b>CURRENT:</b>				<b>CURRENT:</b>			
Cash on hand and in bank . . . . .		\$ 826.24	\$ 2,043.18	Accounts Payable . . . . .		\$ 2,476.18	\$ 2,321.54
Accounts Receivable . . . . .	\$3,425.85			Rebates to Branches . . . . .		479.39	641.81
Less: Reserve for Doubtful Accounts . . . . .	126.42	3,299.43	2,596.43			\$ 2,955.57	\$ 2,963.35
Arrears of Fees—Estimated . . . . .		2,500.00	2,500.00	<b>SPECIAL FUNDS:</b>			
		\$ 6,625.67	\$ 7,139.61	As per Statement attached . . . . .		13,336.60	13,682.39
<b>SPECIAL FUNDS—INVESTMENT ACCOUNT:</b>				RESERVE FOR BUILDING MAINTENANCE . . . . .		1,350.00	1,350.00
Investments . . . . .	\$11,760.14			<b>SURPLUS ACCOUNT:</b>			
Cash in Savings Accounts . . . . .	1,876.21	13,636.35	13,682.39	Balance as at 1st January, 1941 . . . . .		108,687.45	
<b>INVESTMENTS—AT COST:</b>				Add: Excess of Revenue over Expenditure for the year as per Statement attached . . . . .		1,771.99	
<b>BONDS:</b>						\$110,459.44	
Dominion of Canada, 3%, 1951 . . . . .	\$2,500.00			Less: Write down in valuation of Land and Buildings . . . . .		55,495.22	
Dominion of Canada, 4½%, 1946 . . . . .	96.50					54,964.22	108,687.45
Dominion of Canada, 4½%, 1958 . . . . .	180.00						
Dominion of Canada, 4½%, 1959 . . . . .	4,090.71						
Montreal Tramways, 5%, 1941 . . . . .	950.30						
Montreal Tramways, 5%, 1955 . . . . .	2,199.00						
Province of Saskatchewan, 5%, 1959 . . . . .	502.50						
<b>SHARES:</b>							
Canada Permanent Mortgage Corporation, 2 Shares . . . . .	215.00						
Montreal Light, Heat and Power Cons.—40 shares N.P.V. . . . .	324.50						
		\$11,058.51	\$ 8,558.51				
(Approximate market value—12,065.00).							
<b>ADVANCES TO BRANCHES . . . . .</b>		100.00	100.00				
<b>DEPOSIT—POSTMASTER . . . . .</b>		100.00	100.00				
<b>PREPAID AND DEFERRED EXPENSES . . . . .</b>		275.00	700.00				
<b>GOLD MEDAL . . . . .</b>		45.00	45.00				
<b>LIBRARY—At cost less depreciation . . . . .</b>		1,448.13	1,448.13				
<b>FURNITURE AND FIXTURES—Cost \$15,421.84</b>							
Less: Depreciation . . . . .	12,104.11	3,317.73	3,414.33				
			91,495.22				
<b>LAND AND BUILDINGS—Cost . . . . .</b>	\$91,495.22						
Less: Depreciation . . . . .	55,495.22	36,000.00					
Assessed Valuation . . . . .							
		\$72,606.39	\$126,683.19			\$72,606.39	126,683.19

### AUDIT CERTIFICATE

We have audited the books and vouchers of The Engineering Institute of Canada for the year ended 31st December, 1941, and have received all the information we required. In our opinion the above Statement of Assets and Liabilities and attached Statement of Revenue and Expenditure for 1941 are properly drawn up so as to exhibit a true and correct view of the Institute's affairs as at 31st December, 1941, and of its operations for the year ended that date, according to the best of our information and the explanations given to us and as shown by the books.

(Sgd.) RITCHIE, BROWN & Co.,  
*Chartered Accountants.*

MONTREAL, 13th January, 1942.

assistance if called upon, and is very pleased to report that no legislative difficulties interrupted the activities of The Institute during this time of national emergency.

Respectfully submitted,

E. M. KREBSER, M.E.I.C., *Chairman.*

### BOARD OF EXAMINERS AND EDUCATION

The President and Council:

Your Board of Examiners and Education for the year 1941 has had prepared and read the following examination papers with the results as indicated:

	Number of Candidates	Number Passing
I. Elementary Physics and Mechanics ..	2	1
II. (a) Strength and Elasticity of Materials .....	2	1
V. (a) General Metallurgy .....	1	1
V. (b) (1) Metallurgy of Iron and Steel	1	1

Respectfully submitted,

R. A. SPENCER, M.E.I.C., *Chairman.*

### COMMITTEE ON WESTERN WATER PROBLEMS

The President and Council:

A very comprehensive report was prepared by the Committee on Western Water Problems and approved by Council February 5, 1941, as set out in minutes 1527 to 1539, and published in the Journal for May 1941. This report was formally and officially submitted to the Rt. Hon. W. L. Mackenzie King, Prime Minister, under date of April 26, 1941.

As a result of representations made to the Dominion Government by various individuals and organizations, including members of our Committee, the Dominion Government, by Order-in-Council dated February 17, 1941, appointed a committee to be known as The St. Mary and Milk River Waters Development Committee, consisting of Mr. Victor Meek, M.E.I.C., Controller, Dominion Water and Power Bureau; Mr. George Spence, Director, Prairie Farm Rehabilitation; and Mr. W. E. Hunter, of the Department of Finance.

This committee is charged with the duty of making a thorough study and reporting within a year upon all aspects of the proposals that further storage and irrigation works be built in Canada on the St. Mary and Milk rivers. Without limiting the generality of the foregoing, the committee shall consider the following matters:

(a) The water supply in Canada's share of international streams in Southern Alberta, the water requirements of the presently constructed projects and water available for further irrigation development.

(b) The most feasible plan to put these waters to beneficial use, including selection of lands to be irrigated, estimates of cost of storage reservoirs and other works required for complete development.

(c) Construction programme with annual estimated expenditure over the period of years required to complete full development.

(d) The arrangements necessary with the owners of the present irrigation projects and the owners of the further lands to be irrigated.

(e) The benefits which this water development would confer on Canada, the province of Alberta and the residents of the districts affected.

(f) The allocation of costs and methods of financing.

(g) The administrative control to be exercised over the projects after completion, including maintenance and operation of the works constructed and colonization of the irrigable lands.

The committee shall not hold public hearings. With that limitation, it may invite and receive representations,

in person or in writing or both, from interested bodies and individuals.

The committee may invite the co-operation of Departments of the Canadian Government not represented thereon. In particular, the committee shall invite the co-operation of the Department of External Affairs in dealing with international aspects of the proposals.

The Dominion Government also invited the Government of the Province of Alberta to designate one or more persons to work with their committee. The Province complied with this request by appointing a committee, to be known as the Alberta Water Development Committee, consisting of Hon. N. E. Tanner, Minister of Lands and Mines; Hon. D. B. McMillan, Minister of Agriculture, and Mr. P. M. Sauder, M.E.I.C., Director of Water Resources.

The two Government committees have held three hearings in western Canada, lasting from three to five days each, at which the western members of the E.I.C. Committee and Sub-committee, and other members of the Institute were present and gave whatever assistance they could to the Government committees. On the occasion of the inspection of the dam site on the St. Mary river by the full membership of the two Government committees, on September 21, 1941, the following members of the Institute Committee and Sub-committee were present: Messrs. G. A. Gaherty, Chairman; T. H. Hogg, Past-President, E.I.C.; S. G. Porter, Past-President, E.I.C.; A. Griffin; P. M. Sauder; D. W. Hays; H. J. McLean.

Other members of the Engineering Institute of Canada present were: Messrs. B. Russell, Senior Consulting Engineer, P.F.R.A., (Prairie Farm Rehabilitation Act); W. L. Foss, District Engineer, P.F.R.A., in charge of St. Mary Surveys; O. H. Hoover, Officer in Charge, Dominion Water and Power Bureau, Calgary.

The members of the Government committee and other officials and individuals interested in this problem have expressed their appreciation of the very material assistance that has been rendered by the Institute Committee, both through its report and through the advice and help given by the individual members of the Institute Committee. The Dominion Government Committee now has all the data it requires in hand, and is engaged in preparing its final report and recommendations to the Government.

It is recommended that the Committee of the Institute be continued for another year in order that it may stand by and give whatever other assistance it is able to render to the Government Committee.

Respectfully submitted on behalf of the Committee on Western Water Problems.

G. A. GAHERTY, M.E.I.C., *Chairman.*

### COMMITTEE ON INTERNATIONAL RELATIONS

The President and Council:

During the past year an effort has been made by the Committee on International Relations to further wherever possible the contact of members of The Institute and of Canadian engineers generally with the engineers of other countries.

The most formal and extensive of these contacts has been through the participation of The Engineering Institute of Canada in the deliberations of the Engineers' Council for Professional Development. Several members of The Institute who have served on committees of E.C.P.D. have attended meetings of their committees in the United States, and at the annual meeting of E.C.P.D. held in New York City, on October 30, nine Institute members, including the president and four past-presidents took part in the deliberations. The reception that has been accorded the representatives from Canada on these occasions has been most gratifying and it is evident that much benefit in an international sense has flowed from their participation.

Useful international work has been done in showing courtesies to refugee engineers and other non-Canadian engineers temporarily in Canada. This has been most outstanding in connection with members of the Association of Polish Engineers in Canada and of the Institution of Electrical Engineers. At the first meeting of the Toronto Branch of The Institute for the season, sixteen Polish engineers were the guests of the Branch and one of them presented an excellent paper. Thanks to the generosity of Council, *The Engineering Journal* will be sent free of charge for the year 1942 to engineers from other countries now in Canada on war work.

Isolated cases of useful international contacts were found in the participation of members of The Institute in two important annual conventions of American engineering organizations held in Toronto during the past summer. For the summer convention of the American Institute of Electrical Engineers, Mr. M. J. McHenry, a member of The Institute's Committee on International Relations, was the chairman of the Convention Committee and The Institute was formally represented by Past-President Hogg and by the general secretary. At the annual meeting of the American Water Works Association, held also in Toronto during the past summer, many members of The Institute took part and the chairman of The Institute's Committee on International Relations was asked to represent President Mackenzie at the banquet.

Past-President Camsell, another member of the Committee has, as a member of the Board of Directors of the American Institute of Mining and Metallurgical Engineers, been able generally to further international goodwill and understanding and has taken pains to explain to his fellow directors Canada's war activities and our vital relationship to Great Britain and to the United States in the present crisis.

On the occasion of the granting of honorary membership in the American Society of Mechanical Engineers to the Honourable C. D. Howe, HON.M.E.I.C., The Institute was appropriately represented by Past-President Challies, Professor R. W. Angus, HON.M.E.I.C. and by the general secretary.

Respectfully submitted,

C. R. YOUNG, M.E.I.C., *Chairman.*

### MEMBERSHIP COMMITTEE

The President and Council:

In these strenuous times all citizens have assumed more work and added duties or are ready to do so. Engineers are particularly in the forefront. Their services are so much in demand that their efforts must be organized, regulated and co-ordinated in order that they may be applied in the most effective manner. The very splendid part that our Institute has been able to play in this work brings a glow of satisfaction and pride to every member.

With particular reference to membership, however, we can note that the record of service and help rendered by The Institute impresses other engineers who have not been Institute members. They should want and no doubt many of them do want to become members of the organization in which they can identify themselves with such nationally helpful activities.

In wartime there is, of necessity, considerable shifting around from place to place. Membership in The Institute makes available the facilities of the widespread branches throughout Canada. If an engineer finds himself moved to United States or England or elsewhere, the benefits from Institute membership are more important. A certificate of membership in The Institute affords opportunity to meet men of the same profession who are members of similar organizations in their own land. It is a valuable professional introduction.

These points are mentioned here to remind the membership committees of the various branches of the expectancy of new memberships at this time. We are being afforded opportunities of meeting and being of service to many who are not Institute members. Let us point out to them the effective work The Institute has been able to perform for the war effort and emphasize what services The Institute has to offer them.

Respectfully submitted,

H. NOLAN MACPHERSON, M.E.I.C., *Chairman.*

### COMMITTEE ON DETERIORATION OF CONCRETE STRUCTURES

The President and Council:

The Committee on the Deterioration of Concrete has been relatively inactive for the past year, due largely to the fact that its members are very busy men and under present conditions have not been able to devote the usual time to its work. Therefore, the Committee can only report that certain papers recording the success of important repairs made to concrete structures, which it had hoped to have ready for publication this year, are still in preparation and may not become available for some time.

The Committee is continuing to gather data as circumstances permit and it hopes at a more favourable time to place these data before the Institute.

Respectfully submitted,

R. B. YOUNG, M.E.I.C., *Chairman.*

### COMMITTEE ON PROFESSIONAL INTERESTS

The President and Council:

The policy of the Council in promoting closer co-operation with the provincial professional associations is still achieving definite results. As a result of protracted negotiations, an agreement between The Institute and the Association of Professional Engineers of New Brunswick has been approved by both bodies. The extraordinarily strong support given in the formal balloting within both The Institute and the Association augurs well for a mutually satisfactory consummation of the desire of the great majority of the members of both organizations resident in New Brunswick for a simplification in engineering organization that will lead to greater solidarity in the profession. This agreement is to be formally completed at the Annual Meeting of the Association in Saint John on Monday, January 12th, 1942.

The committee is glad to report that close co-operation is being achieved on a mutually satisfactory basis between The Institute and the associations in the provinces of Saskatchewan, Alberta and Nova Scotia.

There is nothing definite to report from the province of Manitoba apart from a renewed intimation by the president and the general secretary when they were in Winnipeg in September last that The Institute would be glad to discuss a co-operative agreement with the Association of Professional Engineers of Manitoba whenever the officers of the Association desire it.

The committee feels that it should again record its appreciation of the sympathetic understanding that has always existed between The Institute and the Corporation of Professional Engineers of Quebec. As for the provinces of Ontario and British Columbia, the readiness of The Institute's committee to discuss co-operation with the very efficiently operated registration bodies is well known.

Respectfully submitted,

J. B. CHALLIES, M.E.I.C., *Chairman.*

### EMPLOYMENT SERVICE

The President and Council:

The work done during the year is summarized in the following table and the corresponding figures for 1940 are given for purposes of comparison:

	1940	1941
Registered members.....	129	77
Registered non-members.....	89	75
Number of members advertising for positions	41	14
Replies received from employers.....	21	9
Vacant positions registered.....	260	229
Vacancies advertised in <i>The Journal</i> .....	43	35
Replies received to advertised positions.....	143	110
Men's records forwarded to prospective employers.....	179	302
Men notified of vacancies.....	178	306
Placements definitely known.....	147	71
Registered vacancies cancelled.....	2	10
Registered vacancies still open.....	33	31

Early in the year, the Government established the Wartime Bureau of Technical Personnel at Ottawa. It will be recalled that this Bureau is operated by The Institute and other engineering societies. The services of the general secretary have been made available by Council to the Bureau, in the office of assistant director.

The activities of The Institute Employment Service have been affected greatly by the Bureau in that all information relative to openings or men available has been sent to the Bureau and frequently subsequent placements have resulted from a combination of the efforts of both organizations.

Originally it was hoped the Bureau might establish an office in Montreal in which case it was expected that all employment activities of The Institute would be transferred to it in order to give a better national service to all engineers. This still remains a possibility in which The Institute will be glad to co-operate.

The facilities of The Institute and its twenty-five branches across the country have been made available to the Bureau for the verification of qualifications in the case of candidates for important war positions.

It may be interesting to record an example of close co-operation with the Wartime Bureau. Through one of its members in England, The Institute received during the year an urgent request from the British Ministry of Aircraft Production for twenty-five engineers and draughtsmen. The Institute Employment Service communicated immediately with the Wartime Bureau and, with the facilities of the two organizations, many candidates were assembled. When the British representative came from England, the candidates from the district of Montreal were interviewed at Headquarters and our Employment Service files were again of great assistance.

The figures tabulated above indicate the vacancies registered and the placements effected by The Institute Employment Service alone; they do not record the work done in co-operation with the Wartime Bureau.

It can be said that no member of The Institute has been unemployed for any long period of time during the year. As might be expected the demand has been larger than the supply. This applies particularly to engineers with plant experience in mechanical, electrical and chemical engineering. The result is that several civil engineers whose previous experience had been mostly in the field have entered the plant and are being trained to do mechanical or other industrial work.

The unusual demand from industry and from Government departments has resulted in several retired engineers resuming their activity. The Employment Service has been able to assist in several such instances.

It is significant that very few from the graduating classes this year have found it necessary to make use of the Employment Service. The great majority had already secured positions before graduation. On the other hand a large number of engineering students have obtained summer employment through our facilities.

The active forces have again this year resorted to our files and it has been possible for us to help frequently in recruiting technically qualified men for the various units.

In spite of the numerous vacancies conspicuously advertised in the press, we have again this year interviewed many applicants for work. These were mostly members of The Institute who wanted to make sure that their qualifications were used to the best advantage in the war effort. We have thus been able to help in the transfer of several engineers from non-essential industries to important war work. Canadians who had been employed outside of the country for the past few years have enquired whether their services could be used in the war effort and several have returned upon our advice and have been placed advantageously.

L. AUSTIN WRIGHT, *General Secretary.*

#### PAST PRESIDENTS' PRIZE COMMITTEE

The President and Council:

Your Committee on the Past-Presidents' Prize has nothing to report. No papers were received this year, and no meetings of the committee have been held.

The committee awaits with interest the reaction of Council to the suggestions regarding a change in procedure which were presented by the committee two years ago.

Respectfully submitted,

R. DEL. FRENCH, M.E.I.C., *Chairman.*

#### GZOWSKI MEDAL COMMITTEE

The President and Council:

It is the unanimous recommendation of your committee that the award be made to Mr. S. R. Banks, M.E.I.C., for his paper, "The Lion's Gate Bridge, Vancouver, B.C."

So many excellent papers have been found eligible for consideration this year that your committee members have found it very difficult to make a choice.

Among many other papers of outstanding interest may be mentioned Mr. J. A. McCrory's paper, "Construction of the Hydro-Electric Development at La Tuque";—Mr. F. P. Shearwood's paper, "The Justification and Control of the Limit Design Method";—and the paper by Messrs. W. Storrie and A. E. Berry, "Modern Sanitation and Water Supply Practice."

Respectfully submitted,

H. O. KEAY, M.E.I.C., *Chairman.*

#### DUGGAN PRIZE COMMITTEE

The President and Council:

Your committee, entrusted with the task of selecting and recommending papers worthy of this award, has carefully reviewed the papers presented to The Institute during the period July 1940 to June 1941, and now begs to report.

After a careful review, your committee selected five papers which, in its opinion, appeared to meet the conditions attached to this award.

Of the papers considered, each could be said to be a contribution of distinct value, and certainly worthy of consideration for the award. The diversity of subjects covered made it rather difficult to set up a standard of comparison; and in any case, it was felt by the committee that the margin between the different papers was very narrow. It was therefore rather gratifying to discover that the three members of the committee had, after due consideration and without previous consultation, arrived at the same decision.

We recommend that the Duggan Medal and Prize be awarded to Mr. O. W. Ellis for his paper "The Forgeability of Metals."

Respectfully submitted,

JOHN T. FARMER, M.E.I.C., *Chairman.*

### PLUMMER MEDAL COMMITTEE

The President and Council:

Your committee considers that the papers presented do not quite measure up to the standard of previous medal papers, and that it would be in order to omit the award of the Plummer Medal this year.

Respectfully submitted,

J. F. HARKOM, M.E.I.C., *Chairman.*

### LEONARD MEDAL COMMITTEE

The President and Council:

Your committee, consisting of Messrs. L. L. Bolton, A. E. Cameron, G. E. Cole and V. Dolmage, with myself as chairman, recommend that the Leonard Medal for this year be awarded to Mr. G. Reuben Yourt for his paper called "Ventilation and Dust Control at the Wright-Hargreaves Mine," published in the November 1940 issue of the *Canadian Mining & Metallurgical Bulletin*.

The committee is pleased to give honourable mention to Mr. M. F. Goudge for his paper on "Magnesia from Canadian Brucite" published in the September 1940 issue of the *Canadian Mining & Metallurgical Bulletin*.

Respectfully submitted,

A. D. CAMPBELL, M.E.I.C., *Chairman.*

### STUDENTS' AND JUNIORS' PRIZES

The reports of the examiners appointed in the various zones to judge the papers submitted for the prizes for Students and Juniors of The Institute were submitted to Council at its meeting on January 17th, 1942, and the following awards were made:

H. N. Ruttan Prize (Western Provinces). No papers received.

John Galbraith Prize (Province of Ontario), to A. L. Malby, J.R.E.I.C., for his paper "Carrier Current Control of Peak Loads."

Phelps Johnson Prize (Province of Quebec—English), to G. N. Martin, J.R.E.I.C., for his paper "Characteristics and Peculiarities of Some Recent Large Power Boilers in England."

Ernest Marceau Prize (Province of Quebec—French), to A. T. Monti, S.E.I.C., for his paper "Vedette de 40 Pieds de Longueur."

Martin Murphy Prize (Maritime Provinces). No papers received.

### NOMINATING COMMITTEE

*Chairman:* E. P. MUNTZ.

<i>Branch</i>	<i>Representative</i>
Border Cities .....	C. G. R. Armstrong
Calgary .....	F. K. Beach
Cape Breton .....	J. A. McLeod
Edmonton .....	W. R. Mount
Halifax .....	R. L. Dunsmore
Hamilton .....	A. Love
Kingston .....	A. Jackson
Lakehead .....	P. E. Doncaster
Lethbridge .....	J. M. Davidson
London .....	V. A. McKillop
Moncton .....	B. E. Bayne
Montreal .....	R. DeL. French
Niagara Peninsula .....	C. G. Moon
Ottawa .....	J. H. Parkin
Peterborough .....	W. M. Cruthers
Quebec .....	A. O. Dufresne
Saguenay .....	N. D. Paine
Saint John .....	J. R. Freeman
St. Maurice Valley .....	E. B. Wardle
Saskatchewan .....	R. A. Spencer
Sault Ste. Marie .....	K. G. Ross
Toronto .....	W. E. Bonn
Vancouver .....	J. N. Finlayson
Victoria .....	S. H. Frame
Winnipeg .....	H. W. McLeod

# Abstracts of Reports from Branches

## BORDER CITIES BRANCH

The Executive Committee met eight times during the year for the transaction of branch business.

Eight branch meetings were held including a special meeting honouring the visit of our president and the annual meeting.

Information about the various meetings follows, attendance being given in brackets:

- Jan. 10—Mr. R. K. Scales of the Ethyl Corporation, Detroit, addressed the branch on **Fuels and Engines of the Future**. (35).
- Feb. 14—Mr. H. Lloyd Johnson, Resident Engineer, Canadian Industries Limited, addressed the branch on the **Warden System of Civilian Defence**. (27).
- Mar. 14—Mr. J. A. McCrory, Vice-President and Chief Engineer of the Shawinigan Engineering Company, addressed the branch on the **Power Development of the St. Maurice River**. (59).
- April 25—Mr. Cyril Cooper, Manager of the Windsor Elementary Flying Training School, addressed the Branch on the **British Commonwealth Air Training Plan**. (31).
- May 17—Dr. N. W. McLeod, of the Imperial Oil Ltd., addressed the branch at the Sarnia Riding Club on **Soil Technology as Applied to Modern Highway and Air port Construction**. (29).
- Nov. 14—Mr. D. Ramseyer, Superintendent of the Ford Soy-Bean Plant, Dearborn, Michigan, addressed the branch on **Soy-Beans in Industry**. (53).
- Nov. 26—Special meeting honouring Dean C. J. Mackenzie, our President, accompanied by Vice-President K. M. Cameron, Councillor J. A. Vance and H. F. Bennett, from the London Branch. Dr. Mackenzie spoke on the **Work of the National Research Council**. (31).
- Dec. 12—Annual meeting and election of officers, complimentary dinner to F. H. Kester. An address on **Recruiting and Training Activities of the Air Force** was given by Flight-Lieutenant Hugh C. Flemming, Commanding Officer of the Windsor recruiting station of the Royal Canadian Air Force.

## CALGARY BRANCH

The following report covers the activities of the branch for the year 1941. Attendances are shown in brackets:

### MEETINGS

- Jan. 16—**Soil Mechanics**, by Prof. R. M. Hardy. (50).
- Jan. 30—Seven reels of motion pictures loaned by the U.S. Bureau of Mines were shown. These pictures depicted the **Manufacture of Steel**. (51).
- Feb. 13—Students and Juniors night. Speakers: Mr. Langston, **Gun Perforation in Oil Wells**; Mr. Stanley, **Cascade Power Project**; Mr. Sharp, **Motion Picture Projectors**. (47).
- Feb. 27—**Explosives**, by R. W. Watson. (46).
- Mar. 8—Annual Meeting following luncheon (35).
- April 15—**Organization of the R.C.A.F. Civilian Staff**, by T. M. Moran (38).
- Oct. 9—**Exploring for Oil by Geophysics**, by W. H. Gibson (63).
- Oct. 23—**Power Plants in Australia**, by H. K. Dutcher (58).
- Nov. 6—**Aircraft Design**, by Flight-Lieutenant W. Thornber (57).
- Nov. 20—A motion picture was shown by Mr. Davidson and Mr. Pettinger of the Alberta Wheat Pool entitled **The History of Power in Canada** (53).
- Dec. 4—Business meeting to discuss the proposed new By-laws of the Calgary Branch (15).
- Dec. 17—Showing of coloured scenic pictures by Dr. Pilchard and Mr. S. G. Coultis. This was our annual ladies night (81).

In addition to the above regular meetings, a banquet was held on September 26, in honour of Dr. C. J. Mackenzie, president of The Institute.

During the year, the Branch Executive Committee met eight times.

## EDMONTON BRANCH

1941 saw a large increase in the membership of the Edmonton Branch, due to the agreement with the Association of Professional Engineers.

During the year nine meetings in all were held. All but two of these were preceded by a dinner. The following

## Note—For Membership and Financial Statements see pages 94 and 95.

summary gives particulars. Attendances are shown in brackets:

- Jan. 14—**The Development of the Combustion Chamber of the Diesel Engine**, by E. A. Hardy, Professor of Agricultural Engineering, University of Saskatchewan (40).
- Jan. 27—Motion picture in seven reels showing the manufacturing of steel. Meeting arranged by the Engineering Students Society of the University of Alberta.
- Feb. 25—**Arc-welding in Industry**, by C. W. Carry, Standard Iron Works, Edmonton (40).
- April 1—Annual ladies night. Entertainment by the Belasco Players and showing of a motion picture entitled "Silvercraft" (52).
- April 22—**Compressed air—Its application in construction and effect on workers**, by D. Hutchison, Mackenzie River Transport. This was the final meeting of the 1940-41 session and election of branch officers took place (25).
- Oct. 2—The visit of the president, Dr. C. J. Mackenzie, coincided with the banquet of the Regional Convention of the Canadian Institute of Mining and Metallurgy. The president of the Engineering Institute was guest-speaker at a banquet arranged by the C.I.M. & M. Eleven members of the Institute and their wives attended, while others were present as members of C.I.M. & M.
- Oct. 29—The motion picture **Tacoma Bridge Failure** was shown. I. F. Morrison, Professor of Civil Engineering, University Of Alberta, lead an interesting discussion. Chrysler Corporation films were also shown (53).
- Nov. 18—**CKUA New Broadcasting Station**, by J. W. Porteous, University of Alberta (47).
- Dec. 16—**St. Mary and Milk River Irrigation Development**, by W. L. Foss, of the Prairie Farm Rehabilitation Office (30).

## HALIFAX BRANCH

The following is a resume of the activities of the branch for the past year.

In spite of the increased burden placed on practically all members by the war, we are able to report that all meetings have been well attended, and would like to thank the members for their continued interest.

During the year five dinner meetings were held, as follows:

- Feb. 20—Mr. C. D. Harvey, Provincial Archivist, spoke on **The First Settlers of this Province and their Effect on its Future**. Also Mr. R. L. Dunsmore gave a brief outline of the recent Annual Meeting of the Institute at Hamilton. At this meeting Mr. S. W. Gray took over the duties of secretary-treasurer of the branch.
- Mar. 20—Mr. R. L. Dunsmore presented a technicolour talking picture, **Friction Fighters**. At this meeting, Mr. I. P. MacNab presented the certificate for the Institute Student Prize to Wallace A. MacCallum, of Amherst, N.S.
- May 12—This was the most important meeting of the year, as our guests included our President Dean Mackenzie, Vice-President K. M. Cameron, General Secretary L. Austin Wright, Councillor J. A. Vance, and R. L. Dobbin and G. A. Gaherty. The guest speaker of the evening was Father Burns, Professor of Philosophy at St. Mary's College, whose subject was **Social Reconstruction after the War**. President Mackenzie spoke briefly on the contribution being made by engineers to the war work, and the fact that their value is recognized, particularly in Great Britain. Mr. Wright gave a short talk on, **The Progress and Problems of the Wartime Bureau of Technical Personnel**. The Institute film showing the collapse of the Tacoma Bridge was the final feature of the evening.
- Oct. 23—Mr. Guina, Assistant General Manager of the Canadian Colloid Company, spoke on the subject of **Boiler Feed Water and its Control**.
- Nov. 27—Mr. M. Walsh, Chief Engineer of the Gunite and Waterproofing Company, described the **Method of Prestressing Concrete**, and presented a film showing the construction of large storage tanks by gunite.
- May 22—Mr. P. A. Lovett presented the Institute Student Prize to Harold T. Rose at the Graduation Exercises of the Nova Scotia Technical College.

During the year the Executive held eleven meetings, at which the ordinary routine business was transacted.

Pactically all matters in connection with the co-operation of the Institute and the Association of Professional Engineers have been cleared up.

The membership of our branch since the agreement was completed, has increased by 107 members,—only four corporate members are not members of the Association.

The purchase of an \$80.00 War Savings Certificate was made during the year from monies saved by not having any musical entertainment at our Dinner Meetings.

### HAMILTON BRANCH

The branch has continued in the co-operation with allied societies by having joint meetings when possible. The following is a brief account of meetings and activities during the year, attendances being shown in brackets:

Jan. 6—Annual Business Meeting and Dinner held at the Rock Garden Lodge. **Current Events** was the subject chosen by Colonel Beauchemin, who gave an excellent address until being relieved of his disguise when it became evident that the imposter was Mr. T. S. Glover, M.E.I.C. Chairman. Alex. Love closed his term of office and turned the affairs of the Branch to the incoming Chairman, W. A. T. Gilmour (64).

Feb. 6 and

Feb. 7—The Fifty-fifth Annual General Meeting of the Institute re-convened at the Royal Connaught Hotel, Hamilton. The Hamilton Branch wishes to thank all of the branches for their attendance and support which helped to make the meeting an outstanding success. An unusual and enjoyable feature was the joint dinner (615) with the Niagara District Electric Club and the demonstration and lecture given by Mr. J. O. Perrine, Assistant Vice-President of the American Telegraph and Telephone Company.

Mar. 10—**Aerial Surveying**, by Professor K. B. Jackson, held at McMaster University (52.)

Apr. 18—**Electricity in National Defence**, by Mr. C. A. Powell, of the Westinghouse Company, Pittsburgh, held in the Westinghouse Auditorium. This was a joint meeting with the Toronto Section of the American Institute of Electrical Engineers (226).

May 9—**Alcohol from Wheat**, by Dr. H. B. Speakman, Director of Ontario Research Foundation, Toronto. Held at McMaster University (36).

Oct. 2—**The 220 Kv. System of the Hydro Electric Power Commission**, by Mr. A. H. Frampton, of the H.E.P.C. of Ontario. Held in the Westinghouse Auditorium. This was a joint meeting with the Toronto Section of the American Institute of Electrical Engineers (168).

Nov. 7—**War Production** was exemplified during an evening visit to the plant of The Dominion Foundries and Steel Limited. The tour of inspection was conducted by guides under the able direction of Mr. W. D. Lamont, Chief Metallurgist. The light supper served in the cafeteria after the long tour was thoroughly appreciated by our party (65).

Dec. 16—**Tool Steels for Engineers**, by Mr. H. B. Chambers, Metallurgist, Atlas Steels Limited, Welland. Held at McMaster University (46). During this meeting a quiz of ten questions about tool steel was handed out to members and guests. Each one checked his neighbour's paper while Mr. Chambers gave the correct replies. The prize, a current novel, was won by a guest.

After our meetings at McMaster, it is our general practice to serve coffee and sandwiches and enjoy half an hour of good fellowship.

### OBITUARY

The Branch will miss the kind and genial presence of Mr. F. P. Adams, City Engineer of Brantford, who passed away during the year after so many years of work in the Institute.

### PUBLICITY

The Executive wishes to express some appreciation to the press, especially *The Hamilton Spectator* and *The Daily Commercial News* for their generous support.

### GENERAL

The usefulness of the Branch has been greatly enlarged by the many courtesies and help given to us by the management of McMaster University and we record, here, our very deep appreciation for all these things.

The Executive Committee held eight business meetings with an average attendance of seven.

### KINGSTON BRANCH

The branch held the following meetings during the year:

Jan. 30—Dinner meeting at Queen's Students' Union. Lt.-Col. LeRoy F. Grant presented the award of the Institute to Mr. James M. Courtright, Science '41, a student at Queen's. Mr. M. N. Hay, of the Aluminum Co. of Canada Ltd., Kingston, spoke on **The Aluminium Industry of the World**.

Feb. 25—Meeting held in conjunction with a dinner at Queen's Student's Union. The chairman, Mr. T. A. McGinnis, presided. The guest speaker was Dr. A. E. Berry, Director of the Sanitary Engineering Division of the Ontario Department of Health. His subject was **The Engineer in Public Health**.

Mar. 13—Joint meeting was held with the Queen's University Engineering Society to enable a large number of science students the opportunity of hearing Mr. Otto Holden, Chief Hydraulic Engineer of the Hydro-electric Power Commission of Ontario speak on **The Ogoki River and Long Lake Diversions**.

June 14—Special dinner meeting was held at the Catarqui Golf Club in honour of the election of Principal Wallace of Queen's University to honorary membership in the Institute. Many out of town guests were present as the Council had been invited to hold a meeting in Kingston to celebrate the occasion. During the afternoon Chairman and Mrs. McGinnis entertained at tea.

### LAKEHEAD BRANCH

The branch held the following meetings during the year:

Jan. 15—Dinner meeting at the Royal Edward Hotel, in Fort William. The chairman, Mr. H. G. O'Leary, presided. The speaker was Mr. J. I. Carmichael of the Canadian Car and Foundry who spoke on **Some Problems in Aircraft Production**.

Feb. 14—Annual ladies night was held. This year it took the form of a St. Valentine's supper dance in the Norman Room of the Royal Edward Hotel.

Mar. 20—Meeting was held in the City Council Chambers in the Whalen Building, Port Arthur. The vice-chairman, Mr. B. A. Culpeper, presided in the absence of the chairman. The speaker was Mr. R. B. Chandler, Manager of the Port Arthur Public Utilities Commission, who spoke on **The Ogoki and Long Lac Diversions**.

April 23—Dinner meeting was held at the Royal Edward Hotel, in Fort William. The chairman presided. The speaker was Mr. R. R. Holmes of the Thunder Bay Paper Co., who spoke on **The Treatment of Boiler Feedwater**.

May 21—Annual dinner meeting was held at the Port Arthur Golf and Country Club. The chairman presided and presented his report. He welcomed the incoming officers and handed over the chairmanship to Mr. B. A. Culpeper.

Aug. 16—Special meeting was called to make an inspection tour of Temporary Grain Storage Buildings and conveyor galleries being constructed for the bulk storage of grain. The storage buildings inspected were those being constructed for the United Grain Growers Limited at Port Arthur.

Sept. 22—Dinner meeting was held at the Royal Edward Hotel, in Fort William. The president, vice-president and general secretary were special guests. Dr. Mackenzie spoke on **The National Research Council in Relationship to the War**.

Oct. 15—Dinner meeting was held at the Italian Hall, in Port Arthur. Five short addresses were given as follows: G. H. Burbidge, on **Lakehead Winds**; J. Koreen, **Building of a Ship**; S. T. McCavour, **The Trials and Tribulations of the Pulp and Paper Industry in Wartime**; R. J. Prett, **Prefabricated Hangars**, and H. P. Sisson, **Building of a Road**.

### LETHBRIDGE BRANCH

The regular meetings of the branch were held in the Marquis Hotel, on Wednesdays, with refreshments served after the meetings, in accordance with the policy decided on in the previous year. One meeting, at which the Tacoma Bridge film was shown, was held in the Auditorium of the Collegiate Institute.

The following is the list of the meetings held, with the speakers and subjects, with attendance shown in brackets:

Jan. 15—Mr. J. H. Ross, Director of Y.T. for Alberta, **Co-ordination of the Youth Training Movement with the National Defense Movement** (29).

- Feb. 5—Preceded by corporate members meeting. Mr. John Dykes, **The Life of Robert Burns**. (14).
- Mar. 22—Joint meeting with the Assoc. of Prof. Eng. of Alberta. Mayor D. H. Elton, **History Repeats Itself**.
- Feb. 26—Mr. L. B. George, Div. Master Mech. C.P.R., **A Visit to an Aeroplane Plant** (25).
- Nov. 5—Subject: Films: 1. **Tacoma Bridge Disaster**; 2. **Crude Oil Refining**; 3. **Crude Oil Production**.

The annual meeting of the branch was held on April 2nd.

On May 10, 1941, R. B. McKenzie, Jr.E.I.C. was appointed secretary-treasurer, E. A. Lawrence having volunteered for active service.

### LONDON BRANCH

During the year 1941, the executive held six business meetings. Nine regular and special meetings were held as follows. Attendance is given in brackets:

- Jan. 15—Annual meeting and election of officers held at the Grange Tea Rooms, London. **The Machinery of Law**, by R. E. Laidlaw of the Canadian National Railways legal staff (56).
- Feb. 19—Regular meeting held in the Board of Education board rooms, City Hall, London. **The Analysis of Stresses by Polarized Light**, by H. C. Boardman of the Chicago Bridge & Iron Works (56).
- Mar. 13—Regular meeting held in the Board of Education board rooms, City Hall, London. **Power Development on the St. Maurice River**. J. A. McCrory, Chief Engineer of The Shawinigan Engineering Co. (37).
- Apr. 17—Regular meeting held in the Board of Education board rooms, City Hall, London. **Junior Engineers Meeting**, A. L. Furanna, Chief Draftsman Public Utilities Commission, London, spoke on **The 1940 Analysis of London's Low Voltage Network**, A. F. Hertel, Engineer, Dept. of Public Works, spoke on **Some Ways of Winning the War**. H. G. Stead, Chief Engineer, E. Leonard & Sons, spoke on **The Development of Power** (28).
- May 21—Regular meeting held in Gettas Tea Rooms, Talbot St., St. Thomas. Supper meeting followed by showing of the film **The Failure of the Tacoma Bridge** (40).
- Oct. 1—Regular meeting held in the Officers' Mess of the Talbot St. Armouries, London. **Recent Electrical Engineering Developments**, J. M. Galillee, Assistant Advertising Manager of The Candian Westinghouse Co. (70).
- Oct. 29—Regular meeting held in the Drill Hall of the Talbot St. Armouries, London. **Films depicting various scenes of the Present War**. (150)
- Nov. 26—Special luncheon meeting held in the Crystal Ball Room, Hotel London, London. **Research and War**. Dean C. J. Mackenzie, President of the Institute. Meeting was held in conjunction with the Canadian Club (30).
- Dec. 10—Regular meeting held at the Hume Cronyn Memorial Observatory, University of Western Ontario, London. **The Planets and Stars**, by Prof. Kingston, University of Western Ontario.

Average attendance of all meetings: 50.

### MONCTON BRANCH

The Executive Committee held four meetings. Six meetings of the branch were held as follows:

- Mar. 18—A meeting was held in the City Hall. A motion picture sound film entitled **The Mining, Smelting and Refining of Copper-Nickel Ores** was shown.
- Apr. 22—A combined meeting of Moncton Branch, and the Engineering Society of Mount Allison, was held in the Science Building of Mount Allison University, Sackville. C. S. G. Rogers, Bridge Engineer, Atlantic Region, Canadian National Railways, gave a review of the causes of the Tacoma Bridge collapse. Mr. Rogers' remarks were illustrated with moving picture film.
- May 14—A dinner meeting was held at the Riverdale Golf Club, for the purpose of meeting the president of the Institute, Dean C. J. Mackenzie, Vice-President K. M. Cameron, Chairman of the Papers Committee, J. A. Vance, and R. L. Dobbin, member of the Legislation Committee.
- May 30—The annual meeting was held on this date.
- Nov. 28—A meeting was held in the City Hall. R. M. Phinney, S.B., Engineer of Train Operation, General Railway Signal Co., Rochester, N.Y., gave an illustrated address on **Centralized Traffic Control**.
- Dec. 1—A combined meeting of Moncton Branch, and the Engineering Society of Mount Allison, was held in the Science Building of Mount Allison University, Sackville. R. M.

Phinney repeated his address on **Centralized Traffic Control**.

It is with regret that we record the passing of Robert Leslie Murray, S.E.I.C., whose death occurred on November 17th.

### MONTREAL BRANCH

Notwithstanding the difficult conditions imposed by the war, the affairs of the branch have been conducted as usual. Though engineers and technical men have been unusually busy, the attendance has been good, and the interest and enthusiasm most encouraging. As in the past, members of all committees have given active and efficient support to all branch activities.

The outstanding achievement of the year was the campaign for funds to effect repairs to the Headquarters building of the Institute. The responsibility of contacting the membership of the branch was undertaken by the Executive Committee who were ably assisted by Past Presidents, Councillors and several members of the branch in carrying out this important assignment. The splendid result achieved speaks for itself, an amount of \$6,000 has been collected for the fund.

A special committee was organized to co-operate with the Royal Canadian Engineers in finding suitable candidates for officers and other ranks. Several meetings were held—the initiative now being in the hands of Lt.-Col. P. M. Knowles, O.C., R.C.E., Montreal.

On February 11, through the courtesy of the Rotary Club of Montreal, the members were invited to a luncheon which was addressed by the Honourable C. D. Howe, Hon.M.E.I.C., Minister of Munitions and Supply, who had recently returned from England.

On April 28, l'Association des Anciens Elèves de l'Ecole Polytechnique invited all members of the Branch to attend a lecture in the new auditorium of l'Ecole Polytechnique on **The Place of Soil Technology in Modern Highway and Airport Construction**, by Mr. N. W. McLeod, D.Sc., C.E.

### PAPERS AND MEETINGS COMMITTEE (Chairman: J. M. CRAWFORD)

The regular Thursday night meetings have been carried on as usual despite the increased tempo of activity in industrial and engineering circles. In some cases, however, it has not been possible to secure what would have been most interesting papers due to the necessary restrictions placed upon the publicizing of certain phases of work directly connected with the war effort.

Mention is here made of the visit on June 12, to the plant of Canadian Vickers Limited. A record crowd of 300 taxed the well-organized preparations of Vickers, showing the keen interest of Institute members in such plant visits.

Following is a list of the papers delivered during the calendar year of 1941, with the attendance shown in brackets:

- Jan. 9—Annual Meeting of the Branch (80).
- Jan. 16—**Our Cities: Their Role in the National Economy**, by George S. Mooney (50).
- Jan. 23—**Diesel Electric Locomotives**, by Prof. Louis E. Endsley (100).
- Jan. 30—Annual Branch Smoker (482).
- Feb. 3—**Energy, Frequencies and Noise Relations in Line and Amplifiers of Coaxial Cables and Other Multi-Channel Telephone Systems**, by Dr. J. O. Perrine (100)
- Feb. 13—**Recent Installations of Large Boilers in England**, by Gerald N. Martin (65).
- Feb. 20—**Development of Transport Mechanization**, by R. L. Martin (80)
- Feb. 27—**Transmission Line Fault Location**, by E. W. Knapp, M.E.I.C. (90).
- Mar. 6—**Automotive Industry's War Effort**, by R. D. Kerby (77).
- Mar. 13—**Destructive Forces, Damage and Repair**, by John Dibblee, M.E.I.C. (68).
- Mar. 20—**Departures in Bridge Foundation Construction**, by A. Sedgwick (125).
- Mar. 27—**Utilization of the Power Resources of the Upper St. Maurice River**, by E. V. Leopoldt, M.E.I.C. (85).

- April 3—**War Time Communications**, by G. L. Long and J. L. Clarke (60).
- April 17—**Improving Operations in Industrial Plants**, by W. T. Johnson (95).
- April 24—**Soil-Cement Paving**, by Roy A. Crysler (75).
- June 12—**Plant Visit—Canadian Vickers Ltd.** (300).
- Oct. 2—**Opening meeting—Movie and Refreshments** (160).
- Oct. 9—**Modern Power and Distribution Systems in Industrial Plants**, by J. L. McKeever (85).
- Oct. 16—**Control of Operating Costs by Budget**, by H. M. Hetherington (55).
- Oct. 23—**The Aluminum Industry Related to our War Effort**, by A. W. Whitaker, Jr. (190).
- Oct. 30—**Municipal Management and the Engineer**, by J. Asselin (50).
- Nov. 6—**Centralized Traffic Control for Railway Operation**, by Robert M. Phinney (65).
- Nov. 13—**Glass in National Defense**, by C. J. Phillips (120).
- Nov. 20—**Annual Student Night** (170)
- Nov. 27—**Portland-Montreal Pipeline**, by W. R. Finney (225).
- Dec. 4—**The Trolley Bus**, by L. W. Birch (65).
- Dec. 11—**The Chemical Descent of Man**, by Robert R. Williams, M.S.Sc.D. (125).

#### JUNIOR SECTION

(Chairman: A. P. BENOIT)

The Junior Section has had another successful year, in spite of the fact that the war activities both in the military and industrial fields, have somewhat impeded its progress. The student engineer and the young engineer are for a good part doing military training in the evenings and have little time to attend meetings as often as they would like.

As in previous years, the Students' Night, which took place on November 20, was the highlight of the Junior Section's activities. Mr. H. A. N. Holland, of McGill University, carried off first prize with a very original paper on construction and Mr. R. Quintal, of l'Ecole Polytechnique was awarded second prize for a most interesting talk in Geophysical Prospecting. One of the main objects of the Junior Section is to interest students in Institute affairs. It has been suggested that students should join the Institute, when registering with their respective universities each fall, and this plan will be tried out next year. This year, Mr. R. E. Hertz addressed the McGill Students while Mr. L. Trudel spoke at l'Ecole Polytechnique.

The executive of the Junior Section is at present drafting a circular letter which will be sent to all students, to invite them to present papers and to take a more active part in the Institute's activities and the discussions at the meetings.

The Junior Section was instrumental in securing a Branch News Editor, Mr. Graham Wanless having kindly consented to assume the duties.

The following is a list of the Junior Section meetings with the attendance given in brackets:

- Jan. 27—**Annual Meeting**—Prof. R. E. Jamieson, M.E.I.C., spoke on the **Corporation of Professional Engineers of Quebec** (40).
- Feb. 10—**Experimental Research on Soil Stabilization**, by Jacques Hurtibise, Jr. E.I.C. (16).
- Feb. 24—**Aspect Légal de l'Arpentage**, par Gabriel Dorais, Jr. E.I.C. (20).
- Mar. 17—**Some Aspects and Problems encountered in Television Broadcasting** by W. B. Morrison, B.A.Sc. (39)
- Mar. 31—**A Simple Explanation of Ship Model Testing**, by A. Monti, S.E.I.C. (20).
- Oct. 6—**Opening night. Talk by Mr. R. E. Hertz on Policy and the Young Engineer** (90).
- Oct. 20—**Transformer Troubles**, by Pierre Duchastel (21).
- Nov. 20—**Student night. Synthetic Gasoline**, by R. M. Rousseau (Ecole Polytechnique), **First Summer in Construction**, by H. A. N. Holland (McGill); **Geophysical Prospecting**, by R. Quintal (Ecole Polytechnique); **Surveying and Mapping in Newfoundland**, by M. C. Baker (McGill). A motion picture was shown through the courtesy of The Canadian General Electric Co. (170).
- Dec. 5—**Synthetic Rubbers in War-Time**, by J. W. Crosby (80). (Joint meeting with Quebec Rubber and Plastics Group held at the Faculty Club.)
- Dec. 15—**Engineering Services of the Montreal C.N.R. Terminal**, by Richard Noonan, Jr. E.I.C. (25).

#### MEMBERSHIP COMMITTEE

(Chairman: P. E. SAVAGE)

The Membership Committee this year concentrated its efforts on students at McGill University and the Ecole Polytechnique. This work was done mainly through the Junior Section, which carried it out very thoroughly, and with gratifying results.

The second main effort of the Committee was directed at non-members who made use of the Institute Employment Service. Most of these men who had obtained positions in the past two years were canvassed by means of personal letters, but with very disappointing results. It was noted that most of the men in this group would qualify for Affiliate Membership.

#### OBITUARIES

It is with regret that we record the names of those who have died during the year, and we wish to extend to their families the most sincere sympathy of the Branch.

#### MEMBERS

William Israel Bishop	Patrick Philip
Joseph Elie Blanchard	Robert Ramsay
George Prince Hawley	William Lewis Reford Stewart
Sir Herbert Samuel Holt	James Weir
Joseph Arthur Lamoureux	

#### STUDENT

Gaston Lalonde

#### PUBLICITY COMMITTEE

(Chairman: GORDON D. HULME)

In order to establish and maintain friendly relations with the press, representatives of the Montreal newspapers were invited to discuss with the Publicity Committee steps which should be taken to publicize the Branch's activities during the coming season. Three representatives from the *Gazette*, two from the *Montreal Daily Star* and one from *La Presse* attended a Committee meeting.

Announcements concerning each Branch function were included in the city items of the various papers, at the request of the committee.

On the organization of the Annual General Meeting Committee, the Branch publicity committee was invited as a group to handle the publicity for that function. The invitation was accepted and the committee is now operating in that capacity as well as continuing the publicizing of items of local interest.

#### RECEPTION AND ENTERTAINMENT COMMITTEE

(Chairman: W. W. TIMMINS)

A smoker was held at the Ritz-Carlton Hotel on Thursday evening, January 31, for which a record number of 545 tickets were sold. The smoker was organized by Mr. W. P. Malone and was intended to create the atmosphere of the gay nineties.

Refreshments were served at the Annual Meetings and the opening fall meetings of the Branch and of the Junior Section and also at the Student Night. Several courtesy dinners were given to out-of-town speakers, but due to small attendances the Executive Committee has decided to drop this function for the present. Out-of-town guests are to be entertained by the sponsors of the papers and any members wishing to join are entirely welcome to do so.

Throughout the world, the Branch is represented in various units of the armed forces. We look to our fellow members with pride and keep them constantly in our thoughts. Our hope is that they may have a safe and speedy return.

#### NIAGARA PENINSULA BRANCH

The Executive held four business meetings and one electoral meeting to conduct the affairs of the branch.

The programme committee arranged and conducted the following professional meetings:

## MEMBERSHIP AND FINANCIAL STATEMENTS

Branches	Border Cities	Calgary	Cape Breton	Edmonton	Halifax	Hamilton	Kingston	Lakehead	Lethbridge	London
<b>MEMBERSHIP</b>										
<b>Resident</b>										
Hon. Members.....	..	..	..	..	..	..	2	..	..	..
Members.....	51	95	31	67	145	88	38	29	14	31
Juniors.....	9	14	3	9	9	18	12	2	1	4
Students.....	7	12	4	24	17	21	24	5	..	3
Affiliates.....	..	..	2	1	1	1	..	5	6	..
Total.....	67	121	40	101	172	128	76	41	21	38
<b>Non-Resident</b>										
Hon. Members.....	..	..	..	..	..	..	..	..	..	..
Members.....	18	15	24	7	71	17	8	18	23	9
Juniors.....	9	4	9	1	4	1	2	4	4	..
Students.....	4	5	3	4	9	..	5	5	9	2
Affiliates.....	..	..	1	..	..	..	..	..	1	1
Total.....	31	24	37	12	84	18	15	27	37	12
Grand Total December 31st, 1941.....	98	145	77	113	256	146	91	68	58	50
“ December 31st, 1940.....	97	128	70	83	233	151	73	64	40	54
Branch Affiliates, December 31st, 1941...	..	39	..	..	..	17	..	..	..	1
<b>FINANCIAL STATEMENTS</b>										
Balance as of December 31st, 1940.....	189.84	205.83	241.57	88.61	249.56	180.34	78.63	162.87	61.33	260.67
<b>Income</b>										
Rebates from Institute Headquarters..	157.12	262.60	141.63	207.93	37.20	286.30	109.62	150.10	..	93.35
Payments by Professional Assns.....	..	..	..	..	469.20	..	..	..	80.30	..
Branch Affiliate Dues.....	..	112.00	..	..	..	39.00	..	..	7.00	..
Interest.....	..	41.31	..	..	0.56	53.55	0.09	1.77	0.28	..
Miscellaneous.....	184.70	..	..	..	17.53	479.00	..	390.63	..	..
Headquarters Building Fund Subscrip- tions.....	59.00	..	..	..	94.15	..	..	..	29.00	..
Total Income.....	400.82	415.91	141.63	207.93	618.64	857.85	109.71	542.50	116.58	93.35
<b>Disbursements</b>										
Printing, Notices, Postage ①.....	45.31	12.51	1.14	58.29	109.00	89.54	42.72	15.58	5.00	40.98
General Meeting Expense ②.....	259.64	154.48	..	22.50	98.74	57.64	7.75	220.43	57.43	27.52
Special Meeting Expense ③.....	..	39.93	..	53.89	..	129.21	45.05	218.22	..	15.25
Honorarium for Secretary.....	..	..	..	50.00	62.50	..	25.00	10.00	..	..
Stenographic Services.....	8.00	10.00	12.00	..	34.65	50.00	12.55	..	..	5.00
Headquarters Building Fund.....	59.00	125.00	25.00	..	94.35	125.15	..	..	26.00	54.00
Travelling Expenses ④.....	..	..	..	8.60	..	2.80	..	..	..	..
Subscriptions to other organizations...	..	..	..	10.00	..	..	15.00	..	..	..
Subscriptions to <i>The Journal</i> .....	..	16.15	..	..	..	..	..	..	..	..
Special Expenses.....	..	46.86	..	..	60.00	300.00	..	..	..	..
Miscellaneous.....	8.15	113.24	..	0.12	3.55	3.30	..	11.00	0.45	..
Professional Assn. Registration Fees...	..	..	90.00	..	180.00	..	..	..	..	..
Total Disbursements.....	380.10	518.17	128.14	203.40	642.79	757.64	148.07	475.23	88.88	142.75
Surplus or <i>Deficit</i> .....	20.72	102.26	13.49	4.53	24.15	100.21	38.36	67.27	27.70	49.40
Balance as of December 31, 1941.....	210.56	103.57	255.06	93.14	220.41	280.55	40.27	230.14	89.03	209.92

① Includes general printing, meeting notices, postage, telegraph, telephone and stationery.

② Includes rental of rooms, lanterns, operators, lantern slides and other expenses.

③ Includes dinners, entertainments, social functions, and so forth.

④ Includes speakers, councillors or branch officers.

OF THE BRANCHES AS AT DECEMBER 31, 1941

Moncton	Montreal	Niagara Peninsula	Ottawa	Peterborough	Quebec	Saguenay	Saint John	St. Maurice Valley	Saskatchewan	Sault Ste. Marie	Toronto	Vancouver	Victoria	Winnipeg
17	3 780	2 63	2 290	30	82	50	29	30	98	18	1 348	120	1 44	125
5	149	15	34	13	13	16	5	17	10	5	53	7	2	13
4	359	25	38	15	18	20	8	19	38	2	78	10	5	66
..	16	4	3	..	1	3	2	..	..	..	10	5	..	3
26	1307	107	367	58	114	89	44	66	146	25	490	142	52	207
4	47	9	51	21	18	3	25	4	71	36	12	1 46	9	17
4	19	..	9	5	4	..	7	3	17	14	9	3	2	5
7	24	1	15	4	4	..	26	1	24	15	9	5	2	2
..	2	..	2	1	1	..	..	..	2	..	1	..	..	..
15	92	10	77	31	27	3	58	8	114	65	31	55	13	24
41	1399*	117	444	89	141	92	102	74	260	90	521	197	65	231
41	1350	133	438	91	139	71	93	94	220	98	541	199	57	220
4	6	10	19	7	..	..	..	..	..	12	..	..	1	7

\*For voting purposes only, there should be added to Montreal Branch, an additional 309 members, 186 being resident in the United States, 98 British possessions and 32 in foreign countries.

6.39	1,688.27	309.14	572.76	166.59	99.66	279.39	282.21	84.63	20.94	392.11	964.85	192.93	106.30	214.82
8.23	1,960.88	224.55	630.88	152.90	272.33	143.89	132.05	121.58	2.35 271.43	147.07	685.24	315.65	102.50	348.45
5.00	73.00	39.55	54.00	14.00	..	..	..	..	..	33.00	..	..	3.00	35.00
2.15	13.85	1.50	45.72	0.75	0.96	..	..	..	..	6.04	1.85	0.40	..	22.50
..	819.45	81.39	2.96	..	385.55	..	70.00	34.83	..	94.00	269.83	..	..	40.87
..	..	23.00	379.00	..	..	..	40.85	..	..	..	..	99.15	17.00	63.03
5.38	2,867.18	369.99	1,112.56	167.65	658.84	143.89	242.90	156.41	294.72	280.11	956.42	415.20	122.50	509.85
8.65	817.90	79.70	147.22	50.14	82.04	26.10	51.32	28.77	35.26	18.12	130.30	64.00	20.00	134.85
0.91	107.65	40.30	..	46.50	173.50	19.00	5.00	17.63	139.28	121.86	190.15	65.00	..	49.02
3.90	1,098.36	34.98	217.45	34.38	358.04	77.01	120.50	28.21	..	39.40	257.00	..	9.65	14.77
5.00	300.00	75.00	..	..	100.00	..	25.00	..	58.00	25.00	125.00	50.00	35.00	50.00
0.00	120.00	3.00	25.00	..	9.00	..	10.00	5.00	14.00	1.00	..	20.00	1.75	20.00
..	73.58	23.15	379.00	..	..	..	40.85	..	..	100.00	..	99.00	60.00	64.00
..	49.53	9.75	..	..	..	8.10	..	23.55	22.23	..	17.20	..	..	..
..	..	..	..	..	..	..	..	..	..	..	10.00	..	..	..
8.00	32.00	16.30	6.00	6.00	..	..	..	..	..	10.00	..	..	..	14.00
..	68.29	100.00	30.00	59.50	..	62.56	..	26.15	..	..	480.00	..	..	34.68
7.21	100.88	..	53.07	3.30	2.02	0.85	14.56	0.79	2.66	1.00	21.50	26.13	2.50	10.00
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
3.67	2,768.19	382.18	857.74	199.82	724.60	193.62	267.23	130.10	271.43	316.38	1,231.15	324.13	128.90	391.32
8.29	98.99	12.19	254.82	32.17	65.76	49.73	24.33	26.31	23.29	36.27	274.23	91.07	6.40	118.53
8.10	1,787.26	296.95	827.58	134.42	33.90	220.66	257.88	110.94	44.23	355.84	690.62	284.00	99.90	333.35

- Jan. 24—Dinner meeting at the Leonard Hotel, St. Catharines. The speaker, Professor R. W. Angus, gave an illustrated talk on **The History of the Development of Water Turbines and Pumps**.
- Mar. 21—Dinner meeting at the Reeta Hotel, Welland. The speaker, Mr. H. B. Chambers, of the Atlas Steel Company, gave an illustrated talk on **Some Fundamental Steel Characteristics of Special Interest to Engineers**.
- May 16—Joint dinner meeting with the Ontario Chapter of the American Society for Metals, held at the Leonard Hotel, St. Catharines. The speaker, Mr. O. W. Ellis of the Ontario Research Foundation, talked on **Forgeability** as applied to both ferrous and non-ferrous metals.
- June 16—Annual dinner meeting held at the General Brock Hotel, Niagara Falls. After the dinner, the newly elected branch officers and executive were introduced to the membership. The speaker, Mr. E. L. Durkee of the Bethlehem Steel Company, gave a talk on **The Erection of the Steel Superstructure of the Rainbow Bridge**. This most interesting talk was illustrated with three reels of motion pictures.
- Oct. 29—Dinner meeting held at the General Brock Hotel, Niagara Falls. The principal speaker was Dr. Shortridge Hardesty of Waddell and Hardesty, New York, who spoke on **The Rainbow Bridge** from the viewpoint of design. Mr. E. L. Durkee, resident engineer of the Bethlehem Steel Company, provided a running commentary to the Bethlehem Steel Company's movie on the construction of the bridge. The co-operation of the Niagara Falls Bridge Commission is appreciated for making this meeting possible, and for opening the work to inspection in the afternoon.
- Nov. 20—Joint dinner meeting with the Niagara Group of the American Institute of Electrical Engineers, held at the Welland House, St. Catharines. The speaker, Mr. J. W. Bateman of the Canadian General Electric Company, gave a talk and demonstration on **Some Interesting Applications of Light, Ultra-Violet and Infra-Red Radiations**.

### OTTAWA BRANCH

During the year the Managing Committee held ten meetings for the transaction of general business.

It is with deep regret that we report the deaths of four of our members: W. M. Johnstone, M.E.I.C., J. A. Vermette, M.E.I.C., A. C. Wright, M.E.I.C., and J. A. Lamoureux, M.E.I.C., of Fort Coulonge, P.Q.

As in previous years the Branch donated two sets of draughting instruments to the Ottawa Technical School for presentation as prizes for proficiency in draughting. A copy of "Technical Methods of Analysis" by Griffin was presented to the Hull Technical School to be awarded to one of its students.

The following is a list of meetings held during 1940, with attendance figures in brackets. Unless otherwise stated, these were luncheon meetings at the Chateau Laurier:

- Jan. 9—Evening meeting, Auditorium, National Research Council Building. Annual meeting, Ottawa Branch, E.I.C. Address by Dr. C. A. Robb, **Gauges for Mass Production** (80).
- Jan. 30—**Air Raid Precautions**, by Mr. Alan Hay, Consulting Engineer, Federal District Commission (96).
- Feb. 13—**Military Explosives**, by Mr. E. T. Sterne, Allied War Supplies (122).
- Feb. 27—**Planning and Construction of Aerodromes**, by Mr. G. L. McGee, Department of Transport (114).
- Mar. 13—**Fighter Squadron**, by Flying Officer H. T. Mitchell (145).
- Mar. 27—**Research and Security**, by Mr. L. A. Hawkins, General Electric Company, Schenectady, N.Y. (76).
- April 10—Evening Meeting, Auditorium, National Research Council Building. Mr. A. E. Davison, Hydro Electric Power Commission of Ontario, spoke on **Dancing Cables and Bridges** (198).
- Aug. 17—Visit of members of the Ottawa Branch and their friends to the Royal Canadian Engineering Training Centre at Petawawa on invitation of the Commanding Officer, Lieut.-Col. J. P. Richards (80).
- Oct. 23—**The Role of Research in War**, by Dr. C. J. Mackenzie, Acting President, National Research Council (105).
- Nov. 20—**The Royal Canadian Navy 1911-1941**, by Commander H. N. Lay, Naval Service Headquarters, Ottawa (105).
- Dec. 4—**Air Co-operation**, by Squadron Leader W. W. Ross, R.C.A.F. Station, Rockcliffe (77).
- Dec. 18—**Construction Features of the Barrett Chute Development**, by Mr. A. L. Malcolm, Hydro Electric power Commission of Ontario (81).

### PETERBOROUGH BRANCH

The following meetings were held during the year 1941, with attendance shown in brackets:

- Jan. 16—**Power Transmission**, A. E. Davidson, Electrical Engineering Dept., Hydro Electric Power Commission, Toronto, Ontario (66).
- Feb. 13—**Modern Trends in Industrial Applications**, L. E. Marion, Apparatus Sales Dept., Canadian General Electric Co. Ltd., Toronto, Ontario (33).
- Feb. 27—**Processing of Copper**, C. L. Sherman, Metallurgist, Phillips Electrical Works Ltd., Brockville, Ontario (51).
- Mar. 20—**Juniors and Students Night. Some Aspects of Railway Signalling**, J. M. Mercier, Test Dept., Canadian General Electric Co. Ltd., Peterborough (64).
- April 24—**Carrier Current for Peak Load Control**, A. L. Malby, Industrial Control Eng. Dept., Canadian General Electric Company Ltd., Peterborough (39).
- May 15—Annual Meeting and Election of Branch Executive (36).
- Sept. 27—Joint Meeting E.I.C., Peterborough Branch and A.I.E.E., Toronto Section. **Short Time Rating of Electrical Equipment**. (108).
- Oct. 23—**Plastics**, A. E. Byrne, Appliance and Merchandise Dept., Canadian General Electric Co. Ltd., Toronto (30).
- Nov. 6—**The 220,000 Volt System of the H.E.P.C.**, A. H. Framp-ton, Assistant Electrical Engineer, Hydro Electric Power Commission, Toronto, Ontario (46).
- Nov. 18—Annual Dinner. Attended by President C. J. Mackenzie, Vice-Presidents de Gaspé Beaubien and K. M. Cameron and other guests (72).
- Dec. 11—**The causes of Accidents to Electrical Equipment**, C. A. Laverty, Engineer and Electrical Inspector, Boiler Inspection and Insurance Co., Montreal (24).

The number of Branch Executive meetings held during year 1941-7.

### SPECIAL COMMITTEES

- Meetings and Papers Committee—A. J. Girdwood, Jr. E.I.C.  
Social and Entertainment Committee—R. L. Dobbin, M.E.I.C.  
Membership and Attendance Committee—A. L. Malby, Jr. E.I.C.; J. M. Mercier, S.E.I.C.  
Branch News Editor—E. W. Whiteley, Jr. E.I.C.  
Auditor—E. R. Shirley, M.E.I.C.  
Peterboro Representative on Nominating Committee—W. M. Cruthers, M.E.I.C.

### QUEBEC BRANCH

Ten general branch meetings were held through the year: as listed below with the attendance given in brackets.

- Jan. 27—**Municipal Management by an Engineer**, by Robert Dorion, M.E.I.C., Manager of Shawinigan Falls, Quebec (45).
- Feb. 8—**Annual Branch Dance** at Quebec Winter Club (116).
- Feb. 17—**Nickel Industry**, sound films presented at Palais Montcalm Theatre (200).
- Feb. 28—**Mining and its Importance in the War**, by Hon. T. A. Crerar, at a luncheon-meeting, Chateau Frontenac. (Joint meeting with Canadian, Rotary and Kiwanis Clubs).
- Mar. 10—**The Engineer and Hydroelectric Development**, by MM. Huet Massue, M.E.I.C., and Guy Rinfret, M.E.I.C., sponsored by Shawinigan Water & Power Co. (500).
- April 28—Visit to the Building and Laboratories of the New Science Faculty, Laval University, and film presentation **Tacoma Bridge Disaster** (50).
- Sept. 15—**First Annual Golf Tournament** at Royal Quebec Golf Club (44).
- Nov. 15—President C. J. Mackenzie visit and Institute's Regional Council Meeting at Chateau Frontenac (37).
- Dec. 1—General Annual Meeting and election of Officers of the Quebec Branch. Film **Colourful Gaspesian Tour**, by Alex. Larivière (55).
- Dec. 15—**Technical Principles of Radio-Communication**, by G. E. Sarault, chief engineer C.B.F. Radio-Canada and "Rambling Radio-Canada Stations" films in Technicolor, which Mr. Aurèle Séguin of C.B.C. explained (200).

During the year six meetings of the Executive Committee were held, at which the attendance averaged seven, or sixty-five per cent.

## SAGUENAY BRANCH

- The branch held the following meetings during the year:
- Jan. 14—**Experiences of an Engineer in China**, by A. T. Cairncross of the Aluminum Co. of Canada Limited.
  - Feb. 21—**Combustion Boiler Installations**, by W. H. D. Clark, Chief Engineer of the Combustion Engineering Corporation.
  - Mar. 28—**Engineering in the Battle of France**, by Jean Flahault, Aluminum Co. of Canada Limited.
  - May 2—Film showing **Tacoma Bridge Disaster**. Also **Electric Welding and Brazing of Copper and Aluminum**, by H. Brayne of the Aluminum Co. of Canada Limited.
  - May 28—Film on **Fighting Oil Fires by the Water Fog Method**, shown by the Rockwood Sprinkler Co.
  - July 4—Annual Meeting and election of Executive Committee.
  - Aug. 22—**Sub-surface Engineering**, by Professor R. F. Legget of the University of Toronto.
  - Oct. 14—**Construction Problems**, by V. G. Youngusband, Vice-President of the Foundation Co. of Canada.
  - Nov. 25—**The General Principles of Petroleum Oil Refining**, by C. D. McCoy, Oil Refining Division of Foster Wheeler Corporation.
  - Dec. 16—**Road Building**, by J. A. E. Gohier, Chief Engineer of the Quebec Roads Department.

## SAINT JOHN BRANCH

Six meetings of the Executive Committee were held during the year, and five general branch meetings were held, as follows. Attendance is given in brackets:

- Jan. 15—Annual joint dinner meeting with the Association of Professional Engineers of the Province of New Brunswick. A paper on **The LaTuque Development** was presented by J. A. McCrory, of Shawinigan Engineering Co. (42).
- Mar. 21—Supper meeting. An International Nickel Co. four-reel picture **The Nickel Industry** was shown (16).
- April 18—Evening meeting. A two-reel film **The Tacoma Bridge Disaster** was shown, followed by several coloured reels of New Brunswick, shown by H. P. Lingley (20).
- May 16—Annual dinner and election of officers of the branch. Special guests were Dean C. J. Mackenzie, President of the Institute, K. M. Cameron, Vice-President for Ontario, J. A. Vance and H. Massue, Councillors, L. Austin Wright, General Secretary, R. L. Dobbin and G. A. Gaberty. The president spoke on the relation of the engineer and the engineering profession to the War (43).
- Dec. 11—Supper meeting. Address on **Mechanization in War**, by G. W. Berry, Manager of the Ford Motor of Canada at Saint John, illustrated by a film "Tools for the Job." (33).

## ST. MAURICE VALLEY BRANCH

The following meetings were held by the Branch this year:

- Mar. 22—Annual dinner meeting at the Cascade Inn, Shawinigan Falls. Retiring Chairman C. H. Champion introduced the newly elected chairman, Dr. A. H. Heatley, of Shawinigan Falls. L. Austin Wright, general secretary, spoke on **The Wartime Bureau of Technical Personnel**.
- April 29—Meeting was held at the Laurentide Club, Grand' Mère. The guest speaker was Dr. P. L. Pratley, who gave a brief outlook on the design of suspended bridges. The Institute film **Tacoma Bridge Failure**, was shown.

## SASKATCHEWAN BRANCH

Twenty-four members of the Branch are on active service with His Majesty's Forces, nine being overseas and all holding commissions in the Navy, Army or Air Force.

As in the past several years all meetings, except the annual and one special meeting, were held jointly with the Association of Professional Engineers and the local branch of the American Institute of Electrical Engineers. The programme for the year was as follows:

- Jan. 24—**The Making and Shaping of Steel**, a nine-reel film loaned by the United States Bureau of Standards.
- Feb. 21—Annual Meeting.
- Mar. 21—**Air Gunnery and Bombing**, by F/L. Geo. Thornber, illustrated by lantern slides.
- Sept. 25—Special meeting to meet President C. J. Mackenzie.
- Nov. 21—**The Tacoma Bridge**, a two-reel film depicting structural problems and failure after four months of life.
- Dec. 16—Talk by Major T. G. Tyrer giving personal reminiscences of his recent military trip overseas.

The average attendance at the meetings was 46, a decrease of 11 from last year, explainable in part by the fact that a number of the members are absent on active service.

## SAULT STE. MARIE BRANCH

The Executive Committee met on January 8th, 1941, and appointed standing committees. The committees and the chairman are as follows:

- Papers and Publicity . . . . . J. S. MACLEOD, M.E.I.C.
- Entertainment . . . . . J. L. LANG, M.E.I.C.
- Membership . . . . . A. H. RUSSELL, M.E.I.C.
- Legislation and Remuneration . . . F. SMALLWOOD, M.E.I.C.
- Junior Engineers . . . . . N. C. COWIE, JR. E.I.C.

It will be noted that an additional committee, the Junior Engineers' Committee, was formed this year. A meeting was held this year under the auspices of the Junior Engineers' Committee. This committee also furnished the Papers Committee with an additional speaker during the year.

The executive met three times during the year to conduct and promote the activities of the Branch and Institute.

Seven dinner meetings were held during the year. The average attendance was 20 members and guests. While the meetings were usually held on the last Friday of the month, this was not a rigid rule as some were arranged to suit the convenience of the speaker.

Programmes of the meetings held were as follows:

- Jan. 31—**Installation and Operation of Modern Strip Mills**, by L. F. McCaffrey.
- Feb. 28—**Kilowatts, Horse-power and Water**, by N. C. Cowie, Jr. E.I.C.
- Mar. 21—**The Queen Elizabeth Highway**, by A. L. MacDougall.
- April 22—**The St. Lawrence Deepening and Its Possibilities**, by J. H. MacDonald.
- Sept. 26—**Blast Furnace Plant of the Algoma Steel Corporation**, T. F. Rahilly, Jr. E.I.C.
- Nov. 28—**The Steel Industry**, by David L. Mekeel.
- Dec. 12—Annual Meeting and **Tacoma Bridge Film**.

## TORONTO BRANCH

The annual meeting of the Branch was held at the Granite Club on Thursday, April 3rd, 1941. The meeting was preceded by a dinner at 7 p.m., at which several representatives from the outside branches and sister societies were present. Among these J. A. Vance, Councillor, London Branch; Prof. W. G. McIntosh, representing the A.S.M.E.; Norman J. Howard, President American Waterworks Association; Stanley R. Frost, President, Association of Professional Engineers of Ontario; A. R. Hannaford, Secretary-Treasurer, Hamilton Branch; J. M. Thomson, representing the A.I.E.E.; Wills Maclachlan, representing the Royal Canadian Institute and Bruce Wright representing the Ontario Association of Architects.

During the past year the executive committee has held nine meetings with an average attendance of eight members.

The regular meetings held during the year are listed below with attendance given in brackets:

- Jan. 16—Student's Competition, **Relay Protection of Transformers**, by P. B. Smith; **The Co-Axial Cable in Telephone Transmission**, by G. M. Nixon. **Wind Tunnel Testing**, by D. P. MacVannell. **Estimation of Aircraft Performance**, by B. Etkin. **A Modern Method of Placing Concrete**, by W. D. Ramore. **Future Trend in Aircraft Design**, by J. W. Ames (55).
- Feb. 20—**The Helen Mine and Beneficiating Plant**, by George W. MacLeod, M.E.I.C. (70).
- Mar. 8—**The Achievements of Engineering**, by Professor C. R. Young, M.E.I.C., This was a joint meeting with the Royal Canadian Institute.
- Mar. 20—**Ground Line Preservation of Poles**, by T. H. Chisholm. **Measurement and Control of Conductor Vibration**, by G. B. Tebo. **Fatigue of Metals**, by D. G. Watt. **Recent Developments in Concrete Technology**, by R. B. Young. This was a session on research development and given by members of the Research Laboratory of the Hydro-Electric Power Commission of Ontario (70).

- Oct. 16—**Plastic Moulded Wood in Aircraft Construction**, by Mr. J. W. Jakimiuk (100).
- Nov. 6—**Air Bombing and Structural Defence**, by D. C. Tennant, M.E.I.C. (180).
- Nov. 29—**What Use the Engineer Makes of Geology**, by Professor H. Ries. This was a joint meeting with the Royal Canadian Institute.
- Dec. 4—**Water Situation in Southern Ontario**, by Prof. A. F. Coventry. **Forestry Situation in Ontario**, by Mr. F. A. MacDougall. **Public Health in Ontario and Conservation**, by Dr. A. E. Berry, M.E.I.C. Introduction of the speakers and the film **The River**, by Professor R. F. Legget, M.E.I.C. (400).
- Dec. 8—**Fluorescent Lamps and Lighting Materials**, by Mr. Harris Reinhardt. This was a joint meeting with the I.R.E.; I.E.S. and A.I.E.E.

Previous to each regular meeting, dinner has been held in Hart House. These have been well attended and enjoyed by all who have availed themselves of the opportunity to attend.

A Social Evening was held on Saturday evening, January 11th, for the members and their wives at the Engineers' Club. The President, Dr. T. H. Hogg and Mrs. Hogg, the chairman of the Branch, Nicol MacNicol and Mrs. MacNicol, received the guests. Dinner was served and was followed by entertainment. There were 143 present on this occasion.

It is with deep regret that we record the death of the following members of the branch during the year:—A. S. Cook, H. B. Kippen, Brig.-Gen. C. H. Mitchell, Grant Moloney and R. F. Uniacke.

#### VANCOUVER BRANCH

The following meetings were held by the Branch this year:

- Jan. 20—Programme meeting was held at U.B.C. Dean J. N. Finlayson, chairman, presided. F. O. Forward, associate professor of metallurgy, and W. O. Richmond, assistant professor of mechanical engineering, were the guest speakers. Their subjects were **The Heat Treatment of Steel** and **The Application of Material Tests to Design**.
- Feb. 26—Meeting was held at the Hotel Georgia. The chairman presided and the guest speaker was Mr. Ralph Hull, professor of mathematics at U.B.C., who spoke on **The Origin, Theory and Dynamics of Tides**.
- Mar. 7—Meeting was held at U.B.C., when the speaker was Mr. E. C. Gosnell, chemical engineer, Lukens Steel Co. of America. His subject was **Clad Metals, their Manufacture, Application in Industry and Anti-Corrosive Properties**.
- Mar. 27—Meeting was held to hear an address by A. H. Eggleton, manager of the Industrial X-Ray Co., Vancouver, on **Industrial Applications of the X-ray**.
- May 21—Meeting was held in the Georgia Hotel. The vice-chairman, Mr. W. O. Scott, presided in the absence of the chairman. The speaker for the evening was Mr. W. N. Kelly, whose subject was **Woodenwalls and Iron Clads**.
- Sept. 29—Dinner meeting was held at the Hotel Georgia in honour of the president, Dean Mackenzie. He gave a most interesting address on **The National Research Council and War Work**.

- Oct. 16—Programme meeting was held in the Medical Dental building. The speaker was Mr. Jack Cribb, superintendent of West Coast Shipbuilders Ltd. His subject was **Some Marine Salvage Experiences of the Pacific Coast**.
- Nov. 6—The guest speaker at this meeting was W. O. Scott, vice-chairman of the branch, and assistant superintendent of the Dominion Bridge Co. in Vancouver. The subject of his address was **Tool Steels—their Use from the View-point of the Shop**.

#### VICTORIA BRANCH

Five meetings of the executive committee and four general branch meetings were held during 1941 as follows:

- Jan. 17—Dinner meeting. Annual meeting and election of officers. Motion pictures of interest to engineers by Mr. D. S. Scott.
- Oct. 27—Dinner meeting. Address, **Spans in Time and Space**, by Sir Heaton Forbes Robinson, C.G.M., M.I.C.E.
- Nov. 10—Dinner meeting. **Tacoma Bridge Films**, together with additional pictures and explanations by Mr. A. L. Carruthers, M.E.I.C.
- Dec. 16—Nomination luncheon meeting. Owing to the prevailing blackout in the Pacific Coast region, a general meeting of the branch called for early in December, at which a paper was to have been read, had to be postponed to a later date.

The branch regrets to report the loss by death of three of its Life Members during the year in the persons of F. J. O'Reilly, J. H. Gray, and George Phillips.

Despite the loss by death and removals to other jurisdictions, the membership of the branch has been increased by 8 to 66, mainly through transfer of members of His Majesty's Services to this branch district. Several applications for membership are at present under consideration.

#### WINNIPEG BRANCH

The following meetings were held by the Branch during the year:

- Feb. 6—Annual meeting. The retiring chairman, H. L. Briggs gave his address and was thanked by Professor G. H. Herriott. Following the election of the new officers a sound film entitled **There is a difference** was shown.
- April 3—Meeting in the Theatre of the University of Manitoba. Two coloured movies were shown through the courtesy of the Department of Mines and Natural Resources of the Province of Manitoba. **Base Line Survey** was prefaced with remarks by Mr. H. E. Beresford, director of Surveys and **The Summerberry Fur Rehabilitation Project** had a running commentary by the Honourable J. S. McDiarmid, Minister of Mines and Natural Resources.
- Sept. 24—Luncheon meeting in the Georgian Dining Room of the Hudson's Bay Company. D. M. Stephens, vice-chairman, presided in the absence of the chairman. We were privileged to have as guests the president, vice-president and general secretary of the Institute. President Mackenzie was the principal speaker at the meeting.
- Oct. 16—Meeting in the Broadway Building of the University of Manitoba. The speaker was J. C. Trueman, designing engineer, Dominion Bridge Co., Winnipeg. He presented a motion picture on **The Tacoma Bridge Failure**, introducing the picture with a short historical paper.

## CALCUTTA UNDERGROUND RESERVOIRS

From *Indian Engineering* (CALCUTTA), JULY, 1941

Following the sanction by the Government of Bengal for the construction of 130 underground reservoirs in Calcutta, work is in progress on some of them by the Corporation of Calcutta in consultation with the Chief Officer of the Calcutta Fire Brigade. These are being constructed with a view to providing an alternate source of unfiltered water for fighting fires that might be caused in the city by air raids. The reservoirs, which will each have a capacity of about 8,000 gallons, will cost about 11½ lakhs of rupees. For the balance of the reservoirs, the Government have requested the Corporation to prepare a list of sites.

## GASOMETERS

From *Indian Engineering* (CALCUTTA), JULY, 1941

Many people appear to think that if a bomb explodes on a gasholder, it is bound to blow up. In general it has been proved in Europe that the gasholders commonly used are comparatively free from danger. What would happen if a bomb effects a direct hit on a gasholder is a troublesome question, but it does not follow that the gasometer would blow up. It is a question difficult to answer because it depends on many factors, viz., the type of holder, its age and amount of gas in store, and the type of bomb with which it has been struck. There are two main types of holders, which, between them, store approximately 90 per cent of domestic and industrial gas storage. These are the guide-framed water-sealed holder, and the spiral-guided water-sealed holder. In one large undertaking in Britain a gasholder received a direct hit. The incendiary bomb, on contact with the holder, which was two-thirds filled, burst the side sheets and ignited the gas; two high explosive bombs following penetrated the same lift, burst through the tank plates, and exploded in the raft, causing a large hole in the tank. The effect of this was to release the water. Immediate attention averted worse damage.

## BURMA ROAD

From *Indian Engineering* (CALCUTTA), JULY, 1941

It is reported that a determined effort is being made to speed up the transport of vital supplies to China via the Burma road. As a step towards this end, all the Highway Administration's engineering bureaux throughout China which have hitherto been under various Government Departments are to be placed under the centralised control of the Transport Control Board of the National Military Council. Reports are to hand that floods and landslides in the northern Shan States of Burma have interrupted traffic on the China Highway. It is hoped to replace a vital wrecked bridge within a few days. Transport in Burma has also been affected. This is unfortunate, but only to be expected at this time of the year with the Monsoon in full strength. Moreover, the road may be bombed again by the Japs, particularly following a recent message from New York to the effect that President Roosevelt recently issued a proclamation suspending "foreign discriminating duties on tonnage and imposts within the United States" in respect of vessels to Burma and their cargoes. This is apparently designed to help to expedite the flow of war materials to China over the Burma road.

## Abstracts of articles appearing in the current technical periodicals

### AUSTRALIAN MUNITION INDUSTRY

From *Trade and Engineering* (LONDON), NOVEMBER, 1941

"No business in the history of Australia has been expanded to such a magnitude, with such violence and under such pressure, as the vast munitions industry," said Mr. Menzies recently. The amazing growth of new industries since the war, he added, had made Australia a first-class manufacturing country, with a great export potentiality, and had laid a strong foundation for a new peace-time order. There are now 150,000 Australians working in war industries, of whom over 50,000 are directly engaged in munition-making, and Mr. Menzies indicated that before the end of 1942 this latter number would be increased threefold.

In the last war munition-making in Australia employed only 2,700 persons. To-day, in South Australia alone, which before the war was a minor industrial State, there are already more persons working on munitions than there were in Australia by the end of the last War. One of South Australia's largest industrial enterprises, General Motors-Holdens, is over 90 per cent engaged in war production. It is already employing 20 per cent more hands than before the war and will soon employ more. Over 5,000 workers are producing in its plant anti-tank guns, large presses for explosives, bomb bodies, pontoons, folding boats and aeroplane parts. The hundredth two-pounder anti-tank gun produced at this factory was recently delivered. The production of the requisite toughened steel presented a problem in overcoming which Australian engineers devised new forging and machining processes.

Over 300 3-7 in. anti-aircraft guns have now been delivered, the Government ordnance factory having achieved an output in excess of that for which it was designed. Searchlight units, anti-aircraft predictors, and telephone and radio equipment for anti-aircraft posts are being produced. The Bren gun is in mass production, and the universal carrier, a development of the Bren-gun carrier, is being produced at the rate of more than double what was expected of the factory. Hundreds of firms in all parts of the Commonwealth are making components, and four shops will soon be engaged in assembling the vehicles.

Australia is making her own lenses for optical munitions such as range-finders, telescopic gun sights and tank periscopes, with all the tools essential to their manufacture. Plans for the establishment in Government factories, in Victoria and Queensland, of annexes for building marine engines for the standard merchant ships which the Ship-building Commission has ordered are being pushed ahead. These annexes will carry the heavy engineering capacity of Australia a further stage forward. The Commission intends to foster also the making of ships' equipment such as compasses and chain cable.

### AIRCRAFT MANUFACTURE

Working round the clock with a staff of 800, ultimately to be increased to 1,200, the Commonwealth Aircraft Corporation's new factory, which has cost £A1,500,000, has begun to build the Pratt and Whitney twin-row Wasp engine, the production of which will lift Australia into the ranks of the principal air powers. Factories elsewhere have long been producing Gipsy Major and single-row Pratt and Whitney Wasp engines. With the twin-row engines and with duralumin, to be fabricated at the Aus-

tralian Aluminium Company's new workshops, Australia can build some of the speediest aeroplanes yet designed. These engines will be used in the Australian-built Bristol *Beaufort* bomber and in the new twin-engined fighter-bomber, designed by Wing Commander L. J. Wackett, general manager of C.A.C., and also in a new British twin-engined fighter which the Government hopes to produce later.

The completion of the works in under 20 months from the drafting of plans to the beginning of manufacture sets a remarkable standard in speedy organization. Before the war experts declared that Australia could not build even motor-car engines, yet she has turned out 150 h.p. and 600 h.p. aero engines in considerable volume, and now she is about to produce 1,200 h.p. aero engines. Scores of engineering firms in New South Wales, Victoria, and South Australia are making engine parts as sub-contractors. The factory is already being extended to facilitate an increasing output of engines for new types of aircraft, and when completed it will be comparable to the largest aero-engine factories overseas. The magneto, carburettor, and ball-bearings of the twin-row Wasp are imported but the magneto will soon be manufactured in Australia, and later the other parts mentioned.

The Aircraft Commission estimates that of a total aeroplane production to the value of £A20,000,000 in 1942 exports will be valued at over £A12,000,000. The Commission expects to produce over 1,000 aeroplanes next year. From June, 1939, when C.A.C. completed its first *Wirraway*, to the end of December next, the value of the industry's output will be £A10,000,000, the value of this year's production being £A7,000,000.

These figures give some indication of the rapid expansion of the industry. Already Australia is producing far more training machines than she needs for herself, and elementary trainers are being exported at the rate of 50 a month. The first Bristol *Beaufort* assembled in Australia from imported parts, with certain adaptations to local needs, has proved a faster machine than its oversea prototype. It attained an average ground speed of 270 m.p.h. in an 850-miles flight from Melbourne to Brisbane—a new Australian record. Later, in a non-stop flight of 1,500 miles from Cairns (Queensland) to Melbourne in 7¾ hours it averaged nearly 200 m.p.h. against a head wind, easily the best combination of speed and distance an aeroplane has achieved in Australia. It is designed as a dive-bomber, as well as a high-level attack machine, and is expected to be exceptionally fast. Everything is in readiness for quantity production as soon as it has satisfactorily completed its tests. Many of its components are inter-changeable with those of the *Wirraway*.

### THE DEMAND FOR TECHNICIANS

From *Indian Engineering* (CALCUTTA), JULY, 1941

Some of the results of the Eastern Group Supply Conference, held at Delhi last year, are now becoming visible. The factories and workshops of this country are pouring out an ever-increasing stream of products in demand for the immediate needs of war. We are producing more and more, some of the things are a mere multiplication and extension of established industry, others are new to us from the point of view of local manufacture. In this way, the aim to increase this country's contribution to the paramount task of victory is being achieved. All India should be proud of the contribution we have made already towards the great defeats of the Italian Dictator's ambitions in Africa, but it is far too early to rest on our laurels. A lot, a great lot more, remains to be done. We are comparatively still only at the beginning of our maximum effort, for our capacity to produce is immense. It is true India is looked upon mainly as an agricultural

country, which she is, but there is also more than ample room for vast industrial enterprise to redress the balance of a one-sided national economy. In time of peace, industrialisation was with us a very slow process. Many natural and artificial obstacles had to be overcome, and only some vital emergency provided the necessary impetus for more rapid strides forward. The last Great War set us going, and the present still greater emergency is driving us forward at a terrific speed for the habits and hesitations of this country. Even so, when compared with the more industrialised countries, our rate of progress is still far too slow, in spite of the actual stream of production now flowing to supply and replenish the stores and equipment in such immense demand. There are two very adequate reasons to account for it:— There is first the lack of trained technicians, and, secondly, the difficulty of securing the plant and tools needed. Gradually both these obstacles will be overcome, but we ought not to allow this opportunity to pass without learning our lessons. None of these tremendous obstacles need have arisen had we taken long ago a wider view of the potentialities of industry in this vast country, with its immense reserve of raw materials. Had we given sufficient encouragement and taken steps to create and assemble sufficient cadres of trained technicians in the years gone by, industry might well at this time have been sufficiently ahead to largely resolve the difficulties of personnel and equipment now encountered. In this connection it is no less useful to consider the lack of enterprise on the part of capital and individuals in this country, as well as the wrong bias in the educational sphere. In both these spheres we have largely failed to appreciate the needs and requirements of the present age. Let us, therefore, keep carefully in mind the fact that the present vast expansion of industrial enterprise for a specific purpose is bound to have wide repercussions later, and to consider the remedies needed to repair past mistakes. We must draw the moral now for future guidance.

### DEVELOPMENT OF "BRISTOL" AIRCRAFT GUN TURRETS

From *The Engineer* (LONDON), NOVEMBER 21, 1941

One of the first aeroplanes to be fitted with an enclosed gun turret, necessary for the protection of the gunner from the air flow at high speeds, was a *Bristol* machine, known as type 120, which was developed in 1930 and 1931. In this case the turret was mechanically operated. The first *Bristol* hydraulically operated power-driven gun turret was developed in 1935 and fitted in the nose of the *Bombay* bomber transport; and the first *Bristol* power-operated gun turret to be located amidships was fitted to the *Blenheim*. These turrets proved of great value from the very first, enabling the air gunner to aim and fire steadily and accurately on the beam when flying at high operational speeds.

But the successful development of the power-driven gun turret depended in the first place on the equally important development of the successful hydraulic system, which should be simple, reliable, and, above all, light in weight. The advantages claimed for the *Bristol* hydraulic system are greater flexibility of control, a quick yet smooth reversal of motion without shock, a useful "slip" for overloads or obstruction, an easily convenient location of transmission members, and the use of relief or control valves to safeguard against overloading. This hydraulic system was developed in 1935, in a research department specially devoted to the purpose. Unit testing was undertaken of such items as pumps, control valves, undercarriage jacks or "rams", and flap controls, etc. The most important development, however, resulted from prolonged and active research into the design of suitable hydraulic pumps, as the existing types suffered from the

drawbacks of insufficient capacity and pressure to be suitable for the requirements of high-performance aircraft. The plunger type of pump suffered from violent fluctuation of pressure, which caused breakages; so that either the vane type had to be employed with its considerable limitations for high pressures, or else the gear pump, in which the faults were that it was difficult to get clearances sufficiently fine to reduce the "slip", and when they were obtained there was a resulting tendency to seize up. The first "Bristol" pump was tested early in 1936. It was a multi-stage gear pump, which stepped up the pressure very considerably.

Realising that existing types of gear pump would only work satisfactorily up to a pressure of about 300 lb. per square inch, several such pumps were placed in series. To ensure a full supply of oil to each it was arranged that the output from each unit should be theoretically in excess of the requirements for the succeeding stage. To control the output from each section a small adjustable relief valve was introduced between the stages. This design has since been developed to the extent of producing a practical three-stage hydraulic pump which will give pressures of 1,500 lb. per square inch or more, with a flow of 6 gallons per minute at normal engine revolutions.

The modern pump has three stages, the main production version covering a range of pressures up to 1,200 lb. per square inch, with a delivery up to 180 gallons per hour. Actually this unit is known in the industry as the B.H. integral type, though it is built under Bristol patents. The first of these pumps to be type tested completed a hundred hours' test satisfactorily in February, 1936. It is claimed to have been the first successful hydraulic pump to meet aircraft requirements, and it is now being produced in very large numbers by sub-contractors. These hydraulic pumps form part of the back cover auxiliary equipment for all types of aero-engines, water-cooled and air-cooled radial types, British and American.

The Bristol hydraulic system is operated as an open system, thus obviating the use of a "recuperator" or supplementary air pressure, which is necessary with a "closed system", involving, as it does, the use of auxiliary pumps operated either by hand or by motor.

The hydraulically operated gun turret on the *Blenheim* was small—having only a 30" ring—and it was housed in a low-drag retractable cupola which was operated mechanically. The low drag of the Bristol cupola was attained largely by the use of a moving seat for the gunner, synchronised with the gun movement. Another feature of this Bristol turret was the "secondary motion" of the column on which the guns were mounted. It could be operated independently to enlarge the field of fire and to cover such areas as could not be reached by normal rotation. The first *Blenheim* turret was fitted with one Lewis gun and later with the Vickers G.O. or "gas-operated" gun. This turret was then developed for twin Browning guns, with which it is fitted to-day. The design was such that it could be manufactured with ordinary engineering plant without requiring unduly skilled labour. It was probably the only turret in the early days that could be sub-contracted and built straight from the drawings, while the hydraulic system could be serviced by the ordinary R.A.F. personnel in the Service without "sending for the makers."

The fitting of a power-operated gun turret amidships in the fuselage involved the problem of a simple and efficient "fire cut-out", as well as "gun restrictor gears" to avoid shooting off the tailplane, fin, wireless masts or airscrew discs, etc., or fouling the fuselage itself. The Bristol turret, it is claimed, was the first to be provided with a compensator for rotational speeds on the "fire cut-out" mechanism. It ensures that a minimum of "cut-out cover" is provided for slow operational speeds of rotation,

the cut-out cover being automatically increased in proportion to the increased speed of rotation.

A special gun mounting incorporating a "harmonisation gear" and a shock absorber system incorporated with a quick-release mechanism has been developed. The "harmonisation gear" is very simple and enables four guns to be lined up quickly and independently on the target. The quick release device enables the guns to be removed at the touch of a lever and to be as easily replaced without handling anything but the gun, which becomes automatically locked in position when it is pushed home.

## HIGH-SPEED ARC WELDING

By S. G. P. de Lange and E. S. Waddington

From *Electrical Review*, DECEMBER 5, 1941

In devising the series of experiments here described as to the possibility of obtaining a substantial increase in welding speed, it was decided that the line of research should be bounded by the following limitations:— Existing personnel to be used; cost of production not to be more; existing machines and equipment in the average works to be used with a minimum of additions for which reasonable delivery could be obtained or which could be fabricated in the works themselves; the process to be applicable to all types of firms and to shop as well as yard work and site fabrication.

These limitations ruled out such methods of increasing production as the use of automatic welding and of very heavy electrodes, leaving two alternatives for investigation. The first was the use of normal electrodes with increased currents and higher operating speeds. Preliminary tests, however, showed that currents in excess of makers' normal recommendations on normal types of electrodes resulted in a very small increase in welding speed and in considerable difficulties in many cases.

The second possibility was the use of electrodes with a high depositing speed due to the type of coating employed. Preliminary investigation of theoretical depositing speeds with such electrodes showed that probable results would be so striking as to justify complete investigation and the obtaining of practical proof. Jigs and mechanical manipulators are not dealt with because they should be employed with either type of electrode, but the speed obtained by their use will be greatly increased with high-speed electrodes.

TABLE 1 — SPEED OF DEPOSITION

Gauge	Unit of Deposit	Time per unit deposit in one foot of weld
10 single run	30 grams.	Not more than 70 sec.
8 single run	54 grams.	Not more than 90 sec.
6 single run	60 grams.	Not more than 90 sec.

The next step was to decide the specification of high-speed electrodes. So as to eliminate the human element, since the actual amount of deposited metal varies to a certain extent with individual welders, the speed of a rod was based on a definite weight of deposit in a given time, and the figures in Table 1 were taken to represent the minimum depositing times for a high-speed electrode. Other deposit weights of multi-runs were based on calculations from these figures.

A programme of experiments was then drawn up with the object of covering a large number of welds that would prove the advantages in production of the method advocated, involving the minimum of variables and eliminating as far as possible human error. As it was essential to obtain tests that could be easily compared with results in practice without unnecessary elaboration, the theoretical depositing efficiency, power consumption, efficiency of the welding plant, extra time, cost of electricity, welding arc and energy in watts were not incorporated in the

tests. An efficiency test was, however, carried out on all the electrodes used, so that if necessary a more elaborate form of findings could be presented for those interested more in the theoretical side than the practical increase in production.

The efficiency test consisted in taking three of each type and gauge of the electrodes employed on the speed tests, removing their coating and weighing the core wire. The total weight of the three selected electrodes was divided by three so as to give the average weight of steel per electrode. The electrodes were then deposited at the makers' recommended currents on suitable bases of steel. The increased weight of plate after welding was taken after allowance had been made for the weight and length of rod remaining in the holder. The weight of the welding deposit was taken to an accuracy of half a gramme and the figure of the percentage yield by weight was used for the efficiency of the electrode in question.

In the tests, pieces of mid-steel plate  $\frac{1}{4}$ ,  $\frac{3}{8}$  and  $\frac{1}{2}$ " thick were taken, the length of each piece being slightly in excess of 12". The plates were weighed to an accuracy of one gramme. A large number of pieces were prepared so that fillet and butt welds could be carried out. The fillet welds were made to two standards; one with a reasonable throat thickness such as is common practice in many works and suitable for a large number of ordinary production jobs, and the other with a full-throat thickness to comply with British Standard Specification No. 538. The butt-weld test pieces were vee'd to 70°.

First the fillet weld tests were carried out, the procedure being to deposit the selected electrode with the maximum speed and the highest possible current that could be used with satisfactory mechanical and physical properties. After welding, the test pieces were thoroughly cleaned and accurately weighed in order to ascertain the amount of deposited metal. Exact times were taken with a stop-watch of first-grade accuracy and the operating currents were measured by an external ammeter.

For the butt welds a similar procedure was carried out and the whole of the results were brought together in a large number of tables from which Table 2 is quoted.

De-slagging times were not taken into account, as these varied very considerably with the different makes of electrodes. The high-speed electrodes employed were of the instantaneous de-slagging types, so that a comparison that included these times would be even more favourable; also if the efficiency figures had been used in the calculations, the result again would have been more favourable, as the efficiency of the high-speed electrodes varied from 89.5 to 96 per cent. compared with 62.6 to 90.5 per cent for the normal electrodes.

TABLE 2. — SAVINGS IN MAN-HOURS AND WAGES ON 1 MILLION FEET

No. of Test	Average man-hours saved (based on average of slowest and fastest normal electrodes)	Average saving (based on slowest and fastest times) (per cent.)	Average saving in wages—at 2s per hour
1	9.305	32.9	930
2	10.278	21.2	1027
3	11.805	24.1	1180
4	15.972	38.7	1597
5	24.306	26.1	2430
6	17.222	21.1	1722
7	11.945	33.1	1194
8	43.333	27.0	4333
9	51.250	46.0	5125

The average number of man-hours saved in the nine tests was 21.712.

Dealing with the summary of savings the following striking figures are found. The average saving based on

the slowest and fastest times is 30 per cent. and the highest average is 45 per cent. for the heavier plate.

Then again in one million feet of weld the average of nine tests shows a saving of 21.712 man-hours with a maximum saving of 51.250 man-hours, again based on one million feet of weld, but without taking into account de-slagging times or electrode efficiency.

Photographs taken of welds obtained in the tests prove that the high-speed welds were equal, if not superior, to the normal welds.

As all the pieces were satisfactory, the findings from the tests can be taken as conclusive proof that these results can be obtained by any works which desires to increase welding production without having to alter existing equipment or train operators in an entirely new technique and methods.

For instance, let us suppose that a general fabrication shop has a large contract to carry out involving 1 million ft. of  $\frac{1}{4}$ " plate and 2 million ft. of  $\frac{3}{8}$ " plate, fillet weld, both of normal throat thickness, and  $\frac{1}{2}$ " million ft. of  $\frac{1}{2}$ " plate, butt weld, the corresponding savings would be 32.9, 38.7 and 46 per cent.

Assuming that the average wages for a first-class welder are 2s. per hour and that the overheads on labour are 150 per cent., then the saving on the above work alone would represent £16.716, apart from the saving in man-hours and production in a far shorter time. Even this figure would be increased in many cases, due to taking into account electrode efficiency.

## WOMEN WAR WELDERS

FROM ROBERT WILLIAMSON\*

Managers of Britain's war factories are discovering that the women now coming into their works from shops, offices, the professions and private life, have very definite likes and dislikes about the kind of work they wish to do. Some take to turning wheels, others prefer to use hand-tools; some enjoy work calling for concentration, others would sooner have simple repetition work.

Welding is a job that many women are turning to now, but even here there are two distinct camps, those who like the fireworks of electric arc welding and those who prefer fusion welding. It is often very difficult to get women to transfer from one method to the other.

But in one important British factory fusion welding has been made much simpler and more effective by a new process which eliminates the usual defects. Its main feature is the application of a controlled temperature applied before and during either a manual or a machine weld. Other features prevent the formation of gas crevices or pockets. Formerly, in spite of X-ray examination, weaknesses were liable to occur, and could be finally detected only in mechanical tests.

## PAPER AND MUNITIONS

From *Engineering* (LONDON), November 28, 1941

The war of 1914-18 was the first conflict, we believe, which really qualified for the description of a "paper war"; not merely on the score of the innumerable Notes and other diplomatic communications which passed and re-passed in bewildering profusion, but by reason of the quantity of "paper work" which complicated the existence of everyone concerned in it. There are various "establishments" laid down for the quantity of ammunition, food, and other consumable stores with which a warship, or a military unit of whatever size, from a battalion upwards, is required to take with it when on active service, but we do not recall having seen anywhere in such lists an item, "paper, tonnage of"; yet the account books which even

\* London Correspondent of *The Engineering Journal*.

a company quartermaster-sergeant had to take with him to the front needed some carrying. But, in that war, paper had not really come into its own as a munition; war was still very much an affair of steel, and brass, and the more expensive kinds of timber. Ammunition boxes were made of walnut; why walnut, we have never heard explained. Towards the end of the war, someone in authority began to see reason, and cheaper timbers were used; but the war was hardly over before stocks of practically new walnut ammunition boxes were being sold for firewood. A North-East Coast workhouse-master bought 50 tons of them for his clientele to chop up.

This is a more expensive war than the last but in a few ways it is being conducted more economically. Ammunition boxes, and many other really useful military stores, are now made from waste paper, as the Press of the country has been telling the public with unwonted unanimity for the past month or more. It is for this purpose, and not to relieve the shortage of paper for printing (for which, in any case, the salvaged waste is not suitable) that Lord Beaverbrook made his appeal for an immediate 100,000 tons—a total which, large as it appears, represents only about 3 per cent of the pre-war annual consumption of paper in Great Britain. The progress of the various local collections suggests that a great part of this amount should be forthcoming from domestic sources, but this is a reserve which, once consumed, cannot be replenished while the war lasts. For the regular flow that will be still required, therefore, it is probable that increased reliance must be placed on industrial accumulations. How extensive these are is probably not fully realised even yet by many firms and public-utility undertakings. We should not have thought it possible, had the question been put to us at the outbreak of war, before the paper problem became acute, that the offices of *Engineering* could contribute over 11 tons of paper to the national collection; yet this has proved to be the case. Admittedly, this total has been achieved only by the sacrifice of some files of periodicals which, in happier times, we should have preferred to keep for a year or two longer, for possible reference purposes; but the issues concerned can all be consulted in such public reference files as those of the Patent Office (where photographic copies of particular articles can still be obtained), the Science Library at South Kensington, and the libraries of the technical institutions, the value of which has not been so fully appreciated in the past by industry as it has been by research workers.

This is one direction in which firms might look for the quota of waste paper that the national need requires of them. Like all purges, however, it should be conducted with discrimination; and we would suggest once again that, before jettisoning files of periodicals that are not likely to be widely preserved in this country, but which are of technical value, firms or individuals should inquire

of the more important public and semi-public libraries whether any particular issues are needed to complete their own sets. This precaution is especially desirable, of course, in the case of Continental publications, though there are some British works of reference, complete files of which are not to be found even in the great national libraries.

There are many other directions, however, in which engineering firms may be able to assist, one of the most promising being the masses of blue prints which are frequently retained as shop records of finished work, even though they may show no departure whatever from the original tracings. The preservation of such prints is very liable to become a habit; and, even if some copies must be kept as records of modifications, they usually represent only a fraction of the prints that are pigeon-holed away because it is no one's particular responsibility to decide their fate. Timekeepers' records, stores issue books, and similar papers of purely ephemeral utility are not infrequently preserved for years after they have ceased to have any real value. Among the more technical publications which are apt to outlive their usefulness may be mentioned proof copies of papers read before institutions, and obsolete issues of *British Standard* and other specifications, long superseded by revised editions.

While, realising the need for waste paper, we have been glad to do our share in striving to bring it home to those who may not yet appreciate its real urgency, we still feel that Government departments themselves might do much more to set a national example in avoiding the wasteful use of paper. The case, reported in *The Times* on November 25, of the shipmaster who collected 5 tons of waste paper from his holds and 'tween decks after the cargo had been discharged, but was forced to take it to sea and dump it overboard because, if landed, it would have been classed as an "import", for which no authority existed, is a typical piece of official absurdity; but it is not so much worse than some of the waste of new paper that occurs when an all-powerful department decides to set up a publishing organisation. We have recently received a copy of No. 1 of *The Midnight Watch*, the wall-sheet with which apparently, the whole country is to be placarded in the supposed interests of the fire guards and other civil defence forces. As an example of the wasteful use of paper, it is outstanding. Other departments continually shower upon us, and presumably on other editorial offices also, quantities of notices, memoranda and circulars of no conceivable interest to any engineering journal; in one case, at least, after we had written to request that no further matter should be sent and had received the thanks of the department for doing so. When such official waste persists, it is not easy to persuade the public of the necessity for such drastic economy as is enforced by the Control of Paper (No. 36) Order, the full scope of which they have not yet begun to realise.

## HALIFAX BRANCH MOVES UP

The fourth branch in Canada to pass the two hundred mark in membership is Halifax. At the January meeting of Council, acknowledgement of the new status was made by approving the selection of a second councillor for the branch. Halifax now joins with Montreal, Toronto and Ottawa to make the "big four."

The workings of the co-operative agreement have aided considerably in bringing about this change, but principal credit must go to the engineers themselves who have worked unceasingly towards building up the membership and consolidating the profession in the province. It was this group which worked out the agreement and saw to it that co-operation became more than a word.

The membership of two hundred in a city the size of Halifax is something of which to be proud. It must not be thought that this figure has been reached by transfers from other branches or by other newcomers to the city. It was made up of the citizens in Halifax, who are showing their approval of the co-operative efforts of both the Association and The Institute by joining both organizations.

It is interesting to note that after two years of co-ordinated activity ninety-six per cent of all members of The Institute in the province are now members of the Association as well. In Nova Scotia under a voluntary agreement, joint membership—the first step towards real co-operation—has become a reality.

Congratulations to Halifax and to Nova Scotia.

## FOREIGN CORRESPONDENTS

*Journal* readers will have noticed, for some time, occasional short articles written by Robert Williamson, and more recently, articles by Lt. Colonel W. Lockwood Marsh and Major Oliver Stewart. These gentlemen write from London, England, and *The Journal* is very pleased to have their contributions.

Mr. Williamson is a free-lance writer in the field of general engineering. He has sent us interesting accounts of developments in such fields as civil engineering, metal trades, aircraft, railways and so on.

Lt. Colonel Marsh is editor of *Aircraft Engineering*, published in London, and frequently prepares articles on aircraft for the Ministry of Information. He is recognized as an expert in this field. His paper "Equipment and Armament of the Royal Air Force" in the October *Journal* was one of the most informative papers of its kind published on this side of the Atlantic. The present issue also carries an interesting article by the same author on the quality of the British aeroplane.

Major Stewart is editor of *Aeronautics*, and is a regular contributor to the *London Evening Standard*, in addition to doing a regular weekly air review for the *Sunday Observer*. His contributions are largely restricted to the subject of aeronautics, a field in which he is well qualified to speak. His article "Tactics and Unorthodox Aircraft" in the January *Journal* has received much favourable comment. As would be expected, this paper had to be submitted to the Canadian censors, and it was only after a clearance had been obtained from the English censors that permission was given for publication in *The Journal*.

It is expected that further contributions will be received from these "London Correspondents." *The Journal* counts

## News of the Institute and other Societies, Comments and Correspondence, Elections and Transfers

itself fortunate to be able to secure up-to-date engineering articles from the centre of Empire by such competent authors.

## POLISH ENGINEERS IN CANADA

A short time ago, on instruction of Council, a letter was sent to all those newcomers to Canada who are members of the Association of Polish Engineers in Canada, informing them of the Institute's desire to welcome them to this country, and inviting them to participate in Institute activities. For their convenience the communication was translated into Polish.

Herewith is an acknowledgment from the president of the Association. For obvious reasons his name is not published. All of these visitors have relatives still in Poland, and everything possible must be done to protect them from the diabolical activities of the Hun invader. The letter expresses appreciation of the Institute's assistance, but most significant is the note of courage and hope. It says "our Fatherland . . . still remains proud and unbroken."

The story of the Hun invasion, its unspeakable cruelties, the courage of the Polish people and their continued defiance of their despicable enemy will some day be known to the world. In the meantime, in Canada we have the opportunity of knowing some of these people who have come here to continue their fight against the despoilers of their homes and country. It is a privilege to be associated with them.

Herewith is the president's letter.

## ASSOCIATION OF POLISH ENGINEERS IN CANADA

Montreal, Que.,  
January 9th, 1942.

L. AUSTIN WRIGHT, ESQ.,  
GENERAL SECRETARY OF THE  
ENGINEERING INSTITUTE OF CANADA, MONTREAL.

Dear Mr. Wright:

I have been asked, as President of the Association of Polish Engineers in Canada, to express to you and to your Institute, the deep gratitude of our members for your more than kind letter of January 7th.

We appreciate very much the sympathetic feelings of your association, so nicely expressed in your letter, written in our mother tongue; as well as the cordial hospitality we are enjoying in your noble country.

This hospitality enables us to continue in a most effective manner—producing war tools in the Canadian war factories—the task, the only task we have now, to fight the enemy—the common enemy—the invader of our unhappy Fatherland which, though oppressed, still remains proud and unbroken.

I have been assured by my colleagues that they already love your beautiful country, as I do myself.

After this war is over, the friendship and love between the Canadian and Polish peoples, in spite of the distance separating our countries, will be deep and sincere.

Thanking you for the promise to send us *The Engineering Journal*,

I am,

Sincerely yours,

ASSOCIATION OF POLISH ENGINEERS IN CANADA.  
President.

## POST WAR RECONSTRUCTION

Today one hears so much about post war problems that it would seem as if the war problems had all been solved. Many persons and organizations are rushing into print and discussions as if each thought the problem the most important matter on the world agenda. Doubtless it is important, but with victory still not fully arranged for, its sudden appearance in the forefront of our deliberations may, to some, appear to be inappropriate.

Several months ago and at frequent intervals since, proposals have been made that some attention should be paid to such matters by the Council of the Institute. Council did investigate the situation and was informed that a committee which appeared to be competent had been appointed by the Federal government to go into the problem in a national way. Council agreed that sectional thinking or planning would offer no satisfactory solution, and undertook to wait until the committee had had a chance to examine the situation and prepare a solution that would include all parts of Canada and all occupational groups within it. It was Council's thought that in such a plan there must be a section which would be of particular interest to engineers and the Institute, to which it might apply its influence and energies.

Insufficient publicity has been given to the creation and the work of the Federal "Committee on Reconstruction." Doubtless this has contributed to the anxiety of many people and led to the belief that no planning was being done. This in turn has caused many organizations to start something of their own without any idea that others were already active and that each was duplicating or complicating the work of the other. To the end that a better understanding of the situation and the problem may be had, the *Journal* publishes herewith a "release" which has been furnished it in consequence of an interview with Dr. Cyril James during which permission was asked to publicize the establishment and the work of the committee.

Branches of the Institute may give real assistance to the committee by attacking specific problems that may be placed before them. By virtue of the national character of the Institute, it may be that comprehensive information can be assembled that will show the variation in the needs and desires of different parts of the country. In such things the Institute may find a real activity and render a real service.

Council has these matters before it and is in close touch with the committee. As soon as specific direction is given to it, instructions and advice will be sent to the branches. It is desired to emphasize that planning to be constructive and effective should be done on a national co-operative basis. If every separate interest or group strikes out by itself, there will be much overlapping, many omissions and constant confusion.

### COMMITTEE ON RECONSTRUCTION Dominion Government, Ottawa

The Dominion Government gave its first attention to the problems of reconstruction after the war as early as December, 1939, when a special Committee of the Cabinet was constituted (by P.C. 4068½) "to procure information respecting and give full consideration to and report regarding the problems which will arise from the demobilization and the discharge from time to time of members of the Forces during and after the conclusion of the present war, and the rehabilitation of such members into civil life." The Committee, in February, 1941, advised that "the scope of its duties should be enlarged to include an examination and discussion of the general question of post-war reconstruction, and to make recommendation as to what Government facilities should be established to deal with this question." By P.C. 1218 of February 17th, 1941, the functions of the Cabinet Committee were enlarged accordingly; and an advisory Committee on Reconstruction was set up shortly afterwards.

Speaking before the Parliamentary Committee on the Pension Act and the War Veterans' Allowance Act (April 4th, 1941), the Hon. Ian A. Mackenzie, Minister of Pensions and National Health referred to this as follows:

"It has been found that all the bodies, official and unofficial, which have been giving consideration to the question of rehabilitation of our ex-service men have become concerned about the question of post-war reconstruction. It must be clear that this matter of reconstruction is much wider than that of the rehabilitation of our serving soldiers, sailors and airmen. So great indeed are the implications, so wide the variety of problems, and so significant for the future of our whole Dominion, that the study of the question should be begun now—and obviously it cannot be confined to any one group of men or Department, but must be the concern of every branch of the public service, and of every provincial and municipal authority in Canada. Such being the case, the difficulty arises as to where a start can be made. The General Advisory Committee has at many points touched this problem, and as it is representative of many Departments of the Government, its co-operation in any study of the matter is essential. It seemed wise that a small Committee should undertake a survey of the whole field and look on the problem in a broad way. In consequence P.C. 1218 amending P.C. 4068½ empowers the special Committee of Cabinet to examine and discuss the general question of post-war reconstruction, and to make recommendation as to what Government facilities should be established to deal with this question."

The powers and functions of the Committee on Reconstruction, as the advisory body set up to report to the Cabinet Committee on these matters, have recently been codified by Order-in-Council (P.C. 6874). This order authorizes the Committee to secure all necessary information "with regard to reconstruction policies and activities in Canada and abroad" and charges all departments or agencies of the government to co-operate with the Committee in the performance of its duties.

The chairman of the Committee is Dr. F. Cyril James, Principal and Vice-Chancellor of McGill University. Other members are Mr. Tom Moore, president of the Trades and Labour Congress of Canada and former vice-chairman of the National Employment Commission; Mr. D. G. McKenzie, vice-president of United Grain Growers, Ltd., and former Minister of Agriculture in the Province of Manitoba; Mr. J. Stanley McLean, of the Canadian Chamber of Commerce; Dr. R. C. Wallace, Principal of Queen's University and past president of the Royal Society of Canada, and Dr. Edouard Montpetit, K.C., Secretary-General of the Université de Montréal. All these members serve without remuneration. Ex-officio members are Dr. W. A. Mackintosh, chairman of the Joint (Canadian-American) Economic Committee; Mr. Walter S. Woods, Associate Deputy Minister of Pensions and National Health; and Brig.-Gen. H. F. McDonald, chairman of the Advisory Committee on Demobilization and Rehabilitation. Dr. Leonard C. Marsh, formerly Director of Social Research at McGill University, is Research Adviser; and Mr. Robert England, formerly Director of the Canadian Legion Educational Services, is Executive Secretary.

By P.C. 6874 it is provided that the chairman of "any other committee which may be appointed to consider any question of post-war economic reconstruction" shall attend meetings of the Committee on Reconstruction, and in other ways offer the fullest co-operation to the Committee.

On the nature of the Committee and the formidable tasks before it, the Minister (in the same speech previously cited) has said the following:

"It will be observed that the Cabinet Committee is not, under (the) additional term of reference (of P.C. 4068½) instructed to submit a programme for post-war reconstruction; it is asked to consider the whole problem,

and to make recommendation as to what facilities the Government should establish to deal with the question. It was therefore thought wise that a small group of able and distinguished citizens who were not already under pressure of Departmental war work in the public service, should be charged with the study of this work and asked to report to the Cabinet Committee. This Committee will assemble information from various bodies now engaged in a study of the aspects of economic, social, and international trends during war-time, and the probable direction of trade and development subsequent to the war. Through the Department of External Affairs, our High Commissioners and Legations abroad are sending us details of plans being made in Great Britain and the sister Dominions, and an effort will be made to secure as complete documentation as possible upon the whole problem. The forecast of a possible international system, the principles of social security which may be basic in a reconstruction programme, technological change, regional specialization in relation to probable new methods and types of international trade, will have to be taken into account when consideration is given to planning of our post-war economy. This suggests at once a whole series of very difficult questions. What war-time controls now imposed upon industry and agriculture should be relinquished or maintained, either partially or wholly? How can transfer of war-time industry for peace-time purposes be achieved? How can such transfer and new equipment be financed? What will be the relation of our regional economies resting on raw material export to world trade? Can unemployed labour be absorbed by the subsidizing of public works or by the use of public credit or funds? What measures of physical reconstruction are necessary for the improvement of housing and health? Questions of social policy as well as economic policy will be involved . . ."

The Advisory Committee has formulated a comprehensive programme of inquiry to cover the wide range of post-war economic and social problems which constitute the territory of "reconstruction." A number of exploratory studies are now under way, all for the moment specifically Canadian in their area of reference, but geared to close co-operation with the work of similar Committees in Great Britain, other Dominions, and the United States. The special problems of demobilization of the armed forces are not included, as these are receiving the detailed attention of the Committee on Demobilization and Rehabilitation and its several sub-committees. The Committee on Reconstruction, like the Committee on Demobilization, reports directly to the Cabinet Committee, so that its documents are necessarily not public unless so authorized by the government. The Committee, is, however, open to receive suggestions from interested agencies and individuals, and welcomes the co-operation and interest of the citizen body of the Dominion.

In addition to the above information the following extracts from correspondence are submitted to explain or illustrate the field and the work of the committee.

Two special committees have been set up by the Dominion Government. Each of these is an advisory body charged with recommending on facilities and relevant policy, to a special Cabinet Committee set up in December, 1940, empowered to act on all matters relating to rehabilitation and reconstruction.

#### 1. Demobilization and Rehabilitation

One of these is specifically concerned with the demobilization of the armed forces and their re-establishment into civil life. This is composed of ranking civil servants, and is also an inter-departmental committee, so that it brings together all kinds of governmental personnel concerned. The parent committee has set up a series of sub-committees, all of which are busily engaged. Its activities range all the way from immediate demobilization techniques to admin-

istrative procedures and provisions necessary for getting in the ex-service man on and across the threshold of civil employment.

Undoubtedly the major product of the work of this committee so far is that embodied in a recent Order-in-Council, P.C. 7633, which provides particularly for two things: the extension of unemployment insurance provisions to members of the forces; and secondly, comprehensive facilities for all men who wish to continue training or education after their period of military service. I know that the Demobilization Committee attaches great importance to this measure, and I think with good reason.

#### 2. Reconstruction

The second committee is the Committee on Reconstruction, which is charged with all phases of economic and social reconstruction over and above the problems of specific demobilization.

This committee is of a different character, in accordance with the scope, and undoubtedly with the controversial nature of its task. It is directly linked with the Demobilization Committee through its joint executive secretary (Mr. England), and has other liaisons with governmental committees both in Canada and elsewhere. But its primary members receive no remuneration and are in a position to give completely independent expression of their views.

The secretariat of the committee has, among other things, built up as comprehensive as possible a body of information on the economic and social problems which must be the subject of reconstruction. The committee sketched out the general territory of reconstruction; and has undertaken a series of special studies relating to particular divisions of this territory. Since the reports and memoranda of the committee are the property of the Cabinet, they cannot, of course, be made public unless the government so desires. And in any case, the scope of the field is so vast that it would be futile to expect cut and dried plans to be drawn up at this stage. It is quite easy for this silence to be interpreted as meaning that the committee is not doing any work; but I can assure you that such an impression would be wholly erroneous.

But there is, of course, no secret about the territory of reconstruction, and the type of problems which have to receive consideration. They include:

- (i) The problems of re-employment and the structure of the post-war labour market; probably extending to the relations of the social services and educational facilities.
- (ii) The re-adaptation or re-orientation of the industrial and other economic expansion now proceeding at rapid pace for the prosecution of the war. It is of course possible to break this down into divisions of manufacturing industry, construction, agriculture and primary resources, etc.
- (iii) The redirection and restoration of international trade; and allied reconstruction in the sphere of monetary systems and international investment.
- (iv) The redirection, abandonment, or other modification of the structure of legislative economic controls.
- (v) Works programmes, whether for emergency employment provision or as part of the major tasks of physical and economic restoration. This of course may be conceived broadly as including such important matters as housing, and also natural resources conservation.

All these topics will, of course, be the subject of much public discussion; there is already growing evidence of this interest, though it can hardly take precedence over interest in our first winning the war.

I am sure there is no suggestion in the minds of any one connected with the Committee that this discussion of post-war problems and policy is the monopoly of the govern-

ment's advisory committee. Public opinion itself is part of the reconstruction picture. From another angle, provincial and local governments are obviously concerned in present planning and future administration. Yet again, there is the vital fact that Canada's economic future is tied up inextricably with that of Britain, the Dominions and the United States. The Committee is well aware of these ramifications.

### MEETING OF COUNCIL

A meeting of the Council of The Institute was held at Headquarters on Saturday, January 17th, 1942, at ten thirty a.m.

Present: Vice-President K. M. Cameron, in the chair; Past-President J. B. Challies; Vice-President de Gaspé Beaubien; Councillors J. H. Fregeau, J. G. Hall, W. G. Hunt, A. Larivière, C. K. McLeod, and G. M. Pitts; General Secretary L. Austin Wright, and Assistant General Secretary Louis Trudel.

Vice-President Cameron reported on the joint meeting of the Association of Professional Engineers and The Institute branches in New Brunswick held in Saint John on January 12th, at which the co-operative agreement between The Institute and the Association had been signed. The president had been unable to make the trip, and had asked Mr. Cameron to sign on behalf of The Institute, an honor which he had greatly appreciated.

A very successful meeting had been held. The Premier of the Province was present and gave a notable address on public affairs, which had been widely quoted in the press. Mr. Cameron remarked that this made four provinces out of eight in which there was a co-operative agreement between The Institute and the Provincial Professional Association. There is no Professional Association in Prince Edward Island. From general reports he believed that the movement would gradually extend to the other provinces. Mr. Wright spoke of the forthcoming annual meeting of The Institute, and from conversations with the Premier and other officials it seemed to Mr. Cameron that there would be a good representation of engineers from the province of New Brunswick at the meeting.

The general secretary reported briefly on the meeting of the executive committee of the Engineers' Council for Professional Development which he had attended, at Council's request, in place of Dr. J. B. Challies, The Institute's representative on the Council. Although a great deal of work had been done at this meeting, there was little new to report, the business consisting mostly of confirming the policies adopted at the recent annual meeting and the setting up of machinery necessary to carrying them out. Mr. Henninger, of the Committee on Information had submitted a dummy of the new booklet "Engineering as a Career." It would be distributed at a cost of ten cents a copy, or seven and a half cents a copy in lots of one hundred or more. Mr. Wright explained that Mr. H. F. Bennett had thought this would be a good booklet to distribute to heads of engineering schools and high schools, although it covered much of the same ground as our own booklet, which is also in the course of preparation.

Mr. Beaubien, chairman of the Finance Committee, presented the auditors' statement for the year 1941. He pointed out that the report was made up in the usual way as far as the various items were concerned, but at the meeting of the Finance Committee some changes had been suggested. The land and buildings are carried on the books at actual cost, \$91,495.22, which is out of proportion with their present value. In past years very little depreciation had been shown, and the Finance Committee recommended that an amount of \$55,495.22 be allowed for depreciation, which would show the land and buildings at their assessed value, namely \$36,000.00.

Mr. Beaubien explained the various items on the state-

ment, and pointed out that the financial condition of The Institute is better than it has been for a number of years.

Mr. Wright reported that arrangements for the Annual Meeting were progressing favourably, although there was still some uncertainty as to whether or not two of the principal speakers will be able to be present. However, some very distinguished American engineers were expected at the meeting, and it was hoped that it would be possible to arrange for substitutes should there be any last minute cancellations.

Mr. Hunt, chairman of the Annual Meeting Committee, gave a detailed report on the financing of the meeting. The desirability of asking for subscriptions from outside organizations was discussed, and it was agreed that the decision on this should be left to the annual meeting committee. In any case, Council would assume the responsibility for any deficit.

The general secretary presented a report from the Provisional Committee of the Julian C. Smith Memorial Medal in which it was recommended that for the year 1941 three additional awards be made which, in conjunction with the eight made last year, would be known as inaugural awards. It recommended that the following persons receive the medal:

WILBERT GEORGE MCBRIDE MONTREAL  
*Professor and Head of Department of Mining Engineering, McGill University.*

For outstanding academic service to a great university and for his contribution to the Canadian mining industry.

WILLIAM GEORGE MURRIN VANCOUVER  
*President, British Columbia Power Corporation, Limited.*

For his contribution to the development of the Province of British Columbia as a leading utility, banking and business executive.

ERNEST WALTER STEDMAN, O.B.E. OTTAWA  
*Air Vice-Marshal*

For professional service of vital importance to the Empire as Air Member of the Air Council for Aeronautical Engineering in the Royal Canadian Air Force.

Council accepted the report unanimously, and directed that copies of it be submitted to all members of Council and to all past-presidents. It also requested that the three additional recipients be appropriately advised by the president.

The Provisional Committee's report also made certain recommendations with regard to rules and regulations for future awards. These are to be considered at the February meeting of Council.

The general secretary reported that the corporate membership of the Halifax Branch has now passed the two-hundred mark, and that, in accordance with the by-laws, the branch is now entitled to a second councillor. On the recommendation of the executive, it was unanimously **RESOLVED** that John R. Kaye, M.E.I.C., be appointed as the second councillor representing the Halifax Branch.

A letter was presented from the secretary of the Toronto Branch requesting Council to hold a regional meeting of Council in Toronto on a Saturday early in April. The Council of the Association of Professional Engineers of Ontario holds its regular quarterly meeting about that time, and it was proposed that the two bodies should meet on the same day and devote the evening to a joint dinner to honour C. R. Young as the new dean of the Faculty of Applied Science and Engineering at the University of Toronto and also as president of The Institute.

A letter from the secretary of the Association indicated that Saturday, April 18th, would be the most suitable date

for the Association meeting. Accordingly, subject to the approval of the incoming Council, it was unanimously agreed that the April meeting of Council should be held in Toronto, on Saturday, the 18th, and that a joint dinner be held in the evening, at which the guest of honour would be Dean C. R. Young.

The general secretary reported on the work of the War-time Bureau of Technical Personnel. He mentioned the possibility of a change in regulations whereby the Bureau might be given additional work to do along with additional responsibilities. He also stated that he was endeavouring to arrange things in such a way that he would have to spend less time at Ottawa and therefore would have more time for Institute affairs.

It was noted that the Association of Professional Engineers of Ontario was holding its annual meeting on the evening of the Council meeting, when W. C. Miller, M.E.I.C., of St. Thomas, would be installed as the new president. The general secretary was directed to send the congratulations and good wishes of Council to the Association and to Mr. Miller.

In view of the fact that The Institute's representative on the National Construction Council of Canada is now residing in Montreal, and as his term of office will expire within the next month or two, it was suggested that some member of The Institute in Ontario, who would be in a better position to take an active part in the deliberations of the Council, should be asked to accept this appointment. Accordingly, it was unanimously **RESOLVED** that Mr. D. C. Tennant, M.E.I.C., of Toronto, be appointed as The Institute's representative on the Council for the coming year.

On the motion of Dr. Challies, seconded by Mr. Hall, it was unanimously **RESOLVED** that Dr. P. L. Pratley, M.E.I.C., be renominated for a further three-year period as The Institute's representative on the Main Committee of the Canadian Engineering Standards Association.

Letters were presented from Mr. Fraser S. Keith and Mr. Mudge suggesting that the gun which stands on The Institute's property on Mansfield Street should be turned over to the government for war purposes. There was an interesting story in connection with the gun, which Mr. Keith could supply, and which might be published if the gun were presented to the government.

Mr. McLeod understood that all such guns were the property of the government. The City of Westmount had been informed that the government was calling for tenders to collect all these guns and salvage them. After discussion, it was left with the general secretary to make inquiries and find out just what the situation is, and dispose of the gun to the best advantage of the government-sponsored salvage campaign.

A resolution from the Lakehead Branch of The Institute was presented to Council. This resolution dealt with post-war problems and concluded with a recommendation that the resolution be submitted for discussion at the next annual meeting, in the belief that out of such a discussion could be developed a policy for The Institute to follow. The resolution made certain specific recommendations for an Institute organization, and concluded with the recommendation "that planning for the post-war period be undertaken and continued as one of the major activities of The Institute until such time as normal peacetime conditions have been restored."

A long discussion followed. It was pointed out that this matter had been before Council several times, and that at previous meetings it was decided to take no action at the moment in view of the fact that the Dominion government had set up a non-partisan committee to examine the whole problem. Council's attitude had always been that it was undesirable to step into this very complicated

field without first determining what had already been done by the main committee. In this way The Institute's efforts could be made to work in conjunction with the general plan, eliminating any possibility of hindering the work of the main committee.

The general secretary reported that under instructions from the president he had interviewed Dr. F. Cyril James, principal of McGill, and chairman of the Federal Committee on Reconstruction, in order to offer the co-operation of The Institute and to determine the lines upon which any Institute activities should be developed. It was Dr. James' opinion that such an offer would be very helpful, and he announced that a sub-committee was being established to investigate that portion of the problem which had to do with construction. He also announced that he had asked Mr. K. M. Cameron, chief engineer of the Department of Public Works, to accept the chairmanship.

Mr. Cameron then outlined the situation as explained to him by Dr. James and by Dr. Marsh, who is the research adviser to the committee. He stated that very clear "terms of reference" had been given to him prescribing the work which his committee was to do. He also stated that the organization work was not yet complete and that very careful consideration was being given to it so that the persons most competent to contribute would be appointed.

Mr. Cameron pointed out that no publicity had been given to the work of Dr. James' committee, and that consequently there was little likelihood at the present time of publicity being given to the appointment of the committee of which he was chairman. However, he hoped that when details of the organization were finally drawn up, proper announcement could be made. In the meantime he recommended that further consideration by Council be left in abeyance until he could report some more definite plans towards which Institute attention could be directed.

Several councillors took part in the discussion which followed, and it was agreed that as the situation is still in a state of flux further activities on the part of The Institute should await advice from Mr. Cameron. It was hoped that something conclusive could be reported to the annual meeting of Council in February, which, in turn, might be announced to the annual general meeting.

The general secretary was instructed to inform the Lakehead Branch that Council appreciated its interest and would be glad to follow up on their resolution after further intimation had been received from Dr. James or Mr. Cameron. It was also suggested that some publicity might be given to the fact that a national committee is already considering the post-war problems so that members would know that something was already under way, and that The Institute was standing-by at the request of Dr. James to assist as soon as clear definite lines had been established.

A number of applications were considered, and the following elections and transfers were effected:

**ADMISSIONS**

Members .....	12
Juniors .....	1
Students .....	20
Affiliate .....	1

**TRANSFERS**

Junior to Member.....	1
Student to Member.....	2
Student to Junior.....	3

It was noted that the next meeting of Council would be held at Headquarters in Montreal on Wednesday, February 4th, 1942, at ten thirty a.m.

## ELECTIONS AND TRANSFERS

At the meeting of Council held on January 17th, 1942, the following elections and transfers were effected:

### Members

**Barratt**, Ernest F., B.A.Sc. (Univ. of Toronto), county engr. and road supt., Hamilton Suburban Roads Commission, Hamilton, Ont.  
**Brown**, Raymond Warrington, B.Sc. (Mech.), (Univ. of Sask.), asst. mech. supt., Winnipeg Free Press Co. Ltd., Winnipeg, Man.  
**Gagnon**, Paul Edouard, Chem. Engr. (Laval Univ.), D.Sc. (Univ. of Paris), D.I.C. (Univ. of London), Ph.D. (Laval Univ.), director, dept. of chem. engrg., president, Graduate School, Laval Univ., Quebec, Que.  
**Gunn**, George John Tait, B.Sc. (Engrg.), (Heriot-Watt College), chief asst. engr., Trinidad Electricity Board, Port of Spain, Trinidad, B.W.I.  
**Helwig**, Carl Everett, B.A.Sc., M.A.Sc. (Univ. of Toronto), lecturer, dept. of civil engrg., Univ. of Toronto, Ont.  
**Irwin**, Harold Stephen, B.A.Sc. (Univ. of Toronto), squad boss, Dominion Bridge Co. Ltd., dtg. room, Toronto, Ont.  
**McRitchie**, Charles Bell, (Glasgow & West of Scotland Tech. Coll.), partner, R. A. Rankin & Co., Montreal, Que.  
**Price**, Gordon James, chief dftsmn., Ont. Divn., Dominion Bridge Co. Ltd., Toronto, Ont.  
**Short**, Harold William, sales engr., Dominion Bridge Co. Ltd., Toronto, Ont.  
**Smith**, Duncan Norman, B.S. (C.E.), (Tri-State College of Engrg.), struct'l designer & estimator, Dominion Bridge Co. Ltd., Toronto, Ont.  
**Whiteley**, Frederick Bryan, res. engr., Dept. of Transport, Belleville, Ont.

### Junior

**Holgate**, David Crossley, B.Eng. (Civil), (McGill Univ.), dftsmn., Dominion Bridge Co. Ltd., Toronto, Ont.

### Affiliate

**Baudoin**, Hector Oswald, chief electrician, Price Bros. & Co. Ltd., Riverbend, Que.

### Transferred from the class of Junior to that of Member

**Paterson**, Walter Howard, B.Sc. (Queen's Univ.), field engr., Geological Dept., Tropical Oil Co., Barranca Bermeja, Colombia, S.A.

### Transferred from the class of Student to that of Member

**Nowlan**, Brete Cassius, Jr., B.Eng. (Elec.), (McGill Univ.), Lieut., E. Section Comdr., 4th Cdn. Divn. Sigs. (A.F.), Debert Camp, N.S.

**Thorne**, James Lawrence, B.Sc. (Elec.), (Queen's Univ.), asst. shift charge engr., London Power Co., London, England.

### Transferred from the class of Student to that of Junior

**Bridges**, Robert James, B.Sc. (Elec.), (Univ. of Man.), wire & cable sales engr., Northern Electric Co. Ltd., Winnipeg, Man.

**Smiley**, Donald Charles, B.Sc. (Queen's Univ.), instructor, R.C.A.F., Radio Detachment, Queen's Univ., Kingston, Ont.

**Turanna**, Anthony Louis, B.Sc. (Queen's Univ.), asst. to chief engr., Public Utilities Commission, London, Ont.

### Students Admitted

**Anderson**, John MacDonald, (McGill Univ.), 102 Fentiman Ave., Ottawa, Ont.

**Archambault**, Jean-Jacques, (Ecole Polytechnique), 6650 De Normandie St., Montreal, Que.

**Brett**, John Edward, (McGill Univ.), 4180 Melrose Ave., Montreal, Que.

**Cann**, John Leonard, (Univ. of Man.), 497 Craig St., Winnipeg, Man.

**Dalkin**, Robert S., (McGill Univ.), 9 Willow Avenue, Westmount, Que.

**Dancose**, Leon, (Ecole Polytechnique), 3591 Jeanne-Mance St., Montreal, Que.

**Le Grandmont**, Marcel, (McGill Univ.), 3647 Durocher St., Montreal, Que.

**Griesbach**, Robert Johnston, (McGill Univ.), 185 Dufferin Rd., Hampstead, Que.

**Hand**, Dennis Herbert, (Univ. of Man.), 273 Eugenie St., Winnipeg, Man.

**Laquerre**, Maurice, (Ecole Polytechnique), 5025 Delorimier Ave., Montreal, Que.

**MacEachern**, Clinton Whitman, (McGill Univ.), 419 Prince Arthur St., Montreal, Que.

**Moffatt**, Allan Gray, (Univ. of Toronto), 150 Lascelles Blvd., Toronto, Ont.

**McCulloch**, Urban Francis, (McGill Univ.), 127 Percival Ave., Montreal West, Que.

**McFarlane**, Howard William, (Univ. of N.B.), 210 Lancaster Ave., West Saint John, N.B.

**Mills**, John Wesley, (Queen's Univ.), 72 Craig St., Ottawa, Ont.

**Nathanson**, Herzl King, (McGill Univ.), 376 Clarke Ave., Westmount, Que.

**Park**, John Kenneth, (McGill Univ.), 177-17th Ave., Lachine, Que.

**Pearson**, Edward Bernard, (McGill Univ.), 477 Prince Arthur St. West, Montreal, Que.

**Petitpas**, Marcel, (Ecole Polytechnique), 5509 Laurendeau St., Cote St. Paul, Montreal, Que.

**St-Jacques**, Maurice, (Ecole Polytechnique), 386 St. Catherine Road, Outremont, Que.

## R.A.F.'S AIRACOBAS

From *Trade and Engineering* (LONDON), NOVEMBER, 1941

For many months conflicting reports have been reaching this country from the United States regarding the performance and capabilities of the Bell *Airacobra*. Not for many years has such a controversy existed about an aeroplane. The strange thing about the statements on the *Airacobra* is that they ranged from the sublime to the ridiculous. Some spoke of speeds of about 500 m.p.h., others 400 m.p.h.; still others raised doubts whether the Allison engine would stand up to the work required of a modern fighter. The reason for all this discussion and for the discrepancy in the reports was no doubt that few people had seen the *Airacobra* flying and not many more had even seen it on the ground.

The most striking feature of the machine is that although it has a tractor airscrew the liquid-cooled engine is installed behind the pilot's cockpit, the airscrew being driven by a long shaft which passes through the pilot's cockpit under the seat. It is also fitted with the tricycle under carriage which is becoming almost a regular feature of all new American aircraft. It was not until the first *Airacobras* had been in this country for a week or two that some rational opinions could be obtained about the aircraft and its performance. Now the first squadron equipped with *Airacobras* has been formed as part of Fighter Command, and it has just become fully operational. The writer was permitted to visit the squadron recently to watch the machines in the air and on the ground and to ask the pilots what they thought about their new aircraft. The machines were deployed on the airfield and, with their tails held in the air by the tricycle undercarriage near the nose of the fuselage, they presented a strange picture.

The pilots of this squadron have now had their *Airacobras* sufficiently long to know all there is to be known about them. The squadron commander, a pilot of great experience who has flown *Spitfires*, *Blenheims*, *Hurricanes*, *Beaufighters*, and several other types, expressed the view that, up to certain heights (which may not be specified), the *Airacobra* is the finest fighter in the world—and he did not exclude the British *Spitfires* and *Hurricanes*. Up to these heights, he said the American fighter was faster. Its manoeuvrability was about the same as that of the *Spitfire* and slightly less than that of the *Hurricane*. The *Airacobra*, he added, has limitations in altitude, but, as he pointed out, one cannot have everything in a single machine, and for the work to which it would be put he did not ask for a better all-round machine.

In appearance the *Airacobra* is not unlike the *Hurricane*, though on the ground its tricycle undercarriage gives it a distinctive appearance. The front wheels of the undercarriage retract inwards, the outside shields of the wheels folding back flush with the floor of the fuselage. This single-seat, low-winged monoplane is powered by a liquid-cooled Allison 12-cylinder engine of 1,150 h.p. No performance figures are available in respect of the type used by the R.A.F. There are several versions of armament. One consists of a 20mm. cannon, firing through the airscrew hub, two machine-guns located in the nose and firing through the airscrew, and four machine-guns in the wings. Another version has the 20mm. Oerlikon cannon in the nose, and four machine-guns in the wings—two 0.5 and two 0.303.

**Louis O'Sullivan**, M.E.I.C., has been appointed general executive assistant with Montreal Light, Heat and Power Consolidated. He has been on the staff of the company since 1923 and has held the positions of field engineer, designing engineer and transmission and right-of-way engineer, his duties being connected with the design and construction of electrical substations, transmission and dis-



L. O'Sullivan, M.E.I.C.

tribution lines, as well as supervision of land surveys, property purchases and title records.

Mr. O'Sullivan is a graduate of McGill University where he obtained the degree of Bachelor of Science in 1921. From 1921 to 1923 he worked for the City of Montreal on construction of its new aqueduct canal.

**Major-General H. F. G. Letson**, M.C., M.E.I.C., has recently been appointed Adjutant General in the Department of National Defence Headquarters at Ottawa. Previously he was Canadian Military Attaché in Washington.

Born at Vancouver, B.C., in 1896, he served in France with the 54th Battalion, C.E.F., in the Great War. He was severely wounded, and was awarded the Military Cross. Major-General Letson maintained his military interest after demobilization and had been associated with the Non-Permanent Active Militia.

He received his education at the University of British Columbia, where he graduated with the degree of B.Sc. in mechanical engineering in 1919. In 1923 he was granted the degree of Ph.D., in engineering by the University of London, England, and was appointed assistant professor of mechanical engineering at the University of British Columbia. In 1931 he became associate professor of mechanical engineering, a position which he retained until 1934. At that time he became chief engineer and managing director of Letson and Burpee, Vancouver. In 1936 he was president of the Association of Professional Engineers of British Columbia.

**Major-General J. P. Mackenzie**, D.S.O., M.E.I.C., of Vancouver, has been appointed Quartermaster-General in the Department of National Defence Headquarters at Ottawa. Until this appointment he was in command of an infantry brigade with the Canadian Army overseas.

Major-General Mackenzie was born at Boissevain, Man., in 1884 and was educated at the University of Glasgow. He served overseas in the first great war with the Canadian Expeditionary Forces and upon his return to Canada in 1919 he became engaged in construction work. From 1920 to 1927 he was chief engineer of Henry and McFee at Seattle, Washington. In 1927-1928 he was field engineer

## News of the Personal Activities of members of the Institute, and visitors to Headquarters

for the St. John Dry Dock and Shipbuilding Company at St. John, N.B. He joined the staff of the Western Bridge Company at Vancouver as general sales manager in 1929 and in 1932 he was made general manager, a position which he occupied until the outbreak of war.

**Stanley Shupe**, M.E.I.C., is the newly elected chairman of the Hamilton Branch of the Institute. He was educated at the University of Toronto where he received the degree of Bachelor of Applied Science in 1914. Mr. Shupe is city engineer of Kitchener, Ont., and has had extensive experience in municipal engineering having been county engineer of Haldimand, Ont., and later town engineer of Oshawa. He is a past president of the Canadian Institute on Sewage and Sanitation.



Stanley Shupe, M.E.I.C.

**J. B. Stirling**, M.E.I.C., is the newly elected president of the Canadian Construction Association for the current year. He is vice-president of E. G. M. Cape and Company, contractors, Montreal.

Born at Dundas, Ont., Mr. Stirling graduated from Queen's University as a Bachelor of Arts in 1909 and as a Bachelor of Science in 1911. In the early days of his career he worked on municipal construction projects. During the last war he served with the Canadian Expeditionary Force overseas, in the Royal Canadian Engineers. He has been associated with E. G. M. Cape and Company for the past twenty-six years, first as a field engineer and later as a supervising engineer. In 1928 he became a partner in the firm and a few years ago he was made vice-president in charge of operations.

Mr. Stirling has been connected with construction projects such as the Banting Institute in Toronto, docks and grain elevators at Saint John, N.B., and at Georgian Bay, and the Canadian Vickers plant in Montreal.

He is a member of the executive of the Montreal Branch of the Institute.

**C. C. Lindsay**, M.E.I.C., has recently been appointed by the government of the province of Quebec a member of the Montreal Tramways Commission. Mr. Lindsay is in private practice at Montreal as a consulting engineer and land surveyor. He has been a member of the Institute for several years having been particularly active in the Montreal Branch.

**W. B. Scoular**, M.E.I.C., division engineer of the Wayagamack Division of the Consolidated Paper Corporation, has

obtained a leave of absence to accept a position as works manager of the gun plant of the Dominion Bridge Company at Vancouver, B.C. Mr. Scouler graduated from Glasgow University in 1923, with the degree of Bachelor of Science. He came to Canada in 1929 and accepted a position on the staff of Dominion Bridge Company with whom he remained until 1936 when he went with Consolidated Paper Corporation, Laurentide Division.

**Flying Officer Walter L. Rice**, M.E.I.C., has accepted a commission with the Royal Canadian Air Force and has been posted to No. 3 Training Command Headquarters, Works and Buildings, Montreal, where he has been employed as senior assistant engineer since July, 1941.

**D. D. Whitson**, M.E.I.C., plan examiner, Department of Buildings, City of Toronto, is now with the Works and Buildings Branch, Naval Service, Department of National Defence, Ottawa.

**William A. Hillman**, M.E.I.C., is with the Foundation Company of Canada at Kenogami, Que., as superintendent of crushing and mining plants on the Shipshaw power project.

**G. W. Holder**, M.E.I.C., who, at the beginning of last year had relinquished his position as manager of the Sturgeon Falls division of the Abitibi Power and Paper Company Limited, has now been transferred to the engineering department of the Sault Ste. Marie mills of the Company. In the meantime, he had spent last winter as chief draughtsman at Iroquois Falls, and last summer his services had been loaned to the Government for the organization of the Wartime Machine Shop Board of the Canadian Pulp and Paper Association.



**H. Lloyd Johnston**, M.E.I.C.

**H. Lloyd Johnston**, M.E.I.C., has been elected chairman of the Border Cities Branch of the Institute. Born at Vancouver, B.C., he was educated at the University of British Columbia and at McGill University where he graduated in 1927. In the same year he became connected with the Canada Power and Paper Corporation as engineer in charge of building construction. In 1928 he was designing engineer and until 1936 was plant engineer for the same company at Windsor Mills, Que. He joined the staff of Canadian Industries Limited at Montreal in 1936 and in 1938 he was transferred to the Windsor, Ont., plant of the company.

**Drummond Giles**, M.E.I.C., vice-president of the Canadian SKF Company Ltd., has been appointed associate director-general of the subcontract branch of the Department of Munitions and Supply, Ottawa.

**Professor E. A. Allcut**, M.E.I.C., professor of mechanical engineering at the University of Toronto, has been appointed technical advisory editor of *Manufacturing and Industrial Engineering*, a monthly publication from Toronto.

**Jacques E. Hurtubise, Jr.**, E.I.C., is the newly elected chairman of the Junior Section of the Montreal Branch of the Institute. He was educated at Ecole Polytechnique where he received his degree in civil engineering in 1934. Upon graduation he joined the teaching staff of the Ecole Polytechnique as an instructor in the laboratory for testing



**J. E. Hurtubise, Jr.**, E.I.C.

materials. In 1937 and 1938 he was reinforced concrete designer for Baulne and Leonard, Montreal. He is at present in charge of the laboratory for testing materials at the Ecole.

**André P. Benoit**, Jr., E.I.C., has recently obtained a leave of absence from Dominion Rubber Company Limited, Montreal, to join the inspection staff of the Department of Munitions and Supply. A few days after he had been posted at the Montreal Locomotive Works Limited he suffered an accident when he slipped and fractured his right leg while testing a newly constructed tank. He is at present recovering in the hospital. Mr. Benoit was chairman of the Junior Section of the Montreal Branch of the Institute last year. His friends wish him a rapid and complete recovery.



**T. M. Moran**, M.E.I.C.

**T. M. Moran**, M.E.I.C., vice-president of Stevenson and Kellogg Limited, was recently elected president of United Tool Engineering and Design Ltd., Toronto.

**H. A. Crombie**, M.E.I.C., has been recently appointed administrator of plant machinery, equipment and supplies for the Wartime Prices and Trade Board with offices in Montreal. Mr. Crombie is assistant manager of the Dominion Engineering Company Limited, Montreal, having joined this firm in 1920.

**Flight-Lieut. E. H. Jones**, M.E.I.C., who was commissioned in the Royal Canadian Air Force in June, 1941, is now officer commanding, Works and Buildings Division, No. 1 Service Flying Training School, at Camp Borden, Ont.

**A. E. K. Bunnell**, M.E.I.C., partner, Wilson and Bunnell, consulting engineers, Toronto, is serving in the office of Mr. James Stewart, National Administrator of Services, the Wartime Prices and Trade Board, Toronto. Mr. Bunnell is director of Public Utility services.

**Robert W. Tassie**, M.E.I.C., has joined the staff of Empresa Electrica de Guatemala at Guatemala, C.A. Mr. Tassie, who is vice-president of Empresas Electricas Brasileiras, has been located in South America since 1911. At one time he was manager of the operating department of the Latin American projects of the Montreal Engineering Company.

**Stanley R. Frost**, M.E.I.C., has been granted leave of absence by the North American Cyanamid Company Limited to take a position on the staff of the Wartime Bureau of Technical Personnel at Ottawa. Mr. Frost is the immediate past president of the Association of Professional Engineers of Ontario.



Stanley R. Frost, M.E.I.C.

**Jean V. Arpin**, Jr.E.I.C., has recently been put in charge of the inert component shop at Canadian Car Munitions Ltd. at St. Paul L'Ermite, Que., and at the same time he acts as technical advisor for the shell-filling groups. After graduating from the Ecole Polytechnique in 1938, he took a post graduate course in chemical engineering at the Ecole and in 1939 he was with the Department of Roads of the Province of Quebec. In 1940 he joined the staff of Canadian Car Munitions Ltd., and was sent to England, from where he returned to help organize the production in the company's plant.

**N. W. D. Mann**, Jr.E.I.C., is stationed at Ottawa as junior engineer on construction of the new headquarters building of the Royal Canadian Air Force. He graduated with the degree of Bachelor of Science in civil engineering at the University of New Brunswick in the class of 1937. From 1937 to 1940 he was with the Department of Highways of New Brunswick as instrumentman and junior engineer. In 1940 he joined the works and buildings division of the Department of National Defence at Gander, Newfoundland.

**John T. Mazur**, S.E.I.C., has accepted a position with Massey-Harris Aircraft at Weston, Ont., as a tool and jig designer. He graduated from the University of Manitoba in 1940 with the degree of Bachelor of Science in civil engineering.

**S. D. Levine**, S.E.I.C., has recently been transferred from the inspection staff of the Republic Steel Corporation in Buffalo, New York, to the Crucible Steel Company, at Harrison, N.J., with the Inspection Board of the United Kingdom and Canada. He graduated from the University of Toronto in 1939.

**D. C. R. Miller**, S.E.I.C., has accepted a position with Research Enterprises Limited at Leaside, Ont. Previously he was connected with the Duplate Safety Glass Company at Oshawa.

**E. R. Jacobsen**, M.E.I.C., was recently appointed personal assistant to L. R. Macgregor, director-general of the recently formed Australian War Supplies Procurement in Washington, D.C. Mr. Jacobsen is on temporary leave of absence from the Dominion Bridge Company, Limited, Montreal.

**T. S. Glover**, M.E.I.C., manager, industrial department, Russell T. Kelley, Limited, Hamilton, has obtained a leave of absence to join the staff of the Wartime Bureau of Technical Personnel at Ottawa. He is vice-chairman of the Hamilton Branch of the Institute.



T. S. Glover, M.E.I.C.

**B. H. Geary**, S.E.I.C., has recently been transferred from the Peterborough Works to the Davenport Works of the Canadian General Electric Company in Toronto. He graduated in electrical engineering from the University of New Brunswick in the class of 1940.

#### VISITORS TO HEADQUARTERS

**H. F. Lambart**, M.E.I.C., Life Member, Ottawa, Ont., on January 9th.

**W. E. Ross**, M.E.I.C., manager, apparatus sales department, Canadian General Electric Company, Toronto, Ont., on January 15th.

**Wills Maclachlan**, M.E.I.C., secretary-treasurer and engineer, Electrical Employers' Association of Ontario, Toronto, Ont., on January 20th.

**G. H. Thurber**, M.E.I.C., Department of Public Works, Ottawa, Ont., on January 22nd.

**J. W. MacDonald**, M.E.I.C., Avon River Power Company, Windsor, N.S., on January 26th.

**R. W. Boyle**, M.E.I.C., Director, Division of Physics and Electrical Engineering, National Research Council, Ottawa, Ont., on January 26th.

**E. B. Horton**, M.E.I.C., Boston, Mass., on January 30th.

# Obituaries

*The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.*

**Walter Ritchie Duckworth**, M.E.I.C., died in Vancouver, B.C., on January 13th, 1942. He was born at Montreal on December 31, 1870, and was educated at the Montreal High School, McGill University and later at St. Paul, Minn. From 1890 to 1892 he worked in the office of Chas. F. Loweth, consulting engineer in the department of bridge engineering and construction of the Northern Pacific Railway Company and the Chicago, Milwaukee and St. Paul Railway Company. In 1892 he joined the staff of Dominion Bridge Company at Montreal as a designing draughtsman on swing bridge machinery. In 1896 he was appointed chief inspector and in 1912 he went to Vancouver. He was for some time connected with the Granby Consolidated Mining & Smelting & Power Company at Anyox, B.C., and later with the Greater Vancouver Water District Board. Lately he had been connected with the Dominion Bridge Company at Vancouver as plant engineer and assistant superintendent.

Mr. Duckworth joined the Institute as an Associate Member in 1912 and became a Member in 1940.

**Robert Leslie Murray**, S.E.I.C., died at Vernon, P.E.I., on November 17th, 1941. He was born at Vernon on November 11th, 1913, and received his education at Mount Allison University and Nova Scotia Technical College. From 1937 until 1940 he was engaged on highway construction for the Department of Highways of Prince Edward Island. In 1940



R. L. Murray, S.E.I.C.

he joined the Department of National Defence of Canada and worked on airport construction at Summerside, P.E.I. He was appointed assistant engineer in charge of construction in April, 1941.

Mr. Murray joined the Institute as a Student in 1931.

**William James Smither**, M.E.I.C., died at his home in Toronto on January 18th, 1942, after a short illness. He was born at St. Thomas, Ont., on November 29th, 1880, and received his education at the University of Toronto, where he graduated as a Bachelor of Applied Science in 1905. Following his graduation he spent some years engaged in engineering work in Vancouver, B.C., San Francisco and Los Angeles, Cal. His work in the latter two cities was in connection with the installation of hydraulic plants. In 1911 he joined the engineering staff of the University of Toronto as a demonstrator in structural design. In 1915 he became lecturer, and in 1921, assistant professor of structural engineering. Later he became associate professor.

Professor Smither joined the Institute as an Associate Member in 1914 and he was transferred to Member in 1925.

**William Morrison Johnstone**, M.E.I.C., died at his home in Ottawa on December 22nd, 1941. He was born at Stamford, Ont., on October 11th, 1889, and was educated at Queen's University where he received his Bachelor of Science degree in 1913. Upon graduation he joined the engineering staff of the City of Toronto and after a few months he became resident engineer on sewer construction. In 1916 he joined the staff of the International Nickel Company at Copper Cliff, Ont., and worked for this firm as construction cost engineer until 1918 when he went overseas. In 1919, upon his return to Canada, he joined the staff of the City of Hamilton, where he was employed on sidewalk construction. Later he became in charge of sewers and underground construction. In 1930 he became managing director of Stanley Contracting Limited, Hamilton, and in 1932 he joined the engineering staff of the City of Ottawa as deputy engineer. In 1934 he became assistant commissioner of works for the city, a position which he occupied at the time of his death.

Mr. Johnstone joined the Institute as an Associate Member in 1921. He became a Member in 1940.

**Archibald Alexander MacDiarmid**, M.E.I.C., died at his home in Quebec city on January 7th, 1942. He was born at Covey Hill, Que., on May 13th, 1885, and was educated at McGill University, where he received the degree of Bachelor of Science in 1910. Upon graduation he joined the engineering department of the Montreal Light, Heat and Power Consolidated and after two years he became in charge of this department.

In 1914 he was employed by the Bathurst Lumber Company at Bathurst, N.B., as chief engineer of the Lumber, Pulp and Paper Division, on the design, construction and operation of mills. For seven months in 1916 Mr. MacDiarmid was the chief engineer of the Mattagami Pulp and Paper Company at Smooth Rock Falls, Ont. From there he transferred to the Anglo-Newfoundland Development Company at Grand Falls, Newfoundland, as manager. In 1918 he was the special representative of the Federal Trade Committee in the Newsprint Price Fixing Case at Washington, D.C. From 1919 to 1921 he was employed as chief engineer of the Ironsides Paper Board Company, Norwich, Conn.

In 1922 he joined the staff of Price Bros. & Co. Ltd., as chief engineer, a position which he occupied until his death.

Mr. MacDiarmid joined the Institute as a Student in 1909. In 1914 he was transferred to Associate Member and he became a Member in 1926.

## COMING MEETINGS

**Ontario Good Roads Association**—Annual Convention, Royal York Hotel, Toronto, February 25-26th. Secretary, T. J. Mahony, Box 485, Hamilton, Ont.

**Canadian Institute of Mining and Metallurgy**—Forty-sixth Annual General Meeting, Royal York Hotel, Toronto, March 9-11th. Secretary, E. J. Carlysle, 906 Drummond Bldg., Montreal.

**American Water Works Association, Canadian Section**—Annual Convention at the General Brock Hotel, Niagara Falls, Ont., April 15-17th. Secretary, Dr. A. E. Berry, Ontario Department of Health, Parliament Buildings, Toronto.

**American Water Works Association**—Sixty-second Annual Convention at Stevens Hotel, Chicago, Ill., June 21-25th. Executive Secretary, Harry E. Jordan, 22 East 40th Street, New York, N.Y.

## HALIFAX BRANCH

S. W. GRAY, M.E.I.C. - - - - Secretary-Treasurer  
G. V. ROSS, M.E.I.C. - - - - Branch News Editor

The annual meeting of the Halifax Branch was held as an informal dinner at the Halifax Hotel on December 18th. Fifty-five members and guests were present.

S. W. Gray, secretary-treasurer, presented his financial statement and report for the past year. The report of the scrutineers showed the following new executive members had been elected: Percy A. Lovett (Chairman), J. D. Fraser, G. T. Clarke and G. J. Currie of Halifax, G. T. Medforth, Amherst, and J. W. MacDonald, Windsor.

S. L. Fultz, retiring chairman, reviewed the activities of the branch during 1941. Since the co-operative agreement between the Institute and the Association of Professional Engineers of Nova Scotia, the membership of the branch has increased by 170 to a total of 256, of whom 216 are full members. Five dinner meetings were held during the year, also the joint E.I.C. and A.P.E.N.S. banquet. Branch members have contributed ninety-five dollars to the Headquarters Building Fund and eighty dollars has been invested in War Savings Certificates. The latter amount is the result of a decision to eliminate musical entertainment from the monthly dinner meetings and use the money for this purpose.

Mr. Lovett took over as chairman and asked the members to support the executive as they have in the past. He stated that the recent increase in membership would entitle the branch to representation by an additional member on the Council.

It was decided to hold the joint banquet with the Association of Professional Engineers in January.

An entertainment feature of the evening was provided by a General Electric Company film—"Exploring With X-Rays."

## LONDON BRANCH

H. G. STEAD, M.E.I.C. - - - - Secretary-Treasurer  
A. L. FURANNA, S.E.I.C. - - - - Branch News Editor

The December meeting of the branch was held on December 10th in the new Cronyn Memorial Observatory at the University of Western Ontario. Dr. H. R. Kingston, head of the Department of Mathematics and Astronomy, and Rev. W. G. Colgrove, a member of the university staff, presented a most interesting programme.

The first part of the evening was spent in the dome of the observatory where Rev. Colgrove explained the principles of their fine telescope. This telescope has a 10-inch lens and is the largest of its kind to be cast and ground on this side of the ocean. Unfortunately, the sky was overcast and there was no opportunity to view the planets through the telescope.

For the second part of the evening, Dr. Kingston gave a lecture on astronomy, in which the meeting was given some idea of the complicated workings of our universe and of its enormous size. The lecture was illustrated by many models made by Rev. Colgrove.

Rev. Colgrove then demonstrated his working model of our sun, earth and moon. This model showed simultaneously all the motions of the earth and moon around the sun. The model also illustrated the seasons, the midnight sun, midday night and the phases of the moon.

At the close of the lecture demonstration, R. W. Garrett, the branch chairman, called upon W. C. Miller who thanked both Dr. Kingston and Rev. Colgrove for their very interesting programme.

Following the meeting a number of members remained to see the observatory's prized possession, a meteor.

Many members took advantage of the invitation extended to their wives and lady friends.

## Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

## MONTREAL BRANCH

L. A. DUCHASTEL, M.E.I.C. - - - Secretary-Treasurer  
G. G. WANLESS, JR., E.I.C. - - - Branch News Editor

On January 8th Mr. Howard Johnson, a naval architect and ship surveyor, general manager of Midland Shipyards Ltd., addressed the branch on **Shipyard Production Methods**. He has had wide experience in a number of shipbuilding firms in England and Scotland, and has had the opportunity of visiting many yards in different countries.

The paper deals with the application of straight-line production methods to construction of standardized 10,000 ton cargo vessels, as a means of speeding up shipbuilding during the emergency. It is published in this issue of the *Journal*.

Mr. Johnson said that it is presently possible to complete a 10,000 ton standardized cargo vessel by such means in 25 weeks, of which 20 weeks are in the berth. During the discussion, Mr. R. E. Hertz described progress in Canadian yards, along these lines. It is expected that the 6 $\frac{1}{4}$ -month building period will be reduced to 4 $\frac{1}{2}$  months in time. This will be a major contribution to our defence.

The branch was privileged to have present at its Annual Meeting on January 15th, Dr. C. J. Mackenzie, President of The Institute.

The chairman, R. E. Hertz, discussed the 24th Annual Report which had been mailed to all members and commented on the good and active work of all committees. All activities had been maintained at full level despite the pressure of emergency duties. The membership committee showed a 90 per cent increase. A broader presentation of the Institute to the public was ably begun by Mr. Hulme's Publicity Committee. The Junior Section was complimented on their being able to maintain attendance; one of their meetings drew 170 members. The chairman expressed regret that Mr. André Benoit, Junior Section Chairman, should have had an unfortunate accident at this time.

The following officers were elected for the coming year: J. A. Lalonde, Chairman; R. S. Eadie, Vice-Chairman; L. A. Duchastel, Secretary-Treasurer; R. E. Hertz, Past-Chairman; J. Comeau, J. M. Crawford, J. B. Stirling, H. F. Finnemore, R. C. Flitton, G. D. Hulme, Councillors.

Mr. Hertz presented to Dr. Mackenzie, as the Montreal Branch contribution to the Headquarters Building Fund, a cheque for \$6,000.

Dr. Mackenzie said that success in the building fund campaign had had a salutary effect in solidifying the national organization. The Institute is the best developed of such national organizations, and being such should be capable of playing an outstanding part in general affairs, which of necessity must be more collectivistic in the future. He spoke of the Institute, through its early beginnings in Montreal, as "an organization born a bit before its time, in an era when specialization and individualism were dominant." This had made it possible for some groups to survive more easily than others. Now collectivism was necessary for survival, as many European countries have learned before now.

The speaker mentioned the large number of key positions now held by engineers in Army, Navy, Air Force, as well as Government Departments directly connected with the war effort. Industrial production was seen as just now entering its fourth stage in which quantity production would be shortly achieved and a shortage of manpower would become evident.

In addition to creating the fighting services and equipping them, Dr. Mackenzie foresaw a third major engineering problem—that of maintaining a price ceiling without reduction of quality standards.

Mr. L. O'Sullivan moved the vote of thanks to the speaker which was most heartily endorsed by all those present.

Mr. Heartz expressed his sincere thanks to the secretary-treasurer and all committee chairmen for having made his term of office so successful.

The new Chairman, J. A. Lalonde, was escorted to the chair by Past-Presidents O. O. Lefebvre and F. P. Shearwood. Mr. Lalonde, addressing himself to Dr. Mackenzie, Mr. Heartz and the members of the branch, promised to keep us busy and pledged his energy to maintaining the high standard of the Montreal Branch. He spoke in English and in French.

By courtesy of the St. Maurice Power Co., a most instructive film was presented, which showed stages in the building of the La Tuque dam.

Mr. W. G. Hunt discussed highlights of the Annual Meeting to be held February 5th and 6th.

The meeting adjourned for refreshments.

### OTTAWA BRANCH

A. A. SWINNERTON, M.E.I.C. - - *Secretary-Treasurer*

At the noon luncheon on December 18th, 1941, A. L. Malcolm, B.A.Sc., senior field engineer in charge of hydro-electric development construction for the Ontario Hydro-Electric Power Commission, spoke upon some of the **Construction Features of the Barrett Chute Development** on the Madawaska river in Ontario, about 25 miles southeast of Pembroke. His talk was illustrated by coloured motion pictures.

This development was begun in September, 1940, and is expected to be complete early in midsummer of 1942. It is designed to supply an additional 54,000 horsepower which will mean much to Ontario where a large part of Canada's war industries are concentrated.

Mr. Malcolm's paper dealt in large part with the construction of the dam itself and was listened to with a great deal of interest by the members. It is the intention to publish this paper in *The Journal*.

The Annual Meeting of the Ottawa Branch was held on the evening of January 8th at the auditorium of the National Research Laboratories, followed by an illustrated address and demonstration by J. W. Bateman of Toronto on the **"Magic of the Spectrum."**

At the Annual Meeting the usual reports were presented and the results of the elections to the branch were announced. Chairman for the forthcoming year is N. B. MacRostie, secretary-treasurer is A. A. Swinnerton, and new members of the Managing Committee are W. H. G. Flay, G. A. Lindsay and R. Yuill. The retiring secretary-treasurer, R. K. Odell, was presented with a handsome travelling bag and a gold Engineering Institute pin.

Mr. MacRostie presented an interim report on the work of the Committee on Air Raid Shelters and stated that a survey was being made of downtown and commercial buildings and of residences and apartments in other sections of the city in connection with air raid shelter facilities. He said the libraries had secured books and pamphlets on the question of air raid shelters and these were available to the public.

The secretary-treasurer's report showed an increase in branch membership of 26 during the year, the total now being 402 resident and 103 non-resident members. Two sets of drafting instruments were donated to the Ottawa Technical School for presentation as prizes for proficiency in drafting and a copy of "Technical Methods of Analysis" by Griffin was presented to the Hull Technical School to be awarded to one of the students. The meeting voted unanimously to set aside \$30 for the same purposes again this year.

President C. J. Mackenzie and General Secretary L. Austin Wright of the Institute spoke briefly on the reconstruction plans of the Institute.

The address and demonstration by J. W. Bateman required the use of considerable apparatus and was listened to with rapt attention on the part of the audience. Mr. Bateman traced the history of artificial indoor lighting from the days of the general use of the candle to the ultra-modern methods of present-day illumination. He was thanked by Lieut. Commander C. P. Edwards and A. K. Hay.

At the conclusion of the meeting refreshments were served.

### SAGUENAY BRANCH

D. S. ESTABROOKS, M.E.I.C. - - *Secretary-Treasurer*  
J. P. ESTABROOK, J.E.I.C. - - *Branch News Editor*

A meeting of the Saguenay Branch was held on December 16th in the Arvida Protestant School.

Before being addressed by the speaker, the members were shown a film on **"Photoelastic Stress Analysis"** as it had been developed and investigated at the University of Manitoba. Transparent plastic models were used in this work and various engineering problems were given attention.

Following this, the speaker, Mr. Jas. A. E. Gohier, was introduced by our chairman, Mr. N. F. McCaghey. As chief engineer of the Quebec Roads Department, Mr. Gohier was able to give a clear and interesting presentation of his subject—**"Road Building in Quebec."**

Three factors must be considered in this work, namely, speed, density of traffic, and the size and nature of the vehicles to be accommodated. The severe changes experienced in these characteristics has demanded an alert and progressive planning of road projects during the past twenty-five years. An outline of the maximum and average traffic densities experienced on the main routes showed this to be the governing factor in the selection of a road type. In this regard, there are four important classes—two-lane, three-lane, four-lane divided and four-lane undivided highways.

A two-lane highway can handle 3,500 cars per day with a percentage of trucks of from fifteen to twenty. However, with variations of crown and other features, the capacity may be reduced to 3,000. The three-lane can accommodate from six to ten thousand cars per day and is usually of concrete or asphalt construction. Although it is in a lower accident class, other characteristics do not usually warrant its use in this province.

The four-lane undivided highway takes care of a traffic flow of from ten to twenty thousand cars and has the advantage of adaptability during peak hours when traffic is predominantly in one direction. At such times three lanes may serve in one direction and one in the other.

In the future we may expect to see our highways constructed with a maximum curvature of four degrees and a greatly increased range of visibility.

The speaker pointed out that accident increase was completely out of proportion to the increase in registration of automobiles and mentioned the aids being provided the driver to induce him to be more careful. Pavement marking machines are in use and 874 miles of pavement have already been marked. The standard highway markings as used in the New York and Ontario road systems are to be closely followed.

Films shown and explained by Mr. Gohier depicted road building as it has recently been carried out in the province. In making the pavements, an eight-inch layer of crushed stone is first put down as a cushion, covered with tar paper, and a concrete layer placed on top of this. This base is still abrasive and a finishing layer of pavement one and a half inches thick completes the road surface. Following this, the new concrete is covered with burlap and then with a special type of curing paper for five-days. Earth is no longer used at this stage of the work.

Special mention was made of the construction of a traffic circle at Dorval and in closing Mr. Gohier stressed the importance of roads in times of an emergency.



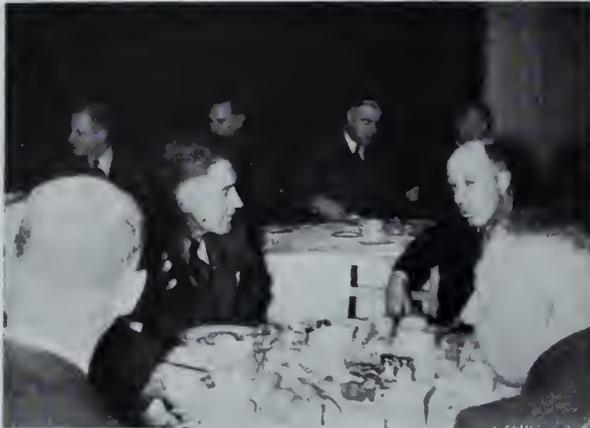
Councillor W. J. W. Reid, Col. D. A. White, Commandant, Army Trades School, Hamilton, and Councillor W. L. McFaul.



Professor E. A. Allcut of Toronto, guest speaker, and W. A. T. Gilmour, Branch Chairman for 1941.



Professor Allcut, W. A. T. Gilmour, General Secretary L. Austin Wright and new Branch Chairman Stanley Shupe.



F. R. Leadlay, H. A. Cooch and J. F. Crowley.



W. E. Sprague, F. H. Midgley, Mark Yong, E. G. Mackay and J. R. Dunbar.



Left:  
J. T. Thwaites,  
Geo. Howse and  
J. Elliott.



Right:  
N. S. Braden,  
H. A. Lumsden and  
J. Hannaford.



A. J. Turney and T. J. Boyle.



Geo. Foot and C. H. Hutton.

## QUEBEC BRANCH

PAUL VINCENT, M.E.I.C. - *Secretary-Treasurer*

Lundi soir, le premier décembre, les membres de la section de Québec, tenaient leur trente-troisième Assemblée Générale Annuelle, dans la salle de réception de Québec Power à Québec. Cinquante-cinq membres y assistaient.

Après la nomination des scrutateurs chargés de dépouiller le scrutin pour l'année 1941-42, le secrétaire donnait lecture du procès-verbal de l'Assemblée Annuelle du 25 novembre 1940, du rapport du Conseil sur les activités de l'année 1941 et il présentait le rapport financier pour l'année écoulée.

L'assemblée procéda ensuite à la formation des divers comités de la Section, qui s'établissent comme suit:

- Législation:* MM. O. Desjardins, président,  
J. O. Martineau et J. G. O'Donnell.
- Recrutement:* MM. Hector Cimon, président,  
E. D. Gray-Donald et Paul Vincent.
- Excursions:* MM. Théo. Miville Dechêne, président,  
W. R. Caron et Yvon R. Tassé.
- Bibliothèque:* MM. A. V. Dumas, président, René Dupuis, Théo. Miville Dechêne, J. O. Martineau et Burroughs Pelletier.
- Nominations:* MM. Gustave St-Jacques, Jean St-Jacques et Théo. Miville Dechêne.

Les scrutateurs, Yvon de Guise et Lucien Buteau, présentèrent alors leur rapport sur le résultat des élections de la section de Québec pour 1941-42 et le président de l'assemblée, Monsieur L. C. Dupuis, en donna lecture aux Membres comme suit:

- Président:* L. C. Dupuis—réélu par acclamation  
*Vice-Président:* René Dupuis— élu " "  
*Secr.-Trésorier:* Paul Vincent—réélu " "  
*Conseillers élus pour deux ans:* Stanislas Picard  
Ludger Gagnon  
G. W. Waddington.

Trois autres conseillers ont encore un an d'office ce sont: MM. O. Desjardins, R. Sauvage et Gustave St-Jacques.

Le conseil est complété par les membres ex-officio: MM. Hector Cimon, E. D. Gray-Donald, Alex. Larivière, R. B. McDunnough et Philippe Méthé, et enfin Monsieur A. R. Décar, président honoraire à vie de la section de Québec.

Il avait été décidé que la coupe du premier tournoi de golf joué au Royal Quebec Golf Club, le 15 septembre 1941, serait présentée au champion avec les inscriptions de circonstance gravées sur la coupe. Le président, L. C. Dupuis, offrit donc officiellement cette magnifique coupe, donnée par la Maison Geo. T. Davie & Sons, à Monsieur Ph. A. Dupuis, le champion pour 1941. Cette cérémonie raviva des souvenirs nombreux et variés et amena la discussion sur cet événement que tous souhaitent voir se répéter les années prochaines.

L. C. Dupuis, le président réélu, termina l'assemblée en adressant quelques mots aux membres. Il les remercia d'abord de leur vote de confiance en le réalisant pour une seconde année, il exhorta les membres à venir en grand nombre à toutes nos réunions et il les félicita de s'être rendus aussi nombreux à l'Assemblée Annuelle. Il termina ces quelques mots par des tributs marques de reconnaissance à l'adresse des officiers de Québec Power pour avoir mis leur salle à la disposition des membres de la section.

M. Alex. Larivière nous fit ensuite apprécier durant une heure ses talents de cinématographe, en nous promenant autour de notre péninsule Gaspésienne. Ce fut un voyage magnifique. M. Larivière tint toute l'assistance en suspens par des films excitants sur la destruction de la flotte française à Dakar, la chute du Pont Tacoma, et les belles ondines du New York World's Fair.

La réunion se clôtura par des rafraîchissements servis aux membres pendant qu'ils échangeaient leurs vues sur les sujets d'actualité.

Le 15 décembre 1941, la section de Québec avait une des réunions les plus instructives de l'année, dans la Salle des Comités du Château-Frontenac, à 8.15 hrs.

Sous la présidence de Monsieur L. C. Dupuis, président de la section, MM. Gilles E. Sarault, ingénieur régional à Radio-Canada, Poste CBF, et Aurèle Séguin, commentateur de la même Société, nous entretenaient de la radio-diffusion.

Les ingénieurs, accompagnés de leurs épouses ou amies, se rendirent au nombre de 200 pour écouter ces conférences compétentes.

M. G. E. Sarault nous parla de "**La Technique de la Radiodiffusion.**" Il commença par donner à son auditoire un rapide aperçu des principes fondamentaux de la radio; puis il passa à l'application pratique de ces principes, en faisant une revue de l'organisation nécessaire à une radiodiffusion complète. Cette conférence, brillamment illustrée par des projections de diagrammes et de schémas très bien imaginés et de nombreux appareils installés dans la salle, eut un vif succès dont tout le monde parle encore.

M. Aurèle Séguin commenta ensuite un film en couleur préparé par la Société Radio-Canada et présenté pour la première fois à Québec. La Section de Québec de l'Institut profita de cette primeur et sût goûter la merveilleuse présentation de ces films. Chacun eut l'occasion de voir à l'écran ses artistes préférés de la radio dans les sketches populaires "Pension Velder," "Un Homme et son Pêché," "S.V.P.," etc. Ces films commentés par l'excellent conférencier qu'est Monsieur Séguin n'ont pas manqué d'intérêt pour toute l'assistance et ce dernier nous faisait des remarques et des réflexions intéressantes et très instructives, même des vers que nous citons ici:

Si tu veux, faisons un rêve.  
Montons sur deux électrons;  
Tu m'emmènes, je t'enlève,  
Vois! déjà nous démarrons.

Nous filons à toute allure  
Sans quitter notre fauteuil;  
Pas besoin d'autre monture  
Pour faire un voyage à l'oeil.

Autrefois les pauvres types  
Qui voulaient franchir l'octroi,  
Risquant de casser leur pipe,  
Enfourchaient un palefroi.

Pour aller chercher fortune  
Chez le Turc ou le Castillan,  
Il suffit, chose opportune,  
D'un' p'tite antenne d'appartement.

Les conférenciers ont été ensuite remerciés: Monsieur Gilles Sarault par un de ses confrères de McGill, Monsieur Henri F. Béique, et Monsieur Aurèle Séguin par Monsieur Philippe Méthé.

Monsieur Adrien Morin, l'auteur de ces films était à l'appareil de cinématographie et de reproduction. Ces films des mieux réussis furent vivement appréciés par tout l'auditoire.

La soirée eu le résultat d'enthousiasmer tout le monde, tel qu'on pouvait s'y attendre.

## SASKATCHEWAN BRANCH

STEWART YOUNG, M.E.I.C. - - - *Secretary-Treasurer*

The Saskatchewan Branch met in joint session with the Association of Professional Engineers and the American Institute of Electrical Engineers at the Kitchener Hotel, Regina, on Tuesday evening, December 16th, 1941, to hear an address by Major T. G. Tyrer, recently returned from overseas. The meeting was preceded by the usual dinner, at which 30 members and guests were in attendance.

Major Tyrer gave an outline of his personal experiences while on active service, following which there was a general discussion on conditions in the old land and a hearty vote of thanks to the speaker.

**JOINT MEETING OF INSTITUTE BRANCHES IN NEW BRUNSWICK AND ASSOCIATION OF PROFESSIONAL ENGINEERS—for Signing of Co-operative Agreement.**



G. L. Dickson, immediate Past-President of the Association and Councillor of the Institute representing the Moncton Branch.



A. A. Turnbull, C. C. Kirby, signing the agreement, G. L. Dickson and Hon. J. B. McNair, Premier of New Brunswick.



Above: Left to right around the table, T. C. Macnabb, W. A. S. McLansan, D. C. Oxley, F. G. Thompson, A. R. Bennett.



Left: Premier J. B. McNair, F. O. Condon and Vice-President K. M. Cameron.



Right: H. R. Logie, A. R. Crookshank, Past-President H. W. McKiel addressing the meeting, and A. O. Wolff.



Sydney Hogg, R. Judge, C. C. Kirby, F. A. Patriquen, W. Ganderton.



Left to right around the table, Councillor G. G. Murdoch, G. A. Vandervoort, H. W. McKiel, A. O. Wolff, A. Gray, J. P. Mooney.

## ST. MAURICE VALLEY BRANCH

C. G. DE TONNANCOUR, S.E.I.C. - *Secretary-Treasurer*

On December 3rd, at 8 p.m., in the Cascade Inn, Shawinigan Falls, the members of the Shawinigan Chemical Institute and the Canadian Club were guests of the St. Maurice Valley Branch, forming an audience of over a hundred.

The subject under discussion was a difficult and controversial one, indeed, the St. Lawrence Deep Sea Waterway, but it was very well treated by our members, Messrs. J. R. Eastwood, of Grand'Mère; R. H. Ferguson, of Trois-Rivières; and J. W. Stafford, of Shawinigan Falls; and illustrated by up-to-date maps and charts prepared for the occasion by the speakers.

The meeting was jointly presided over by Dr. A. H. Heatley, Branch Chairman, and Mr. Hembly, Chairman of the Chemical Institute. Due to the last minute absence of Mr. Stafford, Dr. Heatley delivered his paper, while Mr. Timmis replaced Dr. Heatley in the chair.

The evening was a success, and the credit goes to our speakers who must have spent considerable time and effort in its preparation. Their aim was to give the audience a clearer knowledge of the work already done, of the size and cost of the enterprise, and of the immediate results of its realization.

The speakers were purely objective in their views. A general discussion followed, Messrs. E. R. Williams, Hembly, E. B. Wardle and A. H. Heatley being the leading contributors, among many others.

## VICTORIA BRANCH

J. H. BLAKE, M.E.I.C. - - - - *Secretary-Treasurer*

The University of Manitoba film, "Photoelastic Stress Analysis," kindly loaned to the Victoria Branch through Professor A. E. Macdonald of the Department of Civil

Engineering, was the subject of a very interesting hour following the annual meeting of the branch on January 16th.

This film was taken around a series of particularly interesting experiments based on the study of internal stresses in plastic models of structures by means of the application of the principle of polarized light. Prior to the showing of this film, the executive of the branch arranged for a brief explanation of the principle of polarized light by a recent graduate of the University of British Columbia, Mr. Wm. H. Mathews, of the Provincial Department of Mines. Mr. Mathews' explanations greatly assisted in a more complete understanding of the experiments shown on this film.

The film deals with the preparation of suitable plastics for the construction of models by which stresses due to various fixed and movable loads are studied by means of the passage of light being controlled by means of polarization. By rotation of these planes the internal stresses can be visibly plotted and studied as by no other means, and pictorial records of them made. A number of various models are studied under actual proportionate load conditions and the resulting stresses, many of which are shown by coloured bands, can be seen under duplicated operating conditions. This process opens up an entirely new field for the determination of internal stresses otherwise only obtainable by theoretical mathematical calculations.

It is a long time since any engineering subject has provoked such a lengthy discussion period following presentation as that resulting from the showing of this film, and the University of Manitoba and Professor Macdonald in particular are to be complimented on the production of this film and for making it available to the branches of the Institute.

This branch is looking forward to an active and interesting year under the direction of the new officers elected at this annual meeting.

# News of Other Societies

## ASSOCIATION OF PROFESSIONAL ENGINEERS OF ONTARIO

Warren C. Miller, M.E.I.C., City Engineer, St. Thomas, has been elected president of the Association of Professional Engineers of the Province of Ontario and assumed office at the General Meeting of the Association which was held in the Royal York Hotel, Toronto, on January 17th.



Warren C. Miller, M.E.I.C.

Born in Point Edward, Ontario, he received his preliminary education at St. Thomas. After graduating from Queen's University in 1917, he served overseas with the Royal Canadian Engineers. In 1919, he went to St. Thomas

## Items of interest regarding activities of other engineering societies or associations

as an inspector in the city engineer's department. Six months later he was appointed city engineer, a position which he has held continuously since that time.

Major Miller has been a member of the Council of the Association for the past four years, and during that time has been chairman of the Legislation Committee. He is a past-president of the Canadian Institute on Sewage and Sanitation, a past chairman of the Canadian Section of the American Waterworks Association, and has served on the Council of The Engineering Institute of Canada. He was a member of the committee appointed jointly by the American Waterworks Association and the Municipal Finance Officers' Association that prepared the new waterworks accounting manual. He is also a member of the American Public Works Association.

Most of his spare time is devoted to his job as Churchwarden which he has held for eight years. He is also Lay Chairman of the Archdeaconry of Elgin and a member of the Executive Committee of the Synod of Huron.

The following have been elected as members of the Council of the Association of Professional Engineers of the Province of Ontario for the year 1942:

VICE-PRESIDENT: R. A. Elliott, General Manager, Deloro Smelting & Refining Co. Ltd., Deloro; PAST-PRESIDENT: S. R. Frost, M.E.I.C., Sales Director, North American Cyanamid Ltd., Toronto.

COUNCILLORS: *Civil Branch*—J. Clark Keith, M.E.I.C., General Manager, Windsor Utilities Comm., Windsor; J. L. Lang, M.E.I.C., Lang & Ross, 620 Queen St., Sault Ste. Marie; N. D. Wilson, M.E.I.C., Wilson & Bunnell, 388 Yonge

St., Toronto; *Chemical Branch*—R. M. Coleman, Smelter Supt., International Nickel Co. of Canada Ltd., Copper Cliff; E. T. Sterne, Manager, G. F. Sterne & Sons Ltd., Brantford; H. P. Stockwell, Chem. Engr., Ottawa Water Purification Plant, Ottawa; *Electrical Branch*—M. J. Aykroyd, Outside Plant Engineer, Bell Telephone Co. of Canada Ltd., Toronto; C. P. Edwards, M.E.I.C., Deputy Minister, Dept. of Transport, Ottawa; H. J. MacTavish, Secretary, Toronto Electric Commissioners, Toronto;

*Mechanical Branch*—C. C. Cariss, M.E.I.C., Chief Engr., Waterous Limited, Brantford; G. Ross Lord, M.E.I.C., Asst. Professor of Mechanical Engrg., University of Toronto; K. R. Rybka, M.E.I.C., Associate, Walter J. Armstrong, Cons. Engr., 989 Bay St., Toronto; *Mining Branch*—J. M. Carter, Mill Supt., McIntyre-Porcupine Mines Ltd., Schumacher; C. H. Hitchcock, Vice-President, Smith & Travers Co. Ltd., Sudbury; D. G. Sinclair, Asst. Deputy Minister, Ontario Dept. of Mines, Toronto.

## Library Notes

### ADDITIONS TO THE LIBRARY

#### TECHNICAL BOOKS

##### Canadian Almanac, 1942:

Edited by Horace C. Corner, Toronto, Copp Clark Co. Ltd., 6 x 9 in., \$7.00.

##### Canadian Engineering Publications Ltd.:

*The Engineering Catalogue, 1941.*

#### PROCEEDINGS, TRANSACTIONS

##### Institution of Mechanical Engineers:

*Proceedings, Jan. to June, 1941. London, vol. 145.*

##### Royal Society of Canada:

*Transactions, section 2, 3rd series, vol. 35, meeting of May, 1941.*

##### American Society of Civil Engineers:

*Reprint from the Transactions vol. 106, 1941 paper 2121, Masonry Dams, a symposium, 224 pages.*

#### REPORTS

##### American Society of Civil Engineers—Manuals of Engineering: Practice Nos. 23, 24.

*Military roads in forward areas, July 21, 1941. Surveys of highway engineering positions and salaries, July 21, 1941.*

##### Saskatchewan, Association of Professional Engineers:

*Membership list, 1941.*

##### U.S. Bureau of Standards—Building Materials and Structures:

*Report BMS78—Structural, heat-transfer, and water-permeability properties of five earth-wall constructions. Report BMS79—Water-distributing systems for buildings.*

##### Engineering Opportunities:

*General prospectus of the British Institute of Engineering Technology Ltd.*

##### Bell Telephone System—Technical Publications:

*Magnetostriction Young's modulus and damping of 68 permalloy; Macromolecular properties of linear polyesters; Current rating and life of cold-cathode tubes; Dilatometric study of the order-disorder transformation in Cu-Au alloys; Electron microscopes and their uses; Electron diffraction studies of thin films; Monographs B-1303, 1310, 1315-18.*

##### University of California Publications:

*Geology of the western Sierra Nevada between the Kings and San Joaquin Rivers, California, by Gordon A. MacDonald.*

##### Canada, Department of Mines and Resources—Mines and Geology Branch—Geological Survey Memoirs:

*Noranda District, Quebec, by M. E. Wilson, Memoir 229; Bousquet Joannes*

### Book notes, Additions to the Library of the Engineering Institute, Reviews of New Books and Publications

#### BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet the books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

#### ACOUSTICS OF BUILDINGS, including Acoustics of Auditoriums and Sound-proofing of Rooms

By F. R. Watson. 3 ed. John Wiley & Sons, New York; Chapman & Hall, London, 1941. 171 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$3.00.

This well-known text has been rewritten to take account of developments during the last ten years, and again offers a convenient account of current opinion and practice. The conditions for perfect acoustics, the behavior of sound waves in rooms, the design of auditoriums and methods of sound insulation are discussed in detail.

#### AIR BASE

By B. T. Guyton. McGraw-Hill Book Co. (Whittlesey House), New York and London, 1941. 295 pp., illus., 8½ x 5½ in., cloth, \$2.50.

In narrative style the author describes the environment and activities of a modern air base from his personal experience. The training of pilots, the how and why of cruises, and the human side of life in the squadrons are some of the topics considered in this picture of air base life for the layman.

#### AN APPROXIMATE MEASURE OF EARTHQUAKE EFFECT ON FRAMED STRUCTURES

By R. S. Chew. Revised June 25, 1941. Richard Sanders Chew, 844-a Mills Building, San Francisco, Calif. 96 pp., diagrs., charts, tables, 11 x 8½ in., paper, manifold, \$5.00.

The intention of this work is to provide architects and engineers with a practical viewpoint and solution of the earthquake problem within certain defined limits. The major part of the book consists of a practical rather than mathematical attempt to indicate approximately the effect on a structure of oscillation of its foundation in a horizontal direction. A theoretical treatment of the problem is appended.

#### BELT CONVEYORS AND BELT ELEVATORS

By F. V. Hetzel and R. K. Albright. 3 ed. rev. & enl., John Wiley & Sons, New York; Chapman & Hall, London, 1941. 439 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$6.00.

This standard work on belt conveyors and belt elevators explains the principles of these mechanisms in a comprehensive, practical manner. Belt manufacture is covered, driving

*Area, Quebec, by H. C. Gunning, Memoir 231; Mining Industry of Yukon, 1939 and 1940, by H. S. Bostock, Memoir 234.*

##### Canada, Department of Mines and Resources—Mines and Geology Branch—Bureau of Mines:

*Pictou County Coalfield—Physical and chemical survey of coals from Canadian Collieries, No. 3.*

##### University of Illinois—Engineering Experiment Station Bulletins:

*Heat transfer to clouds of falling particles, by H. F. Johnstone, R. L. Pigford and J. H. Chapin, Bulletin 330; Tests of Cylindrical Shells, by W. M. Wilson and E. D. Olson, Bulletin 331; Analyses of skew slabs, by Vernon P. Jensen, Bulletin 332.*

##### U.S. Department of the Interior—Bureau of Mines—Bulletins:

*Mechanical concentration of gases, No. 431; Some essential safety factors in tunneling, No. 439; Metal and non-metal mine accidents in the U.S., 1939 (excluding coal mines), No. 440.*

##### U.S. Department of the Interior—Bureau of Mines—Technical Papers:

*Carbonizing properties and petrographic composition of No. 1 bed coal from bell No. 1 mine, Sturgis, Crittenden County, Ky., and the effect of blending this coal with Pocahontas No. 3 and No. 4 bed coals, T.P. 628; Carbonizing properties and petrographic composition of Powellton-Bed coal from Elk Creek No. 1 mine, Emmett, Logan County, W.Va., and the effect of blending this coal with Pocahontas No. 3 and No. 4 bed coals, T.P. 630; Coal paleobotany, T.P. 631; Theoretical calculations for explosives, T.P. 632.*

##### National Management Council of the U.S.A.:

*Harry Arthur Hopf, fifth Cios medalist, April, 1940.*

##### Ottawa, King's Printer:

*Dominion-provincial conference, Jan. 14 and 15, 1941.*

##### Boston Society of Civil Engineers:

*Geological investigation of dam sites on the St. Maurice river, Quebec, by Irving B. Crosby.*

##### Revue Trimestrielle Canadienne:

*Extract from the June issue, 1941. Le Saint-Laurent et son aménagement, by Olivier Lefebvre. 32 pages.*

##### Portland Cement Association:

*Continuous hollow girder concrete bridges. 39 pages.*

and supporting equipment is discussed, particular uses for certain types of conveyors are indicated, and reasons are given for the various technical details described.

### **BOULDER CANYON PROJECT FINAL REPORTS. Part IV—Design and Construction**

*Bulletin 1—General Features. 301 pp.*  
*Bulletin 2—Boulder Dam. 253 pp.*  
*U.S. Dept. of the Interior, Bureau of Reclamation, Denver, Colorado, 1941.*  
*Illus., diagrs., charts, tables, maps, 9½ x 6 in., cloth, \$2.00 each; paper, \$1.50 each.*

Continuing the series on the Boulder Canyon project, the present bulletins deal with design and construction work. Bulletin 1 presents general descriptive information about the preliminary construction, the power plant and other appurtenances to the dam, Lake Mead and the All-American Canal system. Bulletin 2 presents detailed data and information regarding the design and construction of the dam itself.

### **BRIDGES AND THEIR BUILDERS**

*By D. B. Steinman and S. R. Watson.*  
*G. P. Putnam's Sons, New York, 1941.*  
*379 pp., illus., diagrs., woodcuts, 9 x 6 in., cloth, \$3.75.*

The development of the bridge through the ages is told in narrative style. The bridges are considered not only as pieces of engineering construction but also as expressions of the periods in which they were erected, and the characters and achievements of the builders are set forth against the background of the conditions under which they worked. With respect to the more important bridges a considerable amount of technical and factual data has been included.

### **CAREER IN ENGINEERING, Requirements, Opportunities**

*By L. O. Stewart. Iowa State College Press, Ames, Iowa, 1941. 87 pp., illus., tables, 9 x 6 in., paper (\$0.75, single copies; \$0.50 for five or more).*

The first objective of this booklet is to furnish information about engineering to young men who are considering a career in that field. To do this the author presents answers for the three standard questions: what does an engineer do; what are the necessary qualifications; and what are the prospects for the future in the field.

### **CIVIL DEFENCE**

*By C. W. Glover. 3 ed. revised and enlarged. Chemical Publishing Co., Brooklyn, New York, 1941. 794 pp., illus., diagrs., charts, tables, 9 x 5½ in., cloth, \$16.50.*

This practical manual presents, with working drawings, the methods required for adequate protection against aerial attack. The comprehensive nature of the work is indicated by the inclusion of material on bombs and their effects, war gases, camouflage, civilian instruction, training of A.R.P. personnel, and cost estimates (British figures), in addition to the large amount of space devoted to the construction of all types of protective buildings and shelters. There is a bibliography.

### **COLLECTIVE WAGE DETERMINATION**

*By Z. C. Dickinson. Ronald Press Co., New York, 1941. 640 pp., diagrs., charts, tables, 8½ x 6 in., cloth, \$5.00.*

Problems and principles in bargaining, arbitration and legislation are discussed in this general treatment of the question of remuneration of workers. The material is divided into five parts, as follows: survey of the field; factors commonly invoked in collective wage adjustments; wages and industrial fluctuations; wage policies and practices in private collective bargaining; and influences of public policy on wages.

### **ELECTRIC POWER STATIONS, Vol. I**

*By T. H. Carr, with a foreword by Sir L. Pearce. D. Van Nostrand Co., New York, 1941. 376 pp., illus., diagrs., charts, tables, 9 x 5½ in., cloth, \$7.50.*

Volume I of this work on electric power stations deals mainly with the mechanical engineering aspects. Topics treated include the circulating water system, cooling towers, coal and ash handling, the boiler plant, pipe-work and turbines. There is an introductory chapter on design fundamentals, and the construction and layout of buildings are covered. Many sketches and diagrams illustrate the text.

### **ELECTRICAL WIRING SPECIFICATIONS**

*Edited by E. Whitehorne. McGraw-Hill Book Co., New York and London, 1941.*  
*181 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$2.50.*

This book is a simple working guide for those concerned with the design of wiring installations, laying out systems and preparing specifications for any given job in an industrial, commercial or residential building.

### **ENGINEERING ELECTRICITY**

*By R. G. Hudson. 3 ed. John Wiley & Sons, New York, 1941. 284 pp., illus., diagrs., charts, tables, 8 x 5 in., lea., \$3.00.*

Written primarily for technical students not specializing in electrical engineering, this textbook is designed to provide a course with a broad objective. To this end an outline is presented of the fundamental principles and of the applications of electricity and magnetism most frequently encountered in engineering practice. There is a large section of practice problems with answers.

### **ENGINEERING TOOLS AND PROCESSES, a Study of Production Technique**

*By H. C. Hesse. D. Van Nostrand Co., New York, 1941. 627 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$4.50.*

Engineering shop processes and practices are covered by this comprehensive text. The first three chapters offer a survey of basic materials, elements and devices. The text then takes up the usual shop processes and machines for foundry work, wood shop and machine shop. Succeeding chapters discuss production machinery and processes not ordinarily presented in college laboratories, and illustrates their application to the manufacture of specific parts. A large bibliography and a section of questions and problems are appended.

### **GASEOUS CONDUCTORS, Theory and Engineering Applications. (Electrical Engineering Texts)**

*By J. D. Cobine. McGraw-Hill Book Co., New York and London, 1941. 606 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$5.50.*

Discussion of the fundamental principles of physics involved in the conduction of electricity in gases is combined with a complete presentation of the field of application in engineering. The treatment is thorough and logical, and covers the principles essential to an understanding of conduction phenomena, such as the kinetic theory of gases, ionic motion, atomic structure, ionization and de-ionization processes, emission phenomena and space charge effects.

### **HANDBOOK FOR CIVILIAN DEFENCE**

*By H. Mayer-Dexland. Civilian Advisory Service, 41 Park Row, New York, 1941.*  
*88 pp., illus., diagrs., 9 x 6 in., paper, \$1.00.*

This elementary handbook for civilian defence workers has two objectives. First, it deals in a simple, concise manner with all phases of civilian defence training and organization for war conditions; and second, it shows the value of such training for various peace-time emergencies and natural disasters.

### **HOUSING FOR HEALTH, Papers Presented under the Auspices of the Committee on the Hygiene of Housing of the American Public Health Association**

*Science Press Printing Co., Lancaster, Pa., 1941. 221 pp., diagrs., charts, tables, 9 x 6 in., paper, \$1.00.*

A variety of subjects is considered in this collection of papers presented under the auspices of the American Public Health Association. Housing codes and surveys, slum-clearance, health and recreational facilities in housing projects, noise control, house construction, and social implications are among the topics dealt with by various authorities in the field.

### **AN INTRODUCTION TO THE OPERATIONAL CALCULUS**

*By W. J. Seeley. International Textbook Co., Scranton, Pa., 1941. 167 pp., diagrs., tables, 8½ x 5 in., cloth, \$2.00.*

The first part of this book is devoted to a rapid review of long established methods of solving linear differential equations with constant coefficients. The use of the notation and nomenclature of the operational calculus prepares the student for the development of the operational method which, with its applications, mainly to circuit analysis, occupies the rest of the book.

### **MACHINE SHOP, Theory and Practice**

*By A. M. Wagener and H. O. Arthur. D. Van Nostrand Co., New York, 1941.*  
*306 pp., illus., diagrs., charts, tables, 11 x 8½ in., cloth, \$2.28; paper, \$1.60.*

The introductory and closing chapters of this textbook for beginners and apprentices in the machine trades describe respectively the commonly used precision and semi-precision tools found in the shop, and the uses of the so-called bench tools and small hand tools. The construction and operation of the various machines, from shapers to grinders, are dealt with in between in a practical order and manner. Safety suggestions, review questions and many illustrations are included.

### **OUTLINES OF PAINT TECHNOLOGY, based on Hurst's "Painters' Colours, Oils and Varnishes"**

*By N. Heaton. 2 ed. rev. J. B. Lippincott Co., Phila. and New York, 1940. 413 pp., illus., diagrs., tables, 9 x 6 in., cloth, \$12.00.*

Concise, practical information concerning the raw materials and manufacture of all types of paints and of many allied compounds is presented in this general guide for students of paint technology. The various pigments, driers, solvents, etc., are described and this new edition has an added chapter on synthetic resins. A bibliography and glossary of the names of pigments are appended.

### **PLASTICS MOLD DESIGNING**

*By G. B. Thayer. American Industrial Publishers, Cleveland, Ohio, 1941. 64 pp., illus., diagrs., tables, 9½ x 6 in., cloth, \$2.50.*

The fundamentals of plastics mold design are discussed and applied to representative types of compression and injection molds. Some space is devoted to fixtures, mold sinking methods are described, and product design is discussed in relation to mold building methods. There is a glossary.

### **PRACTICAL MATHEMATICS FOR SHIPFITTERS and Other Shipyard Workers**

*By L. Q. Moss. Pitman Publishing Corp., New York and Chicago, 1941. 108 pp., diagrs., charts, tables, 8½ x 5 in., cloth, \$1.50.*

This simple presentation of mathematics is intended for use by organizations participating in the current programme for training shipyard workers. Every problem illustrates an application of a mathematical process to a real trade situation, and the text has been thoroughly tested in the classroom.

(Continued on page 123)

# PRELIMINARY NOTICE

of Applications for Admission and for Transfer

January 30th, 1942.

The By-laws provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.—

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

**Communications relating to applicants are considered by the Council as strictly confidential.**

The Council will consider the applications herein described at the March meeting.

L. AUSTIN WRIGHT, General Secretary.

\*The professional requirements are as follows:—

A **Member** shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupillage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science or engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A **Junior** shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A **Student** shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An **Affiliate** shall be one who is not an engineer by profession but whose pursuits, scientific attainment or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

## FOR ADMISSION

ALLAN—GEORGE WILLIAM, of 3814-14th Ave. West, Vancouver, B.C. Born at Stirling, Scotland, Sept. 28th, 1889; Educ.: 1909-11, Technical College, Glasgow; R.P.E. of B.C.; 1905-11, ap'ticeship, 5 years all depts., 1 year, engrg. office, Mirrless-Watson Co., Glasgow; 1911-12, engrg. office, B.C. Sugar Refining Co., Vancouver; 1912-18, Allan and McKelvie, Engineers, Vancouver; 1918-26, vice-president, 1926 to date, president, Canadian Sumner Iron Works Ltd., Vancouver. (Designing and manufacturing of steam engines, saw mill, pulp mill and shingle mill machy., coal stokers, steam marine steering engines, and ships equipment).

References: W. N. Kelly, J. Robertson, J. N. Finlayson, H. N. Macpherson, W. O. C. Scott.

CLARK—ANDREW TUDHOPE, of 19 Glencairn Ave., Toronto, Ont. Born at Glasgow, Scotland, Oct. 6th, 1886; Educ.: B.Sc. (Engrg.), Glasgow Univ., 1906; 1906-10, ap'ticeship, as civil engr. with Babbie, Shaw and Morton, Glasgow; 1910-11, asst. engr., Caledonian Rly., Scotland; 1911-12, res. engr., Can. Nor. Rly.; with the City

of Toronto Works Dept., 1913-15, water supply section, i/c surveys for Victoria Park Scheme, 1915-18, i/c water supply section; 1918 to date with the H.E.P.C. of Ontario as follows: 1918-31, asst. to the constrn. engr., constrn. dept., 1931-34, i/c constrn. plant, tools, etc., and supervn. of machine and other shops at Atlantic Ave., Toronto; 1935-38, i/c of constrn. plant, and equipment dept.; 1938 to date, i/c of section of constrn. dept., which handles all constrn. plant tools and equipment, also all salvage and reclamation work of the Commission.

References: Holden, H. E. Brandon, D. Forgan, W. P. Dobson, W. E. Bonn, R. L. Hearn.

EWENS—FRANK GORDON, of 4800 Cote des Neiges Road, Montreal, Que. Born at Owen Sound, Ont., Jan. 6th, 1897; Educ.: B.A.Sc., 1932, M.A.Sc., 1940, Univ. of Toronto; 1932-37, demonstrator, 1938-40, instructor in thermodynamics, dept. of mech. engrg., and 1939-40, lecturer in air conditioning, dept. of university extension, University of Toronto; 5 months summer periods as follows: 1933, testing ore mills, Wm. Kennedy & Sons Ltd.; 1934-35, design and testing of ore mills, Amalgamated Mills & Mines Ltd.; 1936-37, research, Univ. of Toronto; 1937-38, i/c design and installn. of air conditioning systems, Canadian Air Conditioning Co. Ltd.; also consltg. engr., heating, ventilating and air conditioning; at present, design of heating, ventilating and air conditioning systems, Defence Industries Ltd.

References: H. C. Karn, R. DeL. French, R. W. Angus, E. A. Allcut.

FRECHETTE—JOSEPH ALEXIS, of 6 Dufferin Terrace, Quebec, Que. Born at Montreal, April 30th, 1905; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1933; R.P.E. of Que.; 1937-41, res. engr., highway dept., Prov. of Quebec; 1941 to date, chief of technical bureau, dept. of colonization, Prov. of Quebec.

References: P. Vincent, A. Circe, J. H. A. Laplante, A. Frigon, J. A. Lefebvre.

HAMEL—JOSEPH HENRY, of Loretteville, Que. Born at Quebec, Nov. 2nd, 1887; Educ.: B.S., St. Dunstan's Univ., P.E.I., 1905; 1906-8, complete engrg. course, I.C.S.; 1906-12, chairman, rodman, leveller, instr'man., C.N.R.; 1912-15 and 1918-22, asst. engr., Marine & Fisheries, Quebec; 1915-18, Lieut., C.E.F.; 1922-25, asst. engr., 1925-30, bridge and bldg. engr., C.N.R.; 1930-36, asst. engr., Quebec Harbour Commn.; 1939-40, National Defence Staff, Valcartier; 1940-41, engr., Dominion Arsenal, Valcartier; 1941, supt. and engr., National Defence, at Lauzon, Que.; at present, supt. and engr. for E. G. M. Cape & Co., of Montreal, at St. John's, Nfld.

References: J. L. Bizier, L. Beaudry.

HARRIS—JOHN THOMAS, of 38 Atlas Ave., Toronto, Ont. Born at Wandsworth, London, England, March 11th, 1898; Educ.: 1914-17, 1919-21, Battersea Polytechnic, London; 1st Class Cert., Struct'l. Steel Design, Central Tech. School, Toronto, 1923; R.P.E. of Ont.; 1914-16, ap'tice, W. J. Harrison, London, England; 1916-21, improver and ftsman., Harvey Siemens Gas Furnace Co. Ltd., London; 1923-39, McGregor McIntyre Ltd., later Dominion Bridge Co. Ltd., as struct'l. steel ftsman. and checker, mech. designer; 1939 to date, plant engr., munitions dept., Dominion Bridge Co. Ltd., Toronto, Ont.

References: A. R. Robertson, G. P. Wilbur, D. E. Perriton, D. C. Tennant, C. H. Timm, C. R. Whittemore.

HOLLEBONE, RALPH ALLAN, of 125 Glenora Ave., Ottawa, Ont. Born at Paris, France, Feb. 8th, 1910; Educ.: I.C.S. elec. engrg. course; 1926-27, student ftsman., arch. elec. and mech., Shorey and Ritchie, Architects, Montreal; 1927-32, arch., elec. and mech. design, bldg. constrn. supervr., J. A. Ewart, Architect, Ottawa; 1932-37, compilation of data, layouts, etc., Ottawa Gas Co., Ottawa; 1937 to date, designer and ftsman., design and reconstrn. of elec. and gas dist. systems, new bldgs. and alterations, design of plant and equipment for change over of gas works from coke ovens to water gas, plans for alterations to power house equipment, etc., Ottawa Light Heat & Power Co. Ltd., Ottawa, Ont.

References: J. A. Ewart, W. H. Munro, N. B. MacRostie, J. A. Dick, W. H. G. Flay.

LEDUC—RENE, of 2533 Queen St. E., Montreal, Que. Born at Montreal, Dec. 18th, 1915; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1939; R.P.E. of Que.; 1936 (summer), Roads Dept., Prov. of Quebec; 1937-38 (summers), Le Controle Technique Ltee, laboratory; 1939-41, Roads Dept., Prov. of Quebec; 1941 to date, lands engrg. dept., Consolidated Paper Corp. Ltd., Montreal, Que.

References: A. Gratton, A. A. Wickenden, A. Circe, L. Trudel, A. Bolduc.

McMILLIN, GEORGE R., of Dartmouth, N.S. Born at Barrie, Ont., July 17th, 1909; Educ.: B.A.Sc. (Chem.), Univ. of Toronto, 1933; 1933-38, asst., inspection dept., Sarnia refinery, 1938, asst., mfg. dept., Toronto office, Imperial Oil Ltd., 1938-39, acting chief, inspection dept., International Petroleum Co., Talara, Peru; 1939 to date, chief—inspection dept., and chairman, Refinery Technical Committee, Imperial Oil Ltd., Dartmouth, N.S.

References: R. L. Dunsmore, C. Scrymgeour, I. H. Nevitt, W. P. Morrison.

## FOR TRANSFER FROM THE CLASS OF JUNIOR

VERNOT—GEORGE EDWARD, of 5617 Gatineau Ave., Montreal, Que. Born at Montreal, Feb. 27th, 1901; Educ.: B.Sc., McGill Univ., 1926; R.P.E. of Que.; 1925-26, instr'man., E. G. M. Cape & Co.; 1926-29, asst. engr., Frazer Brace Co. Ltd.; 1930-39, res. engr., Montreal Sewers Commn.; 1939 to date, city assessor, City of Montreal. (St. 1923, Jr. 1928).

References: H. A. Gibeau, R. E. Heartz, T. J. Lafreniere, G. R. MacLeod.

REES—HUGH CAMPBELL, of 9 Kennedy Ave., Toronto, Ont. Born at Toronto, Dec. 21st, 1905; Educ.: B.A.Sc., Univ. of Toronto, 1929; 1926-27-28, summer survey work; 1929-37, asst. testing engr., 1937 to date, testing engr., engrg. materials lab., H.E.P.C. of Ont., Toronto, Ont. (Jr. 1931).

References: R. B. Young, W. P. Dobson, E. Viens, A. E. Nourse, G. R. Lord.

## FOR TRANSFER FROM THE CLASS OF STUDENT

DAVEY—ROLAND ERIC, of Shelburne, N.S. Born at Meaford, Ont., Nov. 25th, 1913; Educ.: B.A.Sc., Univ. of Toronto, 1935; 1935-37, Dufferin Paving Co. Ltd., Toronto; 1937-39, H.E.P.C. of Ont., Toronto; 1939-40, asst. on dredging surveys, property surveys and some constrn., Dept. of Public Works of Canada, London, Ont.; Jan. 1941 to date, works and bldgs. branch, Naval Service, Halifax, Jan.-May, in charge of surveys, and from June 1941 to date, res. engr. in charge of bldgs., roads, sewers, etc. (St. 1935).

References: K. M. Cameron, H. F. Bennett, O. Holden, C. R. Young, F. Alport, J. M. R. Fairbairn.

MITCHELL—WILLIAM REGINALD, of 430 Giles Blvd. West, Windsor, Ont. Born at Winnipeg, Man., June 15th, 1912; Educ.: B.Sc. (C.E.), Univ. of Man., 1934; 1928-34 (summers), gen. constrn. experience, Clayton Co. Ltd., contractors, Winnipeg; 1934-35, production clerk, 1935-36, shop inspr., 1936-37, sales engr., Manitoba Bridge & Iron Works; 1937-39, estimator, sales and detailing, London Structural Steel Co. Ltd., London, Ont.; 1940, designer, Defence Industries Ltd., Montreal; April 1940 to date, designer and estimator, Canadian Bridge Co. Ltd., Walkerville, Ont. (St. 1934).

References: P. E. Adams, G. G. Henderson, A. E. West, E. M. Krebser, A. E. MacDonald.

SENTANCE—LAWRENCE CRAWLEY, of 95 Hill Crest Ave., Hamilton, Ont. Born at Melville, Sask., Dec. 20th, 1913; Educ.: B.Eng., 1935, M.Sc., 1937, Univ. of Sask.; 1935 (summer), surveying, water development, etc.; 1936 (summer), materials inspr., ftsman., Dept. of Highways, Sask.; 1935-37, instructor, mech. engrg. dept., Univ. of Sask.; 1937-39, engr. ap'tice course, and 1939 to date, mech. engr., Canadian Westinghouse Co. Ltd., Hamilton, Ont. (St. 1936).

References: H. A. Cooch, C. A. Price, D. W. Callander, J. R. Dunbar, G. W. Arnold, C. J. Mackenzie, I. M. Fraser.

# Employment Service Bureau

## SITUATIONS VACANT

**MECHANICAL DESIGNING DRAUGHTSMAN.** Graduate preferred, urgently needed for work in Arvida for specification drawings for plate work, elevators, conveyors, etc., equipment layouts, pipe layouts and details. Apply to Box No. 2375-V.

**MECHANICAL GRADUATE ENGINEER** with machine shop experience required for work in Mackenzie, British Guiana, on essential war work. Apply to Box No. 2441-V.

**ENGINEERING DRAUGHTSMAN** with experience in machine and structural design, proficient in steel design calculation, and having ability for estimating. We require a man with at least five years' industrial experience, preferably in the paper mill field. Position is permanent. State experience and give physical description. Include small photograph and a sample of draughtsmanship. Apply to Box No. 2458-V.

**MECHANICAL DRAUGHTSMAN**, experienced in making layouts for various installations, piping, etc., around a paper mill. Applicant must be a college graduate. State previous experience, wages expected, etc. Apply to Box No. 2461-V.

**GRADUATE MECHANICAL ENGINEER** required for Mackenzie, B.G., immediately on work of plant and mining equipment maintenance. We are prepared to do necessary training which will give exceptional opportunity for experience. Apply to Box No. 2481-V.

**MECHANICAL ENGINEER** preferred with experience on diesels and tractors, for work in Mackenzie, B.G. Apply to Box No. 2482-V.

**MECHANICAL DRAUGHTSMEN** and engineers for pulp and paper mill work. Experienced men preferred. Good salary to qualified candidates. Apply to Box No. 2483-V.

**ELECTRICAL ENGINEER**, young French Canadian graduate engineer to be trained on work involving hydro-electric plant operation, transmission lines and construction, meter testing and inspection. Good opportunity to acquire first-hand electrical power experience. Apply to Box No. 2487-V.

**GRADUATE DRAUGHTSMAN**, for industrial plant design and detailing. Apply to Box 2497-V.

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.

**MECHANICAL DRAUGHTSMAN**, for piping and general equipment layout work. Apply to Box 2498-V.

**CIVIL ENGINEER**, 25-32 years of age, for heavy construction work in British Guiana. Apply to Box 2499-V.

**MECHANICAL ENGINEER**, for general maintenance work at Arvida, Que. Apply to Box 2500-V.

## ENGINEER OFFICERS WANTED

Applications are invited for Commissions in the Royal Canadian Ordnance Corps for service both overseas and in Canada as Ordnance Mechanical Engineers. Since it is probable that several new units will be organized in the near future, a number of senior appointments may be open, and applications from engineers with a good background of military experience would be welcomed in this connection. Applications should be submitted on the regular Royal Canadian Ordnance Corps application forms, which can be obtained from the District Ordnance Officers of the respective Military Districts.

## SITUATIONS WANTED

**ELECTRICAL ENGINEER**, B.E., in electrical engineering, McGill University, Age 24, married, available on two weeks notice. Undergraduate experience, cable testing and cathode ray oscillography. Since graduation, five months on construction of large and small electrical equipment in plant and sub-station. One year operating electrical engineer in medium size central steam station paralleled with large Hydro system. At present employed, but is interested in research or teaching. Associate member of the American Institute of Electrical Engineers. Apply to Box No. 2419-W.

**CIVIL AND STRUCTURAL ENGINEER**, M.E.I.C., R.P.E. (Ont.), Age 49. Married. Home in To-

ronto. Experience in Britain, Africa, Canada, Turkey. Chief engineer reinforced concrete design offices, steelworks construction. Resident engineer design and construction munitions plants, and general civil engineering work. Extensive surveys, draughting, harbour and municipal work. Location immaterial. Available now. Apply Box No. 2425-W.

**ELECTRICAL, MECHANICAL ENGINEER**, age 35. Dip. and Assoc. R.T.C., Glasgow, A.M.I.E.E., (Students Premium) G.I. Mech.E., M.E.I.C., Assoc. Am.I.E.E. Married. Available after December 22nd. Seventeen years experience covering machine shop apprenticeship, A.C. and D.C. motors, transformers, steel and glass bulb arc rectifiers, design, testing and erection sectional electric news and fingerprints paper machine drives, experience tap changers H.V., L.V. and marine switchgear. Apply to Box No. 2426-W.

**MECHANICAL ENGINEER** age 55 years. Married. Available at once. Thirty years experience in draughting and general machine shop and foundry work. Fifteen years as works manager. Considerable experience in pump work, including estimating and inspection. Apply to Box 2427-W.

**ELECTRICAL ENGINEERING** student in third year, age 27, desires summer position starting in April, with view to permanency on graduation. Two summers on design of shop equipment and electrical apparatus. Three years experience on test and experimental work for relays and control equipment. Student E.I.C., and Associate member American Institute of Electrical Engineers. Location immaterial. Apply to Box No. 2428-W.

**ENGINEER ADMINISTRATOR**, experienced in public utilities, shipyard construction, airplane construction, crane construction, general mechanical engineering and inspection work, also sales promotion. Open for appointment. Apply to Box 2429-W.

## LIBRARY NOTES (Continued)

### PRINCIPLES OF SEWAGE TREATMENT. (National Lime Association Bulletin 212)

By W. Rudolfs. National Lime Association, Washington, D.C., 1941. 128 pp., illus., diags., charts, tables, 9 x 6 in., paper, \$0.50

This booklet has been prepared for those who desire information on the subject but lack the time or training for an extended study. The sources and composition of sewage are briefly noted, the microbiology of sewage treatment and sewage stabilization are discussed, methods of treatment, disposal and analysis are described, and plant operation is covered.

### RHOMBIC ANTENNA DESIGN

By A. E. Harper. D. Van Nostrand Co., New York, 1941. 111 pp., diags., charts, tables, 11½ x 8½ in., cloth, \$4.00.

This is an eminently practical discussion of the design and construction of rhombic antennas, based upon the work of the engineers of the Bell Telephone System. Much of this has been unpublished heretofore. An introduction discusses directional radio transmission. This is followed by a description of methods for designing horizontal rhombic antennas and for their construction. The data needed in computation are included, and plans of typical transmitting and receiving antennas are appended.

### TECHNICAL REPORT WRITING. (Chemical Engineering Series)

By F. H. Rhodes. McGraw-Hill Book Co., New York and London, 1941. 125 pp., charts, tables, 9½ x 6 in., cloth, \$1.50.

This guide to report writing is based on long experience in teaching the art to engineering students and can be recommended as

an excellent one. By confining himself to reports, and omitting the material on other technical writing usually found in texts on the subject, the author has been able to cover the subject thoroughly and practically in a small book.

### TRAINS IN TRANSITION

By L. Beebe. D. Appleton-Century Co., New York and London, 1941. 210 pp., illus., tables, 11½ x 8 in., cloth, \$5.00.

The third of Mr. Beebe's books on American railroading offers the same attractive combination of readable text and excellent photographs that its predecessors displayed. In this volume, the author is concerned with the changes in practice and equipment which have taken place in recent years, especially the effects of the diesel-electric locomotive, light weight cars and air-flow design.

Look at it from any angle...

It's in your own interest to

"INVEST" in CANADA'S VICTORY BONDS

## STEAM JET EJECTORS

Elliott Company, Jeannette, Pa., has recently issued a 32-page booklet G-7 which, accompanied by many illustrations, describes the company's single-stage, two-stage, three-stage, four-stage and five-stage ejectors and also contains sections dealing with the many advantages of the steam ejector, ejector characteristics and factors affecting ejector selection. The final section features, under several main classifications, the fields in which ejectors are used most extensively. A pressure-temperature conversion table and other data are also included.

## TOOLING TURRET LATHES

A 4-page Bulletin, No. 141, published by Kennametal of Canada Ltd., Hamilton, Ont., features the use of Kennametal steel cutting carbide tools for tooling turret lathes for small lot production. Includes turret lathe setups using Kennametal tools.

## WATER TREATMENT

"Supplementary Treatment of Boiler Feedwater" is the title of a 12-page Bulletin, No. 2420, made available by the Permutit Co. of Canada Ltd., Montreal, Que. Presents a complete discussion on the supplementary treatment of boiler feedwater by the addition of chemicals to the water at various points in the feedwater line and the methods of feeding these chemicals. Such treatment generally consists in feeding phosphate, sodium sulphate, and sodium sulphite in varying amounts.

## PUBLICATIONS AVAILABLE

An 8-page List "B" entitled "List B For Facts About Monel, Rolled Nickel and Inconel," recently issued by The International Nickel Co. of Canada Ltd., Toronto, Ont., contains a list of current publications of the company with the various bulletins and booklets grouped under various classifications or under the names of industries to which they are most pertinent. A number of new publications issued since the last edition of the list are included.

## DRILLING MACHINES

Canadian Blower & Forge Co. Ltd., Kitchener, Ont., has available a 16-page Bulletin, No. 2730-D, which describes the company's "Buffalo No. 16" drilling machines (No. 2 Morse Taper). These machines are available in 1 to 6 spindles, with 8-in., 12-in., and 15-in. overhang, and in sensitive type or power feed according to the descriptions, illustrations, and tables and specifications contained in this bulletin. Round column floor, bench, and pedestal types are shown.

## INDICATING INSTRUMENTS

The company's line of "U-Type" and "Well-Type" manometers, draft gauges, flow meters, mercury pressure gauges, tank gauges and accessories for accurately measuring pressures, vacuums and flows of liquids and gases are described in the 8-page Catalogue, No. C-10, published by the Meriam Company, Cleveland, Ohio. Illustrations and descriptions of the equipment, suggestions for use, size ranges, dimensions, weights, list prices, etc., are also included.

## DISTRIBUTOR APPOINTED

It is announced that the X-Pando Corp., New York, have appointed LaSalle Products Limited, Montreal, as Canadian distributors for their complete line of materials. X-Pando is a compound which expands after setting, preventing all leaks and making a perfect tight bond. The distribution of this product in Canada will be under the supervision of E. F. Vincent, who is well-known to the industrial trade.

## Industrial development — new products — changes in personnel — special events — trade literature

### MECHANICAL RUBBER GOODS

Dunlop Tire and Rubber Goods Co. Ltd., Toronto, Ont., has issued a 36-page Catalogue, No. 104, which contains descriptive and technical data with accompanying illustrations covering the company's wide range of mechanical rubber goods including various types of belts, conveyors, launder lining, agricultural supplies, hose, rubber covered rolls, mats, packing, tape and miscellaneous items.

### PUMPS FOR DIVERSIFIED INDUSTRIAL APPLICATION

Practical information concerning pump adaptation for a wide range of duties under varying conditions is the theme of a new 24-page Bulletin, No. 29-A107, published by the Pomona Pump Co., Pomona, Calif. It describes and illustrates a variety of actual applications, accompanying each with an installation drawing. The design of the Pomona pump is also illustrated and explained.

### INDUSTRIAL ADVERTISING USED TO AID WAR EFFORT

During the past year many advertisers of industrial equipment have developed the theme of their copy along lines directed towards the publicizing of some branch of Canada's war effort.

Some of these advertisements feature specific developments in war industries; others carry messages of the importance of subscribing to Canada's Victory Loan; while others have adopted more diversified themes intended to emphasize the great cause for which everyone is playing his part. Outstanding in this category is the series of inserts published by the Canadian SKF Company Limited. This issue of *The Journal* contains a number of these special advertisements, among which may be mentioned those of Northern Electric Co. Limited, Canadian Ingersoll-Rand Co. Limited, and Canadian Controllers Limited.

Commencing with the March issue of *The Journal*, the English Electric Co. of Canada Limited will run the first of a special series of advertisements designed for reproduction as posters. One of these advertisements, reproduced in miniature, is shown below. Copies of this series, in wall poster size, will be supplied by the company to any interested parties upon request.



### HEATING SYSTEMS AND PRODUCTS

C. A. Dunham Co. Ltd., Toronto, Ont., has released a series of looseleaf data sheets for inclusion in their engineering catalogue on "Dunham" heating systems and products. There are seventeen of these sheets covering control equipment, convectors and unit heaters.

### ONTARIO REPRESENTATIVE APPOINTED

The Permutit Co., New York, N.Y., has recently appointed S. A. McWilliams Ltd. as its representative in the Province of Ontario. The company continues to be represented in Montreal by C. K. McLeod and in Winnipeg and Calgary by Stanley Brock Ltd.

### NEW LINE ANNOUNCED

Burlec Limited are building in Canada an extensive range of gasoline engine electric power supplies for use as emergency supplies of lighting or power. These are available in sizes up to 60 kilowatts and for all voltages and frequencies. The gasoline engines have automatic speed governors and the generators are controlled by voltage regulators so as to give a smooth, closely regulated power output. The controls provided include complete gasoline engine instruments such as temperature gauge, ammeter, fuel gauge, oil pressure gauge and tachometer. The generator output is controlled by an appropriately sized switch which is trip free and has thermal overload. Necessary meters are also supplied.

### FUSE CUTOUTS

"A 3-Minute Story of the 'PVD' Fuse Cutout," the title of a 20-page booklet published by Canadian Line Materials Ltd., Toronto, Ont., presents the story in a novel manner by the use of an ingenious design of the booklet. In order to show the action of the fuse, a large cutaway illustration is used with short and long pages superimposing the part of the illustration showing each change so that the complete sequence of action from the initial fused state to the final "blown" state is depicted graphically. Each action is described, while the simplicity of "re-fusing" and other important features are explained in detail and illustrated.

### NEW C-G-E COLOUR MOVIE

Canadian General Electric's latest movie entitled "Curves of Colour," highlights scenes of the experiments performed by Sir Isaac Newton discovering the visible spectrum and an explanation of why that spectrum is only one small part of the vast electro-magnetic spectrum which has since been discovered by modern men of science. The film explains a new scientific device called a recording photoelectric spectrophotometer which is capable of distinguishing accurately more than two million colours. This ten-minute movie is one of a number that the company lends, free of charge, to educational institutions, churches, social and civic groups, etc.

### NEPTUNE BUILDS NEW PLANT

As announced by Mr. W. T. Randall, vice-president and general manager of Neptune Meters Ltd., Toronto, the company moved into its new plant on December 29th. The new Neptune Meter plant is located in Long Branch, with 400 feet frontage on Lakeshore Road. It occupies 10 acres and offers 30,000 square feet of floor space. Designed by T. Pringle & Son, industrial engineers, the new Neptune Meter plant is of structural steel and brick construction.

# THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 25

MONTREAL, MARCH 1942

NUMBER 3



"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

★ ★ ★

## CONTENTS

"WE HAVE TO WIN THIS WAR BY OUR WITS" . . . . .	Cover
<i>(General McNaughton at the Annual Banquet)</i>	
A NEW FIELD AND A NEW EMPHASIS . . . . .	127
<i>Dean C. R. Young, M.E.I.C.</i>	
THE ORGANIZATION AND WORK OF RESEARCH ENTERPRISES LIMITED . . . . .	129
<i>Colonel W. E. Phillips</i>	
THE ALASKA HIGHWAY . . . . .	136
<i>J. M. Wardle, M.E.I.C.</i>	
THE WAR ACTIVITIES OF THE NATIONAL RESEARCH COUNCIL OF CANADA . . . . .	141
<i>C. J. Mackenzie, M.E.I.C.</i>	
A MESSAGE TO CANADIAN ENGINEERS . . . . .	145
<i>Lieut.-General A. G. L. McNaughton, C.B., C.M.G., D.S.O., M.E.I.C.</i>	
CANADIAN INDUSTRY IN THE WAR . . . . .	147
<i>C. D. Howe, Hon.M.E.I.C.</i>	
NATIONAL SERVICE—A CHALLENGE TO THE ENGINEER . . . . .	151
<i>E. M. Little</i>	
THE FIFTY-SIXTH ANNUAL GENERAL MEETING . . . . .	154
ABSTRACTS OF CURRENT LITERATURE . . . . .	168
FROM MONTH TO MONTH . . . . .	172
NEWLY ELECTED OFFICERS . . . . .	180
INSTITUTE PRIZE WINNERS . . . . .	185
PERSONALS . . . . .	187
<i>Visitors to Headquarters . . . . . 189</i>	
<i>Obituaries . . . . . 189</i>	
NEWS OF THE BRANCHES . . . . .	191
NEWS OF OTHER SOCIETIES . . . . .	199
LIBRARY NOTES . . . . .	199
PRELIMINARY NOTICE . . . . .	204
EMPLOYMENT SERVICE . . . . .	205
INDUSTRIAL NEWS . . . . .	206

PUBLISHED MONTHLY BY  
THE ENGINEERING INSTITUTE  
OF CANADA

2050 MANSFIELD STREET - MONTREAL

L. AUSTIN WRIGHT, M.E.I.C.  
*Editor*

N. E. D. SHEPPARD, M.E.I.C.  
*Advertising Manager*

### PUBLICATION COMMITTEE

C. K. McLEOD, M.E.I.C., *Chairman*  
R. DeL. FRENCH, M.E.I.C., *Vice-Chairman*  
A. C. D. BLANCHARD, M.E.I.C.  
H. F. FINNEMORE, M.E.I.C.  
T. J. LAFRENIÈRE, M.E.I.C.

Price 50 cents a copy, \$3.00 a year: in Canada, British Possessions, United States and Mexico. \$4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, \$2.00 a year. —Entered at the Post Office, Montreal, as Second Class Matter.

THE INSTITUTE as a body is not responsible either for the statements made or for the opinions expressed in the following pages.

# THE ENGINEERING INSTITUTE OF CANADA

## MEMBERS OF COUNCIL

### PRESIDENT

C. R. YOUNG, Toronto, Ont.

### VICE-PRESIDENTS

\*A. L. CARRUTHERS, Victoria, B.C.  
†H. CIMON, Quebec, Que.

†J. L. LANG, Sault Ste. Marie, Ont.  
†G. G. MURDOCH, Saint John, N.B.

### PAST-PRESIDENTS

†T. H. HOGG, Toronto, Ont.

†C. J. MACKENZIE, Ottawa, Ont.

### COUNCILLORS

†E. D. GRAY-DONALD, Quebec, Que.  
†J. HAIMES, Lethbridge, Alta.  
\*J. G. HALL, Montreal, Que.  
†R. E. HEARTZ, Montreal, Que.  
†W. G. HUNT, Montreal, Que.  
†E. W. IZARD, Victoria, B.C.  
†J. R. KAYE, Halifax, N.S.  
\*E. M. KREBSE, Walkerville, Ont.  
†N. MACNICOL, Toronto, Ont.  
\*H. N. MACPHERSON, Vancouver, B.C.  
\*H. F. MORRISEY, Saint John, N.B.

\*W. H. MUNRO, Ottawa, Ont.  
†T. A. McELHANNEY, Ottawa, Ont.  
\*C. K. McLEOD, Montreal, Que.  
†A. W. F. McQUEEN, Niagara Falls, Ont.  
†A. E. PICKERING, Sault Ste. Marie, Ont.  
†G. McL. PITTS, Montreal, Que.  
†W. J. W. REID, Hamilton, Ont.  
†J. W. SANGER, Winnipeg, Man.  
\*M. G. SAUNDERS, Arvida, Que.  
†H. R. SILLS, Peterborough, Ont.  
\*J. A. VANCE, Woodstock, Ont.

\*For 1942    †For 1942-43    ‡For 1942-43-44

### TREASURER

E. G. M. CAPE, Montreal, Que.

### GENERAL SECRETARY

L. AUSTIN WRIGHT, Montreal, Que.

### ASSISTANT GENERAL SECRETARY

LOUIS TRUDEL, Montreal, Que.

### SECRETARY-EMERITUS

R. J. DURLEY, Montreal, Que.

## STANDING COMMITTEES

### FINANCE

DEG. BEAUBIEN, *Chairman*  
J. E. ARMSTRONG  
E. G. M. CAPE  
G. A. GAHERTY  
J. A. McCRORY  
F. NEWELL

### LEGISLATION

J. L. LANG, *Chairman*  
R. L. DOBBIN  
R. J. DURLEY

### PAPERS

J. A. VANCE, *Chairman*  
DEG. BEAUBIEN  
K. M. CAMERON  
A. L. CARRUTHERS  
H. CIMON  
J. L. LANG  
G. G. MURDOCH

### LIBRARY AND HOUSE

W. G. HUNT, *Chairman*

### PUBLICATION

C. K. McLEOD, *Chairman*  
R. DeL. FRENCH, *Vice-Chairman*  
A. C. D. BLANCHARD  
H. F. FINNEMORE  
T. J. LAFRENIERE

## SPECIAL COMMITTEES

### BOARD OF EXAMINERS AND EDUCATION

R. A. SPENCER, *Chairman*

### INTERNATIONAL RELATIONS

R. W. ANGUS, *Chairman*

### DETERIORATION OF CONCRETE STRUCTURES

R. B. YOUNG, *Chairman*

### GZOWSKI MEDAL

H. V. ANDERSON, *Chairman*

### STUDENTS' AND JUNIORS' PRIZES

**Zone A (Western Provinces)**  
H. N. Ruttan Prize  
A. L. CARRUTHERS, *Chairman*  
**Zone B (Province of Ontario)**  
John Galbraith Prize  
J. L. LANG, *Chairman*  
**Zone C (Province of Quebec)**  
Phelps Johnson Prize (English)  
DEG. BEAUBIEN, *Chairman*  
Ernest Marceau Prize (French)  
H. CIMON, *Chairman*  
**Zone D (Maritime Provinces)**  
Martin Murphy Prize  
G. G. MURDOCH, *Chairman*

### MEMBERSHIP

J. G. HALL, *Chairman*

### DUGGAN MEDAL AND PRIZE

J. T. FARMER, *Chairman*

### PROFESSIONAL INTERESTS

J. B. CHALLIES, *Chairman*

### PLUMMER MEDAL

C. R. WHITTEMORE, *Chairman*

### WESTERN WATER PROBLEMS

G. A. GAHERTY, *Chairman*

### THE YOUNG ENGINEER

H. F. BENNETT, *Chairman*

## LIST OF INSTITUTE MEDALS AND PRIZES

Sir John Kennedy Medal	For outstanding merit or noteworthy contribution to science of engineering, or to benefit of the Institute.	Leonard Medal	Gold medal	For a paper on a mining subject, open to members of the Canadian Institute of Mining and Metallurgy as well as The Engineering Institute.
Duggan Medal and Prize	Medal and cash to value of \$100	Students and Juniors	Books to the value of \$25 (5 prizes)	For papers on any subject presented by Student or Junior members.
Gzowski Medal	Gold medal	University Students	\$25 in cash (11 prizes)	For the third year student in each college, making the best showing in college work and activities in student or local branch of engineering society.
Plummer Medal	Gold medal			

## A NEW FIELD AND A NEW EMPHASIS

**I**N THE affairs of both men and institutions there are times when, after long uncertainty and painful orientation, the way of progress becomes clear and notable advances are made with comparative ease. During the pause which follows, gains are consolidated, new plans are developed and in due season the forward movement is resumed.

Such has been the lot of the engineering profession in Canada. Its early years were devoted to laborious technological tasks, well and faithfully performed—tasks that brought to the engineer heightened prestige and the confidence of the public in his ability and integrity. Thus was laid the sure and firm foundation of trust upon which wider recognition of engineering as a learned profession was to be reposed.

With the outbreak of total mechanized war, governments and corporations have instinctively turned to the engineer as one possessing not merely the indispensable technical background but that decisiveness, dependability and sense of proportion everywhere sought in times of national distress.

And so the engineering profession finds itself in the highest favour that it has ever enjoyed. From the Commander-in-Chief of the Canadian Corps overseas down, engineers are giving distinguished service in the armed forces. In less stirring wartime tasks very many are occupying vital executive and directional posts. This is but natural. Creating, marshalling and distributing the equipment and commodities of war is an undertaking not different in kind from those about which gathers the normal practice of the engineer. In large measure wartime duties represent no more than another of the periodic transfers of activity to which practitioners in many branches of the profession have long been accustomed.

In parallel with this resurgence in the profession, the usefulness, power and influence of The Engineering Institute of Canada has grown. Its membership is at a new high; its financial position is sound and constantly improving; it is rapidly growing in the public esteem.

While conscientiously fulfilling its role as a forum for the dissemination of engineering knowledge, The Institute has in co-operation with the 'provincial associations of professional engineers and in its vigorous participation in the work of the Engineers' Council for Professional Development, embarked upon activities that promise to be of far-reaching consequence. A new emphasis is being placed upon those things that represent the significant difference between a professional engineer and a technologist.

It is impossible to overestimate the long-range importance of those attributes of a well-rounded professional man that lie beyond and above a mere knowledge of the techniques and procedures necessary to the attainment of the physical objectives of his work. If he is to be accorded whole-hearted public recognition as a member of a learned profession he must earnestly seek to acquire and manifest these characteristics.

To those activities that bring a development of individual professional stature in all of its implications The Engineering Institute of Canada may well and profitably devote increased attention. There could scarcely be a more attractive field of endeavour and none offering greater prospect of service to the profession.



President.

# THE ENGINEERING INSTITUTE OF CANADA

## OFFICERS OF BRANCHES

### BORDER CITIES

*Chairman*, H. L. JOHNSTON  
*Vice-Chair.*, G. G. HENDERSON  
*Executive*, W. P. AUGUSTINE  
 J. F. G. BLOWEY  
 W. R. STICKNEY  
 (Ex-Officio), E. M. KREBSER  
 G. E. MEDLAR  
*Sec.-Treas.*, J. B. DOWLER,  
 754 Chilver Road,  
 Walkerville, Ont.

### CALGARY

*Chairman*, J. B. DEHART  
*Vice-Chair.*, H. J. McEWEN  
*Executive*, F. J. HEUPERMAN  
 T. D. STANLEY  
 J. W. YOUNG  
 (Ex-Officio), S. G. COULTIS  
 J. HADDIN  
 J. McMILLAN  
*Sec.-Treas.*, P. F. PEELE  
 248 Scarboro Avenue,  
 Calgary, Alta.

### CAPE BRETON

*Chairman*, J. A. MacLEOD  
*Executive*, J. A. RUSSELL M. F. COSSITT  
 (Ex-Officio), F. W. GRAY  
*Sec.-Treas.*, S. C. MIFFLEN,  
 60 Whitney Ave., Sydney, N.S.

### EDMONTON

*Chairman*, R. M. HARDY  
*Vice-Chair.*, D. A. HANSEN  
*Executive*, J. A. CARRUTHERS  
 C. W. CARRY  
 D. HUTCHISON  
 B. W. PITFIELD  
 E. R. T. SKARIN  
 W. F. STEVENSON  
 (Ex-Officio), J. GARRETT  
 E. NELSON  
*Sec.-Treas.*, F. R. BURFIELD,  
 Water Resources Office,  
 Provincial Government,  
 Edmonton, Alta.

### HALIFAX

*Chairman*, P. A. LOVETT  
*Executive*, A. E. CAMERON  
 G. T. CLARKE G. J. CURRIE  
 A. E. FLYNN J. D. FRASER  
 D. G. DUNBAR J. A. MacKAY  
 J. F. F. MacKENZIE  
 J. W. MacDONALD  
 G. T. MEDFORTH  
 (Ex-Officio), S. L. FULTZ J. R. KAYE  
*Sec.-Treas.*, S. W. GRAY,  
 The Nova Scotia Power  
 Commission,  
 Halifax, N.S.

### HAMILTON

*Chairman*, STANLEY SHUPE  
*Vice-Chair.*, T. S. GLOVER  
*Executive*, H. A. COOCH  
 NORMAN EAGER  
 A. C. MacNAB  
 A. H. WINGFIELD  
 (Ex-Officio), W. J. W. REID  
 W. A. T. GILMOUR  
*Sec.-Treas.*, A. R. HANNAFORD,  
 354 Herkimer Street,  
 Hamilton, Ont.

### KINGSTON

*Chairman*, T. A. McGINNIS  
*Vice-Chair.*, P. ROY  
*Executive*, V. R. DAVIES  
 K. H. McKIBBIN  
 K. M. WINSLOW  
 A. H. MUNRO  
 (Ex-Officio), G. G. M. CARR-HARRIS  
 D. S. ELLIS  
*Sec.-Treas.*, J. B. BATY,  
 Queen's University,  
 Kingston, Ont.

### LAKEHEAD

*Chairman*, B. A. CULPEPER  
*Vice-Chair.*, MISS E. M. G. MacGILL  
*Executive*, E. J. DAVIES  
 J. I. CARMICHAEL  
 S. E. FLOOK  
 S. T. McCAVOUR  
 R. B. CHANDLER  
 W. H. SMALL  
 C. D. MACKINTOSH  
 (Ex-Officio), H. G. O'LEARY  
 J. M. FLEMING  
*Sec.-Treas.*, W. C. BYERS,  
 c/o C. D. Howe Co. Ltd.,  
 Port Arthur, Ont.

### LETHBRIDGE

*Chairman*, C. S. DONALDSON  
*Vice-Chair.*, W. MELDRUM  
*Executive*, R. F. P. BOWMAN G. S. BROWN  
 N. H. BRADLEY  
 C. S. CLENDENING  
 (Ex-Officio), J. HAIMES  
 A. J. BRANCH J. T. WATSON  
*Sec.-Treas.*, R. B. McKENZIE,  
 McKenzie Electric Ltd.,  
 706, 3rd Ave. S., Lethbridge, Alta.

### LONDON

*Chairman*, F. T. JULIAN  
*Vice-Chair.*, T. L. McMANAMNA  
*Executive*, F. C. BALL  
 V. A. McKILLOP  
 H. F. BENNETT  
 A. L. PURANNA  
 R. S. CHARLES  
 (Ex-Officio), R. W. GARRETT  
 J. A. VANCE  
*Sec.-Treas.*, H. G. STEAD,  
 60 Alexandra Street,  
 London, Ont.

### MONCTON

*Chairman*, F. O. CONDON  
*Vice-Chair.*, H. J. CRUDGE  
*Executive*, B. E. BAYNE E. R. EVANS  
 G. L. DICKSON E. B. MARTIN  
 T. H. DICKSON G. E. SMITH  
 R. H. EMMERSON  
 (Ex-Officio), H. W. McKIEL  
*Sec.-Treas.*, V. C. BLACKETT,  
 Engr. Dept., C.N.R.,  
 Moncton, N.B.

### MONTREAL

*Chairman*, J. A. LALONDE  
*Vice-Chair.*, R. S. EADIE  
*Executive*, R. E. HEARTZ  
 J. B. STIRLING  
 J. M. CRAWFORD  
 J. COMEAU  
 H. F. FINNEMORE  
 R. C. FLITTON  
 G. D. HULME  
 (Ex-Officio), DE G. BEAUBIEN  
 J. E. ARMSTRONG  
 J. G. HALL  
 W. G. HUNT  
 C. K. McLEOD  
 G. McL. PITTS  
*Sec.-Treas.*, L. A. DUCHASTEL,  
 40 Kelvin Avenue,  
 Outremont, Que.

### NIAGARA PENINSULA

*Chairman*, A. L. McPHAIL  
*Vice-Chair.*, C. G. CLINE  
*Executive*, L. J. RUSSELL  
 J. H. TUCK  
 A. C. BLUE  
 G. F. VOLLMER  
 G. E. GRIFFITHS  
 D. W. BRACKEN  
 L. L. GISBORNE  
 (Ex-Officio), A. W. F. McQUEEN  
*Sec.-Treas.*, J. H. INGS,  
 1870 Ferry Street,  
 Niagara Falls, Ont.

### OTTAWA

*Chairman*, N. B. MacROSTIE  
*Executive*, W. G. C. GLIDDON  
 R. M. PRENDERGAST  
 W. H. G. FLAY  
 G. A. LINDSAY  
 R. YULL  
 (Ex-Officio), K. M. CAMERON  
 C. J. MacKENZIE  
 W. H. MUNRO  
 T. A. McELHANNAY  
 R. K. ODELL  
*Sec.-Treas.*, A. A. SWINNERTON,  
 Dept. of Mines and Resources,  
 Ottawa, Ont.

### PETERBOROUGH

*Chairman*, J. CAMERON  
*Executive*, A. J. GIRDWOOD I. F. McRAE  
 J. W. PIERCE F. R. POPE  
 (Ex-Officio), R. L. DOBBIN  
 H. R. SILLS  
 A. L. MALBY  
*Sec.-Treas.*, D. J. EMERY,  
 589 King Street,  
 Peterborough, Ont.

### QUEBEC

*Life Hon. Chair.*, A. R. DECARY  
*Chairman*, L. C. DUPUIS  
*Vice-Chair.*, RENÉ DUPUIS  
*Executive*, O. DESJARDINS G. ST-JACQUES  
 R. SAUVAGE L. GAGNON  
 S. PICARD  
 G. W. WADDINGTON  
 (Ex-Officio), E. D. GRAY-DONALD P. MÉTHÉ  
 R. B. McDUNNOUGH  
 H. CIMON  
*Sec.-Treas.*, PAUL VINCENT,  
 Colonization Department,  
 Room 333-A, Parliament Bldgs.,  
 Quebec, Que.

### SAGUENAY

*Chairman*, N. F. McCAGHEY  
*Vice-Chair.*, R. H. RIMMER  
*Executive*, B. BAUMAN  
 G. B. MOXON  
 A. I. CUNNINGHAM  
 W. J. THOMSON  
 (Ex-Officio), M. G. SAUNDERS  
 J. W. WARD  
*Sec.-Treas.*, D. S. ESTABROOKS,  
 Price Bros. & Co. Ltd.,  
 Riverbend, Que.

### SAINT JOHN

*Chairman*, F. A. PATRIQUEN  
*Vice-Chair.*, D. R. SMITH  
*Executive*, A. O. WOLFF  
 H. P. LINGLEY  
 W. B. AKERLEY  
 (Ex-Officio), J. P. MOONEY  
 H. F. MORRISEY  
 G. G. MURDOCH  
*Sec.-Treas.*, V. S. CHESNUT,  
 P.O. Box 1393,  
 Saint John, N.B.

### ST. MAURICE VALLEY

*Chairman*, A. H. HEATLEY  
*Vice-Chair.*, H. G. TIMMIS  
*Executive*, A. C. ABBOTT J. M. MITCHELL  
 R. DORION G. RINFRET  
 V. JEPSEN H. J. WARD  
 J. JOYAL H. K. WYMAN  
 H. O. KEAY  
 (Ex-Officio), C. H. CHAMPION  
 J. H. FREGEAU  
*Sec.-Treas.*, C. G. deTONNANCOUR,  
 Engineering Department,  
 Shawinigan Chemicals, Limited,  
 Shawinigan Falls, Que.

### SASKATCHEWAN

*Chairman*, A. P. LINTON  
*Vice-Chair.*, A. M. MacGILLIVRAY  
*Executive*, F. C. DEMPSEY  
 N. B. HUTCHEON  
 J. G. SCHAEFFER  
 R. W. JACKLING  
 H. R. MacKENZIE  
 B. RUSSELL  
 (Ex-Officio), I. M. FRASER  
*Sec.-Treas.*, STEWART YOUNG  
 P. O. Box 101,  
 Regina, Sask.

### SAULT STE. MARIE

*Chairman*, E. M. MacQUARRIE  
*Vice-Chair.*, L. R. BROWN  
*Executive*, R. A. CAMPBELL  
 N. C. COWIE  
 C. O. MADDOCK  
 C. R. MURDOCK  
 (Ex-Officio), J. L. LANG  
 A. E. PICKERING  
*Sec.-Treas.*, O. A. EVANS,  
 159 Upton Road,  
 Sault Ste. Marie, Ont.

### TORONTO

*Chairman*, H. E. BRANDON  
*Vice-Chair.*, W. S. WILSON  
*Executive*, F. J. BLAIR  
 W. H. M. LAUGHLIN  
 G. R. JACK  
 D. FORGAN  
 R. F. LEGGET  
 S. R. FROST  
 (Ex-Officio), A. E. BERRY N. MacNICOL  
 T. H. HOGG C. R. YOUNG  
*Sec.-Treas.*, J. J. SPENCE  
 Engineering Building  
 University of Toronto,  
 Toronto, Ont.

### VANCOUVER

*Chairman*, W. O. SCOTT  
*Vice-Chair.*, W. N. KELLY  
*Executive*, H. P. ARCHIBALD  
 I. C. BARLTROP  
 H. C. FITZ-JAMES  
 H. J. MacLEOD  
 R. E. POTTER  
 (Ex-Officio), J. N. FINLAYSON  
 T. V. BERRY  
 H. N. MacPHERSON  
*Sec.-Treas.*, P. B. STROYAN,  
 2099 Beach Avenue,  
 Vancouver, B.C.

### VICTORIA

*Chairman*, A. S. G. MUSGRAVE  
*Vice-Chair.*, KENNETH REID  
*Executive*, A. L. FORD  
 B. T. O'GRADY  
 J. B. PARHAM  
 R. BOWERING  
 (Ex-Officio), A. L. CARRUTHERS  
 G. M. IRWIN  
 E. W. IZARD  
*Sec.-Treas.*, J. H. BLAKE,  
 605 Victoria Avenue,  
 Victoria, B.C.

### WINNIPEG

*Chairman*, D. M. STEPHENS  
*Vice-Chair.*, J. T. DYMENT  
*Executive*, C. V. ANTENBRING  
 N. M. HALL  
 T. H. KIRBY  
 E. W. R. BUTLER  
 H. B. BREHAUT  
 (Ex-Officio), J. W. SANGER  
 V. MICHIE  
 C. P. HALTALIN  
*Sec.-Treas.*, THOMAS E. STOREY,  
 55 Princess Street,  
 Winnipeg, Man.

# THE ORGANIZATION AND WORK OF RESEARCH ENTERPRISES LIMITED

A government-owned company established for the production of precision instruments

COLONEL W. E. PHILLIPS

*President, Research Enterprises Limited, Toronto, Ont.*

Paper presented before the General Professional Meeting of The Engineering Institute of Canada, at Montreal, Que., on February 5th, 1942

The story of Research Enterprises is an interesting example of the problems associated with the establishment of a specialized industry in war time.

In the early summer of 1940, new industries seemed to spring from the head of the new Department of Munitions and Supply. In some cases such as explosives or ammunition, the facilities and experience of existing industry lent themselves readily to large-scale expansion. But, in other instances, as in the case of the precision instruments required for fire control and other purposes, neither facilities nor experience in Canada were available for the task.

In October, 1939, General McNaughton suggested to the War Supply Board that consideration might well be given to the production of optical parts in Canada, and indeed proposed at that time that this work should be commenced on a small scale at the National Research Council. It would appear that in the press of business no decision was made; the matter was only re-opened on the organization of the Department of Munitions and Supply, and was brought to their attention in connection with an urgent demand for binoculars. In the meantime the technical problems involved had received some study at the National Research Council Laboratories.

It was soon found that the requirements ranged from binoculars to dial sights, including such highly specialized instruments as range-finders.

To meet this demand, Research Enterprises Limited was organized in August, 1940, as a wholly-owned government company operating under the Minister of Munitions. This decision recognized the clear line of demarcation between research and production.

The need for optical glass was the immediate justification for the creation of the company. This was to be followed, as a matter of course, by the production of a variety of optical instruments. At the same time it was realized that such a company might well undertake the quantity production of other types of instruments which might be developed by the National Research Council.

In the United Kingdom a long-established separate industry supplied optical glass blanks in pressings to a number of experienced instrument firms, each of which was principally concerned with the production of a few specific types of optical instruments.

The position in Canada was quite different. Provision had to be made for completely integrated operation starting with the raw materials for glass-making and ending with the delivery of some twenty-five types of finished instruments in small quantities.

On September 3rd, 1940, a start was made in Toronto with two employees. Despite the race against time and almost complete lack of experience progress has been made, and by the end of January, 1942, some 3,000 optical instruments valued at \$475,000 have been completed and shipped.

In ordinary times the design of such an enterprise would require a detailed manufacturing knowledge of the products to be produced, and information as to quantities and rates of delivery. Under existing circumstances only the most fragmentary information was available, and it was necessary to embark on a series of limited gambles,

creating facilities in what looked like minimum economic units, expanding, altering and adjusting these as the real requirements became apparent.

As things have turned out, the rapid expansion of our manufacturing programme has more than occupied the capacity provided.

The conception of a company, totally owned by the government, but operating with the full freedom of a private enterprise, was due mainly to the late Gordon Scott, Mr. Henry Borden, and Mr. R. A. C. Henry, members of the Executive Committee of the Department. Such a scheme provided the conditions essential to the rapid development of a large-scale enterprise for which obviously there was no adequate departmental precedent.

In November, 1940, a demand was made for the production of a series of secret detection devices, of which, by now, some general information has reached the public by way of the press. Soon finding that we knew less and less about more and more, the task was to sort out and study the separate components which had to be worked into a going industrial concern. These are indicated in Table I.

TABLE I.  
THE SCOPE OF THE ENTERPRISE

1	2	3	4	
{ Radio Production }	{ Instrument Assembly }	{ Optical Glass }	{ Metal Working }	
5	6	7	8	
{ Grinding & Polishing }	{ Range Finders }	{ Inspection & Control }	{ Plant Engineering }	
9	10	11	12	13
{ Design Engineering & Planning }	{ Field Station }	{ Cathode Ray Tubes }	{ Mobile Assembly }	{ Admini- stration }

Figure 1 shows the general form of the organization evolved, establishing the skeleton upon which the enterprise has been built.

Great importance was attached to the question of organization, for in such a case good organization is even more important than good personnel. In matters of organization it seems a natural instinct of the Anglo-Saxon to choose a static form of design, fixed, as it were, from the top downwards. In our case, it seemed important to plan for a more dynamic framework, sensitive and responsive to changes perceptible at first only from the lower levels of the organization. In other words, it was more a question of "learn how" than "know how." In any event, compromise was the order of the day, as experienced personnel simply were not available.

In the early stages, committees and groups were the rule rather than the exception, but as time goes on, familiarity with the task makes it possible to assign clearly defined responsibility to individuals who have proved their merit, and at the same time to give them complete authority within their own sphere.

## PERSONNEL

As may be easily imagined, our requirements for technical personnel covered a wide field. The technical staff

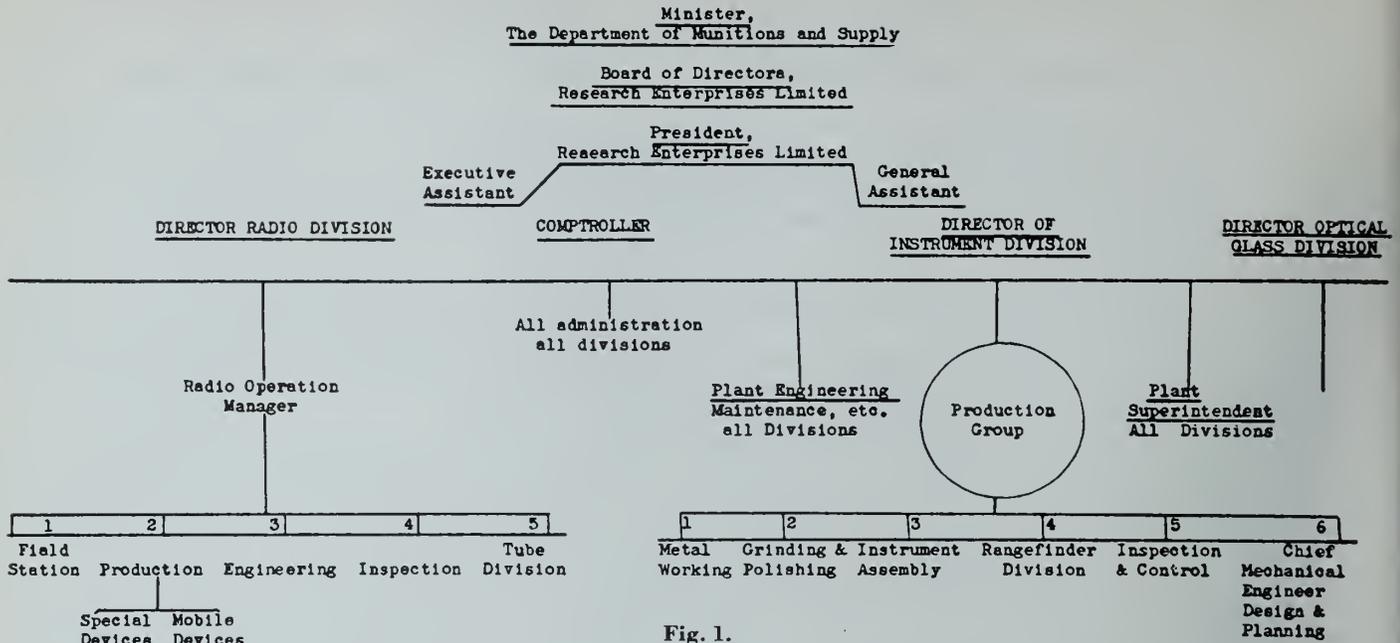


Fig. 1.

today numbers over a hundred, including 56 graduate engineers, 20 physicists, 3 graduates in engineering physics, and 5 chemists, with some 13 general technical assistants in miscellaneous fields. Of this total, some 84 are graduates of Canadian universities, which should be a matter of general satisfaction. The total number of employees is 3,000, of whom 700 are women.

TRAINING CLASSES

From the beginning it was evident that training must be provided for many of the workers. Courses have been established for machine operators, drafting, radio, glass blowing, and in addition, a fairly extensive series of night classes are held for our own employees. This policy has been highly successful, and over 400 present employees are graduates from such classes.

OPTICAL GLASS

Optical glass is now a fundamental requirement in the production of fire control instruments for warfare because modern artillery practice is concerned almost altogether with indirect targets, invisible to the gunner, but whose positions have been accurately located on the map. Thus methods of instrumental aim, known as indirect fire control, are essential. This involves the use of surveying instruments in order to determine the line of sight and the range of the targets with reference to certain fixed points visible to the battery.

The instruments used are for the most part of the telescopic type. Obviously, glass must be an integral part of the optical systems involved, and as the accuracy of the instrument is largely dependent upon the quality of the image, it follows that the glass must be of the very best.

The use of glass in lenses and prisms is based on its property of refraction. Speaking generally, its function in instruments is to so bend the rays of light from any distant point that they will converge to a single, corresponding point in the image.

To better understand the problems associated with the manufacture of optical glass, a general knowledge of the principles of refraction is needed. Figure 2 shows a ray of light, incident on a glass surface, and traces its path through the glass until it emerges.

Actually, the velocity of light in glass is less than that in air. Thus in passing from air into glass the ray is deflected so that the angle between its path and the normal to the surface is reduced. The ratio of the sines of the two angles (AOB and COD in the figure) is called the "index of refraction," and is a number  $N$  which expresses the ratio between the velocity in air  $V_0$  and the velocity  $V$  in the given medium. In fact  $N = \frac{V_0}{V}$ .

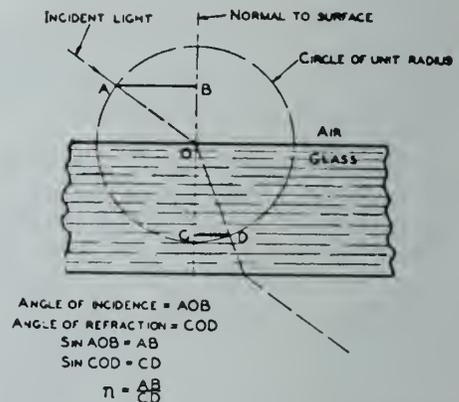


Fig. 2—Measurement of index of refraction.

It will be seen that a ray of light slows up and swerves when it meets a medium of greater optical density, just as a motor car slows up and swerves when one wheel leaves the concrete and gets on the softer shoulder of the road.

In practice, the refractive index measured for the D line of sodium ( $A^\circ .5893$ ) is the value used for commercial purposes. Its symbol is  $N_d$ .

DISPERSION

Another property of glass which is of great importance in determining its optical characteristics is its "dispersion." Radiations of the seven colours of the visible spectrum travel with the same velocity in a vacuum. The result to the eyes is white light. This is true to all intents and purposes in air.

In an optically denser medium, however, such as glass,

the longest-legged colour, red, travels fastest. The shortest-legged colour, violet, travels the slowest. Thus, in the denser medium, the colours of white light are dispersed, producing the familiar colours of the rainbow. The effect of a prism is shown in Fig. 3.

The angle of refraction evidently varies with the wavelength of the incident light. The difference in the refrac-

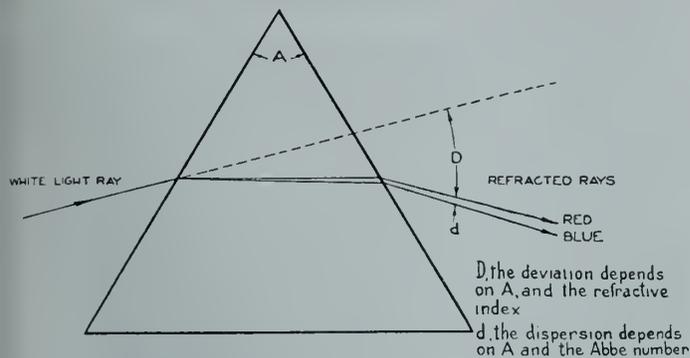


Fig. 3—Refraction of white light by a prism.

tive indices of a particular glass for light of different wavelengths is known as its "partial dispersion" between those particular wavelengths.

This phenomenon is obviously of great importance in the design of optical systems.

In commercial practice, four different wavelengths of light, the red, blue and violet of hydrogen and the yellow of sodium are used as standards.

The refractive indices for these various wavelengths are designated as  $N_c$ ,  $N_f$ ,  $N_g$ , and  $N_d$  respectively.

#### REFRACTION AND DISPERSION

In specifying the optical constants for the glasses in this list, nine spectral lines are used. Table II gives the wavelengths, etc., of these nine lines.

The "mean" index of refraction in air is given for the d line, and the "mean" dispersion between the C and F lines.

From these data is obtained the reciprocal dispersive power (constringence)  $\frac{n_d-1}{n_f-n_c}$  usually denoted by  $v$  or  $V$ .

The partial dispersions b to C, C to d, d to e, e to F, F to g, and g to h are given, and the ratios these partial dispersions bear to the mean dispersion (relative partial dispersions). In addition, for reference, the indices of refraction for the sodium D line and the hydrogen G<sup>1</sup> line are quoted.

The routine measurements of refractive indices of meltings are made with a Pulfrich refractometer (which has been standardised by reference prisms carefully measured on an accurate spectrometer). It will, therefore, be generally recognised that the values of the dispersions sent to customers with each melting of glass cannot be relied on to within less than .00003.

Special care has been taken to ensure that the relative dispersions given in the list are accurate. In each case an optically worked prism has been measured on an accurate spectrometer.

The value derived from these differences in refractive

index, as between different wavelengths, is known as the "Abbe number," and is given by the formula

$$V = \frac{N_d - 1}{N_f - N_c}$$

The reciprocal of this value is a measure of the dispersive power of the glass.

The term, which is in general use, serves to measure dispersion, and, together with  $N_d$  the refractive index for the D line of sodium, is sufficient to characterize any optical glass.

The fundamental task in lens design is to bring together, to the same focus, rays of one or more colours. This procedure can be successful only to the degree that the relative dispersions in the two glasses are similar. If this be not the case, there is residual colour in the image which cannot be eliminated. (See Fig. 4.)

By the proper combination of different types of glass of suitable index and dispersion, we can eliminate the effects of dispersion and produce an image free of colour.

By combining lens elements of glasses of different refractive indices and dispersions, it is possible for the designer to obtain much more perfect images and optical performance than with single lenses.

#### TYPES OF GLASS

Although the fundamentals of glass-melting were known from the very earliest times, it was not until the end of

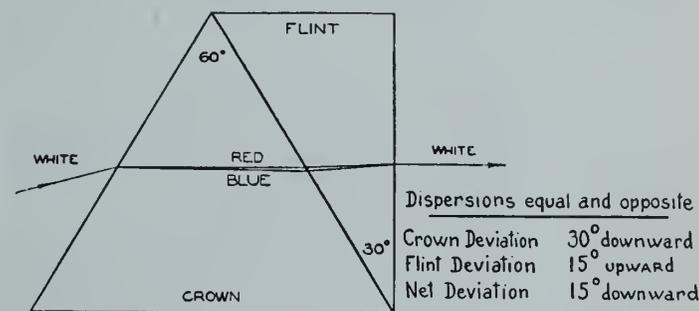


Fig. 4—Achromatic prism combination.

the 18th century that satisfactory optical glass became available. This followed the discovery by Guinand in 1790 that, by stirring the molten glass, it was possible largely to free it from physical imperfections, such as stones, bubbles, seeds, etc.

For many years, there were but two general types of glass available: the "flints" and the "crowns." The "flints" contained appreciable quantities of lead oxide and were characterized by higher refractive index and greater dispersive qualities than the "crowns." The relationship between refractive index and dispersion was fixed, inasmuch as the dispersion always increased as the refractive index increased.

The materials used in the manufacture of these glasses were largely the oxides of silica, sodium, potassium, lead, aluminium, and possibly thellium.

It was apparent that improved performance in optical

TABLE II.

	Red		Yellow		Green	Blue		Violet	
Helium.....	b		d						
Hydrogen.....	C					F		G <sup>1</sup>	
Sodium.....			D						
Mercury.....					e	g		h	
Wave-lengths in tenth-metres (A)...	7065	6563	5893	5875	5461	4861	4359	4341	4047

TABLE III.

OPTICAL CHARACTERISTICS OF GLASS MADE AT RESEARCH ENTERPRISES LIMITED

Type	Code	Refractive Index for Sodium Line $N_D$	$V = \frac{N_D - 1}{N_F - N_C}$
Borosilicate Crown.....	510644	1.5100	64.4
	517641	1.5170	64.1
Hard Crown.....	519604	1.5190	60.4
Light Barium Crown....	540595	1.5400	59.5
Medium Barium Crown..	572577	1.5720	57.7
Light Barium Flint.....	551515	1.5510	51.5
	575520	1.5750	52.0
Light Flint.....	575426	1.5750	42.6
	578407	1.5780	40.7
Dense Flint.....	617366	1.6170	36.6
	620361	1.6200	36.1
	623360	1.6230	36.0
Extra Dense Flint.....	648338	1.6480	33.8
	653336	1.6530	33.6

systems depended upon the development of additional types of glass with a different relationship between index and dispersion.

In 1890, Schott and Abbé at Jena, using many new materials, developed glasses which were characterized by a relationship between refractive index and dispersion quite different from that of the older types.

The new types included borosilicate crowns, barium crowns, barium flints, borate flints, and opened up a completely new field to the optical industry.

For many years Jena led the world in the production of these glasses, but long before the last war Chance Brothers, in England, had achieved an enviable reputation for the quality of their optical glass.

Following the last war, and working closely with the Admiralty, Chance Brothers have concentrated on the development of optical glass, and for many years they have occupied a technical position at least equal to Schott und Genossen at Jena.

Chance Brothers' present catalogue lists well over a hundred different types of optical glass. Our instrument programme here requires some fifteen different types, all of which we have now made successfully.

In 1917, the United States was faced with the necessity of establishing its own optical glass industry from the ground up. The situation was in many respects similar to the one we faced in 1940. Fortunately, a very complete record of their experience is available. It discloses the great difficulties they encountered.

Prior to this war, there was an established optical glass industry in the United States. One manufacturer, Bausch & Lomb, in particular, had continued production and developed a variety of types of glass designed for use in the manufacture of their own instruments.

There was also a small commercial operation in the Bureau of Standards in Washington, the output of which went largely to the United States Government workshops.

The types of glass developed by American industry have been generally standardized as to optical characteristics. These differ considerably from those in use in the United Kingdom, and the American types do not lend themselves readily for use in the optical systems of the British instruments which had to be copied.

Thus after thorough study of the record of the difficulties met by the Americans in 1917 and '18, it seemed best to follow the successful methods of the outstanding British manufacturer—Chance Brothers, of Birmingham.

Chance Brothers have been making fine glass for over one hundred years and were well entitled to place a very

high value on their manufacturing knowledge. Nevertheless a very satisfactory arrangement was concluded with them, and they have made available to us every detail in connection with their operations. Now that our Glass Division is established on a modest commercial basis, it must be admitted that the mere copying has taxed our abilities, but had this arrangement not been made with Chance Brothers, we might still be experimenting instead of producing.

In the early stages, there was no information upon which to estimate the quantity of optical glass required, so it was decided to set up the smallest economic unit, which was estimated to have a capacity of 5,000 pounds of usable glass per month.

The first melt was made on June 5th, 1941. The colour was perfect. Of course there were plenty of seeds and bubbles, etc., but a few thousand pounds of good quality glass were produced in July and August. In September, this increased to 4,000 pounds; in October, to 10,000; in November, to 12,500; and it is expected to maintain this rate until March, when two new furnaces will be in operation and the monthly yield should reach 20,000 pounds of usable glass.

Our methods differ only in minor details from those of Chance Brothers. The quality of the glass produced has been excellent—surprising even ourselves—and, as experience is gained, the yields of good glass, which even now are very satisfactory except in the more difficult barium glasses, will steadily improve.

A few general observations on the process may serve to explain some of the operations in glass manufacture.

#### POTS

The problem of refractory pots for glass-melting is one of the most difficult. For many years, an old type of hand-built clay pot, laboriously constructed by skilled workmen, was the only satisfactory type available. So far as we were concerned, the production of old-style pots was quite out of the question, as no skilled workmen were available. We, consequently, followed the method of making pots by slip-casting, and received very considerable assistance from the work which had been done at the Bureau of Standards in Washington.

The characteristics of the pot are all important. It must be mechanically strong at temperatures up to 1500 degrees C., not only to hold approximately 2,000 pounds of melted glass, but to permit its being handled by mechanical means, and it must, above all else, be chemically resistant to the action of the molten glass at these high temperatures.

Very serious problems arise with certain of the glasses, particularly those containing barium. Although we are able to maintain very high standards of purity in our batch chemicals, it is not so easy to obtain clays equally free from impurities, and it therefore becomes doubly important to restrict solution of pot impurities by the action of the molten glass.

There is no definite scientific procedure for the control of pot-making. The methods are largely empirical. We use a mixture consisting of three types of china clay and two types of ball clay, together with sodium silicate and sodium hydroxide as defloculants.

Apart from close mechanical control, success depends largely upon the skill of the potter, the modern representative of the oldest of the crafts.

After many disappointments we have had extremely good luck, and appear to have solved the pot problem for even the most difficult of the glasses made. The pots, normally, take about three months to dry; it may prove necessary to adopt some mechanical means to hasten the drying period without impairing the qualities of the pot.

The pot is used only once, but the remains of the burned

begins. This lasts for, roughly, five hours, with speed and stroke varying according to the type of glass. When this stirring is complete, the pot is removed.

### ANNEALING

Good optical glass must be isotropic, that is to say its properties—such as refractive index and dispersion—must be the same in all directions.

When glass is cooled, two general effects appear. First, a molecular effect which depends on the rate of cooling and which is uniform throughout the whole body of the glass. Under these conditions, for example, glass of similar composition, cooled rapidly, will have a different refractive index, etc., from the same glass cooled slowly. This effect must be considered in cooling the pot after its first removal from the furnace.

The second effect may be described as a mass or volume effect, and results from differential cooling within the same pot of glass. For example, if one part of the glass cools more rapidly than another, stress will be set up between the two parts and strain will result. This is the phenomenon which causes the greatest difficulty.

Glass which is non-uniformly strained will have one refractive index for light travelling parallel to the direction of strain and a quite different refractive index, etc., for light travelling at right angles to it. In other words, it becomes doubly refractive. This is, of course, a familiar phenomenon, and inasmuch as the birefringence is proportional to the magnitude of the strain, the precise value and location of the strain may be measured by polarized light.

It is clear, therefore, that the annealing of optical glass in its various stages of manufacture is of the greatest importance. In the early stages, the process is known as "rough annealing", although it is controlled as closely as possible, but when the glass reaches its final shape, either as a slab or a pressing, it undergoes a last "fine annealing" operation in which the rate of cooling is very closely controlled.

It is of interest to note that the actual fine annealing requirements involve the treatment of large amounts of glass at the one time. The holding temperature, ranging from 430 to 570 degrees C. (which represents the first stage in the operation), requires the maintenance of tem-

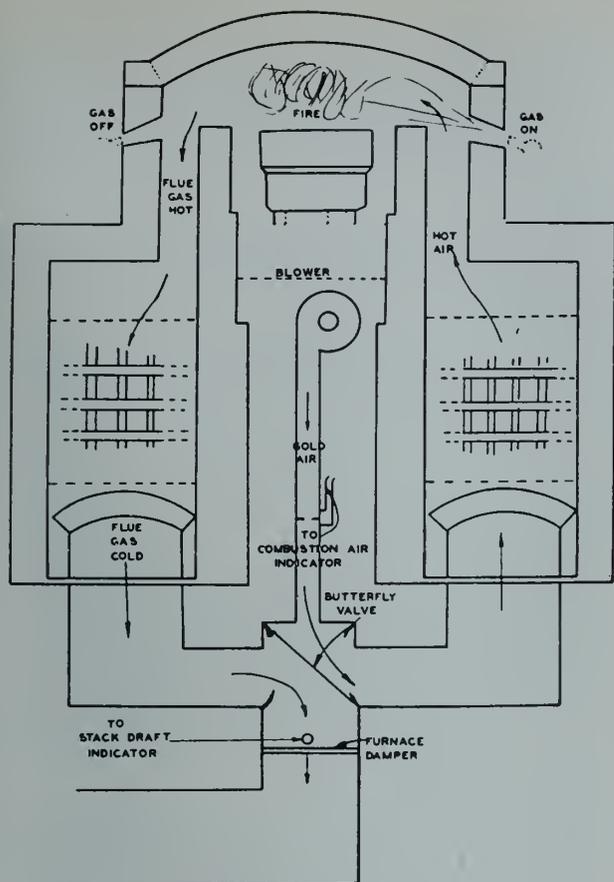


Fig. 5—Regenerative Furnace.

pot are carefully separated from particles of glass, then pulverized and screened, and used again to provide about half of the raw material for the making of new pots.

### FURNACES

The furnaces are of the single pot type and may be either regenerative or recuperative. (See Figs. 5 and 6.)

The pots are mostly heated by radiation from the furnace crown, and it is essential that the temperatures be uniform and subject to close control.

The regenerative type of furnace (Fig. 5) is the more popular type in America, but more expensive to construct. The recuperative furnace (Fig. 6) has been found quite satisfactory in English practice and is simpler to build. Both types will be in operation in Canada.

City gas of 490 B.T.U.'s is used. This is an ideal fuel from the point of view of cleanliness, but as the consumption, even now, is some ten million cubic feet per month, the question of cost becomes a serious one. Under existing conditions, our fuel costs are from four to five times as high as the corresponding costs at Chance Brothers, who use producer gas. Having gained sufficient confidence in the technique of the melting operation, oil-burning equipment is being installed for the two additional furnaces.

### MELTING

Previous to the melting operation the pots are preheated in the pot-arches to 1100 degrees C., and are moved quickly to the melting furnace. The temperature is then raised to above 1450 degrees, the pot is glazed by throwing in cullet of the same type of glass as that to be melted, and the batch is then "filled on."

Chemical reaction follows quickly, resulting in the fusion of the constituents and the formation of various silicates. In the process there is an evolution of gases which rise to the surface, and when all these have escaped, the glass is said to be "fined," and the stirring process

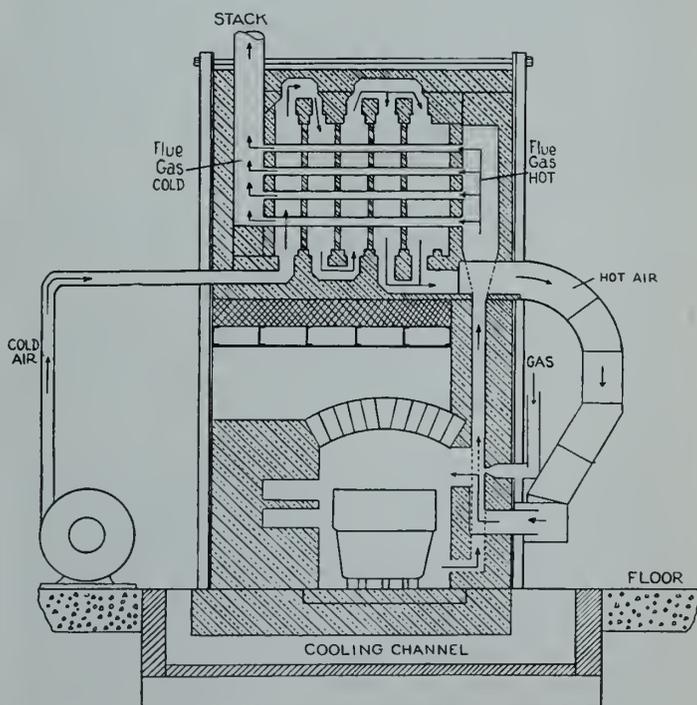


Fig. 6—Recuperative Furnace.

perature within one degree, plus or minus, for periods of 24 hours at least.

Further the cooling temperature requirements involve the maintenance of rates of temperature drop as low as 5 degrees per 24 hours. With modern equipment, we are able to control this operation entirely automatically.

Minimum standards for ordinary optical components require that the strain shall not produce birefringence equivalent to more than ten millimicrons per centimetre of light path. In many cases, our own product shows no detectable strain whatever.

#### FORMS OF PRODUCT

Optical glass is available in three standard forms:

1. *Chunks*: as they come from the broken pot;
2. *Slabs*: which are made from chunks of glass by softening and pressing in a mould, then grinding and polishing the edges;
3. *Mouldings or pressings*: These latter represent the form in which the largest proportion of the output is delivered.

The pot of glass is broken down by hand until the lumps are approximately of the required weight and it is then softened and pressed in an iron mould, which is made, roughly, to the shape of the finished optical component, sufficient allowance being made to provide for the grinding and polishing operations.

This method has many advantages and meets the requirements for all instruments other than those of the highest precision. In the latter case, the optical glass must be cut by means of a saw from selected slabs or plates.

#### OPTICS

The production of finished optical glass parts appeared at first to be one of our most serious problems. There was no similar operation anywhere in Canada, nor was trained personnel available anywhere on this continent.

Fortunately, Dr. Jones was secured from the National Research Council, and he threw himself wholeheartedly into the problem. Arrangements were made with Bausch & Lomb to take nine of our carefully selected learners and put them in their own plant for some four to six months.

Tooling for this work is just as much a problem as tooling for machine work, and there is the further complication that the computation of optical systems is a highly specialized mathematical problem. Dr. Crooker, of the University of British Columbia, was engaged as optical designer. Despite the impression in the industry that years of practical experience were essential, Dr. Crooker has solved our design problem.

By the end of June, a few polished components were actually being produced every week, but the rejections were in the neighbourhood of ninety per cent. By one means or another, this has been removed from our list of problems. In the second week of January, for example, over 8,000 individual, finished, polished optical components were turned out, and the rejections were 13.7 per cent. This is an encouraging record, and proves that much can be accomplished if the urgency is sufficiently great.

The fabrication of optical parts differs from that of metal parts in a number of respects, perhaps the most conspicuous of which is the considerable amount of hand-work which is still found necessary even in the largest plants. This state of the art will almost certainly continue in the case of the more precise parts used in small quantities on large, expensive instruments, while on the smaller parts, required in greater quantity, the traditional methods are considerably modified in order to produce more rapid results. There are two principal operations in the production of optical parts:

#### (a) GRINDING

This is usually done with loose abrasive on a cast-iron tool. Whenever possible, multiple fixtures are used to facilitate production. A number of operations are also done with milling machines, using diamond charged cutters.

#### (b) POLISHING

All precision polishing is done with a lap, coated with pitch and using an oxide, usually iron oxide, as the polishing material.

Polishing differs from grinding operations in that it is necessarily a lapping operation in which the floating tool principle is used and the accuracy is not contingent on the accuracy of machine ways. The method of holding the work differs from machine practice in that the glass part is either held to an iron tool by pitch or by bedding in plaster of paris, or in the most accurate work, by optical contact with a finished optical surface on a holding fixture.

The testing of the accuracy of the polished surface is based on optical interference. The familiar Newton rings are observed between the work and a master test plate. In the case of low power telescope lenses, the work is held to a tolerance of five rings. In the case of higher power instruments, the tolerance may be as little as one ring, or in the case of master test flats, the surfaces are worked so that no rings show. In this latter case, the accuracy is 1/6th wave length or better.

Translating these into terms of ordinary measurement, an interference ring is equal to 1/2 wave length and is equal to approximately 1/100,000th of an inch. In flat work, the tolerances are commonly more stringent than in lens work, and in certain cases good performance demands a surface which is flat within 1/1,000,000 of an inch.

Linear dimensions of optical parts are held to tolerances somewhat similar to those in the metal-working industries. Diameters are held to the same tolerances as lens cells, commonly plus or minus .0005. In some prisms extremely high accuracy is required in the angles; for example, we are turning out deflecting wedges in which the tolerance is five seconds of angle, plus or minus.

Optical methods of measurement and optical contact blocking permit the obtaining of this accuracy with very few rejections. The final correcting of the angles, although done in a multiple fixture, is usually a hand operation. In fact, it is true that the high performance of all the more precise instruments, such as the rangefinder, heightfinder, etc., depends on optical components which are finally finished by hand.

#### MANUFACTURE OF METAL INSTRUMENT PARTS

In the early stages of our planning, we quite underestimated the difficulties associated with the production of metal instrument parts. We took it for granted that our real difficulties would lie in the field of glass-making and optics.

Instrument-making is more than a mere extension of fine machine shop practice. It demands a slightly different point of view, which is a good reason for the special term "instrument-maker".

The design of the British instruments we are reproducing has not been greatly influenced by considerations of quantity production. The standards are very high. Indeed, in many cases, it would seem that some lowering of peacetime design standards might be well justified by the exigencies of war-time demand for quantities.

There appears to be a difference in instrument-making practice between Bausch and Lomb, for example, in the United States, and at least the many smaller instrument firms in the United Kingdom.

In the United Kingdom, the ample supply of instrument-makers seems to justify the use of these highly skilled workmen on machine tools of types we would consider old-fashioned. Nevertheless, in skilled hands, the quality of the work is up to the necessary standard.

In American practice, on the other hand, the tendency is to make much greater use of turret lathes and automatic machines, leaving the final fitting to the relatively smaller number of instrument-makers.

In our case, however, the instrument-maker simply did not exist, and it has been necessary to take the best type of tool-maker available; he has had to learn the requirements of the job by hard experience.

Practically all the drawings which have been supplied to us contained insufficient information on tolerances to permit their use in the manufacture of interchangeable parts. As a rule, these drawings are prepared for third angle projection which, in many cases, is confusing to men who were used to first angle projection. The wide use of Whitworth, B.A. and B.S.A. screw thread standards created problems which could only be solved by time.

In practice, it was necessary to adopt the expedient of making a model instrument in every case by hand, altering it until it came up to the established performance specifications, and then preparing our own manufacturing drawings. Under existing conditions, this has proved to be a tremendous task.

The actual operations involved follow familiar lines, with special emphasis on the close fits required, the high finish necessary, and the great number of threaded components. Most metal part manufacturing is done on standard and universal type machines with suitable fixtures, etc. Very few single performance machines are used.

It may be of interest to note that the large majority of our threaded parts are more satisfactorily threaded by chasing rather than by cutting with a tap or die.

Our gear-making problem is unique in that many of the gear trains demand extremely high accuracy, in which no backlash can be tolerated. Some of these gear trains demand special cam gears in which the teeth are cut on the contour of a specially calculated cam.

Most of our gear work consists of very small units and extensive use is made of the standard machines as produced by Barber-Coleman, Gleason and Fellowes, together with a variety of checking equipment.

Assembly of the metal parts involves a very large degree of hand-fitting. In general, it is more economical to manufacture the parts to a high commercial accuracy, and do this small amount of hand-fitting to achieve the necessary sensitivity, rather than to attempt to manufacture parts individually to the highest degree of gauge precision.

There are, however, many instruments, such as the tank periscope, in which virtually no fitting whatever is required, and the assembly is done by girls trained in a few weeks.

The assembly of the optics in the metal parts is an operation which never has been done on any large scale in Canada prior to the building of Research Enterprises. These operations require the use of carefully constructed and calibrated collimators and the best of careful workmanship. As an indication of the care with which optical parts must be mounted, here are the tests to which one small instrument is subjected.

It is heated to 150 degrees F., cooled to minus 40 degrees F., placed in a vacuum for one-half hour, then immersed in a steam bath and finally vibrated with an amplitude of 1/32 inch and frequency of 2,200 vibrations per minute. After these tests, the instrument must be as optically perfect as before the tests were made. Such tests obviously require that the optical parts be very securely mounted, very carefully sealed, and further that there be no strain transferred to the glass by the mounting.

Of our activities in connection with secret devices, it is not permitted to speak. It might, however, be said that the work is in a field hitherto practically unknown on this continent. It is based on research and development work undertaken in the United Kingdom and on the extension of this work in the laboratories of the National Research Council.

Some idea of the magnitude of the whole operation may be gathered from the fact that we have approximately \$100,000,000 worth of orders in this field, as against some \$10,000,000 in the instrument field. These are astronomical figures, and we interpret them to mean that all that we can make can be used as rapidly as we can produce it.

It is obvious that any undertaking of such scope as that of Research Enterprises must present many deficiencies, but it appears that the technical aspect of our problem has practically been solved, so far as personnel and facilities are concerned. The immediate task is to complete and perfect, so far as may be possible, the organization for production.

It is difficult to find an index to indicate progress to date but it may be interesting to learn that our billings, up until the end of January, amount to over \$1,300,000, with some \$5,000,000 worth of work in process nearing completion.

The author wishes to take this opportunity of emphasizing the debt owed to the countless people and institutions who have helped in so many ways. It is impossible to list them by name, but, above all else, the practical effective co-operation from the Department of Munitions and Supply should be recognized.

# THE ALASKA HIGHWAY

J. M. WARDLE, M.E.I.C.

*Member of International Fact Finding Committee 1931-33.*

*Member of British Columbia-Yukon-Alaska Highway Commission, (Canada).*

**EDITOR'S NOTE**—Since this article was written, a decision has been reached to build a highway for military purposes. A location following generally the air route from Edmonton to Alaska will be developed immediately.

From time to time projects arise whose magnitude and character stir the imagination and challenge the ability of the engineer. Such a project is the proposed highway to Alaska. It involves the location and construction of 1,200 miles of highway through unsettled and mountainous territory, far off the beaten track; the extension of the highway systems of Canada and the United States to the 65th parallel of latitude, and the making accessible to the motor car of areas which, a few short years ago, could only be reached by pioneer methods of transportation.

An overland connection between the United States and Alaska was first suggested forty years ago, when Mr. E. H. Harriman, of railroad fame, planned a railway through the Pacific Northwest, that would pass not only through British Columbia and the Yukon to Alaska, but would cross Bering Strait to Asia. In later years, Pan-American enthusiasts spoke of a highway from the southern tip of South America northerly through Panama, Mexico and the United States and Western Canada, to Alaska. Some investigation has already been made of a route through Panama and Central America, and its possibilities have been the subject of several articles.

Insofar as a highway to Alaska through British Columbia and the Yukon is concerned, it seemed to take definite shape in 1929, when various public bodies on the Pacific coast began to support and encourage the project.

These groups felt interested because, as Alaska lies to the north, and is west of Canada, they regarded the highway as a project associated with the states, provinces, and territories bordering the Pacific. The inhabitants of Alaska itself were naturally strongly in favour of a road connection with the United States, and the whole Pacific area supported the project, with some reservations as to the distribution of construction costs between Canada and the United States.

The claim of the people of Alaska for an overland connection with the continental United States is outlined by the United States Alaskan Highway Commission in its report of April 1940. A few quotations from this report follow:—

"People generally believe this territory (Alaska) to be the land of ice and snow. They look upon it as a point, and not as an area. They do not know that Alaska alone covers 590,000 square miles; that it is over 1,200 miles from the southern point to the northern tip and 3,000 miles to the western extremity of the Aleutian Islands, with all the variations of climate from that of the temperate zone to arctic conditions. In many portions the climate equals that of the eastern seaboard of the United States. Juneau, Alaska, has milder winters than Washington, D.C."

\* \* \* \* \*

"The gold fields of Atlin and Dease Lake, the silver, lead, and zinc deposits of the Ingenika region, the rich gold-gravel deposits of the Omineca, and vast gold fields of Groundhog, in British Columbia, alone justify a road. Heap on the known resources of Alaska and the total potential dividends should so far exceed the capital investment of an international highway as to make it almost folly not to proceed on the basis of the mineral wealth alone."

"Furthermore, Alaska and the Canadian Northwest provide a natural vacation ground which, because there is no through highway, is inaccessible to thousands of motorists desiring the opportunity to drive farther north rather than south for their summer vacation. During the four months from June through October the mild northern climate is, for the most part, ideal. Hay fever is practically unknown."

\* \* \* \* \*

"The small population of Alaska should not be used as an argument against the international highway, for economically this small population is one of the richest in the world. With less than 80,000 people in the Territory, about equally divided between whites and natives, the annual wealth production in the Territory is close to \$100,000,000. This is a world-high average of \$1,250 per capita per year and, inasmuch as at least 75 percent of the native population is not in industrial competition, the figure is amazing. On the basis that 1 in 5 persons is gainfully employed, which is maximum for Alaska, each Alaskan producer is yielding \$5,000 in actual wealth. In addition to its own produce, Alaska imports more than \$40,000,000 worth of supplies per annum, or an average of \$500 per capita. The exports amount to \$80,000,000. These statistics show that Alaska is probably the greatest producer and consumer of produce per capita in the world."

\* \* \* \* \*

Even while the report quoted was being written, Alaska had leaped into prominence as the site of great northern United States air bases, and these are being developed with characteristic speed and vigour.

The first official recognition of the possibility of an Alaska highway was given late in 1930, when the Congress of the United States authorized three representatives to meet with three representatives selected by the Canadian Government, and constitute an International Fact Finding Committee, for the purpose of investigating the proposed highway. The committee members at once began collecting information, the Government of British Columbia promptly placing at their disposal reports on reconnaissance surveys by ground and air that had been underway on road routes northerly from Hazelton, B.C. The initial responsibility of the committee was to decide whether or not there was a feasible route to Alaska through British Columbia and the Yukon Territory, and at a meeting held late in 1931, sufficient information was found to be available for this purpose. The view of the Fact Finding Committee on the highway at that time was expressed as follows:—

"The final conclusion was that the committee considered the project of constructing a road as an extension of the Pacific Highway north from Hazelton through Northern British Columbia, Yukon and Alaska to Fairbanks as being feasible from an engineering standpoint; that there was not sufficient information available to determine whether the undertaking was economically sound, that further information is to be obtained, and that the committee will meet again at the call of the chairman."

Enough information was collected on a route that seemed feasible, to arrive at a very rough estimate of cost. This was based on a passable road from 14 to 16 feet wide, with no provision for any improvements to existing roads leading from Blaine on the International Boundary, to Prince George or Hazelton, B.C. This very preliminary estimate is summarized herewith:—

Blaine to Hazelton, B.C. ....	815 miles	
(Passable road)		
Hazelton to Yukon Territory, ..	610 miles	
(New work) .....		\$ 7,320,000.00
Yukon Boundary to Alaska		
Boundary, .....	530 miles	
(Improvements and new work)		4,575,000.00
Alaska Boundary to Fairbanks	270 miles	
(of which 180 miles new ....		
work) .....		3,000,000.00
Totals .....	2,225 miles	\$14,895,000.00

Investigations in regard to probable revenue from tourist traffic, development of natural resources, and economic benefits to Canada and the United States were carried out by the Committee until 1933, and a good deal of interesting information collected. However, interest in the project waned during the depression, and there was no further activity until 1938.

In that year, the question of the highway was again raised by the United States, and an inter-departmental committee was formed in Ottawa to review the situation from the Canadian standpoint. This committee, on which were represented the Departments of External Affairs, Justice, Mines and Resources, and National Defence, completed their report in July of that year. Briefly, it expressed the view that the Alaska Highway was feasible from the engineering standpoint, but that information available did not indicate that it was justified from the economic standpoint at that time.

Further exchanges between the governments of Canada and the United States resulted in a communication from the United States Government, in regard to the desirability of providing for the construction of the highway, which stated that the President of the United States was empowered to appoint a commission of five persons "to co-operate and communicate directly with any similar agency which may be appointed in the Dominion of Canada in a study for the survey, location, and construction of a highway to connect the Pacific Northwest part of continental United States with British Columbia and the Yukon Territory in the Dominion of Canada and the Territory of Alaska."

On the President appointing the United States Commission of five persons, Canada did likewise by order-in-council.

The wording of the United States communication confined immediate investigations to a highway through British Columbia and the Yukon Territory to Alaska, and both commissions proceeded on this basis.

Since approximately 1,800 miles of the proposed road would be in Canada, and only some 225 miles in territory of the United States, the Canadian commission was obliged to assume much greater responsibilities than the United States commission, insofar as investigations were concerned.

The Canadian commission undertook to collect information and do necessary reconnaissance survey work on the highway through British Columbia and the Yukon, while the United States Commission was to submit estimates on a route or routes from the Alaskan-Yukon boundary to Fairbanks.

The Canadian commission was fortunate in having immediately available most useful information, obtained by the Province of British Columbia through exploration and reconnaissance surveys in northern sections of the province,—as well as a great deal of material collected by the Fact Finding Committee of 1931-33.

This was supplemented during the course of the commission's work by aerial and ground reconnaissance surveys, by evidence taken at public hearings at such geo-

graphic centres as Prince George, Hazelton, Atlin and Whitehorse; and by the examination of the large amount of pertinent data available in Dominion and Provincial Government records.

In collecting information, engineers covered 4,000 miles by aerial reconnaissance, and over 3,000 miles by ground reconnaissance surveys. Exploration by air was not so much to discover new routes as to "eliminate those that were definitely unfavourable, thus saving the cost of ground investigations, and to confirm the possibility of routes on which favourable reports had already been received." It was only the great advantages of air reconnaissance that permitted the commission to examine, in the short space of three seasons, the main features of the large mileage involved in main and alternate routes. Thousands of dollars were thus saved through avoiding expensive ground reconnaissance over routes that on aerial observation proved impractical.

The Alaska Highway presents a very interesting problem from the standpoint of general location, and one that is but rarely afforded. In the first place it is not a local, provincial, nor national project, but an international one. This characteristic had to be kept in mind continually when possible diversions with substantial local advantages were under consideration. Probably no highway problem has required closer attention to climatic conditions, since these will affect construction, maintenance and operation. The advantages which the route selected might afford to air transportation were also dependent on weather conditions. Maximum elevations, always important in mountainous areas, have still greater weight at northerly latitudes.

The location of the highway in relation to the development of Canada's natural resources in the north-west was a factor of vital interest. Any route chosen should make forested and mineral areas reasonably accessible, and should not overlook the tourist traffic possibilities of new recreational areas.

The desire of towns and smaller settlements in northern British Columbia, the Yukon Territory, and the Alaskan panhandle to be on the highway or within striking distance of it, was still another factor.

The members of the United States commission, who were deeply interested in the route of the highway through Canadian territory, naturally hoped a feasible route could be found near enough to the Pacific Coast to benefit the Alaskan panhandle.

The extent to which existing roads should influence the general location was considered, and in this respect the Canadian commission in its report states "that while existing roads below the standard of construction required had great value as aids to construction, they could not be regarded as conclusive factors in determining routes."

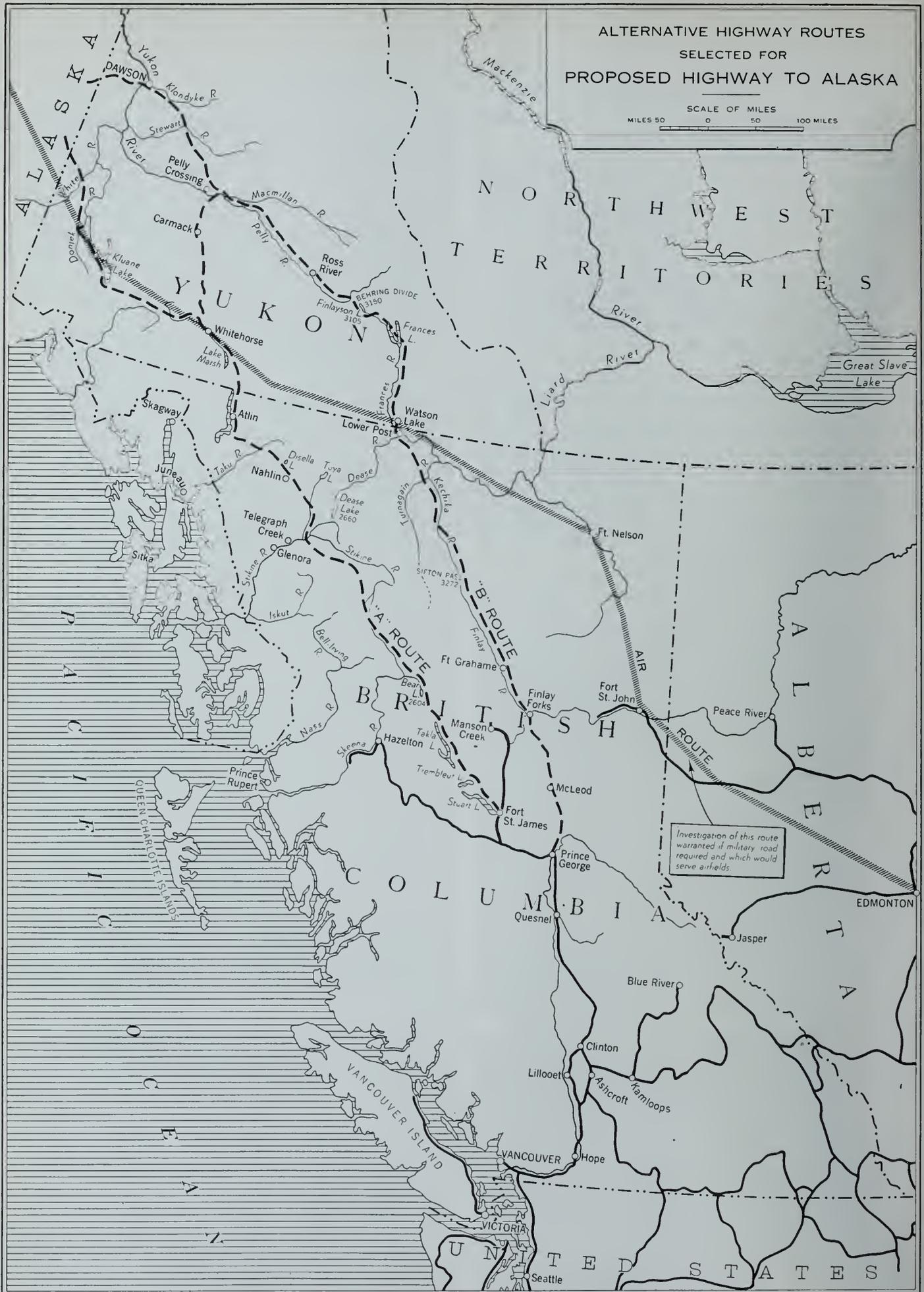
Various meetings were held by the commission from time to time as its investigations progressed, and several joint meetings with the United States commission took place.

The instructions of the Canadian commission made no reference to investigation of the highway from a military standpoint. This question at once arose when war broke out in 1939, and became increasingly important with the formation of the Joint Defence Board of Canada and the United States. On asking for advice, it was suggested to the commission that it continue and complete its investigations, supplying to the Canadian section of the Joint Defence Board such information as the latter might require from time to time.

In April 1940 the Canadian commission presented to the Dominion Government authorities a preliminary report covering its findings to that date. At about the same time, the United States commission issued a report, which used the preliminary Canadian report as a basis for its information on routes through Canadian territory.

ALTERNATIVE HIGHWAY ROUTES  
SELECTED FOR  
PROPOSED HIGHWAY TO ALASKA

SCALE OF MILES  
MILES 50 0 50 100 MILES



The Canadian commission presented its main report in November 1941, and it was tabled in the House of Commons on November 13th, 1941, and in the Senate on January 21st, 1942.

In its report the Canadian commission found that north from the existing east and west highway connecting Prince George and Hazelton, two main routes through British Columbia and the Yukon Territory were acceptable from the engineering standpoint. Both these routes take advantage of the north and south trend of drainage in British Columbia, this feature being an important factor in keeping estimated costs to a reasonable figure.

One of these routes, designated as "A", leaves the existing road system at Fort St. James and follows approximately the centre of the province. It traverses the valleys of Stuart and Takla Lakes, the Driftwood River, and the Skeena River. Leaving the latter near its source it follows the Klappan River valley to the Tanzilla River east of Telegraph Creek. From this point the Tuya River valley and the country in the vicinity of Gun and Disella Lakes is followed to the Atlin Lake drainage basin. The east shore of this lake and Lake Marsh is then followed to Whitehorse. From the Klappan River north, the "A" route conforms to the route regarded as practical by the 1931 Fact Finding Committee.

From Whitehorse there are two possible routes, one striking westerly to Kluane Lake and then north-westerly to the Alaska boundary, and the other following approximately the established overland route through the Yukon to Dawson and thence west to the Alaska boundary by the upper valley of Sixtymile Creek.

The first alternative is favoured by the United States commission since it reports an easier location through Alaskan territory; the second by the Canadian commission in view of its greater benefit to the Yukon Territory. Mileage of new road in Alaska is approximately the same by either route.

The "A" route as described has the advantages of medium precipitation, scenic value, and accessibility to areas with natural resources in minerals and timber. It affords attractive new fishing and hunting districts and the promise of some ranching areas. Satisfactory grades and alignment are possible without excessive cost.

The other route selected by the commission is well to the east of "A" and is known as the "B" route. It utilizes, north of Prince George, B.C., the Rocky Mountain Trench or its extension, which the Canadian commission states in its report is "a feature with great advantages from the highway or railway location standpoint."

Leaving the existing road at Prince George, "B" route goes northerly via Fort McLeod, Finlay River, Sifton Pass, the Kechika River and the Liard to the Frances River. Following up this stream it skirts Frances Lake and reaches the Bering Divide by way of Finlayson Lake. North of the Divide it strikes the headwaters of the Pelly River and follows this stream to where, near Pelly Crossing, it joins the "A" route, following it to Dawson and the Alaska boundary.

The "B" route is shorter and more direct than the "A" route, and would have the advantage of lower construction and maintenance costs.

While not as centrally located from the geographic standpoint as the "A" route, it would afford reasonable accessibility to mineral areas in central British Columbia, is subject to very moderate precipitation, and presents no difficulty in regard to grade and alignment. The topographical features of the country lend themselves to easy building of pioneer or tote roads, which would facilitate the undertaking of main construction operations.

Climatic conditions along "B" route are favourable from the standpoint of air transportation. The air route between Edmonton, Whitehorse, and Fairbanks, Alaska,

crosses it at Watson Lake, and there is contact at Prince George with the air line from Vancouver.

From the military standpoint, "B" route is well to the east of those coastal areas that might be subject to attack, and lends itself to rapid construction to any standard in case of emergency. The location of this route in the eastern part of the province also makes possible convenient connections with the Peace River Block and the province of Alberta.

Inspector Moodie, of the Royal North West Mounted Police, on his historic overland trip in 1897-98, from Edmonton to Fort Selkirk, Yukon Territory, blazed a trail that from Finlay Forks north is practically the "B" route. Moodie's party made a westerly diversion into Dease Lake, following down the Dease River to Lower Post on the Liard River, otherwise the general route is the same. In his 411-day journey the inspector travelled 1,800 miles, recording carefully the features of the country traversed. His topographical sketch map is remarkably accurate, and with his diary, would furnish ample guidance for anyone ambitious enough to follow in his footsteps.

It is likely that a route fairly near the Pacific coast was in the minds of the first supporters of the Alaska Highway, as such a route, if feasible, would afford the possibility of short lateral connections to Pacific coast settlements. Early in the investigations, however, it became evident that such a route was impracticable because of heavy precipitation and unfavourable topographical features. Climatic conditions were also unfavourable from the stand point of air transportation. The coast range is a very formidable obstacle to any east and west highway that might be considered north of the 55th parallel, and the report states that "even if expensive surveys revealed locations on which a road might be built, the cost of construction and maintenance, combined with a short season, would in no way be justified by the advantages that might be gained."

In developing the two general routes finally selected, the commission made preliminary investigations of a large number of alternative locations, of lengths varying from 5 or 6 miles to as much as 60 miles. One important alternative on "A" route was only considered practical after winter reconnaissance had established that snow conditions were not as bad as indicated by first reports. In many cases, final decision as to the best general location must await the outcome of location surveys. In this respect, the report states that "all estimates of costs given . . . are based on reconnaissance surveys, and are therefore necessarily only approximate. Before construction could begin, location surveys would be necessary to decide on the final location of the road where certain alternative routes are available and to confirm and enlarge information already obtained."

It was appreciated by the commission that neither the time nor the funds available permitted estimates of cost to be based on actual location surveys. The preparation of these estimates is thus interesting, in that the commission believes fairly reliable figures have been secured through careful ground reconnaissance supported by air observation. In the main reconnaissance flights, planes flew at a constant elevation in relation to the ground, and the type of country was carefully noted. Information so obtained was supplemented by aerial photographs taken at numerous points. Ground reconnaissance parties travelled over various sections of the same routes, and their findings in regard to topography, forest growth, drainage, and nature of soil were compared with the conclusions reached through aerial observation. Before investigations were completed, practically all of the "A" and "B" routes were covered by ground reconnaissance surveys, some sections being covered more than once and by different engineers.

Some eight engineers in all undertook ground and aerial reconnaissance, all of whom had had location or construction experience in terrain similar to that through which the highway would pass. The cost estimates of these engineers were then compared and adjusted so that the resulting figures would reflect with reasonable accuracy the character of the country traversed. Such estimates were adjusted on the basis of actual cost figures that were available in Dominion and provincial records for construction in similar types of country and with comparative climatic conditions. All estimates were based on a finished graded road 24 ft. in width, with gravelled surfacing 20 ft. wide.

The commission was careful to emphasize in its report that the estimates were based on wage rates, and material and equipment costs, that prevailed in British Columbia and the Yukon in April 1940, and records of such figures were kept for further reference. Under this arrangement, estimates can be quickly revised to cover construction at any period by comparing current wages and material costs with those prevailing in April 1940. The latter date was chosen for basic costs as a good many estimates had been prepared by that time, and as it antedated increased costs and taxes arising from the war.

A summary of estimated costs of "A" and "B" routes is given herewith:—

#### ESTIMATED COSTS

24-foot grade with gravelling 20 feet wide. Based on wages, material, and equipment costs as prevailing in April, 1940.

<b>"B" Route</b>		Miles	Cost
Section 1	Vancouver to Prince George, B.C., via existing highways (Improvement and revision) . . . . .	525.5	\$4,710,000
Section 2	Prince George to Yukon boundary, via Summit Lake (New construction) . . . . .	526	7,900,000
Sections 3 4 and 5	Yukon boundary to Dawson . . . . .	586	8,310,000
Section 6	Dawson to Alaska boundary, via routes "A" and "A-1" . . . . .	68	1,880,000
TOTAL . . . . .			\$22,800,000
Engineering and contingencies (10% approx.) . . . . .			2,200,000
TOTAL—Vancouver to Alaska . . . . .		1,705.5	\$25,000,000

#### **"Central A" Route via Dawson**

Section 1	Vancouver to Fort St. James, via existing highways (Improvement and revision) . . . . .	639.5	\$ 5,760,000
Section 2	Fort St. James to Yukon boundary (New construction) . . . . .	736	12,170,000
Sections 3 4 and 5	Yukon boundary to Dawson . . . . .	458	6,790,000
Section 6	Dawson to Alaska boundary, via routes "A" and "A-1" . . . . .	68	1,880,000
TOTAL . . . . .			\$26,600,000
Engineering and contingencies (10% approx.) . . . . .			2,600,000
TOTAL—Vancouver to Alaska . . . . .		1,901.5	\$29,200,000

#### **"Central A" Route via Whitehorse and Kluane Lake to Mirror Creek**

Section 1	Vancouver to Fort St. James, via existing highways (Improvement and revision) . . . . .	639.5	\$ 5,760,000
Section 2	Fort St. James to Yukon boundary (New construction) . . . . .	736	12,170,000
Section 3	Yukon boundary to Whitehorse . . . . .	76	1,170,000
Section 4	Whitehorse to Alaska boundary at Mirror Creek, via Kluane Lake . . . . .	307	4,000,000
TOTAL . . . . .			\$23,100,000
Engineering and contingencies (10% approx.) . . . . .			2,300,000
TOTAL—Vancouver to Alaska . . . . .		1,758.5	\$25,400,000

The estimates provide for the construction of from 1,100 to 1,260 miles of new highway, depending on the route taken, and the improvement to the standard required of the existing highway from Vancouver to Prince George or Fort St. James, as the case may be. Some fairly substantial revisions in existing roads are provided for.

The commission's report deals only with possible routes through British Columbia and the Yukon. Since it was submitted, war with Japan has made the Alaska Highway a live question for defence authorities, and introduced a new factor, namely that of building a highway primarily for military purposes. This involves consideration of possible routes through other areas in the Pacific northwest in the light of advantages they might afford in this particular respect.

Since the commission's instructions did not include examination of routes east of the Rockies, the absence of information in its report on possible routes through northern Alberta does not necessarily mean these do not exist. The report, however, reviews at some length existing and possible road connections between the northern highway systems of Alberta and British Columbia.

That there will be benefits to Canada from the construction of the Alaska Highway cannot be doubted. Natural resources in much of the country traversed are wholly undeveloped, and these will attract a great deal of attention after the war. With the opening up of vast new areas for motoring, hunting, fishing, and other recreational purposes, the tourist traffic field offers great possibilities. Whether or not Canada will be paying too much for these opportunities, will depend on what arrangements can be made to meet construction costs.

When the highway will be built is not known at this time. It is a matter of international policy that will be governed by events. It is conceivable that the defensive and offensive strategy of the Allied Nations may make it a vital issue over night, and will also determine the route on which the road must be built. On the other hand, it may be destined to take its place as a post-war project, contributing to the development of a Northern Empire.

# THE WAR ACTIVITIES OF THE NATIONAL RESEARCH COUNCIL OF CANADA

C. J. MACKENZIE, M.E.I.C.

*President, The Engineering Institute of Canada, 1941; Acting President, National Research Council, Ottawa*

**Retiring address delivered at the Annual General Meeting of The Engineering Institute of Canada, at Montreal, on February 5th, 1942**

Tradition and custom prescribe a presidential address at the end of a year of office but neither precedent nor practice restricts the form it may take. The presidency of The Engineering Institute of Canada is essentially an honour and distinction; the administrative accounting and history of the year's activities have been presented in the report of the general secretary who is the chief executive officer of the Council.

In the more leisurely days of peace, presidents often chose for discourse some question of general interest to the profession, treating it in a philosophical manner reflecting long interest and matured thought. Other past-presidents have presented at length valuable technical contributions to the literature of our profession, arising out of their personal work and experiences. Neither of these alternatives seems appropriate in February 1942 when practically the entire world is locked in deadly conflict in a fight to the finish between two diametrically opposed ways of life. The issues are so grave, our perils so great, that it seems to me, if we are to survive, our thoughts must not wander far from the immediate tasks before our hands. Military experts know well that to make good soldiers they must be taught to think continually in terms of war and, by the same token, if in this totalitarian struggle we are to win, most of us civilians must put aside for the moment strictly peacetime interests and speculations, and concentrate intensely on war activities and objectives.

This morning, therefore, I intend to speak of the war activities of the National Research Council of Canada, but, before entering formally into my subject, I would like to acknowledge the great honour I have felt in being your president for the past year. The presidential office of the Institute carries with it honourable traditions and every new incumbent finds his path made bright by the reflected glory of a line of great past-presidents, and his duties made light by the invaluable and freely given advice and guidance of his immediate predecessors. It is also a pleasure to pay tribute to the active vice-presidents whose responsibilities are real, not nominal, and all of whom have made my year easier by their loyalty and devotion to duty. It was my good fortune to visit most of the branches from Halifax to Vancouver and everywhere I was impressed with the fine work branch chairmen, secretaries and executives are doing, and also with the high quality of the membership at large, their interest and their enthusiasm. In the four provinces where co-operative agreements have been reached with the local provincial professional associations there is a complete and amicable merging of professional life and to me personally one of the most outstanding Institute events of the year was the signing in New Brunswick, the province of my birth, of an agreement between The Engineering Institute of Canada and the professional association.

The committees of the Institute all deserve commendation but I would like to pay special tribute to the chairman of the Montreal Branch and his committee on their contribution to the Building Fund; the performance of the branch was magnificent and its success a personal tribute to R. E. Heartz, the branch chairman.

An Institute such as ours depends for success more on its general secretary than on its presidents: The Engineer-

ing Institute has been fortunate in its general secretaries, and Mr. L. Austin Wright is maintaining the high tradition of that office. To him goes the credit of administering the affairs of the Institute in a most efficient, effective and agreeable manner; his innate courtesy, his kindness coupled with enthusiasm, loyalty and energy have gained for him and the Institute the confidence and friendship of branch officers and the entire membership across Canada. This year without extra compensation he has voluntarily carried a double burden and his war service as assistant director of the Wartime Bureau of Technical Personnel has been a great credit to him personally and to this Institute.

## THE NATIONAL RESEARCH COUNCIL

The National Research Council to-day probably touches as many aspects of Canada's war effort as does any other agency and the ramifications of its direct and associated activities extend to nearly every field of scientific research and development work in connection with our war effort both civil and military. The reason for this is that, while the Council operates directly extensive research laboratories, it was not designed for that particular purpose but was set up to serve as the Government's agency for the stimulation and co-ordination of co-operative scientific and industrial research in Canada. It carries no mandatory power to enforce the acceptance of any of its research findings; its function is to assist, advise and organize research projects. It does not compete but co-operates with universities or other private or governmental scientific laboratories, and the actual investigational work is done wherever the best facilities are available. That this method of co-ordinating research in a country of Canada's size is sound has been proved by the way the Research Council has been able to mobilize the nation's scientific resources to meet the war emergency.

## GENERAL HISTORY

I propose to sketch briefly the origin and early history of the Council to indicate how, in September 1939, it was transformed for war service, and, within the limits of security restrictions which prevent the disclosure of the most interesting details, to present a general picture of the war projects underway.

The National Research Council was established in 1916 on the suggestion of the Imperial Government that the Dominions should create a scientific organization to co-operate with similar organizations in Britain in order to correlate allied war research. Brought into being in one war which it was too young to serve, it developed and matured in the intervening years of peace and was ready and competent when called upon for service in a second war in 1939.

Until 1932 the functions of the Council were restricted to granting financial aid to research students and workers in the various universities and organizing and supporting co-operative research programmes of a national character which were carried out in laboratories across Canada. In 1929, under the wise and experienced guidance of President H. M. Tory, plans were drawn and in 1932 the Council's own laboratories were opened in Ottawa and these added facilities permitted a rapid expansion of investiga-

tional work and scientific standardization in Canada. From 1935 to 1939, under the able and brilliant presidency of Lt.-Gen. A. G. L. McNaughton, the National Research Council Laboratories were extended and in anticipation of inevitable war more attention was paid to co-operation with the Department of National Defence on military problems. When hostilities broke out in 1939 Canada had in the Research Council a virile, enterprising, rapidly growing institution with a young but highly qualified and experienced staff particularly suited for adaptation to the urgent scientific needs of war.

#### ORGANIZATION

The Council's activities can be divided broadly into three main categories. Granting financial aid to individual workers in pure science and scholarships to research students at Canadian universities; supporting and directing co-operative researches across Canada through the medium of Associate Committees, and thirdly the administration of its own extensive laboratories in Ottawa.

By its policy of grants in aid of research and of scholarships over a period of 20 years, pure research centres have been fostered and nearly 1,000 of the country's most brilliant students have been assisted in their graduate work. A really remarkable result, which is often overlooked, is that in the present emergency, when scientific personnel is so much in demand, Canada has been able to supply all of its own needs, and in addition give aid to Britain.

The organizing of co-operative researches through the medium of Associate Committees is one of the Council's most useful functions. By this governmental device many major research programmes of significance have been successfully carried out. To cite only one or two examples, aeronautical research in Canada has long been directed by an Associate Committee headed by Air Vice-Marshal E. W. Stedman, M.E.I.C., and composed of expert officers of the R.C.A.F., the Department of Transport, civil air-transport companies, aircraft manufacturers, the Meteorological Service, the Department of Mines and Resources, universities and the National Research Council. The operation of the Associate Committees on medical research is another excellent example of projects administered in this way, where the entire research studies are carried out in the various medical research laboratories of the Dominion, and where the committees bring together experts from the medical schools, the profession, the armed forces and the many scientific branches of departments of the Government.

Altogether there are over 30 Associate Committees in active operation in such widely diversified fields as field crop diseases, storage and transport of food, laundry research, coal classification, metallic magnesium, industrial radiology, radio, fish culture, and oceanography.

Since war broke out many special committees have been set up such as those on gauge testing, wooden aircraft construction, gasoline substitutes, and high explosive testing, which deal with special and secret projects of interest to the services and the Department of Munitions and supply.

In all such extensive programmes of national interest there is the most intimate and cordial co-operation of the well-equipped and competently staffed Mineralogical, Metallurgical and Forest Products Laboratories of the Department of Mines and Resources, the extensive laboratories of the Department of Agriculture, the National Research Council Laboratories and other government, university and private laboratories of the Dominion.

#### NATIONAL RESEARCH COUNCIL LABORATORIES

In the National Research Council Laboratories there are four research divisions—Mechanical Engineering, Physics and Electrical Engineering, Chemistry, and Applied Biology, each headed by a director who carries the

professional responsibility of directing all research in his division. There are also sections on Research Plans and Publications, and Codes and Specifications.

#### DIVISION OF MECHANICAL ENGINEERING

The Division of Mechanical Engineering under Mr. J. H. Parkin, M.E.I.C., is essentially an aeronautical engineering laboratory. In peacetime, this division was busy with aerodynamic problems relating to civil aviation, wind tunnel and model basin testing, studies on skis, floats and a variety of special assignments. In the engine testing, gasoline, lubrication and fire hazard testing laboratories well qualified and trained staffs were engaged on civil work. When hostilities broke out, strictly peacetime problems were curtailed and with little dislocation the emphasis placed on problems directly related to war. The division has expanded, new laboratories have been built and the staff is busy with a growing programme of work covering a wide field; in addition to the study of aerodynamical and wind tunnel problems, a comprehensive investigation of plastic plywood construction for aeroplanes is underway, calibration and repair of aeroplane instruments continues, and studies of gasolines and lubricants both for planes and tanks have assumed large proportions. With the growth of the aeroplane industry in Canada, an increasing number of problems are arising and the new, well-equipped engine testing laboratory, where facilities are available for testing engines equipped with propellers, will soon be enlarged to permit the full scale testing of the largest engines now in use.

In addition to laboratory investigations, experimental studies with full-scale aircraft are made in co-operation with the Test and Development Establishment of the R.C.A.F. where a wide range of special devices and developments are tested in actual flight and many important and extensive programmes such as those on de-icing are carried out.

The Model and Instruments Shops, as originally planned, were designed to serve the needs of all the divisions for experimental equipment and instruments, but the war has brought a heavy demand for the design and manufacture of special gun sights, a large range of secret ordnance and other special service equipment. Moreover, work on gauges for the Department of Munitions and Supply has been undertaken and when the extension now being built is finished the shop will be equipped to handle a shift of 100 mechanics, and if, as seems probable, it is put on a 24-hour basis it will become in essence an industrial shop employing several hundred highly specialized mechanics.

#### DIVISION OF PHYSICS AND ELECTRICAL ENGINEERING

The Division of Physics and Electrical Engineering under the director, Dr. R. W. Boyle, M.E.I.C., is one of the largest and most interesting divisions, and has grown rapidly during the war. In the years prior to 1939 its principal function was that of a Bureau of Standards. The sections of metrology, electrical measurements, optics, acoustics, heat, radiology, radio and general physics were responsible for setting up Government standards and maintaining the official units such as those of mass, length, and of many others in electricity, light, heat and sound. In addition to this high grade type of standards and approval work, the division had started a number of investigational projects in the fields of radio, vibration, ballistics, aerial photography, etc., and when the war broke out was in the fortunate position of being well equipped and staffed with competent and experienced staff particularly well suited to meet the great demands that war has placed on physicists.

It is possible to mention only a few of the major activities. The metrology section which is responsible for maintaining the standards of length undertook the task of

Setting up a gauge testing laboratory so necessary in munitions production. Early in October 1939, in anticipation of the demands which it was known would materialize, an Associate Committee on Gauges was set up with representatives from the Department of National Defence, the J.K. Inspection Board, the Supply Board (now the Department of Munitions and Supply), the Ontario Research Foundation and the National Research Council. Decisions were taken as to the equipment which would probably be needed, orders were placed at once to equip laboratories at the Ontario Research Foundation and the National Research Council, and arrangements made to select and train staffs in anticipation of future demands. This procedure proved wise, and to date the gauge examination laboratories operated by the Ontario Research Foundation and by the National Research Council have been able to meet all demands. The National Research Council laboratory has increased steadily and is still expanding. At present there is a staff of over 70, mostly women, and to date over 2,000 different types of gauges have been measured.

The Optics Section at the outbreak of war, in co-operation with representatives of the Master General of the Ordnance and latterly with officials of the Department of Munitions and Supply, undertook a survey of the possibilities of the manufacture in Canada of optical glass and fire control instruments. Visits were made to establishments in the United States, and laboratory equipment for cutting, grinding and polishing glass was installed and experience gained in the art. In the summer of 1940 the Department of Munitions and Supply decided that it would be wise to undertake manufacture in Canada on a sizeable scale, and it became apparent at about the same time that in the radio field much equipment of a secret nature developed by the Research Council would also have to be manufactured in mass quantities and the Department of Munitions and Supply decided to set up a Government-owned company for these purposes. As a consequence, Research Enterprises Limited was established, and under the energetic, competent and enterprising direction of the president, Colonel W. E. Phillips, is now, in record time, in production on a very large programme of optical glass, fire control instruments and special equipment.\*

The Optical Section of the National Research Council is now working on many important secret developments in connection with aerial photography and the design and construction of optical devices for synthetic training equipment and many other purposes.

The Radio Section has been one of the most spectacular developments of the Council. Starting with only a few men in 1939 it now employs nearly 300 and has already produced for the forces of Canada and the United Kingdom many important secret devices in the field of radio location, and has developed prototypes of many equipments for reproduction by Research Enterprises Limited.

The sections on general physics, acoustics and electrical engineering are engaged on important work for the Navy and Army in connection with anti-submarine, anti-mine, ballistics, sound ranging, electrical plotting and many other technical and scientific aspects of warfare. In addition to the laboratories for naval work at Ottawa, stations have been established at two centres on the eastern coast and one on the western coast of Canada.

Investigational and standardization work in the technique of x-ray examination of metals carried on in co-operation with industrial firms has been of the greatest value in connection with light alloy casting production for the aircraft industry, and steps are now being taken to work out similar procedures in the heavy metal field.

In the Heat Laboratories investigations in connection with the de-icing and defrosting problem of aviation are

being actively pursued and studies have been made of the possible use of infra-red radiation.

#### CHEMISTRY DIVISION

The war work of the Chemistry Division, under Dr. E. W. R. Steacie, can be divided generally into three broad groups: chemical warfare, emergency production of materials urgently required, and a general advisory consulting service in connection with preparation of specifications, testing and reporting on a wide range of materials.

The work on chemical warfare is carried on in the closest co-operation with the Department of National Defence, and all phases of this work are covered in a most comprehensive manner by the integrated effort of the two bodies. Active work on selected problems is being carried out at 13 Canadian universities and the Ontario Research Foundation, and large programmes are underway not only at the National Research Laboratories but at several other stations and laboratories in Canada.

Some idea of the work done by this division in connection with materials may be had from the fact that this year over 3,000 reports have been made to the Departments of National Defence and Munitions and Supply on different questions referred and samples submitted.

The textile laboratory has been particularly busy in testing, writing specifications for and advising on army uniforms and clothing, parachute fabrics, impregnating and gas proofing of materials. The rubber laboratory has investigated a variety of products used for the armed forces and has studied a total of seventy different substitutes for rubber.

In the colloid section a great deal of work has been done on plastics for use in plastic plywood construction and several special developments have been made involving the substitution of plastics for metals in connection with military needs.

The work of the paint laboratory has increased many fold and tests have been carried out on hundreds of different special paints used by the services.

In co-operation with a group of industrialists a process for the production of metallic magnesium, developed by a member of the Council's staff, has been carried through the pilot plant stage. Limited quantities of very pure magnesium have been sold to the Department of Munitions and Supply regularly for some months. The process is receiving keen attention from interested bodies and large scale production plants, both in Canada and the United States, are being designed for early construction.

Numerous other problems are being studied, such as the corrosion of aluminum and steel alloys, the manufacture of various components of gas masks, asbestos products, and the development of special gas indicators. Several small plants have been built for the production in small quantities of fine chemicals and such urgently needed materials as special fuse charcoal.

In addition to actual laboratory work the officers of the Chemistry Division have spent much time, at the request of the Departments of National Defence and Munitions and Supply, in preparing Canadian equivalents of British material specifications to bring them into line with Canadian production methods.

#### DIVISION OF BIOLOGY

The Division of Applied Biology, under Dr. W. H. Cook, has been used extensively on war work, chiefly in connection with the handling and transportation of perishable foods under the restricted shipping facilities resulting from the war. A contribution of major importance has been made in the development of a method of low cost temporary refrigeration of ordinary ships holds which has already permitted large quantities of bacon to be shipped satisfactorily to England.

\*A paper on this project by Col. W. E. Phillips appears on pages 129-135 of this issue.

The general problems of preparing, processing, packing and preserving foods for transport are being intensively studied and the shortage of refrigerating space on ocean vessels has made doubly urgent the studies on preservatives for bacon and shell eggs. Methods for the drying of eggs and meats are also being actively studied, and canning processing methods have been improved and standards worked out.

#### GOVERNMENT SPECIFICATIONS

The Special Committee on Government Purchasing Standards, an organization set up in peacetime to prepare standard specifications for commodities purchased by two or more Government departments, has been found very useful in war. While the committee has no mandatory power to enforce adoption of its specifications, there has been general acceptance by the departments concerned, and in 1940 over 10,000 copies of different specifications were distributed on request, and in 1941 this figure increased to 17,000 of which 12,000 were distributed to war departments of Government and outside parties interested in war contracts. This committee apart from its normal functions has placed its staff and organization at the service of the Department of National Defence and has given advice and assistance in the preparation of many special specifications.

#### MEDICAL RESEARCH

Medical research has developed rapidly in Canada during the war and the initiative and impetus originally given by the late Sir Frederick Banting has been maintained by Dr. J. B. Collip, Colonel Duncan Graham, and Dr. C. H. Best as chairmen of the Main Associate Committee on Medical Research and the special ones on Aviation and Naval Medical Research. The main committee has tended more and more to direct its research to problems of war importance and valuable results have already been obtained on shock, blood substitutes, wound infection, and other aspects of medicine and surgery accentuated by war.

The Committees on Aviation and Naval Medical Research are not concerned with disease but with health; their interest is not with medicine as a healing art but with means of lessening the physiological strains under which aircrews and sailors must operate in order to increase their efficiency and security. Work of the greatest importance has already been done to overcome the natural handicaps of low partial oxygen pressure and low temperatures encountered at high altitudes, and the effects of exposure to unnatural forces, noise and fatigue on both ships and planes. Numerous other problems in connection with selection, diet, and general health are being attended to in intimate co-operation with the medical services of the three armed forces.

#### LIAISON

As has been indicated, all of the war work under the Research Council in Canada is done in the closest co-operation with officers of the defence departments. Problems and suggestions for study originate in many ways; most arise directly out of needs felt by the services but many of the important developments have originated in scientific laboratories or have been suggested by in-

dividuals. But no matter where the studies originate, all proposed developments are thoroughly canvassed at an early date, not only as to their scientific soundness but as to their tactical usefulness, the requirements of service operations and what is becoming of greater importance daily, the possibilities of obtaining production in quantity in a reasonable time. This procedure ensures that Canada's limited resources will not be dissipated in investigations of questionable use in this war.

The scientific departments and professors of the universities of Canada have been of the greatest service. While staffs have been depleted by the drafting of individuals to many important positions, those left, in addition to increased teaching burdens, have undertaken still further work and at the present time nearly every university in Canada is co-operating with the National Research Council, and over 70 different research problems, many of the greatest importance, are being solved in the different Canadian institutions. When the detailed history can be written it will be found that in the field of war research the universities of Canada have made a contribution of first magnitude.

Effective liaison is also closely maintained with war research establishments in the United Kingdom and the United States. The British Government has maintained a liaison office at the National Research Council since early in 1940 and the chief scientific officer has always been a distinguished and senior scientist well informed on all phases of war work. The National Research Council maintains a permanent liaison office at Canada House in England and through these two offices all reports of work done are immediately available to workers in the respective countries. In addition, experts are continually crossing the Atlantic and, since 1940, 35 expert scientists and engineers from the Council have spent periods varying from a few weeks to months in England in order to bring back the most up to date information from their laboratories and research stations.

A similar and even more intimate liaison has existed between scientific stations in Canada and the United States ever since the summer of 1940 and experts from our respective countries visit freely and frequently laboratories and stations across the border. On many important projects, co-operative action is obtained by an actual exchange of personnel on committees.

#### CONCLUSION

As a concluding summary it can be said that war has greatly increased the activities of the National Research Council. At present over 210 different projects are being vigorously attacked; the staff has grown from less than 300 to over 1,000, the yearly expenditures have increased four fold and the direct expenditures this year will be over \$4,000,000. The interests and activities cover a wide field and touch nearly every phase of the war effort. The close liaison and co-operation at home with the services, government departments and agencies, and abroad with research stations in the United Kingdom and the United States, guarantees that the research facilities of Canada are being well and realistically focussed on important and urgent problems and it can be said that results of great value and significance are being obtained.

# A MESSAGE TO CANADIAN ENGINEERS

LIEUT.-GENERAL A. G. L. McNAUGHTON, C.B., C.M.G., D.S.O., M.E.I.C.

*Officer Commanding, Canadian Army Corps, England, and President, National Research Council of Canada.*

An address delivered at the Fifty-Sixth Annual Banquet of The Engineering Institute of Canada, at Montreal, on February 6th, 1942.

You must forgive me to-night if the warm welcome you have just given me has made it almost impossible to address to you any coherent message, except that which comes straight from the heart.

I feel on many counts that this, for me, is a most memorable occasion. I recall the words that have been said to me by the mothers and the sisters of the men in the Canadian Corps who stand on guard in the great island of Britain. They remind me of my responsibility for looking after those men and seeing that their lives, which have been given as hostages to fortune, shall be used in the way that they should be, in order to bring to an end the terrible calamity which now afflicts the world.

The words of the presidents of the American engineering societies have greatly impressed me. Every one of them has the vision which looks beyond the trials and tribulations of the present to the great task which faces us when the dictator powers, with the forces of evil they have let loose on us, shall have been brought into subjection and we are free once more to resume the onward march of civilization.

In the dire straits in which we stand to-day it is a great inspiration to receive that message of hope and that challenge to use engineering for the purpose for which engineering should be used, the happiness of humanity. That purpose should be uppermost in the minds of all engineers.

I feel too, in coming here tonight, that I have an opportunity to acknowledge publicly the great debt of gratitude which I owe to the distinguished engineer who now occupies the chair as president of this Institute.

Some years before the outbreak of war, it had been my lot to leave active military work and become president of the national Research Council of Canada. The work was of a most enthralling nature, and of a character which interested me deeply as an electrical engineer. I was supported by a splendid staff that had been gathered there, which I inherited. In fact the position was one which should completely satisfy the aspirations of any engineer. The opportunities for useful service were abundant, and were opening day by day in front of us; we had the sympathy of the members of the Government—both the Government that was then in office, and the Government that succeeded them. There was every possibility of doing something that was worth while.

Then the shadow of war appeared on the horizon, and it fell to my lot, through past experience and past service, to be given the honour of taking our First Division overseas. When I was sent for by the Prime Minister and heard of the obligation which was to be placed on my shoulders, my greatest anxiety was as to what would happen in the Research Council. As I listened to that invitation to undertake the new task, the names of many possible successors passed through my mind in quick review. It was soon clear who that man should be.

Actually I made Dean Mackenzie's appointment one of two conditions that were attached to my accepting office as a soldier again. And all the time, through the long



Lieut.-General A. G. L. McNaughton, C.B., C.M.G., D.S.O., M.E.I.C.

months that we have been away, he has been good enough to send me each month a running account of what was going on. In each of his letters one could see the seed of the purpose which we had held in our mind before in the Research Council growing, coming to flower and bearing fruit, not only in implementing the war effort of the Dominion of Canada, and contributing to the war effort of Great Britain and of the sister Dominions, but also in the constant thought that the organization which was growing would be of service in the years that are to come, beyond the war.

Standing here tonight, with a very considerable knowledge of the situation, I can say that one of the happiest thoughts in my mind is the feeling that the National Research Council, and all it stands for under Mackenzie's

leadership, is performing that duty of scientific leadership and helpfulness in the way in which it is being carried out to-day. And it is indeed fortunate for the Dominion of Canada, for the Empire, and for all those associated in the war effort that it should be so. For, as one of the speakers has already said, this is an engineers' war. We have to do more than follow the patterns of existing weapons and implements of death. These were developed slowly in the years of peace—far too slowly in the democratic countries, because we neglected our defence and we put our trust in the pledged word. We could hardly conceive of the villainy of people who would deliberately plunge the world into the agony in which we find ourselves at the present time. It was unbelievable, and in consequence we neglected our defence. So we started not only with weapons short in quantity, but with weapons and tools of war that were antiquated in design. Now we must equip our forces with new and more effective weapons.

This is a war in which the development in the whole of the Axis countries of the powers of science, of engineering and art and everything else, has been focussed by our enemies on one purpose only, and that is our death. To meet that we have to focus our own attention likewise, to insure that we will emerge triumphant, as we will.

Now we have taken the patterns of equipment and so on that were available to us at the outbreak of war in our country and the other countries of the Empire—and we are happy to say, in the United States also—and our industry has been converted from peace-time uses to produce and improve those weapons and articles of war.

But it seems to me, as I move about, that I can detect some little complacency as to what has been done. It has been a great achievement. Nobody knows that better than we who have had to stand on the front, awaiting the perils of invasion from the theatre of war on many occasions without weapons in our hands at all, knowing that the weapons were coming forward, and now seeing the supply arriving in abundance. But this is not enough.

One of the primary reasons of my return to Canada at this time was to carry a message to Canadian industry and to the Canadian engineers that we want to win this war, not by the blood of our sons—and our daughters, because our daughters stand in the line as well—but by

our intelligence. We must take our wits and put them to work, and the engineers must not only think out newer weapons, and better types of weapons, but must forge them and design them so they can be mass-produced; industry must give these newer and better weapons in the vast quantities which we shall need in order to bring this chaos to a satisfactory conclusion without the expenditure of more than is necessary of the precious lives that have been entrusted to our care.

We have to win this war by our wits, and it is through our wits, and through intelligence in the production of newer and better weapons that we should win it. I appeal to The Engineering Institute of Canada, and to all those associated with us, to see that we never rest content, and that there is no complacency in this eternal struggle for better, more powerful, more far-reaching weapons.

This is a mechanical war. We appeal to you for tools with which to multiply the power and the speed of man to add to the range and effectiveness of the weapons which are created and put in our hands, and to give us that equipment in quantities.

It is true that many engineers are with the Forces overseas. But we have need of many more engineers to handle the complex machinery we are about to use.

At the moment the Canadian Forces are standing on guard in Britain. They are doing so because the best authorities in the land, including the Prime Minister of Great Britain, have said that that was the task we should perform. The war will not be won by standing on guard. We have been given a period of grace while we are doing one task, and we have got to use that period in order to forge these more powerful weapons, and the organizations to handle them, and that is what the Canadian Corps is doing to-day.

I have described its purpose more than once. It is to be a dagger pointed at the heart of Berlin, and that is the description which I think best fits the case, because the time will come when we can use that instrument to put an end to this tyranny and this menace which afflicts the world.

To my many old friends here—including my old friend, Jack Mackenzie, Mr. Fairbairn and Mr. Challies, and those with whom I have been privileged to be associated on committees of The Engineering Institute, the Canadian Engineering Standards Association, and other bodies—may I say, I thank you from the absolute bottom of my heart for the welcome that you have given to-night to my wife and myself.



The Fifty-Sixth Annual Banquet of the Institute.

# CANADIAN INDUSTRY IN THE WAR

C. D. HOWE, HON. M. E. I. C.

*Minister of Munitions and Supply of Canada, Ottawa, Ont.*

A luncheon address delivered at the General Professional Meeting of The Engineering Institute of Canada, at Montreal, on February 5th, 1942.

When I received an invitation to address you on this occasion, I was placed in an embarrassing position. I could not show any possible discourtesy to my fellow engineers at a time like this, and especially at a time when I was receiving so much assistance, freely and generously given, from them.

But on the other hand, with the work of my Department and the additional time required for the session of Parliament, I felt that it would be impossible for me to prepare a paper. Therefore I agreed to speak on the understanding that I would not have a written document, and that I could speak to you quite informally about the work and policies of the Department of Munitions and Supply.

The idea of civilian buying for the armed services dates back to some three or four months before the war. For many years it has been the prerogative of the army, the air force and the navy to purchase their own supplies. However, while trying to cool up for this war before its outbreak, we found that the army was not properly organized to do the kind of buying that is required in modern warfare, and it was decided to set up a civilian body to do that work, with the title of the Defence Purchasing Board.

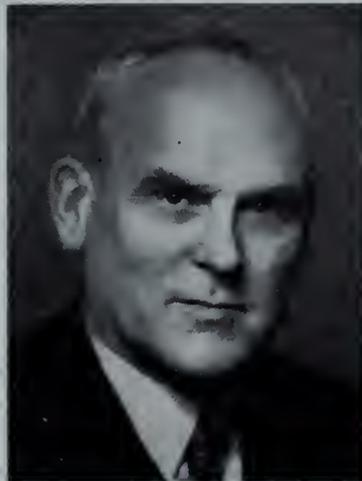
It was thought wise at the time to hedge this body about with restrictions. As yet there was no war, no one was in very much of a hurry, and it was felt that the public should be safeguarded in war buying by limitations of profits in several ways. But it was well understood that in the event of actual war the restrictions would be too onerous to permit the speed of operation necessary to meet the situation.

Therefore, after the outbreak of war, the Board was renamed the War Supply Board. At the same time, legislation was passed setting up the Ministry of Munitions and Supply, and charging the Minister with two duties; first, to purchase all the requirements of the Army, the Navy and the Air Force; and second, to mobilize industry for the maximum output of war munitions and war supplies.

I think that while our legislation in that respect was unique, we were fortunate in having hit upon a sound form of organization. It is interesting to note that quite recently Britain has come to our form of organization. The organization for buying in Britain as originally set up was based on three Ministries. The Ministry of Supply purchased the requirements of the Army, the Ministry of Aircraft Production purchased those of the Air Force; and the Navy did its own purchasing.

An over-riding Ministry has now been set up in Britain with jurisdiction over these three buying agencies, thus avoiding the difficulties that arose because the three services were competing for supplies with each other in the same factories.

There has also been a movement in the United States to change from buying by the services themselves to buying by a civilian agency. There seems to be a trend there towards the type of organization that we now have in Canada.



C. D. Howe, HON. M. E. I. C.

The early problems in the Department of Munitions and Supply were not the problems that we have to-day. You remember that the Department started from absolute zero. We first had to find an office, a typewriter and desk, and a stenographer, and then build up a competent organization.

Frankly, we were quite ruthless. We looked over the whole field of industry and business in Canada, and we picked out the men that we thought were most able to do a job in the new Department. Having practised engineering in Canada for a number of years, I had a very wide acquaintanceship among my own profession and throughout Canadian industry, and I used that acquaintanceship to help me in selecting the men who would work with me in the job at hand.

I am very proud of the organization that we have built up in Ottawa to handle munitions and supply problems. Its personnel now comprises over three thousand men and women. From the outbreak of war these men and women have not stinted the time or effort they have given to the work of the Department. You can drive by the Munitions buildings in Ottawa at any hour of the night and find lights burning and people working in a great many of the offices. We have been, I think, fortunate in attracting able people to our Department.

Our first task was to buy personal equipment, uniforms, and things that had to be furnished immediately.

Then we undertook to provide the munitions of all the types required by the Army and the Navy and the Air Force, and there we had a real problem. Canada is not a military country. In peace time it kept a very small nucleus of an army, practically no air force at all, and a navy which, I think, consisted of some thirteen or fourteen craft.

At first we had very little designing organization, and we had none of the plans and specifications and information required to produce types of munitions which were needed in the war, but which were new to this country.

In the last war we had developed the technique of making shells and components of finished rounds of ammunition, and we were able to tackle that problem fairly rapidly, so that our first progress was made in the field of ammunition.

We had at the Quebec arsenal a plant for making small arms ammunition, and we started immediately to expand that greatly. I think at the outbreak of war Quebec arsenals were making three million rounds of small arms ammunition a year. To-day they are making more than three million rounds every two weeks; this will give some idea of the expansion that has taken place in that particular field.

We also had a very efficient Canadian motor industry with a strong designing staff. Thus we were able to start very quickly in the making of the mechanized equipment for our army, which is required in such vast quantities for the type of warfare that we now have to provide for.

We have continued to expand that industry and I think to-day we have delivered over 216,000 motor vehicles of

army type, either to our own forces or overseas to the many theatres of warfare.

However, we had no experience in manufacturing guns in this country, except the old Ross rifle, which did not turn out so well. Therefore we had to call on the Old Country for technicians and for designers to enable us to set up a technique for producing guns of all types.

Just before the outbreak of war we had undertaken to make the Bren machine gun in this country. This project was under way when war began, but was the only step which had been taken to develop a gun industry.

To-day, we are building almost every type of gun used in the war, except the very large coast defence guns. We are building naval guns of every calibre; naval gun-mountings; 25-pounder field artillery; 6-pounder tank guns, anti-tank guns, and several types of heavy guns. In the field of automatic guns the Bren gun production is now more than three thousand a month, and we expect ultimately to reach 4,500 a month. We have stepped up the production of Colt Browning guns up to about 2,000 a month. The Bofors anti-aircraft gun is coming into large production; we are making the Sten sub-machine guns, and are producing great quantities of Lee-Enfield rifles.

The year before the war I think we turned out 200 aircraft. We had only a small industry working mostly on small planes for transport work, and one or two types of army planes. Today we are turning out planes at the rate of about 70 a week or 300 a month. We are independent now of outside help in furnishing planes for our great Air Training Plan, and we are also building several of the most modern types of planes that are used by the fighting forces. From a small nucleus we have built up a very strong aircraft industry.

In the field of shipbuilding, we formerly built ships to some extent in Canada, but during the depression years that industry reached a low ebb, and its activities had been confined largely to repair work. Trained mechanics were scarce and it was necessary to start gradually in stepping up production. However, we commenced immediately to build several types of naval ships. The corvette, which is a small edition of the destroyer, was put in hand, with several types of minesweepers, and also a great number of the small craft which are necessary as auxiliaries of the navy.

From some fourteen or fifteen vessels at the outbreak of war, our naval strength has now risen to about 330 ships of all types, and we expect that the year 1942 will see another large increase.

Then with the sinkings on the Atlantic, the Battle of the Atlantic was taking such a course that it was necessary to divert some of our shipbuilding capacity from naval work to the building of merchant ships. A programme has been established which for this year should produce almost as many new merchant ships as will be launched by the merchant shipbuilding industry of Great Britain; this I think is rather an accomplishment.

During the last war we built up an explosives industry, but, unfortunately, it was all scrapped when peace came and we had to start again from zero. Before making the explosives themselves, we had to provide for the manufacture of the many components of explosives, and we have to-day in that field built some twenty-five new plants, with an expenditure of about \$125,000,000. To-day we have an explosives programme large enough to enable us to cover our own needs, supply the deficiencies of Great Britain, and also help our friends in the United States with quite a quantity of chemicals and explosives of which they are short at the moment. I should say something about the help that we have received from science, from the scientists of Canada, and particularly from the National Research Council and its staff under the direction of Dean Mackenzie.

At the outset we knew very little about the many secret devices that have played such a great part in winning the Battle of Britain and fending off the attack of aircraft on that island. Dean Mackenzie undertook the work of developing that equipment and to-day I believe that Canada is not only abreast of Britain in the quality of its secret equipment, but at the moment possibly a step or two ahead.

We established a government-owned plant, Research Enterprises Ltd., to manufacture this apparatus, and have spent a good deal of money on it, but the results to-day are exciting the interest of every country that is taking part in this war on the side of the Allies.

I suppose Colonel W. E. Phillips has more technical visitors to that plant than come to any other plant we have. It is a revelation to see what he is doing there, for he has orders in hand for over \$100,000,000 worth of equipment of that type.

In addition, he has developed the manufacture of optical glass, so that Canada is making all the optical glass needed for her war instruments, such as lenses and periscopes. Here again, we are able to help out our Allies, by exporting certain quantities of optical glass.

Another triumph of the staff of Dean Mackenzie is the development of a new process for manufacturing magnesium. Magnesium is a metal very highly valued in the war, both as a light weight metal of great strength, and as a powder in connection with pyrotechnics and incendiary bombs.

Dean Mackenzie's organization has developed a plant that will produce magnesium with about one-half the capital expenditure of the old method, and that can be built in about one-half the time required for the chemical plants that have been producing magnesium up to this time. The new process will produce magnesium at about the same price as the older more elaborate method.

The United States are now faced with a shortage of that metal, and you will be interested to know that their programme involves the construction of a number of magnesium plants of the kind and type that have been invented by our own research laboratories. And we, ourselves, are building plants following that process, to produce Canada's magnesium requirements.

It has not been possible, of course, to build up this output of munitions without greatly increasing our production of raw materials. I think our aluminum production has been expanded five fold since the war began. We are now producing about 43 per cent of all the aluminum that is made in North America and we are supplying Great Britain with about 85 per cent of her aluminum requirements.

We are producing larger amounts of zinc and copper and lead, and all the lesser minerals that are essential to the war effort. Our production of steel in this country has more than doubled and we are still expanding that industry. We have multiplied the output of the alloy steels used for gun production by five since the war began, and it is still increasing. We have also stepped up greatly the output of brass which, as you know, is used for cartridge cases and a great number of war requirements.

We have kept abreast of the raw materials situation as well as we could, and have it fairly in hand, although we have still to depend on the United States for considerable supplies of steel.

Many problems have had to be met as we have gone along. One of the first of these was the method to be used by the government in expanding plants. Of course, in the early days it was not necessary to expand many plants. The task was rather to fill up the capacity that already existed, but very soon machine capacity had to be added to existing plants, and new plants had to be established.

Our policy has been to ask private industry to expand where we thought that the industry was strong enough to

be able to do the expansion at its own expense, and in those cases we have provided special depreciation to allow the war expenditure to be written off.

We have set up a Board which assesses the post-war value of a privately built improvement, and sets a figure and a rate of depreciation for the war expenditure. That is a method used where the industry itself is able to take care of its financial requirements for expansion.

In the matter of installing new machinery we have decided that the government would purchase the machinery and own it, place it in the plant, and reclaim it from the plant after the war period. I think we have purchased some \$60,000,000 worth of machinery which has been installed in plants and of which the government has retained ownership.

Where a new building has been required, or a new project required, it has been our policy that the government would build and own this requirement, that it be operated at cost, and that the management would be obtained by a management fee arrangement with an organization capable of providing that management. I think the government's investment in that type of plant to-day is in excess of \$600,000,000.

We own the land these buildings are put on. We insist that the land be deeded outright to the government for a dollar. We own the buildings, we own the equipment and when the war is over we can turn the key of the lock, if we like, and take that building out of competition with private industry. Thus it has been our policy to take our depreciation at the start, rather than to write it off against the cost of the goods produced. We pay for the plant; we pay for the machinery, and we obtain our goods at cost.

The year 1941 was not a great production year in war munitions, for the reason that so much of the year was used in building and tooling and getting under way. However, in that year Canada did produce munitions on a very considerable scale.

You know that Canada's munitions programme in the last war was a worth while effort. You know the story of Sir Joseph Flavelle and Lloyd Harris, and the success that they had in turning out munitions in that war. So, when I tell you that in the year 1941 we made more munitions in Canada than we did throughout the whole history of the Great War, you will realize that it was not a lost year by any means.

A statistical study of the possibilities for 1942 indicates that we will turn out about two and one-thirds times as many munitions as we did in the year 1941, so that in this year our munitions industry will really be going. We are still starting new projects, and as the requirements of warfare change, with the flowing tide of battle, we shall continue to start new plants and take on new obligations.

Now, where are these munitions going? You read in the papers that they are short of rifles on the west coast, or short of this and that in other areas. That may be perfectly true. We are not attempting to hold these munitions of ours in Canada. We are building them to help win the war and we are sending them where they will do the most good for that purpose. Huge quantities of our munitions have gone to England to equip our own troops there, and to bring British formations up to strength in the matter of equipment.

We have shipped still greater quantities to the Middle East. I believe the battle there has been fought very largely with Canadian mechanical transport and Canadian Bren gun carriers, to say nothing of artillery and machine guns that we have been shipping there for many months. We had Canadian munitions and lots of them in the battle of Greece. We have Canadian munitions in the Far East, in the Netherlands East Indies, in Singapore and Java and the other battle areas.

We have sent great quantities of raw materials and munitions to our sister Dominions, Australia, New Zealand, South Africa, India and Burma. We have supplied large amounts of munitions to China. You have heard a good deal about North American aid to China. I can tell you that the first shipment of North American aid to China, taken in over the Burma road, consisted of a thousand Bren guns and ten million rounds of Canadian ammunition.

Incidentally, one of my Christmas presents, which I value highly, was a photograph of Generalissimo Chiang Kai-Shek, sent from China and autographed in Chinese characters, with a message of thanks to myself.

Our entire production of Valentine tanks has been for several months going to Russia and we are sending across three tanks every day to assist the Russians in their great fight against Germany. I may say that we have valued letters of appreciation from the Russians on the type of work that those tanks are doing.

When the sudden crisis came to the United States we were proud to be able to offer munitions for shipment to Hawaii and to the Philippines; Canadian munitions are in the fight in both those areas.

We are making a munitions programme to help win the war. If it were merely a question of equipping Canadian troops, only a small fraction of our present output would be required, but we have taken the view that until the Allies have a parity of munitions with the enemy in every battlefield, it is our job to turn out as many munitions as we can and to send those munitions where they are most needed.

Occasionally I get a little disturbed by criticism. Recently, a complaint was made in the House of Commons that our troops on the west coast were using old rifles. Well, it is true they are using old rifles. They are perfectly good rifles, but still it is a very natural question: why, if Canada is such a great munitions making country, cannot the troops on the west coast have new rifles?

I said to my friend, Colonel Ralston, "Let us stop this criticism. Let us take a month's production from our small arms plant and give our troops new rifles."

He said, "Not at all. Those rifles are promised to Singapore, they are going to Singapore, and we will take the criticism."

I would like to make it clear that any success we have had in developing an arms industry in Canada and in expanding our industrial capacity has been due to the splendid support that I have had from industry, from the engineering profession and particularly from the ranks of labour. I think that we can compare our effort in this country with that of any country in the world in any of those respects.

I do not believe that, even in England, industry has been more full-out to help the government and to do everything asked of it in turning over its facilities for the manufacture of munitions. And I am sure that when the record of organized and of unorganized labour in this country has been written, it will be seen that we have had as much co-operation from labour as has been attained by any of our Allies in this war.

Lord Beaverbrook has said on two or three occasions, and said publicly, that on a per capita basis Canada is turning out more munitions of war than any one country in the world, including the enemy countries. This may well be true, as far as any statistics I can find would indicate, but, even if true, it is not a matter for complacency. It is our job to turn out everything that Canada can turn out.

If anyone had told me a year ago that we could bring about the expansion of industry that has taken place in the last year, I would have said that I hardly believed it.

We have been constantly raising our sights. What is true of our position I think is true of industry itself. If you had gone into one of our large manufacturing plants a year and a half or two years ago and said that we wanted them to expand their plant up to what they are actually doing to-day, I think the management would have told us that that would be quite impossible.

The limitations of our programme are, we find, the limitations of skilled management. We have yet to run into a serious shortage of manpower and womanpower—and womanpower is playing a part in our plans to an increasing extent every day—but we do find difficulty in developing skilled management. We are still looking for firms that can take on more work, but we find that firms with what we believe to be the required experience have about all they can handle at the present time.

Throughout the year we have greatly increased production by encouraging sub-contracting and expanding

a programme that we call our bits and pieces programme. We have carried the work of making small bits of ordnance or small bits of some other type of production into the very small factories. In fact, I think the smallest plant we have is a two-car garage with three lathes which is making a part of a 25-pounder gun.

That is necessarily a slow and difficult development. It is not easy to get large manufacturers to break down their contracts into small bits and it is difficult to get the small bits all out to the small firms. However, a process of education has been going on and is achieving splendid results. The bits and pieces system, I think, will continue to be an effective means of further expanding our industrial output.

I see my time is up. May I say how glad I am that I did not let the lack of a paper prevent me coming here. I have enjoyed speaking extemporaneously, and thank you very much for having invited me.

# NATIONAL SERVICE—A CHALLENGE TO THE ENGINEER

E. M. LITTLE

*Director, Wartime Bureau of Technical Personnel, Ottawa, Ont.  
General Manager, Anglo-Canadian Pulp and Paper Mills, Quebec, Que.*

Address delivered at the General Professional Meeting of The Engineering Institute of Canada,  
at Montreal, Que., on February 6th, 1942

I welcome the opportunity to speak of two matters which I hope you, as engineers, will find of some interest: first, a brief review of the activity of the Wartime Bureau of Technical Personnel; and, second, the necessity of planning for the period of post-war rehabilitation and construction. Planning for the post-war period is, for the engineer, both an opportunity and a duty.

Most of you are familiar with the part already played by the engineers and chemists of Canada, through your Institute, the Canadian Institute of Chemistry, The Canadian Institute of Mining and Metallurgy and the provincial professional engineering associations, in plans to mobilize the technical personnel of Canada for the war effort. The leadership shown by the three Institutes has been helpful in promoting the establishment, about a year ago, of the Wartime Bureau of Technical Personnel, under the Department of Labour at Ottawa.

It is not intended to dwell at any length on the activities of the Bureau, as these have been, and will continue to be, reported, from time to time, through your journals and other media. However, a brief summary of what has been accomplished and a statement of a few of our difficulties may be timely.

Our first job was to find out how many engineers and chemists there were in Canada, where they were, what they were doing, what they could do, and since we were operating under the voluntary system, what they *would* do. All of that information was not available anywhere in Canada.

For an all-out effort, which we believed necessary—and which we felt the technical men knew to be necessary—we needed that information. The result was the questionnaire and classification list, now familiar to most of you.

The Bureau now has, we believe, the most comprehensive data on technical personnel ever available in Canada. While the register is not yet complete, it is rapidly approaching completion. Some have not filled in the questionnaire, because they have not received one due to change of address or errors in the mailing list; while others have not seen fit to reply, because they do not appreciate the need for providing the information or they are not too anxious to risk being inconvenienced. Those engineers and chemists who have not yet received a questionnaire may be assured that the Bureau is making every possible effort to correct this condition. As regards those who have not seen fit to respond, we believe suitable measures are being taken to the end that the information shall be forthcoming. On the whole, however, the response has been splendid, both in the promptness with which the information was supplied, and the willingness of nearly all of those answering, to be transferred to more essential work, including service in the armed forces.

Our questionnaire has the weakness of all questionnaires—it is only up to date in some respects, as from the date it was filled out. Changes in address and employment and experience acquired since signing the questionnaire cannot yet be secured except by a cumbersome time-and-labour consuming follow-up system. We believe this difficulty will be overcome in the very near future by a simple, efficient, continuing inventory of our technical personnel.

The cost of operating the Bureau to the end of 1941 has been less than half of our appropriation for the Gov-

ernment fiscal year, ending March 31st, 1942. However, the demands on the Bureau are expanding and our staff and cost of operation will increase accordingly. We have secured over five hundred engineers and chemists for essential industries and for civilian occupations in the armed forces. The requests for help through the Bureau are increasing so fast that we are having difficulty in locating and/or arranging for the transfer of the numbers required. With demand greater than supply, each request for help must be investigated carefully by the Bureau. We appeal to employers to search carefully within their own organizations, before they ask for outside assistance. Employers must expect and provide for the necessity of turning out more and more production with less and less men, and in addition must be prepared to train and release engineers and artisans for the armed forces.

We have placed appreciable numbers of Polish engineers and skilled artisans, whose qualifications and sympathies have been carefully scrutinized by the proper authorities before being turned over to the Bureau for placement. And as a result of an urgent call from London, we have secured engineers for special work in England.

The placement work of the Bureau cannot be likened to, or compared with, the function of a peacetime employment office dealing with professional engineers. The problem now is not to find work for the engineers; but to find the engineers for the work—in most cases very special work, and in many instances several jobs for the one engineer. These conditions introduce problems not experienced by peacetime employment agencies and necessitate more effort in the handling of each individual case.

Almost from the date of its establishment, the Bureau has maintained close contact with the universities. There is some confusion in the minds of both the university authorities and the students as to what they should do to make their full contribution. Should the student finish his course or enlist now—should the university graduate him early with or without a degree? The different branches of the armed forces suggest one thing and our Bureau suggests something else. We are doing everything we can with the authorities at Ottawa to secure greater co-operation between ourselves and the armed forces, to the end that this confusion may be minimized, and so that the universities may better meet the combined needs of the armed forces and war industries.

We are being requested by certain government departments to assist in the adjudication of an increasing number of cases affecting technical personnel.

The shortage of technical personnel is becoming more acute. The work of the Bureau is increasing and will continue to do so. We will centralize our activities in Ottawa only to the extent necessary for planning. We now propose to decentralize as may be necessary for the execution of the work. Within the next few weeks we shall start placing field men in the larger industrial centres so that local or more direct contact may be made with the employer and the technician. We shall need the most intelligent understanding and sympathetic attitude on the part of both the employer and the technician in our efforts to ration properly the technical skill of the country.

In our work at Ottawa, we have become impressed with the lack of adequate information on the manpower of

Canada. No proper machinery has ever existed to obtain it and to keep it up to date. The National Registration of 1940 gave some essential basic information on the numbers, sex and age groups of our people as of August, 1940, but it falls far short of giving all the information necessary as of February, 1942. We need a running or continuing inventory of our manpower. We must know quickly of the improvement in the skills of our people. We must know where they are to-day and what they are capable of doing to-day, and if three months or one year from now conditions require new information, we must have the machinery to get it and get it quickly, on such portion of our manpower as may be affected. How we can plan an all-out war effort on either a voluntary or compulsory system without such a running inventory, remains a mystery. It is not only essential to have this information for our war planning, but as will appear later in this talk, it will be equally desirable in post-war planning. It is satisfactory to note that considerable attention has been given to this matter during the past few months by officials in the Department of Labour and others at Ottawa, and I am hopeful that some suitable plan will be evolved on which action will be taken in the near future.

The privilege given some of us to serve the war effort in a modest way through the Bureau has enabled us to appreciate some of the work and difficulties of government departments. We are particularly impressed with the need for each of us, as Canadians and as engineers, to do more toward the solution of immediate and future matters of national interest and import, than we have heretofore. We have all been critical of the government, but based on our experience in the Bureau, we are satisfied that the collective stupidity of Ottawa is at least equalled if not surpassed by that of the public. Nor are all the prima donnas, quacks and crackpots, great or small, in the government service.

Too many of us turn to some heavily laden government department, expecting it to find a solution to our problem. Many of us, when a reasonable solution is found, prevent its adoption either through ignorance or because it appears to clash with our own selfish interests. On the other hand, some of us are prepared to give all the answers to all the problems of the country, past, present and future, without any real knowledge of such problems. As citizens we are grossly ignorant of, or apathetic towards, national questions and too many of us are chronic protesters. Our national affairs will never be properly conducted by this or any future government unless we wake up and cease to be a nation of leaners. To be effective, a government needs the support of an informed public. We are not an informed public, and the only way to become informed is to work and think. And, with the critical job now facing us and with the problems that will confront us in the post-war period, the time to start working to make our full contribution to the solution of national problems is *now*.

No words from me are needed to give you a better appreciation of the seriousness of our present job,—winning the war. I am sure you realize the totality of effort *in time* which we must put forth to win, and the terrible consequences to all of us, if we should lose the struggle, or even if it should result in a draw. Planning for the post-war days means nothing but waste effort unless we win;—but plan we must, as failure to do so may have results almost as serious as those due to our lack of planning for defence prior to the outbreak of war.

Each job, the winning of the war and the planning for the post-war period, must be given its proper weight and timing.

Canada, as one of the allied nations, must go all-out in its effort. Every pound of essential material and every man-hour of labour which can be diverted to that one purpose will be necessary. And the more closely we ap-

proach that all-out effort the more difficult the re-adjustment will be, unless planned.

What are the problems that we shall face immediately the war is won? How shall we plan and prepare to meet them, where and how do we get the information on which to plan, and who shall do the planning?

In my opinion, the one fundamental and all-important problem of the immediate post-war period, upon the solution of which the measure of prosperity we are to experience will largely depend, will be the finding of *useful* employment for the men and women of Canada of working age,—*useful* employment for the men and women who, by the end of the war, will be in the active forces, in the factories producing war materials, and in other directly or indirectly associated industries in which the employment level may then be abnormally high due to the war production boom.

That, I believe, is *the* post-war problem. As one begins its study it becomes apparent that because of the inter-relationship between employment and our whole national economy, its solution will provide the answers for many other questions. To solve any problem it is first necessary to have a clear appreciation of its nature. To avoid fumbling we must know where and on what to start, for a job well started is half done. I suggest that we start on that one problem, believing that in solving it we solve many others.

Before we try to visualize the size of the job of providing *useful* employment to those who may be thrown out of work when the war ends, let us note briefly how the study of that problem takes us into many phases of national activity

Employment prior to the war was provided principally by agriculture, industry, governments and professional services of various kinds. Our agriculture, particularly wheat, has been largely dependent on export markets. Thus the level of employment which can be provided for the wheat farmer depends on our success in securing a sufficiently large and remunerative export market, or increase in our domestic market, or both. The wheat farmer, and all Canadians affected by the degree of prosperity secured for him, have an interest in point four of the Atlantic Charter in which Mr. Churchill and Mr. Roosevelt declare: "they will endeavour, with due respect to their existing obligations, to further the enjoyment by all states, great or small, victor or vanquished, of access, on equal terms, to the trade and to the raw materials of the world which are needed for their economic prosperity."

What does access on equal terms mean?

And how are we to build up the domestic market for wheat and other agricultural products? Can we consume more with the same population, or do we need more people? Would immigration help? Would it lessen or add to employment? If we decide on immigration, who shall come in, what kind of people can best be assimilated into our social life, at what rate shall they be allowed to enter, and how do we attract them to Canada? Should any immigration plan be short or long term,—and if long term, how do we ensure its continuity?

Our industries can be divided into two principal classes, those depending largely on export markets, such as forest products (pulp and paper), and mining, and those depending on domestic markets which include importing industries. The exporting industries must concern themselves with the improvement of their export position, or reduce their dependence on the export markets by increasing their domestic markets, or both. They also, therefore, are concerned with point four of the Atlantic Charter. Must they prepare to compete with subsidized exports and depreciated currencies, or does "access on equal terms" mean "currency equalization" or "quotas," or both? All our industries, exporting, domestic and importing,—must

be concerned with the development of our domestic market, if the levels of employment are to be sufficient for the needs.

The measure of prosperity which we can secure for our agriculture and our industries will have a large bearing on our ability to provide useful employment after the war.

For how many people must we find *useful* employment in the post-war re-adjustment period? It is conceivable that if the war should continue, Canada may have a million men and women in the active forces. It is also conceivable, if the war is prolonged, that one to two million men and women may be thrown out of employment when we stop producing war materials and as employment in other activities diminishes as the war production boom abates. We should, therefore, prepare to face the job of finding *useful* employment for two to three million men and women.

If, with the luck of the devil and a fast outfield, we happen to experience a prosperous immediate post-war period our worries may be minimized,—but if we don't, what then? The problem of finding and/or making *useful* employment for two to three million people, *in time*, will not be easy;—indeed it will be extremely difficult. But it must be done, and if planned well and soon enough, if boldly conceived, intelligently organized and vigorously pursued, it can be done.

What kind of work do we plan for those two to three million men and women? Is it not necessary to know not only how many there are, but what kind of people they are, their education, their training, their experience? Are we only to plan for numbers and waste those assets?

How do we get this information? Up to now there has not existed any machinery by which this information could be obtained in sufficient detail, and *in time*. But the same machinery which is necessary to get information on our manpower in wartime can be used to secure the information for the post-war planning. And that machinery must be kept working and well oiled until Canada is rid of unemployment. Our last period of unemployment, necessitating direct relief, with all its attendant evils and abuses, was in the opinion of many, not well handled for two principal reasons,—first, because we, as individuals, assumed little or no responsibility for it; and, second, because it was poorly planned, due to lack of information. We cannot build anything unless we know what we want to build and what we have to work with. Full and accurate information on our people is a prerequisite to planning.

Assuming we shall have available, *in time*, all the necessary information on those to be rehabilitated at the end of the war, what kind of work do we plan? As far as is humanly possible, we must plan *useful* work. It will not do merely to have people occupied digging post holes and filling them in again. The doctor, the engineer, the nurse, the lawyer and the mechanic should, if possible, be provided with the work they are best qualified to do. The kind of work we plan must, where possible, take cognizance of the training of our people, and be consistent with the long-term economic development of Canada.

If the number already stated, for whom we must find suitable employment, is a reasonably close estimate, we are facing quite some job. It is of such national importance that it needs the consideration first of the Federal Government. It should be their responsibility to see that plans are drawn up in their broader outlines; to secure, *in time*, the necessary information on the men and women for whom employment is to be found; to initiate, *in time*, plans for Federal Government projects; and to enlist, *in time*, the support and active assistance of all the provincial governments and of industry, large and small.

It will not suffice to confine our work planning to gov-

ernment undertakings. All the useful projects which governments can undertake must be supplemented by all the work all our industries and enterprises can provide. The delaying of every job, large or small, which can be delayed till war is over, the planning by industry of plant improvement and expansion, the study to determine how to convert our war plants to new peacetime use, the development of new industries, the conservation and development of our natural resources, reafforestation, necessary housing projects, slum clearance and a comprehensive health programme, are only a few of the many possibilities to which proper attention must be given *soon*, considering the time required for planning.

Now what has all this to do with the engineer? At some stage in this planning, all these broad outlines, all the projects and undertakings, any new industries, or plant rehabilitation, any conservation or reforestation, must be worked out and translated into pounds or other quantities of materials; into man-hours of work for the production, preparation and transportation of that material; and into the man-hours of work for fabricating the material into the finished products. And then those man-hours must be broken down into work for the miner, the carpenter, the mechanic, the mason, the forester, the engineer, the architect and so on up and down the whole list. The engineer is so important to this part of the planning that I can safely say it cannot be done without him.

But there is another function the engineer can perform which is important at an earlier stage in the planning. Many of you know from experience that some well conceived plans fail in their execution because some detail has been overlooked, that undertakings supposedly well organized missed something in the organization, that people who are eminently capable of planning in broad outline may neither have time for, nor appreciation of, the details necessary to carry those plans to complete fulfilment. The engineer must do his part to see that in this planning no detail is omitted, that in the organization of this vast job no step is missed. Those who are, or may be, charged with the planning of the broad outlines, should enlist the engineers' assistance as early as is desirable, or permissible.

The prophecy of President Wickenden, of the Case School of Applied Science, in his able address delivered at your Hamilton meeting a year ago, is, let us hope, about to be realized. He said "They (the engineers) will be called upon to share the control of disease with physicians, the control of finance with bankers, the bearing of risks with underwriters, the organizing of distribution with merchants and purchasing agents, the supplying of food with packers and purveyors, the raising of food with farmers and the operation of the home with the housewives."

But he also said "In few of these new fields, if any, will engineers be self-sufficient;—to be useful they must be team workers; and they must be prepared to deal with 'men and their ways' no less than 'things and their forces'."

Planning for the post-war period will take us into an ocean of problems. We cannot have too many skippers, else they may want to chart different courses, and the ship will be left stranded. If the Federal Government (or its nominees), must chart the course,—and in view of the national scope of the problem, it seems logical that this should be done—then let us be part of the crew, and do our full part.

Though the job may be large, and the difficulties great, team work will do it. The opportunity for the engineer to render national service has never before presented itself on such a scale. Will the engineer meet the challenge without for one moment forgetting the job in hand—that of having a post-war period in which *our* plans shall prevail?

# THE FIFTY-SIXTH ANNUAL GENERAL MEETING

Convened at Headquarters, Montreal, on January 22nd, 1942, and adjourned to the Windsor Hotel, Montreal, on February 5th, 1942.

The Fifty-Sixth Annual General Meeting of The Engineering Institute of Canada was convened at Headquarters on Thursday, January twenty-second, nineteen hundred and forty-two, at eight forty-five p.m., with Councillor Huet Massue, M.E.I.C., in the chair.

The assistant general secretary having read the notice convening the meeting, the minutes of the fifty-fifth annual general meeting were submitted, and, on the motion of J. A. Lalonde, M.E.I.C., seconded by J. M. Crawford, M.E.I.C., were taken as read and confirmed.

## APPOINTMENT OF SCRUTINEERS

On the motion of W. B. Korcheski, M.E.I.C., seconded by C. F. Davison, M.E.I.C., Messrs. E. V. Gage, M.E.I.C., P. E. Poitras, M.E.I.C., and J. K. Sexton, M.E.I.C., were appointed scrutineers to canvass the officers' ballot and report the result.

There being no other formal business, it was resolved, on the motion of A. S. Runciman, M.E.I.C., seconded by W. H. Moore, M.E.I.C., that the meeting do adjourn to reconvene at the Windsor Hotel, Montreal, at ten o'clock a.m. on the fifth day of February, nineteen hundred and forty-two.

## ADJOURNED GENERAL MEETING AT THE WINDSOR HOTEL, MONTREAL, QUE.

The adjourned meeting convened at ten o'clock a.m. on Thursday, February 5th, 1942, with President C. J. Mackenzie in the chair.

The general secretary announced the membership of the Nominating Committee of the Institute for the year 1942 as follows:

### NOMINATING COMMITTEE—1942

Chairman: E. P. MUNTZ

Branch	Representative
Border Cities.....	C. G. R. Armstrong
Calgary.....	F. K. Beach
Cape Breton.....	J. A. McLeod
Edmonton.....	W. R. Mount
Halifax.....	R. L. Dunsmore
Hamilton.....	A. Love
Kingston.....	A. Jackson
Lakehead.....	P. E. Doncaster
Lethbridge.....	J. M. Davidson
London.....	V. A. McKillop
Moncton.....	B. E. Bayne
Montreal.....	R. DeL. French
Niagara Peninsula.....	C. G. Moon
Ottawa.....	J. H. Parkin
Peterborough.....	W. M. Cruthers
Quebec.....	A. O. Dufresne
Saguenay.....	N. D. Paine
Saint John.....	J. R. Freeman
St. Maurice Valley.....	E. B. Wardle
Saskatchewan.....	R. A. Spencer
Sault Ste. Marie.....	K. G. Ross
Toronto.....	W. E. Bonn
Vancouver.....	J. N. Finlayson
Victoria.....	S. H. Frame
Winnipeg.....	H. W. McLeod

## AWARDS OF MEDALS AND PRIZES

The general secretary announced the awards of the various medals and prizes of the Institute as follows, stating that the formal presentation of these distinctions would be made at the annual dinner of the Institute on Friday evening:

\* For an additional name, H. E. T. Haultain,

154 see Council minute 42/1866.

*Gzowski Medal*—To S. R. Banks, M.E.I.C., Montreal, for his paper, "The Lions' Gate Bridge, Vancouver."

*Duggan Medal and Prize*—To O. W. Ellis, M.E.I.C., Toronto, for his paper, "Forgeability of Metals."

*Leonard Medal*—To G. Reuben Yourt, STUD. C.I.M.M., Kirkland Lake, for his paper "Ventilation and Dust Control at the Wright-Hargreaves Mine."

\* *Julian C. Smith Medals* (Additional Inaugural Awards), "For Achievement in the Development of Canada," to W. G. McBride, M.E.I.C., Montreal, W. G. Murrin, M.E.I.C., Vancouver, and E. W. Stedman, M.E.I.C., Ottawa.

## STUDENTS' AND JUNIORS' PRIZES

*John Galbraith Prize* (Province of Ontario)—To A. L. Malby, Jr. E.I.C., Peterborough, for his paper, "Carrier Current Control of Peak Loads."

*Phelps Johnson Prize* (Province of Quebec—English)—To G. N. Martin, Jr. E.I.C., Montreal, for his paper, "Characteristics and Peculiarities of some Recent Large Boilers in England."

*Ernest Marceau Prize* (Province of Quebec—French)—To A. T. Monti, S.E.I.C., Montreal, for his paper, "Vedette de 40 Pieds de Longueur."

## REPORT OF COUNCIL

On the motion of R. L. Dunsmore, seconded by J. G. Hall, it was RESOLVED that the report of Council for the year 1941, as published in the February *Journal*, be accepted and approved.

## REPORT OF FINANCE COMMITTEE, FINANCIAL STATEMENT AND THE TREASURER'S REPORT

On the motion of G. A. Walkem, seconded by P. B. Motley, it was RESOLVED that the report of the Finance Committee, the financial statement and the Treasurer's report, as published in the February *Journal*, be accepted and approved.

## REPORTS OF COMMITTEES

On the motion of C. R. Young, seconded by K. M. Cameron, it was RESOLVED that the reports of the following committees be taken as read and accepted: Publication; Papers; Training and Welfare of the Young Engineer; Library and House; Legislation; Board of Examiners and Education; Western Water Problems; International Relations; Membership; Deterioration of Concrete Structures; Professional Interests, Employment Service.

## BRANCH REPORTS

On the motion of T. R. Durley, seconded by M. G. Saunders, it was RESOLVED that the reports of the various branches be taken as read and approved.

## LIFE MEMBERSHIPS

Mr. P. B. Motley presented a memorandum outlining Council's present method of granting Life Membership, and moved that Council consider and report at the next annual general meeting on the desirability of amending the by-laws so that Life Membership would be removed from the section dealing with exemptions from the payment of annual fees, and placed in a section similar to that dealing with Honorary Membership, and that such Life Membership be granted automatically and as an honour, without application from the member.

Mr. Motley's motion was seconded by Mr. S. Blumental, and after some discussion, was carried.

## POST-WAR RECONSTRUCTION

The president announced that the Lakehead Branch had submitted a resolution asking Council to take definite

tion with regard to post-war reconstruction. The resolution had been considered by Council at two meetings, and had finally been referred to the incoming Council for consideration and action. However, as Mr. P. E. Doncaster, from the Lakehead Branch, was present, he would ask him to present the resolution to the meeting.

Mr. Doncaster explained that he was not presenting this resolution for action by the annual meeting as it was already before Council. However, he did wish to let the meeting know of the resolution and, if possible, obtain some discussion which might be helpful in pursuing the matter further. He then read the resolution as follows:

The Lakehead Branch of The Engineering Institute of Canada submits to the annual meeting of the Institute for discussion and action the following resolution:

WHEREAS, it is generally agreed that, immediately after the cessation of the war in which this country is presently engaged, some millions of our citizens in the fighting forces or in employment in the production of war equipment and materials must be afforded opportunity for employment in peace-time occupation; and

WHEREAS, it is incumbent on all citizens of this country who are competent and whose time, training, and abilities are not fully employed in the war effort should be engaged in planning for the post-war period; and

WHEREAS, a lead in the direction and carrying out of the plans for the post-war period must be given and be sustained by competent individual organized groups and authorities acting alone in their respective fields, and also in co-operation with others in co-ordinating efforts; and, inasmuch as post-war employment will, in large measure, be based on technological surveys, investigations, planning, direction and supervision; and

WHEREAS, The Engineering Institute of Canada is peculiarly organized and fitted to take an active and a leading part in the planning herein referred; to Therefore,

BE IT RESOLVED that this resolution be submitted for discussion at the 1942 annual meeting of The Institute, and, if endorsed: that Council be instructed to set up at once a strong "SPECIAL PLANNING FOR POST-WAR" committee, composed of a central group of four members, which will initiate and promote enquiries, and from which group any member may be assigned by Council to represent The Institute on one or more other groups or committees set up by other organizations or authorities on similar planning work;

THAT, Council appoint one or more members from each of the Institute Zones who will act with the central committee as an advisory group, and who shall in turn arrange for the appointment of a chairman and two to four members of each branch of The Institute to act as a local or branch planning committee charged with the responsibility of carrying out instructions of the central committee in promoting planning within the boundaries of its branch area.

In giving effect to the foregoing organization it is suggested the services of vice-presidents and councillors of The Institute be utilized to the greatest possible extent, consistent with their availability for the project, and

FURTHER, that planning for the post-war period be undertaken and continued as one of the major activities of The Institute until such time as normal peace-time conditions have been restored.

Mr. Doncaster then referred to the federal committee which had been appointed under the chairmanship of Dr. F. Cyril James of McGill University, to investigate post-war conditions from coast to coast. He informed the meeting that Mr. K. M. Cameron, a vice-president of The Institute, has been selected by Dr. James and his committee as chairman of the sub-committee to investigate the construction phases of the general problem. He expressed the hope that Mr. Cameron's committee would consult with all organizations qualified to contribute to the thinking

on the problem, and would not confine itself to a small circle. He hoped that every member of The Institute, no matter where he resided, would be given a chance to participate in the deliberations.

The president pointed out that the subject of the motion was not a new one. It had been before Council for many months, and nobody disagreed with the general principle that thought should be given to it. He pointed out that Council, at yesterday's meeting, had instructed the incoming officers to give this matter their consideration.

Mr. K. M. Cameron then told something of the sub-committee of the federal committee under Dr. James. He assured Mr. Doncaster and the meeting that everyone would be given an opportunity to express his ideas. He emphasized that it was only natural that on such a subject The Institute would be vitally concerned. At the present time he thought that there was little that could be done as the organization of committees and sub-committees required a lot of thought in order to make certain that the proper persons were appointed. He recommended that every person attend the professional session the following day, at which Mr. E. M. Little was presenting a paper on post-war problems, in the discussion of which Dr. Leonard C. Marsh, research adviser to the federal committee, would participate. He pointed out that in the last war post-war planning was left almost until the end of the war. He hoped things would be much better this time. Mr. Cameron intimated that discussion on this matter might more properly be made at the professional session the following day than at this meeting.

#### ELECTION OF OFFICERS

The general secretary read the report of the scrutineers appointed to canvass the officers' ballot for the year 1942 as follows:

President.....C. R. Young

Vice-Presidents:

Zone B (Province of Ontario).....J. L. Lang

Zone C (Province of Quebec).....H. Cimon

Zone D (Maritime Provinces).....G. G. Murdoch

Councillors:

Victoria Branch.....E. W. Izard

Lethbridge Branch.....J. Haines

Calgary Branch.....S. G. Coultis

Winnipeg Branch.....J. W. Sanger

Sault Ste. Marie Branch.....A. E. Pickering

Hamilton Branch.....W. J. W. Reid

Niagara Peninsula Branch.....A. W. F. McQueen

Ottawa Branch.....T. A. McElhanney

Toronto Branch.....Nicol MacNicol

Peterborough Branch.....H. R. Sills

Montreal Branch.....J. E. Armstrong

R. E. Heartz

W. G. Hunt

Quebec Branch.....E. D. Gray-Donald

Moncton Branch.....G. L. Dickson

Cape Breton Branch.....F. W. Gray

On the motion of P. G. Gauthier, seconded by S. N. Tremblay, it was RESOLVED that the report of the scrutineers be adopted, that a vote of thanks be tendered to them for their services in preparing the report, and that the ballot papers be destroyed.

The general secretary announced that the newly elected officers would be inducted at the annual dinner on the following night.

The president then delivered his retiring address on "The War Activities of the National Research Council of Canada," which will be found on page 141 of this issue of the *Journal*.

On the motion of G. F. St. Jacques, seconded by Paul Vincent, it was unanimously RESOLVED that a hearty vote of thanks be extended to the Montreal Branch in recognition of their hospitality and activity in connection with the Fifty-Sixth Annual General Meeting.

# THE PRESIDENT'S DINNER



*Left to right: Past-presidents G. H. Duggan, A. Surveyer and F. P. Shearwood.*



*Past-president G.H.Duggan.*



*Past-presidents T. H. Hogg, O. O. Lefebvre and G. A. Walkem.*

*Below: The chairman and host talks to Beaudry Leman.*



*Below, left to right: N. F. McCaghey, Walter G. Hunt, J. H. Fregeau, L. A. Duchastel.*



*Below, left to right: J. G. Hall, J. E. Armstrong, K. M. Cameron, J. A. Vance, M. G. Saunders and P. M. Sauder, C. K. McLeod in the foreground.*



# THE LUNCHEONS



The chairman, J. A. Lalonde.



The speaker at the Thursday luncheon, the Hon. C. D. Howe.



Above: deGaspé Beaubien speaks for the Victory Loan.



Above: The speaker at the Friday luncheon, James W. Parker. On his right, J. H. Maude, W. G. Hunt, Mrs. F. W. Taylor-Bailey, L. A. Duchastel.

Mayor Adémar Raynault welcomes the delegates to Montreal.



On the motion of T. A. McElhanney, seconded by H. A. Lumsden, it was unanimously **RESOLVED** that a hearty vote of thanks be accorded to the retiring president and members of Council in appreciation of the work they have done for The Institute during the past year.

There being no further business the meeting adjourned at eleven forty-five a.m.

## THE GENERAL PROFESSIONAL MEETING

### PROFESSIONAL SESSIONS

The attendance at professional meetings exceeded anything recorded previously. The Prince of Wales Salon will seat two hundred and fifty comfortably. It was full and overflowing practically for every session. At least another hundred were crowded in on several occasions, and all audiences were well rewarded for their attendance and attention.

On the afternoon of Thursday, the programme was opened by Colonel W. E. Phillips, president of Research Enterprises Limited, who described the work of that Crown company in interesting detail. His talk was illustrated by moving pictures and "delineographs"—the latter being

coloured photographs projected on the screen without benefit of film or slide. He also offered an exhibition of optical glass produced in record time at the plant. McNeely DuBose was in the chair. The paper is presented in full in this issue of the *Journal*.

W. F. Drysdale, M.E.I.C., vice-president, Montreal Locomotive Works, Limited, also Canadian Steel Tire and Wheel Company, Limited, Montreal; Director-General of Industrial Planning, Department of Munitions and Supply, Ottawa, presented his paper "The Manufacture of 25-Pounder Guns in Canada." This gun plant appears to be the only one in America where the continuous operations begin with the scrap metal. Mr. Drysdale also used movies and delineographs to illustrate his talk. John T. Farmer was chairman. This paper appeared in the January *Journal*.

Friday morning three papers were presented. "Accident Prevention Methods and Results" by Wills MacLachlan, M.E.I.C., Chairman R. E. Hartz, and "Rational Column Analysis" by Professor J. A. Van den Broek, Chairman C. M. Goodrich, were run simultaneously in the Prince of Wales Salon and the Oak Room. Both papers have appeared in the *Journal*, the former in the January number and the latter in the December number. Discussions of Professor Van den Broek's paper were so extensive that an afternoon session was arranged at the request of the audience.

The third paper, "The New 'Oil-hydraulic' Press in Munitions Manufacture" was presented by J. H. Maude, M.E.I.C., with Dean Armand Circé in the chair. The author



The American guests visited Headquarters during the meeting. *Front row—left to right:* Dr. A. H. White, President, Society for the Promotion of Engineering Education; Ernest B. Black, President, American Society of Civil Engineers; Dr. Eugene McAuliffe, President, American Institute of Mining and Metallurgical Engineers; George T. Seabury, Secretary, American Society of Civil Engineers; Dr. C. J. Mackenzie, Acting President, National Research Council of Canada. *Standing—left to right:* Dean C. R. Young, President, The Engineering Institute of Canada; A. B. Parsons, Secretary, American Institute of Mining and Metallurgical Engineers; C. E. Davies, Secretary, American Society of Mechanical Engineers; H. H. Henline, Secretary, American Institute of Electrical Engineers; S. L. Tyler, Secretary, American Institute of Chemical Engineers; James W. Parker, President, American Society of Mechanical Engineers; D. C. Prince, President, American Institute of Electrical Engineers; S. D. Kirkpatrick, President, American Institute of Chemical Engineers; Professor C. F. Scott, Chairman, Committee on Professional Recognition, Engineers' Council for Professional Development; C. C. Knipmeyer, President, National Council of State Boards of Engineering Examiners; J. A. Van den Broek, Professor of Engineering Mechanics, University of Michigan, Ann Arbor.

*Right:* The ladies register. In the group are Mrs. L. C. Jacobs, Mrs. J. A. Lalonde, Mrs. R. S. Eadie and Mrs. F. W. Taylor Bailey.



The committee goes to work. *Left to right:* Gordon D. Hulme, J. A. Lalonde, A. G. Moore, Walter G. Hunt and I. S. Patterson.

The Joint Conference Committee of the Founders Societies meet with Presidents and the Secretary of the Institute. *Seated, from left to right:* C. R. Young, E. B. Black, J. W. Parker, H. H. Henline, Eugene McAuliffe, C. J. Mackenzie. *Standing:* Col. C. E. Davies, D. C. Prince, G. T. Seabury, A. B. Parsons, L. Austin Wright.

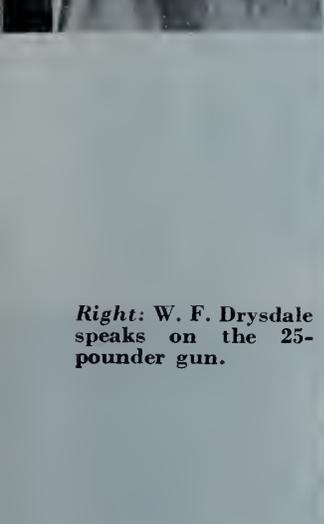


## PROFESSIONAL SESSIONS



**Left:** Col. W. E. Phillips, president of Research Enterprises Limited, Toronto.

**Right:** Walter D. Binger of New York and Chairman H. A. Gibeau.



**Right:** W. F. Drysdale speaks on the 25-pounder gun.



should be helpful to Government planning which is now underway. It appears in this number of the *Journal*.

The last professional session was an address "Some of the Engineering Implications of Civilian Defence," by Walter D. Binger, commissioner of Borough Works, City of New York, and chairman, National Technological Civil Protection Committee of the United States. H. A. Gibeau was in the chair. Mr. Binger had visited England to obtain first-hand information upon which he based his talk. He appears to be the only civil engineer in America who has studied this problem on the ground from the engineering point of view. His comments and recommendations are founded on experience, not just on the written word. Although Mr. Binger spoke from notes only, a verbatim

had an interesting exhibit which showed the work turned out by the press, and the method of operating. This paper has been published in full in the February *Journal*.

In the afternoon the first professional session was given over to "National Service—a Challenge to Engineers," a paper by E. M. Little, director of the Wartime Bureau of Technical Personnel, general manager of the Anglo-Canadian Pulp and Paper Mills, Limited, and president of the Gaspesia Sulphite Company, Limited, Professor R. DeL. French was chairman. This paper dealt with post-war planning in relation to labour, and emphasized the need of keeping in mind, in all such planning, that work provided should be useful or economically sound, and not just any kind of work. Mr. Little's paper



**Left:** E. M. Little, discusses the Wartime Bureau of Technical Personnel and conditions after the war.



**Left:** A portion of the audience. From left to right: W. H. M. Laughlin, D. Forgan, W. P. Dobson, and A. B. Cooper, all from Toronto.



**Right:** Chairman Armand Circé introduces J. H. Maude.

## SPEAKERS AT THE BANQUET



*Above:* President Mackenzie is a perfect chairman. On his right are J. W. Parker and Mrs. J. M. R. Fairbairn.

*Right:* General McNaughton praises Dean Mackenzie while Ernest B. Black and Mrs. McNaughton give close attention.



*Above:* Right to left, Ernest B. Black, President Mackenzie, Gen. McNaughton, Mrs. Mackenzie, J. W. Parker, Mrs. J. M. R. Fairbairn and Eugene McAuliffe.



*Above:* Ernest B. Black, president of the American Society of Civil Engineers.

*Left:* D. C. Prince, pres. American Institute of Electrical Engineers.



*Below:* Eugene McAuliffe, pres. American Institute of Mining and Metallurgical Engineers. Mrs. Fairbairn, Mr. Parker, right.



*Above:* Dean Mackenzie greets Pres. C. R. Young. *Below:* A. H. White, pres. Society for the Promotion of Eng. Education. Mrs. George Walkem, right.



*Above:* S. D. Kirkpatrick, president, American Institute of Chemical Engineers, Mrs. R. P. Vaughan, left.



*Left:* C. C. Knipmeyer, president, National Council of State Boards of Engineering Examiners. *Left,* Mrs. Surveyer. Past-President Walkem in the background.



## AT THE BANQUET



*Above:* General McNaughton presents the Julian C. Smith Medal to Air Vice-Marshal Stedman.



*Above:* General McNaughton presents the Phelps Johnson Prize to G. N. Martin. W. J. W. Reid in the left background.



*Right:* General McNaughton presents the Gzowski Medal to S. R. Banks.



*Above:* E. J. Carlyle, secretary-treasurer of the Canadian Institute of Mining and Metallurgy and Mrs. Carlyle.



*Above:* General McNaughton presents the Ernest Marceau Prize to T. A. Monti.



*Left:* Wing-Commander T. R. Loudon and Mrs. Loudon talk with Mrs. Walter D. Binger of New York.



The receiving line. From right to left: Dean Mackenzie, Mrs. Mackenzie, Mrs. Young, President C. R. Young, Mrs. McNaughton, General McNaughton, Mrs. Lalonde, Mr. J. A. Lalonde.



Professor French enjoys the company of Dr. A. H. White of Ann Arbor, Mich. In the background, S. N. Tremblay and Martin Wolff.



Mr. Howe aids Jules Comeau in the draw for War Savings Certificates.

Left to right: Max V. Sauer, R. B. Young and W. A. M. Cook of Toronto.



was obtained and will appear in an early number of the *Journal*.

## THE PRESIDENT'S DINNER

It would be difficult to imagine a more pleasant affair than the dinner given by Dean Mackenzie on Wednesday evening at the University Club. The delightful custom of the retiring president entertaining his predecessors and officers of The Institute at dinner has become one of the most enjoyable features of an annual meeting. It is always an informal occasion, but this year, with such an inimitable chairman and host, it had added to it, a brilliancy that made it a most unusual occasion.

In the company, which totalled sixty-four, there were nine past presidents and each one of them spoke for a few minutes. C. C. Knipmeyer, President of the National Council of State Board of Engineering Examiner was also present and contributed a delightful impromptu speech in which he explained that he came from the west and therefore was very much at home in such a friendly atmosphere.

A feature of the programme was the presentation by the president of a Julian C. Smith medal to Mr. Beaudry Leman, M.E.I.C., president of the Banque Canadienne Nationale. This award was made last year but the presentation had not taken place as Mr. Leman could not attend the annual meeting in Hamilton. In a short speech he expressed his thanks and reminded the audience of his long association with Mr. Smith, both in engineering and in

business. This long enduring friendship made him more than ever grateful for the honour which had been done him.

As would be expected, the chairman kept the pitch of the meeting at a high level. He emphasized the values that came from social gatherings such as this, and thought it might be a good idea to continue developing this day so that eventually it would become sufficiently attractive that officers and past officers without fail, would come from all over Canada to share in it. It would afford an opportunity for the development of social contacts before the business of the annual meeting took up the time and attention of the members. It might be called "President's Day."

## SOCIAL EVENTS

J. A. Lalonde, chairman of the Montreal Branch, presided at the luncheon on Thursday. His Worship the Mayor, Adhémar Raynault, welcomed the visitors to Montreal—in both French and English, and Vice-President deGaspé Beaubien spoke on behalf of the Victory Loan. The speaker of the day was the Hon. C. D. Howe, HON.M.E.I.C., Minister of Munitions and Supply, who gave the best talk yet heard on Canada's war production. Although Mr. Howe spoke without manuscript or notes, his address was recorded and appears in full in this *Journal*.

R. E. Heartz, retiring chairman of the Branch, thanked the speaker in a manner that met the enthusiastic approval of the audience.

The attendance was a tribute to the speaker. It amounted

to six hundred and twenty-five—almost two hundred higher than any previous luncheon attendance.

#### PAST-PRESIDENTS' DINNER

On Thursday evening at the St. James's Club the past-presidents and their ladies were dinner hosts to the outgoing and incoming presidents, C. J. Mackenzie and Mrs. Mackenzie, and C. R. Young and Mrs. Young, the party breaking up in time to join with the others—the ladies at the Engineers' Club for bridge, and the men at the Windsor Hotel for the smoker.

#### THE SMOKER

The annual smoker of the Montreal Branch has been a successful affair for years, but when combined with the annual meeting of The Institute, it reached new heights. An attendance of eight hundred, and an excellent programme of entertainment provided an evening "packed" with fun and amusement (packed is the right word for it).

#### LUNCHEON FRIDAY

This luncheon was presided over by deGaspé Beaubien, vice-president of The Institute. The speaker was James W. Parker, president of the American Society of Mechanical Engineers and vice-president and chief engineer of the Detroit Edison Company. His subject was "The Management-Employee Problem for Engineers." This was a very timely topic and the address can be studied with great advantage to labour and the profession. It is printed in this number of the *Journal*.

#### THE BANQUET

On Friday evening, under the chairmanship of retiring President C. J. Mackenzie, the annual banquet was held in Windsor Hall. No other Institute function has ever equalled this in numbers, enthusiasm or emotional attainment. Under the inspired direction of the chairman, a difficult programme was carried out in a manner that brought great pleasure to the entire assembly.

Lieut.-General McNaughton and Mrs. McNaughton were the guests of honour. Other special guests included the presidents of the seven leading engineering societies in the United States, and the secretaries of six of them. The seven presidents spoke first—for about three minutes each. These were Ernest B. Black, American Society of Civil Engineers, Dr. Eugene McAuliffe, American Institute of Mining and Metallurgical Engineers, James W. Parker, The American Society of Mechanical Engineers, D. C. Prince, American Institute of Electrical Engineers, Dr. A. H. White, Society for the Promotion of Engineering Education, S. D. Kirkpatrick, American Institute of Chemical Engineers, C. C. Knipmeyer, National Council of State Boards of Engineering Examiners. Their remarks are printed elsewhere in this number of the *Journal*.

When General McNaughton rose to speak a most unusual demonstration developed. Applause and cheering broke out from every person in the hall. It was sustained through a long period and clearly demonstrated the place which this great man holds in the minds and hearts of the engineers and the Canadian people.

He spoke of the need of more and better equipment so that precious lives could be spared in the battle for freedom. He spoke with the emphasis that comes from knowl-

edge and conviction. He had no notes, but his interest and his earnestness carried him on without pause or hesitation. His address in full appears in this number.

Past-President H. W. McKiel, of Sackville, N.B., expressed to the American officers the appreciation of The Institute for their attendance at the meeting and the kindly greetings which they had presented.

The retiring president introduced Dean C. R. Young and turned over to him the chair and gavel. Dean Young thanked the members for his election and spoke enthusiastically of the future of The Institute. He introduced the new officers and members of Council, and closed the session with the singing of "O Canada."

#### THE RECEPTION

After the banquet a reception was held in the Rose Room. General McNaughton and Mrs. McNaughton graciously joined in the receiving line with Branch Chairman and Mrs. J. A. Lalonde, President and Mrs. C. R. Young and Past-President and Mrs. C. J. Mackenzie.

#### THE DANCE

Until some early hour in the morning dancing held forth in the Rose Room. As usual this was a popular feature of the whole meeting, both with senior members and juniors.

#### PLANT VISITS

War industry afforded an unusual opportunity for inspection tours. The Canadian Car and Foundry plant at Longue Pointe was visited to see the making of shell forgings by the new methods, followed by an inspection of the tank arsenal at the Montreal Locomotive Works adjacent to the forging plant. This was a greatly appreciated privilege, and the number requesting tickets exceeded the quantity that could be handled. Many persons were disappointed, but only the first three hundred to register could be accommodated, and admission was limited to members.

Transportation by bus was excellently arranged right from the hotel to the plants—a convenience much appreciated by out-of-town members and local members as well.

#### SOCIAL CENTRE

The feature inaugurated last year at Hamilton and known there as "Muriel's Room" was repeated this year at Montreal. Such a centre conveniently located and satisfactorily "equipped" makes it possible for members and guests to meet socially under the most favourable circumstances. It helps to keep the crowd together and to promote that spirit of friendliness and cordiality that means so much to the success of a meeting.

As a tribute to the Hamilton Branch, the Montreal committee used the same title as was developed at last year's meeting. Incidentally, the Hamilton room was formally known as the Mural Room. A slip of the tongue suddenly transformed it into "Muriel's Room." Perhaps it will now become a tradition—certainly it has much to recommend it.

All in all, the meeting was outstanding from every point of view. About eleven hundred were registered. It may not be possible to maintain or repeat such records in the future, but it is a source of great pleasure and gratification to know that they have been reached and experienced in this year of grace 1942.



*Above: M. Barry Watson registers, along with Mr. Motley.*



*Above: Past-president J. B. Challies and P. B. Motley.*



*Left: J. W. D. Farrell from Regina and R. L. Dunsmore from Halifax.*

*Below: A. G. Tapley, Charles Boisvert, Jos. U. Archambault, Paul Vincent and H. S. Van Seoyoc line up at the registration desk.*



*Above: H. W. Lea interviews E. A. Ryan on behalf of the Bureau.*

*Right: From Hamilton, left to right: H. A. Lumsden, T. S. Glover and J. R. Dunbar.*



*Left: P. E. Doncaster discusses post war conditions.*



*Right: N. E. D. Sheppard, advertising manager of The Engineering Journal and R. S. Eadie, chairman of the Papers Committee for the Annual Meeting.*





*Above:* Dean C. R. Young talks with E. M. Proctor. In the background, W. L. McFaul of Hamilton.



*Above:* A. H. Hannaford, secretary-treasurer of the Hamilton Branch, Georges Burdett and Léon Duchastel, secretary-treasurer of the Montreal Branch.



*Right, left to right:* A. B. Parsons, secretary of the American Institute of Mining and Metallurgical Engineers and Professor W. G. McBride, president of the Canadian Institute of Mining and Metallurgy and recipient of the Julian C. Smith medal.



*Above:* The Library exhibit, a portion of the display of historic documents, pictures and books. R. F. Legget facing the camera.



*Below:* In Muriel's room. Right to left: E. P. Muntz, N. S. Braden of Hamilton and J. Morse in the background.



*Above:* J. G. Hall and Fraser S. Keith.



*Above:* J. F. Brett, J. A. McCrory and G. R. McLeod.

# SAID AT THE BANQUET

## SHORT SPEECHES OF PARTICULAR INTEREST

### Greetings from American Guests

ERNEST D. BLACK  
*President*

AMERICAN SOCIETY OF CIVIL ENGINEERS

It is my privilege and honour on this occasion to bear greetings from the American Society of Civil Engineers to The Engineering Institute of Canada, and to assure you that at this time our close neighbourly and professional ties, prevailing in times of peace, are strengthened and made more binding at this time because of our united stand in the war against a common enemy.

Ten days ago, the chief of the United States Corps of Engineers in addressing the District of Columbia section of the American Society of Civil Engineers declared that this is an engineers' war, that for a long time to come there will be no engineering as usual in this country, and that the demands of the war effort have taken and must continue to take precedence over everything else.

In spite of the necessary readjustments in the personal work and plans of the engineer in order to meet the changed conditions while they are on the "no engineering as usual" basis, there can be no doubt that the engineers of Canada and the United States will meet the war situation at least as effectively as it has been met by the engineers of the other united nations.

The engineer has and accepts a responsibility outside of his usual activity, and that is to do his part in helping to determine the route the nations of the world must follow in order to return all peoples to the lasting peace we must eventually secure. In accomplishing this as we look forward into a somewhat obscure future, we should not forget the laborious conditions of the past. We should give them new considerations, and keep alive the experiences on which our country has been so firmly built.

We have every reason to believe in the ultimate success of our course if we can combine and continue the endeavours of the united engineers of the nations, for the purpose of winning this war against civilization, and it will help us to accomplish this end if we remember that this is an engineers' war.

DR. EUGENE McAULIFFE  
*President*

AMERICAN INSTITUTE OF MINING AND METALLURGICAL  
ENGINEERS

I want to bring you the greetings of the American Institute of Mining and Metallurgy, including our students, some 15,500 strong. It is a far-flung body covering a wide range of territory, for we have members on every continent and in practically all of the islands of the Seven Seas. Many are in Canada.

For me it is a special pleasure to be here, for I was born under the Union Jack, and as a child lived in Canada. Unfortunately my visits have not been frequent, perhaps about four times in seventy years, but whenever I do come back here it is refreshing to meet people of my blood and my faith. It is a great privilege to be here tonight.

JAMES W. PARKER  
*President*

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

When I had the honour of speaking at the luncheon today, I felt a little on my dignity in representing The American Society of Mechanical Engineers. I brought that society's

greetings and ask you to consider that they have been repeated. The friendship of The American Society of Mechanical Engineers for this sister institution in Canada is of long standing, and is a very firm and cordial relation.

But this evening I speak for myself. It seems impossible that in the short space of time in which I have been in Montreal I could be made to feel so perfectly at home. I often think that we need not be at all sentimental over the friendship between the people of the United States and the people of Canada. We are peoples of many common heritages. We look back to the same literature, the same historical past, the very beginnings of freedom—those things that you Canadians look back to with reverence, we look back to with reverence, too, because they are our heritage as well as yours.

As for being friends with you, these facts make it very natural. I remember the comment of a newspaper editor on a news item on his desk which reported that a boy had stolen a dog. The editor said, "What an impossible statement. A boy doesn't steal a dog. The boy looks at the dog and the dog looks at the boy and they go off together."

Well, Ladies and Gentlemen, our friendship with Canada is just about as easy as that.

D. C. PRINCE  
*President*

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

I feel today like one of the children saying his part of "The House that Jack Built." For instance, Mr. Black had all his notes and went along as smoothly as could be. Then others come along, each having thought of the nicest things to say. Now, my turn comes and it is my pleasure as well as my privilege to echo the friendly sentiments that have been expressed.

But I want to put in a few words for myself and my group. We are by these gatherings learning how to fight the war together; they give us valuable opportunities to learn how to work together, so we may combine effectively in fighting for peace afterwards.

DR. A. H. WHITE  
*President*

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION

You will notice that the Society for the Promotion of Engineering Education does not have the title of "American" in front of it. I am really at home here, and not a foreigner, because the Canadian universities are members of that society as institutional members. Indeed most of the teachers in your engineering schools are also members of the Society for the Promotion of Engineering Education, so I can speak here as a host and welcome you.

We have all been made to feel at home. We have had a wonderful time. For me there are special memories attaching to Montreal, because fifty-two years ago I was a freshman in McGill University. It is true that I only stayed there one year and I won't say anything about that. But it is a very great pleasure to learn about the wonderful work the Canadian universities are doing, and the achievements of their engineers. We are in fact all working together to make engineers better trained, not only for war but for the future.

S. D. KIRKPATRICK

*President*

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

I would like to take a minute or two to bring you greetings, not from one of the great founder societies, but from a mere foundling, that at the beginning of the century was just a baby left on the doorstep of the Engineering Societies Building in New York.

When that was discovered, some rather searching questions about its parentage were asked. Some there were who insisted the father was mechanical engineering. Others thought that perhaps electrical, or even civil engineering, was the father. Whether or not this strange Institute of Chemical Engineering had been sired by mechanical engineering, we all knew it had been damned by chemistry.

You see the infant was allowed to claim the proud name of chemical engineering, but was not welcomed into the inner circles of engineering. Rather, it was sent back to the crowded tenements of modern chemistry. They put chemical engineering in the attic or down in the basement, and it came to be known as industrial chemistry.

It was not a bad boy, but was always getting into trouble blowing up things with its crazy experiments, so that a sigh of relief went up when he enlisted in the first World War, and listed for the duration.

In four years the youngster helped his country to build a great chemical industry that supplied munitions for America and the Allies, and when peace came made a valuable contribution to the health, happiness and security of the nation. The basis was laid, too, for what some of us think is an important branch of the engineering profession.

In our country, in most of the educational institutions (and I think it is the same here in Canada), chemical engineering is second only to mechanical in enrolment. It leads all others in the graduate schools. In chemical engineering one graduate in six goes on for a Master's or a Doctor's degree, compared with one in ten in all branches of engineering.

One of our distinguished members, the late Dr. Arthur B. Little, a great and good friend of the Dominion, worked for the Canadian government on a survey of the resources of the Dominion, and he used to like to say that chemical engineering was in its energetic and elastic youth, with the last chapter of the Book of Genesis yet to be written.

Mr. Tyler and I have thoroughly enjoyed your meeting, and the duty of representing the American Institute of Chemical Engineers has been a pleasure.

So, on behalf of the little foundling, I want to express deep appreciation for the honour and the courtesies we have received at your hands.

C. C. KNIPMEYER

*President*

NATIONAL COUNCIL OF STATE BOARDS OF ENGINEERING EXAMINERS

Before coming to this meeting of The Engineering Institute I knew that I would meet with many fine engineers and good neighbours. I expected to make some ends, but did not dream that such warmth of friendship would be showered on me. My feelings have been very deeply stirred by your welcome and I shall be proud and

happy to report this to each member of each board of the forty-six Boards of Engineering Registration in the United States regarding my reaction to things here. They, in turn, will pass the word to all of the seventy thousand registered engineers of the United States.

## Dean Mackenzie Introduces Dean Young

I have come to my last duty as the outgoing president of The Engineering Institute of Canada. It is a great privilege to have the very pleasant task of inducting the new president, Dean C. R. Young.

Dean Young needs no introduction to Canadian or American engineers. Crowning his long years of service as a leading Canadian educationalist he has recently been appointed dean of the largest engineering school in the British Empire.

As a consulting engineer he has had long and extensive practical experience; the many structures he has designed and built are in themselves a lasting monument to his ability. As an author he has to his credit several books and innumerable papers and withal he has been one of the most industrious, competent and distinguished workers in Institute and public affairs that Canada has produced. The Institute is most fortunate in its new president.

I hand over the reins of office to you, Dean Young, with every confidence that in the critical year of 1942 this Institute could not be in better hands.

## President Young Takes the Chair

Anyone in my present situation would, I am sure, feel as I do, a very great satisfaction in having been entrusted with the presidency of The Engineering Institute of Canada for the coming year. I am particularly delighted to assume office in the presence of this great company and, in particular, in the presence of Canada's greatest soldier, and of the leaders of engineering in the United States of America.

The Engineering Institute of Canada has built up for itself in the last fifty-five years a magnificent tradition. Dean Mackenzie has been preceded by a long line of distinguished engineers—by the Keefers, whose standing corresponds to that of Telford and the Stephensons in Britain; by Sir Casimir Gzowski, whose name is commemorated in one of our prizes; by Sir John Kennedy; by that fine French-speaking engineer, Ernest Marceau.

These, and many other eminent men, have in their time contributed to the success and the honour of this Institute. It is my hope that I may in my term of office be able to contribute some little measure of addition to that success.

This year we have assuming office a Council which I think will fully maintain the reputation of the Councils that have been responsible for the affairs of the Institute in past years. As is the custom, a number of new members of Council are elected each year. I shall therefore call upon the newly-elected members, and ask them to rise so that the audience may see them in the flesh . . .

Now I am going to ask you to conclude the banquet by the singing of that song that means so much in this part of Canada—"O Canada." And I am going to ask our French-speaking engineers to respond particularly, as they are most capable of doing. Please show our visiting friends from the United States how the French-speaking engineers sing "O Canada."

# Abstracts of Current Literature

## UNDERGROUND PARKING AIDS TRAFFIC HANDLING IN BUENOS AIRES

By F. A. Zamboni, City Engineer, Buenos Aires, Argentina.

From *Engineering News-Record*, OCTOBER 23, 1941

Three years ago the first two municipal underground parking lots in a programme contemplating a total of eight such traffic relief facilities were placed in service in Buenos Aires. These two initial units, with a capacity of 756 cars, have proved a distinct aid in relieving traffic congestion, and their operation, which includes a mechanical ventilation system, has shown that such facilities can be made self-liquidating through a small parking fee (about 15 cents) and rents from sales rooms, repair shops and poster advertising. Because the results have been so satisfactory it is hoped that the entire programme, providing accommodations for 6,770 cars, can now be completed.

The first two subterranean parking garages were built in connection with the widening of the Avenida Nueve de Julio for which a strip of old buildings a block wide and five blocks long was removed; eventually it is planned to extend this tree-lined boulevard completely across the city, but the expense will be large since the work so far completed, including the underground parking garages, cost over \$6,000,000. (U.S.).

The commercial area of Buenos Aires, where traffic congestion is greatest, is located on the rim of the city, rather than near the geographical centre, as is the case in many cities. Subway lines radiate in three directions from this commercial area, and it is on these lines near the limits of this area where the remainder of the parking facilities are to be built. The two existing parking garages, however, are almost in the centre of the commercial area.

Two parking garages are already built. Both are 200' wide. One is 800' long, the other 400'. Ramps, each made up of three 11' lanes, give access to the garages on either side; experience in operation has indicated that two lanes would have given ample capacity. The garage structure is of reinforced concrete, columns with flaring capitals carrying 18" deep flat slab panels 20' x 25' in plan. The ceiling height in the garages is 15'. Although these garages are all on one level, several of two-story type are planned for the future programme.

## U.S. CONCRETE BARGE PROGRAM

From *Engineering News-Record*, OCTOBER 23, 1941

The U. S. Maritime Commission has decided to start its program of building concrete barges somewhat more conservatively than originally intended by limiting the initial construction to fifteen barges—the east, west and gulf coasts to build five each. The commission has developed two alternative types of contract to be used, one a modified form of fee contract, while the other is a lump-sum contract incorporating an escallator clause. Contractors will be offered their choice between the two forms.

The "cost-plus-a-variable-fee" contract is designed to give the contractor the protection of a cost-plus contract, but at the same time to offer him an incentive to hold the costs down. Under this contract an estimated unit cost per vessel is set up. This cost is broken down into estimated monthly payments, divided between labor and material expenditures. Monthly, thereafter, the estimated cost will be adjusted according to the fluctuation of the Bureau of Labor Statistics index of hourly earnings in

## Abstracts of articles appearing in the current technical periodicals

durable goods manufacturing industries and the bureau's index of wholesale metal prices.

As the work progresses, the contractor will be paid his actual costs, including overhead "incident and necessary" to the job. At the completion of each vessel he will receive a fee of 15 per cent of the adjusted estimated cost. If the actual cost plus the fee is greater than the adjusted estimated cost, that is that. If, however, the actual cost runs lower than the estimate, the contractor receives half of the savings. Total of cost savings allotted to the contractor plus bonuses or minus penalties is limited to seven per cent of the estimated cost. A time schedule will be written into the contracts. Liquidated damages of \$50 daily will be charged for failure to meet the schedule, and a like sum will be paid as a bonus if the schedule is exceeded.

The commission may cancel the contract upon payment to the contractor of his actually incurred costs plus ten per cent of the costs or six per cent of the estimated total cost times the percentage of completion achieved at the time of the contract's cancellation—whichever of these two quantities is smaller.

The lump-sum form of contract provides for the establishment of a unit price per vessel to be paid the contractor. This price is to be adjusted for variations in material and labour costs in the same way as is the estimated cost figure in the variable-fee contract already described. Provision is made for liquidated damages, but there is no bonus for early completion. If the contract is cancelled by the commission, the contractor will be paid for work accomplished in terms of a percentage of the contract unit price and will also be paid any cancellation fees he has to pay to his suppliers and sub-contractors.

The contractor's profit under the lump-sum contract is limited to ten per cent of the contract price, and any excess must be turned back to the commission.

## ADAPTION OF MOTOR DESIGN TO CEMENT MAKING

ROBERT WILLIAMSON\*

Cement is a dry, fine powder. It follows that dust is present in the cement works. Motors used in its manufacture must be capable of 100 per cent efficiency in dust-laden atmosphere. Motors of the standard protected type, with self-ventilation by means of a fan, are adequate in dry air but in wet air motors of the totally enclosed, fan cooled type must be used. Nevertheless, with well built works, most drives can be entrusted to standard protected type motors.

Torque determines the type of motor, the highest starting torque being necessary where considerable out-of-balance load has to be overcome and an appreciable mass accelerated.

Other types of drive, where the mass to be accelerated is large, even without excessive friction, also demand a slipping motor.

In large installations, power factor improvement is important. This can be effected by synchronous induction motors for driving one or more of the larger machines. These give a high starting torque, and can be arranged to run at a leading power factor compensating for the lagging current taken by other units.

\* London Correspondent of *The Engineering Journal*.

In one Works, current is taken from 10,000-volt three-phase 50-cycle mains, and stepped down to 440 volts in substations at the main works and the quarry. The quarry substation gives a separate supply for a wash mill plant, the 440-volt circuits being controlled by two G.E.C. industrial pedestal switchboards. One board controls feeders to a chalk excavator and wash mill and to a wet tube mill with its auxiliaries, while the other controls various motor drives.

#### WASH MILLS

Raw material for cement is obtained from "low" and "high" quarries, the first being low carbonate materials, the second, high carbonate materials. These are dug by bucket type electric excavators and conveyed in one yard wagons by diesel locomotives to the washing plant.

Chalk from the "low" quarry is reduced to 4-5 in. lumps and fed into the first wash mill to form "slurry" which is forced through gratings into a sump, and pumped to storage tanks or to the second wash mill where high carbonate material is added. Material put into storage from No. 1 wash mill is used as a standby when No. 1 is not working.

Electrical equipment in this section comprises a 150-hp. 360-rpm. 440-volt G.E.C. synchronous induction motor with liquid starter and oil circuit breaker).

#### SLURRY

The slurry from No. 1 wash mill, and chalk from the "high" quarry, after passing a roller mill, are next mixed in No. 2 wash mill, which has screens. The product of this mill is screened and then passes by gravity to a wet tube mill.

The slurry is then pumped to the storage tanks, which are air-agitated by compressed air at 30 lb. per sq. in. pressure by a rotary compressor direct coupled to a 50 hp. slipring induction motor. The storage tanks have a capacity of 16,000 cu. ft.

#### THE KILN

The slurry is pumped from the storage tanks into a small mixer agitated by a 10-hp. squirrel cage motor and thence it is passed by a three throw ram pump through worm and spur gearing, into a calcinator feeding into the kiln.

The 500-ton kiln is a rotary and consists of a steel tube lined with firebrick and fitted with four cast steel tires running on pairs of rollers. The speed is from 1 rev. in 16 seconds (minimum) to 1 rev. in 55 seconds (maximum). The kiln is driven by a single 85-hp., 440-volt, 3-phase, 60 cycles, variable speed slipring induction motor through triple reduction spur gearing.

The slurry travels slowly down the whole length of the kiln to the "clinkering" zone, being successively dried, calcined, and sintered as the temperature increases from about 100 at entry to about 2,700 deg. F. at the furnace end. Here the clinker is discharged on to a grate cooler. It is next taken by a shaker conveyor and elevator to the coal and clinker store.

#### GRINDING

Next comes the grinding of the clinker (plus gypsum) in the clinker mill house. Preliminary grinding is carried out in two rod mills, driven through gearing from line shafting. The discharges from the rod mills are passed to a large tube mill, driven through gearing by a 400-hp. G.E.C. synchronous induction motor for further grinding.

#### PACKING

The cement is now in its final form and is discharged to a pneumatic conveying system and is taken to storage bins.

The pneumatic conveying systems are supplied with air by three reciprocating compressors driven by slipring motors, two of 45 hp. and one of 70 hp.

Valve type bag packers fill the cement bags at the rate of 35/50 tons per hour.

#### COAL HANDLING PLANT

On arrival the coal is discharged into a receiving hopper, from which it is fed to a vertical elevator leading to a band conveyor, which takes it to the coal and clinker store. From storage it is taken via a magnetic separator and elevators to hoppers leading to an air-swept ball mill, which is gear driven by a 75-hp. slipring motor.

In the coal and clinker store—400 ft. long by 60 ft. wide—wet and dry coal is distributed and the clinker handled by a 5-ton overhead crane fitted with three slipring motors, 25 hp. for hoisting, 12 hp. for longitudinal travelling, and 4½ hp. for cross travel.

The works fitting shop contains a shaping machine, drill, screwing machine, saw, two lathes and two grinders, all of which are driven from line shafting by a 20-hp. motor.

#### MOTORS AND CONTROL GEAR

With the exception of the large synchronous induction motors on the chalk mill and the clinker tube and the kiln motor, all the motors mentioned are standard 440-volt G.E.C. "Witton" induction machines of the protected type running at about 720 or 960 rpm.

#### SIXTY YEARS AGO

##### SUBMARINE ARTILLERY

From *The Engineer* (LONDON), NOVEMBER 21, 1941

On November 14th, 1881, a public trial of Ericsson's torpedo boat, the *Destroyer* took place at New York. The trials were reported to have been in every way successful. The *Destroyer* was an armour-clad torpedo boat, 130' long, 11' deep and 12' wide. She had engines of about 1,000 I.H.P. and her speed was said to be 16 knots. Her novel feature lay in the fact that she carried a long tube on her keelson, the muzzle of which was 6' below water. From this tube there could be discharged elongated projectiles carrying as much as 350 lb. of dynamite. The projectiles were stated to be made of wood and they were propelled out of the submarine gun by steam pressure. Reports received from New York stated that during the trials a projectile carrying a charge of 12 lb. of powder had travelled 600' under water and had penetrated a torpedo net and a target representing the bottom of an iron-clad. In a leading article in our issue of November 18th, 1881, we sought to show that Ericsson's invention had been anticipated in principle by Robert Fulton, who in 1813 carried out experiments to discover what could be done with guns fired under water. He found that a ball fired with 12 lb. of powder from a "columbiad" with its muzzle 2' under water passed clean through a target 3' thick placed 6' from the muzzle of the gun. Following his experiments Fulton designed a ship fitted to discharge a broadside of submarine ordnance, but nothing further seems to have been done with the idea until 1857, when Whitworth made some experiments on submarine artillery. In one experiment carried out at Portsmouth, Whitworth used a 110 lb. Armstrong gun, which was fixed on a platform below high-water mark, loaded when the tide was out and fired when the tide was in. With a charge of 12 lb. of powder this gun sent its projectile clean through a 13½" baulk at a range of 25'. In 1862 Whitworth extended his experiments by firing underwater shots against the side of a wooden hulk protected by six ½" boiler plates. With a conical shot the hulk's side was destroyed over a considerable area. In the same year Forbes, an American, carried out a number of similar experiments and entered into a contract with the United States Government to construct a partially armoured gunboat carrying a submarine gun. The contract, however, was not carried out. Concluding, we referred to some experiments then being made by our own Government, in which a light iron case resembling a fish torpedo in shape was propelled through the water by the discharge of gas at its tail after the manner of a rocket.

## MORALE

Editorial from *Army Ordnance*, Nov.-Dec., 1941

The popular morale of the nation—as distinguished from the military—is its collective mental state affected by such factors as zeal, confidence, spirit, and hope. Our popular morale as regards the all-out effort for arms production is not as high as it should be. Yet, unless that morale is of the highest, the armament production job will fail. We had better diagnose the malady quickly and adopt a remedy at once. For as popular morale goes, so goes everything else—the fighting forces as well as the human machinery of arms production. What are the causes of this low morale, and what are the remedies? Every fair-minded patriotic person will demand that adequate remedies be applied, no matter what the cost.

In seeking the causes one has only to remember the shabby pacifism of the American people during the last two decades. We are now paying the price of that pacifism, and no amount of tall talk can undo the damage done by years of idiocy. And the guilt should not be spread thin.

*The pacifism of the press* did untold harm to the national defense of the United States by its hypercritical denunciations of things military—especially military training and planning. It was the press that fanned to fever heat the stupid crusade against armament manufacture and developed an attitude of mind on the part of the people wherein arms making became synonymous with warmongering.

*The pacifism of the pulpit* all too frequently spoke in derogation of military discipline and training. It helped to inculcate in youth an unrealistic view of the problems of war and peace. It was the pulpit that often misconstrued the cause and effect of war. It was the pulpit—of all places—that frequently branded as unchristian the discipline of the soldier, the dignity of hard work, the thrift of the wise.

*The pacifism of the politician* was exceptionally blatant during those years in its childish crusades against our national-defense machine. Some clumsy politicians did irreparable damage when they turned the technique of smear campaigning upon “munitions makers” and other exponents of military preparedness. Consummate hypocrites, other politicians all but starved the defense forces while wasting billions of dollars on make-believe hard times. It was the cheap politician who misled the people by broadcasting his own ignorance of the national defense at a time when his voice should have been raised in the soundest support of it.

*The pacifism of the pedagogue* was yet more serious. It went to such extreme lengths as to permit an alien visitor to our shores (now safely established in one of our larger universities), to urge the youth of America to renounce arms for the defense of country, thereby striving to indoctrinate our young men with the contemptible treachery of the Oxford Union and the Communist. It was a misguided pedagogue who germinated false doctrines concerning war and peace akin to his other false theories.

What is the remedy? There is only one—sound generalship. Not alone the generalship of the battlefield but the generalship in the factory, on the farm, in the home. We have such generalship in the fighting forces; we do not have enough of it among our civilian leaders. Too many of them are afraid of their shadows! Until leaders come forward in all the respective spheres of action to contest the false doctrines that undermine our national strength, the arms-production programme, and indeed every programme for the welfare of our country, will progress at only a snail's pace. Such generalship, as far as the national defense is concerned, requires a deep knowledge of

the problem. Arms production is a difficult task even for American manufacturing ingenuity. It is a field that has no place for ignoramuses, theorists, or prima donnas. Fearless men in civil life, imbued with a sense of sound generalship, will be the salvation of our armament effort, for they alone can instill the zeal, confidence, spirit, and hope that *are* popular morale. “Free peoples can escape being mastered by others only by being able to master themselves.”

## RUSSIA'S INDUSTRIES

From *Trade and Engineering* (LONDON), NOVEMBER, 1941

During the past month further important manufacturing districts of European Russia have been overrun by Hitler's hordes and hirelings. The U.S.S.R. has suffered grievous losses in consequence, but by steadily pursuing its scorched earth policy it has minimized the enemy's immediate economic gains.

The highly intensive activity of the Donetz Basin, which, during the past three months, has contributed greatly to the Soviet War effort, has come to an end. Operatives have been transferred elsewhere, chiefly to the Urals, where buildings, materials, and machinery have been prepared for them. Kharkov, whose factory equipment has been either removed or destroyed by the Russians, has been a leading centre of machinery manufacture, with one of the largest single plants for producing aircraft, a tractor works, machine tool plants, locomotive works, and electrical engineering concerns in the near neighbourhood.

Rostov has been known for its great agricultural machinery factory. Skilled munition and other workers have been withdrawn from the districts of Kharkov, Moscow, and the Ukraine, and large numbers have taken up employment in factories and mines in the newly developing industrial regions in Asia. From Odessa and other centres important machines, as well as skilled industrial workers, have been moved east.

In Kuibyshev, on the Middle Volga, where all the foreign Embassies and Legations which were in Moscow have been moved, there are new railway repair and carburettor plants, an oil refinery (fed from the “Second Baku” fields between the Volga and the Urals), and many factories producing agricultural equipment and tractors. Kuibyshev is one of the main centres of the great scheme for harnessing the power of the Volga; it has a hydro-electric power station which, when complete, would feed still more new centres beyond the Volga. As headquarters for war the city is important as one of the main junctions between railway and river. Oil coming up from the Caucasus by way of the Caspian and Astrakhan can be transferred from the ships straight on to tank wagons to be sent east or west. Armaments coming by rail could be put on the Volga during the months when the river is free from ice. Round Kuibyshev it is usually blocked by ice between December and April.

In the Ural area there are promising centres of heavy industry, and farther east, near the rich coalfield of Kuzbass, there are others. In Central Asia is the Karaganda coalfield, which produced over 6,000,000 tons in 1940, and there are the other great mining centres which produce over two-thirds of the Soviet lead and zinc and almost the whole of the Soviet chrome, copper, and cotton. Back in the Ural region are the oilfields, the “Second Baku”, based mainly at Ishimbaevo and Makat, which, even in 1938, produced nearly 2,000,000 tons, and were planned to produce nearly 7,000,000 tons by next year.

In these new industrial regions of the east some aircraft and tank factories have been working for years and others have been newly opened, but complete plans of production have not been fully developed.

## POWER SUPPLY IN WARRING COUNTRIES

By H. S. Bennion, Vice-President and Managing Director,  
Edison Electrical Institute.

From *The Electrical Times* (LONDON), Nov. 27, 1941

In our everyday activities so much dependence is now placed on electric service that the following gleanings of information (gathered and surmised from technical journals and a few uncensored reports of happenings in warring countries) are of great importance in considering civilian defence measures.

**RESTRICTED DAMAGE.**—Air bombing appears to be temporarily effective against underground utility distribution systems of all kinds, electricity, water and gas. Overhead electric distribution circuits have proven to be less vulnerable. The effects do not appear to be decisive or permanent, however, since repairs are made promptly either as improvisations or permanent repairs. The duration of outages due to disruption of these facilities grows shorter as operating personnel learn what to expect, how to prepare for it, and how to proceed when it occurs.

In the United States, floods, hurricanes, ice storms, and occasional fires have given the personnel of electric utility companies considerable experience in emergency repairs; and it must be noted that in the case of widespread storms the damage to be dealt with has been vastly more extensive than that which bombing occasions.

The most serious effects of bombing to any utility appears to be the rupture of water mains in conjunction with incendiary bombs, since the means of fighting the incipient fires is thus impaired and they may gain considerable headway. The importance of this feature may be judged by the stress laid upon the desirability of local standing water supplies, such as tanks, pools and other forms of local water storage.

While definite information is lacking, it appears that electric generating stations, occasionally hit and no doubt sometimes damaged, have not been put out of action completely or permanently as a result of enemy bombing, notwithstanding the fact that important generating stations have been among the objectives of bombing attacks. A German article relates that a certain Dutch generating station which had been bombed, and evidently hit, for the removal of a dud bomb within the works was necessary, was "slightly damaged but able to operate." This exhibit of relatively indecisive effect of bombing upon modern, fireproof generating stations appears to be borne out by verbal reports of British experience, and by the record of output there, which could hardly have been maintained at better than the pre-war level if any large amount of generating apparatus had been out of service for any considerable period of time.

**RESTORATION OF SUPPLY.**—Quite a different picture is presented of the effects of large calibre artillery fire, as indicated in a German article describing the restoration of utility service after the occupation of Warsaw in September, 1939. Although primarily a description of the restoration measures that were taken, the article incidentally gives considerable information on the effects of fire.

Although Warsaw had been heavily bombed, the damage to the power plant was specifically ascribed to artillery fire. Warsaw was subjected to artillery fire of all calibres for eight days. As a result at least two turbo-generators in the Warsaw power plant had received direct hits and the remainder showed many hits of a lesser degree. All of the boilers were unfit for service apparently as a result of punctures by shell fire. The German article describes how the boilers were rendered servicable by means of welded patches. The extent of the mechanical damage may be estimated from the following time schedule for restoration:—

0 day.—Station completely inoperative.

5th day.—Two units, aggregating 18,600 kW in service.  
12th day.—Third unit of 15,000 kW in service.  
30th day.—50,000 kW of an original 107,600 kW in service.

Concerning water supply, the article related that a rapid filter had been completely destroyed and chlorinators seriously damaged by artillery fire. The pumping plant was unserviceable because of failure of the power supply. The gas works were badly damaged, in most cases as the direct result of artillery fire. For example, 30-in. pipes and valves were broken, apparently upon impact. Restoration of these water and gas services presented no unusual features beyond the efficiency and expedition with which the work was completed.

**DEMOLITION.**—One German article deals at some length with the demolition methods employed by their adversaries during their retirement from Holland, Belgium and northern France. Reference is made to a Belgian generating station (which had been wrecked by hand) where many parts, such as control instruments, insulators and insulating bushings which could not readily be replaced from any available stock were merely broken. Apparently, this method of demolition was rather efficient. In other cases it was related that essential parts of apparatus were removed by technical specialists among the retiring troops. These acts, however, merely resulted in temporary delays in restoration of service.

**NEW CONSTRUCTION.**—Information as to new construction of power facilities and power output of generating stations has been closely guarded in the Axis countries for the past four years. Recent news stories in this country have indicated prodigious increases in German controlled capacity and output in recent years. So far out of keeping with past performances is this that it seems questionable. At the time of the World War the Germans were given much more credit in such respects than later information showed they were entitled to. The same is probably true at this time, though they did make power gains from 1936 to 1940.

The British have been much freer in publishing information concerning electric power. When the war broke out new installations were stopped and the machinery planned to be installed was sold in the export trade. Information is slow coming out as to output, but the figures for the end of March, 1940, showed output up about 4%, and maximum demand down by 3%. This was an average figure, as might be expected. Certain areas affected by war industries and by the influx of population from the big cities showed substantial increases up to 15% and 20%. It is to be expected that this local variation has happened to a greater extent in Germany because that country has gone to greater lengths in scattering its industries, to make them less vulnerable to bombing attacks.

## SHEFFIELD SALUTES STALINGRAD

ROBERT WILLIAMSON\*

In a steel casket designed by a Sheffield craftswoman greetings have been sent from Britain's steel city to Stalingrad, its opposite number in Russia.

Thousands of Sheffield signatures, from bishops to steel moulders, have been appended to the message in which the British city pledges itself to the people of Stalingrad to play its part in achieving a maximum output and so ensure the fullest use of its resources to speed the victory over Hitlerite Germany.

Produced under the auspices of Sheffield's Anglo-Soviet Union, whose object is friendship between the British and Soviet peoples, the casket containing the greeting bears the City's Arms, flanked by the British lion on one side and the Soviet hammer and sickle on the other, with inscriptions in English and Russian.

\*London Correspondent of *The Engineering Journal*

# From Month to Month

## PRESIDENT'S MESSAGE

A message from the new President of The Institute, Dean C. R. Young, appears on page 127 of this issue. It is recommended that every member read it carefully.

## ANNUAL MEETING

The 1942 Annual Meeting has joined that long list of successful events that go to make up Institute history. For some time it is likely to shine a bit more brightly than the others, but there is no way in which the brilliance of it all can be preserved in perpetuity. To those who were there, it shall remain an outstanding event but to others, less fortunate, there is no choice or grouping of words that will convey any conception of the "feeling" of what actually took place.

It is simple to recount that new records of attendance were established, that the speeches were excellent, that the social events were happy occasions, and the plant visits unusually interesting, but these statements, or any elaboration of them, do not describe the meeting.

Some happy combination of circumstances developed an atmosphere that coloured every minute of the two crowded days. In the first place the registration ran up to almost eleven hundred, which was an inspiration in itself. The presence of the distinguished American delegation also contributed materially. An unusually large number of out-of-town members engendered a spirit of pleasant reunion but above all, of course, was the thrill that came with the announcement Thursday morning that General McNaughton would be present and would speak at the banquet Friday night. All these things, and perhaps others too, combined to give The Institute the happiest event in its history.

It was particularly pleasing to see the large attendance at the professional meetings. In almost every instance the rooms were crowded to capacity and in every instance discussions could have been carried on to much greater length. On two or three occasions many people had to stand throughout the session. The attendance at these meetings ran as high as three hundred and fifty.

The committee was very fortunate in its choice of luncheon speakers. The Hon. C. D. Howe gave the best account of munitions production in Canada that has yet been heard. He spoke without manuscript or notes and it was very evident that he was in a field where he needed no written word to prompt him or to acquaint him with his subject. He has seldom been heard to better advantage. An audience of six hundred and twenty-five gave him a warm reception and expressed in no uncertain terms its appreciation of the work accomplished by his department and of his part in it. A verbatim report of his address is in this number of the *Journal*. It is recommended that it be read by every Canadian.

At Friday's luncheon, James W. Parker, president of The American Society of Mechanical Engineers, spoke on "The Management-Employee Problem for Engineers." This address will be published in the April number of the *Journal*, and readers are again urged to study it. It contains much wisdom that may well be applied to labour situations throughout Canada. The address was recorded by the CBC and broadcast that evening over the Montreal stations. From enquiries received by telephone and mail, it is evident that many persons other than members were interested by it.

No event could be more enjoyable or thrilling than was the banquet Friday night. Almost seven hundred people testified to that. Under the inspired guidance of President Mackenzie, great heights of humour and emotion were reached. Not many people have been privileged to see and hear a more brilliant, adroit and witty chairman. Blest as

## News of the Institute and other Societies, Comments and Correspondence, Elections and Transfers

he is with a keen sense of humour, and a chuckle that absolutely disarms his listeners, he turned in a performance that will be long remembered, and should forever dispose of the theory that the engineer is inarticulate. Dean Mackenzie surely finished up his term of office in a blaze of glory.

A great tribute was paid The Institute in the presence at the banquet of the presidents of the seven leading engineering societies of the United States, and the secretaries of six of them. With these gentlemen present it is doubtful if a more distinguished group of engineers has ever assembled on this continent. The Institute is rightly proud of this tribute, and will long remember the compliment that has been paid it. Each of the presidents spoke for a few minutes and a verbatim report of their remarks is presented in this number of the *Journal*. An excellent photograph of the group also appears on these pages.

The climax of the whole meeting was reached when General McNaughton rose to speak. No finer acclaim of this man's greatness, or of the affection with which he is held by the people of Canada, could be given than was shown in the sincere demonstration of the audience. A less modest man might have been prepared for it, but General McNaughton was taken entirely by surprise. It was with difficulty that he spoke and in his first words he said, "You must forgive me if the reception I have received has made it impossible for me to speak coherently, or to carry any message except that which comes straight from the heart."

He had no manuscript or notes, and he did speak from his heart—and to the hearts of his listeners. There is no need to dwell on the address itself—it was recorded and appears in this number of the *Journal*—except to say that it carried an important, an urgent message to the engineers of Canada. General McNaughton has been on the ground; he speaks with authority, and he brings this message direct to the engineers. The seriousness of the situation was as evident in his words as in his face, and no one who heard him and saw him could fail to grasp the significance of what he said.

General McNaughton's acknowledgment of Dean Mackenzie's accomplishment at the Research Council met a warm acceptance from the audience. He said, "One of the happiest things that has ever been in my mind is the knowledge that the National Research Council and all it stands for, under Mackenzie's leadership, is carrying the mantle of scientific leadership and helpfulness. It is a happy thought for the Dominion of Canada and all those associated in the war effort. . . for this is an engineers' war."

The concluding feature was the induction of the new president, C. R. Young, Dean of Engineering at the University of Toronto. Retiring President Mackenzie gracefully and fittingly introduced him and the new president as gracefully and fittingly replied.

The closing features of the whole programme were the reception and the dance which followed it. Lieut.-General McNaughton and Mrs. McNaughton joined with the Institute officers and their wives in receiving the guests—a gesture greatly appreciated by everyone.

It is still impossible to put a finger on any one thing that made this meeting so outstanding, but there is no doubt in the mind of anyone but that something did occur to lift it out of the realm of the ordinary and place it high in the minds and memory of all who were privileged to participate in it.

# DEAN CLARENCE RICHARD YOUNG, B.A.Sc., C.E., M.E.I.C.

PRESIDENT OF THE ENGINEERING INSTITUTE OF CANADA, 1942

Less than a year ago a distinguished graduate of the University of Toronto was appointed dean of its Faculty of Applied Science and Engineering, an event which was universally approved. This new dean has just taken office as president of The Engineering Institute of Canada for 1942, following in the presidential chair another dean, whose term of office concluded at the recent memorable annual meeting of The Institute.

Like Past-President Mackenzie, Dean Young is a man of many talents and activities. In fact the list of the educational, professional and public questions with which he has been concerned gives ample evidence of his achievements as an engineer, author, instructor, and administrator.

Clarence Richard Young was born near Picton, Ont., and took his bachelor's degree at the University of Toronto in 1905; the degree of C.E. followed in 1914. His professional experience has been largely in the field of structural engineering, his consulting work having also involved many special investigations and reports regarding technical, economic and legal problems connected with civil engineering. He joined the teaching staff of the University of Toronto more than thirty years ago, in 1929 he was appointed professor of civil engineering in succession to the late Peter Gillespie, and in 1941 became dean of his Faculty.

Always a supporter of The Institute, he is a past councillor and has served as chairman of the Toronto Branch. Last year he was chairman of The Institute's Committee on International Relations, and he now represents The Institute on the Committee for Professional Training of the Engineers' Council for Professional Development. He has taken a prominent part in the work of the Society for the Promotion of Engineering Education. He is a Member of the American Society of Civil Engineers and has served on a number of their technical committees. His work as a committee chairman of the Canadian Engineering Standards Association has been notable, particularly in connection with the Specification on Concrete and Reinforced Concrete. In 1937-38 he sat on Mr. Justice Chevrier's three-man Royal Commission on Transportation, dealing with the economics of commercial motor transport in Ontario.

In addition to Dean Young's more strictly technical work in bridge and structural design he was consulting structural engineer to the Ontario government in connection with hospital and prison work; he served on the international board of three engineers who passed upon the original plans of the Detroit-Windsor bridge; he reported on the impact and vibrational stresses in the Victoria Bridge, Montreal; and recently conducted an experimental investigation of the properties of soils to be employed in the Shand earth dam for the control of the Grand river, Ontario.



Dean Clarence Richard Young, B.A.Sc., C.E., M.E.I.C.

The Bulletins of the University of Toronto School of Engineering Research contain reports of many investigations carried out by and under Dean Young, and he has made frequent contributions to technical journals and the proceedings of engineering societies. He is the author of a standard text book on structural problems and of several sections in Hool and Kinne's Structural Engineers' Handbook Library. He is also joint author of a brief but widely used booklet on Military Law.

The Dean's interest in military affairs dates from the formation of the University of Toronto Contingent, C.O.T.C., of which he was one of the original officers. During the last war, Major Young was second-in-command of the Polish Army Camp at Niagara, where over twenty thousand Polish soldiers were trained and sent to France and later to Poland. He was decorated by both Poland and France for his services and is now chairman of the Toronto Branch of the Canadian Friends of Poland.

The esteem in which Dean Young is held by his past and present students, and their appreciation of his work, were evidenced in 1939, when he was awarded the medal of the Engineering Alumni Association of the University of Toronto, for outstanding achievement in engineering.

This estimate of his worth will be endorsed by his many friends throughout the Dominion, who will join in wishing him a happy and prosperous year of office as president of The Institute, and in congratulating the members of that body on the choice they have made.

## "THE PROFESSION OF ENGINEERING IN CANADA"

A booklet bearing this title has just been published by The Institute under the auspices of the Committee on the Training and Welfare of the Young Engineer. It is the result of many months of investigation, study and labour, and represents the combined efforts of all members of the committees.

The purpose of the booklet is to provide guidance to young men who contemplate engineering as a career. It is being distributed without charge to high school pupils across Canada, and to first year students in engineering at all universities. It is intended to assist in leading the proper types of students into engineering and to directing others into those channels in which they are more likely to succeed.

The committee proposes to set up in each branch district, counsellors or advisors to whom the high school student may appeal for advice. The booklet offers this assistance and the committee believes that many competent members will make themselves available for the service.

The first edition runs to ten thousand and it looks as if it would not last a year. Educational officers in every province have spoken highly of the publication, and have assured the committee that it will fill a long felt need. They are assisting in the distribution.

This publication is one of the most difficult undertaken by The Institute and only the perseverance, intelligence and industry of Mr. H. F. Bennett and his committee have made it possible. Not only The Institute but prospective engineers as well owe a great debt to this small group of workers. The distribution and all subsequent developments are in the hands of the committee.

### AN ENGINEER HEADS THE ARCHITECTS

On Saturday, February 21st, at the Cercle Universitaire, Montreal, Gordon McL. Pitts, M.E.I.C., was installed as president of the Royal Architectural Institute of Canada. Mr. Pitts is well known in The Engineering Institute and is equally well known in architectural organizations. It is unusual to find one person so active in two professions, but Mr. Pitts has made valuable contribution to both and is highly regarded by each. Many engineers were present at the ceremony, to pay tribute to a fellow craftsman and



G. McL. Pitts, M.E.I.C.

to share in the pleasure of installing him in an important office.

A native of Fredericton, N.B., Mr. Pitts graduated from McGill University in 1908 with the degree of B.Sc., and in 1909 received the degree of M.Sc. In 1916 he obtained his degree of B.Arch. In 1906 Mr. Pitts was an engineer on construction with the Canadian Pacific Railway Company and in 1908 he was senior draughtsman with the

Trans-continental Railway at Ottawa, Ont. In 1909 he joined the staff of Peter Lyall and Sons Construction Company, Ltd., as engineer and superintendent, and in 1912 he was supervising engineer on the construction of the Montreal High School for the Protestant Board of School Commissioners. In 1914 he joined the firm of Edward and W. S. Maxwell, architects of Montreal, and from 1916 to 1919 he was assistant to John A. Pearson, architect for the Parliament Buildings at Ottawa. Later he became a partner in the firm of Maxwell and Pitts, Montreal, thereby maintaining one of the oldest architectural practices in Canada.

Mr. Pitts joined The Engineering Institute as a Student in 1908 and was transferred to Associate Member in 1914. He became a Member in 1938. He has always been very active in Institute affairs, particularly as chairman of the Committee on Consolidation, and more recently as chairman of the Radio Broadcasting Committee. He is at present a councillor of The Institute representing the Montreal Branch.

Mr. Pitts is a past-president of the Province of Quebec Association of Architects and in 1940 he was one of the recipients of the medal presented to prominent architects by the Association on the occasion of its 50th anniversary. He is, at present, president of the McGill University Graduates Society.

### WARTIME BUREAU OF TECHNICAL PERSONNEL

#### Monthly Bulletin

Since the first of the year the Bureau has been particularly active in matters related to universities. Negotiations with the authorities were carried on for some time with the object of obtaining for certain students exemption from summer military camp. These have resulted in authorization being given to the officer commanding O.T.C. units to give the usual credits to those students who produced evidence to indicate that they had spent at least twelve weeks in a war industry in lieu of the summer camp. This should result in guaranteeing to industry a useful supply of labour for the summer months, and to the student the proper extension of his training.

Military camp usually came at a time that interrupted the student's summer work, frequently causing the loss of a large portion of the vacation period. Under the present arrangements, students should be able to work continuously throughout the time the universities are closed.

The Bureau has undertaken to secure summer work for engineering and science students. Fifteen hundred companies were canvassed to find out how many openings would be available to students. Three hundred and forty-five companies replied indicating that places were available for at least 1600 students. All of these openings have been catalogued and the information sent to the universities, so that students in consultation with university authorities could determine now the work which they are going to do this summer, thereby eliminating the loss of time which ordinarily occurs.

Mr. L. E. Westman, an assistant director of the Bureau is visiting all the universities in order to facilitate arrangements with regard to summer employment both for undergraduates and this year's graduating class. At the same time he will discuss many other matters that have a bearing on employment and university training.

Dr. David A. Keys—scientific personnel officer of the Bureau, has also visited universities in order to assist in utilizing the services of the science undergraduates and graduates. Dr. Key's particular field lies in research work and he has rendered important services to the armed forces, research organizations and industry. His visit with the universities will assist materially in organizing this field for the future.

In the belief that the usefulness of the Bureau would be increased if engineers and employers of engineers knew more about its activities, it was decided to send representatives to the annual meetings of such organizations as

the Canadian Electrical Association; Canadian Pulp and Paper Association; The Engineering Institute of Canada; Association of Municipal Electric Utilities; Canadian Institute of Chemistry; Canadian Institute of Mining and Metallurgy; Canadian Manufacturers Association, etc.

So far the annual meetings of the first four organizations mentioned have been attended; a desk was provided at the registration counter and suitable signs were made to identify the Bureau. The representatives report the experiment to be successful. They found that many engineers discussed their own cases to see if they could be more profitably used elsewhere and that employers discussed in detail their technical personnel problems. This practice will be continued throughout the year.

Arrangements have been made with the Unemployment Insurance Commission to establish at some points regional offices of the Bureau in the same locations as the Commission offices. Several men have been brought in to the office in Ottawa for training and already three have been sent out as regional officers. Mr. S. R. Frost is in charge of the Toronto office; Mr. T. S. Glover the Hamilton office and Mr. G. H. Burdett the Montreal office. Arrangements are under way to establish another district office at Vancouver. These gentlemen are all professional engineers of the executive type, well and favourably known in their own localities, and in almost every instance have obtained leave of absence from their employers; in some instances, a portion of their salaries is being paid by their former employers.

Closer co-operation is developing with the armed services and it is expected that arrangements will be completed, whereby the Bureau can be of greater service in recruiting technical personnel for commissions in all three branches.

About the middle of January the Bureau moved to new premises in the Confederation Building. The expansion of activities made it necessary to obtain additional floor space which was not available in the New Supreme Court Building. The Bureau is now located in the same building and on the same floor as the Department of Labour, under whose auspices it operates. The new location and layout will assist materially in carrying on the business of the Bureau.

#### PRESIDENTIAL VISIT TO WESTERN BRANCHES

President Young plans to visit all the western branches of the Institute during April. Each branch is arranging its own programme, details of which are not yet available at Headquarters. A regional meeting of Council will be held at Vancouver on April 18th. Following is the itinerary:

Lve. Toronto.....	P.M. Tuesday.....	March	31st
Arr. Sudbury.....	A.M. Wednesday.....	April	1st
Meeting with Canadian Institute of Mining and Metallurgy			
Lve. Sudbury.....	A.M. Thursday.....	April	2nd
Arr. Sault Ste. Marie.....	P.M. Thursday.....	April	2nd
Meeting with Branch.			
Lve. Sault Ste. Marie.....	A.M. Friday.....	April	3rd
Arr. Port Arthur.....	A.M. Saturday.....	April	4th
Meeting with Branch.			
Lve. Port Arthur.....	P.M. Saturday.....	April	4th
Arr. Winnipeg.....	A.M. Sunday.....	April	5th
Meeting with Branch—April 6th.			
Lve. Winnipeg.....	P.M. Tuesday.....	April	7th
Arr. Saskatoon.....	A.M. Wednesday.....	April	8th
Meeting with members of Branch at University			
Lve. Saskatoon.....	P.M. Wednesday.....	April	8th
Arr. Edmonton.....	A.M. Thursday.....	April	9th
Meetings with Branch and University			
Lve. Edmonton.....	P.M. Thursday.....	April	9th
Arr. Calgary.....	A.M. Friday.....	April	10th
Meeting with Branch			
Lve. Calgary.....	A.M. Saturday.....	April	11th
Arr. Lethbridge.....	P.M. Saturday.....	April	11th
Noon Meeting with Branch.			
Lve. Lethbridge.....	P.M. Saturday.....	April	11th
Arr. Vancouver.....	P.M. Sunday.....	April	14th
Meeting with Victoria Branch—April 15th.			
Meeting with Vancouver Branch—Friday, April 17th.			
Regional Meeting of Council at Vancouver—Saturday, April 18th.			
Lve. Vancouver.....	P.M. Saturday.....	April	18th
Arr. Regina.....	A.M. Monday.....	April	20th
Meeting with Branch			
Lve. Regina.....	P.M. Monday.....	April	20th
Arr. Toronto.....	A.M. Thursday.....	April	23rd

## CORRESPONDENCE

DEPARTMENT OF NATIONAL DEFENCE

OTTAWA, Canada, 12th February, 1942.

Dear Mr. Wright:

I most deeply appreciate your note of 9th February, 1942, in reference to the annual banquet of the Institute which I was privileged to attend last week.

I feel most deeply that the obligation is the other way round for I had the opportunity to do two things which I was most anxious to carry out—first, to pay my tribute to Dean Mackenzie, both as the president of The Institute and also, and more particularly, as head of our National Research Council; and second, to tell the engineers of Canada through The Institute, of the vital importance which I attach to the use of their members in the development and production of improved weapons and equipments for the forces overseas.

Also, and as a personal matter, it was a great happiness to myself and to my wife to renew acquaintance with so many old friends.

With kindest regards and best wishes,

Very sincerely yours,

A. G. L. McNAUGHTON.

L. Austin Wright, Esq., General Secretary,  
Engineering Institute of Canada,  
2050 Mansfield Street, Montreal, Que.

#### MEETINGS OF COUNCIL

The annual meeting of the Council of the Institute was held at Headquarters on Wednesday, February 4th, 1942, at ten thirty a.m.

Present: President C. J. Mackenzie (Ottawa) in the chair; Past-Presidents J. B. Challies (Montreal), T. H. Hogg (Toronto), and H. W. McKiel (Sackville); Vice-Presidents deGaspé Beaubien (Montreal), K. M. Cameron (Ottawa), and M. DuBose (Arvida); Councillors A. E. Berry (Toronto), D. S. Ellis (Kingston), J. G. Hall (Montreal), W. G. Hunt (Montreal), E. M. Krebser (Border Cities), A. Lari-vière (Quebec), W. R. Manock (Niagara Peninsula), H. Massue (Montreal) H. N. Macpherson (Vancouver), W. L. McFaul (Hamilton), C. K. McLeod (Montreal), G. M. Pitts (Montreal), M. G. Saunders (Arvida), H. R. Sills (Peterborough), C. E. Sisson (Toronto), and J. A. Vance (London); President-Elect C. R. Young (Toronto); Vice-Presidents-Elect J. L. Lang (Sault Ste. Marie), and G. G. Murdoch (Saint John); Councillors-Elect J. E. Armstrong (Montreal), E. D. Gray-Donald (Quebec), T. A. McElhanney (Ottawa), and W. J. W. Reid (Hamilton). Treasurer John Stadler (Montreal), Secretary Emeritus R. J. Durley, General Secretary L. Austin Wright, and Assistant General Secretary Louis Trudel.

The following were present by invitation—Past-Presidents O. O. Lefebvre (Montreal), F. P. Shearwood (Montreal), and George A. Walkem (Vancouver); Past Vice-Presidents Ernest Brown, J. H. Hunter, W. G. Mitchell, J. A. McCrory and Fred Newell, of Montreal, and P. M. Sauder of Edmonton; Past-Councillors Geoffrey Stead (Saint John), and P. E. Doncaster (Lakehead); L. E. Westman, representing the Wartime Bureau of Technical Personnel; H. F. Bennett, chairman of the Committee on the Training and Welfare of the Young Engineer; Fraser S. Keith, a past general secretary of the Institute; F. A. Patriquen, chairman, Saint John Branch; J. A. Lalonde, chairman, and L. A. Duchastel, secretary, of the Montreal Branch; R. C. Flitton, vice-chairman, and G. D. Hulme, member, of the Montreal Annual Meeting Committee; Colonel E. G. M. Cape, Montreal.

President Mackenzie extended a cordial welcome to all councillors and guests, and had each person rise and introduce himself to the meeting.

The general secretary reported that up to January 31st, the amount received from the various branches towards the Headquarters Building Repairs Fund was \$8,076.00, over \$5,500.00 of which had been received from the Montreal Branch. The president again expressed his appreciation of the splendid effort that had been made by all the branches, and by the Montreal Branch in particular. It was of great advantage to the Institute to have had this contribution towards the extraordinary expenses of repairing the building.

Mr. Durley presented the final revised report on Institute prizes and awards, copies of which had been circulated to members of Council and past-presidents. After Mr. Durley had read the complete report, each item was taken separately discussed, and decisions reached.

After consideration of the report on the prizes and awards of the Institute, the sincere thanks of Council were extended to Mr. Durley for his very complete and comprehensive report.

Following the discussions which had taken place at the last meeting of Council on post-war reconstruction, Mr. Cameron advised that there was nothing new to report. Although this question seemed to be in everyone's mind at the moment, our first efforts must essentially be towards helping win the war. However, the Canadian government, remembering the results of the last war, has set up a committee on post-war reconstruction, under the chairmanship of Principal James of McGill University. This committee, with its several sub-committees, is still in the organization stage, and Principal James has not yet made any public statement regarding its work.

Mr. Cameron pointed out that at the Friday afternoon session of the annual meeting, following the address by E. M. Little, Director of the Wartime Bureau of Technical Personnel, Dr. Leonard C. Marsh, research adviser to Principal James' committee, would give a talk on post-war reconstruction. He advised everyone who possibly could do so to hear this address. In Mr. Cameron's opinion, as time goes on, the place of the engineer and the technical man in Canada's post-war programme will clarify itself, and the part which The Engineering Institute can play in post-war planning will also be defined.

Mr. Doncaster was pleased to hear that the matter was going to be discussed, and hoped that it would receive careful consideration. The Lakehead Branch fully realised that the immediate effort should be directed towards winning the war, but was still of the opinion that definite plans should be made for the post-war period. In the opinion of the branch, The Engineering Institute has a definite and distinct responsibility to the engineers of Canada, and should set up its own committee and work with other committees along specific lines which would include the engineering and technical phases of post-war reconstruction.

The president outlined briefly the work which had already been done and which was being done by the government along these lines, most of which could not be made public at the present time. When the proper time comes, he said The Engineering Institute would be able to take a prominent and active part in the reconstruction programme, but he would not like to see the Institute or any of its branches take any unwise or precipitate action at the moment. He suggested that the matter could very properly be referred to the incoming Council for consideration and action, and after some further discussion, it was unanimously agreed that this should be done.

Mr. Bennett, chairman of the Committee on the Training and Welfare of the Young Engineer, distributed to the meeting copies of the booklet which had been prepared by his committee entitled "The Profession of Engineering in Canada." The booklet was just off the press and was being distributed, free of charge, to over one thousand high schools, as well as to universities and Institute branches. Mr. Bennett suggested that after the first free distribution it might be advisable to make a charge of five cents a copy

for additional supplies. The booklet had been very well received. Several service clubs had already called upon the committee for counselling on matters pertaining to engineering.

Mr. Bennett submitted a draft of a letter which he proposed sending to each branch of the Institute asking them to form student guidance and counselling committees. The letter also described the suggested functions of such committees. Mr. Bennett pointed out that his committee had available a great deal of information received through the Engineers' Council for Professional Development, his committee having been in very close touch with the E.C.P.D. Committee on Student Selection and Guidance. Seven members of his committee were present at this annual meeting, and they hoped to get together in a day or so and complete their organization with a view to continuing their work among graduate engineers in their formative years. In Mr. Bennett's opinion, the Institute must take an active interest in these young engineers, particularly those returning from overseas. They must be contacted by the branches to encourage them to continue their membership in the Institute. Mr. Bennett described briefly the contents of the booklet, which included a reference to the other engineering organizations throughout Canada. It also included a list of the cities in which the Institute branches are located.

The president thanked Mr. Bennett for his splendid report, and congratulated him upon the appearance of the booklet. He assured Mr. Bennett that his committee would receive the continued support of Council.

Following some discussion, it was unanimously agreed that the matter of the further distribution of the booklet be left in the hands of the committee, and that it be distributed free as long as the Finance Committee approved. The draft letter to the branches was also approved, and it was unanimously agreed that the letter should be signed by Mr. Bennett as chairman of the Committee on the Young Engineer, and that the ensuing correspondence should be carried on by him.

As chairman of the Committee on Professional Interests, Mr. Challies reported briefly on the progress being made in the various provinces. A very definite step towards the goal of Dominion-wide co-operation had been made by the signing of an agreement on January 12th, 1942, between the Institute and the Association of Professional Engineers of the Province of New Brunswick. This made the fourth province in which there is a co-operative agreement. The agreements now in effect were working out to the mutual advantage of both parties concerned, and the committee felt that they would eventually cover the whole Dominion. Mr. Challies read figures covering new members added to the Institute in the various provinces under the terms of the co-operative agreements.

He then gave a brief outline of the situation in the four provinces in which co-operative agreements are not yet in force. In the opinion of his committee progress is being made towards the desired goal of solidarity of the profession.

The general secretary reported receipt of a communication from Mr. P. B. Motley, dealing with the question of Life Memberships, and suggesting that the matter be discussed by Council and at the annual general meeting. Mr. Wright pointed out that the general question of Life Memberships had been considered by the Finance Committee on several occasions recently.

Under the by-laws, the Finance Committee has considered individually each request for Life Membership and each resignation received from members who appear to qualify for Life Membership under one or more of the conditions, and has made a definite recommendation to Council in each case. In most cases the opinion of the branch executive has been secured. Frequently it had been difficult to reach a decision.

The memorandum from Mr. Motley recommended that Council give consideration to amending the by-laws so that



The Annual Meeting of Council, held in the auditorium at Headquarters

Life Membership would be removed from the section dealing with exemptions and placed in a section similar to that dealing with Honorary Membership, and that it be granted automatically without application from the Member. He suggested the following wording for the consideration of a sub-committee. "Members who have paid thirty annual fees, and have reached the age of sixty-five, shall become, on account of the support they have given the Institute during their best working years, automatically entitled to the grade of Life Membership without further payment of fees, and the secretary shall send them a suitable certificate and letter of congratulation on this occasion."

The General Secretary reported that a search had been made of the records of other societies and it had been found that it was far from common practice to grant Life Membership automatically. In the Old Country there appeared to be no society following the practice. In the United States two large societies granted life membership automatically when a member reached age seventy and had had thirty years of corporate membership or thirty-five years of corporate membership regardless of age. These societies had fees that were approximately double those of the Institute.

In 1940 and 1941, acting on the present system, the Finance Committee of the Institute had recommended, and the Council had granted, sixteen Life Memberships in each year.

Discussion followed, during which the president pointed out that the fundamental point raised by Mr. Motley appeared to be that under the present by-laws the responsibility of asking for Life Membership rests with the member himself. In Mr. Motley's opinion this should be granted automatically and considered as an honour. As the by-laws now stand it is considered as an exemption from the payment of further annual fees, and not as one of the Institute's honours. What the Council has to decide is whether or not the granting of Life Membership should be considered as an exemption or as an honour.

In Mr. Challies' opinion the object of Council in setting up this form of Life Membership had been to deal with senior members who, for various reasons, could not conveniently continue to pay their annual fees. That had been the intention of Council and the by-law had been administered from that point of view. No attempt had ever been made to advertise the availability of this privilege.

Considerable discussion followed, from which it appeared that in the opinion of the meeting no change should be made in the by-law.

Dean Young described a situation with which the University of Toronto was now confronted, and which he believed existed also at other engineering faculties. He did not ask for a formal resolution on the matter, but thought that a general discussion and expression of opinion would be helpful.

He explained that his university had been asked by recruiting officers to release fourth year students with their degrees before the completion of the full term. He informed the meeting that the Wartime Bureau of Technical Personnel had been consulted and had expressed the opinion that in the light of conditions so far disclosed it would be best to carry on normally, giving full instruction and full examination.

He pointed out that the situation was now rather difficult in that the active service units, as well as industry, were interviewing students with the idea of signing them up prior to graduation and then were applying pressure on the faculty to release the students before their courses were completed. This competitive recruiting was resulting in a lot of confusion in the minds of the students and was retarding them in their normal work. He explained that the Ontario Association of Professional Engineers had thought it inadvisable to shorten the courses as the graduates' position in the profession might be prejudiced when they returned to their usual civilian practice.

Past-President Walkem felt that the universities should complete their courses in the normal way, and not be unduly influenced by recruiting officers from the fighting forces.

The general secretary reported that, knowing of Dean Young's interest in this matter, he had suggested that Mr. L. E. Westman, of the Wartime Bureau of Technical Personnel, attend the meeting in order to participate in the discussion. Mr. Westman was handling all university affairs in the Bureau and had been considering this question from the point of view of all the universities. The president called on Mr. Westman for his opinions.

Mr. Westman presented a report which dealt in a general way with university activities under war conditions. He described how the Bureau had gathered opinions from all

the universities in an endeavour to summarize the situation. From these expressions of opinion and from discussions with government authorities the Bureau had reached the conclusion that the universities should continue their courses in the normal way, and that in the senior year the degree should not be given before the full course and all examinations had been completed. Mr. Westman was careful to point out that changes in conditions might very quickly alter the values and make some other arrangement more desirable. He explained that the Bureau was in close touch with all universities and that this subject was up for constant consideration. He also gave a synopsis of several matters affecting university affairs, but preceded his remarks with the comment that many of these matters were confidential and therefore should not be given wide distribution until the final policy had been determined and proper legislation authorized.

The president pointed out to Dean Young the difficulty of answering his question definitely. If the men were vitally needed he thought they should not be held back; yet, on the other hand, the need may not be so great as to justify an incomplete course. He thought Council should be careful not to give public utterance on a question on which it was not particularly qualified to judge and not empowered to act. He thought the deans of engineering would have to keep close to the situation and then make up their own minds as to what should be done.

Mr. Krebsler inquired as to whether or not it would be feasible to have the students recruited and then given leave of absence to complete their courses. Dean Young replied that he had made this suggestion to an officer some weeks ago, but so far had received no reply.

Dean Ernest Brown stated that he endorsed everything that Dean Young had said. Conditions at McGill were very much the same as at Toronto. He thought that there was an inclination on the part of recruiting officers to over-emphasize the need.

He agreed with Dean Young in that the universities wanted to help in any way they could, but thought they must not lose sight of their responsibility towards the students. He stated that at McGill they were carrying on in the usual way and watching the developments very closely. He agreed with the president that the matter was not one on which the Institute was particularly well qualified to offer advice, but he did think that both he and Dean Young would be glad to have the opinions of councillors.

Dean Young again emphasized that he did not want any formal declaration, but was simply seeking expressions of opinion such as he had received.

A number of applications were considered, and the following elections and transfers were effected:

ADMISSION	
Members.....	3
Students.....	21
TRANSFERS	
Student to Junior.....	1

Before adjourning the meeting, which would be the last over which he would have the privilege of presiding, Dean Mackenzie expressed the great pleasure it had given him to be in the chair at these meetings. He had found the Institute Council to be one of the most effective and business-like bodies with which he had had to deal. The experience had been one of the bright spots in his life.

Mr. Hunter also expressed his thanks at having been invited to attend the meeting, which he had enjoyed very much.

Mr. Challies remarked that The Engineering Institute, in honouring Dean Mackenzie, had undoubtedly honoured itself. His connection with research work, now of paramount importance to Canada and the engineering profession, had

lent great prestige to the Institute throughout the Dominion, and he therefore had great pleasure in moving a hearty vote of thanks to Dean Mackenzie for the splendid way in which he had served the Institute during his term of office.

In seconding the motion, which was carried unanimously, Dean McKiel said that everyone realised what the Institute had gained during Dean Mackenzie's presidency, and he associated himself most heartily with Mr. Challies' motion.

The president expressed his thanks and appreciation.

There being no further business, the Council rose at four-forty p.m.

A meeting of the new Council of the Institute was held at the Windsor Hotel, Montreal, on Thursday, February 5th, 1942, at five o'clock p.m.

Present: President C. R. Young in the chair; Past-Presidents C. J. Mackenzie and H. W. McKiel; Vice-Presidents deGaspé Beaubien, K. M. Cameron, H. Cimon and J. L. Lang; Councillors J. E. Armstrong, A. E. Berry, J. H. Fregeau, E. D. Gray-Donald, J. G. Hall, W. G. Hunt, H. N. Macpherson, T. A. McElhanney, G. McL. Pitts, W. J. W. Reid, M. G. Saunders, H. R. Sills and J. A. Vance; Past Councillor C. E. Sisson, and General Secretary L. Austin Wright.

On reading the minutes of the January meeting of Council, Dean Young had noted that it had been decided, subject to the approval of the new Council, to hold the April meeting of Council in Toronto on April 18th, to coincide with a joint dinner to be held that evening by the Council of the Association of Professional Engineers of Ontario and the Toronto Branch of the Institute. As he was to be the guest of honour at that meeting, this had placed him in rather an embarrassing position, inasmuch as he was planning a trip to the western branches and would be unable to leave Toronto before the first of April. It would be more convenient to him if the meeting could be held a week later, as it would crowd things somewhat if he had to be back in Toronto by the 18th.

Mr. Berry thought that although the date had been more or less decided upon by the Association, they would be agreeable to changing it to the 25th, and he also believed that the 25th would be acceptable to the Toronto Branch. After some discussion, on the motion of Mr. Vance, seconded by Mr. Berry, it was unanimously **RESOLVED** to suggest that, if agreeable to the Association of Professional Engineers of Ontario and to the Toronto Branch of the Institute, the proposed joint dinner be held on Saturday, April 25th, instead of April 18th as previously arranged. If that date was not satisfactory to all concerned, it was left with the president to decide upon a suitable date.

The president inquired as to what should be the next step in connection with the resolution from the Lakehead Branch on post-war reconstruction. Would it be advisable to defer action until Mr. Cameron was prepared to report further on the activities of Dr. James' committee?

Considerable discussion followed as to the part which the Institute branches should take in any post-war reconstruction programme. Some of the branches were most anxious to go ahead, but would be willing to do whatever would fit into the plans of Council.

Mr. Cameron pointed out that he was not yet in a position to tell just what the organization of Dr. James' sub-committees would be. His own sub-committee would be meeting very shortly and would set up its own organization. In working on a problem of this kind, cognizance would have to be taken of The Engineering Institute of Canada. If his sub-committee decides to follow along the lines that he has in mind, the twenty-five branches of the Institute would take a very definite part in the regional distribution of the work of the committee.

Dean Young asked if, in the meantime, there were any instructions that could be sent out to the Institute branches in regard to their activities on post-war reconstruction. Mr.

Wright pointed out that the February *Journal* would contain some information about Dr. James' committee, and additional information would probably be secured from Dr. Marsh's address. If Mr. Cameron was able to accompany the president on his western trip, as was hoped and anticipated, he would by then be in a position to give some information on the work of his committee.

In Dean Mackenzie's opinion too much publicity should not be given to any work being done by the Institute branches on this question. He felt that at the present time, the branches should do little more than study the problem and gather information, and be ready to co-operate when they are asked to do so.

After further discussion, on the motion of Mr. Hunt, seconded by Mr. Vance, it was unanimously agreed that it should be left with the president to decide on the action to be taken, it being suggested that the general secretary, after consultation with the president and Vice-President Cameron, might write a letter to the branches explaining the situation.

Mr. Vance inquired as to the possibility of holding a regional meeting of Council during the president's visit to the west. He was very much in favour of such meetings.

The general secretary explained that it had been customary, whenever possible, to hold regional Council meetings when the president visited the branches. In recent years, one had been held in Regina, Halifax, and Saint John, and two in Calgary. On two occasions they had tied in with the signing of the co-operative agreements. It was desirable that such a meeting be held this year either in Winnipeg or in Vancouver.

Members present agreed that it would be a very good thing for the Institute if such a meeting could be held in Vancouver. Although it had already been decided to hold the April meeting of Council in Toronto, in the discussion which followed it was agreed that although it was not usual to hold two meetings in one month, a regional meeting in Vancouver in April would not in any way conflict with the meeting already planned for Toronto. It was finally decided that the April meeting of Council be convened in Vancouver at the time of the president's visit, and adjourned to meet in Toronto on Saturday, April 25th, or whatever date is decided upon for the joint dinner.

Mr. Gray-Donald reported that the Quebec Branch would like to suggest that consideration be given to the possibility of holding the Annual General Meeting for 1943 in Quebec City. No official action had been taken yet but he thought the local committee would look with favour on such a proposal. A formal invitation could be submitted later, but he would like to place the suggestion on record, and hoped it would receive favourable consideration. This tentative offer was received with appreciation to be considered at a later meeting of Council after the branch committee had given to it the necessary consideration.

Mr. Pitts suggested that it might be very desirable at this time if an arrangement could be made with the founder societies in the United States whereby the publications of those bodies could be issued to their members in Canada and to members of the Institute, through the medium of The Engineering Institute of Canada. Dean Young suggested that Mr. Pitts might develop this thought and submit a memorandum which could be considered later by Council.

On the motion of Mr. Sisson, seconded by Mr. Lang, it was unanimously **RESOLVED** that a hearty vote of thanks be extended to the Montreal Branch for their hospitality, and for the very efficient manner in which the Annual General Meeting had been conducted.

On the motion of Mr. Reid, seconded by Mr. Cimon, it was unanimously **RESOLVED** that the thanks of Council be extended to the retiring president and councillors for their efforts during the past year; much valuable time had been given to committee meetings and to meetings of Council, all of which had been very greatly appreciated.

The general secretary reported that Past-President Duggan had telephoned to say that he would like to entertain at his home on Saturday afternoon any members of Council or guests who were able to stay over. Mr. Wright had undertaken to make arrangements, and extended an invitation to all members present.

It was decided that the next meeting of Council would be held at Headquarters on Saturday, March 14th, at ten-thirty a.m.

The Council rose at six-fifteen p.m.

## ELECTIONS AND TRANSFERS

At the meeting of Council held on February 4th, 1942, the following elections and transfers were effected:

### Members

**Haven**, Frank Goldie, (Univ. of Minn.), res. engr., civil aviation branch, Department of Transport, Winnipeg, Man.  
**Lewis**, William Milton, B.Sc. (Mech.), (Queen's Univ.), road supt. and engr., Township of Ernestown, R.R. No. 4, Napanee, Ont.  
**Wood**, Ernest William, Lieut. (E), R.C.N.(T), Engr. Officer in Charge, Mechanical Training Establishment, Esquimalt, B.C.

### Transferred from the class of Student to that of Junior

**LeBel**, Harry Walter Scott, B.Eng. (McGill Univ.), detailing and design, Horton Steel Works, Ltd., Fort Erie, Ont.

### Students Admitted

**Beresford**, Morris Maskew, (Univ. of Manitoba), 428 Ash St., Winnipeg, Man.  
**Chapman**, Harris James, (McGill Univ.), 3582 Durocher St., Montreal, Que.  
**Daly**, Thomas Cyril Norman, (McGill Univ.), 445 Wiseman Ave., Outremont, Que.  
**deHart**, William Gordon, (Mass.Inst.Tech.), M.I.T. Dorms., Cambridge, Mass.  
**Edwards**, Frank Harry, (McGill Univ.), 79 Victoria Ave., Longueuil, Que.  
**Harkness**, Andrew Dunbar, (McGill Univ.), 4315 Melrose Ave., Montreal, Que.  
**Iliffe**, Francis H., (McGill Univ.), 143 Bedbrook Ave., Montreal West, Que.  
**Jeske**, Robert August, (Univ. of Manitoba), 134 Chestnut St., Winnipeg, Man.  
**Macfadyen**, Allan Burt, (Univ. of Manitoba), Box 872, Flin Flon, Man.  
**Martin**, William Stormont, (McGill Univ.), 4260 Beaconsfield Ave., Montreal, Que.  
**McRostie**, Gordon Callander, (Univ. of Toronto), 186 St. George St., Toronto, Ont.  
**Routly**, William James, (McGill Univ.), 8034 Western Ave., Montreal West, Que.  
**Simpson**, Francis W., (McGill Univ.), 1703 Wm. David St., Montreal, Que.  
**Simpson**, William Tyrie, (McGill Univ.), 5207 Trans-Island Ave., Montreal, Que.  
**Solomon**, Julius Denison, (Univ. of Toronto), 17 Madison Ave., Toronto, Ont.  
**Stapells**, Robert Frederic (McGill Univ.), 4888 Dornal Ave., Montreal, Que.  
**Stoppes**, Reginald Edward, (McGill Univ.), 3429 Peel St., Montreal, Que.  
**Turnbull**, John Arnold, (Univ. of New Brunswick), 3 Mount Pleasant Court, Saint John, N.B.  
**Walker**, Adam Stewart, (Sir George Williams Coll.), 204 Hospital St., Room 35, Montreal, Que.  
**Webster**, John Alexander, (McGill Univ.), 141 Kenaston Rd., Town of Mount Royal, Que.  
**Wilson**, William Henry, (McGill Univ.), 510 Main St., Farnham, Que.

# NEWLY ELECTED OFFICERS OF THE INSTITUTE

**Hector Cimon**, M.E.I.C., secretary of Price Brothers and Company, Limited, Quebec, is the newly elected vice-president of the Institute for the Province of Quebec. He is a very active member, having been secretary-treasurer of the Quebec Branch from 1921 to 1924, and councillor representing the Branch from 1930 to 1937. He was born at Rivière-du-Loup, Que., and received his engineering education at the Ecole Polytechnique, Montreal, where he graduated in 1916. Upon graduation he joined the company with which he has remained ever since and was placed in charge of special surveys and later he was in charge of design and supervision of construction of various engineering works for the company. After several years as engineer of the company, he became secretary in 1939.

Mr. Cimon joined the Institute in 1912 as a Student and was transferred to Associate Member in 1919. He became a Member in 1930.

**J. L. Lang**, M.E.I.C., of the firm of Lang and Ross, consulting engineers, Sault Ste. Marie, Ont., is the newly elected vice-president of the Institute for Ontario. He was born at Hyde, England, and was educated at the University of Toronto, graduating in 1907 with the degree of Bachelor of Applied Science. He has been in private practice at Sault

been connected with the construction of most of the water works and sewage systems in his province.

Mr. Murdoch joined the Institute as a Student in 1905. He was transferred to Associate Member in 1911 and he became a Member in 1919.

**E. G. M. Cape**, M.E.I.C., is the newly appointed treasurer of the Institute. Born at Hamilton, Ont., he was educated at McGill University, Montreal, where he graduated in 1898. Shortly after graduation he was an engineer in charge of the plant of the Lethbridge Water Works and Electric Light Company at Lethbridge, Alta. From 1900 to 1902 he was assistant chief engineer of Lake Superior Power Company at Sault Ste. Marie, Ont., and was in charge of the construction of plants, mills, dams, water works and harbour improvements. From 1902 to 1905 he was in private practice at Montreal. In 1905 he was chief engineer in charge of the construction of the shops of the Canada Car Company. In 1906 he was associated with C. E. Deakin, general contractor. In 1907 he established the firm of E. G. M. Cape and Company, engineers and contractors, Montreal, of which he is still president.

During the last war Colonel Cape recruited and commanded the 3rd Canadian Siege Battery and went overseas



Hector Cimon, M.E.I.C.



John L. Lang, M.E.I.C.



G. G. Murdoch, M.E.I.C.

Ste. Marie ever since his graduation, first as partner in the firm of Lang and Keys. In 1910 the firm took the name of Lang, Keys and Ross and a few months later it became Lang and Ross. Mr. Lang served in the last war with the Canadian Expeditionary Force from 1916 to 1919. He has been closely associated with the development of the northern part of the province and at one time he was district engineer of the Northern Development Branch. As a consulting engineer, he has been connected with most of the important engineering projects carried out in his district.

Mr. Lang joined the Institute as a Member in 1921.

**G. G. Murdoch**, M.E.I.C., has been elected a vice-president of the Institute representing the maritime provinces. He was born at Saint John, N.B., and was educated at the local schools. He received his engineering training in the office of his father, William Murdoch, engineer and superintendent of water and sewage for the City of Saint John. After having obtained his certificate as a deputy land surveyor for New Brunswick, he established himself in private practice at Saint John, N.B. in 1895. For several years he was engineer for the New Brunswick Power Company and in this capacity he has designed and constructed many hydraulic structures. As a consulting engineer he has specialized in municipal engineering and has

in 1915. After training in England, he went to France in June, 1916. Colonel Cape was mentioned twice in dispatches after the battles of the Somme and Vimy Ridge. He was awarded the Distinguished Service Order after the latter battle. After the war he organized and commanded the 2nd Medium Brigade, Royal Canadian Artillery. From 1925 to 1930 he commanded the 2nd Regiment, Royal Canadian Artillery, and he is now Honorary Lieutenant-Colonel of the 2nd Regiment, Royal Canadian Artillery.

Colonel Cape joined the Institute as a Student in 1899. He was transferred to Associate Member in 1902 and became a Member in 1909.

**John E. Armstrong**, M.E.I.C., chief engineer of the Canadian Pacific Railway Company, is one of the newly elected councillors representing the Montreal Branch. He was born at Peoria, Ill., and received his education at Cornell University where he graduated in 1908 as a civil engineer. From 1908 to 1912 he was assistant engineer with the Cleveland and Pittsburg division of the Pennsylvania Company at Cleveland. In 1912 he joined the staff of the Canadian Pacific Railway Company at Montreal as an engineer in the office of the assistant chief engineer, and in 1928 he became assistant chief engineer of the company. Since 1938 he has been chief engineer. Mr. Armstrong has been engaged on many important works, including the



Col. E. G. M. Cape, M.E.I.C.



J. E. Armstrong, M.E.I.C.



S. G. Coultis, M.E.I.C.

Quebec joint terminal, the waterfront development at Saint John, N.B., the railway revision during the last war and the construction of the Toronto viaduct from 1924 to 1930.

In 1934 he was president of the American Railway Engineering Association, and in 1940, president of the Canadian Railway Club.

Mr. Armstrong joined the Institute as an Associate Member in 1917 and he was transferred to Member in 1940. He has served on the Finance Committee of the Institute for the last two years.

**S. G. Coultis, M.E.I.C.**, is the newly elected councillor representing the Calgary Branch. He was born at Forest, Ont., and was educated at the University of Michigan where he graduated in chemistry from the class of 1909. He was in the employ of Smith and Leisenring as a chemist from 1909 till 1913, when he went to Calgary as assistant chemist with the city. From 1917 until 1920 he was superintendent of the Southern Alberta Refineries and in 1920 became superintendent of the Royalite Oil Company at Black Diamond, Alta. In 1937 he returned to Calgary.

Mr. Coultis joined the Institute as a Member in 1925.

**G. L. Dickson, M.E.I.C.**, has been elected councillor to represent the Moncton Branch. He was born at Truro, N.S., and received his education at Acadia University where he graduated in 1900. From 1905 until 1910 he was chief electrician with the Pictou County Electric Company and from 1910 to 1916 he held the same position with the Nova Scotia Steel and Coal Company at Wabana, Newfoundland. In the years 1916-1917 he was manager of Chambers Electric Light and Power Company. In 1919 he joined the

Canadian National Railways as general power plant inspector for the Eastern Lines. In 1923 he became electric and signal engineer for the Atlantic Region at Moncton, N.B.

Mr. Dickson joined the Institute as an Associate Member in 1923 and he became a Member in 1940.

**F. W. Gray, M.E.I.C.**, assistant general manager of the Dominion Steel and Coal Corporation, Sydney, N.S., is the newly elected councillor representing the Cape Breton Branch. Born in Yorkshire, England, he was educated at Firth College, Sheffield. In 1904 he came to Canada as assistant to the general manager of the Dominion Coal Company at Sydney. In 1908 he became assistant to the president of the Nova Scotia Steel and Coal Company. From 1919 to 1921 he was editor of the Canadian Mining Journal and Iron and Steel of Canada. In 1921 he became assistant to the vice-president of the British Empire Steel Corporation and in 1923 he was made assistant to the president. In 1928 he was appointed to the position which he now holds. After long residence in the maritimes, he holds an advisory position in one of the most important industries of that region.

Besides being an authority on under-sea coal mining, Dr. Gray is also an author and an artist. A staunch supporter of professional engineering bodies, he is a past-president of the Canadian Institute of Mining and Metallurgy and of the Mining Society of Nova Scotia.

Dr. Gray joined the Engineering Institute as an Associate Member in 1921 and he became a Member in 1924. Last year he was one of the recipients of the inaugural awards of the Julian C. Smith Medal of the Institute.



G. L. Dickson, M.E.I.C.



F. W. Gray, M.E.I.C.



E. D. Gray-Donald, M.E.I.C.



J. Haimes, M.E.I.C.



R. E. Hartz, M.E.I.C.

**E. D. Gray-Donald, M.E.I.C.**, has been elected councillor representing the Quebec Branch. Born at Amoy, China, he received his primary education at Victoria, B.C., and attended George Watson's College, Edinburgh. In 1921 he came to McGill University where he graduated in electrical engineering in the class of 1926. He is also a Master of Science of Laval University, Quebec. Upon graduation from McGill University he joined the Shawinigan Water and Power Company as an apprentice, and in 1927 he was transferred to the Quebec Power Company as an assistant engineer. He became assistant superintendent of the power division in 1928 and was appointed superintendent in 1930. In 1937 he was made assistant general superintendent of the company and in 1939 was promoted to general superintendent, the office which he now holds.

Mr. Gray-Donald joined the Institute as a Student in 1922 and he was transferred to Junior in 1926. He was made an Associate Member in 1934 and was transferred to Member in 1939.

**James Haimes, M.E.I.C.**, is the newly elected councillor for the Lethbridge Branch. Born at Barnsley, Yorkshire, he was educated in the local public and technical schools and served his apprenticeship as a mining engineer in the Wharnccliffe Collieries, Limited, at Barnsley. He came to Canada in 1911 as an instrument-man with the City of Lethbridge, later becoming office engineer. During the last war he served in France from 1916 to 1918. Upon his return to Canada in 1919 he became assistant city engineer at Lethbridge. In 1930 he became city engineer, a position which he still holds.

Mr. Haimes joined the Institute as an Associate Member in 1925 and he became a Member in 1940.

**R. E. Hartz, M.E.I.C.**, is one of the newly elected councillors for the Montreal Branch. Born at Marshfield, P.E.I., he graduated from McGill in 1917 with the degree of B.Sc., and immediately after graduation was employed by the St. Maurice Construction Company at La Loutre, on the construction of the Gouin dam. Later in the same year he enlisted with the Royal Air Force, received his commission early in 1918, and was appointed flying instructor, being demobilized in 1919. In that year he joined the Fraser-Brace Engineering Company, Limited, and was employed on the construction of the Big Eddy dam on the Spanish river. Mr. Hartz became resident engineer at La Gabelle development on the St. Maurice river in 1922, having joined the staff of the Shawinigan Engineering Company in 1920. He was resident engineer on the St. Narcisse development on the Batiscan river in 1924-1925, and in 1926 was transferred to Montreal for investigating preliminary design of hydro-electric developments. In 1927 Mr. Hartz was appointed resident engineer of the Pagan Falls development on the Gatineau river, and since the completion of that undertaking has been connected with the design and construction of different hydro-electric projects. He is now assistant chief engineer of Shawinigan Engineering Company, Montreal. At present he is on loan to the Wartime Merchant Shipping, Limited, where he occupies the position of general manager.

Mr. Hartz joined the Institute as a Student in 1917. He became an Associate Member in 1926 and was transferred to Member in 1933. Last year he was chairman of the Montreal Branch, and it was under his energetic management that the building fund campaign was completed with such success.



W. G. Hunt, M.E.I.C.



E. W. Izard, M.E.I.C.



J. R. Kaye, M.E.I.C.



Nicol MacNicol, M.E.I.C.

**Walter G. Hunt, M.E.I.C.**, president and managing director of Walter G. Hunt Company, Limited, engineers and contractors, is one of the newly elected councillors of the Montreal Branch. Born at Bury, Que., he was educated at McGill University where he graduated in 1917. For several years he was associated with the firm of Ross-Meagher Company, engineers and general contractors, Ottawa, as engineer and later as general superintendent. In 1926 he came to Montreal and two years later formed the firm of Walter G. Hunt Company, Limited. One of the recent outstanding projects carried out by the firm is the construction of the Sir Arthur Currie memorial gymnasium and armoury for McGill University. More recently his firm has carried out extensions to the tank shops for the Canadian Pacific Railway Company, and construction work at the St. Hubert and Dorval airports, near Montreal. Mr. Hunt is a director of the Stanstead and Sherbrooke Fire Insurance Company and a past-president of the Builders Exchange Incorporated.

Mr. Hunt joined the Institute as a Student in 1916, transferring to Junior in 1919. He was transferred to Associate Member in 1922 and he became a Member in 1932. He has always been active in Institute affairs and he was the chairman of the committee on arrangements for the Annual Meeting in Montreal this year.

**E. W. Izard, M.E.I.C.**, is the newly elected councillor for the Victoria Branch. Born at Wisbeach, Cambridgeshire, England, he received his engineering education at Brighton Technical College and Glasgow University. He served his apprenticeship in shipbuilding with Yarrow and Company in London from 1906 to 1908. Later, until 1911 he was with

John Brown and Company at Clydebank. In 1912 he returned to Yarrow and Company at Glasgow and was employed on the design of turbines and internal combustion engines. He came to Canada in 1914 and was in charge of the dry docking and repairs of passenger, cargo and naval vessels for his company. He is at present works manager at Victoria.

Mr. Izard joined the Institute as a Member in 1937. He was chairman of the Victoria Branch of the Institute in 1940.

**J. R. Kaye, M.E.I.C.**, is a newly elected councillor representing the Halifax Branch. Born at Halifax, N.S., he was educated at Dalhousie and McGill Universities, and graduated in mechanical engineering from the latter in 1924. A few months after graduation he joined the staff of the Montreal Engineering Company and was employed with that firm until 1931, first on maintenance and reconstruction with the Calgary Power Company at Seebe, Alta., and in 1926 he was transferred to the Venezuela Power Company at Maracaibo, Ven. From 1928 to 1930 he was general superintendent at Maracaibo. Returning to Canada in 1931 he later established a consulting engineering practice and is, at present, a partner in the firm Engineering Service Company, Limited, at Halifax, N.S.

Mr. Kaye joined the Institute as a Student in 1924. He was transferred to Associate Member in 1931 and became a Member in 1940.

**Nicol MacNicol, M.E.I.C.**, is the newly elected councillor representing the Toronto Branch. Born at Barrie, Ont., he received his education at the University of Toronto where



T. A. McElhanney, M.E.I.C.



A. W. F. McQueen, M.E.I.C.

he graduated in 1919. For a few years after graduation he was employed with various firms of consulting engineers, and was connected with the design and construction of several engineering projects. In 1923 he was appointed engineer of Etobicoke Township and in 1931 he became works commissioner for Forest Hill Village, Ont., which position he still holds.

Mr. MacNicol joined the Institute as a Student in 1919 and was transferred to Junior in 1923. In 1935 he became a Member. He was chairman of the Toronto Branch of the Institute in 1940.

**T. A. McElhanney**, M.E.I.C., superintendent of the Forest Products Laboratories at Ottawa, is the newly elected councillor of the Institute representing the Ottawa Branch. He was born in Ripley, Ont., and graduated from the University of Toronto in 1912. After graduation he was connected with the British Columbia government on survey work, and from 1913 to 1917 he was a partner of the firm of McElhanney Brothers, surveyors and engineers. In 1919 he was appointed assistant controller of surveys in the Topographical Surveys branch at Ottawa. In 1923

Gzowski Medal. He was chairman of the Niagara Peninsula Branch of the Institute in 1939.

**A. E. Pickering**, M.E.I.C., has been elected councillor representing the Sault Ste. Marie Branch. Born at Brampton, Ont., he graduated from the University of Toronto in mechanical and electrical engineering. From 1905 to 1912 he was assistant engineer and in 1912-1913 manager and engineer of the Lake Superior Power Company. From 1916 to 1932 he was manager and engineer and from 1932 to date vice-president and manager of the Great Lakes Power Company, Ltd., at Sault Ste. Marie.

Mr. Pickering joined the Institute as a Member in 1921. From 1930 to 1933 he served on the Council as a representative of the Sault Ste. Marie Branch.

**W. J. W. Reid**, M.E.I.C., is the newly elected councillor representing the Hamilton Branch. Born at Oak River, Man., he was educated at the University of Toronto where he graduated in 1924. Upon graduation he joined the staff of Otis-Fensom Elevator Company at Hamilton and in 1925 he was put in charge of electrical manufacture. In



A. E. Pickering, M.E.I.C.



W. J. W. Reid, M.E.I.C.



J. W. Sanger, M.E.I.C.

he was appointed acting superintendent of the Vancouver laboratory of the Forest Products Laboratories of Canada, and in 1938 he became superintendent of the Laboratories at Ottawa.

Mr. McElhanney joined the Institute as an Associate Member in 1932 and he became a Member in 1940.

**A. W. F. McQueen**, M.E.I.C., is the newly elected councillor for the Niagara Peninsula Branch. Born at Lowestoft, England, he graduated from the University of Toronto in 1923 and entered the service of the Hydro-Electric Power Commission of Ontario. For three years he was assistant engineer of tests and for another three years he remained with the Commission in charge of various hydrological and hydraulic investigations. In 1927 he became assistant engineer with H. G. Acres and Company, Ltd., Consulting Engineers, Niagara Falls, Ont., and in 1934 hydraulic engineer, which position he holds at the present time.

Mr. McQueen joined the Institute as a Student in 1920. He was transferred to Junior in 1927 and to Associate Member in 1929. He became a Member in 1939. He is the author of several papers that have been published in *The Journal*. In 1932 he was awarded the Past-Presidents' Prize for a paper on "Engineering Education." In 1938 he was the joint author of the paper "The 18-Foot Diameter Steel Pipe Line at Outardes Falls," which was awarded the

1926 he became assistant construction manager and in 1928 construction manager. He was transferred to the engineering department in 1931 and in 1933 he became works manager, a position which he still holds with that of manager of munitions.

Mr. Reid joined the Institute as an Associate Member in 1929 and he was transferred to Member in 1937.

**J. W. Sanger**, M.E.I.C., chief engineer of the City of Winnipeg Hydro-Electric System and commissioner of the Manitoba Power Commission, is the newly elected councillor representing the Winnipeg Branch. Born at Bristol, England, he received his technical education at Faraday House, London. From 1907 until 1911 he was district superintendent of the Midland Electric Power Corporation at Staffordshire, England. In 1912 he came to Canada as engineer and superintendent of distribution for the City of Winnipeg Hydro-Electric System. In 1915 he became superintendent of the System, and in 1932 he was appointed chief engineer. He became a commissioner of the Manitoba Power Commission in 1931.

Mr. Sanger joined the Institute as an Associate Member in 1921, transferring to Member in 1936. He was chairman in 1939 of the Winnipeg Branch of the Institute. In 1933 Mr. Sanger was president of the Association of Professional Engineers of Manitoba.

## INSTITUTE PRIZE WINNERS

**W. G. McBride**, M.E.I.C., is one of the recipients for 1941 of the additional inaugural awards of the Julian C. Smith Medal "for achievement in the development of Canada."

Twenty-five years after his graduation from McGill University, Mr. McBride was persuaded to leave the copper-mining industry of the west, and return to his old university as head of the department of mining engineering and metallurgy, the position which he occupies today.

During his career in Mexico and Arizona his achievements as mine manager, after overcoming serious technical and labour difficulties, gained for him recognition as a leading authority in metal mining. He has been prominent in the work of professional societies, both in administrative work and as a contributor to technical knowledge. He was president in 1941 of the Canadian Institute of Mining and Metallurgy and is serving his second term on the Council of the Institution of Mining and Metallurgy, London. His services as a consultant have been widely sought. At McGill University he has manifested his great capacity for unstinted service and helpful leadership.



W. G. McBride, M.E.I.C.



W. G. Murrin, M.E.I.C.



E. W. Stedman, M.E.I.C.

**W. G. Murrin**, M.E.I.C., president of the British Columbia Power Corporation Limited and associated companies, has been awarded one of the additional inaugural awards of the Julian C. Smith Medal for 1941. An electrical engineer of wide experience and high standing, Mr. Murrin received his professional training and early experience in England.

During his thirty years' residence in Canada he has been identified with the growth, organization and operation of the great public utility in British Columbia, of which he has been president since 1929. The remarkable development of the electrical power industry which has taken place in that province is in no small measure due to his technical knowledge, energy and leadership. He is prominent also on the directorate of important industrial and financial organizations and in the community life of the city in which he lives.

**Air Vice-Marshal E. W. Stedman**, M.E.I.C., is one of the recipients for 1941 of the additional inaugural awards of the Julian C. Smith Medal.

The career of Air Vice-Marshal Stedman well illustrates the indispensable nature of the services which trained engineers render in aerial warfare. A brilliant student at the Royal College of Science, London, and a Whitworth Scholar, he took up research work in aeronautics at the National Physical Laboratory, Teddington. On the outbreak of war

in 1914 he joined the Royal Naval Air Service—afterwards merged in the Royal Air Force—and was demobilized in 1919 with the rank of Lieutenant-Colonel.

After a period of service as chief of the technical staff of Handley Page Limited, he came to Canada in 1920, on the creation of the Air Board. His distinguished work as chief aeronautical engineer of the Royal Canadian Air Force led to steady promotion in the service; he is now a member of the Air Council, responsible for aeronautical engineering.

A frequent contributor of valuable papers to aeronautical and other journals, he has been honoured by many leading technical and scientific bodies.

**S. R. Banks**, M.E.I.C., has been awarded the Gzowski Medal for 1941 for his paper, "Lions' Gate Bridge, Vancouver, B.C." He was born in Liverpool, England, and received his general education at Liverpool Collegiate School. Studying civil engineering at the University of the same city, he graduated with honours in 1924, and two years afterwards advanced to the degree of M.Eng. His

first appointment was that of junior engineer with the Bridge Stress Committee of the Department of Scientific and Industrial Research, Great Britain. Subsequently he was for some time in the office of Messrs. Rendel, Palmer and Tritton, consulting engineers, of Westminster.

Mr. Banks came to Canada in 1929, and was at first employed by the Dominion Bridge Company at Lachine in the capacity of structural designer and field engineer. From 1932 to 1940 he was assistant engineer with Messrs. Monsarrat and Pratley, consulting engineers, of Montreal. With this firm his duties were closely connected with the design and supervision of erection of the Ile d'Orléans and Lions' Gate suspension bridges, and with inspections of the Jacques Cartier bridge and of the main line bridges of the Newfoundland Railway. For the past two years Mr. Banks has been with the Aluminum Company of Canada, Limited, at Montreal, engaged in the design of works involved in the company's wartime building programme.

Mr. Banks is an Associate Member of the Institution of Civil Engineers, by which body he was awarded a Telford Premium in 1936. He is also an Associate Member of the Institution of Structural Engineers.

It is expected that Mr. Banks' prize-winning paper will be published in the *Journal* starting with the April issue.



S. R. Banks, M.E.I.C.



O. W. Ellis, M.E.I.C.



G. Reuben Yourt

**O. W. Ellis, M.E.I.C.**, is the recipient of the Duggan Medal and Prize for 1941 for his paper, "Forgeability of Metals," presented before the Niagara Peninsula Branch of the Institute and published in the October, 1941, issue of the *Journal*. He was born at Swindon, England, and served an apprenticeship with the Great Western Railway Locomotive Works at Swindon. He came to Canada in 1910 as an educational instructor with the Canadian Pacific Railway Company at Montreal. Returning to England in 1911 he entered the Department of Metallurgy at the University of Birmingham, England, and received his degree of B.Sc. in metallurgy in 1914. During the war 1914 to 1918 he worked as a metallurgist in the Royal Ordnance Factories. In 1916 he received the degree of M.Sc. from the University of Birmingham. At the end of the war he was appointed chief metallurgist at the Royal Laboratory Department of the Royal Ordnance Factories, and in 1920 he was called upon to reorganize all the metallurgical laboratories of the factories. In 1921 he returned to Canada as an assistant professor of metallurgical engineering at the University of Toronto, a position which he retained until 1925. At that date he was appointed an Industrial Fellow at the Mellon Institute of Industrial Research, University of Pittsburgh, where he carried out work on metals for bearings. From 1926 to 1929 he was in the research department of the Westinghouse Electric and Manufacturing Company. In 1929 he was appointed to his present position as Director of Metallurgical Research at the Ontario Research Foundation, Toronto. Mr. Ellis is the author of numerous papers on metallurgical subjects, both ferrous and non-ferrous. He is a contributor to the National Metals Handbook.

Mr. Ellis was awarded the Plummer Medal of the Institute in 1940.

**G. Reuben Yourt, Stud.C.I.M.M.**, is the recipient of the Leonard Medal for 1941 for his paper, "Ventilation and Dust Control at the Wright-Hargreaves Mine."

Mr. Yourt is a graduate of Queen's University where he obtained the degree of Bachelor of Arts. In January, 1936, he became connected with Wright-Hargreaves Mines, Limited, at Kirkland Lake, Ont., as a sampler, later transferring to the engineering department. He is at present ventilation and field engineer of this company.

Mr. Yourt's paper was published in the November, 1940, issue of the *Canadian Mining Bulletin*.

**A. L. Malby, Jr., E.I.C.**, is the recipient of the John Galbraith Prize for 1941 for his paper, "Carrier Current Control of Peak Loads." Born at London, England, Mr. Malby received his education at St. Johns Technical High School, Manitoba, and graduated as a Bachelor of Science in electrical engineering from the University of Manitoba in 1934. Upon graduation he joined the staff of the Canadian General Electric Company, Limited, at Peterborough, Ont., and was engaged on testing and generator erection work. In 1936 he was appointed assistant industrial control engineer, which position he still holds.

Mr. Malby is a past secretary-treasurer of the Peterborough Branch of the Institute.

**Gerald N. Martin, Jr., E.I.C.**, has been awarded the Phelps Johnson Prize for 1941 for his paper entitled, "Character-



A. L. Malby, Jr., E.I.C.



G. N. Martin, Jr., E.I.C.



T. A. Monti, S.E.I.C.

istics and Peculiarities of Some Recent Large Boilers in England" presented before the Montreal Branch of the Institute and published in the June, 1941, issue of the *Journal*. Born at Lachine, Que., he received his primary education at the Mont St-Louis College and he graduated from the Ecole Polytechnique of Montreal in 1934. Mr. Martin joined the staff of the Dominion Bridge Company upon graduation and worked as a designer in the structural and boiler departments. In 1938 he was granted a two years' leave of absence to obtain added experience and to study modern combustion engineering under the Central Electricity Board in London, England. While in England he worked on the design and operation of the highest pressure boiler units in use and was stationed for a time at the Brimsdown Station of the North Metropolitan Power Supply Company. He returned to Canada in the spring of 1940 and resumed his position in the boiler department of the Dominion Bridge Company. A few months later he was loaned to the Aluminum Company of Canada,

Limited, Montreal, where he has since been engaged on design work.

Mr. Martin has been an active member of the Junior Section of the Montreal Branch and at one time he was on the executive committee. He was awarded the Phelps Johnson Prize once before, in 1937, for a paper on "The Elements of Modern Combustion Engineering."

**T. A. Monti**, S.E.I.C., is the recipient of the Ernest Marceau Prize for 1941 for his paper, "Vedette de 40 pieds de Longueur" presented before the Junior Section of the Montreal Branch. Born in Italy, he was educated at the Ecole Polytechnique, Montreal, where he graduated in 1941. During his college vacations he worked for the Northern Electric Company, the Quebec Streams Commission, and the Department of Roads of the Province of Quebec. Since graduation he has been on the engineering staff of the Dominion Bridge Company, Limited, Montreal, in the mechanical design department.

## Personals

**D. E. Blair**, M.E.I.C., general manager of Montreal Tramways Company, has been appointed a vice-president of the company and will combine the duties of this office with his present position.

Mr. Blair, who has been associated with the Montreal Tramways Company for 39 years, was born at Montmagny, Que., and was educated at Quebec High School and McGill University where he graduated with a B.A.Sc., degree in 1897. He started his career in the transportation industry by entering the service of the Quebec Street Railway Company as electrical engineer. In this position he superintended the electrification of the Quebec, Montmorency and Charlevoix, formerly a steam railway. In 1903 he joined the Montreal Street Railway as assistant general superintendent. A year later he was appointed superintendent of



**D. E. Blair** M.E.I.C.

rolling stock and became responsible for the design, construction and maintenance of all street cars used in Montreal. In 1925 he was promoted to the position of general superintendent in charge of operation and maintenance and in 1938 was named general manager.

**H. J. Leitch**, M.E.I.C., has been appointed as assistant to the director-general of the shipbuilding branch of the Department of Munitions and Supply. At the time of his appointment, Mr. Leitch was general sales manager of Algoma Steel Corporation Limited at Montreal and his services have been loaned to the Government by this firm.

## News of the Personal Activities of members of the Institute, and visitors to Headquarters



**A. Duperron**, M.E.I.C.

**Arthur Duperron**, M.E.I.C., has been appointed assistant general manager of the Montreal Tramways Company. He was born at Nicolet, Que., and was educated at Mount St. Louis College and Ecole Polytechnique, Montreal, where he graduated with the degree of B.A.Sc., in 1911. He began his professional career with the C.P.R. Bridge Department and, after spending three years with the company, was associated with the Quebec Streams Commission from 1918 to 1927, becoming assistant chief engineer of this Commission in 1925. He was appointed chief engineer of the Montreal Tramways Commission in 1927.

He joined the Montreal Tramways Company in 1937 as chief engineer, a position which he has occupied until his recent promotion. In 1925 Mr. Duperron was appointed professor of public works at Ecole Polytechnique. In 1930 he served as chairman of the Montreal Branch of the Institute and in 1937-38-39 he was on the Council.

**D. M. Stephens**, M.E.I.C., was recently elected chairman of the Winnipeg Branch of the Institute. He is a graduate in civil engineering from the University of Manitoba in the class of 1931. For two years after graduation he was instructor in civil engineering at the University of Manitoba and in 1933 he joined the staff of the surveys branch of the Department of Mines and Natural Resources at Winnipeg as technical draughtsman. He is at present office engineer in the same department.

**N. B. MacRostie**, M.E.I.C., is the newly elected chairman of the Ottawa Branch. He was born at Metcalfe, Ont., and was educated at Queen's University where he graduated in 1911. In 1912 he was in charge of field work as assistant to the inspector of surveys in Manitoba and Saskatchewan and in 1913 he was employed with J. B. McRae, consulting engineer, Ottawa, as inspector on construction of a dam at High Falls, Que. In 1913 he joined the engineering department of the City of Ottawa, first as assistant roadway engineer and later he became in charge of sidewalks as well as city surveyor. From 1916 to 1918 he was gauge examiner with the Imperial Munitions Board.



**N. B. MacRostie, M.E.I.C.**

In the spring of 1918 he joined the Royal Canadian Engineers and went overseas. Upon his return to Canada in 1919 he became a member of the firm of Lewis and MacRostie, civil engineers and surveyors, Ottawa. Later he was associated with the firm of MacRostie and White. At present he is in private practice on his own account.

**Noel J. Ogilvie**, M.E.I.C., Dominion Geodesist and Canadian International Boundary Commissioner was recently appointed to a committee on aerial surveying and mapping at a meeting in New York of the executive committee of the Surveying and Mapping Division, American Society of Civil Engineers.

**P. A. Lovett**, M.E.I.C., has recently been elected chairman of the Halifax Branch of the Institute. Born at Liverpool, N.S., he was educated at the Massachusetts Institute of Technology and at Nova Scotia Technical College where he graduated in 1928 in electrical engineering. For two years after graduation he followed the apprenticeship course of Canadian Westinghouse Company Limited and in 1930 he joined the staff of the Maritime Telegraph and Telephone Company as assistant engineer. Since 1933 he has been associated as consulting engineer with J. R. Kaye, M.E.I.C., in the firm Engineering Service Company Limited, Halifax.

**F. T. Julian**, M.E.I.C., is the newly elected chairman of the London Branch of the Institute. Born at Brampton, Ont., he was educated at the University of Toronto where he graduated in 1920. During the last war he was with the Royal Canadian Engineers from 1916 to 1919. In the years 1920 and 1921 he was on the staff of the Hydro-Electric Power Commission of Ontario as a junior engineer on the St. Lawrence river investigation. In 1921 he joined the staff of J. A. Vance, M.E.I.C., general contractor, Woodstock, Ont., as a foreman and superintendent. He has been with this firm ever since and has been connected with several construction projects in the field of civil engineering.

**Ross W. Bastable**, M.E.I.C., has accepted a commission as pilot officer in the Royal Canadian Air Force. Previous to his enlistment he was with the Bell Telephone Company of Canada at Montreal. He graduated in mechanical engineering from McGill University in 1922 and spent two years on mechanical design of grain elevators with the John S. Metcalf Company, Montreal. In 1925 he joined the staff of the Bell Telephone Company of Canada and worked on building maintenance until 1928 when he became supervisor of buildings in the western division. In 1930 he was transferred to eastern division. Later he was appointed superintendent of buildings for the company.

**Louis Trudel**, M.E.I.C., assistant general secretary of the Institute, has been appointed member of the Civilian Committee for the selection of French-Canadian officers in Military District No. 4.

**A. A. Swinnerton**, M.E.I.C., has been elected secretary-treasurer of the Ottawa Branch of the Institute at the recent annual meeting of the Branch. Born at Hyderabad, India, Mr. Swinnerton was educated at the University of Toronto, where he graduated in chemical engineering in 1919. He served overseas during the last war from 1915 to 1917. Upon his return to Canada in 1917 he worked as a chemist with British Acetones, Toronto, and in 1919 he was appointed assistant chemist in the Department of Mines at Ottawa. In 1921 he was promoted to chemist in charge of oil shale investigations. Later he was transferred to the fuel research laboratories in the same department. He is at present connected with the Dominion Fuel Board in the Department of Mines and Resources, Ottawa.

**Selwyn H. Wilson**, M.E.I.C., has been appointed maintenance superintendent in charge of the maintenance department of Ottawa Car and Aircraft Limited. He succeeds L. D. Byce who has been loaned to the Government.

Mr. Wilson served with the Royal Canadian Artillery in the last war, winning the Military Cross in action at the Canal du Nord. Returning to Canada, he graduated from



**Selwyn H. Wilson, M.E.I.C.**

McGill University in 1922 and held positions with Consolidated Mining and Smelting Company, St. Maurice Paper Company plant at Hawkesbury, Ont., for three years. In 1928 Mr. Wilson was appointed chief engineer for the Dryden Paper Company and in 1936 and 1937 he was with the maintenance department of St. Lawrence Paper Company. Before joining the Ottawa Car in 1940 he had been mechanical superintendent at the Lake St. John Paper Company plant at Dolbeau, Que.

**F. H. C. Sefton**, M.E.I.C., is now stationed with No. 2 Air Navigation School at Penfield Ridge, N.B. Previous to joining the Air Force he was with the Toronto Transportation Commission, Toronto.

## Obituaries

*The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.*

**Marcel Lamoureux, M.E.I.C.**, who was assistant engineer in the Ottawa district office of the Department of Public Works is now district engineer of the Department of Transport at Parry Sound, Ont. He is a graduate of McGill University and upon graduation in 1932 he worked on the construction of the Lake St. Louis bridge, near Montreal. In the years 1934 and 1935 he was with the Quebec Streams Commission. In 1935-36 he was employed as superintending engineer on road construction with the Raymond and McDonnell Company in northern Quebec. He joined the staff of the Department of Public Works at Montreal as a junior engineer in 1936. In 1938 he was transferred to the Ottawa district branch office as assistant engineer.

**David C. Holgate, Jr., E.I.C.**, has recently been transferred from the Dominion Bridge Company, Toronto, to the Sault Structural Steel Company Limited at Sault Ste. Marie, Ont., where he holds the position of engineer and designer.

**H. O. Wilson, Jr., E.I.C.**, has joined the Royal Canadian Naval Volunteer Reserve as a sub-lieutenant and is at present stationed at Ottawa.

**E. A. Russell, Jr., E.I.C.**, has recently returned to the staff of Defence Industries Limited, and is at present employed as construction engineer in charge of plant extension at Winnipeg.

**Pilot-Officer W. M. Diggle, Jr., E.I.C.**, has recently completed his course at the School of Aeronautical Engineering at Montreal, and has been posted to No. 9 Repair Depot at St. Johns, Que.

**Lieutenant Guy Beaudet, Jr., E.I.C.**, is at present stationed at the Royal Canadian Engineers' training centre at Petawawa, Ont. Previous to his enlistment last August he was city engineer at Thetford Mines, Que. He is a graduate of the Ecole Polytechnique from the class of 1938.

**W. E. Soles, Jr., E.I.C.**, who formerly was with Gaspesia Sulphite Company at Chandler, Que., is now with Anglo-Canadian Pulp and Paper Company at Quebec. He graduated from Queen's University in 1935.

**W. J. Farago, S.E.I.C.**, is now employed with Kelsey Wheel Company Limited at Windsor, Ont. Upon his graduation from the University of Saskatchewan in 1940 he joined the staff of McKinnon Industries Limited at St. Catharines, Ont.

### VISITORS TO HEADQUARTERS

**P. M. Sauder, M.E.I.C.**, director of water resources' Edmonton, Alta., on February 4th.

**P. E. Doncaster, M.E.I.C.**, district engineer, Department of Public Works, Canada, Port Arthur, Ont., on February 4th.

**Thomas M. West, M.E.I.C.**, secretary-treasurer, J. & J. Taylor Safe Works, Limited, Toronto, Ont., on February 7th.

**A. R. Hannaford, M.E.I.C.**, designing engineer, Corporation of the City of Hamilton, Hamilton, Ont., on February 7th.

**D. Hutchison, M.E.I.C.**, Edmonton, Alta., on February 10th.

**Lieutenant O. J. E. Rankin, S.E.I.C.**, Staff Mess, O.T.C., Brockville, Ont., on February 10th.

**Frederick R. Duncan, S.E.I.C.**, Toronto, Ont., on February 14th.

**L. P. Cousineau, M.E.I.C.**, Dufresne Engineering Company, Limited, Dolbeau, Que., on February 18th.

**Edgar H. Davis, Jr., E.I.C.**, Lethbridge, Alta., on February 21st.

**H. A. Ripley, Jr., E.I.C.**, Lethbridge, Alta., on February 21st.

**Pilot-Officer A. L. Denton, M.E.I.C.**, No. 10 Air Observers School, R.C.A.F., Chatham, N.B., on February 25th.

**Archibald Fullarton Byers, M.E.I.C.**, well-known construction engineer, died in the hospital at Montreal on February 9th, 1942. He was born at Gananoque, Ont., on December 18th, 1877. He received his primary education at the local public and high schools, and entered Queen's University at Kingston in 1896. Two years later he left Queen's and went to McGill University, Montreal, where he graduated with the degree of Bachelor of Science in 1900. Following graduation, he was forced to remain inactive for two years on account of ill health and for another two years afterwards he travelled extensively in Europe doing post graduate work.

In 1904 he was employed by Canadian Car Company at Montreal as a draughtsman and a building inspector. In 1905 he was superintendent of construction work for Forest City Paving Company. From 1905 to 1907 he was in the contracting business on his own account. From 1907 to 1913 he was senior partner in the firm of Byers and Anglin, general contractors, Montreal.



A. F. Byers, M.E.I.C.

In 1913 he established the firm of A. F. Byers and Company Limited, construction engineers and contractors, Montreal, and he remained president of the organization until his death. Under his direction the firm has carried on extensive general engineering projects from coast to coast. At the time of his death, Mr. Byers was also president of Aerocrete Construction Company.

Mr. Byers was a great public-spirited citizen and he was closely associated with the development of the Town of Hampstead, near Montreal. He was a member of the Council of the town during the years 1924 and 1925, and he served as mayor in 1932, 1933 and 1934. Much reform and reorganization of the town's affairs were initiated and successfully concluded during Mr. Byers' regime as mayor and he was instrumental in establishing the sound financial and administrative foundation of the town's present organization.

He served for several years on the Hampstead School Board and he was chairman in 1929-30. From 1925 to 1929 he acted as representative of Hampstead, Outremont and Ville St. Pierre on the Central School Board of Montreal.

Mr. Byers was very much interested in conservation. His interest originated in 1925 because of his personal knowledge of speckled trout fishing at Lake Manitou, Que., where he had his summer home. Fishing conditions were poor at that time, and further enquiries on his part led him to believe that the factors responsible for these conditions existed throughout the province.

Mr. Byer's ability to see this and the energy and per-

severance he manifested in securing the attention and interest of the officials concerned, illustrate well his devotion to public welfare. His efforts in securing the interest of government officials, as well as his fellow citizens, was directly responsible for a great improvement and broadening in the organizations occupied with the maintenance of our natural resources, particularly fish and game. For some years he worked closely with the government of the Province of Quebec to encourage research and biological studies of the native game fish. He was an honorary member of the Mastacouche Fish and Game Club and the St. Bernard Fish and Game Club.

He was a member of the Alpha Delta Phi fraternity, the University Club of Montreal, and the Masonic Order, in the Royal Albert Lodge.

Mr. Byers joined The Institute as a Student in 1899. He became an Associate Member in 1906 and a Member in 1911. Since 1936 he had been a Life Member of The Institute.

**Kenneth Thomas Cregeen**, M.E.I.C., died at Montreal on February 8th, 1942. He was born at Montreal on December 31st, 1898 and received his education at the Montreal High School and at McGill University, where he graduated with the degree of Bachelor of Science in 1923. Upon graduation he spent a few months with the Montreal Light, Heat and Power Consolidated in the electrical distribution department. In October of the same year he joined the staff of the Sun Life Assurance Company of Canada as assistant to the building superintendent. In 1924 he became resident engineer in charge of building operations and plant for the company, a position which he occupied until his sudden death.

Mr. Cregeen joined The Institute as a Student in 1921, and was transferred to Junior in 1927. In 1933 he was transferred to Associate Member and he became a Member in 1940.

**Royden John Fuller**, M.E.I.C., well-known structural engineer with the firm of Anglin-Norcross Ontario, Ltd., died suddenly at his home in Toronto, on January 27th, 1942, after suffering a severe heart attack. Mr. Fuller was born in the town of Alliston, Ont., on January 26, 1882, the eldest son of Mr. W. S. Fuller. He attended public and high school in Watford, the Model School in Sarnia and the School of Pedagogy in Hamilton, following which he taught in several schools in Ontario. In 1908 he entered the University of Toronto in the Faculty of Applied Science, and graduated with honours in mechanical engineering in 1911, receiving the degree of B.A.Sc., a year later. He then joined the staff of the city architect in Toronto and specialized in structural engineering. He was successively, chief engineer of the John V. Gray Construction Company, and with the Roy Bishop Construction Company, the Fergusson Construction Company, and, lately Anglin-Norcross Ontario, Ltd.

On the day of his funeral, Mr. Fuller was to have taken part in presenting a paper before the Toronto Branch of The Institute on the "Design and Construction of a Concrete Head Frame for Hollinger Mine," which had been erected by Anglin-Norcross under his supervision.

Mr. Fuller is survived by his wife, formerly Miss Frances M. Telfer, one daughter, Mrs. J. B. Wadland, and one son, Robert Telfer, all of Toronto. He is mourned also by all members of the engineering professions with whom he has been associated.

Mr. Fuller joined The Institute as an Associate Member in 1921 and he became a Member in 1940.

**John Courtenay Mews**, Jr., M.E.I.C., died at Buchans, Newfoundland, on January 19th, 1942. He was born at St. Johns, Newfoundland, on June 30th, 1896 and received his education in local institutions. He was for a number of years with the Nova Scotia Steel and Coal Company at Wabana, Newfoundland. During the last war he was on active service from 1915 until demobilized in 1919. He was

first with the Royal Naval Reserve and later with the Royal Newfoundland Regiment.

After the war he returned with the Nova Scotia Steel and Coal Company at Wabana and in 1927 he joined the staff of the Buchans Mining Company, Limited at Buchans, Newfoundland, as assistant to the construction engineer, later becoming superintendent of surface transportation and construction.

Mr. Mews joined The Institute as a Junior in 1921.

**Thomas Wint Weir Parker**, M.E.I.C., died accidentally at Montreal on February 9th, 1942. He was born at Dumbarton, Scotland, on September 20th, 1885, and received his education at the Royal Technical College, Glasgow. From 1901 to 1906 he was a pupil in the city engineer's office at Glasgow and from 1906 to 1911 he was assistant engineer.

He came to Canada in 1911 as instrumentman for the South Vancouver Municipality. During 1911 and 1912 he was a draughtsman in the city engineer's office at Prince Rupert, B.C., and from 1912 to 1915 he was assistant city engineer.

During the last war he served first with the 3rd Battalion, Canadian Railway Troops in France in 1916 and 1917, and from 1917 to 1919 with the Royal Engineers at Salonica and Caucasus.

Upon his return to Canada in 1920 he spent a few months in the office of A. D. Swan, Montreal, as a designer, and then went to Vancouver on construction of the new harbour works. Later he was with Monsarrat and Pratley, consulting engineers, Montreal, and with the Anticosti Corporation, Montreal. In 1937 he was with Northern Construction and J. W. Stewart Limited at Niagara Falls and the following year at Montreal. In 1939 he joined the staff of Rayner Construction Limited and until his tragic death was employed with this firm on the Shand Dam construction at Fergus.

Mr. Parker had been in attendance at the Annual Meeting of The Institute in Montreal a few days before his death.

He joined The Institute as an Associate Member in 1921 and he became a Member in 1940.

**John Sugden Tempest**, M.E.I.C., died suddenly at his home at Victoria, B.C., on July 1st, 1941. He was born at Keighley, England, on January 11th, 1864 and received his education at South Kensington School of Science, England. Previous to his coming to Canada he spent several years in England with W. H. and A. Sugden, architects and surveyors, Keighley.

In 1896 he came to Sault Ste. Marie, Ont., where he was engaged in farming with his brothers. In 1898 he joined a survey party for the Algoma Central Railway in northern Ontario, and for a number of years was engaged in railway survey and location for various concerns, including three years as locating engineer for the Grand Trunk Pacific Railway north of Lake Nipigon.

In 1908 he moved to the West and located at Calgary, Alta., where he was inspecting engineer with the irrigation branch of the Department of the Interior. In 1910-1911 he was in charge of exploration work at Hudson Bay for the Algoma Central Railway. From 1911 to 1913 he was in charge of railway location for the Edmonton, Dunvegan and B.C. Railway. In 1913 he returned to the irrigation branch of the Department of the Interior at Calgary as hydrometric and inspecting engineer and in 1919 he became supervising hydraulic engineer, reclamation service, Department of the Interior, Ottawa. In 1924 he was made Commissioner of Irrigation and Reclamation for the Prairie provinces and was engaged in this work until he retired in 1934. During all these years he had lived in Calgary, but in 1940 he moved to Victoria, B.C., where he died one year later. He was the father of Frank Tempest, M.E.I.C., of Calgary, Alta.

Mr. J. S. Tempest joined The Institute as an Associate Member in 1907 and he became a Member in 1920.

## EDMONTON BRANCH

F. R. BURFIELD, M.E.I.C. - *Secretary-Treasurer*  
L. A. THORSSEN, M.E.I.C. - *Branch News Editor*

The link between the need for oil in time of war and the oil resources of Alberta was described to the Edmonton Branch at its dinner meeting in the Macdonald Hotel on January 31st. The speaker, Mr. W. H. Gibson, who is with the exploration department of the McColl-Frontenac Oil Co., had as his subject **Geographical Methods for Oil Exploration**.

Mr. Gibson explained the fundamental conditions for the formation and accumulation of oil. He emphasized that the hunt for oil was not a search for oil itself, but for the rock structures in which oil can accumulate.

A review of the methods used to locate oil structures formed the body of the address. The earliest method was limited to surface geology but before long underground structures were examined in deep, open cuts and mines. The unexposed structures were later studied by electrical methods based on the potential drop between electrodes driven at different points into the ground. In another method, a delicate, gravity-measuring instrument locates changes in mass distribution of underground rock. Where rocks have magnetic properties a dip compass points to the rock mass. The seismic methods of exploration make use of the time a sound wave takes to travel underground from a point where an explosion is set off to a recording seismic instrument. There are two types of seismic exploration, one in which the sound waves are refracted through the underlying rock, and the other in which the sound waves are reflected from the rock surface. The speaker discussed the ways in which the velocities of sound waves underground are determined, and outlined the advantages and disadvantages of the two seismic methods. He claimed that the reflection method is more popular because the equipment is more centralized and because smaller quantities of explosives are needed. Mr. Gibson described the field procedure in conducting a seismic exploration and showed photographs of equipment as well as actual seismic records recorded in the field. He stated that the seismic method has been used successfully in the U.S.A. and that there is no reason to assume that the same is not true in Alberta. Recently chemical analyses of soil above existing oil fields have shown traces of gases which may have risen from the oil pockets. Mr. Gibson pointed out that these gases may have come from open wells and that the merit of this method will not be known until a new field is discovered by it. He stated that at the present time soil analyses are being taken above regions which a seismic exploration has shown to be possible oil bearing structure.

Mr. Gibson was introduced by the chairman, Professor R. M. Hardy. Following a lengthy discussion, Mr. Hutcheson moved a vote of thanks.

The annual Institute Prize to a third year student at the University of Alberta for scholastic standing in engineering was presented by Councillor J. Garret to Mr. R. McMannus.

## HALIFAX BRANCH

S. W. GRAY, M.E.I.C. - *Secretary-Treasurer*  
G. V. ROSS, M.E.I.C. - *Branch News Editor*

Over two hundred and fifty members of the Halifax Branch, the Association of Professional Engineers of Nova Scotia, and guests gathered at the Nova Scotian Hotel, on January 22nd, for their joint banquet. The popularity of this dinner continues to increase, and many men outside the profession attend every year and look forward to it with as much interest as do the members.

Dr. A. Stanley Walker, Principal of King's College, Halifax, delivered an address which all will remember for a long time. Reviewing the rise and decline of peoples and

## Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

empires during the centuries, he traced a direct relationship between forward movements to greatness and engineering. The ancient civilizations of Egypt, Persia and Rome continued to prosper and expand so long as their people continued to push forward such works as roads, bridges, and communications. Then decline began when their people lost the capacity to continue the works which knit their people together, and moved the products of their labour. The centuries following the fall of the Roman Empire were a time of stagnation, the "Dark Ages," and during this period, engineering works were almost unknown. The British Empire has become great because her engineers have kept up a steady pace of development in industry, transportation, communication and public service.

"After this war we should see to it that the principles of engineering are applied to our problems. The practice of drawing blueprints and experimenting with small things before major plans are attempted will be required if we are to avoid the muddle which followed the last war. If the world would take the gifts which engineers had given and the sense which God had given, and apply them to its problems, it should be able to make a better job of showing the gifts which the world has to offer."

Joint chairmen presiding were Donald Dunbar, Stellarton, N.S., president of A.P.E.N.S., and Percy Lovett, chairman of the Halifax Branch of the Institute.

An interesting feature of the evening was a presentation to Mr. W. P. Morrison. Twenty years ago, the Association of Professional Engineers came into being with Mr. Morrison as secretary-treasurer. He continued to hold that office until the Association and the Institute went into a co-operative agreement in 1940. In appreciation of his services, he was presented with a pipe and humidor and an illuminated address by Mr. Lorne Allen, on behalf of the members of the Association.

Another presentation, that of the Institute Prize, to a junior at the Technical College, was made by S. L. Fultz to H. Rose.

The toast to the services by Col. F. W. W. Doane, was responded to by Captain W. D. Creery, R.C.N., captain-in-charge, Halifax. One to the engineering profession by J. G. Dunlop, manager, Imperial Oil Limited, Halifax, was responded to by Mr. H. C. Burehell, of Windsor, N.S., senior engineer of Nova Scotia. Short remarks were made by Premier A. S. MacMillan, Mayor W. E. Donovan, and Mr. E. C. Kemp, U.S. Consul General. Other guests were Brigadier C. E. Connolly, D.S.O., O.D., M.D. No. 6, and Wing Commander H. D. Carefoot, R.C.A.F.

Harry Cochrane and assisting artists supplied music and entertainment features. Favours were donated by Northern Electric Co., Canada Cement Co., Imperial Oil Ltd., Donald C. Keddy, Canadian Westinghouse Co., Moloney Electric Co., Wm. Stairs, Son and Morrow Ltd.

## LAKEHEAD BRANCH

W. C. BYERS, JR., E.I.C. - *Secretary-Treasurer*  
A. L. PIERCE, M.E.I.C. - *Branch News Editor*

A meeting of the Lakehead Branch of the Institute was held at the New York Lunch in Fort William at 6.30 p.m., January 14th, 1942. In the absence of both the chairman and vice-chairman, Mr. E. J. Davies took the chair.

Mr. J. I. Carmichael introduced the speaker for the evening, Mr. Z. Kryzwoblocki, now with the Canadian Car & Foundry Co. Ltd., of Fort William, Ont. Mr. Kryzwoblocki is a graduate of Lwow College of Engineering in Poland, and has had considerable experience on the design and production of aircraft. He was employed for a time as lecturer in

the Department of Aeronautics at Lwow College of Engineering. On the outbreak of war with Germany, Mr. Kryzwoblocki joined the Polish Air Force as lieutenant-observer, and when Poland was overrun he escaped through Roumania to France. Here he was employed by the Amiot Company on the production of a big bomber. Then France collapsed. He escaped to London and thence to Canada. He is a member of the Polish Military Mission to Ottawa.

Mr. Kryzwoblocki spoke on **The Rocket Wing-Bomb and Rocket Torpedo**. He mentioned that the great majority of people generally are too conservative in their estimation of possible technical developments but expressed the belief that this was possibly due to the fact that any new developments are usually in the hands of a few scientists who do not seem willing to inform the general public of their discoveries. Amongst these experiments now being made were those on the development of rockets and rocket propulsion.

Mr. Kryzwoblocki stated that considerable experimental work and research on the use of rockets and rocket propulsion has already been done in Europe and that possibly most of this information is now in the hands of the Germans. England, of course, and the United States have not overlooked this possible weapon and are also experimenting along these lines.

The great advantage, of course, in the use of rockets, would be the increased range for bombing. If the use of rockets and rocket propulsion could be perfected as a weapon it would give a bombing range of, let us say, 200 miles. It is therefore easy to see how difficult it would be for an enemy to defend an area which would be within a 200-mile radius from the bombing point. Conversely, attacking an objective from such a distance would be much easier and less dangerous to a bombing crew.

Mr. Kryzwoblocki then went on to describe three possibilities of accomplishing this long distance bombing.

- (1) The wing-bomb.
- (2) The rocket-wing-bomb.
- (3) The rocket-torpedo.

The wing-bomb would be located on or under an aeroplane and would be released at a distance from the objective to glide to the target. In order to keep the bomb in flight some means of propulsion would be required, of which rocket propulsion is the simplest method now known. At present the efficiency of such a weapon is low, but with our scientific knowledge increasing along these lines it possesses the greatest possibilities.

The rocket-torpedo is merely a large rocket-wing-bomb launched from the ground instead of from an aeroplane in flight. This type of weapon, stated Mr. Kryzwoblocki, has very great possibilities, and when perfected would be the ideal solution to the problem of bombing from a distance.

Mr. Kryzwoblocki spoke of his associations with various European scientists experimenting along these lines and expressed the opinion that the future would show very interesting results regarding rockets and rocket-propulsion.

### LONDON BRANCH

H. G. STEAD, Jr.E.I.C. - - Secretary-Treasurer  
A. L. FURANNA, Jr.E.I.C. - - Branch News Editor

The annual meeting and dinner of the Branch was held on Wednesday, January 21st, at the Grange Tea Rooms. Dinner was preceded by the annual meeting at which officers for the present year were elected. Dr. S. F. Maine, professor of history at the University of Western Ontario, was the speaker. His subject was the **Rise of the Universities**.

Dr. Maine began his history of the universities back in the days of the Roman Empire. They had their own educational system, but it died with imperial Rome. So between that time and the time of the Crusades, learning was kept alive only within the cloisters of the monasteries. Now, when the crusaders began to arrive in the East, they found that the Mohammedans had a higher civilization than they had themselves. This led to dissatisfaction in Europe and a

desire for knowledge which resulted in schools taught by the Monks. Next, out of these schools came the free-lance teachers who formed the students' guilds. Thus three typical schools arose, one of law, another of arts, and one of medicine. Italy never got away from Roman ideals, and thus Bolonia became the seat of legal learning in medieval times. In the same era, Paris became the centre of learning in arts. The study of medicine also began in Italy, although the early doctors were not Europeans but from the East. At that time, Westerners still worked on the principle of evil possession. However, this new school began to dissect the bodies of animals and of man and as they learned more and more about anatomy, advancement became rapid. This school gradually moved to Palermo to form the beginning of the famous Palermo University.

In the 13th century, Oxford became an offshoot of the Paris school. Also during the same century the Sorbonne in France became the first university to be composed of buildings as well as students. With the Renaissance came the revival of the classics, Latin, Greek and Hebrew. These subjects persisted in the universities until about 100 years ago. It was at that time that the social revolution required the introduction of new subjects, the sciences, and the opening of the universities to more students.

Denominational colleges were the first to rise in Canada. These universities taught science, as well as the other arts, and were the first to open their doors to women. In Ontario, one hundred years ago the first university arose in the east with Queen's at Kingston, next came Toronto in the centre of the province, and seventy years ago Western began in London to the west. To-day these universities are reaching far beyond their walls through the extension and extramural departments.

Concluding the meeting Mr. E. V. Buchanan proposed, and Mr. H. F. Bennett seconded, a vote of thanks to the speaker, Dr. Maine. Also Mr. W. C. Miller was congratulated on his election as president of the Association of Professional Engineers of the Province of Ontario.

### MONTREAL BRANCH

L. A. DUCHASTEL, M.E.I.C. - Secretary-Treasurer  
G. G. WANLESS, Jr.E.I.C. - Branch News Editor

A branch meeting was held jointly with the Institute of Radio Engineers, on January 22nd to hear Mr. E. O. Swan speak on the **Problems Encountered in Erecting Canada's First Directive Broadcast Station**. The chairman was W. H. Moore.

Mr. Swan is a member of the Toronto Section of the I.R.E., and of the Association of Professional Engineers of Ontario. He has been engaged in radio work for over twenty years and for the past twelve has been chief engineer of CKCL, Toronto.

In the early days of radio, a powerful city station would cover several points on the tuning dial, and as more stations were built this condition of jamming became worse. The Havana Conference of 1937 re-allotted the wave lengths and left the then existing Canadian stations crowded in too narrow an area. Mr. Swan described a solution to this problem for a relatively low-powered local station, by means of "directional broadcasting." Beginning March 1st 1940, his station CKCL was the first in Canada to make use of this modern technique.

With old type, long receiving antennae, sets were able to receive signals more effectively in certain directions, which were related to the direction of the antenna wire. This principle is now applied in modern broadcasting stations, and it enables them to send their signals most effectively to the areas of greatest population. It also permits of a minimum of overlapping of other stations, whose field the directional station does not wish to cover. This is accomplished in part by a planned layout of the towers of the broadcasting aerials.

Mr. Swan illustrated his paper with numerous slides showing views of the modern electrical apparatus used in

CKCL. Two reels of movies described the construction of the new station.

Mr. J. T. Dymont, chief engineer of Trans-Canada Airlines, addressed the branch, on January 29th, on **Aircraft Transport Design**. His paper was an extremely interesting discussion of what he believes the purchaser of air transport equipment desires in the way of performance, comfort and safety devices.

Most airlines are obliged to buy standard models, fitting only special equipment of their own specification. Even this may involve as many as 300 modifications to a standard design.

The striking progress of the industry is due in no small measure to existing reciprocal arrangements whereby all lines have access to latest developments in design and safety features. The commercial accident record for the last five years in North America shows only 21 per cent of accidents due to structural failure; all of these were confined to the undercarriage.

Mr. Dymont outlined his idea of the future air liner as follows:

1. *A Stall-Proof and Spin-Proof Plane*. "Boundary layer control"—i.e., minimizing turbulence in the air stream—is required. Diagrams illustrating flight theory showed how turbulence can be reduced by wing design. When the icing problem is solved, wing slots will prevent stalling. Spinning can be controlled by alteration of curvature at wing tips, at slight expense to lifting efficiency. The new Northrup tail-less plane uses an advanced principle of wing design to counteract air turbulence.

2. *Freedom from icing*. The Goodrich pneumatic shoe is the best answer yet, but is not perfect. Some types of "sticky ice" will adhere to the rubber surfaces. Experienced TCA pilots have learned to recognize this and do not use the de-icers under such conditions. It is expected that the use of heat in the leading edge of the wing will provide a more satisfactory solution. Propellers are protected from icing by flowing alcohol through grooves in the leading edge of the blades—a method pioneered by TCA and Goodrich. Windshield de-icing is not adequately solved. Injection type carburetors greatly minimize icing at the air intake.

3. *A full feathering propeller*. To minimize engine damage in case of failure. Electrical and hydraulic types are now well developed.

4. *Ultra high frequency radio beam equipment*. Present beam signals are subject to static and geographical influences, especially in mountainous areas.

5. *An absolute altimeter*. Aneroid types require correction for ground pressures and are inaccurate over mountains. "Terrain clearance indicators" which operate similarly to naval sounding equipment are being developed. At present they are too heavy for most planes.

6. *A radio compass*. To enable the pilot to tune to local stations and be directed to the landing field of that city. Static troubles influence this device at present.

7. *Flight ray indicator*. A cathode ray device which reduces the number of important instruments to be watched by the pilot.

8. *Tricycle landing gear*. With a forward wheel rather than a tail wheel. This permits a "forward center of gravity" which counteracts ground-looping while landing.

9. *Safety fuel*. Boiling range 325-400 deg. F. and flash point of about 105 deg. F.

10. *Safety tires* of the "Lifeguard" type.

11. *Capacity*. About the same capacity as a consolidated B-24 bomber, being capable of carrying 32 passengers by day and 24 by night, with a crew of five. Weight loaded to be about 45,000 lb. In regard to weight reduction, some manufacturers are now pre-stretching the aluminum alloys used, thereby raising tensile strength from 45,000 to 60,000 lb. For fuselage and wing construction, the British geodetic design is the highest ever developed for a fabric-covered plane.

12. *Engines*. Four engines capable of cruising at 50 per

cent of their power, in order to keep maintenance costs at a minimum. Added efficiency is expected from new designs which obtain additional forward thrust from exhausted gases.

Air-cooled designs are preferred. Spark-ignition system engines, weighing about one pound per horsepower, are lighter than compression-ignition engines, but are more complicated. The Bristol sleeve valve engine is promising as a means of reducing the number of parts.

Super-charged ignition systems are desirable to protect insulation.

Supercharger should be of turbo type, two stage, to operate at 9,000 and 18,000-20,000 ft. levels.

Dynafocal type of rubber engine mounts are preferred. Engines need to be arranged for quick changing.

13. *Aerodynamically clean fuselage design*. The present Boeing Stratoliners have achieved a high degree of perfection in this regard.

On February 12th, the Branch was addressed by Mr. C. G. Axworthy, assistant plant manager for Defence Industries Limited, Verdun, P.Q., on the topic **Photoelastic Stress Analysis**. A film illustrating various applications, produced under the speaker's direction at the University of Manitoba, accompanied the talk.

Photoelasticity is based upon the temporary double-refraction produced by stress in certain transparent materials. It is possible to utilize this property in studying the distribution of co-planar stresses by placing the loaded body, usually a bakelite or other plastic model, between crossed polarizers. The light from the first polarizer, vibrating in a single plane, is split up at a point into two components which vibrate along directions coinciding respectively with the maximum and minimum indices of refraction. These directions correspond also to the minimum and maximum stresses, called the principal stresses. The components traverse the model, a plate, at different velocities and emerge out of step. The amount by which the components are out of phase is directly proportional to the principal stress difference or shear and can be observed conveniently by bringing the components into a single plane by means of the second polarizer or analyzer, as it is called. In white light, a multicoloured pattern is observed which is indicative of the stress distribution and which, after calibration of the material, gives quantitative results.

Today most analyses are made in monochromatic light. The stress pattern is of a single colour which, when photographed, gives a series of black lines very easy to interpret. The lines are called "isochromatics" and are loci of equal shear. A crowding together of the isochromatics indicates high stress concentration. Quantitative values are attached to the fringes by calibrating by means of a known stress system, the case of pure tension being the simplest.

Apart from the isochromatics there are the isoclinics or loci of equal inclination of the principal stresses. They correspond to points where the plane of vibration of the incident light is oriented in the direction of one of the principal stresses. Where this occurs the light vibrates on emerging from the model in the same plane as the original plane of vibration and is therefore extinguished by the second polarizer placed at right angles to the first. The isoclinics are consequently black lines. They serve to determine the orientation of the principal stresses. Rotation of the polarizers causes the isoclinics to sweep the stress-field permitting a stress-direction determination for all points. Inclusion of the isoclinics in the monochromatic photograph is confusing. They can be eliminated by the use of quarter-wave plates to destroy the directional qualities of the light by causing it to spin in effect.

Photoelasticity has left the university laboratory to enter the industrial field. This rather recent development has been brought about by the introduction of large field polarizers and the use of highly optical-sensitive plastics, as the model material, in conjunction with the photographic process.

Some interesting applications of the photoelastic method were shown in Mr. Axworthy's film. The study of oscillating, impact and moving loads seems to be particularly within the province of cinematography. The film showed the action of an oscillating load obtained by spring-suspending a weight to the bakelite model: the stresses were actually "seen" to pulsate within the model. The impact loading of an Izod test specimen was also illustrated. Mr. Axworthy seems to have done very original work in using the film to illustrate the action of dynamic stresses.

The photoelastic apparatus used in making the film was designed by and built under the supervision of Mr. Axworthy at the University of Manitoba.

A discussion followed in which was brought up the question of three-dimensional stress which, it is well known, is not within the scope of the conventional photoelastic method.

On February 19th, the Branch was addressed by Mr. N. B. McCreery on the subject of **Plates in Shipbuilding**. Mr. McCreery, who is assistant sales manager, Structural and Plate Division of Carnegie-Illinois Steel Corporation, specialized in the metallurgy of steels at Carnegie-Institute of Technology. His work has included production and testing of armour plate and special alloy steels.

In American practice, a plate is considered as being greater than 48 inches wide, flat, hot rolled (a) from ingots to slabs, (b) cooled for inspection, (c) reheated, (d) rolled from slabs to finished plates. The speaker gave a general survey of types of equipment for production of plates in American mills:

(a) *Three-high shear plate mill*, which has no vertical edge rolls, thus necessitating that the plates be sheared on both sides and ends. With this type of mill especially, orders for small size plates involving much extra cutting can cause a serious bottleneck—even to the point where the mill must be shut down so that shearing operations can catch up.

(b) *Universal mill*, which is a reversing mill, and has vertical rolls to take care of the sides of the plates. It is necessary to shear only the ends of the plates.

(c) *Four-high continuous plate mill*, is a large and high speed operation, co-ordinating the blooming mill, slab mill, reversing mill, automatic descaling equipment, and four finishing stands.

(d) *Continuous hot strip mills*, which were designed for production of light automobile plates.

In the United States, there are 13 shear plate mills which can roll ship plates of 90-inch width and over, but they cannot meet the demand. The 26 continuous hot strip mills are capable of rolling narrower plates, usually up to 72-inch width, which will relieve a substantial part of the bottleneck, if shipbuilders can redesign to make use of these narrower plates. Up to  $\frac{3}{8}$ -inch plates are being so rolled at present, but it is thought by some that it may be eventually possible to roll  $\frac{3}{4}$ -inch plates on these mills.

In regard to structural shapes, considerable relief has already been given to the mills, by reducing and standardizing on a lesser number of items. Carnegie formerly rolled 226 sections to 848 different weights; now they roll 174 sections to only 439 different weights. This permits the mill to carry a small stock of each item and to give more prompt service on small orders.

The shipbuilding expansion programme has made unprecedented demands on the mills. Prior to launching of the programme there were in the United States 83 completed ways and 37 partially dismantled ways, capable of producing sea-going freighters. Now there are 406 ways for such purposes. Steel requirements for the merchant ship building programme totalled in 1940, 132,000 tons per month, in 1941, 247,000 tons per month. The present rate is 500,000 tons and it is expected to reach 700,000 tons per month by the end of 1942. (By comparison there are about 35,000 tons of steel in the Jacques Cartier bridge). It is expected that requirements of the naval building programme may approximate the above tonnages.

An enthusiastic discussion followed the paper. The speaker was heartily applauded for his description of heat treating practice for heavy plates such as are used for bell armour on capital ships.

Once again it was the Branch's good fortune in being able to secure an outstanding speaker. Our appreciation was expressed by Mr. Midgley.

#### NIAGARA PENINSULA BRANCH

J. H. INGS, M.E.I.C. - *Secretary-Treasurer*  
C. G. CLINE, M.E.I.C. - *Branch News Editor*

On January 22nd at the Welland House, St. Catharines, the Niagara Peninsula Branch held a joint dinner meeting with the Niagara District Chemical and Industrial Association, which is a branch of the Canadian Chemical Association. There was an attendance of 60. Messrs. F. C. Rutherford, of the N.D.C. & I.A., and A. L. McPhail, of the Institute, acted as joint chairmen. Mr. W. H. McCartney introduced the speaker, Mr. Douglas Lorimer, president of the Canadian Chemical Association and controller of chemicals, Department of Munitions and Supply. Mr. Lorimer spoke on **Problems of War-Time Control of Chemical Resources**. He mentioned the 12 controllers who meet for consultation as members of the War-Time Industries Control Board, and he outlined the duties and powers of his own office as controller of chemicals. Getting down to particulars, he discussed the supply situation for such chemicals and related articles as: sulphuric acid, soda ash, glycerine, alcohol, bakelite, formaldehyde, creosote, phenol, citric acid, chlorine, aspirin, acetone, lacquer, leather and rubber. The vote of thanks was proposed by Mr. W. R. Manock.

#### OTTAWA BRANCH

A. A. SWINNERTON, M.E.I.C. - *Secretary-Treasurer*

The first noon luncheon of the 1942 term, held at the Chateau Laurier on January 22, was addressed by F. Cooksey, district chief of the Ottawa Fire Department, on the subject of **Incendiary Bombs**. N. B. MacRostie, newly elected chairman of the Branch, presided.

Mr. Cooksey, in connection with his address, exhibited a sample of the usual small incendiary bomb composed of magnesium metal filled with thermite and also the stirrup pump in such general use by the householder in the Old Country for dealing with it.

He began his address with the supposition that an air raid was in progress over the city of Ottawa in which two enemy planes only were involved, each carrying its load of 2,000 incendiary bombs. From these 4,000 bombs, 8 per cent would be effective thereby causing 320 fires to start within a very brief space of time. Even if Ottawa's fire fighting equipment were stepped up to ten times its present strength it would only be able to deal with 40 fires thereby leaving 280 fires to be handled by the population themselves. The necessity for everyone knowing exactly what to do and to have the means at his disposal for doing it is at once apparent.

The small incendiary bomb, he explained, burns with an intense heat for the first 55 or 60 seconds flinging off burning pieces of molten metal for distances up to 30 ft. Attention should be given first of all to these burning pieces and under no circumstances should a stream of water or a fire extinguisher be used against the bomb itself. The bomb, after burning fiercely for the first minute, settles down to a more steady rate when it may be more closely approached. When it falls in a place where it is incapable of doing harm it may burn itself out in about fifteen minutes. If properly fought it may be controlled in a matter of two or three minutes.

It has been learned in the Old Country that merely covering the bomb with sand does not necessarily extinguish it. If the bomb is lying on inflammable material as on a wooden floor gases will be given off which feed the bomb.

The best way is to place a layer of sand alongside the bomb, drag the bomb over it and then cover with sand. A fine spray of water placed in the neighborhood of the bomb assists to prevent the fire spreading. The stirrup pump is fitted with a nozzle through which a spray may be directed or else it may be turned on in a full stream when fighting a fire which has attacked adjacent woodwork or other inflammable material. Eight gallons of water should be able to control a bomb, when used with the stirrup pump.

If every other house in Ottawa were supplied with a stirrup pump, a liberal quantity of sand preferably in small fifteen-pound bags, said Mr. Cooksey, and if Mr. and Mrs. Householder and the children had all had practice and instruction in combatting fires caused by incendiary bombs, then the city would be in a better position than it is to-day to deal with a blitz air raid. At the present time, unfortunately, there is no supply in quantity in Ottawa of stirrup pumps so the garden hose would have to do in the meantime. Also there is a considerable lack of knowledge of how an incendiary bomb acts.

He offered the suggestion that instruction should be available to the population at convenient centres in methods of fighting incendiary bombs and made a special appeal for more of the people to join the auxiliary fire services, which needs 400 for full strength.

J. Leslie Rannie, assistant district warden for the central district, also spoke on behalf of the A.R.P. Warden Service and mentioned the steps that had been taken to educate the wardens themselves more completely in methods of combatting incendiary bombs. He reminded his audience that fire insurance would not protect one in case of loss from this cause so everyone should be prepared.

#### PETERBOROUGH BRANCH

D. J. EMERY, M.E.I.C. - *Secretary-Treasurer*  
E. WHITELEY, Jr., E.I.C. - *Branch News Editor*

At its January 22nd meeting, the Branch learned something of a new technique in training industrial workers. The paper, **Visual Aids for the Industrialist**, had been prepared by Mr. J. Chisholm, of Associated Screen News Limited, but when he was unable to give it, Mr. F. O'Byrne, Ontario manager of the same company, presented it for him.

Actually, the paper was a short introduction to several motion pictures, pointing out the need for every useful aid in training industrial workers for our rapidly growing war industries, and showing how visual aids increase in effectiveness as they make the audience more completely live the experience presented.

One picture is worth a thousand words. Very few descriptions in words only are effective, especially technical ones. One or more simple diagrams will be used, blueprints go one step further, and photographs even more completely convey a story. If now the photograph can be made to move and be accompanied by music, narration, and appropriate sound effects, the audience will absorb the information as effectively as a real-life experience—more effectively even, in some cases. Besides the full use of visual and aural impressions, the motion picture has a great advantage in the fact that the audience, seated in a darkened room, has its full attention concentrated on the scenes which live on the screen before them.

To prove his point the speaker then showed several films. The first dealt with "The Milling Machine," showing the essential functions of the machine. Others showed the use of various gauges. These pictures were some of the series prepared for Industrial Training Programmes by the U.S. Office of Education.

All who were there agreed that Mr. O'Byrne had given them an excellent proof of his thesis, that words supplemented by visual aids can very effectively convey ideas to an audience. The Branch held a technical meeting on February 5th. The speaker, Mr. F. R. Pope, assistant superintendent of the Western Clock Company, presented his paper, **Alarm Clocks—How They Are Made.**

Mr. Pope began by making some observations on the history of time keeping. Time was defined as a system of reckoning duration. There are three chief methods of reckoning time—solar, sidereal and mean solar. Solar is sun time and therefore varies with the length of the day. Sidereal or start time over long periods introduces slight errors in the calendar. Modern time keeping is based on the average day length and is called mean solar time.

The advent of railroad trains made it necessary to have a standard for the whole country. It is a matter of interest that the late Sir Sandford Fleming, a former Peterborough resident, was instrumental in introducing the system of standard time to the world. This involves a common standard and time belts to compensate for differences in longitude.

The first clocks as we know them were introduced by a monk, Gerbert, in the 13th century, and were driven by weights. Galileo developed the pendulum, but the greatest advance was made by Cook in 1660 who invented the oscillating balance wheel.

The essentials of a clock are a source of power, a train of gears for transmission to an indicating mechanism, an oscillating balance wheel and an escapement. The lever escapement, the most accurate devised to date is used in Westclox alarms.

Mr. Pope admitted that from a manufacturing standpoint the problems involved in making high quality clocks for the prevailing low prices are formidable. Extensive tools, fixtures and automatic machine tools are necessary. To justify the large amount of equipment involved, production must be high and the Peterborough plant turns out some 6,000 units per day.

Practically all holes in a clock mechanism are pierced and a few subsequently reamed. Gears are stamped out of sheet. A lubrication problem is obviously present when it is learned that the balance wheel in a Big Ben oscillates about half a billion times in four years—the usual period a clock will run without cleaning and reoiling. Mr. Pope outlined many other manufacturing details, using models and samples for illustration.

We were told that modern clocks are quieter than older ones for much the same reason that modern cars are smoother—rubber mounting and sound deadening applications.

In concluding, Mr. Pope attributed the excellence of Westclox alarms in a great measure to the skill developed by the personnel.

Mr. D. A. Drynan introduced the speaker, and Mr. A. J. Girdwood moved the vote of thanks.

#### SAGUENAY BRANCH

D. S. ESTABROOKS, M.E.I.C. - *Secretary-Treasurer*  
J. P. ESTABROOK, Jr., E.I.C. - *Branch News Editor*

A meeting of the Saguenay Branch of The Engineering Institute of Canada was held in the Arvida school on the evening of the 15th of January.

The meeting was addressed by Dr. D. L. Thomson, head of the Department of Biochemistry at McGill University, speaking on the subject, **Man as an Engineering Miracle.**

Dr. Thomson based his introductory remarks on a general appraisal of man according to engineering standards. The lubrication of muscles and joints and their well-defined hinge action provided the first comparison and this was followed by a study of the human body as an energy converting unit. The efficiency of energy conversion is 30 per cent and on the basis of heat engine performance would require a working range of 1,000 deg. C.

Man can develop and repair damaged structures whereas machines can never do this. This ability to replace cells is done with the assistance of vitamin "C" and it has been found that there is a complete turnover of cells and atoms in the body structure every three or four years. The exceptions in this case are permanent structures such as tooth enamel.

The heart provides a miraculous solution of a difficult hydraulics problem. Here we have a pump working at the rate of five gallons per minute against a six-foot head with a fluid whose viscosity is subject to constant change and with ducts whose elasticity is constantly effecting changes in cross-sectional area. The pulsating motion of the fluid also adds to the complicating factors.

The eye closely resembles a camera in structure, with its shutter, diaphragm, lens and sensitive film. In our human system these are constantly being regulated by what amounts to an automatic exposure meter. In this unconventional system of working, the eye also incorporates the ability to change the shape of its lens at will.

Electrical engineering is represented by the nervous system. Different types of nerves have the task of carrying different sensations and when these are located close together and are operating under stress we can get a short-circuiting effect with a mixed reaction on the senses. An example of this is the well known effect of a blow on the head producing a shock on the optic nerves and causing sensations of light. In recording impressions of the intensity of light, the nerves ordinarily transmit these as a vibrational frequency and they are interpreted in the brain in the form of light intensity.

The speaker's final comparison was that pain is a danger signal in the body system just as vibration is in the engineering sphere of work.

## SASKATCHEWAN BRANCH

STEWART YOUNG, M.E.I.C. - *Secretary-Treasurer*

The Saskatchewan Branch met in the Kitchener Hotel, Regina, jointly with the Association of Professional Engineers and the Saskatchewan Section of the American Institute of Electrical Engineers, on Friday evening, January 23, 1942. The attendance, including the wives and lady friends of members, was 60.

The speaker of the evening, Mr. Ernest Dickinson, gave an illustrated lecture on his experiences from 1936 to 1940 in South America with the Bolivian Power Company, a subsidiary of The Montreal Engineering Company. The lecture, which included numerous still pictures and two reels of moving pictures, one in colour, dealt with life in general in Western South America, the City of La Paz, Bolivia, in particular and the Bolivian Power Company (La Paz) System, a hydro-electric plant in the Andes Mountains. The elevation of the City of La Paz is 12,200 ft. above sea level.

## TORONTO BRANCH

J. J. SPENCE, M.E.I.C. - *Secretary-Treasurer*  
D. FORGAN, M.E.I.C. - *Branch News Editor*

On January 29, a well-attended meeting of the Toronto Branch of the Institute was held in the Debates Room at Hart House. In addition to the members of the Institute, representatives were present from the Canadian Institute of Mining and Metallurgy. The chairman of the Branch, Mr. H. E. Brandon, conducted the meeting.

The speaker of the evening, A. H. Harkness, D.Eng., who is well-known throughout Canada for the many outstanding engineering works which he has designed, was introduced by the chairman. His subject was **Design and Construction of a Concrete Head Frame for Hollinger Mine**. Mr. R. J. Fuller, of the firm of Anglin Norcross Limited, general contractors for construction of the head frame, was to have joined with Dr. Harkness in discussing details of construction. Mr. H. E. Brandon offered regrets of the Institute on the death of Mr. R. J. Fuller, which occurred only two days previous to the meeting. Arrangements were made, however, to have Mr. J. W. Falkner read Mr. Fuller's paper, and to illustrate it with numerous lantern slides prepared by Mr. Fuller.

Dr. Harkness covered in detail the design of the rein-

forced head frame at the No. 26 shaft on the Hollinger Gold Mine's property at Timmins, the only one of its size in Canada. The structure is unique in that, with very simple architectural treatment, it was possible to create a structure most pleasing and monumental in character—quite different to the type of utilitarian structure generally built over mine shafts. It was pointed out that the concrete building, with only few partial floors, would require considerably less maintenance than is necessary for the usual type of structures built for this purpose. At its conclusion, considerable discussion was held, especially with regard to the advantage of using structural steel for head frames which could be removed and re-used elsewhere.

Mr. R. B. Young moved that the thanks of the meeting be extended to Dr. Harkness and J. W. Falkner for the interesting papers presented.

The annual Students' Night of the Toronto Branch of the Institute was held on January 15 in Hart House. There was an excellent attendance, the students having an especially good turnout. The annual Students' Night is one of the most enlightening and beneficial meetings of the year; it was enlightening to the older members in that all student competitors seemed to be experienced speakers and treated their subjects so fluently; it was beneficial to the students as it gave them confidence in themselves. Refreshments were served after the meeting.

The three judges, Messrs. E. A. Stone, J. K. Partridge and W. H. Slinn, had a very hard time making decisions because of the excellent quality of the papers presented.

During the intermission, three comic films were shown, which were thoroughly enjoyed by all.

The winners were as follows:

### JUNIOR SCHOOL

W. O. Cartier—"Frequency Modulation Receiver."

### SENIOR SCHOOL

- 1st—W. S. Glynn, "Prestressed Concrete Construction."
- 2nd—C. B. Livingstone—"On Spinning of Airplanes."
- 3rd—A. B. Extence—"Centrifugal Pumps."
- 4th—C. W. Shearer—"Mercury Arc Power Rectifiers."

The sixth Annual Social Night of the Branch, a gathering sponsored and largely organized by the wives of the members, took place in the Engineers' Club, Toronto, on Saturday, January 10. About 130 attended for dinner and the entertainment which followed. Mr. H. E. Brandon, branch chairman, with Mrs. Brandon, and Dean Young with Mrs. Young, received the guests. It was a most enjoyable evening for everyone.

## VANCOUVER BRANCH

P. B. STROYAN, M.E.I.C. - *Secretary-Treasurer*  
A. PEEBLES, M.E.I.C. - *Branch News Editor*

The first meeting of the Branch for 1942 was held on January 20th in the Medical-Dental building. The speaker was W. D. McLaren, general manager of the West Coast Shipbuilders Ltd., a company engaged in building standard cargo vessels for Wartime Merchant Shipping Ltd. His subject was **Ships: Selection of Type**.

Mr. McLaren first explained the general considerations governing the design of standard cargo vessels now under construction throughout Canada and the United States. They are of a reasonably economical size for war service, and of simple lines to facilitate fabrication. Their speed is sufficient for service in convoy, and their engines and boilers are of a type which can be built without highly specialized plant and machinery. Existing facilities had to be used as far as possible both for engines and hull fabrication. Hence there is some variation in practice among different yards, some using more welding than others, some doing considerable pre-fabrication in shops with a minimum of welding and rivetting on the ways.

(Vancouver Branch, continued on page 198)

**TORONTO BRANCH ANNUAL LADIES' NIGHT**



**Mrs. W. E. Bonn, W. E. Bonn and Mrs. H. E. Brandon.**



**In the group: Nicol MacNicol, Ross Robertson and R. L. Hewitt.**



**In the group: Mrs. W. S. Wilson, Mrs. Otto Holden, Ross Dobbin, Mrs. W. E. Ross, H. E. Brandon, Mrs. W. E. Bonn and E. C. Higgins.**



**From left to right: J. J. Spence, S. R. Frost and H. E. Brandon.**



**Mrs. A. U. Sanderson, Otto Holden and Mrs. J. S. Keenan.**



**D. C. Tennant, Professor R. W. Angus, Mrs. R. W. Angus and H. H. Angus.**



**From left to right: Professor C. F. Morrison, D. C. Tennant, Mrs. and Mr. John Hall, J. S. Keenan and W. E. Ross.**

The trend towards larger ships is explained by the effort to secure a lower size-speed ratio. An increase in length means an increase (usually) in the length-beam ratio, resulting in lessened resistances and a higher relative speed. Other factors have been better engine and boiler efficiencies and performance. The cruiser type of stern serves to lengthen a ship at the water line. In the light of tank experiments the once popular sharp bow has given way to a blunt or more rounded style. In hull design, the high stresses occurring at various points have been met with the use of high strength steels. Since a ship acts somewhat as a bridge, sometimes supported near the ends and sometimes near the center, wide variations in stress occur throughout the members.

In the early days of steamships the size of the engine cylinders practically designed the ship. Later, improvements were made by balancing the engines, but ultimately a limit was reached in bulkiness, and in speed when the piston velocity reached about 1,000 ft. per minute. The invention of the steam turbine made increased speeds and greater power possible. Early difficulties were associated with the gearing, which was reversed from that of the reciprocating engine.

The water tube boiler and oil fuel provided the means for further increases in power and speed. A gradual reduction in weight for the power developed was achieved. The latest step in this advance was brought about by the diesel engine, which also has a much higher thermal efficiency than the steam engine.

After his address, the speaker answered many questions, and several persons added to the information divulged. A vote of thanks was tendered by Dean J. N. Finlayson, on behalf of the 43 members and friends present.

Members of the Branch were guests at one of the largest and most successful meetings ever held in this city. An attendance of nearly 400 indicates the degree of interest in the subject of arc welding at the present time, and the important part which it occupies in war industry.

The meeting was under the auspices of the British Columbia Chapter of the American Society for Metals, a recently formed group which is achieving remarkable success in drawing together those engineers and technicians who deal with metals in any form. A course of lectures is being conducted and over 100 students are taking part. Prof. F. A. Forward of the University of British Columbia is chairman of the chapter.

The meeting opened with a dinner served in the dining-room of David Spencer Ltd., at which more than 200 were present. During dinner, a short talk was delivered by Mr. W. Hanson, Admiralty Inspector from London, England, at present doing work in Vancouver. He reminded the engineers of the Pacific Coast of the necessity for pushing war production to the limit, and indicated that a permanent industrial development would remain in this area after the war.

After dinner, a film was presented showing the principles of the arc welding process, how it should and should not be done.

The principal speaker was Mr. James F. Lincoln, president of the Lincoln Electric Co. of Cleveland, and director of its allied companies in Canada, England and Australia. His subject was **Electric Welding Developments**. The principal theme throughout the address was the need for the use of imagination, knowledge and skill in the creation and adoption of new ideas, new methods, new materials and new products in our industrial system. The speaker illustrated his viewpoint by showing its present results in the field of arc welding.

Arc welding may be classed with tool and alloy steels, for the part which it has played in modern mechanical engineering and shop practice. In its early stages when plain mild steel welding rods were used, results were often unsatisfactory and its application was somewhat restricted. The modern shielded arc, using coated rods to achieve specific results in the weld, have made arc welding a reliable and economical tool in the working of most metals. Welding has already found wide application in the fabricating of structural steel for buildings, in ships, in airplanes, in gun mountings, and in motor vehicles and tanks. So far, however, the welded article has been a close copy of the cast one in size, shape and proportion, and there is a tremendously wide field open in the re-design of such products, whereby the amount of cutting, bending, welding and other operations may be reduced. A wider knowledge of the stresses set up in a structure or machine in service, will make possible changes in the proportioning of parts, resulting in future economy. Slides were shown depicting examples of the replacement of cast parts with welded parts, giving a comparison of weight and cost, both of which favour the welded type.

Following the address, many questions were asked, and much useful information resulted. The practice of bobbing welds has no basic advantage, and in most cases is actually detrimental. In certain circumstances, where a tensile strength is not a governing factor, bobbing may serve to reduce warping of plates without seriously weakening the weld. Stress relieving is necessary for welded pressure vessels for severe types of service, but is ordinarily not required, since internal stresses induced by welding will gradually adjust themselves with time. Welding is not advisable with most non-ferrous metals, though it can be done. The reduction in strength which occurs makes it undesirable in many cases, unless restoration can be effected by heat treating.

Mr. Lincoln stated that the estimated saving to industry which would have accrued from full application of the ideas and methods suggested in the first competition sponsored by the Lincoln Foundation a few years ago, amounted to \$1,600,000,000. A hearty vote of thanks was tendered the speaker by Dean J. N. Finlayson.

## ANNUAL FEES

Members are reminded that a reduction of one dollar is allowed on their annual fees if paid on or before March 31st of the current year. The date of mailing, as shown by the postmark on the envelope, is taken as the date of payment. This gives equal opportunity to all members wherever they are residing.

# News of Other Societies

## DINNER TO HONOUR DEAN YOUNG

To honour C. R. Young, M.E.I.C., recently appointed Dean of the Faculty of Applied Science and Engineering of the University of Toronto, and President of The Engineering Institute of Canada, the Association of Professional Engineers of Ontario and the Toronto Branch of The Engineering Institute of Canada are jointly sponsoring a commemorative dinner in Hart House on April 25th. This dinner will be open to all engineers and will not only be a gala night for the members of the profession, but will at the same time serve to impress upon the public the great contribution that engineers are making in the present conflict.

Arrangements for this dinner are being made by a joint Committee of the Association and of the Toronto Branch of The Institute under the chairmanship of Mr. S. R. Frost.

## A.I.E.E. NOMINATIONS

The National Nominating Committee of the American Institute of Electrical Engineers, consisting of members from various parts of the country, has nominated the following official ticket of candidates for the offices becoming vacant August 1, 1942:

*For President:* Harold S. Osborne, Plant Engineer, Operation and Engineering Dept., American Telephone and Telegraph Co., New York, N.Y.

*For Vice-Presidents:* (North Eastern District)—Karl B. McEachron, Research Engineer, High Voltage Practice, General Electric Co., Pittsfield, Mass.; (New York City District)—C. R. Jones, Eastern Transportation

## Items of interest regarding activities of other engineering societies or associations

Manager, Westinghouse Electric & Mfg. Co., New York, N.Y.; (Great Lakes District)—A. G. Dewars, Manager, System Planning Dept., Northern States Power Co., Minneapolis, Minn.; (South West District)—E. T. Mahood, Engineer, In Charge of Area Engineering Force, Southwestern Bell Telephone Co., Kansas City, Mo.; (North West District)—E. W. Schilling, Professor and Head of Department of Electrical Engineering, Montana State College, Bozeman, Mont.

*For Directors:* K. L. Hansen, Consulting Engineer, Harnischfeger Corp., Milwaukee, Wis.; W. B. Morton, Senior Field Engineer, Philadelphia Electric Co., Philadelphia, Pa.; W. R. Smith, Safety Engineer, Public Service Electric and Gas Co., Newark, N.J.

*For National Treasurer:* W. I. Slichter, Professor Emeritus of Electrical Engineering, Columbia University, New York, N.Y.

These official candidates, together with any independent nominees that may be proposed later, will be voted upon by the membership at the coming election this spring.

## ANNUAL MEETING OF QUEBEC CORPORATION

The annual meeting of the Corporation of Professional Engineers of Quebec will take place on March 28th, at 2.15 p.m., in the meeting hall of The Engineering Institute of Canada, 2050 Mansfield Street, Montreal, Que.

Refreshments will be served at the conclusion of the meeting.

# Library Notes

## Book notes, Additions to the Library of the Engineering Institute, Reviews of New Books and Publications

### BOOK REVIEW

#### BRIDGES AND THEIR BUILDERS

By D. B. Steinman and Sarah R. Watson. G. P. Putnam's Sons, New York, 1941. 6 x 9 inches. 379 pages. Illustrated. \$3.75

Reviewed by S. R. BANKS, M.E.I.C.\*

In this book the authors engage to review their vast subject ". . . as a heart-stirring narrative of high adventure and deep dramatic interest." They see in the planning and building of bridges an epitome of human aspiration and achievement; and, in the course of the eighteen chapters, the reader is conducted from a glimpse of a stone-age man crossing a torrent on the uncertain footholds of a fallen tree to the contemplation of Robinson and Steinman's forty-million-dollar proposal for a suspension bridge of 4,620-foot span between Brooklyn and Staten Island.

The triumphal progress of the bridge-builders' art is traced from primitive civilizations, through the times of the Greeks and Romans, through the dark ages when the medieval churchman alone pressed forward, through the Renaissance, and on to the pioneering days of civil engineering and the astounding accomplishments of the twentieth century. Bridges of stone, of wood, and of iron are successively described against the spacious backgrounds of their days, while the tempo of our own age is reflected in the culminating catalogue of span upon longer span of steel. In telling their story the authors rightly eschew the technicalities of the structural engineer, and the reader's attention is stimulated by copious fund of anecdote, biography, and even verse.

It is likely that the layman and the engineer alike will find of greatest interest those chapters that deal specifically with what may

be termed the classic early bridges of steel. The Eads Bridge, the Brooklyn Bridge, and the Forth Bridge are so treated, and in each instance the history of the project is told from its conception to its fulfilment. Of particular value are the occasional excerpts from the papers of the outstanding men through whose vision and courageous effort those prodigious undertakings were guided to fruition.

One or two criticisms occur to the reviewer of this book. In the first place, surely no record of great bridges of the last two decades can be complete without advertence to the disconcerting behaviour of heat-treated wires in the Mount Hope and Detroit bridges, and to the subsequent engineering feats of dismantling the huge cables of those structures and replacing them with wires of the cold-drawn type. Again, while the lessons learned from the failure of Tacoma Bridge undoubtedly represent an advance in knowledge, it does not seem right that "Recent Developments in Bridge Engineering" should be the heading of a chapter which deals almost exclusively with that disaster. With regard to the chapter on suspension bridges, the authors appear to be mistaken in their brief reference to the Lions' Gate Bridge at Vancouver, because that bridge was designed and built in Canada. Lastly, the present review would be incomplete without an expression of regret that the dignity of this otherwise objective survey of bridge engineering should be detracted from by over-frequent reference to the famous partnership of engineers of which one of the authors is a member.

"Bridges and Their Builders" is very readable and will appeal strongly to all who are inspired by the romance and vigour of its subject. The illustrations are good and are well-chosen. It is a pity that no alphabetical index is provided for the reader's convenience.

\*General Engineering Department, Aluminum Company of Canada, Ltd., Montreal, Que.

## ADDITIONS TO THE LIBRARY

### TECHNICAL BOOKS

#### Bridges and Their Builders:

David B. Steinman and Sarah Ruth Watson. N.Y., G. P. Putnam's Sons, (C1941). 6 x 8 3/4 in. \$3.75.

#### Refuse Collection Practice:

Committee on Refuse Collection and Disposal. American Public Works Association, 1313 East 60th St., Chicago, Ill., 1941. 6 x 9 1/4 in. \$5.00.

#### Surveying:

Charles B. Breed. N.Y., John Wiley and Sons, Inc., 1942. 5 x 7 1/2 in. \$3.00.

#### Electrical Illumination:

John O. Kraehenbuehl. N.Y., John Wiley and Sons, Inc., 1942. 6 x 9 1/4 in. \$3.75.

### PROCEEDINGS, TRANSACTIONS

#### Institution of Naval Architects:

Transactions, 1941. volume 83.

#### American Society of Civil Engineers:

Transactions No. 106, 1941. Issued as part 2 of the Proceedings. Vol. 67, No. 8, Pt. 2, October, 1941.

#### Royal Society of Canada:

Transactions, section 3 and 4, 3rd series, vol. 35, meeting of May, 1941.

#### Institution of Mining and Metallurgy:

Transactions, 49th session 1939-40. Vol. 49, 1940.

### REPORTS

#### American Institute of Electrical Engineers—Standard Committee:

Standard for wet tests No. 29, November 1941; Proposed standard for capacitance potential devices and outdoor coupling capacitors, No. 31, December, 1941.

#### American Institute of Electrical Engineers—Committee on Electrical Machinery:

Proposed test code for single phase motors. AIEE No. 502, 1941.

#### Canada—Department of Mines and Resources:

Rapport du Ministère pour l'année financière terminée le 31 mars 1940 et pour l'année financière terminée le 31 mars 1941 accompagné du rapport sur l'établissement des soldats au Canada. Ottawa, 1941. 50c. each.

#### Purdue University—Engineering Bulletin:

Research series No. 83—Report of the research and extension activities for the sessions of 1940-41. Extension series No. 52. Highways then and now by Ben H. Petty.

#### Bell Telephone System—Technical Publications:

Calculation of the Torque on a ferromagnetic single crystal in a magnetic field; Micro-gas analysis methods and their application to research; New microphone providing uniform directivity over extended frequency range; Operation of electrostatic photomultipliers; Spectral and total thermal emissivities of oxide-coated cathodes; Film scanner for use in television transmission tests; Steric hindrance in organic solids; Echoes from near-by short-wave transmitters; The structure of black carbon; Monographs B1297-1302, 1304-05, 09.

#### Ohio State University—Engineering Experiment Station:

Use of washed North Carolina Kaolin as an ingredient of porcelain bodies, by William H. Earhart. Circular No. 42.

#### American Institute of Chemical Engineers:

Directory of officers and members and committee appointments for 1941.

#### American Institute of Steel Construction:

Specification for the design, fabrication and erection of structural steel for buildings, rev. July 1941; Code of standard practice for steel structures other than bridges, rev. Aug. 1941.

#### Electrochemical Society—Preprints:

Solubility of nickel ions in aqueous alkaline carbonate-tungstate solutions; The oxidation of cerous sulfate at a rotating anode; Perborate formation at a rotating anode; Nos. 81-2-4.

#### Quebec Streams Commission:

Twenty-fifth report for the year 1936.

#### Canada—Department of Transport:

Annual report for the fiscal year from April 1940 to March 31, 1941.

#### Canada—Department of Mines and Resources—Geological Survey:

Clérycy and La Pause map-areas, Quebec, by J. W. Ambrose. Memoir 233.

#### Vaillancourt, Emile:

Guillaume D'Orange.

#### University of Minnesota—Engineering Experiment Station:

Comparative performance of four different types of dust counters. Technical paper No. 35.

#### The Converter Process in the Steel Foundry

A 12-page report—Investigation No. 1138—"Some Practical Considerations of the Use of Side-Blow Converters in the Present Emergency," December 24th, 1941. Just issued by the Department of Mines and Resources, Ottawa, draws attention to the advantages of the converter process for the production of light and medium steel castings under wartime conditions. Now that electric furnace capacity is fully employed, grey iron foundries can be readily equipped with side-blow converters, thus releasing electric furnaces for the specific applications for which they are pre-eminently satisfactory.

The side-blow converter equipment is described in some detail, and the technique of its operation discussed. Special mention is made of the control of sulphur and other constituents of the finished product. The limitations of the process are pointed out as well as its advantages.

Copies of the report can be obtained from "The Chief, Bureau of Mines, Department of Mines and Resources, Ottawa."

### BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet the books are not in The Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

#### A.S.T.M. STANDARDS ON RUBBER PRODUCTS, prepared by A.S.T.M. Committee D-11 on Rubber Products Methods of Testing, Specifications December, 1941.

American Society for Testing Materials, 260 So. Broad St., Phila., Pa., 1941. 280 pp., illus., diags., charts, tables, 9 x 6 in., paper, \$1.75.

This annual publication gives in their latest approved form the specifications and methods of test adopted by the Society. Among them are several new standards. There are also numerous revisions of earlier ones. There is a useful bibliography on the properties and testing of rubber.

#### ACTIVE CARBON, THE MODERN PURIFIER

By J. W. Hassler. West Virginia Pulp and Paper Co., 230 Park Ave., New York,

1941. 159 pp., illus., diags., charts, tables, 9 1/2 x 6 in., cloth, gratis.

This book constitutes a collection of the existing knowledge regarding the commercial applications of the decolorizing types of active carbon. It presents a general survey of the subject, detailed descriptions of various applications, basic principles for the research chemist and methods of evaluation of carbons. There is a large bibliography.

#### AIRCRAFT TORCH WELDING

By C. von Borchers and A. Ciffrin. Pitman Publishing Corp., New York and Chicago, 1941. 157 pp., illus., diags., charts, tables, 8 1/2 x 5 in., cloth, \$1.50.

This book outlines a training course for aircraft welders based on well-established principles. It deals only with gas welding. Topics treated include equipment, the use of gases, torch and flames, welding technique, jigs and fixtures, inspection methods and repair welding. Review questions accompany each chapter.

#### AIRPLANE DESIGN

By K. D. Wood, 6th ed., Nov., 1941, published by the author at Purdue University Lafayette, Ind., and distributed by the Cornell Co-op. Society, Ithaca, N.Y., pagged in sections, illus., diags., charts, tables, 11 x 9 in., paper, \$4.00.

Practical design procedure covering airplane layout and stress calculations is presented in this textbook. Particular emphasis is laid on the economics of airplane design, and many photographs and diagrams accompany the descriptive material. A large appendix furnishes most of the data necessary for a student to carry a design project through its preliminary stages.

#### AMERICAN SOCIETY FOR TESTING MATERIALS—1941 Supplement to A.S.T.M. Standards including Tentative Standards

Part 1. Metals. 597 pp.

Part 2. Nonmetallic Materials—Constructional. 427 pp.

Part 3. Nonmetallic Materials—General. 641 pp.

A.S.T.M., 260 South Broad St., Phila., Pa., 1941. Illus., diags., charts, tables, 9 1/2 x 6 in., cloth, \$3 for any one part, \$5 for any two parts, \$7 for all three parts.

To keep up to date its triennially published Book of Standards, the American Society for Testing Materials publishes, in the two intervening years, supplements to each of the three volumes of that set. This 1941 supplement gives in their latest approved form the 370 specifications, tests and definitions either issued for the first time in 1941 or revised.

#### ANNUAL REVIEWS OF PETROLEUM TECHNOLOGY, Vol. 6 (covering 1940)

Edited by F. H. Garner, published by The Institute of Petroleum, c/o The University of Birmingham, Birmingham, England, 1941. 318 pp., illus., diags., charts, tables, 9 x 6 in., paper, 11s. or \$2.50 (incl. postage).

Reviews by experts of developments during 1940 are contained in this annual compilation which covers the whole range of petroleum technology; geology, drilling and production, transportation and storage, refining operations, alternative fuels, analysis and testing, road materials, lubrication, etc. In addition to chapter references there is a general review of petroleum literature in 1940, and a chapter on production and commercial statistics is included.

#### ARMS AND THE AFTERMATH

By P. Stryker. Houghton Mifflin Co., Boston, 1942. 157 pp., tables, 8 1/2 x 5 1/2 in., cloth, \$1.75.

The meaning of industrial mobilization is explained, together with the importance of effective mass production methods, and the

results of the change-over and tremendous financing problems for armament are indicated. The purpose is to give the reader a behind-the-scenes view of the causes, functioning and effects of this mobilization of industry for the war effort.

### THE ART OF CAMOUFLAGE

By C. H. R. Chesney. Robert Hale Ltd., London, written in 1939, published in 1941. 253 pp., illus., maps, 8 x 5 in., cloth, 8s. 6d.

Camouflage, "the art of concealing the fact that you are concealing," is thoroughly covered in this book. The first section discusses camouflage as practised by creatures in their natural environment, and presents general considerations upon civil camouflage. The second section discusses the development of military camouflage in the War of 1914-18, and future developments for both military and civil use. Strategic camouflage in military movements is demonstrated in the last section, with examples from campaigns. In this section and in an epilogue the author stresses also the political camouflage which will be used and has been so amply demonstrated just recently.

### BUILDING CONSTRUCTION, Materials and Types of Construction

By W. C. Huntington. 2 ed. John Wiley & Sons, New York, 1941. 674 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$6.00.

This book deals with the materials and types of construction used for the various parts of buildings, but not with the structural design except in its qualitative aspects. In the present edition particular attention has been paid to recent developments in our knowledge of soil behaviour, foundations, brick cavity-walls, wood construction and connectors, steel welding, reinforced concrete arches and rigid frames, the protection of wood from termites and the newer structural materials.

### DIESEL ENGINEERING HANDBOOK, Vol. 2

Edited by L. H. Morrison. Diesel Publications, New York, 1941. 574 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$5.00.

This volume is intended to supplement both the 1935 and 1939-40 editions. The material contained is either entirely new or an amplification of topics considered in the previous editions. Engine efficiencies, specifications, special installations and various types of auxiliary equipment not previously covered are discussed exhaustively with many illustrations.

### DONE IN OIL

By D. D. Levon. Carleton Publishers, New York, 1941. 1,084 pp., illus., diags., charts, maps, tables, 9½ x 6 in., leather, \$10.00.

The first section of this comprehensive volume covers general petroleum economics, oil reserves and conservation, the international situation and the importance of oil in war. The succeeding five sections deal respectively with finding and producing oil, transportation and refining, financing the oil industry, oil royalty business and investments, and the regulating of securities and markets. Sample leases and deeds, a large glossary of terms and a list of sources of further information are appended.

### EXPERIMENTAL PHYSICAL CHEMISTRY

By W. G. Palmer. MacMillan Co., New York; University Press, Cambridge, England, 1941. 321 pp., diags., charts, tables, 8½ x 5½ in., cloth, \$2.75.

The experiments presented have been chosen among those used in the University Chemical Laboratory at Cambridge, choice having been of those which can be carried out

in customary laboratory periods, with ordinary equipment. Detailed directions are given, and the principles involved are set forth in considerable fulness. There are completely worked examples of most experiments.

### FATIGUE OF WORKERS, Its Relation to Industrial Production

By Committee on Work in Industry of the National Research Council. Reinhold Publishing Corp., New York, 1941. 165 pp., 9½ x 6 in., cloth, \$2.50.

This volume is the complete report of the findings of a committee which made a detailed study of all kinds of variations in working conditions, both physical and psychological considerations were investigated with respect to their effect upon the efficiency of workers. The results of this painstaking study should be of value to employers of all classes.

### FINANCIAL STATEMENT ANALYSIS, Principles and Technique

By J. N. Myer. Prentice-Hall, New York, 1941. 257 pp., charts, tables, 9½ x 6 in., cloth, \$3.75.

Financial statement analysis is considered as a branch of accountancy, and an understanding of such statements and the accounting processes by which they are produced is assumed. The object of the book is to develop sound principles for a technique of analysis and interpretation of the financial statements of business enterprises, and the application of these principles is illustrated in a practical manner.

### Great Britain, Dept. of Scientific and Industrial Research, Building Research WARTIME BUILDING BULLETIN No. 17

His Majesty's Stationery Office, London, 1941. 9 pp., 11 x 8½ in., paper, (obtainable from British Library of Information, 30 Rockefeller Plaza, New York, 15c.).

This pamphlet is based upon an extensive survey of damaged buildings, research data and other information. Damages from explosions above ground, from fire and from ground shock are considered, and tentative recommendations for precautions in design are given.

### Great Britain, Dept. of Scientific and Industrial Research, Road Research Laboratory

#### Wartime Road Note No. 1, RECOMMENDATIONS FOR TAR CARPETS AND SURFACE DRESSINGS. 11 pp.

#### Wartime Road Note No. 2, SOURCES OF NATURALLY-COLOURED CHIP-PINGS IN GREAT BRITAIN. 13 pp.

#### Wartime Road Note No. 3, RECOMMENDATIONS FOR OPEN - TEXTURED ASPHALT CARPETS, 8 pp.

His Majesty's Stationery Office, London, 1941. Tables, 9½ x 6 in., paper, 6d. each. (Obtainable from British Library of Information, 30 Rockefeller Plaza, New York, 15c. each.)

These three pamphlets are intended to assist engineers in dealing with the special problems of road building and maintenance that arise in wartime.

### Great Britain, Dept. of Scientific and Industrial Research, Road Research Laboratory, Wartime Road Note No. 4, SALT TREATMENT FOR ICY ROADS

His Majesty's Stationery Office, London, British Library of Information, 30 Rockefeller Plaza, New York, 1941. 6 pp., tables, 9½ x 6 in., paper, 15c.

Recommendations for the treatment of icy roads with salt-sand mixtures under varying conditions are presented. The purpose of this Road Note series is to assist engineers in dealing with special problems under wartime conditions.

### HANDBOOK OF CHEMISTRY AND PHYSICS, a Ready-Reference Book of Chemical and Physical Data. 25th ed.

Edited by C. D. Hodgman and H. N. Holmes. Chemical Rubber Publishing Co., Cleveland, Ohio, 1941. 2,503 pp., diags., charts, tables, 7½ x 5 in., fabrikoid, \$3.50.

The popularity of this well-known reference work is indicated by the appearance of twenty-five editions in twenty-eight years. The present issue retains the original purpose, to provide accurate data constantly wanted by physicists and chemists in convenient form for quick reference. The present edition has been revised throughout and new matter added where called for.

### (The) HIGHWAY SPIRAL

By G. I. Gibbs. T. D. Toler, Roanoke, Va., 1941. 229 pp., diags., charts, tables, 8 x 4½ in., cloth, \$2.50.

The object of this book is to explain and enlarge upon various formulas, particularly with regard to their practical application to highway alignment. Each of thirteen combinations of tangents, spirals and circular curves is presented separately in chapter form with examples applying formulas to numerical problems. A large section of useful tables is appended.

### HYDRAULICS

By H. W. King, C. O. Wisler and J. G. Woodburn. 4 ed. John Wiley & Sons, New York; Chapman & Hall, London, 1941. 303 pp., diags., charts, tables, 9 x 6 in., cloth, \$2.75.

The fundamental principles of hydraulics are presented, including applications in engineering practice, to provide a text for beginning courses and also to serve as a reference book. The material has been revised in accordance with recent trends of research and practice, expanded treatment being given to the subjects of viscosity, manometers, the energy theorem, laminar flow, compound pipes and non-uniform flow in open channels.

### (The) HYDRAULICS OF STEADY FLOW IN OPEN CHANNELS

By S. M. Woodward and C. J. Posey. John Wiley & Sons, New York; Chapman & Hall, London, 1941. 151 pp., diags., charts, tables, 9½ x 6 ins., cloth, \$2.75.

The theory of the steady flow of water in open channels is presented in concise form, suitable for use in senior and graduate courses and for home study. Backwater curves and flow-profile analysis under varying conditions receive particular treatment. Certain related topics, such as the moving hydraulic jump and slowly varied flow, are also considered.

### (The) INDUSTRIAL CHEMISTRY OF THE FATS AND WAXES.

By T. P. Hilditch. 2 ed. rev. and enl., D. Van Nostrand Co., New York, 1941. 532 pp., diags., tables, 9 x 5½ in., cloth, \$7.50

The aim of this excellent treatise is to supply a concise, connected, logical account of the industries based upon natural fats and waxes. The chemical nature and composition of the fats are considered in the first two sections followed by a description of their transformation for industrial use. Succeeding sections are devoted to edible fats, soap, candles and illuminants, glycerine production, the use of fats and waxes in paints and varnishes, the application of fats to fibers, and fatty lubricants. Each section has a bibliography.

### INORGANIC CHEMICAL TECHNOLOGY (Chemical Engineering Series)

By W. L. Badger and E. M. Baker, 2 ed. McGraw-Hill Book Co., New York, 1941. 237 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$2.50.

This textbook is intended to describe current American practise in the heavy chemical

industries from the viewpoint of the engineer. The various processes are presented in the light of present-day understanding of unit operations. Products dealt with include common salt, various important acids, caustic soda, chlorine, sodium carbonate and other miscellaneous salts.

#### IRON HORSES, American Locomotives 1829-1900

By E. P. Alexander. W. W. Norton & Co., New York, 1941. 239 pp., illus., diags., woodcuts, 11½ x 8½ in., cloth, \$5.00.

This book is a pictorial story of the development of the American locomotive from the first engine to run on rails, in 1829, down to the turn of the century. Following a brief historical résumé of the early years comes a chronological series of prints and lithographs, with case histories, depicting typical locomotives of the years covered by the book. An alphabetical directory of locomotive builders of the United States, past and present, is appended.

#### MANUAL OF ELEMENTARY MACHINE SHOP PRACTICE

By E. C. Phillips. Burgess Publishing Co., 426 South Sixth St., Minneapolis, Minn., 1941. 199 pp., illus., diags., tables, 11 x 8½ in., paper, looseleaf spiral binder, \$2.50.

The content of this manual has been written for the use of those making their first acquaintance with the machines, tools and processes commonly employed in machine-shop work. The material consists of operation sheets which give step-by-step procedures for shop operations, and information sheets which simply describe tools and processes, and the necessary computations.

#### METAL—INSIDE OUT

By A. W. Grosvenor, F. Seitz, W. J. Diederichs, L. E. Ekholm, F. B. Foley and A. H. Staud. American Society for Metals, 7301 Euclid Ave., Cleveland, Ohio, 1941. 115 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$2.00.

This collection of six lectures presents a description of the fundamentals of metallic structures. The lectures discuss respectively the atom and pure metal structures, substitutional and interstitial alloys with the general rules governing alloying, hardness, microscopic appearance, strength and impurities. The dominant idea of the whole is the development of the crystal and the effect of various influences on its characteristics.

#### MODERN MARINE ENGINEER'S MANUAL, Vol. 1

Edited by A. Osbourne and others. Cornell Maritime Press, 350 West 23rd St., New York, 1941. 1,696 pp., illus., diags., charts, tables, 7½ x 5 in., cloth, \$6.00.

This manual has been written to provide a comprehensive American textbook that will adequately explain the design and operation of all the general types of marine equipment. This first of two volumes covers such fundamentals as mathematics, engineering materials, thermodynamics and combustion, and such equipment as boilers, reciprocating engines and steam turbines, together with certain auxiliaries. Each chapter is the product of a specialist, and simplicity is the keynote.

#### MODERN GUN PRODUCTION

Compiled by and reprinted from "Steel," Penton Publishing Co., Cleveland, Ohio, 1941. 51 pp., illus., diags., 11½ x 9 in., paper, \$1.00.

This pamphlet brings together in convenient form a number of articles which have previously appeared in *Steel*. The principles of gun construction and manufacturing operations as carried out at the Watervliet Arsenal and by the Struthers-Wells-Titusville Corporation are described. There are also articles on the design and production of gun carriages, recoil mechanism, range finders and fire-control instruments.

#### MODERN MARINE PIPEFITTING

By E. M. Hansen. Cornell Maritime Press, New York, 1941. 434 pp., illus., diags., charts, tables, 7½ x 5 in., cloth, \$3.00.

The essentials of marine pipefitting, with particular regard for special conditions, are presented in this textbook for students and apprentices. Emphasis has been laid on what the pipefitter will have to know in each phase of his work, as he follows a job from blueprint to completed installation on board ship. Glossaries of shipbuilding and pipefitting terms are included, and there are many working drawings and photographs.

#### MODERN SHELL PRODUCTION

Compiled by and reprinted from "Steel," Penton Publishing Co., Cleveland, Ohio, 1941. 159 pp., illus., diags., charts, tables, 11½ x 9 in., paper, \$1.50.

The material contained in the first and second handbooks on ordnance production prepared by *Steel* appears again in the present publication, together with new material on the manufacture of cartridge cases, ammunition for small arms, and bombs and fuses. Much practical, up-to-date information is presented, with excellent illustrations and drawings.

#### (The) NATURE OF THERMODYNAMICS

By P. W. Bridgman. Harvard University Press, Cambridge, Mass.; Humphrey Milford, London, 1941. 229 pp., diags., 8½ x 5½ in., cloth, \$3.50.

This analysis of thermodynamics is "operational", in that it examines what physicists actually do when they apply the principles of thermodynamics to concrete situations. It centers about a discussion of the two laws of thermodynamics and the corresponding fundamental concepts. Entirely non-mathematical, the book demands an acquaintance with thermodynamics comparable to that of a college student of physics, chemistry or engineering.

#### NOTES AND PROBLEMS IN BLUE PRINT READING OF MACHINE DRAWINGS

By D. E. Hobart. Harper & Brothers, New York and London, 1941. 105 pp., diags., 11 x 8½ in., paper, \$1.00.

The material presented in this book is the outgrowth of the author's experience in teaching the reading of machine drawings to men taking courses in machine-shop practice. The basic principles for reading both detail and assembly drawings are explained, and a large group of sample problem sheets is appended.

#### OIL WELL DRAINAGE

By S. C. Herold. Stanford University Press, Stanford University, California, 1941. 407 pp., illus., diags., charts, maps, tables, 10½ x 7 in., cloth, \$5.00.

Events and conditions within a producing reservoir are described, and the influence of well performance on the movement of the oil and gas is presented in simple terms. Analogies between artificial and natural reservoirs are considered, the nature of reservoir energy is discussed, and the function of gas in the production of oil is set forth. The chapters are divided into two parts, for two types of wells with distinct features in drainage. Many citations of field examples are included.

#### PETROLEUM REFINERY ENGINEERING

By W. L. Nelson, 2 ed. McGraw-Hill Book Co., New York and London, 1941. 715 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$6.00.

The fundamentals of engineering design and processing in the field of refining are presented in this comprehensive text. The composition and properties of petroleum oils, the principles which govern their treatment and the equipment used for the various processes are dealt with at length. The revised edition contains new chapters on rebuilding hydrocarbons,

auxiliaries to processing, and solvent treating or extraction processes. New references have been added to many of the chapters.

#### PLANT PRODUCTION CONTROL

By C. A. Koepke. John Wiley & Sons, New York; Chapman & Hall, London, 1941. 509 pp., illus., diags., charts, tables, 9 x 6 in., cloth, \$4.00.

The maximum production of goods with minimum confusion and expense is the concept dealt with in this book. To this end production control is broken down into its several functions. Each function is treated separately, yet coordinated with the others to show how control of production is obtained for various situations. Review questions and a short bibliography accompany each chapter.

#### POSSIBLE FUTURE OIL PROVINCES OF THE UNITED STATES AND CANADA

Edited by A. I. Levorsen. American Association of Petroleum Geologists, Tulsa, Okla., 1941. 154 pp., diags., maps, charts, 9½ x 6 in., cloth, \$1.50 (to members \$1.00).

The purpose of this symposium is to provide an over-all picture of the undiscovered oil resources of North America, north of the Rio Grande. The separate chapters, prepared by various geological organizations, deal only with outlying areas in which as yet no discoveries of consequence have been made. A map and a section of geology, stratigraphy and structure illustrate each province description.

#### (The) PRACTICAL APPLICATION OF ALUMINIUM BRONZE

By C. H. Meigh. McGraw-Hill Publishing Co., New York and London, 1941. 112 pp., illus., diags., charts, tables, 10 x 7½ in., cloth, \$4.00.

The object of this book is to make available to engineers the results of the experience of a metallurgical engineer who has developed a practical technique in the economic production of aluminium bronzes. Micro-structure, properties and uses are discussed; foundry, hot-working and workshop practices are described; and various faults and failures are explained. Much useful material is appended in tabular form.

#### PRACTICAL MARINE DIESEL ENGINEERING

By L. R. Ford, 3 ed. Simmons-Boardman Publishing Corporation, New York, 1941. 590 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$5.00.

Construction, operation and maintenance of marine Diesel engines are explained from the viewpoint of the operating engineer. Latest developments in new types of equipment associated with motorship propulsion, such as couplings, superchargers, etc., are discussed, and there are chapters on methods and requirements for obtaining a motorship license. This third edition is limited to American engines.

#### PRACTICAL PRINCIPLES OF NAVAL ARCHITECTURE

By S. S. Rabl. Cornell Maritime Press, 350 West 23rd St., New York, 1941. 181 pp., diags., charts, tables, 7½ x 5 in., cloth, \$2.00.

This simple introductory volume for the student and practical worker explains first the essential mathematics. It then describes the various steps leading to the construction of the ship: lines, buoyancy, displacement, stability and trim calculations, etc. Launching is discussed, and the later chapters deal with the strength of materials and of floating structures. Ease of comprehension has been emphasized.

## (The) PRINCIPLES OF PHYSICAL METALLURGY

By G. E. Doan and E. M. Mahla. 2 ed. McGraw-Hill Book Co., New York and London, 1941. 388 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$3.50.

This textbook aims to supply a unified account of present-day knowledge of metals and alloys, with special reference to their behavior when operated upon in manufacturing. The physics of metals, metallography and metal technology are successively discussed, attention being focussed upon the principles of the behavior of metals as a whole, not of individual metals or alloys.

## RADIO AMATEUR'S HANDBOOK, 19th ed., 1942

Published by the American Radio Relay League, West Hartford, Conn. 552 pp., illus., diags., charts, tables, 9½ x 6½ in., paper, \$1.00 in U.S.A.; \$1.50 in foreign countries; \$2.50 bound.

The latest revision of this widely used handbook has incorporated a new arrangement of the material. The first section has become a non-mathematical presentation of the theory of radio, in which the principles and general matters of design are presented. The second section deals with the practical construction and operation of receivers and transmitters. The work retains the high standard of previous issues.

## RUNNING A MILLING MACHINE

By F. H. Colvin. McGraw-Hill Book Co., New York and London, 1941. 157 pp., illus., diags., charts, tables, 8 x 5 in., cloth, \$1.50.

This simple, well-illustrated introductory book gives a working knowledge of milling machines and shows how they are used. It covers the different kinds of machines, their parts, the kind of work each does, how to operate each kind, proper speeds and feeds, etc., Its practical value is increased if used in connection with actual shop work.

## SURFACE TREATMENT OF METALS

Symposium held during the 22nd Annual Convention of the American Society for Metals, Cleveland, Ohio, October 21 to 25, 1940. American Society for Metals, 7301 Euclid Ave., Cleveland, Ohio, 1941. 427 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$5.00.

Fifteen papers by authorities are presented in this symposium on the treatment of metal surfaces. The wide range is indicated by the following sample topics: anodic treatment of aluminum; corrosion resistance of tin plate; diffusion coatings on metals; induction heat-treating; shot blasting; effect of surface conditions on fatigue properties, etc. Discussion of the papers is included.

## SURVEYING

By C. B. Breed. John Wiley & Sons, New York; Chapman & Hall, London, 1942. 495 pp., illus., diags., charts, tables, 7½ x 5 in., cloth, \$3.00.

This book has been prepared to meet the demand for short texts, owing to the current tendency to abridge college courses in surveying. It covers the usual field and office practices in land surveys, leveling, and topographic surveys, discusses aerial surveying briefly, and gives the latest practice in public lands surveys. Attention is also paid to the surveying problems that arise in engineering construction.

## TEXT-BOOK OF ADVANCED MACHINE WORK

By R. H. Smith. 12th ed. rev. and enl. Industrial Education Book Co., Boston, 1940. Page in sections, diags., tables, 8 x 5 in., cloth, \$3.25.

A companion volume to the author's "Principles of Machine Work", this book covers a wide range of machine shop operations. In addition to full descriptions of the tools and processes, schedules of the various operations are given, which provide a complete plan in tabular form of many typical problems in machine construction. These schedules, together with the large number of illustrations, increase the practicality of the book for the inexperienced worker.

## TEXTBOOK OF THE MATERIALS OF ENGINEERING

By H. F. Moore, with a chapter on Concrete by H. F. Gonnerman and a chapter on The Crystalline Structure of Metals by J. O. Draffin. 6 ed. McGraw-Hill Book Co., New York and London, 1941. 454 pp., illus., diags., charts, tables, maps, 9½ x 6 in., cloth, \$4.00.

The physical properties of the common materials used in structures and machines, together with descriptions of their manufacture and fabrication, are presented concisely in suitable form for use as a college textbook. The new edition has an added chapter on plastics, and extensive changes and additions have been made throughout the book.

## THEORETICAL AND PRACTICAL ELECTRICAL ENGINEERING, 2 Vols.

By L. D. Bliss. 5th ed. Bliss Electrical School, Washington, D.C., 1941. Vol. 1, 631 pp., Vol. 2, 671 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$8.00 for both Vols.

These two volumes contain a course of lectures given at The Bliss Electrical School upon the principles and applications of both direct and alternating current apparatus. The early chapters discuss fundamental electrical theories, laws and types of instruments. Generators, motors and transformers are treated in detail, and consideration is given in later chapters to telegraphy, telephony, electronic devices, illumination, electric railways and other applications of electricity.

## THERMODYNAMICS

By J. H. Keenan. John Wiley & Sons, New York, 1941. 499 pp., diags., charts, tables, 9 x 6 in., cloth, \$4.50.

The object of this book is to give a simple and rigorous exposition of the first and second laws of thermodynamics. Work, temperature and heat are explicitly defined. The concept of reversibility, entropy, the availability principle, the relations between pressure, volume and temperature, and states of equilibrium are some of the important subjects discussed. Consideration is also given to engines, cycles, refrigeration, air conditioning and other thermodynamic applications.

## TRAFFIC ENGINEERING HANDBOOK

Edited by H. F. Hammond and L. J. Sorenson; published and distributed by the Institute of Traffic Engineers and the National Conservation Bureau, 60 John St., New York, 1941. 296 pp., illus., diags., charts, tables, 9 x 6 in., cloth, \$3.25.

This authoritative guidebook for engineers engaged in the field of street and highway traffic is the product of fourteen specialists in various phases of the work. Concerned mainly with fundamentals and those portions of the field in which well-accepted principles have

been established, its chief purpose is to serve as a day-to-day reference work for those who deal with technical problems of traffic and transportation.

## WATER PURIFICATION FOR PLANT OPERATORS

By G. D. Norcom and K. W. Brown. McGraw-Hill Book Co., New York and London, 1942. 180 pp., illus., diags., charts, tables, 9 x 6 in., cloth, \$2.50.

This is a comprehensive instruction book for filter-plant operators, in which theory and practice are discussed in an elementary way for those without technical education. The structures and equipment used in water purification are described, and operating methods given in full.

## (The) WELDING ENCYCLOPEDIA and the Welding Industry Buyers' Manual

Compiled and edited by L. B. Mackenzie and H. S. Card; re-edited by S. Plumley. 10th ed. Welding Engineer Publishing Co., Chicago, Ill. 712 pp., illus., diags., charts, tables, 9 x 6 in., fabrikoid, \$5.00.

The subject matter of this comprehensive volume is arranged alphabetically, and all relevant illustrations and technical data are to be found directly associated with the definitions and explanations. Some of the principal topics covered are the main types of welding, the most important fields of use, metals and alloys, metal spraying, testing methods and operator training. Company names are included with a listing of the trade names of their products.

## WIRE AND WIRE GAUGES with Special Section on Wire Ropes

By F. J. Camm. Chemical Publishing Co., Brooklyn, N.Y., 1941. 138 pp., diags., tables, 7 x 4 in., cloth, \$2.50.

Each of the standard wire systems of Europe and America is set forth separately in this manual for greater ease in reference. There is also information on wire drawing and on the construction, use and maintenance of wire rope.

## WOOD TECHNOLOGY, Constitution, Properties and Uses

By H. D. Tiemann. Pitman Publishing Corp., New York and Chicago, 1942. 316 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$3.50.

According to the author, this is the first book in English to give a comprehensive account of our knowledge of wood, its properties and uses. Written by an authority, in a simple and readable style, the book discusses briefly all phases of wood technology and provides references to more detailed discussions of specific subjects. A large number of photographs and microphotographs are included. The book will be of great value to all users of wood.

## GEOLOGY OF THE WESTERN SIERRA NEVADA BETWEEN THE KINGS AND SAN JOAQUIN RIVERS, CALIFORNIA. University of California, Dept. of Geological Sciences, Vol. 26, No. 2, pp. 215-286, plates 42-46.

By G. A. Macdonald. University of California Press, Berkeley and Los Angeles, 1941. Illus., maps, charts, tables, 10½ x 7 in., paper, \$1.00.

The results of an extensive geological survey of the territory outlined are presented in this publication. Following a detailed description of the characteristic rocks and their distribution, come brief treatments of the economic geology, geologic structure and geologic history of the region.

# PRELIMINARY NOTICE

## of Applications for Admission and for Transfer

FOR ADMISSION

February 27th, 1942.

The By-laws provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.—

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

**Communications relating to applicants are considered by the Council as strictly confidential.**

The Council will consider the applications herein described at the April meeting.

L. AUSTIN WRIGHT, General Secretary.

\*The professional requirements are as follows:—

A **Member** shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science or engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A **Junior** shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A **Student** shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An **Affiliate** shall be one who is not an engineer by profession but whose pursuits, scientific attainment or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

**BOURGEOIS**—JOSEPH ALFRED ANDRE, of Montreal, Que. Born at Joliette, Que., June 19th, 1911; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1938; R.P.E. of Que.; Summer work—1935, asst. dftsmn., assayer, geologist, Sullivan Gold Mines, 1937, asst. gold ores assayer, Beaucourt Gold Mines, 1938, plant inspector, and 1939, refinery inspector, Quebec Dept. of Roads; Feb. 1940 to date, asst. hydrometric engr., field and office work, Dominion Water & Power Bureau, Montreal.

References: O. O. Lefebvre, T. J. Lafreniere, A. Duperron, J. A. Lalonde, A. Frigon.

**DYER**—WILLIAM ELMER SEIBERT, of Abington, Penna. Born at Philadelphia, Dec. 5th, 1880; Educ.: Private tuition—research in America and Europe; Member, A.S.M.E.; 1908 to date, private practice as consltg. engr. and architect—design, constrn., installn., power plants, factories, equipments, etc.; designed and supervised constrn. of many plants for various lines of mfr. for clients in U.S., Canada and Europe; at present, consltg. engr. to the Algoma Steel Corporation, Sault Ste. Marie, Ont.

References: L. R. Brown, C. Stenbol, J. L. Lang, W. D. Adams, A. E. Pickering.

**GOLDENSTEIN**—ABRAHAM, of 5380 Park Ave., Montreal, Que. Born at Montreal, March 14th, 1915; Educ.: 1930-33, Montreal Technical School (day classes); 1936-39, foreman i/c machine repairs, rebldg., and dftsmn., Ma-Jam Machine Co., Montreal; 1939-41, gen. bench and tool work, Fairchild Aircraft, Longueuil; at present, dftsmn., Defence Industries Limited, Verdun, Que. (Applying for admission as affiliate.)

References: H. A. Goldman, A. C. Rayment, F. H. Barnes, H. B. Hanna, H. C. Karn.

**HUNT**—EDWIN HAROLD, of 3415-6th St. W., Calgary, Alta. Born at Fredonia, Kansas, April 9th, 1897; 1917, Nebraska Univ.; 1920, special student in geology, Kansas Univ.; R.P.E. of Alberta; 1915-25, asst. geologist and plane table operator with various companies; 1926-27, petroleum geologist, California Petroleum Corporation, Los Angeles (this company absorbed in 1928 by the Texas Company); 1928-35, district petroleum geologist, with The Texas Company, Denver, Colo., and The Texas Company of Canada Limited, Calgary, Alta.; 1936-39, division geologist, The Texas Company, Denver, Colo., Rocky Mountain Divn.; 1939 to date, loaned by The Texas Company to McColl Frontenac Oil Co. Ltd., Calgary, as chief geologist in charge of exploration dept.

References: C. P. Tomlinson, S. G. Coultis, F. K. Beach, W. C. Howells, F. M. Steel.

**MILES**—CHARLES WILLIAM EDMUND, of 4 Armview Apts., Halifax, N.S. Born at Calgary, Alta., Feb. 10th, 1911; Educ.: Grad., R.M.C., 1933; 1927-28-29-32 (summers), rodman, etc., on road constrn.; 1933 (4 mos.), and 1937 (6 mos.), cost-keeper, Standard Paving Maritimes Ltd.; 1933-34, dftsmn. and costkeeper, Imperial Oil Limited; 1930-31 (summers) and 1934-37, trained and served on General List of R.C.A.F.; 1937-39, field constrn., mtee. engr., Imperial Oil Limited; at present, Squadron-Leader, R.C.A.F., Asst. to Chief Works Officer, Eastern Air Command, Halifax, N.S.

References: R. L. Dunsmore, C. Scrymgeour, E. L. Miles, H. W. L. Doane, C. L. Ingles.

**McDIARMID**, FREDERICK JOHN, of 162 Upton Road, Sault Ste. Marie, Ont. Born at Carleton Place, Ont., May 19th, 1909; Educ.: B.Sc., Queen's Univ., 1933; 1931-33 and part 1934, T. C. Gorman Constrn. Co., Montreal; 1933-34, Dept. National Defence, M.D. No. 3; 1935-37, Ford Motor Co. of Canada, Toronto and Windsor, Ont., plant engr.; 1937-40, asst. chief engr., and manager, H. E. McKeen & Co., Montreal; 1940-41, sales and plant engr., Algoma Steel Corp., Montreal and Sault Ste. Marie; at present, field engr., and asst. to W. E. S. Dyer, consltg. engr., Sault Ste. Marie, on design and constrn. for Algoma Steel Corp.

References: W. D. Adams, L. R. Brown, J. L. Lang, C. Stenbol, A. H. Russell.

**McINTYRE**—VERNARD HOWARD, of 4 St. Thomas Street, Toronto, Ont. Born at Toronto, Jan. 21st, 1900; Educ.: B.A.Sc., Univ. of Toronto, 1923; R.P.E. of Ont.; 1921 (4 mos.), field surveying, Dept. of National Development; summer vacations in various depts., McGregor McIntyre Ltd., incl. dftng., estimating, design, shop and erection depts., 1923-28, engr. dept. of same company; 1928 (6 mos.), struct'l. design section, H.E.P.C. of Ontario; 1928-32, i/c sales and design, London Structural Steel Co. Ltd., London, Ont.; 1932 to date, President, V. H. McIntyre Limited, (mfrs. and distributes Teco Timber Connectors, designs, fabricates and erects timber structures).

References: C. R. Young, C. F. Morrison, E. P. Muntz, H. E. Wingfield, H. A. McKay, K. R. Rybka, A. R. Robertson.

**McLELLAN**—JOHN, of 173 St. Germain Ave., Toronto, Ont. Born at Glasgow, May 30th, 1895; Educ.: Montreal Technical School. Corres. Course, struct'l. engr.; 1922-24, Canadian Northwest Steel Co. Ltd., Vancouver, B.C.; 1932-33, plant layout dftsmn., Shell Oil Co. of Canada, Montreal East; 1936-39, detailer, checker, estimator and designer, London Structural Steel Co. Ltd., London, Ont.; 1940 (on loan), struct'l. design, Kerr-Addison Gold Mines Ltd., Larder Lake, Ont.; with the Dominion Bridge Co. Ltd., as follows—1914-15 and 1919-21, struct'l. detailer, 1922-24 struct'l. detailer and checker, Lachine; 1924-25, i/c drawing office, Ottawa; 1925-29, struct'l. checker, 1929-32, estimator and designer, 1936, struct'l. detailer, Lachine; 1939 to date, struct'l. checker, Toronto.

References: D. C. Tennant, G. P. Wilbur, D. E. Perriton, F. J. McHugh, A. Peden, H. A. McKay, D. S. Scrymgeour.

**ROBERTS**—JOHN DAVID, of 817 Desmarchais Blvd., Verdun, Que. Born at Montreal, May 22nd, 1896; Educ.: Montreal Commercial and Technical Schools (evenings), I.C.S.; 1919-23, template shop, and 1923-24, drawing office, Phoenix Bridge & Iron Works, Montreal; 1924-33, dftsmn., shop insp., checker, estimating and design in sales office, Canadian Vickers Ltd.; 1934-41, engr. dept., and at present, sales engr., Farand & Delorme Ltd. Divn., United Steel Corporation, Ltd., Montreal, Que. (Applying for admission as Affiliate).

References: G. V. Roney, M. S. Nelson, D. F. Grahame, F. A. Combe, E. V. Gage.

**TAYLOR**—GEORGE LEOPOLD, of 5311 Park Ave., Montreal, Que. Born at Parry Sound, Ont., June 4th, 1910; 1928 (3 mos.), Geol. Surveys of Canada; 1929-34, topog'l.—township sub-divisions, city engr., chainman, instrument and dftng.; J. T. Coltham, O.L.S., Parry Sound, Ont.; 1934-39, res. engr., highway location and constrn., Dept. of Highways of Ontario, Parry Sound Divn.; 1939-41, res. engr. i/c of airport constrn., Dept. of Transport.

References: F. C. Jewett, W. J. Bishop, F. J. Leduc, J. V. Ludgate, T. F. Francis.

**TUBBY**—ALLAN, of 921 Bronson Ave., Ottawa, Ont. Born at Saskatoon, Sask., March 27th, 1910; Educ.: B.Eng. (Civil), Univ. of Sask., 1932; R.P.E. of Ont.; 1926-34 (summers), with H. J. Tubby, gen. contractors, Sask.; 1935, chief of party, water resources survey, Sask.; 1936-38, sales engr., Toronto office, and June 1938 to date, manager, Ottawa branch and plant, Currie Products Limited.

References: W. L. Saunders, E. K. Phillips, C. F. Morrison, R. A. Spencer, R. Boismenu.

**WHITE**—GERALD LANGDALE, of Toronto, Ont. Born at Heathcote, Ont., Feb. 8th, 1911; Educ.: B.A.Sc., Univ. of Toronto, 1933; R.P.E. of Ont.; since 1933, editor, and at present, editor and asst. business manager, Westman Publications Limited, Toronto, Ont.

References: L. E. Westman, O. W. Ellis, C. R. Whittemore, J. J. Spence, W. S. Wilson.

(Continued on page 205)

# Employment Service Bureau

## SITUATIONS VACANT

**MECHANICAL DESIGNING DRAUGHTSMAN**, Graduate preferred, urgently needed for work in Arvida for specification drawings for plate work, elevators, conveyors, etc., equipment layouts, pipe layouts and details. Apply to Box No. 2375-V.

**MECHANICAL GRADUATE ENGINEER** with machine shop experience required for work in Mackenzie, British Guiana, on essential war work. Apply to Box No. 2441-V.

**MECHANICAL ENGINEER** preferred with experience on diesels and tractors, for work in Mackenzie, B.G. Apply to Box No. 2482-V.

**MECHANICAL DRAUGHTSMEN** and engineers for pulp and paper mill work. Experienced men preferred. Good salary to qualified candidates. Apply to Box No. 2483-V.

**ELECTRICAL ENGINEER**, young French Canadian graduate engineer to be trained on work involving hydro-electric plant operation, transmission lines and construction, meter testing and inspection. Good opportunity to acquire first-hand electrical power experience. Apply to Box No. 2487-V.

**GRADUATE DRAUGHTSMAN**, for industrial plant design and detailing. Apply to Box 2497-V.

**MECHANICAL DRAUGHTSMAN**, for piping and general equipment layout work. Apply to Box 2498-V.

**MECHANICAL ENGINEER**, for general maintenance work at Arvida, Que. Apply to Box 2500-V.

**CHEMICAL CONSULTING ENGINEER** experienced in manufacturing methods to advise on efficient

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to **THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.**

management of small plant near Montreal, manufacturing synthetic iron oxide for production of colours. Apply to Box 2503-V.

**MECHANICAL ENGINEER** with experience in pulp and paper industry for supervision and maintenance work in large paper mill. Must be experienced in machine shop work and the handling of men. Apply Box No. 2522-V.

## ENGINEER OFFICERS WANTED

Applications are invited for Commissions in the Royal Canadian Ordnance Corps for service both overseas and in Canada as Ordnance Mechanical Engineers. Since it is probable that several new units will be organized in the near future, a number of senior appointments may be open, and applications from engineers with a good background of military experience would be welcomed in this connection. Applications should be submitted on the regular Royal Canadian Ordnance Corps application forms, which can be obtained from the District Ordnance Officers of the respective Military Districts.

## SITUATIONS WANTED

**CIVIL AND STRUCTURAL ENGINEER, M.E.I.C., R.P.E. (Ont.)**, Age 49. Married. Home in Toronto. Experience in Britain, Africa, Canada, Turkey. Chief engineer reinforced concrete design offices, steelworks construction. Resident engineer design and construction munitions plants, and general civil engineering work. Extensive surveys, draughting, harbour and municipal work. Location immaterial. Available now. Apply Box No. 2425-W.

**ELECTRICAL, MECHANICAL ENGINEER**, age 35. Dip. and Assoc. R.T.C., Glasgow, A.M.I.E.E., (Students Premium) G.I. mech. E., M.E.I.C., Assoc. Am.I.E.E. Married. Available after December 22nd. Seventeen years experience covering machine shop apprenticeship, A.C. and D.C. motors, transformers, steel and glass bulb arc rectifiers, design, testing and erection sectional electric news and fineprints paper machine drives, experience tap changers H.V., L.V. and marine switchgear. Apply to Box No. 2426-W.

**MECHANICAL ENGINEER** age 55 years. Married. Available at once. Thirty years experience in draughting and general machine shop and foundry work. Fifteen years as works manager. Considerable experience in pump work, including estimating and inspection. Apply to Box 2427-W.

**ELECTRICAL ENGINEERING** student in third year, age 27, desires summer position starting in April, with view to permanency on graduation. Two summers on design of shop equipment and electrical apparatus. Three years experience on test and experimental work for relays and control equipment. Student E.I.C., and Associate member American Institute of Electrical Engineers. Location immaterial. Apply to Box No. 2428-W.

**ENGINEER ADMINISTRATOR**, experienced in public utilities, shipyard construction, airplane construction, crane construction, general mechanical engineering and inspection work, also sales promotion. Open for appointment. Apply to Box 2429-W.

**GRADUATE ENGINEER** in Electrical and Mechanical Engineering, M.E.I.C., and R.P.E., electric utility experience. Age 30. Married. Transmission line, and distribution, estimating, design, survey and construction three years, (one year acting superintendent), interior light and power wiring design, estimating and supervision one year. Electric meters (AC) six months, electric utility drafting six months, foundation layouts and concrete inspection six months. Steam power plant operation two years. Presently employed but desire advancement. Apply to Box No. 2430-W.

## SALES ENGINEERING WORK IN INDUSTRIAL & ELECTRICAL PLANTS

### WANTED

Man for Sales Engineering work in Industrial and Electrical plants. Engineering and University Training desirable but not essential. Man not subject to Military Service preferred. State experience, training, salary expected, etc., in application.

Apply Box No. 2521-V

## ELECTRICAL DRAFTSMAN

Electrical draftsman or engineer, preferably with knowledge of marine practice, required for shipbuilding work, with sufficient experience to requisition material from plans and specifications and generally to act as liaison between drawing office, electrical foreman and purchasing department.

Apply to Box 2523-V

## PRELIMINARY NOTICE

(Continued)

### FOR TRANSFER FROM JUNIOR

**FULLER—HAROLD ALEXANDER**, of Barranca Bermeja, Colombia, S.A. Born at Carievale, Sask., Jan. 28th, 1915; Educ.: B.Sc. (Civil), Univ. of Man., 1938; 1938 (May-Aug.), driller, International Nickel Co.; 1939 (Jan.-Apr.), asst. to surveyor, Land Surveys Br., Prov. of Man.; 1938 (Aug.-Dec.) and 1939 (May-Nov.), highway constr. engr., Dufferin Paving and Crushed Stone, Toronto, Ont.; Feb. 1940 to date, with the Tropical Oil Company, 1½ years, surveyor, geol. dept., and at present, utility engr., gas plant dept. (Jr. 1939).

References: G. H. Herriot, A. E. Macdonald, N. M. Hall, E. Gauer, E. P. Fetherstonhaugh, J. H. Addison, W. H. Paterson.

**LEROUX—JACQUES**, of 3686 St. Hubert St., Montreal, Que. Born at Montreal, July 2nd, 1914; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1939; R.P.E. Que.; 1931-38 (summers), surveys, Quebec Streams Commn., dftsman, junior engr., Public Works of Canada, asst. to city engr., Shawinigan Falls; 1939-30, asst. engr., Dept. of Public Works of Canada, Montreal; 1940, Beauharnois Power Corporation, prelim. work, Cedar Rapids project; 1940 to date, res. engr., air service branch, Dept. of Transport, Mont Joli, Que. (St. 1937, Jr. 1941).

References: A. Circe, J. A. Lalonde, R. Boucher, P. P. Lecoite, F. J. Leduc.

**RYDER—FREDERICK JAMES**, of Toronto, Ont. Born at Holyoke, Mass., June 28th, 1907; Educ.: B.Sc. (Civil), McGill Univ., 1929; 1926-27 (summers), rodman, C.N.R.; 1928, instr'man, for stadia control; 1929-32, struct'l dftsman, 1936-38, misc. iron dftsman, and 1938 to date, sales engr. i/c Toronto office, Canadian Bridge Co. Ltd., Toronto, Ont. (St. 1928, Jr. 1935).

References: P. E. Adams, G. G. Henderson, A. H. MacQuarrie, R. C. Leslie, C. M. Goodrich, E. V. Moore, C. Gerow.

### FOR TRANSFER FROM STUDENT

**CUTHBERTSON—WELLINGTON B.**, of East Saint John, N.B. Born at Saint John, Oct. 22nd, 1913; Educ.: B.Sc. (Elec.), Univ. of N.B., 1935; 1936, dock reconstr., Saint John; 1937-40, highway constr., Prov. of N.B.; 1940 to date, instr'man., Dept. of Transport, Moncton, N.B. (St. 1936).

References: F. A. Patrique, W. C. MacDonald, J. T. Turnbull, A. F. Baird, D. R. Webb, R. J. Griesbach.

**FRASER—FREDERICK WALTER**, of 36 Herrick Street, Sault Ste. Marie, Ont. Born at Calgary, Alta., Aug. 27th, 1915; Educ.: B.Sc. (C.E.), Univ. of Sask., 1941; 1936-39 (summers), rodman, C.P.R., and instr'man., Topographical Surveys of Canada; 1940 (summer), instr'man., McColl Frontenac Oil Co. Ltd.; 1940-41, instructor, summer survey camp, Univ. of Sask.; at present, engr., Sault Structural Steel Co. Ltd., Sault Ste. Marie, Ont. (St. 1941).

References: R. A. Spencer, I. M. Fraser, N. B. Hutcheson, L. R. Brown, C. Neufeld.

**HOBBS—GEORGE PUGH**, of Nobel, Ont. Born at Heart's Content, Nfld., June 22nd, 1917; Educ.: B.Eng. (Elec.), McGill Univ., 1940; 1937-38-39 (summers), submarine cable testing, instr'man., Nfld. Govt. Geol. Surveys; 1940 (June-Oct.), engr., Fraser Brace Engr. Co.; Oct. 1940 to date, elec. engr., Defence Industries Limited, Nobel, Ont. (St. 1940).

References: C. H. S. Venart, W. Shuttleworth, C. V. Christie, J. B. Challies.

**SICOTTE—JEAN**, of 906 Van Horne Ave., Montreal, Que. Born at Montreal, Nov. 28th, 1913; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1940; 1934-40 (summers), road constr., bridge works, airport constr., and at present, asst. mgr., Armand Sicotte & Sons, constructing engrs., Montreal. (St. 1939).

References: J. A. Lalonde, L. A. Duchastel, L. Trudel, E. Gohier, R. Boucher.

**WALLMAN—CLIFFORD GEORGE**, of Cardinal, Ont. Born at Winnipeg, Man., Oct. 7th, 1913; Educ.: B.Sc. (E.E.), Univ. of Man., 1934. B.Eng. (M.E.), McGill Univ., 1938; 1934-37, Prairie Cities Oil Co., Winnipeg, Man.; 1938-41, student training in mech. depts., Corn Products Refining Co., Argo, Illinois; at present, mech. engr., Canada Starch Co. Ltd., Cardinal, Ont. (St. 1934).

References: E. D. McIntosh, J. H. Hunter, N. M. Hall, E. P. Fetherstonhaugh, C. M. McKergow.

**WEBER—PETER ALBERT**, of 226 Westmoreland Ave., Toronto, Ont. Born at Muenster, Sask., Jan. 28th, 1918; Educ.: B.Sc. (Civil), Univ. of Sask., 1940; 1940, rodman on airport constr., Dept. of Transport, Swift Current, Sask.; Jan. 1941 to date, instr'man., land surveys dept., C.N.R., Toronto, Ont. (St. 1940).

References: N. E. Willett, C. J. Mackenzie, R. A. Spencer, E. K. Phillips, I. M. Fraser.

**MILLER—DUDLEY CHIPMAN RAPHAEL**, of 34 Wychwood Park, Toronto, Ont. Born at London, England, July 30th, 1913; Educ.: B.A.Sc., Univ. of Toronto, 1935; 1935-36, asst. engr., Duplate Safety Glass Co., Oshawa, Ont.; 1936-38, plant engr., Duplate (Windsor) Ltd., Windsor, Ont.; 1939-41, chief engr., Fiberglass Canada Ltd., Oshawa, Ont.; 1941 to date, supt. of optical shops, Research Enterprises, Ltd., Toronto, Ont. (St. 1932).

References: E. A. Allcut,

## LECTURES AVAILABLE FOR PRESENTATION

A series of six lectures has been made available by the Canadian General Electric Co. Ltd., for presentation before engineering societies, service clubs and similar groups. These lectures are as follows: Lecture No. 1, "Magic of the Spectrum" by J. W. Bateman; Lecture No. 2, "Electricity in Modern Warfare" by G. E. Bourne; and Lecture No. 3, "Plastics" by A. E. Byrne. Requests for further information may be addressed to the closest C-G-E office or to Mr. V. R. Young, Lecture Bureau, Canadian General Electric Co. Ltd., 212 King St. West, Toronto, Ont.

## CLAY PRODUCTS

National Sewer Pipe Co. Ltd., Toronto, Ont., have issued a catalogue which covers the company's many lines of clay products. Copies of this catalogue are being mailed to all engineers, architects, contractors, building supply dealers and municipal offices.

## HIGH-PRESSURE CONDENSATE RETURN SYSTEM

Cochrane Corporation, Philadelphia, Pa., announce the publication of Bulletin No. 3025, four pages, which covers the new Cochrane-Becker high-pressure condensate return system. A typical installation is described in detail with a four-colour illustration showing steam, condensate and makeup lines. A similar drawing illustrates the operation of the jet-loop principle on which the system operates.

## MEEHANITE HANDBOOK

A complete handbook on "Meehanite" castings, describing their manufacture, metallurgy, and engineering properties which has just been published by Meehanite Research Institute of America, Inc., 311 Ross St., Pittsburgh, Pa., contains 47 pages of facts important to engineers, designers, machinery manufacturers, and every user of castings. Although a nominal price of \$1.00 has been established for the "Meehanite Handbook," copies will be sent free to men of industry who can use the data it contains. In requesting a copy please give your title and write on your business letterhead.

## MOTORS

A 34-page bulletin, MU-183, issued by Wagner Electric Corp., St. Louis, Mo., deals with the company's single-phase, direct-current and small polyphase motors. Contains detailed descriptions of the construction of repulsion-start-induction motors, repulsion-induction motors, capacitor-start motors, split-phase motors, direct-current motors, polyphase motors, fan motors, and explosion-proof motors.

## MULTI-STAGE STEAM TURBINES

The Moore multi-stage steam turbines type "S" are described in bulletin 1955 issued by Moore Steam Turbine Div. of Worthington Pump & Machinery Corp., Harrison, N.J. A drawing showing the longitudinal section of a seven-stage turbine is accompanied by a cut-away drawing and illustrations of all important parts. Dimensional drawings are included for non-condensing and condensing turbines.

## NEW MOTOR FOR TUBE CLEANERS

Elliott Company, Tube Cleaner Dept., Springfield, Ohio, have recently issued bulletin No. Y-9. Under the title "Full-Floating Anti-Friction Power for Refinery Table Cleaning with Elliott (Lagonda Type) Double Ball-Thrust Tube Cleaner Motors (1100 Series)" this bulletin describes the newly announced series 1100, double ball-thrust tube cleaner motors, with which any type of Elliott-Lagonda cutter heads can be used. Several heads are illustrated and a graph shows the increased effective power of the new motor.

## Industrial development — new products — changes in personnel — special events — trade literature



GORDON JANES  
President and General Manager  
Canadian SKF Company Limited

## THE 25TH ANNIVERSARY OF THE CANADIAN SKF COMPANY

### PRESIDENT GORDON JANES RECEIVES CONGRATULATIONS

On the occasion of this 25th anniversary of the Canadian SKF Company in January, its President and General Manager, Mr. Gordon Janes, was the recipient of congratulations from a host of friends throughout Canada.

On January 1st, 1917, the Canadian SKF Company opened a modest office in Toronto under the general management of Mr. Janes, who for several years prior to that time had been the anti-friction bearing specialist for Canadian Fairbanks-Morse Company. The need for speed and greater production, during the first great war, provided the stimulus to mechanical and electrical engineers' interest in the application of anti-friction bearings to their requirements, in place of old babbit type equipment.

Now, of course, owing to their demonstrated reliability and efficiency, the use of anti-friction bearings is almost universal. They are standard equipment in automobiles, all types of industrial machinery, electric motors, pulp and paper machines, locomotives, freight and passenger cars and all other equipment where anti-friction bearings are practical.

The success of the Canadian SKF Company under the direction of Mr. Gordon Janes, who has been President of the Company since 1934, may be gathered from the fact that, from an original sales and office staff of three people in 1917, the organization now totals eighty. Sales and service offices are maintained in principal cities. Sales in Canada today are seventy times greater than they were in 1917. There are two reasons for this phenomenal growth of business; the remarkable efficiency of SKF bearings, and the twenty-five years of consistent educational publicity and engineering sales effort.

Thus, it may be said that the history of the ball and roller bearing industry has paralleled the Dominion-wide activities of the Canadian SKF Company.

Today the symbol SKF has become synonymous with anti-friction bearings not only in Canada but throughout the world. For the

duration of the war, SKF bearings are on a priority basis. Ninety per cent of the available supply is being used in the priority brackets A-1-a to A-10; about 50 per cent coming in the A-1-a to A-1-c classes.

Mr. Gordon Janes and his associates are justly proud of the results achieved during the past twenty-five years; and particularly of the part their organization is playing in Canada's war effort.

## TRAFFIC OVERPASS

A four-page booklet, published by R. G. LeTourneau Inc., Peoria, Ill., describes and illustrates the company's newly developed overpass, designated as Tournapass. The Tournapass is a portable low-cost overpass designed to eliminate traffic congestion at busy intersections. Photographs, actual time studies and car counts taken at a recent demonstration and trial period are featured and transportation, assembly and construction are explained.

## PIPE AND JOINT COMPOUND

LaSalle Products Limited, Montreal, Que., are distributing a leaflet which contains descriptive information and directions for the use of X-Pando, a pipe joint compound consisting of certain oxides and minerals which, when mixed with cold water and allowed to set, expands slightly and hardens. It is used to repair sand holes or cracks in pipes, castings, etc.

## POWER SUPPLIES

Burlee Limited, Toronto, Ont., have issued a four-page bulletin featuring a variety of equipment, portable and stationary, including engine-generator sets, motor-generator sets, converters, etc., with illustrations of various types.

## STAINLESS-CLAD STEEL

Base prices for sheets and plates of Silver-Ply stainless-clad steel for twelve grades of cladding in proportionate thicknesses of cladding from 5 to 50 per cent. are contained in a 16-page price list issued by Jessop Steel Co. Ltd., Toronto, Ont. A section on standard classification of extras for plates includes tables on machining, shearing and flatness tolerances, estimated weights, and size limits for standard production plates and sheets. The last section contains prices for forming standard or A.S.M.E.A.P.I. flanged and dished heads, elliptical dished heads and machining heads.

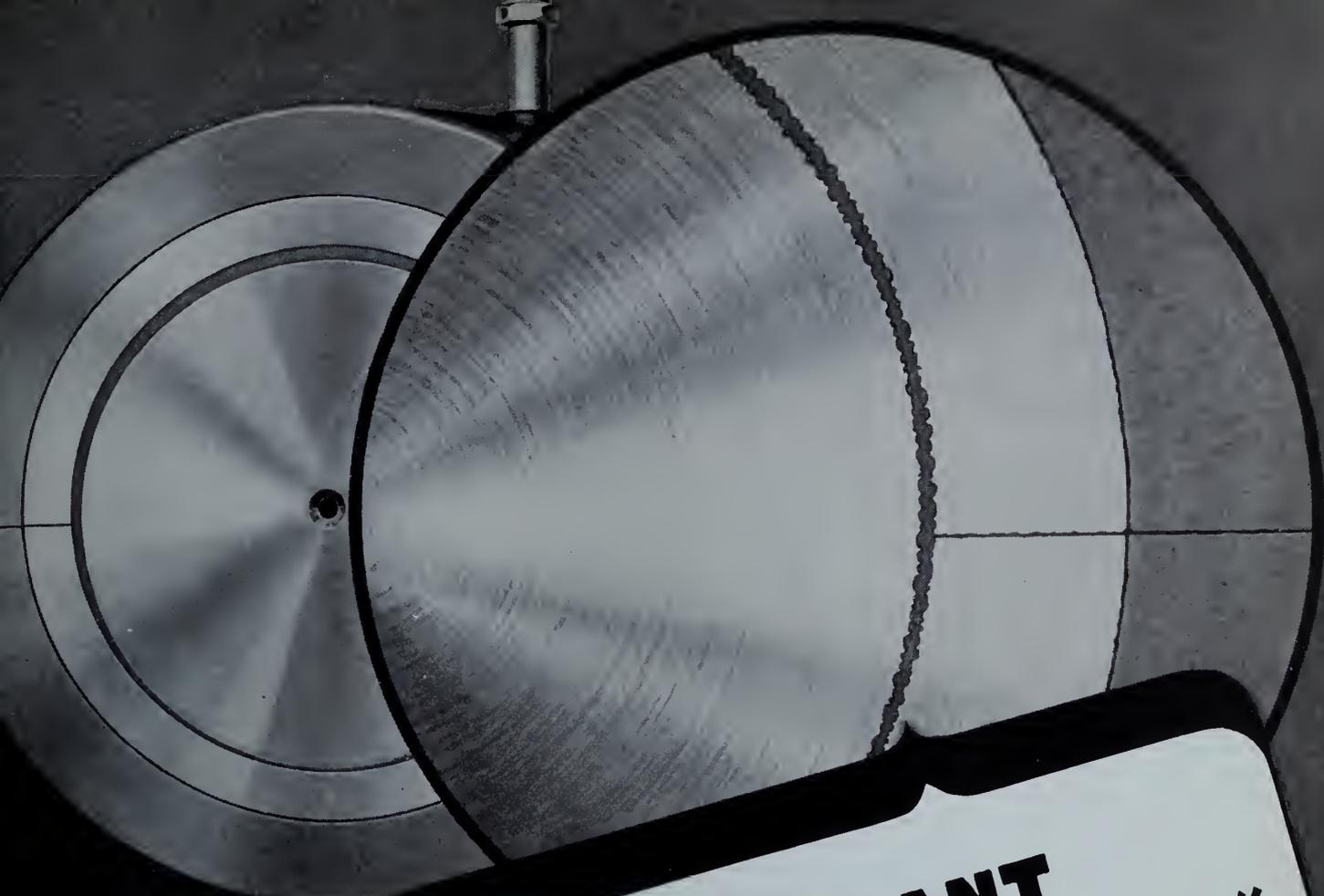
## STEAM TURBINES

Moore Steam Turbine Div., Worthington Pump & Machinery Corp., of Harrison, N.J., have published bulletin No. 1951, featuring types GA and GB of the Moore steam turbines. Combined reduction gears are also featured with sectional drawings and illustrations of all important parts. A dimensional drawing is included with photograph and typical installations.

## TRAINING FOR LEADERSHIP IN INDUSTRY

This booklet, published by Canadian General Electric Co. Ltd., Toronto, Ont., has been prepared for electrical and mechanical engineering graduates of Canadian colleges and is intended to give them a brief survey of the field which they are entering pointing to the opportunities now existing and those being created for the future. It contains a description of the student courses operated by the company with a list of the lectures given and a chart entitled "Experience and Advancement Programme." A large number of illustrations is included showing the company's works. The booklet has 20 pages and is designated as No. 4169A.

(Continued on page 32)



**GARGOYLE LUBRICANTS STAND OUT AND STAND UP!**

**Cylinder Oil** famous for its 10-year ability in a tough, film on piston and cylinder walls.

**D.T.E. Oils** specially made for heat, pressure and vibration.

**Voco Engine Oil** resists wear, repels dirt; efficient in heat or cold.

**Gargoyle D.T.E. Oils**—stand up under heat and pressure; have unusually long life; are used in more than 51% of America's major-sized steam turbines.

**Gargoyle Vacuoline Oils**—combine lubricity and stability for circulation-oiled machines.

**Gargoyle special oils and greases for every industrial operation.**

**IN YOUR PLANT**  
*a "secret weapon"*

Smooth as glass to the naked eye—the polished surface of a bearing shows its ugly, jagged "teeth" under the microscope. That's why, in all machinery, a film of oil must keep moving metal surfaces apart.

The oil film must be tough enough to stand heat and pressure—yet *light enough* to keep down "drag" and save power. Just any oil won't do. In Canada's war produc-

tion, nothing must be left to guesswork.

If you want to be sure of your lubrication you'll be wise to rely on Gargoyle Lubricants. More than 76 years of experience and more than half a million "case histories" have taught the makers of Gargoyle Lubricants how to produce an oil or grease that does exactly what it's supposed to do—*without fail.*

Sold throughout Canada and Newfoundland by Imperial Oil Limited

*For Correct Lubrication use*

**GARGOYLE LUBRICANTS**

Gargoyle Industrial and Marine Lubricants are made by the makers of Mobiloil, the world's quality motor oil.



# I.C.S.

## SPECIALIZED TRAINING

FOR

### THE ENGINEERING PROFESSION

International Correspondence Schools are equipped to provide the non-university man with the specialized training necessary to enable him to study for the examinations of engineering societies and associations. I.C.S. Home Study Courses are of particular interest to prospective applicants for membership in any of these organizations.

I.C.S. courses for examinations are arranged with the object of preparing the candidate for his examinations in the shortest possible time, while omitting no features of his training conducive to thoroughness and diversity of knowledge.

Each candidate will receive the individual attention of a vocational and educational specialist. The candidate's examination courses will be arranged to comply with his individual requirements and his rate of progress will be affected by no other student. He will proceed as rapidly as his ability, his study time and his application will permit. He will be allowed ample time to complete his I.C.S. course and will receive full answers to any questions he may need to ask which come within the scope of his course.

The subjects in which I.C.S. training is available include:

- High School Subjects
- Elementary Physics and Mechanics
- Strength and Elasticity of Metals
- Drawing
- Chemistry
- Chemical Engineering
- Civil Engineering
- Electrical Engineering
- Mechanical Engineering
- Mining Engineering
- Structural Engineering

AN INVITATION—You are invited to send for information about I.C.S. training. You incur no obligation. Just mark and mail the coupon.

International Correspondence Schools,  
Canadian Limited,  
Department H-2,  
Montreal, Canada.

Please send me complete information on I.C.S. training for engineering.

Name .....

Address .....

Employed by .....

## Industrial News

(Continued from page 206)

### BURNDY CABLE LUG

Canadian Line Materials Ltd., Toronto, Ont., have issued a four-page bulletin for insertion in Burndy Catalogues Nos. 40 to 41. Gives numbers, sizes, cable ranges, weights and list prices, for "Versi" type Burndy lugs, links, tees, and taps. Each item is illustrated.

### CARBOLOY STANDARD TOOLS

Featuring ease of selection and prompt deliveries, the eight-page catalogue CGT-140 of Canadian General Electric Co. Ltd., Toronto, Ont., illustrates ten different styles of tools, each accompanied by dimensional drawings, tables of specifications and prices, and a series of drawings showing "typical adaptations you can quickly grind in these standard tools." A list of carboloy products is also given.

### DISCONNECTING SWITCHES

Through a series of illustrations, dimensional drawings, tables and descriptive matter, the G-E line of disconnecting switches for indoor and outdoor service with silver line-pressure contacts is thoroughly covered in a 28-page booklet CGEA-1907C recently published by Canadian General Electric Co. Ltd., Toronto, Ont.

### FLOOR TREATMENT UNIT

Flexrock Company, Toronto, Ont., are distributing a four-page bulletin entitled "Colorflex-Plus" which describes a new product for the dust proofing and preservation of wood or concrete floors and at the same time provides a lasting dye-like colouring which penetrates deeply into the floor.

### HOW TO MAKE TIRES LAST LONGER

In response to requests for authentic information on the subject, a booklet entitled "How to Make Your Tires Last Longer" has been compiled and issued by The Goodyear Tire & Rubber Co. Ltd., New Toronto, Ont. Dealing with driving speeds, checking tires, retreading, regrooving, and the vital necessity of saving tires, the booklet contains information of real importance to users of tires.

### MOTION PICTURES FOR ADVERTISING

"Showmanship at the Canadian National Exhibition," is the title of an eight-page booklet issued by Associated Screen News Ltd., Montreal, Que., giving a news-picture description of motion pictures at work. It presents a survey of different firms using motion pictures; tells what types of films are being used; what is the purpose behind the use of each; and what other forms of promotion are used to round out the motion picture campaign. The Canadian National Exhibition was the scene of the survey—probably the one spot in Canada where such a diversity of examples would be gathered together in one group.

### MOTORS AND CONTROL FOR PART-WINDING STARTING

Bulletin CGEA-3345, four pages, recently issued by Canadian General Electric Co. Ltd., Toronto, Ont., describes part-winding starting and sets forth the four advantages as: simplified control equipment, continuous circuit starting, low starting current, and multipoint increment control. The part-winding motor design and applications of the method are featured as is also the control equipment.

### NEW CANADIAN HEADQUARTERS

Mine Safety Appliances Co. of Canada Ltd., announce the opening of a new Canadian headquarters at 139 Kendal Ave., Toronto, Ont., where they have acquired a new building to conduct the manufacture and assembly of certain M.S.A. products, at the same time stocking all important items made by the parent company, Mine Safety Appliances Co., of Pittsburgh, Pa. The general manager of the Canadian company, Mr. R. Morris, who

was formerly in Montreal, will make his headquarters in Toronto. The company also operates district offices in Montreal, New Glasgow and Sydney, N.S.

### APPOINTED CANADIAN DISTRIBUTORS

Kahn, Bald & Laddon Ltd., Toronto, Ont., have been appointed Canadian distributors for the Gits Molding Corp., Chicago, Ill., manufacturers of a wide line of plastic gifts, games, novelties and specialties.

### MANUFACTURING STAFF PROMOTIONS

Building Products Ltd., Montreal, Que., have announced the promotions of a number of members of its manufacturing staff. C. E. Turner, Superintendent of the company's paper mill at Pont Rouge, Que., has been appointed Assistant General Manufacturing Manager. J. W. Church becomes Assistant Superintendent at the Pont Rouge Mill. L. J. Newton has been appointed Plant Engineer at the Pont Rouge Mill and W. A. Lawson becomes Assistant to Chief Engineer at Montreal. The company's officers are W. R. McNeil, President, C. P. Cowan and D. P. Hatch, Vice-Presidents and R. C. Crooker, Secretary-Treasurer.

### SNOW REMOVAL EQUIPMENT

LaPlant-Choate Mfg. Co. Inc., Cedar Rapids, Iowa, has issued an 8-page booklet, Form No. A-117-643, entitled "Win Against Winter!" Describes in detail the various models of snow plows for use with "Caterpillar" Diesel tractors. Illustrations show the various types of this equipment at work in the field.

### NEW HIGH TENSION LINES

The Shawinigan Water & Power Company has made application to the Quebec Public Service Board for authorization to proceed with the construction of new high tension lines between Three Rivers and Berthier and Sorel and Hemmings Falls, the project involving a total expenditure of \$1,600,000. It is proposed to commence construction of the Sorel-Hemmings Falls section in the spring and to have the entire programme complete early next fall. The lines will be constructed for 110,000 volts, but will be operated at 60,000 volts pending the installation of complete equipment.

### CARBON TOOL STEEL

Jessop Steel Co. Ltd., Toronto, Ont., is issuing an 8-page Bulletin, No. 741, which features the Jessop "Lion" carbon tool steel and provides descriptive technical data under the headings "Forging," "Annealing," "Hardening," "Tempering," "Applications" and "Tool Design."

### TORONTO PLANT EXTENDED

John Inglis Co. Ltd., of Toronto, is expending \$150,000 for a boiler-testing plant and a heat-treating and stress-relieving furnace in its commercial division. This work is now under way. It is also announced that a two-storey addition to the ordnance division is being erected, the building being of reinforced concrete and flat slab construction and 320 feet long. This will further increase the facilities of the Commercial Division of the Inglis Company which is devoted to the production of machinery for the marine, oil, power, paper, mining, steel, rubber and other basic industries.

### MEEHANITE CASTINGS IN DEFENSE WORK

Entitled "Meehanite Castings in Defense Work," a 12-page bulletin published by the Meehanite Research Institute of America Inc., Pittsburgh, Pa., describes and illustrates "Meehanite" castings used in aircraft manufacture, gun and shell manufacture, machine tool castings, and radio, marine, truck, and steel mill equipment.

# THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 25

MONTREAL, APRIL 1942

NUMBER 4



“To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public.”

★ ★ ★

PUBLISHED MONTHLY BY  
THE ENGINEERING INSTITUTE  
OF CANADA

2050 MANSFIELD STREET - MONTREAL

L. AUSTIN WRIGHT, M.E.I.C.  
*Editor*

LOUIS TRUDEL, M.E.I.C.  
*Assistant Editor*

N. E. D. SHEPPARD, M.E.I.C.  
*Advertising Manager*

#### PUBLICATION COMMITTEE

C. K. McLEOD, M.E.I.C., *Chairman*  
R. DeL. FRENCH, M.E.I.C., *Vice-Chairman*  
A. C. D. BLANCHARD, M.E.I.C.  
H. F. FINNEMORE, M.E.I.C.  
T. J. LAFRENIÈRE, M.E.I.C.

## CONTENTS

LIONS' GATE BRIDGE . . . . .	Cover
(Photo S. R. Banks)	
LIONS' GATE BRIDGE—PART I . . . . .	210
S. R. Banks, M.E.I.C.	
PRODUCER GAS FOR MOTOR TRANSPORT . . . . .	223
E. A. Allcut, M.E.I.C.	
TROLLEY COACH OVERHEAD MATERIALS AND DESIGN . . . . .	231
L. W. Birch	
THE MANAGEMENT-EMPLOYEE PROBLEM . . . . .	236
J. W. Parker	
SOME OF THE ENGINEERING IMPLICATIONS OF CIVILIAN DEFENCE . . . . .	238
Walter D. Binger	
CONTROL OF TECHNICAL MAN POWER . . . . .	241
ABSTRACTS OF CURRENT LITERATURE . . . . .	243
FROM MONTH TO MONTH . . . . .	248
PERSONALS . . . . .	254
Visitors to Headquarters . . . . .	256
Obituaries . . . . .	257
NEWS OF THE BRANCHES . . . . .	257
NEWS OF OTHER SOCIETIES . . . . .	264
LIBRARY NOTES . . . . .	265
PRELIMINARY NOTICE . . . . .	268
EMPLOYMENT SERVICE . . . . .	269
INDUSTRIAL NEWS . . . . .	270

Price 50 cents a copy, \$3.00 a year: in Canada, British Possessions, United States and Mexico, \$4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, \$2.00 a year. Entered at the Post Office, Montreal, as Second Class Matter.

THE INSTITUTE as a body is not responsible either for the statements made or for the opinions expressed in the following pages.

# THE ENGINEERING INSTITUTE OF CANADA

## MEMBERS OF COUNCIL - 1942

### PRESIDENT

C. R. YOUNG, Toronto, Ont.

### VICE-PRESIDENTS

\*A. L. CARRUTHERS, Victoria, B.C.  
†H. CIMON, Quebec, Que.

### PAST-PRESIDENTS

†T. H. HOGG, Toronto, Ont.

### COUNCILLORS

†E. D. GRAY-DONALD, Quebec, Que.  
†J. HAIMES, Lethbridge, Alta.  
\*J. G. HALL, Montreal, Que.  
†R. E. HEARTZ, Montreal, Que.  
†W. G. HUNT, Montreal, Que.  
†E. W. IZARD, Victoria, B.C.  
†J. R. KAYE, Halifax, N.S.  
\*E. M. KREBSER, Walkerville, Ont.  
†N. MacNICOL, Toronto, Ont.  
†H. N. MACPHERSON, Vancouver, B.C.  
\*H. F. MORRISSEY, Saint John, N.B.

### TREASURER

E. G. M. CAPE, Montreal, Que.

### GENERAL SECRETARY

L. AUSTIN WRIGHT, Montreal, Que.

†J. L. LANG, Sault Ste. Marie, Ont.  
†G. G. MURDOCH, Saint John, N.B.

†C. J. MACKENZIE, Ottawa, Ont.

\*W. H. MUNRO, Ottawa, Ont.  
†T. A. McELHANNEY, Ottawa, Ont.  
\*C. K. McLEOD, Montreal, Que.  
†A. W. F. McQUEEN, Niagara Falls, Ont.  
†A. E. PICKERING, Sault Ste. Marie, Ont.  
†G. McL. PITTS, Montreal, Que.  
†W. J. W. REID, Hamilton, Ont.  
†J. W. SANGER, Winnipeg, Man.  
\*M. G. SAUNDERS, Arvida, Que.  
†H. R. SILLS, Peterborough, Ont.  
\*J. A. VANCE, Woodstock, Ont.

\*For 1942 †For 1942-43 ‡For 1942-43-44

### SECRETARY-EMERITUS

R. J. DURLEY, Montreal, Que.

### ASSISTANT GENERAL SECRETARY

LOUIS TRUDEL, Montreal, Que.

## STANDING COMMITTEES

### FINANCE

DEG. BEAUBIEN, *Chairman*  
J. E. ARMSTRONG  
E. G. M. CAPE  
G. A. GAHERTY  
J. A. McCRORY  
F. NEWELL

### LEGISLATION

J. L. LANG, *Chairman*  
R. L. DOBBIN  
R. J. DURLEY

### PAPERS

J. A. VANCE, *Chairman*  
DEG. BEAUBIEN  
K. M. CAMERON  
A. L. CARRUTHERS  
H. CIMON  
J. L. LANG  
G. G. MURDOCH

### LIBRARY AND HOUSE

W. G. HUNT, *Chairman*  
A. T. BONE  
J. S. HEWSON  
M. S. NELSON  
G. V. RONEY

### PUBLICATION

C. K. McLEOD, *Chairman*  
R. DeL. FRENCH, *Vice-Chairman*  
A. C. D. BLANCHARD  
H. F. FINNEMORE  
T. J. LAFRENIERE

## SPECIAL COMMITTEES

### BOARD OF EXAMINERS AND EDUCATION

R. A. SPENCER, *Chairman*  
I. M. FRASER  
W. E. LOVELL  
A. P. LINTON  
H. R. MacKENZIE  
E. K. PHILLIPS

### GZOWSKI MEDAL

H. V. ANDERSON, *Chairman*

### DUGGAN MEDAL AND PRIZE

J. T. FARMER, *Chairman*  
J. M. FLEMING  
R. C. FLITTON

### PLUMMER MEDAL

C. R. WHITTEMORE, *Chairman*  
J. CAMERON  
R. L. DOBBIN  
O. W. ELLIS  
J. F. HARKOM

### LEONARD MEDAL

JOHN McLEISH

### JULIAN C. SMITH MEDAL

C. R. YOUNG, *Chairman*  
T. H. HOGG  
C. J. MACKENZIE

### PROFESSIONAL INTERESTS

J. B. CHALLIES, *Chairman*  
J. E. ARMSTRONG  
G. A. GAHERTY  
O. O. LEFEBVRE  
H. W. McKIEL  
J. A. VANCE

### STUDENTS' AND JUNIORS' PRIZES

#### Zone A (Western Provinces)

##### H. N. Ruttan Prize

A. L. CARRUTHERS, *Chairman*  
E. W. IZARD  
H. N. MACPHERSON

#### Zone B (Province of Ontario)

##### John Galbraith Prize

J. L. LANG, *Chairman*  
A. E. PICKERING  
J. A. VANCE

#### Zone C (Province of Quebec)

##### Phelps Johnson Prize (English)

DEGASPE BEAUBIEN, *Chairman*  
J. E. ARMSTRONG  
R. E. HEARTZ

##### Ernest Marceau Prize (French)

H. CIMON, *Chairman*  
J. H. FREGEAU  
E. D. GRAY-DONALD

#### Zone D (Maritime Provinces)

##### Martin Murphy Prize

G. G. MURDOCH, *Chairman*  
G. L. DICKSON  
S. W. GRAY

### THE YOUNG ENGINEER

H. F. BENNETT, *Chairman*  
J. BENOIT  
D. S. ELLIS  
J. N. FINLAYSON  
R. DeL. FRENCH  
R. F. LEGGET  
A. E. MACDONALD  
H. W. McKIEL

### MEMBERSHIP

J. G. HALL, *Chairman*  
S. R. FROST

### INTERNATIONAL RELATIONS

R. W. ANGUS, *Chairman*  
J. B. CHALLIES, *Vice-Chairman*  
E. A. ALLCUT  
C. CAMSELL  
J. M. R. FAIRBAIRN  
O. O. LEFEBVRE  
M. J. McHENRY  
H. H. VAUGHAN  
C. R. YOUNG

### DETERIORATION OF CONCRETE STRUCTURES

R. B. YOUNG, *Chairman*  
E. VIENS, *Vice-Chairman*  
G. P. F. BOESE  
A. G. FLEMING  
W. G. GLIDDON  
O. O. LEFEBVRE  
J. A. McCRORY  
C. J. MACKENZIE  
J. H. McKINNEY  
R. M. SMITH

### WESTERN WATER PROBLEMS

G. A. GAHERTY, *Chairman*  
C. H. ATTWOOD  
L. C. CHARLESWORTH  
A. GRIFFIN  
D. W. HAYS  
G. N. HOUSTON  
T. H. HOGG  
O. O. LEFEBVRE  
C. J. MACKENZIE  
H. J. McLEAN  
F. H. PETERS  
S. G. PORTER  
P. M. SAUDER  
J. M. WARDLE

# THE ENGINEERING INSTITUTE OF CANADA

## OFFICERS OF BRANCHES

### BORDER CITIES

*Chairman*, H. L. JOHNSTON  
*Vice-Chair.*, G. G. HENDERSON  
*Executive*, W. P. AUGUSTINE  
 J. F. G. BLOWEY  
 W. R. STICKNEY  
 (Ex-Officio), E. M. KREBSER  
 G. E. MEDLAR  
*Sec.-Treas.*, J. B. DOWLER,  
 754 Chilver Road,  
 Walkerville, Ont.

### CALGARY

*Chairman*, H. J. McEWEN  
*Vice-Chair.*, J. G. MacGREGOR  
*Executive*, J. N. FORD  
 A. GRIFFIN  
 H. B. SHERMAN  
 (Ex-Officio), G. P. F. BOESE  
 S. G. COULTIS  
 J. B. DEHART  
 P. F. PEELE  
*Sec.-Treas.*, K. W. MITCHELL,  
 803-17th Ave. N.W.,  
 Calgary, Alta.

### CAPE BRETON

*Chairman*, J. A. MacLEOD  
*Executive*, J. A. RUSSELL M. F. COSSITT  
 (Ex-Officio), F. W. GRAY  
*Sec.-Treas.*, S. C. MIFFLEN,  
 60 Whitney Ave., Sydney, N.S.

### EDMONTON

*Chairman*, D. A. HANSEN  
*Vice-Chair.*, D. HUTCHISON  
*Executive*, C. W. CARRY  
 B. W. PITFIELD  
 E. R. T. SKARIN  
 J. A. ALLAN  
 E. ROBERTSON  
 J. W. JUDGE  
 (Ex-Officio), J. GARRETT  
 R. M. HARDY  
*Sec.-Treas.*, F. R. BURFIELD,  
 Water Resources Office,  
 Provincial Government,  
 Edmonton, Alta.

### HALIFAX

*Chairman*, P. A. LOVETT  
*Executive*, A. E. CAMERON  
 G. T. CLARKE G. J. CURRIE  
 A. E. FLYNN J. D. FRASER  
 D. G. DUNBAR J. A. MacKAY  
 J. F. F. MacKENZIE  
 J. W. MacDONALD  
 G. T. MEDFORTH  
 (Ex-Officio), S. L. FULTZ J. R. KAYE  
*Sec.-Treas.*, S. W. GRAY,  
 The Nova Scotia Power  
 Commission,  
 Halifax, N.S.

### HAMILTON

*Chairman*, STANLEY SHUPE  
*Vice-Chair.*, T. S. GLOVER  
*Executive*, H. A. COOCH  
 NORMAN EAGER  
 A. C. MACNAB  
 A. H. WINGFIELD  
 (Ex-Officio), W. J. W. REID  
 W. A. T. GILMOUR  
*Sec.-Treas.*, A. R. HANNAFORD,  
 354 Herkimer Street,  
 Hamilton, Ont.

### KINGSTON

*Chairman*, T. A. McGINNIS  
*Vice-Chair.*, P. ROY  
*Executive*, V. R. DAVIES  
 K. H. McKIBBIN  
 K. M. WINSLOW  
 A. H. MUNRO  
 (Ex-Officio), G. G. M. CARR-HARRIS  
 D. S. ELLIS  
*Sec.-Treas.*, J. B. BATY,  
 Queen's University,  
 Kingston, Ont.

### LAKEHEAD

*Chairman*, B. A. CULPEPER  
*Vice-Chair.*, MISS E. M. G. MacGILL  
*Executive*, E. J. DAVIES  
 J. I. CARMICHAEL  
 S. E. FLOOK  
 S. T. McCAVOUR  
 R. B. CHANDLER  
 W. H. SMALL  
 C. D. MACKINTOSH  
 (Ex-Officio), H. G. O'LEARY  
 J. M. FLEMING  
*Sec.-Treas.*, W. C. BYERS,  
 c/o C. D. Howe Co. Ltd.,  
 Port Arthur, Ont.

### LETHBRIDGE

*Chairman*, C. S. DONALDSON  
*Vice-Chair.*, W. MELDRUM  
*Executive*, R. F. P. BOWMAN G. S. BROWN  
 N. H. BRADLEY  
 C. S. CLENDENING  
 (Ex-Officio), J. HAIMES  
 A. J. BRANCH J. T. WATSON  
*Sec.-Treas.*, R. B. McKENZIE,  
 McKenzie Electric Ltd.,  
 706, 3rd Ave. S., Lethbridge, Alta.

### LONDON

*Chairman*, F. T. JULIAN  
*Vice-Chair.*, T. L. McMANAMNA  
*Executive*, F. C. BALL  
 V. A. McKILLOP  
 H. F. BENNETT  
 A. L. FURANNA  
 R. S. CHARLES  
 (Ex-Officio), R. W. GARRETT  
 J. A. VANCE  
*Sec.-Treas.*, H. G. STEAD,  
 60 Alexandra Street,  
 London, Ont.

### MONCTON

*Chairman*, F. O. CONDON  
*Vice-Chair.*, H. J. CRUDGE  
*Executive*, B. E. BAYNE E. R. EVANS  
 G. L. DICKSON E. B. MARTIN  
 T. H. DICKSON G. E. SMITH  
 (Ex-Officio), H. W. McKIEL  
*Sec.-Treas.*, V. C. BLACKETT,  
 Engr. Dept., C.N.R.,  
 Moncton, N.B.

### MONTREAL

*Chairman*, J. A. LALONDE  
*Vice-Chair.*, R. S. EADIE  
*Executive*, R. E. HEARTZ  
 J. B. STIRLING  
 J. M. CRAWFORD  
 J. COMEAU  
 H. F. FINNEMORE  
 R. C. FLITTON  
 (Ex-Officio), DE G. BEAUBIEN  
 J. E. ARMSTRONG  
 J. G. HALL  
 W. G. HUNT  
 C. K. McLEOD  
 G. McL PITTS  
*Sec.-Treas.*, L. A. DUCHASTEL,  
 40 Kelvin Avenue,  
 Outremont, Que.

### NIAGARA PENINSULA

*Chairman*, A. L. McPHAIL  
*Vice-Chair.*, C. G. CLINE  
*Executive*, L. J. RUSSELL  
 J. H. TUCK  
 A. C. BLUE  
 G. F. VOLLMER  
 G. E. GRIFFITHS  
 D. W. BRACKEN  
 L. L. GISBORNE  
 (Ex-Officio), A. W. F. McQUEEN  
*Sec.-Treas.*, J. H. INGS,  
 1870 Ferry Street,  
 Niagara Falls, Ont.

### OTTAWA

*Chairman*, N. B. MacROSTIE  
*Executive*, W. G. C. GLIDDON  
 R. M. PRENDERGAST  
 W. H. G. FLAY  
 G. A. LINDSAY  
 R. YUILL  
 (Ex-Officio), K. M. CAMERON  
 C. J. MACKENZIE  
 W. H. MUNRO  
 T. A. McELHANNEY  
 R. K. ODELL  
*Sec.-Treas.*, A. A. SWINNERTON,  
 Dept. of Mines and Resources,  
 Ottawa, Ont.

### PETERBOROUGH

*Chairman*, J. CAMERON  
*Executive*, A. J. GIRDWOOD I. F. McRAE  
 J. W. PIERCE F. R. POPE  
 (Ex-Officio), R. L. DOBBIN  
 H. R. SILLS  
 A. L. MALBY  
*Sec.-Treas.*, D. J. EMERY,  
 589 King Street,  
 Peterborough, Ont.

### QUEBEC

*Life Hon.-*  
*Chair.*, A. R. DECARY  
*Chairman*, L. C. DUPUIS  
*Vice-Chair.*, RENÉ DUPUIS  
*Executive*, O. DESJARDINS  
 R. SAUVAGE G. ST-JACQUES  
 S. PICARD L. GAGNON  
 G. W. WADDINGTON  
 (Ex-Officio), E. D. GRAY-DONALD  
 R. B. McDUNNOUGH P. MÉTHÉ  
 H. CIMON  
*Sec.-Treas.*, PAUL VINCENT,  
 Colonization Department,  
 Room 333-A, Parliament Bldgs.,  
 Quebec, Que.

### SAGUENAY

*Chairman*, N. F. McCAGHEY  
*Vice-Chair.*, R. H. RIMMER  
*Executive*, B. BAUMAN  
 G. B. MOXON  
 A. I. CUNNINGHAM  
 W. J. THOMSON  
 (Ex-Officio), M. G. SAUNDERS  
 J. W. WARD  
*Sec.-Treas.*, D. S. ESTABROOKS,  
 Price Bros. & Co. Ltd.  
 Riverbend, Que.

### SAINT JOHN

*Chairman*, F. A. PATRIQUEN  
*Vice-Chair.*, D. R. SMITH  
*Executive*, A. O. WOLFF  
 H. P. LINGLEY  
 W. B. AKERLEY  
 (Ex-Officio), J. P. MOONEY  
 H. F. MURRISEY  
 G. G. MURDOCH  
*Sec.-Treas.*, V. S. CHESNUT,  
 P.O. Box 1393,  
 Saint John, N.B.

### ST. MAURICE VALLEY

*Chairman*, A. H. HEATLEY  
*Vice-Chair.*, H. G. TIMMIS  
*Executive*, A. C. ABBOTT J. M. MITCHELL  
 R. DORION G. RINFRET  
 V. JEPSEN H. J. WARD  
 J. JOYAL H. K. WYMAN  
 H. O. KEAY  
 (Ex-Officio), C. H. CHAMPION  
 J. H. FREGEAU  
*Sec.-Treas.*, C. G. deTONNANCOUR,  
 Engineering Department,  
 Shawinigan Chemicals, Limited,  
 Shawinigan Falls, Que.

### SASKATCHEWAN

*Chairman*, A. P. LINTON  
*Vice-Chair.*, A. M. MACGILLIVRAY  
*Executive*, F. C. DEMPSEY  
 N. B. HUTCHEON  
 J. G. SCHAEFFER  
 R. W. JICKLING  
 H. R. MacKENZIE  
 B. RUSSELL  
 (Ex-Officio), I. M. FRASER  
*Sec.-Treas.*, STEWART YOUNG  
 P. O. Box 101,  
 Regina, Sask.

### SAULT STE. MARIE

*Chairman*, E. M. MacQUARRIE  
*Vice-Chair.*, L. R. BROWN  
*Executive*, R. A. CAMPBELL  
 N. C. COWIE  
 C. O. MADDOCK  
 C. R. MURDOCK  
 (Ex-Officio), J. L. LANG  
 A. E. PICKERING  
*Sec.-Treas.*, O. A. EVANS,  
 159 Upton Road,  
 Sault Ste. Marie, Ont.

### TORONTO

*Chairman*, W. S. WILSON  
*Vice-Chair.*, W. H. M. LAUGHLIN  
*Executive*, D. FORGAN  
 R. F. LEGGET  
 S. R. FROST  
 F. J. BLAIR  
 E. G. HEWSON  
 C. F. MORRISON  
 (Ex-Officio), C. R. YOUNG T. H. HOGG  
 A. E. BERRY N. MacNICOL  
 H. E. BRANDON J. J. SPENCE  
*Sec.-Treas.*, S. H. deJONG  
 Dept. of Civil Engineering,  
 University of Toronto,  
 Toronto, Ont.

### VANCOUVER

*Chairman*, W. O. SCOTT  
*Vice-Chair.*, W. N. KELLY  
*Executive*, H. P. ARCHIBALD  
 I. C. BARLTROP  
 H. C. FITZ-JAMES  
 H. J. MacLEOD  
 R. E. POTTER  
 (Ex-Officio), J. N. FINLAYSON  
 T. V. BERRY  
 H. N. MacPHERSON  
*Sec.-Treas.*, P. B. STROYAN  
 2099 Beach Avenue,  
 Vancouver, B.C.

### VICTORIA

*Chairman*, A. S. G. MUSGRAVE  
*Vice-Chair.*, KENNETH REID  
*Executive*, A. L. FORD  
 B. T. O'GRADY  
 J. B. PARHAM  
 R. BOWERING  
 (Ex-Officio), A. L. CARRUTHERS  
 G. M. IRWIN  
 E. W. IZARD  
*Sec.-Treas.*, J. H. BLAKE,  
 605 Victoria Avenue,  
 Victoria, B.C.

### WINNIPEG

*Chairman*, D. M. STEPHENS  
*Vice-Chair.*, J. T. DYMENT  
*Executive*, C. V. ANTENBRING  
 N. M. HALL  
 T. H. KIRBY  
 E. W. R. BUTLER  
 H. B. BREHAUT  
 (Ex-Officio), J. W. SANGER  
 V. MICHIE  
 C. P. HALTALIN  
*Sec.-Treas.*, THOMAS E. STOREY,  
 55 Princess Street,  
 Winnipeg, Man.

# THE LIONS' GATE BRIDGE—I

S. R. BANKS, M.E.I.C.

General Engineering Department, Aluminum Company of Canada, Limited, Montreal, Que.

Awarded the Gzowski Medal\* for 1941

## INTRODUCTION

### GENERAL DESCRIPTION

The Lions' Gate Bridge crosses the first Narrows (popularly named the Lions' Gate on account of the proximity of the two coast-range mountains well-known as the Lions) of Burrard Inlet, at the entrance to the magnificent natural harbour of Vancouver, British Columbia. It satisfies the long-felt need for a more direct means of communication between the city of Vancouver (the population of which, the third largest city in Canada, is 247,000)\*\* on the south side of the Inlet and the rapidly-growing municipality of West Vancouver, together with parts of the city of North Vancouver, on the north shore (see fig. 1). Prior to the bridge construction which is the subject of this paper, all automobile traffic to West Vancouver, to North Vancouver, and to the various coastal resorts along the north shore as far as Howe Sound, had perforce either to make use of the ferry to North Vancouver or, by means of a long detour, to cross the Inlet by the Second Narrows Bridge, the latter service being frequently interrupted by the opening of the lift-span to shipping. The new bridge, the presence of which has already stimulated noticeably the growth of West Vancouver, is expected to play an important part in the residential development by British Pacific Properties Limited of their extensive Capilano Estates, which are commandingly situated on the southern slopes of Hollyburn Ridge. It may also be considered as a preliminary step towards rendering Garibaldi National Park (distant some 50 miles to the north of Vancouver) conveniently accessible by road, and as a general foreshadowing of considerable highway developments on the north shore of the Inlet.

Built, owned and maintained by private enterprise, the project was necessarily subject to the approval of those public authorities whose jurisdiction extends over the site of the bridge and of its ancillary works, and whose permission had to be received before any construction could be undertaken.

In the first place, the promoting company, The First Narrows Bridge Company Limited, is authorized and empowered by provincial statute (Statutes of British Columbia 1926-1927), the Provincial Government being interested in the bridge as an important link in its highway system. Maximum tolls were fixed by this authority, and the provision of a grade separation at the junction of the bridge road with Marine Drive was, at a later date, stipulated. Permission had also to be obtained for the bridge to cross over the presently disused right-of-way of the Pacific Great Eastern Railway.

Secondly, agreement had to be reached with the City of Vancouver regarding a roadway to connect the bridge with that city. Stanley Park, through which such a road must pass, is the property of the Dominion Government but is leased in perpetuity to the City of Vancouver for public park purposes. It is administered for the city by a Board of Park Commissioners, by whom its unique amenities have always been jealously guarded. The agreement between the owners and the City of Vancouver stipulated that the former should at their own expense build

and maintain a 30-ft. hard-surfaced road connecting the bridge-head with the Georgia-Street entrance to the Park, that roadway to be the property of the City. It was also required that the bridge-plans should be subject to the City's approval, and that the structure should be at all times properly maintained. In addition, it was stipulated that the City should have the right, at the end of a period of 50 years, to purchase the bridge in its entirety from the owners. The agreement was made in November 1933.

Finally, it was necessary to obtain general approval of the plans (particularly in regard to site, span, and clearance) under the provisions of the Navigable Waters Protection Act of Canada. That approval was granted by the Governor-General in Council in September 1936.

The setting of the bridge, at the narrowest part of the waterway, is one of outstanding natural beauty. On the south side of the Lions' Gate is the well-wooded peninsula of Stanley Park, terminating in the picturesque eminence of Prospect Point, and justly famous for its care-

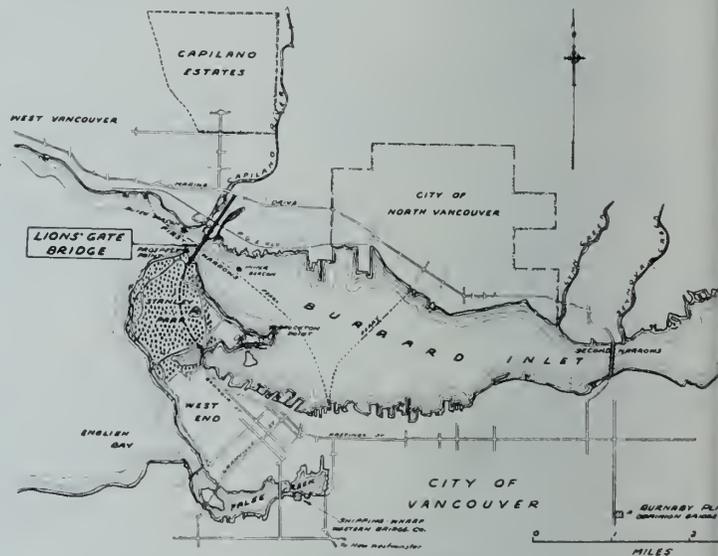


Fig. 1—Map of vicinity.

fully-preserved natural features. Along the north shore, beyond the salt marshes of the Capilano delta and the low-lying terrain of the Capilano Indian Reserve, the land rises within three or four miles to a mountain range of considerable grandeur. Eastwards the harbour, flanked by the waterfronts of Vancouver and North Vancouver, opens out to a width of nearly two miles; and seawards to the west there is an uninterrupted view over the Gulf of Georgia as far as Vancouver Island, some 45 miles away.

Connecting the high ground of Stanley Park a little to the east of Prospect Point with a point on Marine Drive, West Vancouver, a few hundred feet east of the Capilano River, the Lions' Gate Bridge bears in a straight line approximately 31 degrees east of north, the total length of the bridge-works proper being somewhat more than one mile. The distance across the Narrows on the line of the bridge varies from about 1,600 ft. at low water to perhaps as much as 2,200 ft. at extreme high tide, the corresponding tidal range being about 15 ft. Because of navigation hazards in the immediate vicinity of Prospect Point, and

\*The Gzowski Medal is a gold medal provided annually from a fund established in 1889 by Colonel Sir Casimir Gzowski, K.C.M.G., a past-president of the Institute. It is the Institute's senior award.

\*\*Canada Year Book (1931 census)

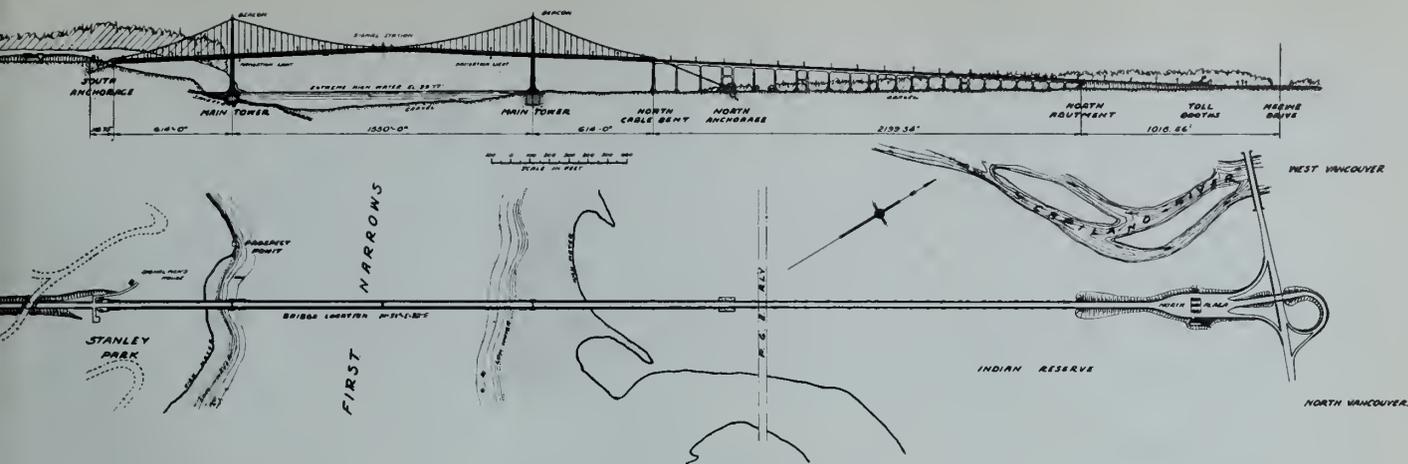


Fig. 2—General plan and elevation.

owing to the constant silting that takes place at the mouth of the Capilano, the navigable channel at present in use (although nominally 1,200 ft.) does not exceed about 1,000 ft. The main span of the Lions' Gate Bridge is of such a length, and the piers are so disposed, that the available channel width is now 1,500 ft—a width that in all probability will never be attained, on account of the enormous dredging programme that would be needed to maintain as well as to establish such a channel. In this connection also, Sir Alexander Gibb, in a report made in 1934, stated that the channel width of the Thames at the busiest part of that river is 1,000 ft., and that the average density of traffic there is more than four times the maximum yet experienced through First Narrows.

The general profile of the bridge, shown in Fig. 2, is dictated by the Dominion Government's requirements regarding the navigation clearance and the length of the main span over the waterway. A suspension bridge was the natural selection for this crossing on account of its intrinsic economy, its aesthetic superiority, and the fact that its erection would entail a minimum of interference with navigation on the busy waterway concerned. The order-in-council to which reference has already been made established the distance between centres of main piers at 1,550 ft., and stipulated a minimum underclearance of 200 ft. for a central fairway of 200 ft. The length of the central span being thus fixed, that of the two flanking side-spans was established provisionally by the distance between the fixed site of the south main pier and the most advantageous location for the anchorage on the Stanley Park hillside. Other factors, chief among which was the necessity for preserving a panel length and suspender spacing that would be adaptable also to the long centre span, led finally to the selection of 614 ft. as the optimum span length.

At the end of the south side-span, where the configuration of the hillside eliminates the need for any approach structure, the bridge roadway traverses an ornamental plaza (built on the upper surface of the large concrete cable-anchorage, which incidentally provides a bearing for the side-span trusses at about 160 ft. above high water), and connects with the new concrete approach highway which, passing in a long easy curve through Stanley Park, meets the western end of Georgia Street at a distance of about 1½ miles from the bridge head.

At the other end of the bridge the conditions are not as favourable. From the shore line to Marine Drive, a distance of about ¾ mile, the land is extremely flat, rising less than 30 ft. from high water level. Considerable approach works are therefore necessary to carry the roadway on a reasonable grade up to the end of the suspension bridge. The first part of these is an earth embankment some 1,000

ft. long, the connection with Marine Drive being made by a "fly-over" junction (to the cost of which the Provincial Government contributed). Situated some 150 ft. south of the convergence of the three roads of the modified "clover-leaf" is the eight-lane toll-collection plaza with four toll booths and a capacious office building. South of this again, the roadway narrows to its normal width, and the fill terminates in a concrete abutment wall which provides bearing for the first of the 25 spans of gradually-increasing length that constitute a 2,200-ft. steel viaduct. At the south end of the viaduct, a steel tower (or cable bent) carries the end-bearings both of the suspended side-span and of the highest of the approach-spans, and at the same time functions as a support for the main cables, which at this point are diverted to a steeper slope, leading downwards to the cable anchorage 388 ft. further to the north.

#### CAPACITY OF BRIDGE

The bridge carries a 29-ft. roadway and two 4-ft. sidewalks. The desirability of the latter provision was evident at once: but the establishment of the former figure as an economical and adequate width of roadway was the subject of much deliberation by all the parties concerned.

On the assumption that the population of Vancouver will be as much as two millions (with a per capita car registration of one in seven), before the bridge is relieved by additional facilities, and neglecting all assistance from the Second Narrows Bridge, from the ferries, and from possible future airway developments, the required total capacity of the bridge was generously estimated as 16½ million vehicles per annum. Comparative traffic figures for a number of similarly-placed bridges and tunnels were adduced in support of this estimate, and two instances may be cited. In the case of the Jacques Cartier Bridge at Montreal (where the situation in regard to tourists and commuters is not dissimilar, and where car registration is about one in 11 persons, with a population of 1,100,000), the annual traffic (not including trucks and buses) is 1,900,000 autos per year. Again, the maximum year's traffic over the four-lane toll-free Manhattan Bridge, which carries the densest traffic of any New York bridge, has been 22 million vehicles; and the daily maximum 61,271 vehicles.

The maximum hourly capacity of a single unobstructed traffic lane has been found\* to be approximately 1,900 vehicles, travelling at a speed of 20 miles per hour, the average spacing of the vehicles being about 60 ft. The possible daily traffic flow (assuming 18 effective hours) of one lane is thus in the neighbourhood of 35,000 vehicles, or, roughly 10 million per year. From this view-

\*Regional Survey of Highway Traffic for New York and Environs.

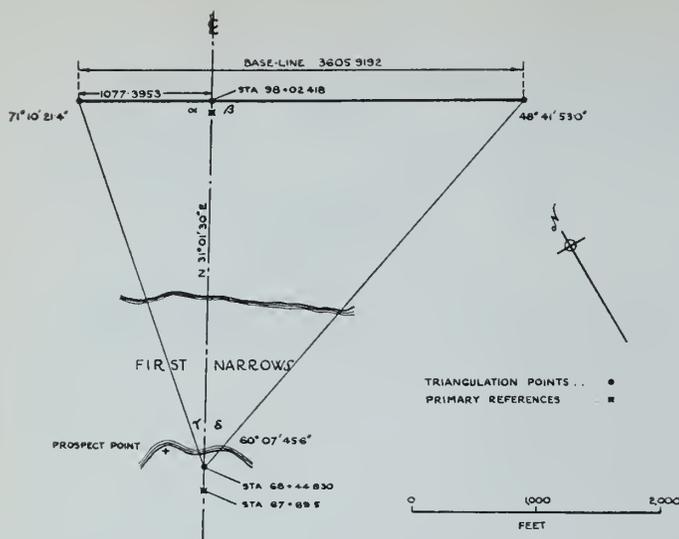


Fig. 3—Triangulation for pier-location.

point it could be argued that a two-lane roadway would provide the capacity required. The engineers, however, recommended the provision of a third lane in view of its value as a relief during short periods of unusually heavy traffic, and also on account of its contribution to the safety of the highway and to the appearance and stability of the structure. Arguments advanced against a three-lane roadway were countered by the fact that the bridge roadway differs from a city street or a country highway in that it is a straight way without any side-turnings, and more particularly in that no stopping is permissible: the road is under supervision over its full length, and obstruction of any part of the road is not likely.

The feasibility of providing a four-lane roadway was also considered, but it was decided that the additional expense involved could not be justified.

The fact that toll has to be collected from all vehicles using the bridge has also an important bearing on its traffic capacity; and, in spite of the provision of eight toll gates, toll taking is probably the governing factor in determining the actual traffic capacity of the bridge. From this point of view, a traffic flow of 1,900 vehicles per hour would mean that cars would be passing through the toll station at the rate of one in every 1.84 seconds. If as many as six toll-gates were in operation in one direction, the time for taking each toll would be 11 seconds. The actual time required for toll taking varies from about two seconds in the case of a commuter to as much as 30 seconds when change has to be given, so that it is probable that the single-lane traffic flow considered above will represent approximately the capacity of the toll station, although it should be possible to deal with a heavier flow for such limited periods as might require the use of two lanes in a single direction.

In the first year's operation of the Lions' Gate Bridge, a total of 1,028,827 vehicles passed over the structure, together with some 2,000,000 persons (including a very large number of pedestrians) apart from the drivers. The maximum week's traffic during the same period was 32,934 vehicles; and the maximum day's traffic (on the first Sunday of operation) was 5,616 vehicles. The largest number of vehicles to cross the bridge in one hour was estimated to have been 2,500. Since the opening of the bridge, the roadway has been divided into two lanes by a line painted on the pavement, and there is no prospect at present of the third lane being put into service as a separate traffic way.

#### THE SUSPENSION BRIDGE

The suspension bridge proper is of particular interest as the outstanding part of the structure, and also in that

it is the longest suspension bridge in the British Empire, or, indeed, outside of the United States of America. The three suspended spans (Fig. 2) have an aggregate length of 2,778 ft. The two cables are 40 ft. apart, 13¼ in. in diameter, and nearly 3,400 ft. in length. They are secured at either end by massive concrete anchorage piers, and each cable is supported by saddles at four intermediate points. Primary support is supplied by the two main towers, which are slender steel structures on granite-faced concrete piers, the main saddles being some 400 ft. above water-level. Secondary saddles are located at the ends of the side-spans, and from these the cables descend to the anchorages in the form of straight backstays.

The riveted stiffening trusses are of the through Warren type, and the batter of the tower legs is so arranged that the ends of the trusses are accommodated conveniently within the tower structure. The trusses are 15 ft. deep, and, hanging in the planes of the cables, are supported from the latter by two-part suspender ropes at 32-ft. 3-in. intervals. The bridge deck is carried on longitudinal stringers framing into floorbeams.

Expansion movements of the trusses and floor system occur at the main towers only, but the lateral system is articulated at each end of each span to permit of transverse wind deflections.

Two somewhat unusual features of the bridge are pedestrian observation platforms cantilevered outside the trusses at sidewalk level, and a marine signal station (replacing that previously situated on the top of Prospect Point) in the shape of a light steel cross-bridge over the roadway at the centre of the main span.

In the detailed description of the bridge works that follows, the subject is treated in its two natural subdivisions of substructure (piers, foundations, and earthworks) and metallic superstructure, the latter being considered under the respective headings of "design and fabrication," and "erection."

It will be noted that occasional reference throughout this paper is made to the Island of Orléans Bridge, Quebec. That suspension bridge,\* with a 1,056-ft. main span, was, prior to the construction here described, the longest in the Dominion. Though of less importance, it may to some extent be considered as the prototype of the Lions' Gate Bridge, and the engineers (as also the superstructure contractors) were considerably assisted by the experience gained in its design and construction.

### SUBSTRUCTURE

#### SURVEYS FOR LOCATION

Preliminary surveying of the site, carried out by Major W. G. Swan, M.E.I.C.,\*\* led to the definite location of the bridge in the position that finally received government approval. The centre line was identified by two hubs, one on either shore, and the position of the south main pier was fixed by a specified chainage from the south-shore hub: the reference of this latter (67+89.5) was accepted as the basis for all chainages.

With the foregoing information as a starting-point, the engineers laid out a base line along the disused P.G.E. right-of-way on the north shore, and on the south shore established a triangulation point (68+44.830) by direct measurement from the primary reference. The base line was measured with a calibrated 300-ft. tape, its length being found to be 3605.9192 ft.; of the several measurements made, none was at variance with that figure by more than 0.0068 ft. Similarly precise chainages tied in the centre line with the base line hubs. The survey (Fig 3) was made in the winter of 1936, and, owing to the

\*The Island of Orléans Bridge, designed by Messrs. Monsarrat & Pratley, has been described by the author (*Journal Inst. C.E.* October, 1936).

\*\*Major Swan was associated with Messrs. Monsarrat & Pratley as their Vancouver partner and representative.

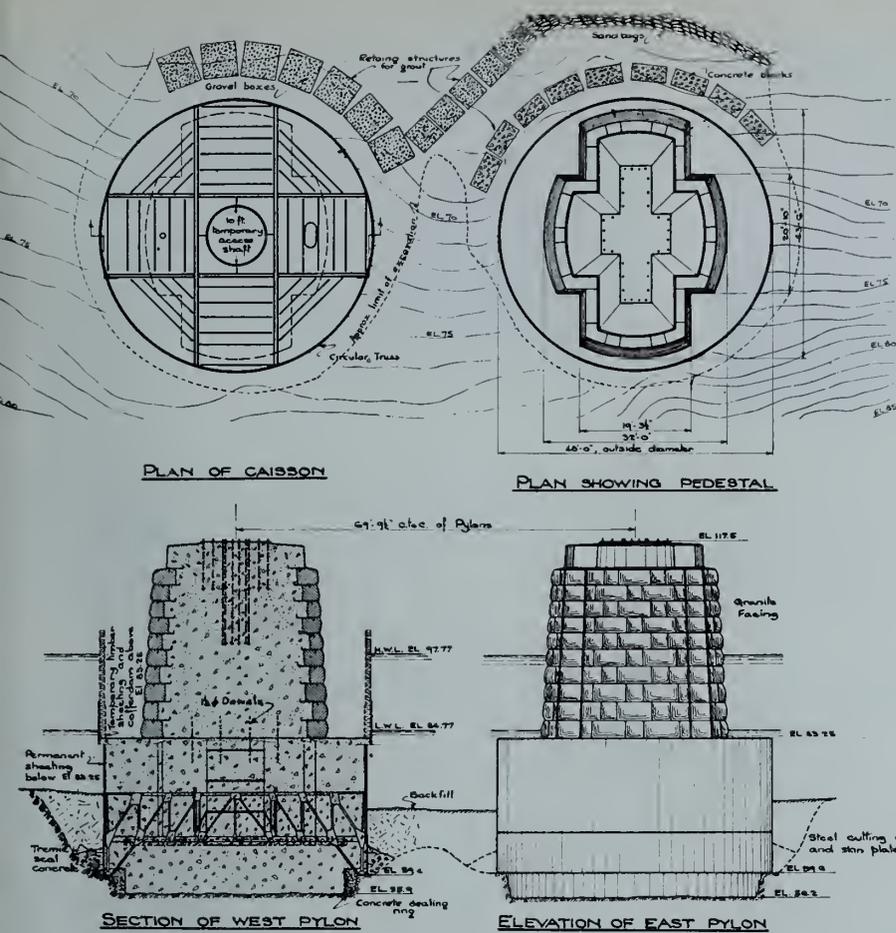


Fig. 4—South main pier.

prevalence of fog at that time of year, considerable difficulty was experienced in making the angular measurements involved. The final and acceptable series of readings was made with a Wild theodolite graduated to single seconds, and the resulting mean readings closed the primary triangle to 3.4 seconds of angle. The adjusted angles are shown in Fig. 3. As a check, the four secondary angles  $\alpha$ ,  $\beta$ ,  $\gamma$ ,  $\delta$  were measured and none of them was found to differ by more than 2.1 seconds from its computed value.

The north piers and viaduct pedestals were located by means of direct chainages from Sta. 98+02.418 (the intersection of the base line and the centre line), a 500-ft. tape being stretched over level crossheads erected at 50-ft. intervals. The location of each point was then carefully referenced by two hubs set on the edges of the right-of-way, out of the way of erection traffic.

Locations on the south shore were more troublesome, on account of the irregular slope of the hillside where the ground rises about 180 ft. in a distance of some 600 ft. Both the main pier and the anchor block were located by direct chainage. In the former case the tape was suspended over the bluff without intermediate support, and corrections for sag and slope (there was a difference in level of about 80 ft. in 130 ft.) were computed. The measurement was checked by running a traverse to the eastward of the line between the two points.

When the piers had been built, a further triangulation was performed by the superstructure contractor to check the relative positions of the two tower bases. A 1,920-ft. base line was laid on the north shore, extending eastward from the main pier approximately at right angles to the centre line of the bridge; and the contractor satisfied himself that the distance lay within  $\frac{3}{8}$  in. of the ideal dimension of 1,550 ft.

After erection of the south tower, a check measurement

of the south side-span length was made by means of a piano wire stretched at deck level, and this disclosed an error of about  $\frac{3}{4}$  in. in the 614-ft. chainage. The error is presumed to have occurred in the difficult measurement down the bluff. No other discrepancies were found.

#### SOUTH MAIN PIER

The south main pier is located about 150 ft. offshore, in a small coastal indentation. The swift (5 or 6 knots) tidal stream of the Narrows is so deflected by the buttress-like outcrop of Prospect Point as to induce a comparatively still backwater around the pier and, consequently, construction problems due to fast water did not arise. However, it was deemed expedient to provide protective rock-filled cribwork to the east and west of the site during the building of the pier.

The bed of the Narrows on this side consists of a soft coarse sandstone which extends some 400 ft. northwards before disappearing underneath a gravel deposit. At the site of the pier the surface of the rock, dipping northwards, lies at an average depth of about 15 ft. below low water level. This material, on exploration by borings to a depth of 40 ft. at the actual pier site, proved to be solid and of uniform consistency except for indications of a thin mud seam or fissure about 15 ft. below the rock surface and of uncertain extent. With such a dense and satisfactory foundation, it was practicable and economical to carry each of the pier shafts on a separate footing. The engineers' drawings therefore called for two rectangular caissons 36 ft. by 48 ft., equipped with steel cutting edges and pneumatic working-chambers. The contractor was later granted permission to substitute open circular caissons of 48-ft. diameter; but, on account of the probable presence of the above-mentioned mud seam, in conjunction with the engineers' insistence on a visual inspection of the bedrock before concreting, the compressed-air features were maintained as a precautionary measure (in case it was found impossible to unwater the working-chambers by pumping). The caissons were made up as shown in Fig. 4, the basis of construction being an 8-ft. circular steel truss supported by four light cross-trusses,

tions of a thin mud seam or fissure about 15 ft. below the rock surface and of uncertain extent. With such a dense and satisfactory foundation, it was practicable and economical to carry each of the pier shafts on a separate footing. The engineers' drawings therefore called for two rectangular caissons 36 ft. by 48 ft., equipped with steel cutting edges and pneumatic working-chambers. The contractor was later granted permission to substitute open circular caissons of 48-ft. diameter; but, on account of the probable presence of the above-mentioned mud seam, in conjunction with the engineers' insistence on a visual inspection of the bedrock before concreting, the compressed-air features were maintained as a precautionary measure (in case it was found impossible to unwater the working-chambers by pumping). The caissons were made up as shown in Fig. 4, the basis of construction being an 8-ft. circular steel truss supported by four light cross-trusses,



Fig. 5—South main pier: caisson-construction on shore.



Fig. 6—South main pier: sinking of caissons.

the lower flanges of which carry steel beams at the ceiling level of the working-chamber. The steel cutting-edge is 5 ft. below the ceiling slab, and the walls of the chamber are lined inside and outside with 3/16-in. plates, which were pierced at intervals to allow tidal water to run in and out during assembly.

The caissons were constructed on a temporary platform a few feet above low water level, and the concrete of the cutting-edge and of the 12-in. ceiling slab was poured before floating into position; and a shell of wood-sheathing of 3-in. planks was carried up some 24 ft. above ceiling level to prevent flooding during that operation (see Fig. 5). While the caissons were being prepared, the rock at the pier site was excavated to make a level landing at Elevation 60 for each cutting-edge. The rock was drilled and blasted from floating equipment, the broken material removed by dipper-dredge, and the bearing-areas then cleaned and trimmed by divers. The caissons were then floated out, and additional concrete was added to the ceiling slab and as a 12-in. wall inside the sheathing, the latter being extended (see Fig. 6) to maintain adequate freeboard. The caissons were sunk on to their beds within 3 in. and 4 in. respectively of their ideal positions, and were sealed to the rock by tremie-concrete placed outside the cutting-edges, this concrete being retained where necessary by a wall of concrete blocks, boxes of gravel, and sand bags on the outside, and by sacks of concrete placed inside.

During unwatering of the caissons, one "blow-in" occurred and was repaired without difficulty. Minor leakages were stopped by grouting, pipes for this purpose having been incorporated into the tremie-seal. A ring of concrete 2 ft. wide was then cast inside and below the cutting-edge to a depth of 3½ ft. The mud seam was revealed under the west caisson, and was entirely removed by complete excavation of the interior to the level of the bottom of the concrete ring, exposing a surface of solid rock at Elevation 56\*, which was tested by a further boring. In the east caisson the solidarity of the rock was proved by sinking a drill hole and test pit after excavation to the base of the concrete ring had been completed, no indication of any imperfection being discovered.

Upon approval of the foundation, each working-chamber was filled with concrete, after which the caisson was concreted solidly to Elevation 83.25, forming a base for the granite-faced pier shaft, which is keyed down by 40 steel dowels 1½ in. in diameter. The granite facing-blocks vary in depth from 2 to 3 ft., and are anchored to the concrete core with steel straps. The courses range in height from 3 ft. 2 in. at the base to 2 ft. 8 in. at the top of the shaft. The stones were all set in cement, vertical joints being grouted up as the work proceeded. The pier

shaft is cruciform in general plan, and terminates in a plain concrete cap or pedestal (4 ft. in depth and set back 2 ft. from the top of the battered granite walls), through the top of which, at Elevation 117.5, protrude the 32 anchor-bolts for the steel tower post. These bolts were set to a steel template and the actual tower seat was bush-hammered to dead level. Small "pilot" areas were prepared, checked, and painted, after which the general area was hammered down to their common elevation. This finished surface was checked by a 12-ft. steel straight-edge equipped with a sensitive level bubble.

The final operation in construction of the south main pier consisted in back-filling around the caisson base, with coarse gravel and stones up to "one-man" size, to the original rock level. The completed pier is shown in Fig. 7.

The handling of all material for the south main pier was effected by means of a timber stiff-leg derrick (100-ft. boom) set up on stone-filled cribwork just shoreward of the pier site. A mixing plant, with a 1½-yd. mixer, a weighing batcher, and suitable storage accommodation, was erected at the foot of the bluff for use in connection with this pier and the south anchorage pier.

Concrete for the cutting-edges, the roof slab of the working-chamber, and for all work on the pier shafts (as distinct from the footings) had a specified strength of 3,000 lb. per sq. in. at 28 days: the mix developed for this contained about 6½ sacks of cement to the cu. yd. The upper part of the footing is built of 2,500-lb. concrete. Seven-sack concrete was used for the tremie-seal, the concrete ring under the cutting edge, and the filling of the working-chambers and around the steel truss-work. To expedite the finishing of the dressed bearing-surfaces of the pier, a high-early-strength cement ("Ceberit") was used for the tops of the pedestals. All mixes were kept reasonably dry, with a slump generally of 3 in. or less (1½ in. for the pedestal tops), though a 6-in. slump was needed for concrete around the truss-work of the caissons. The concrete was vibrated wherever possible. Clean granitic aggregate of excellent quality, obtained from a gravel bank on the shore of Howe Sound, and washed, screened, and graded, was used throughout.

The bearing-pressure at the bases of the pier footings varies from about 4 tons per sq. ft. at high tide and with no live load to about 5.2 tons per sq. ft. under the worst loading conditions, at low water, the figures for the maximum case (for one footing) being as follow.

Pier		
Caisson steelwork . . . . .	95 kips	
Concrete in footing . . . . .	7,522	
Pedestal concrete . . . . .	3,570	
Reinforcing steel . . . . .	56	
Granite facing . . . . .	1,763	
		13,006 kips
Superstructure		
Main tower . . . . .	1,048 kips	
Cable reaction (D.C.T.)**	4,790	
		5,838 kips
Total . . . . .		18,844
Less buoyancy (at low tide) if any . . . . .		2,660
Net total . . . . .		16,184 kips

The base area being 1,810 sq. ft., the unit pressure is thus 10.4 kips, unless the underlying rock is pervious to water,

\*Vancouver Harbour Commissioners datum is referred to throughout this paper.

\*\*D.C.T. indicates the combination of dead load, 'congested' live load, and temperature (see Part II).



Fig. 7—South main pier: completed structure.

in which case the buoyancy reduces this figure to 9.1 kips.

Work on the south main pier was started on April 19th, 1937. Erection of the caissons began on July 5th, and the pier was ready to receive the tower shoes by January 14th, 1938.

#### SOUTH ANCHORAGE

At the south end of the bridge the land rises, steeply at first in the form of a bluff or cliff of very soft sandstone, and then by a more gradual grassy acclivity. At a point about 160 ft. above high water, the new approach road emerges from a cutting some 30 ft. deep through the stiff clay of the hill top, to pass directly over the upper surface of the south anchorage-pier. This pier, shown in Fig. 8, consists essentially of a concrete structure sufficiently heavy to resist the anchorage pull of the main cables, and shaped to take advantage of lateral support from the surrounding earth. The weight is concentrated towards the rear in order to minimize undue toe pressures from the overturning effect of the cable pull: and a heel block extends 12 ft. further into the ground than the remainder of the structure. The conformation of the terrain is such as to render unnecessary any approach structure, and the suspended side-span of the bridge takes its end-bearing on a pedestal at the front face of the anchorage: resting on the same pedestal block are the bases of the two rocker posts carrying cable saddles. While the actual anchor block, being mostly underground, has received no architectural treatment, the extent of its upper surface beyond the requirements for roadway and sidewalks is utilized as a foundation for the various structures pertaining to an ornamental plaza, the weight of this architectural concrete contributing incidentally to the stability of the pier.

The geology of the site presents a glacial deposit of clay containing coarse sand, gravel, and some boulders, the percentage of sand increasing somewhat at lower levels. This formation overlays the sandstone bed (which is gouged into basins by ice action) on which the main pier is founded by varying depths, 80 to 120 ft. of overburden being indicated by wash-borings made on and near the anchorage site. Before any excavation went forward, the findings from those six borings were considerably amplified by the sinking of a test-pit (4 ft. by 6 ft.) for a depth of 50 ft. on the actual site, and the above-described formation was found to extend for the full depth of the hole. The glacial deposit is hard and dense, weighing, in its natural damp state, about 150 lb. per cu. ft.; it resists infiltration of ground-water.

Construction began with the heel block, which took the form of an open cellular caisson with its outer walls poured directly in contact with undisturbed ground. Figure 9 shows the excavation with unsupported sides, for the first 18 ft.; it will be noted that pneumatic spades were needed to cut the material. When excavation had reached a depth of 24 ft., the caisson walls

were poured for that depth, after which excavation continued and the walls were extended downwards by successive 8-ft. pours. Before the 8-ft. sealing-slab at the base of the heel block was laid, 4-in. open-jointed tile drains were laid in a bed of crushed stone around its perimeter, and connected with an 8-in. cast-iron pipe leading to an outfall some 150 ft. away. In view of the impervious nature of the foundation, such drainage was deemed expedient to obviate the possibility of any hydrostatic uplift on the pier, and of any diminution of the friction coefficient due to lubrication.

The concrete of the caisson walls (seen in Fig. 10) and base slab is identified in Fig. 8 as concrete "A," and its placing was followed by the filling of the middle well (and small parts of the outer wells) of the caisson with concrete "B." The two outer wells, which are shaped to accommodate the splayed anchorage forgings, remained open to receive that steel at a later date, suitable openings for its admission being left in the north walls. Excavation for the bifurcated frontal mass of the pier then proceeded, the same policy of maintaining the ground undisturbed being followed. After the concrete "C" of this part of the pier had been placed, the cable anchorage steel was positioned in the outer wells, and incorporated into the pier inside the wedge-shaped concrete masses "E." The junction of this concrete with earlier pours was reinforced, in common with all other important bonding planes, by heavy dowels. Attention was then turned to the building of the pedestal block in front of the anchor pier proper. This, although in contact with the pier, is an independent structure, kept separate on account of possible differences in settlement due to its special loading conditions. Since the hillside falls away at the northeast corner of the site, the eastern side of the pedestal footing (concrete "D") was made correspondingly deeper than the western, and a quantity of backfill was placed about the footing. It may be noted here that the first intention (when the only data available was that from wash-borings) had been to provide added resistance to sliding by means of raking steel piles. In view of the actual soil conditions, however,

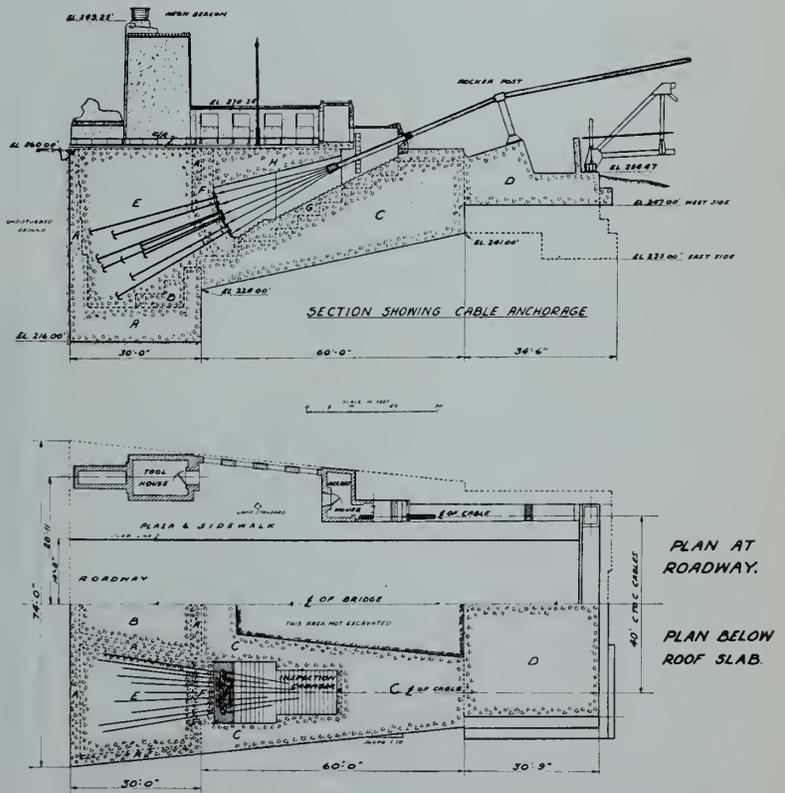


Fig. 8—South anchor-pier.



Fig. 9—South anchor-pier: excavation in stiff clay.



Fig. 10—South anchor-pier: completed walls of heel-block.

it was considered advisable to abandon the piling, and rather to preserve the foundation clay undisturbed. At the same time it became evident that the tougher nature of the soil (in conjunction with the absence of hydraulic effects from tidal water) would allow of the use of a lighter and more compact structure than that necessary on the north shore.

The front pedestal completed, the anchorage remained in its unfinished state, with the cable chambers exposed, until the cable assembly was sufficiently advanced to admit of the placing of concrete "F" behind the anchor buttons, followed by the roof slab "H" and the stairway treads "G." The resulting enclosed inspection chambers were found to be extremely damp during the winter months, owing to condensation, and fans and heaters were therefore installed.

When the "structural" part of the pier had been thus finished, the deck slab and plaza features (see Fig. 11) were taken in hand. These latter are identical in form on either side of the roadway, and are briefly described as follows. At the north end of the anchorage, the main cables each enter (through a battered front wall) into a low box-like structure which is built-on to a small building known as the "access-house," since it provides a means of communication with the inspection chamber that houses the splayed strands. The west access house is provided with toilet accommodation, and either house is available for use by toll-keepers when pedestrian tolls are taken at this end of the bridge. Towards the heel of the caisson are two ornamental pylons, giving architectural emphasis to the entrance to the bridge proper. These are two-storey structures (the spaces within being used for electrical equipment and tool storage), 10 ft. by 15 ft.

at the base and 26 ft. high; and at the top of each is set a specially-designed beacon or cresset, illuminated at night with a soft amber glow by means of concealed neon tubing. Connecting each pylon with the corresponding access house is a screen wall 8 ft. high, pierced with four window-like spaces to break the monotony of its 30-ft. length. Finally, close against the south walls of the pylons are two massive concrete lions, couchant on low pedestals, facing southwards into Stanley Park along the new approach road. A feature of the architectural work is the effective rough finish achieved by bush-hammering the major wall areas to a depth of about  $\frac{1}{4}$  in., thereby giving the work a texture more in harmony with the natural surroundings. The lions (which were pre-cast near the site in carefully-prepared plaster molds, using a high-cement mix with graded granite chippings of small size) received a surface treatment of strong hydrochloric acid, which had the satisfactory result of exposing the granite aggregate in the similitude of natural stone.

After completion of the bridge, the cutting and fill were neatly graded, and, under the direction of the Parks Board, planted with grass and ornamental shrubbery: so that the entrance to the bridge now constitutes one of the formal beauty spots of Stanley Park.

The south anchorage is 90 ft. in length (or 124 ft. inclusive of the front pedestal-block) with a width of 74 ft. at the heel and narrowing to the pedestal width of  $45\frac{1}{2}$  ft. in front. Some 7,290 cu. yds. of concrete are comprised in the structure, and its total weight, including the reinforcing steel (114 kips) and the bedded parts of the cable anchorage (133 kips) is about 15,080 tons.

In reference to the stability of the pier, sliding due to the horizontal part of the cable pull is resisted by the horizontal friction developed between the concrete and the clay foundation; and by positive horizontal bearing on the front pedestal, the battered sides of the bifurcated main structure and of the heel block, and the vertical northern face of the heel block. Assuming a coefficient of friction of 40 per cent, the resistance to sliding developed over the base areas only is just greater than the horizontal component of the cable pull; but when horizontal bearing is taken into account the factor of safety becomes about 1.5. The maximum toe pressure of the pier (occurring under the greatest cable pull) amounts to 4.62 kips per sq. ft. At the rear of the heel block, the greatest pressure took place during construction, before the cables had been assembled, and amounted to 6.51 kips per sq. ft. Under working conditions the heel pressure does not exceed 4.42 kips per sq. ft.

Work on the anchorage was commenced on April 29th,



Photo Leonard Frank, A. R. P. S.

Fig. 11—South plaza and general view from south.

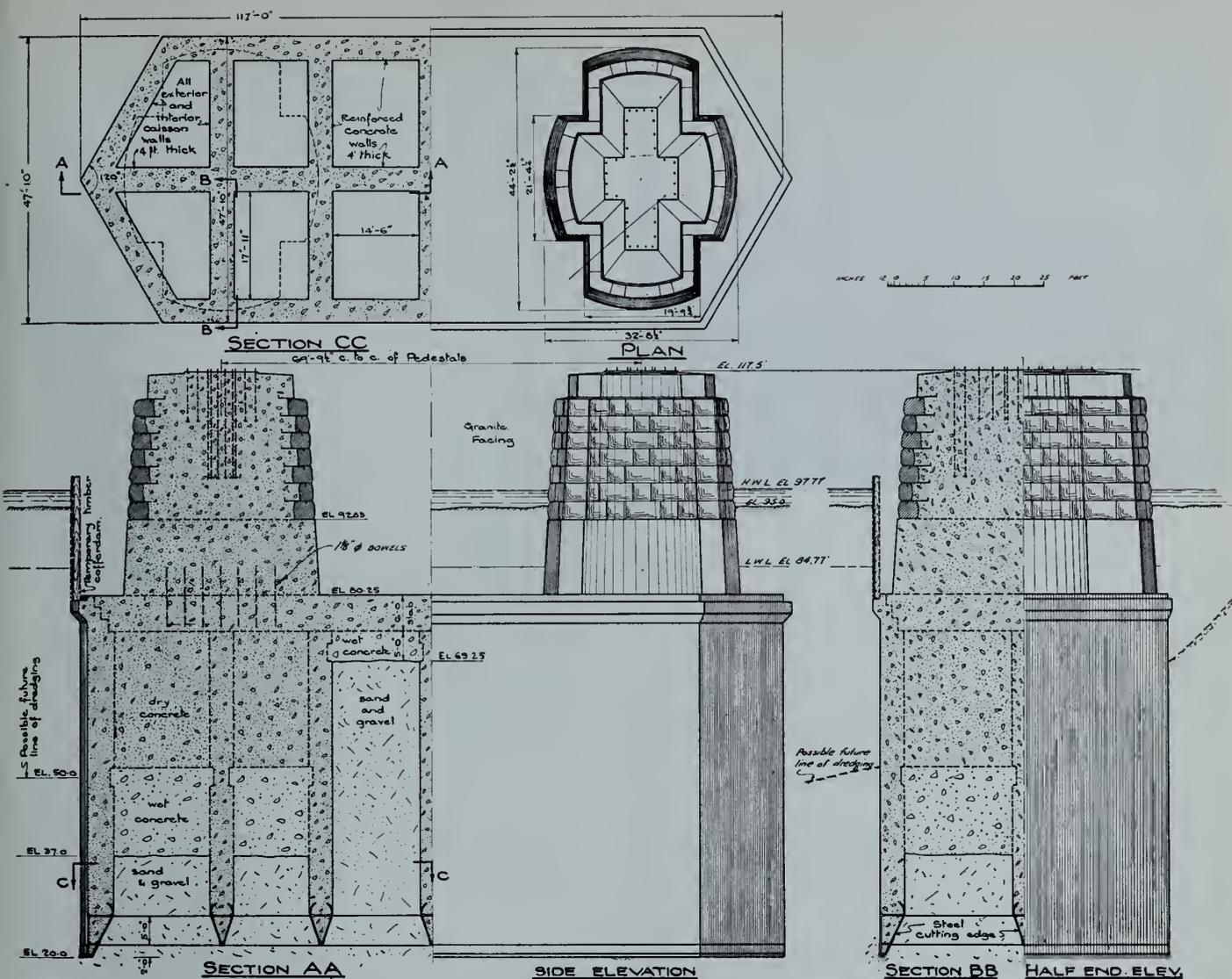


Fig. 12—North main pier.

1937, the excavation proper starting on July 19th of the same year, but the last details of the plaza were not completed until the end of January 1939, some three months after the opening of the bridge to traffic. Concrete for the main part of the pier was hauled from the mixing plant on an inclined railway which passed underground through the bluff at the lower part of the hillside. Later concrete, for the road slab and buildings, was brought ready-mixed from Vancouver. As for other parts of the substructure, a dry mix was always used, and vibrated into place. All concrete for the south anchorage was required to yield a strength of 2,500 pounds per sq. in. at 28 days.

#### NORTH MAIN PIER

The pier which carries the north main tower is situated on shore, above the level of all but high tides. The ground of the north shore is formed of a hard-packed coarse wet gravel, laid down as a deltaic deposit by the Capilano River. This gravel extends to a considerable depth, overlaying the sandstone on which the south main pier rests by about 300 ft., as is evidenced by borings made at the time of construction of Greater Vancouver Water District's pressure-tunnel under First Narrows. The depth and size of this pier were influenced by the extremely remote possibility that the gravel on its south side may be dredged away to Elevation 50 in an endeavour to extend the navigable channel. As the site is at present, scour is non-existent, and the pier is considerably deeper and heavier than is necessary for stability.

The pier footing consists of an open cellular caisson with outside dimensions of 48 ft. and 117 ft. (Fig. 12), the shape being adopted in view of the possible future dredging. The steel cutting-edges (forming the toes of the walls and the partitions, all of which are 4 ft. thick) were assembled on the site after this had been levelled-off at Elevation 92.5; and sinking of the caisson was begun as soon as the reinforced concrete incorporating the cutting-edges had been poured to a height of 7½ ft. The sinking process consisted of alternately dredging inside the pockets (by orange-peel buckets operated by two derricks mounted on piles) and building-up the walls (see Fig. 13) until the cutting-edge had penetrated to the designed level at Elevation 20. A temporary timber cofferdam was built on to the top of the peripheral wall for use during the last stages of sinking and for construction of the pier-shafts in the dry.

The caisson followed the excavation under its own weight for the first 50 ft., after which sinking was accomplished almost entirely by excavating below the cutting-edges and then destroying the skin-friction by the explosion of light charges inside the dredging-pockets, a total of about 200 lb. of 40-per-cent dynamite being used for this purpose. As a matter of incidental record, the skin friction when the caisson was within a few inches of its final set and entirely unsupported by the cutting-edges was computed to be about 450 lb. per sq. ft.; though there is no evidence that this friction would have maintained the pier in its otherwise unsupported condition in-

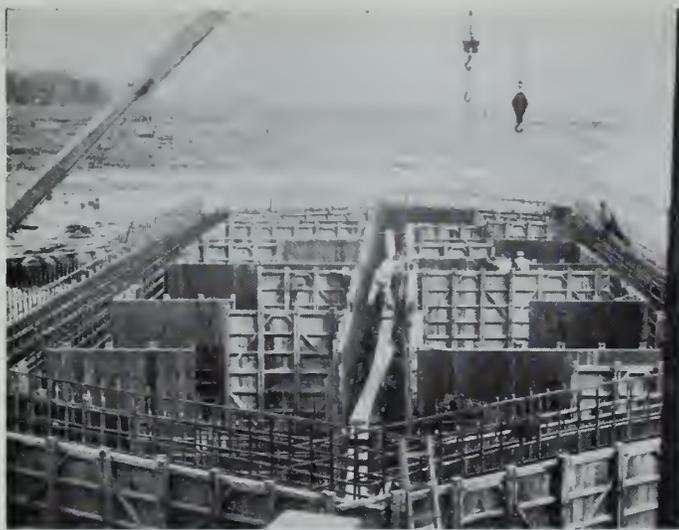


Fig. 13—North main pier; ready for wall-concrete

definitely. The sinking of the caisson occupied a period of three months (August to November 1937), at the end of which the cells were backfilled and concreted as shown in Fig. 12. The operation took place without incident beyond the appearance of several vertical hair-cracks at the top of the 7½-ft. wall, at the first sinking. This condition was rectified by the placing of extra longitudinal wall reinforcement at the bottom of the adjoining pour. The level of the caisson was readily maintained by regulation of the sequence of excavation of the various pockets in accordance with circumstances.

Upon unwatering the timber cofferdam, it was found that the upper 6-ft. rim of the caisson had cracked in a number of places. This top part of the wall, in order to accommodate a solid 6-ft. capping slab, was thinner than the main wall below and was unsupported by the cross-walls; and, since the cracking did not extend into the main wall, it was not considered to be of significance. The cracks were repaired by sealing on the inside with quick-setting cement, and the pier footing was completed by the pouring of the 6-ft. slab over all the pockets, its top surface being at Elevation 80.25.

The pier shafts differ from the south ones only in that they extend 3 ft. deeper and in that the ashlar facing, serving no useful purpose below shore level, is discontinued immediately below that elevation. The elevation of the precisely-dressed caps is 117.5.

Two strengths of concrete were specified. That for the cutting-edges, for the top slab of the footing, and for all work above the footing was required to develop a strength of 3,000 lb. per sq. in. at 28 days; while 2,500-lb. concrete was used for the caisson walls and for backfilling in the pockets. In order to expedite the work towards the end, the pier shafts were capped, as on the south main pier, with concrete containing high-early-strength cement. Slumps varied from 1½ in. for the shaft-tops to 3½ in. for the wall concrete and as much as 6 in. where the concrete had to be worked into the steel of the cutting-edges. Concrete was supplied from a mixing-plant (equipped with two one-yd. mixers with weighing-batchers and a controlled water supply) built nearby, and all material was placed by two timber derricks erected immediately north and south of the site.

Work went forward simultaneously with that on the south side, being started on April 9th, 1937 with the construction of plant. Erection of the cutting-edge began on July 5th, and the pier was finished on February 25th, 1938.

Bearing-pressure under the pier was at first concentrated largely on the cutting-edges. As settlement occurs,

however, owing to the compressibility of the backfill under the concrete plugs of the excavation chambers, the variable pressures at the level of the cutting-edge will tend to reduce to a general average load over the whole base plane; while simultaneously the bearing pressures underneath the concrete plugs of the dredging chambers will increase from a small initial quantity to their final value (which depends on the elevations of the plugs above the bottom of the footing).

From experience of this same gravel-bed at Second Narrows Bridge, six miles further up the Inlet, the engineers anticipated that, during the above-described adjustments of bearing pressures, the pier would settle approximately 1¼ in. over a period of two or three years, and that the greater part of this settlement would occur during the superstructure erection. The pier top was therefore dressed to an elevation higher than the theoretical by that amount. In Fig. 14 the progress of the settlement over the first year has been plotted. Subsequent indications are that the settlement, though rather more than was expected, is tapering off satisfactorily.

Figures for the final average pressure are as follows, the conditions for maximum effect (i.e. low water and greatest superstructure load) being taken. Loads are stated in kips.

Pier:			
Cutting-edge 90, Reinforcing steel 270.....		360	kips
Concrete .....	41,200		
Gravel backfill (wet) in pockets (122 lb./cu. ft.) .....	10,760		
Gravel backfill around pedestals .....	4,840		
Granite facing (170 lb./cu. ft.) .....	2,340		
		<hr/>	
		59,500	kips
Superstructure			
(D.C.T. as for south main pier) ....	11,670		
		<hr/>	
Total .....	71,170		kips
Less: Resistance from skin friction (on footing only) at 400 lb./sq. ft. ....	6,990		
Buoyancy at low water	19,980	26,970	
		<hr/>	
Net total .....	44,200		kips

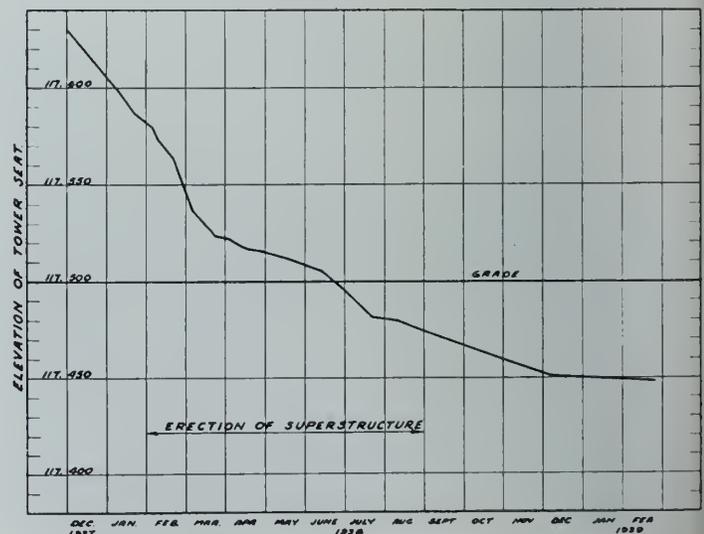


Fig. 14—North main pier; progress of settlement.

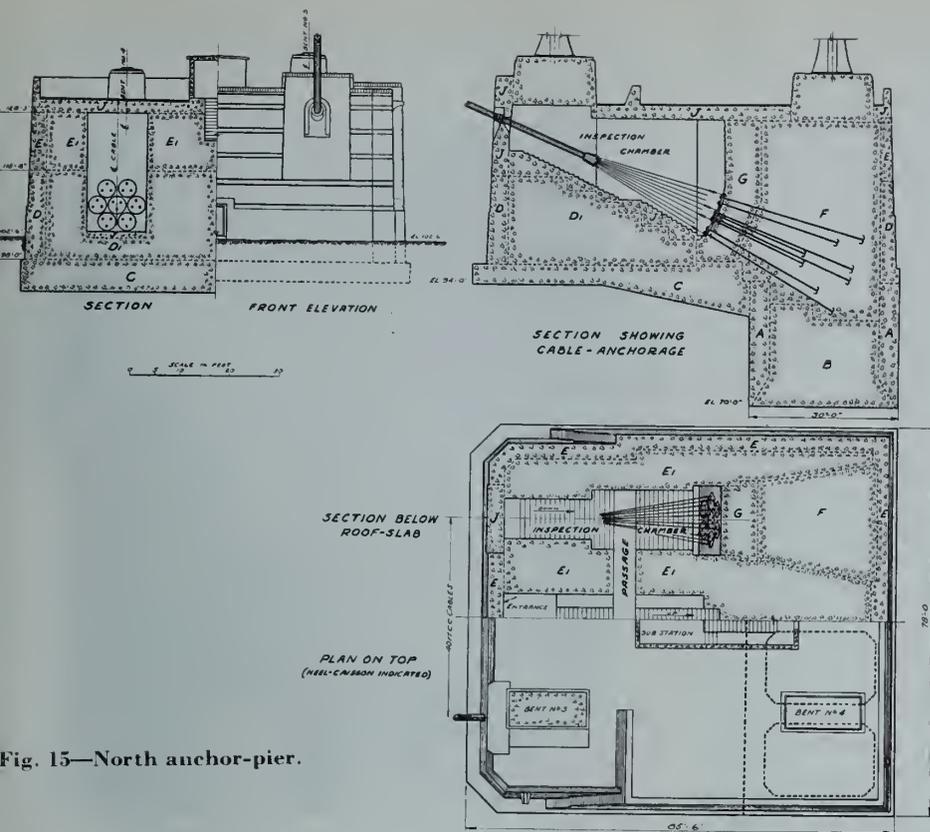


Fig. 15—North anchor-pier.

The base area of the caisson being 4,936 sq. ft., this gives an average bearing pressure over the horizontal plane at Elevation 20 of 9.0 kips per sq. ft.

At the same time, the natural pressure of the gravel on the same plane is made up as follows, figures being in pounds per square foot.

From 11 ft. of "dry" gravel above low water level, 11 x 100 .....	= 1,100
From 64 ft. of wet gravel (with approximately 40% voids) below low water level, with allowance for buoyancy of same, 64 (122 - 64) .....	= 3,712
	4,812

The ultimate "punching" pressure over the area of the base plane is thus 4.2 kips per sq. ft.

#### NORTH ANCHORAGE

Conditions on the north shore, together with the fact that a large structure above ground would not be objectionable (there being no prospect of any development of the low-lying marshy terrain of the delta) led to the choice of a simple gravity-type of anchor-block at this end. The pier is positioned so that it is utilized to support one of the viaduct towers (thus reducing the tonnage of steel in the viaduct and also employing some of its weight as kentledge), while at the same time the slope of the backstay of the main cable is very close to the optimum for economy. The pier is shown in Fig. 15.

Basically, the pier consists of a heavy concrete box containing an anchorage for the main cables together with suitable inspection chambers and means of access. The pedestals for two of the viaduct bents, and also a sub-station whence the electric supply for the bridge is distributed, are carried on the flat roof, which is surrounded by an ornamental parapet wall 4 ft. high. The exterior of the pier is treated architecturally (see Fig. 16), the

dominating features being the provision of a pronounced set-back in each side wall normal to the direction of the cable, and the interruption of the large vertical concrete faces with horizontal rustications. The tops of the parapet walls have a fluted finish, pre-cast gargoyles are provided to throw the roof drainage clear of the walls, and arched niches are employed at the points of egress of the cables. Access to the pier is provided by a door at the bottom of the front face, and a stair connects with the cable-inspection chambers and with the pent-house sub-station, where a door leads out onto the roof. Communication with the viaduct deck may be made by a ladder running up the side of one of the bents. The inspection chambers are ventilated by concrete grilles set low down in the side walls.

At the rear of the pier, and extending over the full 78-ft. width of the structure, is a heel block 30 ft. wide and sunk 24 ft. deeper than the general base of the "box." This was provided in order to concentrate dead weight where it is needed, and also to present a positive resistance to

sliding. Construction began with the laying-down of the cutting edge of a four-pocket open caisson for the heel block. The steel-shod shoes were filled with 3,000-lb. concrete, while 2,500-lb. concrete was used for the caisson walls (denoted by the letter "A" in the figure) and for all other work in this pier. No difficulty was encountered in sinking the caisson, after which the cells (the walls having been roughened to provide maximum bond) were sealed with tremie-concrete to a depth of 12 ft. and built up to the shape denoted by "B." Excavation for the base slab in front of the heel then went forward and this slab "C" was the next to be poured. The outside walls "D" were then built to a construction plane at Elevation 115.67, after which the large mass of concrete "D<sub>1</sub>" was deposited, leaving cavities for the wedge-shaped masses incorporating the anchorage-steel. Then followed walls "E" to the elevation of the bottom of the roof-slab, and the remaining mass-concrete "E<sub>1</sub>" around the anchor cavities. At this stage, the superstructure contractor assembled the cable anchorages, which were then concreted in: the anchor masses "F" each contain about 670 cu. yd. of concrete. Pedestals for the viaduct were then built, those for Bent 3 being carried on shallow concrete beams over the cable chambers. During the building of the pier, all construction joints were thoroughly cleaned of laitance



Fig. 16—North anchor-pier: architectural treatment.

and roughened, important bonding surfaces being heavily reinforced. Vertical wall joints were sealed with copper water stops.

The pier remained in the unfinished state described (i.e. with the roof slab and parapet walls and the upper part of the front wall missing: see Fig. 17) during the assembly of the main cables, the anchorage chambers being open to facilitate unreeling of the strands and assembly of the sockets.

After the cables had taken up their final normal position and the backstays had been wrapped, construction was completed with concrete work "J," which comprises the waterproofed roof slab, parapets, the concrete around the cable entrances, the sub-station, and the stairways. The ground around the pier was backfilled to Elevation 102.5.

Calculations concerning stability were made for all stages of construction, the pours of concrete being so arranged chronologically as to obviate the occurrence of unduly large bearing pressures and dangerous sliding conditions. Sliding resistance was computed separately for the two horizontal bottom surfaces, for the vertical front of the heel block, and for the inclined base of the central slab, the angle of friction of the gravel being taken as  $\tan^{-1}.40$ . The greatest tendency to sliding occurs at high tide, with lateral wind (but no live load) on the approach bents and with maximum cable pull, and for this condition the horizontal component of cable tension is 11,556 kips, while the resistance of the pier to sliding is computed as 24,902 kips. The maximum toe pressure under the pier occurs also with the greatest cable pull, but at low tide and with both live load and wind on the viaduct, and is 6.08 kips per sq. ft. The maximum under the rear edge of the heel caisson took place during construction, immediately before assembly of the cables, and amounted to 7.65 kips per sq. ft. Under working conditions the heel pressure does not exceed 5.40 kips per sq. ft.

The amount of concrete in the pier is about 9,780 cu. yd.; and its total weight, including cutting-edge (13 kips), reinforcing steel (219 kips), and cable anchorage assembly (134 kips), but not including the electrical substation and equipment, amounts to approximately 20,250 tons.

Construction of the pier began on July 6th, 1937, and

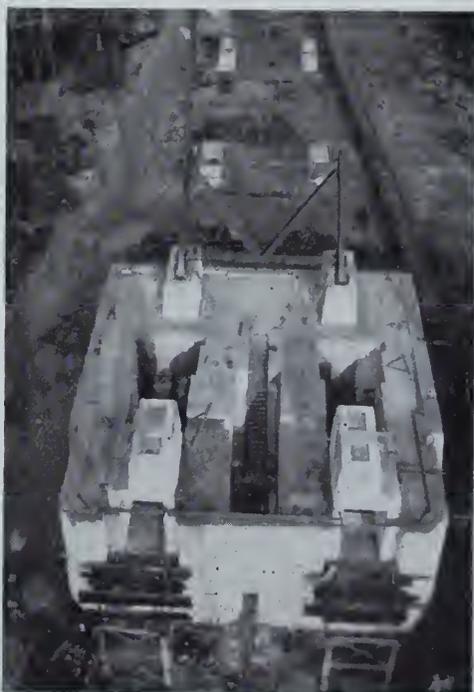


Fig. 17—North anchor-pier; ready for erection of cables.



Fig. 18—Pedestals for north viaduct.

it was ready to receive the anchorage steel in November of that year. The final pour of concrete was made on November 4th, 1938. All concrete was supplied from the mixing-plant near the main pier.

#### VIADUCT SUBSTRUCTURE

The girder-spans of the north viaduct are supported (see Fig. 2) on 24 steel bents, a concrete abutment at the north end, and the cable bent at the end of the side-span. There are twenty-five pairs of concrete pedestals, those which carry Bents 3 and 4 forming part of the anchorage pier, and the remaining 46 being founded on the gravel formation that has already been described. The pedestals have appropriate spread footings which are taken to a depth that depended on the local conditions in each instance. For the footings, 2,000-lb. concrete was specified, and 2,500-lb. concrete for the shafts. The maximum bearing pressure does not exceed 2.6 tons per sq. ft. except in the cases of the most northerly bent (where, owing to the stiffness of the short column, the pressure may attain an extreme value of 3.7 tons per sq. ft.) and of the heavy cable bent (where cable pull and side-winds render 5.6 tons per sq. ft. possible, under the deeper western footing). Anchor-bolts for the steel were set into the concrete, but the bearing surface of the pedestal was not dressed to elevation except for a small central area. On either side of this bush-hammered portion were left 6-in. recesses that were grouted up to the base plates after the bents had been plumbed. In the way of aesthetic treatment, the sides of the pedestals are battered at a slope of 1 in 16, and the upper 8 in. of the sides are set back 3 in., the 8-in. face being painted with black asphaltic paint. A general view of the viaduct pedestals is to be seen in Fig. 18.

The abutment, at the south end of the embankment, consists of a base slab 57 ft. by 20 ft. and 3 ft. thick, on which are carried four columns in the form of longitudinal counterforts (Fig. 19). The two principal columns at 22-ft. centres support the bridge seats, and the two outer columns at 50-ft. centres support the ends of the breast



Fig. 19—Open abutment at north end of viaduct.

wall. This vertical wall is 18 in. thick and 12 ft. deep, suitably reinforced, and serves to retain the fill above a point about 2 ft. below the elevation of the bridge-seats, the remaining depth of the fill being allowed to spill around and through the abutment: the top of the wall is shaped to the profile of the roadway. The height of the abutment from grade to footing is about 40 ft., this figure deriving from study of the comparative costs of embankment and steelwork, and of the permissible weight and lateral extent of the former.

About 3,400 cu. yd. of concrete were required for the pedestals and abutment. This part of the job, including excavation, proceeded concurrently with that of the remainder of the substructure, being started in April 1937 and completed in time to receive the steelwork in November of the same year. No frost was experienced during construction or in the period of curing. Concrete was supplied from the mixer at the north main pier, and distributed by truck.

#### NORTH EMBANKMENT

As may be seen from Fig. 2, the length of the main embankment, extending from the end of steel to the south abutment of the Marine Drive overpass, is approximately 1,000 ft.

For descriptive purposes, it may conveniently be divided into three parts. Over the first section, extending some 340 ft. northward, the roadway continues downward at the grade of the viaduct, and retains its normal 37-ft. overall width. The next section, extending (with a length of 400 ft.) as far as the division of the road into the three traffic ways comprising the junction with Marine Drive, carries the eight-lane toll-collection plaza. A 100-ft. vertical curve reduces the gradient to 0.25 per cent and, in a distance of 220 ft., the roadway widens to the full plaza width of 109 ft. between kerbs, this width being maintained for the remaining 180 ft. of the section (see Fig. 20). Drainage over the plaza is effected by a four-inch parabolic roadway crown,\* assisted by the slight longitudinal gradient; catch-basins and

\*This 4-in. parabolic crown has proved insufficient, the crest of the road being too flat for efficient drainage.

drains are provided. The toll station itself (Fig. 21) consists of three double-lane toll booths, and one single-lane booth on the west side of the road. On the east side stands the administration building which, together with its garage accommodation, covers an area of 31 ft. by 82 ft. The three main toll booths each consist of a small enclosed, heated, concrete building mounted on a concrete "island" 47 ft. long and 9 ft. in maximum width, tapering nearly to a point at each end, where a concrete protection post is set up. The kerbs of these islands are four inches high for the greater part of their length, but increase in height towards the ends to give protection to the booths proper. The two traffic ways between the main booths are sheltered by a common canopy of concrete; but the outer ones, in order to admit high truck loads, are uncovered.

A covered service-trench (for electrical conduits, steam pipes, etc.) connects the series of booths with the administration building; and cavities, covered by removable slabs, have been left in the roadway to permit of the future installation of electro-mechanical traffic-registering gear should the use of such become advisable. The administration building is equipped with water supply, and a septic tank is provided for disposal of the sewage effluent.

The third section of the fill consists of foundations for three diverging roadways. The westerly side-road, forming the inlet from West Vancouver and the popular Whitecliff highway, is 24 ft. in width. That on the east side, being the comparatively little-used outlet towards North Vancouver, is 13 ft. wide as built, but may be broadened in case of necessity. These two outer roads lead directly into Marine Drive on gentle downward gradients. The central road, leading from the plaza on an up-grade of 3.6 per cent, is 24 ft. wide, accommodating traffic both from the east (North Vancouver) and to the

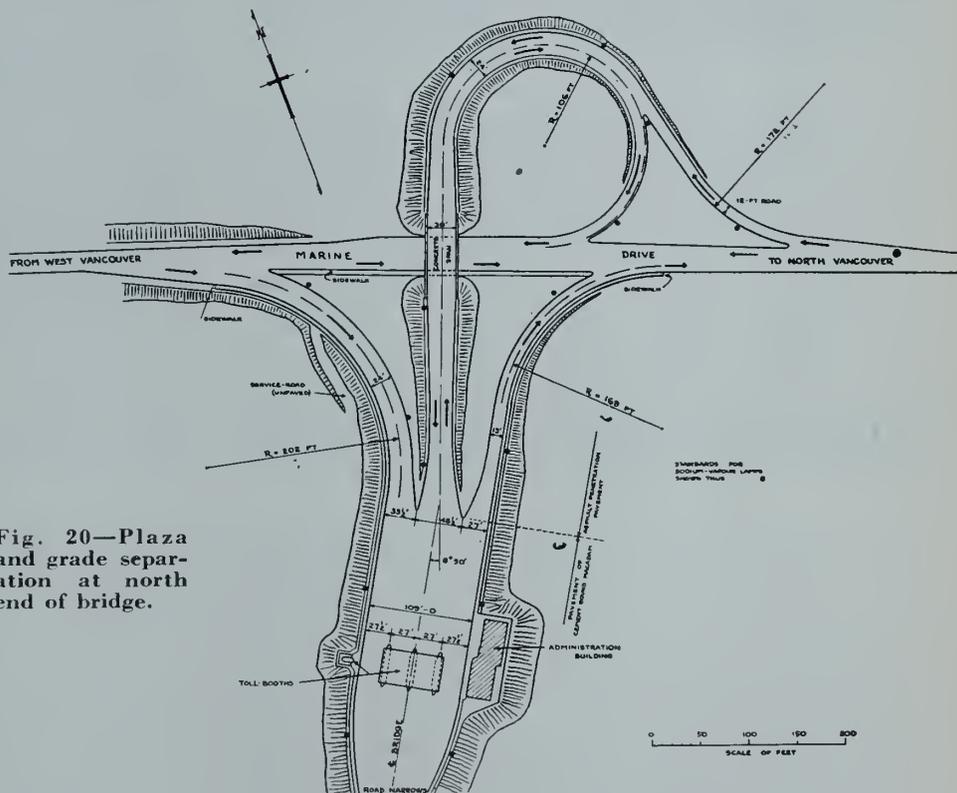


Fig. 20—Plaza and grade separation at north end of bridge.

west. Traversing Marine Drive by a 40-ft. rigid-frame concrete overbridge, this road veers to the east, and, descending on a gravel fill, divides into two single-lane tributaries.

For construction of the embankments, gravel fill of excellent quality was readily obtainable close at hand.

An extensive borrow pit was formed to the east of the right-of-way, on the Capilano Indian Reserve, suitable material being available after clearing the land and removing some 18 inches of top-soil. Although the original specifications contemplated a programme of heavy rolling to consolidate the fill as it was placed, it was found that, provided the gravel were spread in thin layers, consolidation was adequately secured by the heavy traffic incidental to construction. The gravel, which is naturally graded from a sandy soil to boulders of 8 or 9 in. in diameter, bedded down very rapidly and formed an extremely dense, solid and stable embankment, practically impervious to water. The side-slopes throughout were finished to a batter of  $1\frac{1}{2}$  to 1, and the berm-width varies from 2 to 3 ft.

The total amount of fill placed by the contractor was 110,400 cu. yd., of which 45,200 cu. yd. represented additional work involved in the Marine Drive grade separation. Consolidation of this latter fill (placed only a few weeks prior to the opening of the bridge) was expedited by jetting with water as it was dumped. The total unit cost, per cu. yd. in place, including preliminary clearing, did not exceed 30 cents.



Fig. 21—North plaza, toll-booths, and administration building.

The original intention of the engineers had been to provide a temporary pavement on the embankment, to be replaced permanently after a suitable period of consolidation of the sub-grade by traffic and weathering. In view, however, of the remarkably solid nature of the fill, decision was made to proceed at once with the construction of a rigid slab over the main embankment from the end of steel as far as the division of the roadway. It was further decided to use the type of pavement known as "cement-bound macadam," since the prospects were that this could be placed more expeditiously and economically\*

\*Owing to the limited extent of the paved area, and also because of the contractor's lack of experience with this type of pavement, it is doubtful whether any saving was actually effected in time or money.

than a regular concrete slab, while at the same time being of equal wearing-quality. An asphaltic pavement was, however, employed for the three roads of the Marine Drive junction.

Cement-bound macadam consists (to quote from the engineers' specifications\*\*), of "a layer of coarse aggregate over which is poured a Portland cement grout of such fluidity that it will immediately flow through and completely fill the voids"; and the following is an outline of the method used in the construction.

Combined kerb-and-gutter-sections were first constructed of plain concrete, reinforced only by a "Truscon" kerbar, to serve as boundaries for the roadway, and the sidewalk slabs,  $3\frac{1}{2}$  in. deep and reinforced with a light mesh, were keyed into them. The subgrade was then levelled-off to profile, and compacted with a 3-ton roller. Expansion joints, both longitudinal and transverse (the latter at 30-ft. intervals), were provided for by one-in. planks laid on edge and extending from just below the subgrade surface to  $\frac{1}{2}$  in. below the finished grade. The coarse aggregate, a clean durable gravel screened to be principally of 2-in. size, was then spread evenly over the subgrade to the specified depth of 6 in., and lightly rolled to smooth the surface without damaging the stones. The grout mixture consisted of  $87\frac{1}{2}$  lb. of cement to 175 lb. of clean natural sand of specified grading, mixed with sufficient water (about 7 gallons per sack) to obtain the required consistency, and its "fluidity" was defined by the time required for the mixture to flow from a vessel of specified size. The grout was poured over the stones by means of a wooden chute perforated with one-in. holes 3 in. apart, distribution proceeding continuously in order to avoid the formation of air-pockets. Thorough penetration was assured by constant supervision. Sufficient grout was applied to leave a thin film over the top of the stones.

The grout was then left undisturbed for one to two hours, and the pavement was compacted by rolling with a 3-ton roller until a hard even surface was obtained, hand-brooms being used to distribute the grout evenly and to remove any excess. Surface irregularities were removed by 12-ft. tamping templates, and excess water by dragging strips of damp burlap along the road. The final finish (Fig. 21) was obtained by transverse brushing with fibre brooms. The total area paved with cement-bound macadam was 1,730 sq. yd., the amount of stone used being approximately 800 cu. yd.

The embankment roadways are bounded by diamond-mesh wire fences 3 ft. high, carried on 8 by 8 in. cedar posts 9 ft. long. The posts extend 4 ft. 9 in. into the fill, being stabilized by underground cross-timbers: all embedded timber received two coats of preservative.

\*\*Based on those of the Portland Cement Association.

*Editor's Note:*—Part II of this paper, which deals with the design of the superstructure, will appear in the May issue.

# PRODUCER GAS FOR MOTOR TRANSPORT

E. A. ALLCUT, M.E.I.C.

Professor of Mechanical Engineering, University of Toronto, Toronto, Ontario

Paper presented before the Hamilton Branch of The Engineering Institute of Canada, on January 9th, 1942

## ALTERNATIVE FUELS

The use of gasoline and other petroleum products for small, high speed internal combustion engines has been so general in North America that few serious attempts have been made to employ other fuels in this field. The convenience and compactness of gasoline and, until recently, its low cost have discouraged competition, but war-time restrictions and transport difficulties have created fresh interest in the search for suitable alternative fuels. Other countries, less favourably situated than Canada is, with regard to supplies of petroleum products, have already explored this field and are able to subsist, at least to some extent, on home-produced fuels.

The properties desirable in a fuel that is to be used for automotive purposes are:

- 1) *Mobility* in the intake manifold, so that the fuel will be distributed evenly to the various cylinders and will mix well with the air supplied for combustion. This points to a gas or vapour—preferably the former.
- 2) *High anti-knock rating*, so that advantage may be taken of the increased thermal efficiency obtainable by using high compression ratios.
- 3) *Complete combustion* in a short time, and absence of deleterious gases in the exhaust.
- 4) *Minimum wear*, corrosion or clogging in the cylinder and valves.
- 5) *No contamination* of spark points or lubricating oil.
- 6) *Flexibility* with variations of speed and load.
- 7) As nearly as possible, the same *mixture strength* for maximum power and best economy.
- 8) *Low cost* and relative *safety*.

The principal objections to gasoline are:—

- a) Its tendency to *knock* with high compression ratios.
- b) *Fire and explosion* risk at ordinary temperatures.
- c) The maximum *power* is obtained with a *rich* mixture and the best *economy* with a *weak* mixture.
- d) The *combustible range* of air-gasoline mixtures is comparatively small.
- e) If power, acceleration and easy starting are required, the exhaust gas contains dangerous quantities of *carbon monoxide*.
- f) The *control* for different speeds and loads is complicated.
- g) *Distribution* is poor on account of the presence of liquid drops in the manifold.
- h) It is *irreplaceable*. Fresh supplies can only be obtained by going further afield, further underground, or both.

The last condition applies to many of the suggested alternatives, but with the practical difference that there may be more of the alternative fuels available and that the depletion of those resources may be proceeding at a slower rate. Alcohol, for example, can be produced rapidly from growing vegetable matter; wood also is growing, but its rate of replacement is slow. Supplies of anthracite coal are few and restricted, but bituminous coals and lignites are relatively abundant.\*①. Synthetic fuels, generated by the

\*Sir H. Hartley states that, at the present rate of consumption, the world's coal reserves are sufficient for about 4,000 years. No estimate has been made of the world's oil reserves, although they are almost certainly much less extensive than coal.

hydrogenation of coal or by the combination of carbon monoxide and hydrogen, ② (produced from coal or coke) cannot be usefully considered at this time because of the high cost of the plant, the time required to build it and its comparative vulnerability to air attack. The hydrogenation process has been used both in Great Britain and Germany, but in these instances the important arguments in its favour were probably its usefulness in war-time and the political and economic necessity of providing employment for the coal miners. Compressed and liquefied gases, such as methane (from sewage), natural gas, propane, butane, coal gas and hydrogen, have been used satisfactorily, but these are probably unavailable at the present time because of

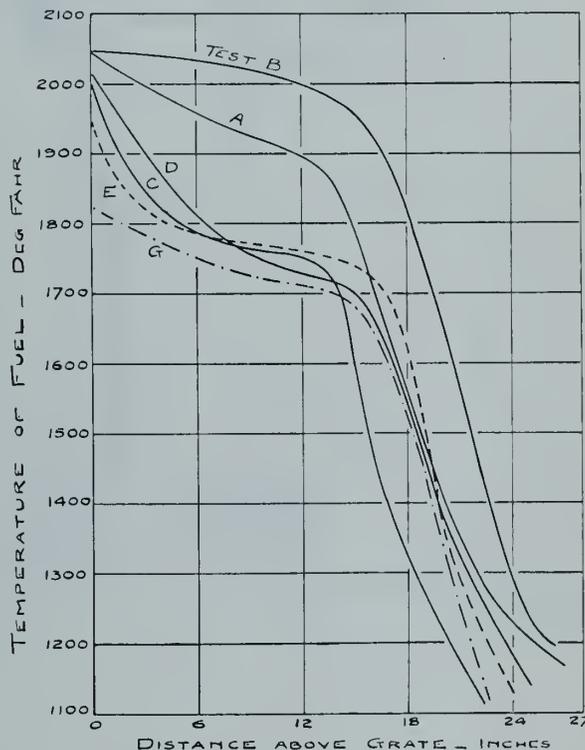


Fig. 1—Fuel temperature in a small up-draft gas producer using anthracite. Water feed in pounds per pound of coal burned: Test A-0.016, Test B-0.232, Test C-0.421, Test D-0.724, Test E-0.718, Test G-1.140.

(1) the difficulty of obtaining compressing plant for gas pressures which may be as high as 3,000-5,000 lb. per sq. in.; (2) the shortage of steel suitable for storage bottles; (3) the lack of the manufacturing facilities necessary for producing light bottles or containers to resist high pressures.\*\* During the First World War, many vehicles were equipped with balloons containing coal gas at atmospheric pressure, the gas being fed to the engines through mixing valves. This arrangement involves a power reduction of about 10 to 20 per cent as compared with gasoline, but in other respects appears to work well. The principal difficulties are, the small radius of action round the filling station (about 20 miles total run) and, at present, the shortage of rubber which is used to make the balloons gas-tight.

Pulverized coal engines have been the subject of extensive experimentation in Germany and it is claimed that a con-

\*\*Storage pressures for propane and butane are comparatively low but, at present, only a small quantity of these gases is available.

siderable measure of success has been obtained with them. The principal difficulties are due to the fouling of the cylinder and oil by ash and tarry matter, together with burning and erosion of some of the surfaces. ② As far as the author is aware, no commercial installations have been made on high speed engines. Numerous attempts have been made to employ acetylene gas with and without the addition of alcohol to suppress knock, but all of these have failed commercially. ③ Benzol, obtained by the distillation of coal or wood, has been used quite extensively in Europe for blending with gasoline. This has the advantage of increasing the knock rating, but the quantity available is small and it has a relatively high freezing point (42 deg. F.).

Apart from petroleum products (which are not being con-

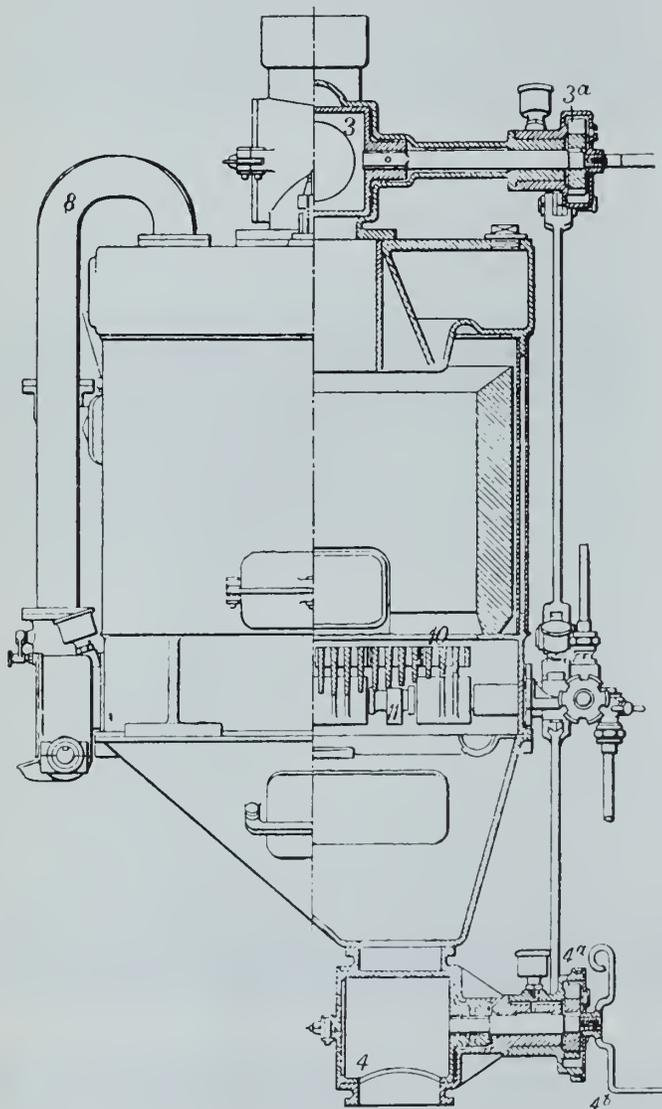


Fig. 2—Early portable gas producer (Col. D. J. Smith) 1919. Grate dia. 12 inches.

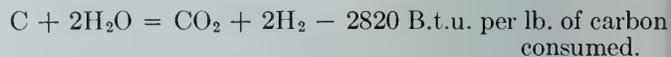
sidered here) the only other liquid fuel that is likely to be suitable is alcohol which, before the war, was produced in forty countries at the rate of 200 million gallons per annum. Several European countries had laws making it compulsory to add from 10 to 20 per cent of home-produced alcohol to all imported gasoline. In others, the use of the blend was optional. ④ Bulletins on this subject have been published in Great Britain, ⑤ Australia, ⑥ and Canada. ⑦ In the last paper, it is indicated that the sugar beet is the most attractive source and that, from an economic standpoint, "the expediency of instituting a power alcohol industry in Canada depends on whether the net advantage to agriculture and to the country as a whole outweighs the increase

in cost of the motor fuel." In times of war, however, economic considerations are likely to be disregarded, or to assume a decidedly different aspect, so that these conditions do not necessarily dispose of the matter at this time. Tests ⑧ and practical experience have shown that internal combustion engines can be run satisfactorily on gasoline-alcohol blends, that the power is practically unaffected and that the fuel has a high anti-knock value. Canada has a large surplus of wheat that cannot be used as food and costs money for storage, spoilage and waste. These factors may easily have an important bearing on the power-alcohol situation.

#### PRODUCER GAS

The production of alcohol on a relatively large scale is not likely to cover much more than 10 per cent of our requirements, and the only reasonable remaining alternative appears to be the production of gas as and when it is needed for power production, thus avoiding problems of storage. The gas is usually produced from anthracite, coke, wood or charcoal, though other solid fuels or waste products have been employed. A supply of air, insufficient for complete combustion, is passed through the fuel bed and heat is produced by the reaction:—

$2C + O_2 = 2CO + 4400$  B.t.u. per lb. of carbon consumed. In most instances water or steam is added to the air (or it may be derived from the moisture in the fuel) giving rise to two reactions:



The use of steam, therefore, enriches the gas by the addition of hydrogen and tends to prevent excessive temperatures and the formation of clinkers in the fire. The latter are undesirable because they obstruct the flow of air and tend to cause hollow spots and channels in the fire, with a consequent reduction in the quality of the gas. These reactions and the effect of fire temperature on them were discussed in a paper written by the author in 1910. ⑨ It was there shown, by means of temperature curves (Fig. 1), that, in a small producer, the process of gas generation could be completed with a fire depth of 12 inches or less and that, beyond that point, the superincumbent layers of fuel are useful only as a fuel reserve and are actually detrimental as far as the quality of the gas is concerned. It was found that the best efficiency was obtained when the ratio of  $\frac{\text{water}}{\text{coal}}$  feed was about 0.75, and that about 72 per cent of the water was decomposed into carbon monoxide and hydrogen.

In the case of mobile producers for cars and trucks, it is difficult to provide suitable controls for regulating the water feed automatically, to suit varying loads, speeds and accelerations, and for this reason many of the modern producers have no water supply other than that obtained from the moisture in the fuel, which sometimes is made to flow through the hot fire. In general, the temperature of the fuel bed in an updraft producer using anthracite, should be between 1800 and 2200 deg. F. to give a good gas in the short time available. The composition of the gas varies under different conditions, but it usually has a calorific value of 110 to 140 B.t.u. per cubic foot and contains about 20 to 30 per cent carbon monoxide, 4 to 12 per cent hydrogen, and 55 to 62 per cent nitrogen. The high percentage of nitrogen and poor calorific value make this gas unsuitable for storage purposes, and the presence of carbon monoxide is always dangerous.

It has been stated ⑩ that one of the earliest mobile producers was designed by J. W. Parker who "between 1901 and 1903, ran something like 1,000 miles in Great Britain, at first with a 2½ h.p. car and afterwards with a

25 h.p. car, carrying several passengers." The author tested producers designed by Col. D. J. Smith (Fig. 2) and Mr. Parker (Fig. 3), respectively, on a car, trucks and a motor boat, in 1919-20, and reported that, while encouraging results were then being obtained, the apparatus was not designed and constructed in such a manner as to make it immediately suitable for commercial development. Messrs. Thornycroft of Basingstoke, England, produced one of the earliest commercial designs in 1922, <sup>①</sup> and manufacturers in France, Germany and other countries rapidly followed suit.

These plants proved to be so popular in countries having no petroleum, that in 1937 France had 4,436, <sup>②</sup> Germany about 2,000, Japan and Italy about the same number, <sup>③</sup> and since the outbreak of war these numbers have probably been greatly increased. Russia was expected to produce 16,000 trucks and 9,000 tractors in 1939, and 40,000 and 15,000, respectively, in 1940. <sup>④</sup> Other countries which have been over-run by the Germans are stated to be almost entirely dependent on this type of prime mover.\* A British report <sup>⑤</sup> states that "producer gas can be recommended as a means of maintaining road transport in operation in an emergency," but that, in peace time, at the present stage of development it "is of doubtful economic value for motor vehicles, except in specially favourable circumstances, e.g., for long distance work with vehicles carrying medium or heavy loads." A specially designed equipment was recommended by the Committee for emergency use, and was based on the results of "400 road tests, covering approximately, 50,000 miles, using 9 vehicles, 22 producers of nine different types and over 120 distinct fuels." It is also stated that the "average driver of a petrol-driven vehicle can learn to operate a producer gas vehicle in a few days, though he will continue to improve for a much longer period."

#### DESIGN OF PLANT

The portable producer plant consists of three principal parts, namely, the gas producer or furnace, the arrangements for cleaning the gas and the mixing valve.

The producer may be of the updraft, down-draft or cross-draft types (Fig. 4). The early producers almost invariably had the fuel feed at the top, the air and steam being introduced below the grate. The producer was lined with refractory material and had a built-in boiler or evaporator (which might be at the top, bottom or surrounding the body as a water jacket); the grate was usually of the "shaking" type and the ash was withdrawn from the bottom, either by hand or through a mechanically operated valve (Fig. 2). The gases were taken off at the top of the producer, so that any moisture in the fuel was removed by evaporation and did not produce any appreciable quantity of hydrogen. In these circumstances, the provision of steam was almost a necessity to provide gas of reasonable calorific value. Also, much of the volatile matter in the fuel left as tar, causing trouble in the cleaning apparatus and sometimes also in the engine.

In the down-draft producer, the air and steam are admitted above the fire and the gas is taken off either at the bottom or about half way down the furnace. The moisture and volatile hydrocarbons are thus made to pass through the high temperature zone and are partly decomposed into hydrogen, carbon monoxide and fixed hydro-

\*It is reported that in German occupied countries there were 150,000 producer-gas trucks on the road in the fall of 1941 and that 33,000 more were scheduled to be produced between October 1941 and March 1942. In addition, 20,000 tractors operating on producer-gas were expected to leave the factories in 1942. Sweden had 66,400 vehicles working on producer-gas in August 1941, of which 33 per cent were private cars. About 40 per cent of the total used wood fuel—the others employed charcoal. France now has 50,000 producer-gas vehicles, mostly using charcoal, and Switzerland about 2,000. (*Engineering*, Feb. 6, 1942 and *The Autocar*, Jan. 30, 1942).

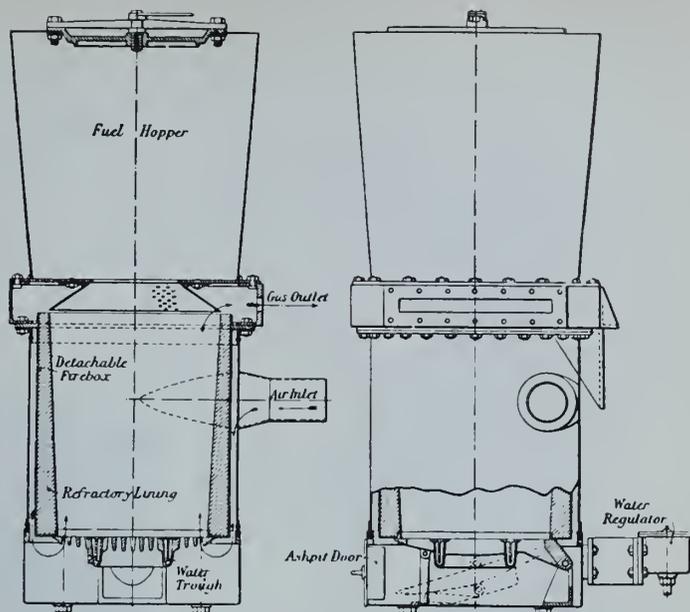


Fig. 3—Early portable gas producer (Parker).  
Grate dia. 11 $\frac{1}{4}$  inches.

carbons, which enrich the gas. The latest tendency is to use the cross-draft type <sup>⑥</sup>, in which the air enters through a tuyere or nozzle near the bottom of the furnace, and the gas is taken off through a grid on the opposite side, the flow thus being horizontal. This provides a simple and compact arrangement incorporating the chief advantages of the down-draft principle. The tuyere may be cooled by water from a "radiator tank" and the upper part of the producer is a simple unlined cylindrical vessel, which acts as a fuel storage. One filling usually suffices for a journey of 100 to 150 miles. Where the length of gas travel through the furnace is fixed by the width of the producer, the time of contact between gas and fuel is necessarily small.

Experiments were made at Melbourne <sup>⑦</sup> on a small producer (6 h.p.) with fire lengths varying from 1 $\frac{3}{4}$  to 6 $\frac{1}{4}$  inches and at 2 $\frac{1}{2}$  inches a good gas was obtained of net calorific value exceeding 130 B.t.u. per cu. ft. with gas discharges between 3.0 and 6.3 cu. ft. per minute. Water was admitted to the extent of 3.3 lb. per 1,000 cu. ft. of gas generated, giving 6.5 to 10 per cent of hydrogen in the gas. The best gas was obtained with a fire about 4 inches long, and the "transit time" was less than 1/100 second.

Vertical draft producers have relatively deep fuel beds and low air velocities, due to the necessity of protecting the grate and lining from high temperatures and clinker deposits. Horizontal (cross) draft producers have small fire volumes and must necessarily have higher temperatures to produce good gas. It has been shown <sup>⑧</sup> that at 2400 deg. F. the conversion of CO<sub>2</sub> into CO, and of steam and carbon into CO and H<sub>2</sub> is practically complete in three seconds. If the temperature is reduced to 1830 deg. F. the conversions, in the same time, are 6 and 15 per cent complete, respectively. In some cross-draft producers, temperatures as high as 3000 deg. F. are required, to give very rapid and complete production of carbon monoxide. As there is no grate in the cross-draft type, the clinker forms a compact, pan-shaped mass, away from the air and gas connections. The high-temperature combustion zone is small and compact <sup>⑨</sup>, but the exit temperature of the gas is high (Fig. 5). So far, it has not been considered practicable to heat the incoming air at the expense of the outgoing gas, the return not being commensurate with the extra cost and complication of the apparatus. Such regeneration is provided in some vertical draft producers (Fig. 4), but is of doubtful value. Tests made by the author in 1911 showed no considerable advantage when the air was heated to 300 deg. F. One type of producer (Koela) <sup>⑩</sup> embodies a combination

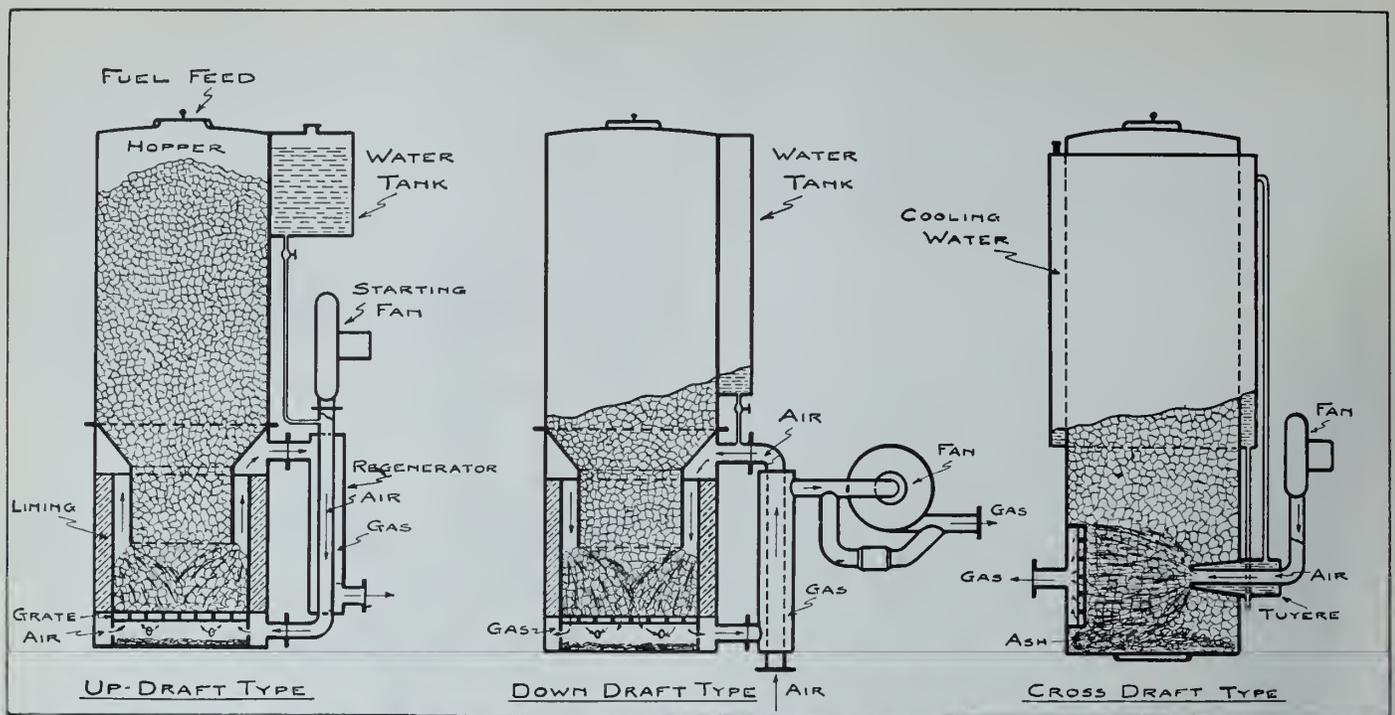


Fig. 4—Up-draft, down-draft and cross-draft producers.

of the updraft and cross-draft principles, and also includes regeneration.

Experiments made on a cross-draft producer with varying water supply <sup>(9)</sup> showed that gas generated without water injection was 12 per cent poorer than the best gas obtainable, corresponding to a decrease of six per cent or more in available engine power. Tests made on an Australian emergency (A E) producer <sup>(10)</sup>, based on the British (B E) design, gave producer efficiencies of 76.4 to 74.1 per cent at engine speeds varying from 750 to 3000 r.p.m. and gas calorific values of 133 to 124.5 B.t.u. per cu. ft. The fire length was 12½ inches, its temperature was about 3000 deg. F. and the diameter of the tuyere was one inch. The air consumption was approximately 5.5 lb. and 83 to 87 cu. ft. of gas were produced, respectively, per lb. carbon burned. The gas temperatures at the mixing valve varied from 80 to 180 deg. F. No water was supplied and the hydrogen in the gas varied from 5.2 to 2.9 per cent, but the carbon monoxide remained constant at 32 to 33 per cent. A similar series of tests was made on the British emergency producer, <sup>(11)</sup> and some of the comparative results obtained are given in Fig. 5.

This shows that the capacity of both producers is about the same at equal air velocities, notwithstanding the fact that the B E tests were made with a blower, and the A E tests with a Ford V-8 engine. The pressure drop across the A E unit is much greater than that across the B E unit, probably because of the greater frictional resistance of the final filter. The temperature of the gas leaving the A E producer varied from 565 to 1000 deg. F., but as these were not final values, <sup>(12)</sup> they have not been plotted on Fig. 5. The temperatures obtained in the B E producer seem to be abnormally high, and it is difficult to understand how burning of the metal is avoided under these conditions.

#### POWER AND ECONOMY

Characteristic power and economy curves for a gasoline engine are shown in Fig. 6. The best economy at full throttle is obtained with a mixture containing from 10 to 15 per cent of excess air, but, as the throttle is closed progressively, somewhat richer mixtures must be supplied. On the other hand, the best power is always obtained with a rich mixture

containing about 20 per cent of excess fuel that cannot be burned. This illustrates the fundamental fallacy of many devices that purport to give both improved power and economy. The conditions that produce greater economy in a gasoline engine almost invariably give less power. Tests made on a single cylinder variable compression engine, <sup>(13)</sup> using producer gas, showed that:—

- (a) The power-mixture strength curve rose to a sharp peak with a mixture containing about two per cent of excess air (Fig. 6). With 30 per cent of carbon monoxide in the gas, this corresponds to slightly less than 50 per cent of gas in the mixture (as compared with about two per cent for gasoline). Good mixture control is therefore essential.
- (b) Compression ratios up to 15:1 may be used without trouble.
- (c) At a compression ratio of nearly 8:1 and a speed of 1500 r.p.m., the combustion period occupied about 40 deg. of crank angle. This indicates the necessity for increased spark advance as compared with gasoline. Alternatively, multiple spark plugs may be used.
- (d) The indicated thermal efficiencies at all compression ratios between 6 and 16 were about 60 per cent of the "air standard" efficiencies. The actual maximum thermal efficiency was about the same as that obtained with gasoline (Fig. 6) and occurred with a mixture about 30 to 40 per cent "weak."
- (e) The net calorific value of the correct producer gas-air mixture is about 70 per cent of that corresponding to the correct gasoline-air mixture. The volumetric efficiency of the engine is also less when gas is used because of the relatively high gas temperature, the absence of the cooling effect derived from the evaporation of liquid fuel and the greater frictional loss of the piping and cleaning apparatus. The mechanical friction in the engine itself is not affected materially by the change from liquid to gaseous fuel and therefore, with the weaker combustible mixture, the mechanical efficiency of the engine falls. For these reasons, the horse power obtainable at low speeds from an engine of a given size, when using pro-

ducer gas, is only 60 to 65 per cent of that obtained on gasoline. The comparison may be still more unfavourable at high engine speeds, as the resistance of the cooling and cleaning apparatus increases rapidly with the speed and may be as high as 30 to 60 inches of water gauge (Fig. 5), particularly if the filters are dirty (16). It is not safe, therefore, to anticipate a maximum power of much more than half that obtainable from liquid fuels. The Australian tests (16) gave a power ratio of 51.5 per cent, and the British report (17) states that a vehicle is "one gear worse" on producer gas than on gasoline. Power ratios of 70 to 75 per cent have been claimed in some instances.

This analysis indicates one of the principal objections to the substitution of producer gas for gasoline in trucks, tractors or marine work where the load factor is high. Most cars work, for the greater part of the time, at less than half of their load capacity, the full power of the engine only being required occasionally, but trucks have to carry heavy loads for long periods and must adhere to definite time schedules. Possible remedies for this difficulty are:—

- (1) The use of larger engines. This is only possible with new vehicles.
- (2) Reduced loads, longer time schedules, or both. These imply a reduction of transport and earning capacities.
- (3) Higher compression ratios (say 8 or 10 to 1). The consequent increase of thermal efficiency will raise the power ratio possibly up to about 70 per cent, but this method introduces difficulties when gasoline is used for starting or emergency operation, though alcohol may perhaps be substituted for these purposes. Moreover, it is frequently difficult to change materially the compression ratio of existing engines.
- (4) Supercharging. This requires a power drive for the supercharger unless exhaust driven superchargers are used. The latter add to the cost, complication and weight of the plant and are of doubtful practicability. Nevertheless, a supercharger of this type has been used by the Brown Boveri Company (18) to put the whole of a wood gas producer plant under pressure. The top of the producer is held down by springs and so acts as a safety valve which blows off at an internal pressure of 7 lb. per sq. in. It is claimed that the test results on this plant indicate that the torque obtained on a Saurer truck at different speeds is equal to that of the same truck driven by a compression ignition (Diesel) engine. The weight of the turbo-charger for 40-150 h.p. engines is 77 lb. Leaky joints or connections would form a considerable hazard in this kind of plant.
- (5) Mixture of producer gas and gasoline. Tests made on a single cylinder stationary engine (19) with a compression ratio of about 5.3 to 1 and a speed of 1500 r.p.m., gave the following comparative results:—

Gasoline, per cent in mixture.....	100	72.1	41.7	22.6	0
Maximum Indicated Mean Effective Pressure, lb. per sq. in.....	137	120	107.5	97.4	93.0
Maximum Brake Mean Effective Pressure, lb. per sq. in.....	117.7	100.5	87.4	76.5	73.5
Power Ratio expressed as a percentage of that obtained with gasoline.	100	85.5	74.3	65.0	62.5

It is impossible to make any categorical statement regarding relative running costs, as so much depends on size, fuel taxation, running conditions, etc., but fuel consumptions of heavy vehicles vary usually from 0.9 to 1.3 lb. of charcoal per h.p. hour. A four-cylinder 12 h.p. car weighing

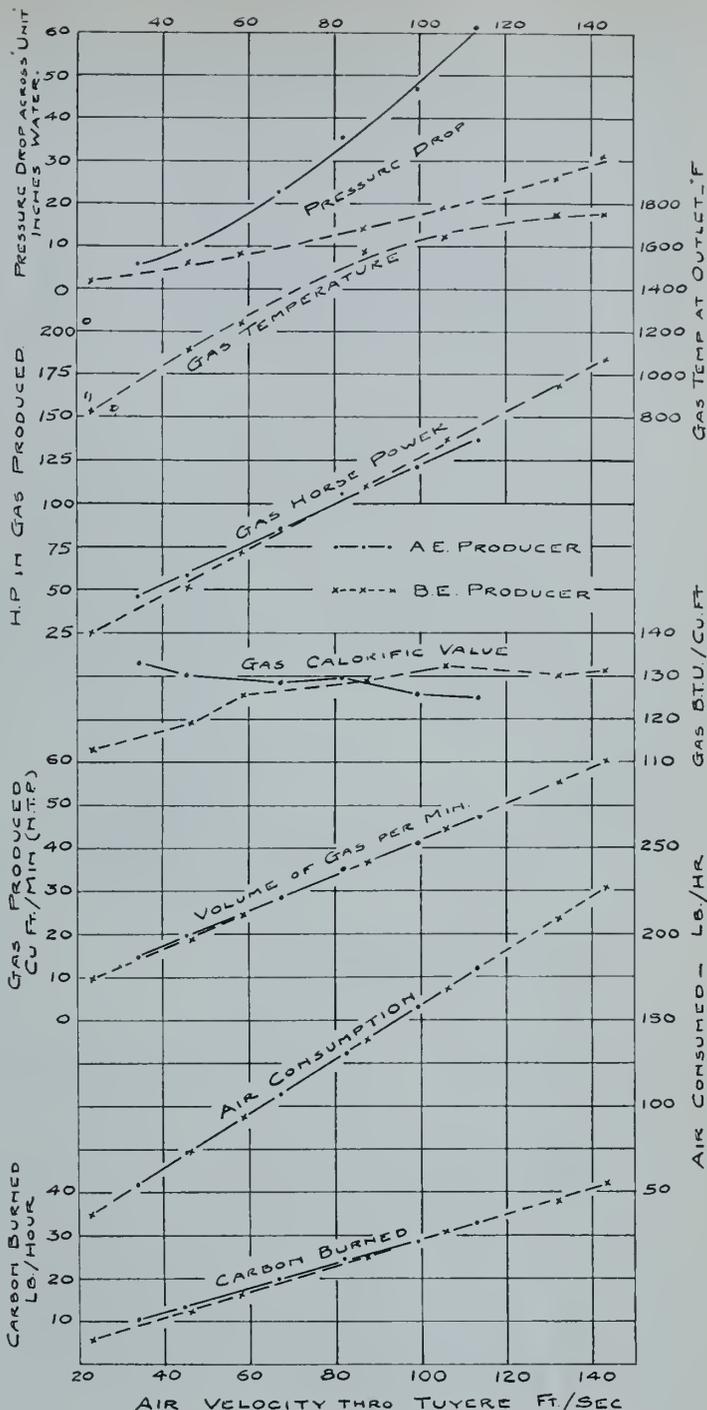


Fig. 5—Comparative test results on the Australian and British emergency cross-draft producers.

2,550 lb. ran for 5,000 miles with an average fuel consumption ("activated progasite") of  $\frac{1}{2}$  lb. per mile, and a continuous run of 100 miles was made on this fuel with a consumption of 0.4 lb. per mile (20). The British report (21) gives the average consumption of anthracite for a vehicle of six tons gross weight as 1.5 to 2 lb. per mile.

Tests made in Australia on the British emergency producer mounted on a trailer (weighing 1,150 lb.) towed by a Ford V-8 utility truck and carrying a load of 550 lb., gave a charcoal consumption of 1.03 lb. per mile. (22) Woods quotes heat consumption figures for trucks ranging from 4,300 to 8,900 B.t.u. per load-ton-mile for pay loads varying from 6.9 to 1.5 tons, respectively, (23) and a test in Great Britain gave a consumption of 4,110 B.t.u. per ton mile for a pay load of 4.6 tons at a speed of 26.3 miles per hour.

Tests made by the French Department of Agriculture (24) indicated that, with an efficient engine, 12 lb. of charcoal (or anthracite) or 22 to 24 lb. of wood (less than 18 per cent

moisture) gave the same mileage as one gallon of gasoline. A comprehensive series of tests was made in Switzerland by Schlöpfer<sup>34</sup>. Various estimates gave comparative fuel costs ranging from one half to less than one third those of gasoline.<sup>35</sup> Comparisons with fuel oil are not so favourable and vary with local rates of taxation on liquid fuels.

As no excess fuel is required in the mixture to produce full power, and as complete mixing of air and fuel are easy, no trouble is experienced with the effects of incomplete combustion or with carbon monoxide in the exhaust gases. The uniform mixture also ensures the generation of equal amounts of power in the different cylinders of multi-cylinder engines.

### FUELS

Producer gas can be made from almost any carbonaceous fuel, but considerations of weight and space occupied by the producer plant and fuel storage play an important part in the final choice. From a gas-making standpoint, the most important property of the fuel is its "reactivity." This is sometimes indicated by its "critical air blast" (C.A.B.) value, which is the minimum rate of air supply that will support the combustion of a graded fuel sample when tested under standard conditions. The lower the C.A.B. value, the greater the reactivity and the more suitable is the fuel for gas-making.

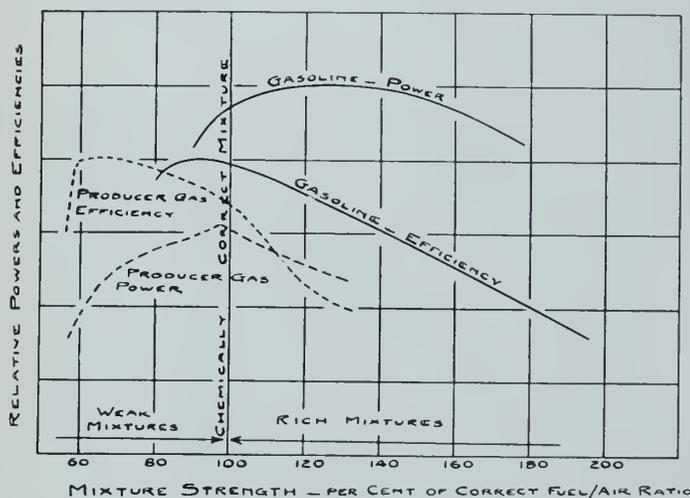


Fig. 6—Relative power and economy curves for producer gas and gasoline with varying mixture strengths. No vertical scale has been given, as the figures are entirely comparative. They are intended to show that the maximum power obtained with producer gas is about 60 per cent of that obtained with gasoline, and that the maximum efficiency is about the same in both cases.

The following typical values are given by Noton:<sup>22</sup>

Charcoal—less than .....	.01
Low temperature coke.....	.01
Bituminous coal—about.....	.02
Anthracite, not less than.....	.035
Gas coke.....	.06
Furnace coke.....	.07

Tests on a cross-draft producer indicated that, for this type of apparatus, the permissible upper limit of the C.A.B. value was .04.

The best results have usually been obtained with wood charcoal, which has the highest reactivity (probably because of its porous structure), and is relatively free from ash and impurities. The provisional specification for Australia<sup>23</sup> describes the principal desirable characteristics and standard methods of testing. The charcoal should be clean, free from "fines," and should not shatter or crumble in service. The size should be between  $\frac{1}{2}$  and one inch, and the ash should not exceed four per cent of the air-dry

weight of the charcoal. No limit is fixed for the volatile matter, but elsewhere it is recommended that this should be about 10 per cent.

The reactivity is expressed, in some instances, as the volume of carbon monoxide formed by passing 100 cubic centimetres of carbon dioxide over the fuel at a temperature of 1,740 deg. F. and at a rate of five cc. per minute. By this valuation the reactivity of charcoal is about 180, and that of coke 40 to 60; this scale appears to be more open than that of the C.A.B. method, and so is a more practical one. Australian charcoal (air dry) has a calorific value of 12,000-13,600 B.t.u. per lb., and Canadian charcoal of 12,500 B.t.u. per lb. or higher. Canadian hardwood charcoal contains approximately five per cent moisture, three per cent ash and 17 per cent volatile matter. Uniformity of size is desirable to avoid excessive resistance in the fire and the clogging of cleaning apparatus by dust and small particles. The low density of charcoal (about 14 lb. per cu. ft.) makes it necessary to provide a large hopper so that a journey of 100 to 150 miles may be made without refuelling. Charcoal briquettes, with densities up to three times that of coal, have been used in some producers, but their advantage is doubtful, on account of the reduced reactivity of the fuel which probably necessitates a larger fire, less flexibility and longer time for starting. It may be advantageous for using up the finer grades of charcoal.

Many producers have been operated on wood, generally containing up to 18 or 20 per cent of moisture<sup>24</sup> and supplied in pieces approximately  $1\frac{1}{2}$  in. by  $1\frac{1}{2}$  in. by 3 in. Hard wood is preferable, but soft woods may be used with a greater depth of fire to break up the volatile matter distilled from the wood.<sup>25</sup> If these vapours are not decomposed, they must be removed in the scrubbers, otherwise they will cause trouble in the engine. For this reason, larger and more complicated cleaning apparatus is usually required. With wood fuel, a larger fuel hopper and furnace must be provided, and also there is an increased loss of heat in the water vapour which leaves with the gas. Nevertheless, the large amount of hardwood that is immediately available in Canada forms an important, potential supply of fuel for use in an emergency.

Peat and peat charcoal are possible fuels, but the former is difficult to dry and the latter is inclined to be friable. Peat charcoal, produced by a special low temperature distillation process, was tested on a four-ton truck in Scotland<sup>26</sup> and is stated to have given better results than those obtained on a low temperature coke. Comparative tests made on low temperature coke and charcoal<sup>27</sup> showed little difference between the two fuels, as far as performance and idling were concerned. The coke gave better acceleration after idling, in spite of the fact that the temperature of the plant was higher than that obtained with charcoal, but the clinker formation was much greater with coke. The latter fuel is also stated to give more cylinder wear than anthracite does.<sup>28</sup>

Countries which have access to coal but possess little timber, generally use anthracite or coke. Accordingly, the British emergency producer<sup>29</sup> is designed principally for these fuels, and the specification gives the best grading for anthracite as  $\frac{1}{4}$  in. to  $\frac{5}{8}$  in., though somewhat smaller sizes can be used, if necessary. The quantity of volatile matter should be less than seven per cent, and the ash less than four per cent. The principal advantages of anthracite are, that no preliminary processing of the fuel is required, the fuel does not disintegrate when shaken and its density is high (about 55 lb. per cu. ft.) so that a large weight can be carried in a small container.

The size and weight of the plant for a given horse power is influenced considerably by the kind of fuel used, as this governs the size of the fire, the dimensions of the fuel hopper and the kind and size of cooling and cleaning apparatus employed.

The following figures are reasonably representative of current practice:

The Brush-Koela producer for a 2½-ton truck is about 14 inches in diameter by 4 ft. 5 in. high, and weighs 280 to 336 lb., according to the layout employed. 25 The Gohin-Poulenc producers vary from 14 to 20 inches in diameter and from 3 ft. 6 in. to 6 ft. 6 in. high. For a seven-ton truck (empty) the weight is 620 lb. or 3.9 per cent of the pay load. A wood burning producer, for the same service, weighed 1,200 lb. or 7.7 per cent of the pay load. The weight of producer for a 32 passenger bus (53 h.p. engine) is 560 lb., and the hopper contains 510 lb. of coal, sufficient for 200 miles. The British emergency producer, which is mounted on a trailer, is 18 inches diameter by 4 ft. 6 in. high, and the weight of the whole trailer unit is 1,150 lb. The producer and cleaning plant are made entirely of steel pressings and are designed for the rapid conversion of vehicles at a minimum cost.

#### COOLING AND CLEANING THE GAS

The temperature at which the gas leaves the producer, which may be as high as 1,750 deg. F. (Fig. 5), makes it necessary to cool the gas as much as possible before it enters the engine, otherwise the reduction of volumetric efficiency will seriously affect the power obtained. With a gas temperature of 120 deg. F. (air temp. 75 deg. F.) the reduction of engine power is about eight per cent if the gas is dry, or 17 per cent if saturated. It is desirable, therefore, to avoid wet scrubbers if the gas can be adequately cooled without using water.

The presence of dust or ash in the gas is also undesirable, as it contaminates the lubricating oil and causes wear in the cylinders. The amount of dust allowable has not been determined definitely, but it is stated that, with less than 20 milligrams per cubic metre of gas (.0002 oz. per cu. ft.) the cylinder wear is no more than that obtained with gasoline. The following figures were quoted by Burstall 26 from results obtained by Reich on charcoal producer gas cleaned in three different ways. Full details were not given, but the results indicate the order of magnitude of wear and the variation due to the various cleaning devices:—

Group A—.205—.253	} thousandths of an inch cylinder wear per 1,000 miles travelled.
B—.327—.343	
C—.46 —.647	

(For comparable figures on gasoline see Ref. 31 and 32.) The average rate of wear with gasoline is generally in agreement with the figures in Group B.

The velocity of air and gas through the fuel bed, which is controlled by the speed and load of the engine, has a great influence on the amount and grade of dust that must be handled by the scrubbers. Beresinsky obtained the following results on an Australian cross-draft producer with a fire 12 inches long between tuyere and outlet grid:—

Rate of Gasification cu. ft./min.	Speed Miles per hour	Dust M.gm. per cu. metre	Dust in Gas lb./1,000 miles
35	35	650	2.5
50	50	5960	22.4

The relatively low gas velocity through the up and down-draft producers (40 to 80 lb. fuel gasified per sq. ft. grate per hour) probably causes less dust to be carried over than in the case of the cross-draft type.

A method of testing the efficiency of cleaners and scrubbers has been devised by Beresinsky 26, consisting of an aspirator drawing heated gas through a standard filter. This gives consistent results and has revealed the fact that, generally, the most efficient cleaners give the greatest resistances to the passage of gas. In the tests on the "A E" producer, the quantity of dust entering the gas mixing valve was less than one milligramme per cubic metre when tested on the road at 30 miles per hour, but usually the

pressure drops obtained during the road tests were greater than those in the bench tests (Fig. 5), probably because the vibration consolidated the fuel in the producer and the fibre in the filter. 26 The cyclone separator used in the A E producer is efficient for removing large particles, but a filter consisting of layers of sisal fibre, cotton waste and felt, is also used to remove fine particles (Fig. 7). Between the two, are four vertical cooling cylinders with cleaning doors, which also act as a gas storage to meet sudden demands from the engine. European practice appears to favour cloth filter bags, but in some instances wet scrubbers are used, particularly with wood fuel. In the latter case, however, it is stated that neither dry nor wet scrubbers can remove every trace of tar and acetic acid from the gas. Oiled coke, or oily baffling surfaces are sometimes em-

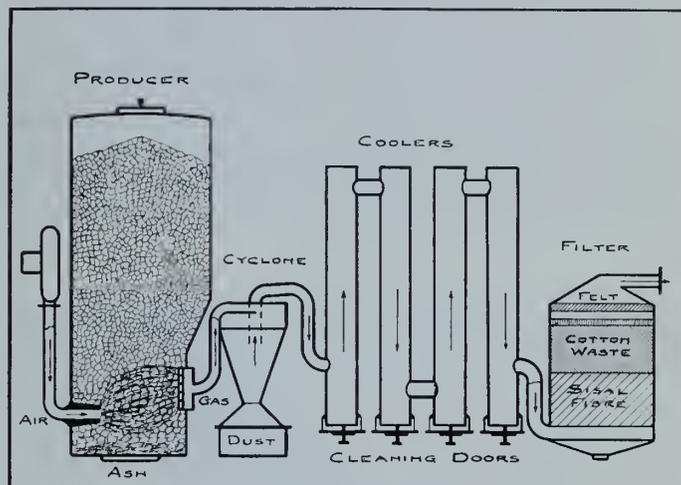


Fig. 7—Diagram of Australian Emergency gas producer plant.

ployed, but are not so efficient as fabric or fibre filters for fine dust separation. The British emergency producer has four horizontal coolers (each 6 in. dia. and 3 ft. 6 in. long) arranged in series, and two filters in parallel, each containing four beds of sisal tow. Regular cleaning is necessary to avoid clogging and excessive resistance, particularly as, if the pressure drop across the sisal filter becomes great, channels may form in the filter bed, reducing its efficiency as a cleaner. In some instances, a flame trap is placed between the mixing valve and the scrubbers. The gas mixing valve and carburettor are connected to a Tee bolted to the intake manifold.

#### OPERATION AND INSTALLATION

The running of a gas producer plant does not offer any great difficulty to the average driver. If water feed is used with hand operation, the rate of water supply controls the temperature of the producer and the quality of the gas, but in most instances this quantity is adjusted automatically to suit the rate of gasification.

Starting from cold is usually performed by running the engine for a short time on gasoline and using the suction to draw a flame into the fuel bed from a torch inserted through the tuyere or other convenient opening. Various starting times, ranging from one to ten minutes, are quoted by different authorities, a good deal depending on the type of producer, kind of fuel and local conditions, but in most instances the fire must be nursed for some time, as full power cannot be obtained until there is a substantial volume of incandescent fuel available for gas making. This period lasts for approximately 20 to 30 minutes after starting. With high compression engines, it may be necessary to use a fan, operated either by hand or electric motor for the purpose of blowing up the fire. In that event, care must be taken to ensure the escape of gas into the open air, and not into a garage, as the 30 per cent of carbon monoxide in the gas is very poisonous.

At the end of the run, or day, the producer is allowed to cool down, after which the ash, clinker, etc., may be removed. Some producers have shaking grates and automatic ash discharges, but these are unusual nowadays, particularly with charcoal fuel. Stops of from one to two hours are possible, but in most instances it is necessary to idle the engine so that the fire may be kept alight. It may also be necessary, on restarting, to run for a short time on gasoline, to re-establish the volume of fire that is required for full load operation.

The necessity of systematically cleaning scrubbers and filters has already been noted.

It is evident from the above, that the gas producer is most suitable for large and heavy vehicles that have been designed specifically for this kind of fuel, although some small plants have been placed in car trunks and on running boards. Buses have the producer enclosed in a special compartment at the back or front, and trucks have them mounted on the side of the chassis. Existing chassis, however, usually have insufficient room for the producers and cleaning plant, so that both the British and Australian emergency producer plants are mounted on two-wheeled trailers that are towed behind the trucks. This increases the wind resistance of the vehicles but gives effective cooling.

#### CONCLUSION

The difficulty of keeping the fire alight during long stops, the dust and dirt encountered when fueling and cleaning, the time taken for starting (particularly if the gas is wet), the difficulty of finding space on the chassis or of manoeuvring in traffic if a trailer is used, and above all, the loss of power and flexibility, make it improbable that gas producers will become popular with the owners of private cars.

Their application would appear to be more directly to trucks or fleets of trucks, where they can be kept in condition by a service staff. Both the British and Australian reports emphasize the necessity of adhering to standard dimensions, and state most distinctly that the design and fabrication of gas producer plants should not be undertaken by amateurs, but should be in the hands of experienced personnel.

The cost of such a plant is in the neighbourhood of \$300-\$500 and the average weight of metal 400-600 lb. This is mostly steel, and assuming an average of 500 lb. of mild steel per vehicle, 25,000 tons would be necessary to equip 100,000 vehicles.\* In addition to this, if trailers are employed, an additional 25,000 tons of steel would be required for the trailers, and 200,000 tires would have to be provided.

The report of the Chemurgic Committee <sup>⑦</sup> states that, in 1940 motor fuel consumption in Canada was nearly 900 million gallons, and it was estimated that 45 million bushels of wheat would be required to replace 10 per cent of this amount by alcohol. Considering 12 lb. of charcoal as equivalent to one gallon of gasoline, an annual consumption of 540,000 tons of charcoal would be necessary for the same purpose.

These factors may be decisive under war conditions.

#### ACKNOWLEDGMENT

The author's thanks are due to Mr. G. H. D. Martin, B.A.Sc., for his assistance in preparing some of the diagrams for this paper.

\*This is slightly less than half the number of trucks registered in Canada in 1940.

- ① "World Heat and Power Requirements and their Social Implications," Sir Harold Hartley, *Overseas Engineer*, Oct. 1941.
- ② "Principles of Motor Fuel Preparation and Application," Nash & Howes, Vol. I.
- ③ See "Text Book on Motor Car Engineering," A. G. Clark (1911) and "Alternative Fuels for Road Vehicles," Burstall, (Department of Information, Melbourne).
- ④ "Motor Fuel Preparation and Application," Nash & Howes, Vol. II, "The Use of Alcohol in Motor Fuel in Foreign Countries." Hopkins, *Can. Chemistry and Metallurgy*, Jan. 1934.
- ⑤ "Agricultural Alcohol for Motor Fuel," Hopkins, National Research Council Publication 886, Ottawa.
- ⑥ "Power Alcohol from Beet," British Power Alcohol Association, 1925.
- ⑦ "The Possibilities of Power Alcohol," Australian Council for Scientific and Industrial Research, 1927.
- ⑧ "A Survey of Canadian Research in the Utilization of Farm Products," by the National Chemurgic Committee of the Canadian Chamber of Commerce, Montreal, May, 1941.
- ⑨ "Engine Performance with Gasoline and Alcohol." Yale University Bulletin No. 16, 1936.
- ⑩ "Gasoline-Alcohol Blends in Internal Combustion Engines," Yale University, Bulletin No. 31, 1938.
- ⑪ Also Kuhring, *Canadian Journal of Research*, Vol. II, Oct. 1934.
- ⑫ "The Effect of Varying Proportions of Air and Steam on a Gas Producer," Proc. Inst. Mech. E., Apr. 1911. (See also Reference 29).
- ⑬ "The Conversion of Petrol Vehicles to Operation by Section Producer Gas," Burstall, Institution of Automotive Engineers, Australia, Nov. 23, 1939.
- ⑭ "Producer Gas for Road Traction," Allcut, Bulletin No. 6 (Section 12) School of Engineering Research, University of Toronto, 1926.
- ⑮ "Wood and Charcoal as Fuel for Vehicles," Ruedy, National Research Council, Sept. 1939.
- ⑯ "Report of the Committee on the Emergency Conversion of Motor Vehicles to Producer Gas." H. M. Stationery Office, 1941.
- ⑰ "Experiments on a Cross Draught Gas Producer," Woods. Trans. Aut. Eng. (Australia), Oct. 1940.
- ⑱ "Tests on the "A E" Charcoal Gas Producer," by A. F. Burstall and K. Hunter, *The Modern Engineer* (Melbourne), Dec. 20, 1940.
- ⑲ "Test of British Emergency Producer Fired with Australian Charcoal" Burstall, Trans. Inst. Aut. Eng. (Australia), Nov. 1940.
- ⑳ "Experiments on a High Speed Producer Gas Engine," *The Engineer*, May 26, 1939. Also, "An Investigation of the High Speed Producer Gas Engine," *The Engineer*, May 17, 1940.
- ㉑ "Mixtures of Producer Gas and Petrol," Kennedy. Trans. Inst. Eng. Aust., Sept. 1940.
- ㉒ *The Autocar*, Aug. 29, 1941.
- ㉓ "Producer Gas Vehicles," Woods, Jrl. Inst. Eng. Aust., Mar. 1938.
- ㉔ *Engineering*, Sept. 2, 1938, p. 288.
- ㉕ Symposium on "Coal as Fuel for Internal Combustion Engines," Jrl. Inst. Mech. E., June, 1939.
- ㉖ *Engineering*, Jan. 19, 1941.
- ㉗ "An Examination of some Australian Hardwood Charcoals," Melbourne, 1940, Council for Scientific and Industrial Research, Pamphlet No. 103.
- ㉘ "Wood and Charcoal as Motor Fuels," *Engineering*, Sept. 2, 1938.
- ㉙ "Producer Gas Driven Vehicles," *The Overseas Engineer*, Oct. 1936.
- ㉚ "Coke as Fuel," *The Automobile Engineer*, Apr. 1929.
- ㉛ *Engineering*, Jan. 19, 1940.
- ㉜ "Physical Processes in a Bed of Fuel," Proc. Inst. Fuel, Dec. 1940.
- ㉝ "The Testing of Cleaners and Scrubbers," *The Modern Engineer*, Melbourne, Feb. 1940.
- ㉞ "Cylinder Wear in Gasoline Engines," Williams, S.A.E. Trans., May 1936, pp. 191-196.
- ㉟ "Observations on Cylinder Bore Wear," Roensch, S.A.E. Trans., Mar. 1937, pp. 89-98.
- ㊱ "Wood and Charcoal as Motor Fuel." Dept. of Mines and Resources, Ottawa, 1936.
- ㊲ "Zur Frage des Betriebes von Automobilmotoren mit Sauggas," Schläpfer and Drotschmann, Bern, 1933.
- ㊳ *The Brown Boveri Review*, Aug. -Sept. 1941.

# TROLLEY COACH OVERHEAD MATERIALS AND DESIGN

L. W. BIRCH

Engineer, Transportation Department, Ohio Brass Company, Mansfield, Ohio, U.S.A.

Paper presented before the Montreal Branch of The Engineering Institute of Canada, on December 4th, 1941

## INTRODUCTION

A vehicle propelled by electric energy collected from a trolley wire system has this advantage, that power is always available. It is not necessary to refill a tank or tender. Trolley coach operation is of this type and is successful because the overhead distribution system is capable of delivering continuous power.

In North America the trolley coach overhead distribution system is part of a \$70,000,000 trolley coach investment which in turn, is part of the mass transportation systems on 50 properties. These systems represent a total investment of \$700,000,000.

## PROBLEMS OF OPERATION AND DESIGN

Primarily a trolley coach overhead system differs from a street car distribution system in that there is no rail return. An aerial negative contact wire replaces the rail. The support and insulation of two aerial contact wires for operation with mobile current collectors present interesting problems. These include:

1. The current collector, itself. Numerous single-pole and two-pole collection equipments have been built and tried on commercial trolley coach routes.
2. Building for operating speeds of 30 to 40 m.p.h. At these speeds the trolley coach may be touring to one side of the trolley wires.
3. Selecting a trolley wire and collector that would prevent excessive wear. Experience with street car current collection demanded that the trolley wire last as long for trolley coach operation as for street car operation.
4. Insulating the positive and negative trolley wire. At both crossovers and turnouts the positive trolley wire crosses the negative trolley wire.
5. Providing a touring range to permit of curb loading, also the passing of other vehicles in traffic. The trolley coach should tour over, at least, three traffic lanes.
6. Automatically selecting the proper path at a turnout point. This necessitates the selection of either turnout or mainline at the will of the operator, and the selection must be made without the operator leaving the coach.

These problems were not solved on the first installations. Our present overhead system is the development of twenty years of experience. The pioneer systems, such as those installed in Toronto, Windsor, Staten Island, Philadelphia,

Baltimore, Rochester and Petersburg, as well as in English cities, were very simple, but they were responsible for many important developments and standards in use to-day. For example, the advantages possible with four trolley wires providing two-way operation rather than two trolley wires providing "single track" operation, were recognized during the early twenties. Furthermore, considerable additional conductivity was made available for the carrying of electric energy.

The selection of 2/0 and 3/0 trolley wire sizes was made on the early installations because the short life of 1/0, and the additional supporting structure necessary for 4/0, were recognized as economically unsound. As early as 1923, the American Transit Association selected a 24-in. spacing between positive and negative trolley wires and recommended a trolley wire height of 18 ft. above the street. These limitations are standard to-day. After many experiments with a



Fig. 2—All metallic collector shoe.

single-pole collector, two individual poles were finally accepted on the Windsor and Staten Island systems as the standard. The general method of insulating the positive from the negative contact wire, the length of insulation and the location of the contact wires with respect to the curb line are other features developed twenty years ago which have helped to secure a well standardized overhead design.

Since 1928, when Salt Lake City installed the first modern 40-passenger, transit type trolley coach, each new installation of trolley coaches has added some new features to the overhead system. These new features have comprised the improvement and development of new devices, the dimensional standards and limitations having remained unchanged. It is an interesting thought that without some of the early standards selected for trolley coach overhead distribution design, we might have had as many different gauges between positive and negative trolley wires as the railroads had track gauges 75 years ago.

## TYPICAL DISTRIBUTION SYSTEM

The standard tangent distribution system, illustrated in Fig. 1, consists of a pole structure, either wood, concrete or steel, which supports four trolley wires with the poles spaced at approximately 100-ft. intervals. The trolley wires are attached to insulated hangers and clamps, and in addition to the insulation placed in the supporting hangers, a secondary insulation, either porcelain or wood, is inserted in the span wire near the pole. The centre line of one pair of trolley



Fig. 1—Standard tangent construction.

wires is usually located 13 ft. from the curb line thus permitting the trolley coach to load at the curb and to tour around double-parked vehicles.

#### DEVELOPMENT OF COLLECTION EQUIPMENT

Early collection equipment included a free-swivelling trolley base mounted on top of the coach, a long trolley pole and a free-swivelling wheel harp for operation under the trolley wire. The trolley base was similar to that installed on street cars, the trolley pole was a lightweight alloy steel pole insulated from the trolley harp and the harp, itself, was a wheel collector similar to an ordinary caster. With this combination the trolley coach could tour on either side of a pair of trolley wires, the limitation to the touring range



Fig. 3—Shoe collector with carbon insert.

being chiefly the length of the poles. This early assembly of equipment is similar to that employed to-day except that the wheel collector has been replaced with a shoe collector. Owing to the point bearing of the trolley wheel and to the swivelling action of the device, the wheel collector was subject to many dewirements when passing through frogs and cross-overs and the milling action of the spinning wheel on the trolley wire, particularly with the trolley coach touring off-centre, was quite injurious. These facts were responsible for the development of the shoe.

With the installation of the larger fleets of trolley coaches and the use of higher accelerations and higher speeds, the wheel collector was abandoned in favour of a shoe collector. The history of the development of the shoe collector is interesting. The first shoe collectors were all-metallic, either malleable iron or forged steel (Fig. 2). The wearing of a groove in these collectors produced a cutting edge that was injurious to trolley wire, particularly round trolley wire that was supported with a trolley ear encircling the wire. Soft nosed or bronze tipped shoes diminished this cutting action but did not prove entirely satisfactory. All of these metallic shoes required lubrication of the contact wires for the prevention of excessive wear to wire and fittings. Usually a graphite lubricant was applied with special roller type lubricator attached to trolley poles mounted on a line truck or a service truck. Five years ago, a collection shoe consisting of a solid piece of carbon permanently embedded in a bronze shoe was installed at Cleveland, Ohio. This was a real step in the right direction but trolley wire lubrication was still necessary since the bronze of the shoe continued to rub the wire. The final step was the development of a collecting shoe consisting of a bronze holder in which is clamped a carbon insert that collects electric energy from the trolley wires and operates in a manner similar to a carbon brush on a commutator (Fig. 3). This small carbon insert is replaced when it is worn to the allowable limit. Lubrication of trolley wire has been completely eliminated since the carbon insert lubricates and burnishes the trolley wire.

#### EFFECT OF SHOES ON TROLLEY WIRE LIFE

When the metallic shoe was first introduced for collection purposes, dewirements diminished, there was less arcing and collector noise disappeared, but on the other hand the cutting effect of the groove worn in the metallic shoe and the wear on trolley wire and fittings was greatly increased.

This wear was controlled by the substitution of grooved trolley wire for round trolley wire. All fittings were attached to the upper lobe of the grooved trolley wire, the lower lobe being free of attachments, thus presenting a smooth underrun to the collector. At this time it was estimated that the life of a 2/0 grooved trolley wire would be 500,000 bus passes. Actual experience showed figures as low as 300,000 bus passes. At the present time the combination of a carbon insert shoe operating on grooved trolley wire has increased 2/0 grooved trolley wire life to figures varying from two million to seven million bus passes. This is equivalent to saying that 2/0 grooved trolley wire might last on the average line from 20 to 70 years. Most installations to-day are being equipped with 2/0 wire. The 3/0 wire is selected only where conductivity demands. Bronze trolley wire, because of its greater life and ability to hold sufficient tension so necessary for good operation, is almost universally used.

#### TROLLEY COACH HANGER

A trolley coach hanger or insulator used for supporting the trolley wires has been developed for this class of two-wire suspension. The hanger carries sufficient insulation with the exception of that placed in the span wires near the poles. However, in some instances a secondary insulator, usually a wood stick, is placed between the positive and negative hangers in the supporting span. Insulation in the hanger is usually a moulded insulation of high dielectric strength



Fig. 4—Segment construction on curves.

and has sufficient resistivity to heat, moisture and mechanical injury to permit of long life. Recently, several installations have been made with a wood stick hanger. This type of hanger provides a longer leakage path than is possible with the moulded insulation hanger. Hangers are built with adjustability in order to properly align the trolley clamps to prevent interference with the collecting shoes.

#### CURVE SEGMENT

The usual conventional curve designed for street railway work requires the frequent installation of pullovers in order to align the trolley wire of the street car with the curvature of the track. This is necessary because of the type of rigid collection equipment normally used on street cars. In the case of the trolley coach, it is not necessary that the vehicle follow beneath the line of trolley wires since the swivelling action of both the trolley base and the harp permit off-centre touring. With this equipment it is not imperative that a trolley wire follow any particular curve except that it must be within reach of the collection equipment.

The conventional curve employing numerous pullovers has been almost entirely replaced by segment construction where the trolley coach does not operate jointly beneath the same trolley wire as the street car. The segment is a large pullover built to provide an easy means of aligning trolley wires over the path of the coach and at the same time eliminate many fittings and cables formerly used on the conventional street railway curve. The segment is built with a comparatively large radius and, of course, connects the several chords on the curve (Fig. 4). An adjustable feature reduces the total number of segments for a given job to a few. This device does not restrict speeds on curves inasmuch as it has been designed to handle the maximum speeds possible for the various curves. It has been responsible for the elimination of some unsightly pullover wires and has contributed to considerably less labour cost during installation.

#### FEEDER SPAN

The frequency of feeder spans for tapping either positive or negative contact wires to aerial feeders is dependent upon electrical loads, cost of annealed trolley wire occasioned by a trolley wire break and the total cost of feed span installation. As a general rule feed spans for the same polarity are located at 800-ft. intervals. This means one negative feed span and one positive feed span in an 800-ft. section. Since tapping of the positive trolley wire requires good insulation in the feed span because of the closeness of the negative contact wires, special equipment has been designed for making these taps. The most recent arrangement uses the copper feed span as a supporting span, direct taps being taken from the span to the trolley ear as illustrated in Fig. 5.



Fig. 5—Feeder span using copper feed span to support trolley wire.

#### SPECIAL WORK FOR INTERSECTIONS

At locations where one trolley coach system crosses another trolley coach system, or where a trolley coach system crosses a street car line, insulated crossovers must be installed. At locations where one trolley coach line leaves another trolley coach line, special turnout equipment is required. In all cases the special equipment includes devices to which a trolley wire is attached. These devices may be for the purpose of crossing two lines or for the purpose of taking one line off another line. In any event, the design of these devices has been made so that the cross-section of the runner pieces, metallic or insulated, is approximately equivalent to that of the trolley wire. This uniform cross-section of trolley wire and fittings reduces bumping and scrubbing and consequent arcing by the collector and also prevents considerable damage and wear. To the trolley coach rider, it is



Fig. 6—Typical crossover using standard insulating unit tips and crossover pan.



Fig. 7—Electrically operated frog installed ahead of a segment.

important because it is responsible for very quiet collection operation. Even the trolley wire splicer is attached to the upper lobe of the trolley wire, itself, in such a manner that there is no obstruction to the passage of the collector.

There are many types of crossovers and turnouts, most of which are constructed with standard parts. For instance, in Fig. 6, similar crossover pans have been used and the same insulation unit occurs repeatedly. The tips for connecting the trolley wire to the devices are the same for the same size of wire. In the case of the turnout, the standard arrangement shown in Fig. 7 is equivalent to that used on all turnouts, the frog pan itself being the only piece that is selected for some particular type of operation. In these illustrations the standard insulating unit, standard tips and crossover pan may be seen. Of course it is understood the degree of turnout may vary the degree of the crossover pan in either a crossover assembly or turnout assembly.

#### INSULATING UNIT FOR TURNOUTS AND CROSSOVERS

The insulating unit used in all crossover and turnout assemblies must withstand the ultimate mechanical loads of the largest sizes of bronze trolley wire. It must provide adequate insulation during the passage of a collection shoe from positive to negative wires and must withstand the repeated arcing caused by the breaking of electrical loads.

Structurally, this unit consists of two phenolic tubes, a tension member and a compression member. The compression member is constructed of insulation only, while the tension member is reinforced with a steel core, properly insulated at the ends, that enables the assembled unit to withstand all mechanical loads transmitted by overhead trolley wires. The unit provides 12 inches of clear insulation between metallic sections, this distance being adequate to prevent the "carryover" of the 600-volt arcs.

### TYPES OF TURNOUTS

Again looking at the standard turnout, a set of ordinary cast trailing frog pans will permit a trolley coach to "trail through" this arrangement from either the main line or the turnout, no additional guiding of the swivelling shoe being necessary. If the direction of operation is reversed, it can be readily seen that further guidance of the shoe is imperative otherwise the shoe may either enter the straight line or the turnout path. Where the trolley coach enters a frog assembly of this type the shoe must be guided.

One type of turnout where the shoe is guided to one path only, is equipped with a spring frog similar to a spring track switch. If the frog is set for the turnout at all times, the shoe will enter and take the turnout at all times. With the spring arrangement it is possible to trail from either the main line or the turnout, the same as a rail car trails through the spring track switch.

The movable runner of this frog, as well as all electrically operated frogs, is of the "double tongue" type. A shoe collector passing through the frog, either over the turnout or over the main line, will travel over one of the runners. Smooth operation of the shoe is accomplished in this way.

There are numerous locations where one trolley coach line branches away from another line. At these locations it is necessary for the operator to select either the main line route or the turnout route. At these locations electrically-operated frogs are usually installed although in some minor cases, frogs operated with pull ropes have been used.

The electrically-operated frog is of two types, the "power-on-power-off" and the Selectric type. In the former type the path at the point of turnout is selected by the operator of the coach by either coasting through the device (power-off) or by taking power (power-on) to actuate the solenoid-operated frog. In this assembly the frog pan is insulated from the trolley wire. It is, however, electrically connected to the trolley wire through a solenoid which operates the frog runners (Fig. 8). If a coach passes through this section with the "power off," the runner remains in the main line position. If, however, the coach passes through this section with the "power on," current passing through the solenoid actuates the frog runner and sets it to the turnout position. Many modifications of this type of frog are in use, however in principle they are similar to this one.

The other type of electric frog depends upon the angularity of the trolley coach body with the trolley coach wires. The electrically-operated frog used with this combination

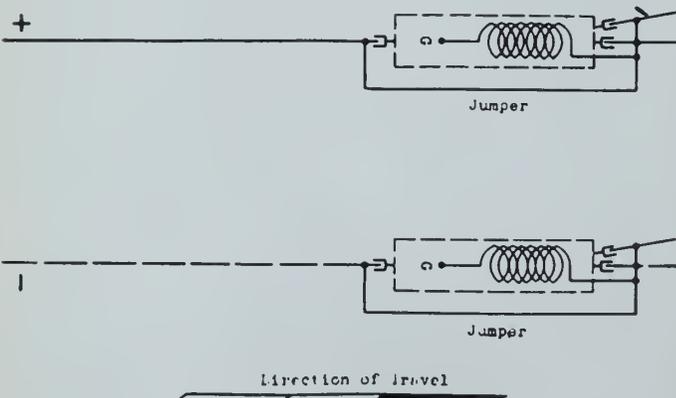


Fig. 8—Wiring diagram of "power-on-power-off" electric frog.

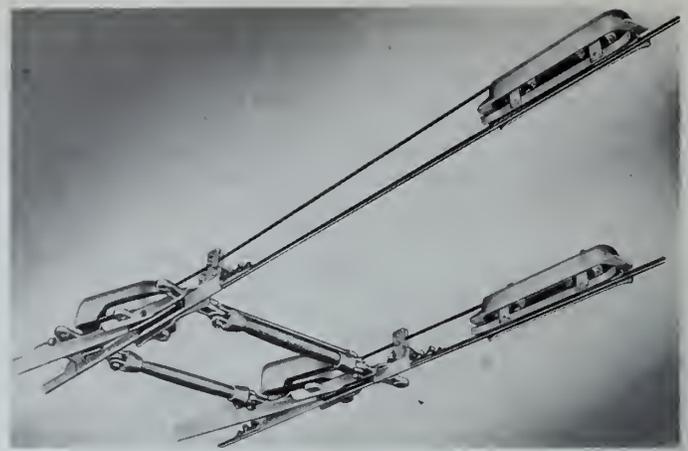


Fig. 9—Location of contactors on trolley wires in front of Selectric frog.

is also equipped with only one solenoid, however, it is also equipped with a mechanical reset. The solenoid actuates the frog runner and after a collector passes through the frog it strikes a trigger and resets the frog to its original position.

Two contactors, one on each trolley wire, are located ahead of the frog. If the two contactors are placed abreast and a trolley coach is continuing over the main line, the collector shoes will be abreast and will strike the two contactors simultaneously. Since these contactors are a part of a circuit to the coil, the frog runner is actuated as the shoes pass beneath them. After the collection shoe has passed through the frog it strikes a mechanical resetting device and throws the frog runner back to its initial position which in this case would be for the turnout. If the coach is to take the turnout, one trolley shoe will lead the other, therefore the shoes cannot strike the two contactors simultaneously and complete a circuit to the solenoid. If the trolley coach is taking a turnout there will be no movement of the frog runner and since the reset position of the runner is for the turnout, the action is positive. See Fig. 9.

Other variations of this type of electric frog are in use, the variations being due chiefly to the locations of contactors. In addition to these variations frequent installations of one-half of an electric frog are used where a street car line either enters or leaves the trolley coach overhead system.

At the present time, an intersection assembly, turnout or crossover, is ordered and shipped as a unit. Previously, the transportation company selected and erected a multitude of small devices, but the confusion caused by this procedure resulted in an effort by all manufacturers to simplify the selection of the proper assemblies for an installation. Unit assemblies are easily identified.

### RESEARCH, AN IMPORTANT FACTOR

The design and development of trolley coach overhead required many laboratory and field tests of materials and assemblies. Impregnated wood beams were first used in crossover assemblies to furnish both mechanical strength and insulation between positive and negative wires. Partially because of bulkiness and weight, but chiefly because of occasional mechanical failures, the wood beam was replaced with a fibre beam. Fibre furnished sufficient insulation for the 600-volt system and provided ample strength but fibre has one inherent feature that was responsible for the discontinuance of its use. Fibre beams warp. As a consequence a straight, smooth under-run was difficult to secure. Variations in moisture even produced warping in stock bins before the devices were shipped. The present tubular, phenolic members of an insulating unit do not warp, have good mechanical strength and furnish excellent insulating qualities over a period of years. Many service tests were necessary during the development of this insulation. The unit is illustrated in Fig. 10.

Life tests on the insulation included repeated collector passages over the runners to determine the deteriorating effect of the arc. An insulating unit is tested with a shoe passing under it at speeds corresponding to the speeds of trolley coach operation in the street. The life of the unit is determined for various values of current at 600 volts. These tests are responsible for the selection of the general design, as well as the selection of materials that will withstand constant arcing. It is to be remembered that the auxiliary load of a trolley coach for lights, heaters and compressor will reach 70 amperes, and this load must be broken at an insulator even when the traction load is cut off.



Fig. 10—Phenolic insulating unit used in crossover and frog assemblies.

The development of the current collection equipment has continued for many years. The first carbon inserts used in the present shoe wore out in less than 10 miles, the next carbon inserts in less than 30 miles and the inserts finally accepted and offered for general use would not last more than 500 miles. The average mileage today for summer and winter, dry weather and wet weather, is considerably over 1,000 miles, and it required four years to secure this mileage. Because of the research conducted by the London Passenger Transport, the present development of the carbon insert collector was no doubt hastened. Similar experiments were carried out in London and in this country. The exchange of data was very helpful in expediting the production of a satisfactory collector.

The usual problems with lightning and radio interference were encountered and satisfactory modifications and improvements were developed to provide the degree of reli-

ability demanded for city transportation service. Today, radio complaints are few and there is no record of damage to the traction motors due to lightning.

#### REDUCTION IN WEIGHT

The weight of the overhead system has always been a problem. A one-pound weight in the overhead system produces from five to eight pounds side load in the supporting structure, either pole or building. The reduction of weight in the overhead system reduces the side loads on the structures and as a consequence, the cost of the system. Substituting 2/0 grooved trolley wire for 3/0 grooved has reduced the weight 20 per cent. The weight of overhead fitting has been reduced 35 per cent since 1934. This weight reduction has permitted the use of many street car poles that formerly supported two trolley wires. Now they support four trolley wires.

#### THE PICTURE OF TROLLEY COACH OPERATION TO-DAY

In addition to the study and development of fittings for overhead design, each new trolley coach installation has required a field study, a study of the application of the materials. To-day, trolley coaches are operating in every climate, almost in every country. They operate at speeds up to 45 m.p.h., accelerate at 4 m.p.h. per sec., collect currents as high as 400 amperes, climb 13 per cent grades, run through subways, through congested streets and over country highways. They do this quietly, swiftly, efficiently, under the overhead distribution system just described.

There are 3,300 trolley coaches now operating in Canada and the United States, 95 per cent of which have been installed within the last ten years. These coaches operating over 1,100 miles of route totalled 100 million coach-miles during 1940, and each coach averaged over 1,000 miles for each trolley pole dewirement.

This is equivalent to saying the trolley coach can run at least five days without a dewirement, a performance that is a measure of the reliability of modern trolley coach overhead.

---

## CHARCOAL HAS WAR-TIME USE

The use of charcoal in making light-weight alloys for aircraft construction has resulted in a substantial increase in the production of charcoal in Canada, reports the Forest Products Laboratories of the Department of Mines and Resources.

Before the war charcoal was used in Canada principally for kindling fires and as a fuel for charcoal cookers. On this continent charcoal was at one time employed in the manufacture of steel but has been largely replaced in that industry by metallurgical coke. In several parts of Europe, in Australia, and in other countries where the price of gasoline is high, charcoal has been used extensively in recent years as a source of producer gas to replace gasoline in the operation of internal combustion engines for buses, tractors, trucks and motor cars. With further

reduction of supplies of gasoline such use may assume importance in Canada.

Charcoal may be made from any species of wood but in Canada it is generally made from the heavy hardwoods—maple, beech, and yellow birch. Two methods of manufacture are employed: charcoal kilns and in steel retorts from which, in addition to charcoal, acetate of lime, methanol, and other by-products are recovered. One cord of air-dry hardwood will produce about 650 pounds of kiln charcoal or about 1,000 pounds of retort charcoal.

The earliest known method of making charcoal was to stack wood in beehive-shaped piles and to cover almost completely with earth. By kindling a fire and regulating the air supply part of the wood is burned, producing sufficient heat to convert the remainder to charcoal.

# THE MANAGEMENT-EMPLOYEE PROBLEM FOR ENGINEERS

JAMES W. PARKER

*Vice-President and Chief Engineer, Detroit Edison Company, Detroit, Mich., U.S.A.*

*President, The American Society of Mechanical Engineers.*

**A luncheon address delivered at the General Professional Meeting of The Engineering Institute of Canada, at Montreal, on February 6th, 1942.**

It is an honour to speak before this meeting of The Engineering Institute of Canada, and a great pleasure to bring you the cordial good wishes of the American Society of Mechanical Engineers. Speaking informally may I say that the views expressed are my own personal views, for my subject is a somewhat controversial one.

Contemplating the world war now in progress, it seems evident that changes in economic conditions after its termination will be momentous, and that the social organization of the nations will differ from that prevailing before this catastrophe.

Many of us feel that the whole issue of the war boils down to a question whether the reorganization of the life of any nation will come from within under leaders of its people's own choosing, or be imposed from without at the hands of a victorious enemy. In either event, the changes will be profound.

When the wave of republicanism swept Europe and America a century and a half ago, and Great Britain eventually emerged successful from the struggle with the French Empire, she found herself free to work out her own scheme of social reform without dictation from the Continent. Reforms took place at last, decades afterward, but in typical British fashion and with the result which you all know. The story would have been a far different one if Napoleon's programme of a new European order had prevailed.

In the United States, changes in the industrial philosophy of the people have been in the making for more than a generation. There are few here who will not remember the time when the purposes of many great corporations were predatory, aimed at the exploitation of both the public and the wage earners.

Those were the days when Theodore Roosevelt used to talk of "malefactors of great wealth." People's consciences were stirred but the way of reform looked long and very nearly hopeless. Yet, since then, the attitude of employers has changed radically. We shall never again see conditions such as prevailed in the days of early steel making in the Ohio Valley. In many ways things have changed for the better. Reasonable hours of work are the rule, good working conditions are general, and the contrast is vast between the conditions under which men work in the great River Rouge plant of the Ford Motor Company, for instance, and those of the steel plants at South Chicago and Pittsburgh in those old unhappy days. The employer has come to have a new concept of the corporation as a great social device and to have a new sense of his three-fold responsibility to the public and to employees, as well as to his shareholders.

It is significant indeed that when the Automobile Labour Relations Board, appointed by President Roosevelt, made its report in 1936, very little had to be said about poor conditions under which men had to work. Indeed, in all the interminable negotiations between unions and manufacturers in recent years, there have been remarkably few complaints about working conditions, and the argument for increased pay has been almost a secondary matter. The issues which arose concerned such matters as membership in unions, representation by collective bargaining agents, and, unhappily, jurisdictional conflict between two types of union organization.

Whether employers or not, there are few thoughtful men who do not believe that in principle, at least, the labour union movement is just, however badly led.

There has, as a matter of fact, been very little of statesmanship in the policies and programme of professional labour leaders. There has, without doubt, been in that leadership an element seeking to inject into the relationship between employer and employee a foreign ideal. It has attempted to arouse class hostility, and has employed the tactics of the European revolutionist; there have been sit-down strikes, and slow-downs, and, I regret to say, much lawlessness.

I do not believe, however, that these alien concepts will take permanent root in America, providing the thoughtful people of the country give constructive attention to this problem. Some industrialists of my acquaintance fear that the labour movement seeks to take over the management and direction of the industrial machine, but it is my own belief that this will never come to pass. My own observation is that wage earners are concerned more with the circumstances which affect their own lives, such as their pay, their conditions of work, or their treatment by the supervisory force, and that they are content to leave to management, as they always have in the past, administrative decisions affecting the conduct of the business.

But the mistakes of management have been many, both in very large manufacturing organizations and in the small 200-man plants. Production men in the automobile companies have repeatedly acknowledged that the unions had chosen stewards from the companies' own employees, who possessed qualities of leadership which management had not discovered.

One hears many stories bearing on this point. A certain manufacturer having a contract with the C.I.O. in his Detroit plant, established a new non-union manufacturing unit at a small city in the northern part of the state. To this arrangement there was immediate objection from the union, and especially from one of his own employees representing his local shop group in Detroit.

My informant, a man of long manufacturing experience who is attempting to establish himself as an industrial relations counsel, talked first to the labour representative and then to the manufacturer, and concluded that the principal cause of disagreement was sheer misunderstanding, rather than a dispute over union membership.

For a time the manufacturer refused to let the shop steward visit the out-of-town plant, and when he finally did consent insisted that the superintendent of the shop accompany the party. Further persuasion was needed before that shop superintendent would permit the shop steward to go freely through that shop. At dinner on the way down from Detroit the shop steward and the shop superintendent sat across the table from each other. My friend hoped they would get talking, but they did not.

When they returned, however, the shop steward had a friendly talk with my informant, and explained that he was pre-occupied because bad management was permitting some work to be done in Detroit which should have been done in the out-of-town plant, and was sending some other operations to the other plant that might better have been carried on in Detroit.

This man had been a trouble-maker in his own shop, but

in regard to what he had seen, his whole attitude was that of an intelligent critic, rather than that of the partisan labour leader that he was supposed to be. I think the incident illustrates a too prevalent inclination on the part of management to withhold confidence from its own employees.

After making allowance for all the pressure to which a man is subjected by union organizers and fellow employees, and for the actual physical coercion which has undoubtedly driven many men into joining a union, there is still another reason which influences men to join unions and to pay dues. They have resented the fact that wage earners have in times past had to deal as individuals with their employers and so have been at a disadvantage. This was not negotiation between equals but rather a suit for relief from conditions objected to, and a decision by a not impartial judge, the employer. The change from this kind of relationship between employee is welcome to almost any man employed.

But, granting the principle, it would be a mistake to conclude that the mere making of a contract with a union will establish a proper relationship with the workers, and between the workers and the employers. Unionized or not unionized, that relationship must be based upon mutual confidence and upon co-operation in meeting problems peculiar to each group—employers and employees alike. It is a result to be studied and worked for unremittingly, as a condition of successful operation, just as merchandisers work for the confidence and good will of the public they serve.

Now, as it happens, engineers play a prominent part in the industrial scene. They and their works are at once the prime cause and product of present day industry, or so we are led to believe. If it is properly in their province to apply the findings of scientific research to the utilization of materials and forces, it is equally their responsibility to deal with the human agencies involved. In the nature of things they gravitate into supervision and administration. Their position is unique, because in their early years of training and experience they have opportunities of forming lasting friendships with the men and the foremen with whom they learn to work.

One of the first questions I have always asked of a junior engineer during his first years in a plant or in a shop is with regard to the workmen—whether or not he has made friends with them and whether or not he likes them. It is a good indication of the boy's worth if he does. One need not ask the workmen whether they like him. If he likes them and admires them it can be taken for granted they have accepted him. Are not such friendships valuable? Out of them come understanding and trust

and they make for success between management and labour in the years ahead.

Men in the ranks look for leadership to the trained, thoughtful men of high purpose with whom they are brought naturally in contact, and if they cannot find it there, they will turn to less worthy sources. The job of management is to maintain a sustained effort to understand and keep the confidence of employees. And it is a job we have too often shirked in the past. Grievances have gone unsatisfied. Men have been offended in ways not even noticed by the supervisory force. I know by experience how dissatisfactions will accumulate in unexpected places, and all under working conditions we had believed as good as it was possible to make them. I believe many an organized demand for wage increases that seemed at the time unreasonable, has been principally the tangible result of neglect on the part of management to treat men with consideration and tact.

I am aware of the uncompromising bearing of some of the labour representatives. But unreasonableness should not be met with unreasonableness, even with the advice of counsel. I have seen too much of that, and, still with advice of counsel, have seen the employer fighting a long-drawn, losing rear-guard action. And, in contrast, I have seen the feeling of the men and even of their organization leaders for such a man as William Knudsen. The job is not one that can safely be delegated to professional labour relations counsel, and then forgotten. That course has been and is still being tried, and the results are not good.

But if the man with engineering training is to prove himself useful in improving these conditions, one may ask what of the unionization of engineers themselves? We hear much about this of late years. I would be the last to deal with the difficult choice often confronting young engineers, in other than realistic fashion. They need the help and advice of older members of the profession, many of them themselves managers and employers of labour. And there are many misconceptions to be removed from people's minds regarding the application of recent labour statutes.

When an engineer makes something of his opportunity to assist in finding solutions for these labour problems, considering it his duty to take that course, rather than one of mere partisanship, the question of unionization within his own profession seems to solve itself. Unionization within a profession is, at best, a contradiction in terms. If a calling is worthy of the name "profession", there must be in it the element of devotion, not for the selfish advantage of some employer or of some self-seeking pressure group, but rather devotion to the interest of the public, in whose service engineers have always done their best work.

# SOME OF THE ENGINEERING IMPLICATIONS OF CIVILIAN DEFENCE

WALTER D. BINGER

*Commissioner of Borough Works, City of New York, and Chairman, National Technological Civil Protection Committee of the United States*

An address presented before the General Professional Meeting of The Engineering Institute of Canada, at Montreal, on February 6th, 1942.

(ABRIDGED)

It is indeed a privilege to bring news of the engineers of England to those of the greatest Dominion.

My one-man expedition to England started from Montreal last September, from whose air-field the bomber flew in a beautiful trip to Scotland with but two hours' stop at Newfoundland.

I have never publicly told of the return trip but it seems fitting to do so here. Montreal was again in our minds on the return journey, which brought us in another very long hop from Scotland to within one hundred miles of Montreal, on what had been a beautiful clear night. About two a.m. some thirty minutes away from Montreal, the plane, without any warning, in view of the fact that the aurora borealis had stilled the radio, suddenly ran into a zone of twelve degrees below zero temperature. Just at the time that the metal of the plane had been cooled to zero, which was about the temperature inside the plane, we encountered a terrific rainstorm, and a phenomenon known as completely frozen rain ensued in which the drops froze so fast that hemispheres of ice built up on the metal. It was estimated that we took on about four tons of ice in a few minutes. There were several inches over the rain-shield.

We still had some distance to go when our altitude dropped to four thousand feet, and kept on dropping at an alarming rate; I understand your hills around here are about twelve hundred feet high. Anyway we were told to put our parachutes on in order to be prepared to bale out. It was dark. It was soon decided to turn around and run away from that ice condition, on the theory that we could always put down on the Atlantic.

We had three rubber boats with us. For three hours we maintained a dead reckoning course back to the east, when suddenly the moon appeared and the navigator found that the storm had been racing toward the North pole, and we were several hundred miles up in Labrador.

We then started south again which was splendid, because we were not only avoiding the danger but we were flying towards the sunlight, and it was a great sight to see the sun try to get through the ice on the windshield. We worked our way south with a failing gasoline supply, and after eighteen hours and seven minutes put down at the Newfoundland airport, still covered with ice and nine hours after we had passed that same meridian in the other direction. So I missed my trip to Montreal altogether, because by that time we were so late we hopped right down to Washington.

I think I should give you some explanation of what took me abroad. About a year and a half ago the American Society of Civil Engineers decided to study the problem of civilian defence. We felt, however, that it was not a task any one institution should undertake by itself, and we suggested to the Secretary of War that he appoint a committee with a member from each of the great American engineering societies—the American Railway Engineering Association, the Institute of Electrical Engineers, the Institute of Heating and Ventilating Engineers, the Chemical Engineers, the Public Health Association, and so on. We took twelve of our outstanding societies and formed a consulting committee, which was empowered to advise the Secretary of War in all things that we thought he ought to know on this subject, and to interpret for him

information which was brought back by military observers from abroad.

Not long after that, Sir Leopold Savile, president of the Institution of Civil Engineers, wrote to the American Society of Civil Engineers, suggesting that a member be sent over there, for, he said, it was impossible to learn this story from reports.

As soon as we felt that we had used all the information we had, we suggested to the Secretary of War that this invitation be accepted, and I was asked to go.

I was sworn in as an expert consultant to the Secretary of War, and attached to the office of the Military Attaché of the Embassy in London.

But the real source of the information I needed was the British Institution of Civil Engineers. They knew what I ought to ask for.

An old professor at the Massachusetts Institute of Technology used to say that in the order of their importance the engineer should be judged, first, by character; second, by judgment; and third, by technical proficiency. And I assure you that the character of the British engineers has a standing fully equal to that of all the other British people.

A striking evidence of this was in the vital decision as to whether or not the repairs made on the public services, such as water supply, gas, and telephone should be of a permanent or temporary nature. With bomb damage occurring many times every night, you can imagine the great temptation, to make temporary repairs. But it was decided that if they did that, then when the bombing was over they would have to tear up their city and do it all over again.

So, in the face of the most terrific air blitz, they made permanent repairs, and when I was in London, some seventy days after the last great air-raid, ninety-five per cent of all the water-mains in London, had been permanently repaired and the streets repaved.

I am in charge of the streets of Manhattan, and when I was over there, the streets of London looked better than the streets of Manhattan. In New York our streets are cut up, owing to a very large amount of new construction going on, whereas at the moment, as you can well realize, there is little new construction in London.

The sewers and the other service lines have also been repaired permanently, but perhaps not to quite as large an extent.

Before I say a few words about water supply, I should tell you that my report was sent back as a sealed document. I was appointed a courier of the State Department, and not allowed to look at it again. The English and the Scotch were not permitted to break the seal under the treaties, and my report was handed in to the Chief of the Intelligence Division of the United States Army. Until that report is finally released as a public document, I am not permitted to divulge any of its contents, nor am I allowed to quote from it. He has, however, already issued one hundred copies of the report, but restricted, so that they are not (under the Espionage Act) permitted to be mentioned in the press, nor passed around without using the greatest discretion.

It is believed that the report will finally be published, but not until the British again have had an opportunity of seeing that there is nothing in it which could possibly injure them.

I carried over with me two hundred questions, prepared by our twelve constituent societies, and brought back the answers to most of them. As I had been working on this subject in all its phases for a year and a half, I was able to discuss it with the British engineers and scientists and officials whom I met, so as to write the report in a give-and-take manner.

The water supply system of London apparently was saved by the fact that it was almost the oldest in the world. According to the chief engineer of the Metropolitan Water Board, the first pipes had been laid in Queen Elizabeth's reign. Of course, they have been renewed many times since, but as the city grew up these water-mains led to street intersections by several different paths. They were not entirely on a rectangular basis, so that in spite of devastating bomb craters which cut many principal mains, there was no district in London he was not able to reach with some line that went another way around.

His message to all American engineers, which I wrote down and I think I may quote, was: Cross-connect, cross-connect, and cross-connect again. Wherever one main meets another, put in a cross-connecting valve, because the time will come when you will need it.

That, of course, does not mean that we in the United States should rebuild our water systems, but it means that those who are designing a water system, which would be good in bombing, would have to bear this in mind.

At this point I should like to say that the Federal and State officials in charge in the United States believe that the time for the expenditure of large sums of money on general protective construction and blackout and air-raid shelters has not yet come, and I agree with this. If we start digging up parks to put in air-raid shelters, or building them in all houses and in streets, and realize that what is done in one city must also be done for others, the expenditure of labour and material would be so enormous that it would really stop first line defence. Obviously, it would be a great error to fall into that frame of mind.

This however, should be the time for intensive planning, not only in general, but in specific cases. A man in control of a big public building should know how he is going to black out that building and which are the safest places in it. It is not intuition that will tell him. It is consulting with qualified engineers who have read the literature of the subject, thought about it, and added what they can themselves.

I think another great mistake would be for us to accept everything that the British have done, because they did not do everything because they wanted to do it. They did a great many things because they had to do them.

For example, take the air-raid shelters in the English cities. Those provided in the streets for pedestrians, are largely built of reinforced brickwork, a horrible kind of construction in which brick is used for what it can give and reinforcing bars are used in such a way that they do not always do the most good.

Statements were made in the United States that the fact that the British were using so much brick was a sign that brick was the best form of protection against blast and splinters. This is not the case. The fact is that when the lumber supplies of Scandinavia were no longer available, the British had not enough foreign lumber to build forms for concrete air-raid shelters. Obviously, since the air-raid shelter is supposed to be a monolithic, homogeneous structure, lying on the pavement, not founded in it, so that in case of a blast the whole structure moves

without collapsing, a reinforced concrete structure is the best.

Another thing that required the most intensive examination and questions was the statement made a year ago in the United States, that no municipal gas holder containing ordinary gas had ever exploded, and therefore that all kinds of gas containers were equally safe, namely, the water-sealed and the waterless type. We did not know whether that was true or not. I was supposed to find out.

There had been a case before the war, where a waterless gas container had exploded in Germany and therefore the British, rightly or wrongly, were afraid that the waterless gas container was a hazard. They therefore withdrew all gas containers of the waterless type from use, so that only water-sealed containers are in use in Britain, with the exception of five individual ones, for which there is no substitute and which are secret. I do not know where they are but they never were hit.

Thus, the answer is that a water-sealed gas container is absolutely safe in any kind of an air-raid, whether incendiary bombs or high explosives, and that is all we can say. We do not know about the others because they have not been exposed.

I mention these things because of the need for going through and beyond statements which are in themselves accurate, but not sufficiently inclusive.

When I decided to look into railways, I went to Mr. E. Graham Clark, the secretary of the Institution of Civil Engineers, and asked him for suggestions. He said that the best man to talk to would be the chief engineer of the most bombed railway. Well, the most bombed railway is one whose name must not be given, but which, while it has only ten per cent of the trackage, has received forty-five per cent of all the bombs. They counted the bombs. Seven thousand five hundred high explosive bombs fell on the right of way of that railway, and tens of thousands of incendiaries. They stopped counting those a long time ago. So you may rest assured the chief engineer of that railway knew all about bombs.

The English use a great amount of brickwork, and are past masters at its use. Their temporary brickwork seems to be better even than our permanent brickwork in New York. They have excellent workmen, which has been a great help to them at a time like this, in repairing the many brick barrel highway bridges which span the two-track railways. One of the railways has a thousand of them. You can repair them simply by bringing down a gang of bricklayers and a few mortar mixers. No plant or complex forms are needed. The result is that they are able to get their lines into use again with remarkable promptness.

Many of the main lines are carried on viaducts of that type. I saw a four-line road on a brick barrel arch system. Large quantities of whiskey were stored under those arches at a point hit by incendiaries. The resulting fire was so hot that the brick actually fused, and ran down, but they had one line in operation in twenty-four hours. They used a very fine system of Royal Engineers' scaffolding, made of steel, very much like our boys' meccano method. You can build it up with any length you want. In a week or so they got the second line running.

It is astonishing to see the way they conserve material. If a barrel arch is destroyed they use every good brick that is left. The result looks like an ancient Tudor construction with new brick fitted in with the old, and concrete put in where they cannot do it any other way.

They have very cleverly built their concrete arches by shovelling concrete into the forms from both sides until they came to a strip eight feet wide in the centre which being immediately overhead could not be shovelled into, and that they repaired with a cement gun.

I had an opportunity of investigating camouflage. That part of my report is marked "secret," at the request of the British, and has been sent to the Army Engineer Board. The British have made great progress in camouflaging things like gas tanks. I am not allowed to say how. It is a clever method and is already available to the American technical people to a considerable extent.

In regard to bombing the British have become fatalists. They know that for practical purposes there is no sure protection against a direct hit. That is not true in case some government department or installation has been buried under many feet of concrete, which might secretly be done. In all other cases a direct hit gets you.

I asked everybody I met in England, taxi drivers and everybody else, where they slept. Practically all of them sleep in their own beds. They have various places they go to when things get pretty hot, but do not imagine that any large percentage of the population use public air-raid shelters as a place to sleep in. At the height of the blitz, and we got the authentic information, only thirty thousand people in London were sleeping in public air-raid shelters. When I was over there there was still a considerable number using the underground railway or tube stations. These tube stations, by the way, are a hundred and fifty feet underground. They are real air-raid shelters. They are not like our subways in New York, where if you did not get killed you would get drowned or asphyxiated because all the gas-lines are directly over your head, supported by a fairly strong roof, but probably protected by only about seven or eight feet of earth.

I found that a thousand people were still sleeping in one of these big stations which had a maximum capacity of 2,500 and they had not had an air-raid in two months or more.

But if you face the fact that it is relatively simple to protect against splinters and glass, and relatively impossible to protect against a direct hit, you have accomplished a good deal, both for your own peace of mind and in knowing what to do.

On the other hand, we shall have to restudy the subject again in the United States, because of the height of the buildings such as we have in our Wall Street area and Radio City.

In such circumstances basement shelters are relatively less useful.

In fact, it seems to be indicated that in streets of high buildings, with frames of steel or reinforced concrete, an air-raid shelter would do better on the third floor, where it would be above the direct blast, and above the action of the massed splinter effect. That would have to be, however, a real air-raid shelter. It would have to be built by bricking up the windows, or making some kind of box inside the room.

Ten per cent of all casualties come from glass splinters and less than two per cent of the casualties are caused by the splinters of the bombs themselves. Of course a large number of the remaining casualties are caused by collapsing of and debris from buildings.

In the case of power stations, protecting the generators from splinters does the greatest amount of good, because the power houses are very big and a direct hit on the generators is unlikely. But splinters can put them out of business. They have developed an excellent system of putting a couple of inches of cork over the casing of the generator and then building a beautiful concrete structure around it, with ring bolts, so the whole thing can be lifted off.

I was shown around the principal power stations by Sir Leonard Pearce, the head of the London Power Company. I said, "There is something delightfully British about building this protection so you can take it off and put it away for another war." He did not answer me, but he showed me where he was going to store it.

You not only get the glass and splinter effect of the explosion, but a remarkable vacuum is created. We have a photograph in New York, in which the whole front of a six-storey wall-bearing building was sucked out into the vacuum of a bomb that never struck it at all. That gives you some idea of what these blows and repercussions are.

In regard to the blackout, which is general throughout England and Scotland, its intensity is unbelievable. I lived in Claridge's Hotel, which was near the Embassy, and every late afternoon the chambermaid came and drew the curtains which were deeply over-lapping, and battened down on the side. Then, when I was ready to step into bed and the lights were out I would pull the curtains apart, and on a moonless night you could hardly see the buildings across the street.

I also travelled by train across the whole of England, starting around seven o'clock, and getting in in the very early hours of the morning, and could see no light anywhere. Every locomotive has a hood between the tender and the cab, of the kind they used to have in the old American covered wagons. All the stoking is done under this and the fireman has a hard time with heat and gas. There are curtains on the car windows and the lights inside are not enough to read by. You do not dare to open the doors from both sides of the English carriages—you do not know whether you are going to step into a ditch or a bridge or where you are. You do not know which side of the station you are on. Men come along with megaphones and call out where you are, and which side you should open up.

The intensity of the lighting in the principal streets is stated to be the intensity of starlight. On a moonlight night London seems comparatively bright, but ordinarily when you come out of a restaurant at night you have to stand still for about thirty seconds before you dare to take a single step. You carry a little flash-light. I carried an American flash-light of the fountain pen type that I kept in my pocket. It had a minute lens, the size of a match-head in the glass. The first night I was there I was stopped by two policemen who told me my flash-light was casting a disk of light on the pavement. This might be seen from an aeroplane, so I had to paste paper over the whole end to get a diffusion of light.

The Americans have been making some experiments of late from aeroplanes and it has been found that blue light is not the least easily seen. A public document will be released within two weeks, giving the concensus of opinion of all the best authorities in the United States, having studied blackouts from all over the world, as to how it can best be achieved. A deep red light is said to be less visible than a blue one.

Those who served in the last war will recall that those blue lights were used in French cities a great deal to protect against air raids. It seems that the principal reason we have all used them since is because the French used them first.

The English extinguish all their street lights on any but main arteries. On the main arteries they have a minute light, very high, covered with a big hood, so that all the light falls downward.

All the railway signal lights are hooded with eighteen-inch cylinders which are apparently perfectly adequate.

The whole theory of blackout, as they have developed it, and it has been proved to be right, is that although it is absolutely impossible to hide a city or even part of a city, you can hide a target, and from the number of bombs that have peppered the neighbourhood of some of those power houses in relation to the relatively few bombs that have hit them, they must be right.

The British have always believed that the first string of bombers are generally the best navigators and you should hide your target from them.

# CONTROL OF TECHNICAL MAN POWER

## THE FIRST STEPS TOWARDS EVEN DISTRIBUTION OF TECHNICAL PERSONNEL IN CANADA

The following regulations became effective on Monday, March 3rd, 1942, and were announced in the House of Commons the following day by the Prime Minister. They are intended to aid in the distribution of those classes of persons in which scarcities have been experienced.

### ORDER IN COUNCIL

P.C. 638

WHEREAS the Minister of Labour reports,—

That having regard to the needs of the armed forces and essential industries there may be a maldistribution of professional engineers, chemists, research scientists, physicists, architects and other technically trained persons in undertakings engaged on essential work;

That the Wartime Bureau of Technical Personnel, which is responsible to the Minister of Labour, was established by Order in Council to organize the placement of technical personnel in the war industries and to co-operate with the Civil Service Commission in arranging for the placement of technical personnel in the Government service; that the Bureau has considerable information concerning such persons, including their qualifications, occupations, the names of their employers and other particulars and that it is desirable that such information be extended and kept up to date;

That there are such persons employed in undertakings not engaged or only partially engaged on essential work and in some undertakings the number employed appears to be in excess of the number required, having regard to their qualifications, the work on which they are engaged and to the national interest at this time;

That after the war, undertakings now engaged on essential work are likely to suffer such a diminution in operations that the number of such persons required in these undertakings will be much smaller;

That there is reason to believe that where such persons are not employed on essential work they would willingly undertake to perform the more arduous duties on essential work if they were so requested by the Minister of Labour and if they were assured that they would be reinstated in their former employment; and

That it is desirable that there should be similarity of treatment in the matter of reinstatement in employment of those who volunteer for service in His Majesty's forces and those who consent to perform services in an undertaking engaged on essential work.

AND WHEREAS the War Measures (Civil Employment Reinstatement) Regulations, 1941 (P.C. 4758), require an employer by whom any person accepted for service in His Majesty's forces was employed when accepted for such service to reinstate him in employment at the termination of that service under conditions not less favourable to him than would have been applicable to him had he not enlisted.

NOW, THEREFORE, His Excellency the Governor General in Council, on the recommendation of the Minister of Labour, and under the authority of the War Measures Act, Chapter 206, Revised Statutes of Canada, 1927, is pleased to make the following regulations and they are hereby made and established accordingly:

### REGULATIONS

1. These Regulations may be cited as the Essential Work (Scientific and Technical Personnel) Regulations, 1942.

2. In these Regulations,

- (a) "Director" means the Director of the Wartime Bureau of Technical Personnel;
- (b) "employer" includes the Crown in the right of the Dominion and in the right of any province;
- (c) "essential work" means work appearing to the Minister of Labour to be essential for the defence of Canada or the efficient prosecution of the war or essential to the life of the community;
- (d) "Minister" means the Minister of Labour;
- (e) "undertaking" includes any branch or department of an undertaking.

3. These Regulations apply to the classes of persons described in the Schedule hereto.

4. Any request made by the Minister, any direction given by him or any notice required to be received or sent by him under these Regulations may be made, given, received or sent, as the case may be, on his behalf by the Director.

5. (a) Any person to whom these Regulations apply may be requested by the Minister to perform, in an undertaking engaged on essential work, such services as that person is, in the opinion of the Minister, capable of performing, being services in the performance of which he should, by reason of his qualifications, in the Minister's opinion, be able to contribute most effectively to the carrying on of essential work.

(b) Notwithstanding any provision in the contract of employment between an employer and any person who is requested by the Minister to perform such services as aforesaid and who consents so to do, it shall be the duty of the employer to release the employee from his contract of employment within thirty days after written notice of the proposed change has been received from the Minister by the employer: provided that during the said period of thirty days the Minister shall consider any written objections made to the proposed change by the employer. The Minister's decision in the matter shall be final.

(c) Notice of the proposed change shall be sent by the Minister to the employer or his agent by post and it shall be deemed to have been received at the time when a letter containing the notice would be delivered in the ordinary course of post and in proving such sending it shall be sufficient to prove that it was properly addressed to the employer's place of business and mailed.

6. It shall be the duty of any employer, who employed a person to whom these Regulations apply immediately before that person at the request of the Minister entered into a contract with another employer to perform services in an undertaking engaged on essential work, to reinstate him at the termination of his contract for such services in a position and under conditions not less favourable than would have been applicable to him had he not consented to perform such services. The provisions of this section shall not apply to the Civil Service of Canada or to the Civil Service of any province of Canada.

7. (a) Where the contract of employment of any person to whom these Regulations apply is to be terminated, or is terminated, it shall be the duty of that person and of his employer each to notify the Director of the proposed or actual termination of the contract.

(b) The notices required by this section shall be given immediately after the party giving notice of his intention to terminate the contract of employment has notified the other of his intention.

8. (a) Any employer who desires to engage a person to whom these Regulations apply must notify the Director of the post to be filled.

(b) Any person to whom these Regulations apply who desires to enter into a contract of employment must notify the Director that his services are available.

9. The notices required by sections 7 and 8 shall give the names of the parties and particulars of the business of the employer, the work on which the employee was, or is, to be engaged, his salary, qualifications, and any other particulars considered by the parties likely to facilitate the proper carrying out of these Regulations. The Minister shall have power to require such further particulars as he may consider necessary for the proper carrying out of these Regulations.

10. After the date on which these Regulations become effective, no contract of employment or arrangement for the services of a person to whom these Regulations apply shall be made until it has been approved by the Minister. Any agreement or arrangement for such services which is made without such approval shall be null and void and where such an agreement or arrangement purports to be for services in an undertaking engaged on essential work, the provisions of section 6 of these Regulations shall not apply.

11. Where a person to whom these Regulations apply enters into a contract to perform services in an undertaking engaged on essential work and the contract is approved by the Minister, such person shall be deemed to have undertaken to perform such services at the request of the Minister and the provisions of section 6 shall apply to such person.

12. In any proceedings for the violation of section 6 of these Regulations, it shall be a defence for the employer who employed a person to whom these Regulations apply before that person agreed, at the request of the Minister, to perform services in an undertaking engaged on essential work, to prove,—

(1) that the person formerly employed by him did not, within two weeks after the termination of his contract for employment on essential work, apply to him for reinstatement; or

(2) that, subject to the provisions of sub-section (1), he failed without reasonable excuse to present himself for employment at the time and place notified to him by the employer; or

(3) that, by reason of a change of circumstances, other than the engagement of some other person to replace him, it was not reasonably practicable to reinstate him or that his reinstatement, in a position and under conditions not less favourable to him than those which would have been applicable to him had he not undertaken essential work, was impracticable and that the employer had offered to reinstate him in the most favourable position and under the most favourable conditions reasonably practicable; or

(4) that he was physically or mentally incapable of performing work available in the employer's service; or

(5) that he was employed to take the place of an employee who had been previously accepted for service in His Majesty's forces or of an employee, being a person to whom these Regulations apply, who, after the date on which they became effective, undertook, at the request of the Minister, to perform services in an undertaking engaged on essential work.

13. Where an employer has reinstated a former employee in accordance with section 6 of these Regulations, he shall not, without reasonable cause, terminate the employment of that employee and, in any proceedings for violation of this section in any case where the employment was terminated within six months of the reinstatement, the

onus shall be on the employer to prove that he had reasonable cause for terminating the employment.

14. An employer shall not terminate the employment of any employee to whom these Regulations apply in the expectancy that the employee, at the request of the Minister, will agree to perform services under another employer. In any proceedings for violation of this section, if the court is of the opinion that there are reasonable grounds for believing that the employment was terminated in violation of this section, the employment shall be deemed to have been so terminated unless the employer proves that the termination was for a reason unconnected with such expectancy.

15. Nothing in these Regulations shall confer on any employer authority to make any contract or arrangement with reference to the period of employment, in any undertaking engaged on essential work, of any of his employees to whom these Regulations apply, and who, at the request of the Minister, consent to perform services in such an undertaking, which he is not authorized to make under any power already possessed by him; but where any employer has entered into an agreement with his employees, being persons to whom these Regulations apply, to restore to their positions employees who undertake to perform services in undertakings engaged on essential work, such agreement shall continue in force to the extent that it is not less advantageous to an employee than the provisions of these Regulations, subject to such interpretation as may be mutually agreed to by the contracting parties.

16. The Minister may make all such orders as he may deem necessary or desirable to carry out the purpose of these Regulations and such orders shall have the force of law.

17. Any person to whom these Regulations apply who fails to comply with the provisions of section 7 or 8 of these Regulations, or of any order made under the authority of these Regulations, shall be guilty of an offence and liable on summary conviction to a fine not exceeding one hundred dollars.

18. Any employer or official who contravenes or fails to comply with the provisions of section 5, 6, 7, 8, 13 or 14 of these Regulations, or of any order made under the authority of these Regulations, shall be guilty of an offence and liable on summary conviction to a fine not exceeding five hundred dollars, and, where the offence is under section 6, 13 or 14, the court shall, in addition, order him to pay to the person whom he has failed to reinstate, or whose employment he has terminated, a sum not exceeding an amount equal to three months' remuneration at the rate at which he was being remunerated by that employer when he undertook, at the request of the Minister, to perform services in an undertaking engaged on essential work.

#### SCHEDULE

1. A person who is normally engaged in the engineering profession in a consulting, technical or supervisory capacity in design, construction, manufacture, operation or maintenance and who has had a regular professional training in practice and in theory as an engineer in any of the following branches of engineering: civil, mechanical, electrical, chemical, metallurgical and mining.

2. A production, industrial or other engineer or chemist who normally holds in any engineering works or manufacturing establishment a position of authority involving responsibility for any phase of executive management or control of any technical function.

3. A person who has obtained a degree at any Canadian or other recognized university and who is normally engaged as a teacher of engineering science or of any branch of science at a university or technical college.

4. A person who has been trained, or who is or has been normally engaged, in the practice of any branch of the science of chemistry but not including a registered pharmacist.

5. A research scientist, that is, a person who, by training or practice, is skilled in the independent search for new knowledge of the properties of matter or energy.

6. A person, other than a teacher, who has obtained a degree at any Canadian or other recognized university in Engineering, Chemistry, Physics, Geology, Mathematics,

Architecture or in any natural science, or who is a technically qualified member of the Engineering Institute of Canada, the Canadian Institute of Chemistry, the Canadian Institute of Mining and Metallurgy, the Royal Architectural Institute of Canada or of any provincial association of professional Engineers, Chemists or Architects.

7. A person, not in the classes described above, who, in the opinion of the Minister, possesses technical qualifications and skill which are needed in undertakings engaged on essential work.

## Abstracts of Current Literature

### REMODELLING THE PLANT OF AN AUSTRALIAN DAILY NEWSPAPER

Extracts from *The Sydney Morning Herald*, OCTOBER 20, 1941

From to-day the *Herald* will be printed on a sheet of a smaller and handier size. The decision to alter the shape of the paper, which was made more than two years ago, was necessitated a large-scale remodelling of the *Herald* building, costing £56,000, and the installation of new presses costing £322,000.

Though the outbreak of war caused anxieties and complications that accounted for the loss at sea of much valuable equipment, the actual work of installation was completed in three months.

Before these changes the *Herald* was equipped with rotary multi-web presses set up in 1922. These have had to be discarded, giving place to a new set of presses able to print the paper on a sheet of a smaller size.

The problem was to install the new machinery while the old presses were still in operation, so that on one night the paper could be produced on the old presses, and not more than two nights later the new machinery could be in full production.

The presses now in operation, plus six more units which are in process of being delivered, will enable the *Herald* to produce 400,000 48-page papers a night. In the chamber underneath the original machine-room there is now space for 24 additional units which would enable the *Herald* to produce one million 48-page papers a day.

#### WORK ON THE BUILDING

There was no space in the machine-rooms as they existed two years ago for more than a few new printing units; at the same time the *Herald* was determined not to transfer its plant to a building elsewhere in the city. It was decided to excavate beneath the existing machines, to underpin them, and to install the new presses below street level. It was therefore necessary to provide for a huge cavern-like sub-basement in hard rock, and at the same time arrange for the plant above to function uninteruptedly.

The overall dimensions for which the builders had to provide were for a chamber 176 ft. long, 27 ft. wide and 34 ft. deep. The chamber was to lie directly under the then existing press-room, and beneath the Scott presses, resting on solid rock 24 ft. below O'Connell Street (These presses weighed about 1,200 tons).

Naturally, at first, the character of the sandstone to be excavated was unknown. What the builders did know, however, was that the proposed chamber would be well below the level of the Tank Stream in Hamilton Street, and also below the highwater level of Sydney Harbor.

The project called for the underpinning of a number of structural columns, the extension of the then existing goods lifts, and, as has been explained, the normal opera-

### Abstracts of articles appearing in the current technical periodicals

tion of the printing machinery during the progress of the operations. The builders were advised that any deflection in the bearings of the presses would be calamitous. A deflection of more than 2/1,000th of an inch would, for instance, seize the bearings and stop the presses!

Another difficulty was the provision of a means of the ingress and egress of all materials, including spoil. In the event this procedure had to be confined to a single opening, only 11 ft. wide, in Pitt Street.

The total amount of rock removed was 150,000 cu. ft. The structural steel used weighed 140 tons.

Ultimately the scheme adopted was the sinking of a shaft 10 ft. deep by 27 ft. in width at the Pitt Street end, then excavating a tunnel of these dimensions—a tunnel somewhat like an underground railway tube. As this tunnel progressed, the machine columns carrying the Scott presses were supported in succession.

Vertical chases were cut in the face of the rock and structural steel columns were inserted under the supports of press No. 4 in the width of 27 ft. Then three-ton structural steel girders, 30 ft. long, were placed under the machine columns.

Great care was necessary to allow for the deflection due to the weight of the presses, 1,200 tons. Each 30-ft. main girder, after being placed in position, was pre-deflected by means of turn buckles and cables anchored to the bottom of the tunnel. This deflection was checked by a dial gauge with an accuracy of 1/1,000th of an inch. Many of the beams, it was found, required half an inch deflection. When the necessary deflection had been obtained, specially prepared steel wedges were driven in, and the spaces were filled with rapid-hardening cement.

This supporting column operation had to be repeated no fewer than 96 times. By then, the whole length and weight of the press-room above, from Pitt Street to O'Connell Street, had been supported on girders, with the new chamber opening below.

The work was successful as no movement could be detected in the press bearings. In short, despite the intricate work going on underneath, the production of the paper continued quite normally.

Where defective layers of stone were removed, strong concrete was inserted under pressure. This was particularly necessary along the northern wall, for the foundations of the heavy building, 190 ft. high, were involved.

The principal structural difficulties were those associated with the underpinning and lengthening of certain columns. Some had to be lengthened by 36 ft., the extended sections each weighing 11 tons. Actually the weight carried by one such column was calculated to be not less than 1,030 tons.

In detail, the procedure adopted was to weld 1½-inch steel plates 8 by 5 ft. on each side of the existing column, to which in turn were welded inclined steel stanchions on concrete foundations.

The bases of the existing columns were then removed and a shaft 36 ft. deep was carried down to the new foundation. The steel extension was thereupon inserted and jacked up.

Extreme care was taken in packing under the new extension columns before the temporary supports were removed. As it turned out, the total compression of each extension did not exceed ½/1,000th of an inch, and no settlement of the building occurred.

Naturally, working conditions were such as to require special ventilation and air-conditioning. Equipment for this purpose was provided as were pumping facilities as the depth of the excavations increased.

Operations were maintained at speed, and during some periods work was continuous for 24 hours. No serious hitch or accident occurred, in spite of the unusual hazards that had to be faced.

The excavation and underpinning took approximately two years to complete, with the men working two shifts, from 7:30 in the morning to 5 o'clock in the afternoon and from 10 o'clock at night to 7:30 a.m.

The work was designed and executed by Stuart Bros., Pty., Ltd., builders of the *Herald* office. They were ably assisted by the advice of Mr. H. R. Smith, of Morris and Smith, their consulting engineers, and had the co-operation of Mr. W. W. F. Denne, the mechanical superintendent of the *Herald*. Under them were a large number of skilled workmen, upon whose proficiency and patience a great deal depended. The excavation called for arduous manual labour, because, although the rock was solid sandstone, no blasting operations could be risked.

#### THE PRINTING EQUIPMENT

Though the essentials of printing have not changed in principle since Gutenberg, nearly five centuries ago, devised a wooden machine modelled on the ancient cheese press (he could print only 20 sheets an hour), the process was revolutionized by the invention of the rotary machine, which made large newspaper circulation possible.

William Nicholson, an English author, school teacher and editor, had, as early as 1790, worked on the idea of printing from type affixed to revolving cylinders, but the problem of attaching the type proved insoluble, and virtually remained so until Robert Hoe, founder of the firm which bears his name, evolved his famous press in 1846.

However, the first machine to print from a continuous reel of paper (instead of sheet paper) was made in 1865 by the American, William Bullock. There were four cylinders—two impression and two plate cylinders—but difficulties arose because the paper had to be cut before printing. Three years later, however, this handicap was overcome in the Walter rotary press used by *The Times*, London, until 1895. From that model the present-day newspaper rotaries undoubtedly developed. It printed reel paper on both sides from curved stereotype plates.

The introduction of electric power, which displaced steam, simplified printing enormously and resulted in a great saving of floor-space. Thus when the *Herald* set up its Scott multi-unit rotary web presses in 1922, the press-room was no longer cluttered up with double and treble decked frameworks, with their mazes of paper, webs and type and impression cylinders. Each of the sixteen units had its own motor and was entirely independent of any other unit. Yet the units could be used in varying combinations. If, for instance, one was thrown out of order, a combination excluding it could be quickly substituted.

These presses, on which until to-day the paper has been printed, could produce 240,000 sixteen-page papers an hour, or half that number of 32-page papers.

Because, however, they did not represent the last word in printing, the proprietors decided in favour of more efficient equipment. Although the war made the change more difficult than had been expected, it has been made successfully and to schedule.

The machinery ordered from R. Hoe and Company, Ltd., London, comprised one 12-unit super-speed line type rotary web newspaper press and one six-unit super-speed line type press.

The double folders and units are so arranged that the following combinations can be speedily selected to meet the varying requirements of the paper:

Six sextuple presses, each consisting of three double-width units and one double folder, to give a total maximum output of 300,000 copies an hour of any size papers from four to 24 pages;

Four octuple presses, four units and one double folder, to give a total maximum output of 200,000 copies an hour of any size papers from 26 to 32 pages;

Three presses, of five or six rolls, to give a total maximum output of 150,000 copies an hour of any size papers, from 34 to 48 pages.

Each of the printing units is chain driven by one 60 hp. commutator type motor, and the electrical connections are such as to enable any motor to be brought in or put out of circuit to suit the various press combinations.

The electrical driving equipment includes a pedestal control station for each sextuple press. These stations are conveniently placed away from the printing machinery, so as to give the operator a clear view over the whole of the presses under his control. To the inexperienced eye each station resembles a complicated high-power wireless set complete with knobs, lights, and handles.

From the station the alignment of the paper as it moves at high speed through the presses, and the automatic tension of each ribbon of paper can be controlled. From it, too, the press is started and stopped.

The presses are equipped with sheet break detectors, consisting of balanced "fingers" supported by the paper web (or ribbon) as it comes from the reel. Should the paper break, these fingers fall and complete an electric circuit which cuts out the motors and applies electromagnetic brakes to each printing cylinder, thus bringing the machinery to a stand-still. In other words, the presses are automatically stopped.

At the same time a knife, operated electrically, cuts the broken ribbon in front of the printing cylinder and in this way prevents the paper from being wound on to the blanket cylinders and causing damage. (The blanket cylinders, it should perhaps be explained, are those which take the impression from the print.)

The paper reels are carried in magazine arms which rotate and, whenever necessary, offer a fresh reel. So that there will be no delay in printing, when the paper from one reel is exhausted an automatic paster cuts the expiring ribbon of paper and joins it to a new reel while the press runs at full speed.

All the driving mechanism, the automatic pasters, and the press control equipment were designed and manufactured by Witton-James Ltd. of Hendon, England.

Actual printing does not, of course, complete the operation, because each paper has to be cut, folded, and delivered to the publishing-room, high above.

Here we have another instance of what can be done by mechanical handling.

Each sextuple press is fitted with an extended delivery, which carries the stream of papers from each folder up through the ceiling of the new machine-room, up again to the ceiling of the old machine-room, over the old rotary presses, and through the floor to the delivery stations in the publishing-room, where an expert staff is waiting to receive them.

One of these deliveries, when filled, carries more than 1,200 copies of the *Herald*.

These masses of papers are automatically counted for distribution.

Every 25th or 50th copy is "kicked" out of the stream in the extended delivery by mechanism in each folder, thus giving a quire count of all copies received in the publishing-room. The paper can thus be collated in lots of 50.

Moreover, special totalisator counters operate electrically with each extended delivery to give the publisher the number of copies from each or all of the deliveries at any given time.

All this time and labour saving equipment was designed and supplied by the Igranic Electric Co., Ltd., of Bedford.

The new presses are served by a new foundry for the casting of stereo. plates. Stereotyping, it should be explained, is the process by which duplicate plates of pages of type and relief printing blocks are obtained. The type and illustrations having been set in the forme, a matrix or mould of the forme is taken in papier mache. The actual printing is done by type-metal castings made from this matrix.

The need for speed and accuracy in newspaper production has brought into general use an ingenious machine called the "autoplate," an American invention, capable of producing such castings very quickly.

The papier mache matrix (on which type and illustrations have been impressed) is fixed into clips and placed in the casting box, which, when closed, is flooded with molten metal, pumped from a large metal pot. The casting box is then opened and the plate is removed from the matrix and cooled by a system of water circulation. The plate is afterwards bored, routed and finished by automatically controlled mechanism. It is then ready for the printing press.

The *Herald's* new foundry consists of three autoplates, three auto-shaving machines, and three routing machines.

This equipment supplies the presses with semi-circular stereo. plates, which are clamped to the printing cylinders, and, when inked by a series of rubber rollers, print on the ribbon of paper as it passes through. Plates are cast at the rate of four per minute per machine.

The 7½-ton pots on each of the machines are fitted with electric heating elements, and the heating is thermostatically controlled to maintain any predetermined casting or stand-by temperature of the stereo. metal. The casting temperature, it should be mentioned, is 580 degrees F., and stand-by temperature—the temperature when the pot is not being used—is 400 degrees.

Directly the stereo. plates are finished they are fed down to the lower machine-room by twin service lifts.

Since the new machine-room is situated, as it were, in the bowels of the earth, and is packed with machinery generating heat, adequate ventilation is a necessity.

To ensure satisfactory working conditions an air-conditioning plant was installed. Clean, fresh air is fed through anemostats in the false ceiling and down vertical trunks to the reel basement. For the benefit of those who may be mystified by the term "anemostats" it should be explained that these are merely circular orifices in the ceiling which give an even spread of fresh air without causing a direct draught.

It will be seen, therefore, that even in this detail the "modern touch" has been applied.

## IT WAVES THE HAIR

### And Also Gives Aircraft Parts to Britain

FROM ROBERT WILLIAMSON\*

A process used in woman's hair-waving is helping to build aircraft for Britain.

\*London Correspondent of *The Engineering Journal*.

It is a form of powder metallurgy, perhaps the greatest innovation in metal-working for thousands of years, in which, instead of using molten metal, articles are made from fine metallic powders and pressed into solid and durable shape.

For ladies' "perms" a metal powder is packed in little sachets of absorbent paper. When moistened, a reaction between the metal and certain chemicals generates the precise amount of heat required, so setting the hair in waves.

In making parts for aeroplanes, guns, ships, tanks and other equipment, powder metallurgy has two great advantages: it is very light and it is self-oiling—that is to say, the metal has fine pores which can absorb oil and retain it almost indefinitely.

The pioneer of powder metallurgy was an Englishman, Mr. W. H. Wollaston, who in 1829 worked out a powder process for platinum because the melting point of this metal was too high for the furnaces then in use. It is being used in Great Britain to-day not only for making metal parts but also for paints, printing inks, metal spraying, soldering and brazing, hardening concrete, dental alloys, fireworks, explosives and diamond tools.

In the near future it may be possible to use it for a ribbonless typewriter in which porous type faces soak up the ink and stamp it on paper.

## INDUSTRY AND INVENTION

FROM *The Beama Journal* (LONDON), DECEMBER, 1941

The proverb telling us that "Necessity is the mother of invention" is a very broad generalization, and by no means always true. Quite often an invention is the result of observation acting upon an acute, alert, and inquisitive mind, eager to learn, but, having learned, content to leave development, application, and financial profit to others. James Watt's first efforts at improving the steam engine were due much more to his awakened interest as he dismantled and examined the Newcomen model that refused to work than to the need of the mining industry for more efficient pumping machinery. Faraday, it is true, had visions of the future of electricity, but no demand for a new motive power directed his brain towards his great discoveries and inventions. Sir J. J. Thomson said that "new ideas on a subject come when one is not thinking about it."

On the other hand, emergencies encourage invention and provide evidence of a basis of truth in the proverb. War brings shoals of fantastic and impracticable ideas to those whose duty it is to sift the wheat from the chaff; but it also spurs on the genuine inventor to effort directed at a definite purpose. Such efforts, however sincerely we may deplore the fact that their ingenuity is generally destructive, are often turned to the aid of industry, transport, and commerce when hostilities cease.

Why are students of science urged to acquire an adequate knowledge of physics, applied mechanics and mathematics, drawing—the tools of their profession? Primarily, that they may be equipped to earn a living. But it is from their ranks, in these days of specialist education, that now and then one man steps out and surprises the world; some moment of close reasoning and logical thinking has acted as a catalyst and precipitated a result that may live in history. Or, it may be, with that same equipment he will produce, at the call of war, a machine, a device, a process, that will influence an entire industry in the direction of speed, of quality, of efficiency. Unknowingly, he may be the leader of that modern phenomenon, so alien to the age of craftsmanship—mass production.

It has been more than once seriously suggested that scientific research should "take a holiday." That idea

will not work. Sir William Bragg, commenting upon it in the presidential address to the British Association in 1928, demolished it. "You cannot prevent interested men from making inquiry," he said. "You cannot prevent the growth of knowledge; you cannot even make a selection of those points of advance which will lead to certain classes of results. No one knows what is over the hill. . . . New applications of scientific knowledge, new ideas, new processes, new machines, must always be in preparation. . . . Nothing in the progress of science, and more particularly of modern science, is so impressive as the growing appreciation of the immensity of what awaits discovery." Here are encouraging words for all workers in the field of industrial invention; and whether their inventiveness is excited by the immediate necessities of war, or is inspired by the mysterious force of unresting thought within them, they will be in the great tradition and acquire merit in that their gifts are for the service of mankind.

### FLEXIBLE PIPE RESEARCH REPORTED

Flexible-pipe culverts made of corrugated metal are able to support the weight of high earth embankments chiefly because of the lateral support of the pipes by the soil in which they are embedded. Such is the report of M. G. Spangler, research engineer of the Iowa Engineering Experiment Station, presented in Bulletin 153 of the Station, which has been issued recently.

Design data for calculating the supporting strength of flexible pipe are developed in the bulletin from both theoretical analysis and field experimentation. The design analysis is a result of an extensive research study, conducted in co-operation with the U.S. Public Roads Administration, which included full-scale field experiments on pipes as large as 60 inches in diameter under earth embankments 15 and 16 ft. high. One of the experiments has been in progress for more than 13 years, and thus furnishes data on long-time increases in pipe deflection.

In addition the study included laboratory tests on full-sized pipes. The bulletin also reports the performance of a flexible-pipe culvert 15 ft. in diameter, installed under a 42-ft. fill in accordance with the design principles presented by Mr. Spangler.

Professor Spangler's study reveals that the thin-ring elastic analysis is valid for calculation of deflections of corrugated-metal pipe. This analysis is used as a basis for deriving a design formula for pipe deflection which evaluates the effect of fill load, pipe size, bedding, properties of the soil, moment of inertia of the pipe wall, modulus of elasticity of the metal, and time of service. Techniques for determining these design factors are presented in the bulletin.

The field experiments show that a corrugated-metal pipe will deflect an additional 25 to 50 per cent after the earth fill over it is completed, although several years may elapse before the maximum deflection occurs. Pre-deformation of large pipes by vertical struts increases the load they will carry without excessive deformation.

The bulletin does not discuss the durability of the various metals used to make corrugated-metal-pipe culverts, nor is the design theory verified experimentally for low heights of fill and large vehicle wheel loads. However, the theory is general and should apply regardless of the load source, Mr. Spangler believes.

The complete research study is reported in Bulletin 153, "The Structural Design of Flexible-Pipe Culverts." Single copies of this 80-page bulletin may be obtained without charge from the Iowa Engineering Experiment Station, Ames, Iowa, U.S.A.

### STEAM RAISING WITH VEGETABLE REFUSE

FROM *Overseas Daily Mail Engineering Supplement*,  
(LONDON), FEBRUARY, 1942

The generation of steam with low-grade vegetable refuse fuels has probably progressed further in the case of sugar factories burning bagasse (cane refuse) than with most other fuels of this kind. This is probably due to the very large quantities of bagasse made each day and requiring disposal, the correspondingly large demand for process steam in the sugar refinery, and the fact that sugar factories are economically of relatively large size and therefore justify the installation of special equipment and furnaces for handling the refuse.

Apart from bagasse, a considerable economy can be effected in many establishments, especially overseas, by the efficient utilization for steam generation of any low-grade vegetable refuse that may be available. This includes, for example, spent tan and a wide range of products such as nutshells, fruit stones, seeds, husks, and skins and cores of soft fruit, as well as materials such as sawdust, shavings, bark, ends and pieces, and similar products from the timber and wood-working industries.

#### RESIDUE FUELS

Another type of low-grade vegetable refuse fuel is the residue after extracting vegetable products of all kinds for tannins, dyestuffs, perfumes, spices, and alkaloids.

During the past twenty years great progress has been made in the design and manufacture of furnace equipment for burning material of this kind, particularly for steam generation. In spite of this, however, in very many cases such refuse material is either not used at all or is burnt more or less with the object of getting rid of a nuisance, even when this applies to the operation of steam boilers. In fact in many cases the methods adopted are so unscientific that not only is no real benefit being obtained from the heating value of the refuse, but it is actually reducing that of the coal, coke, or other fuel that may be used at the same time.

#### GENERAL METHODS

Three general methods can be adopted for burning such refuse fuel. The first is to use handfired forced-draught furnaces, with either steam jets or fans, for the operation of "Lancashire" and other cylindrical boilers.

Another general method is to use water-tube boilers, which may be very small in size if necessary, in conjunction with either inclined step grates, hand or mechanically fed, or travelling grate mechanical stokers, preferably with fan-forced draught and preheated air.

The third method for utilizing low-grade vegetable refuse fuels is to install a small destructor supplying hot water either for process and general heating work or for steam boilers.

Most vegetable refuse fuel of this description has, say, 40 to 50 per cent moisture, with a very low ash content, and a heating value as fired of about 2,000-3,500 B.t.u. per lb. With modern plant it can either be burnt alone or mixed with low-grade small coal or coke breeze.

#### TYPICAL INSTALLATION

An interesting installation at a London works by International Combustion Ltd., consists of a small, inclined tube, water-tube boiler with upper steam and water drum, together with an additional steam drying cylinder and a lower water drum. This burns up to 15,000 lb. per hour of equal parts of coal and of mixed vegetable refuse, which includes wood chippings, sawdust, straw and vegetable refuse from the treatment of cloves and nutmegs.

For this purpose a travelling grate stoker is used, with fan-forced draught, superheaters, air heaters and econ-

mizers on the most scientific lines, the thermal efficiency obtained being stated to average 87 per cent based on the net or lower calorific value of the mixed fuel.

The boiler operates at 450 lb. per sq. in. pressure (725 lb. per sq. in. test pressure), and the normal evaporation is 15,000 lb. of water per hour, with 20,000 lb. maximum, the feed-water being delivered to the boiler at 176 deg. F., while the temperature in the combustion gases at the superheater outlet is slightly over 700 deg. F.

This is a good indication of the fact that the burning of refuse fuels has long since ceased to be a crude and unscientific performance, and that when large amounts of materials are concerned it is just as essential as in the case of coal or other fuel to have a boiler plant operated on the most efficient lines, with high pressures and temperatures if necessary.

#### GROUND-NUT RESIDUE

More and more use is being made of refuse fuels throughout the world, and a typical example of the use of low-grade vegetable refuse fuels is that of ground nuts. These ground nuts are subjected to compression for the production of oil, and the solid residue is made into briquettes and utilized for steam boilers, including those on locomotives.

Before the war this ground-nut residue cake resulting from the compression was used as cattle food, being shipped to France, Finland, Denmark, and Hungary. Now, instead, the residue is briquetted. The heating value of the briquette is 8,000-9,000 B.t.u. per lb. (4,500-5,000 k. cal. per kilo), much higher than the coal hitherto imported, in the ratio of 100:160 by weight.

It is stated, for example, that the Dakar-Niger Railway, which used to burn 5,000 tons of coal per month, will shortly be using 3,000-4,000 tons of these ground nut refuse briquettes per month, the cost of which is less than imported coal.

In addition, even the husks obtained after shelling the ground nuts are being used for fuel, especially in steam boilers for generating steam for driving the machines at the ground nut factories, the heating value of the husks being 6,600 B.t.u. per lb. (3,700-3,900 k. cal. per kilo).

#### BURNING OF WOOD WASTE

Both wet and dry wood wastes form a suitable fuel for steam generation. In up-to-date wood-working establishments the sawdust and chippings from the machines are continuously removed by suction equipment and taken to a central boiler plant, where they are burned either alone or in conjunction with supplementary coal or other fuel.

Dry wood can be satisfactorily burned in many forms of furnace, and refuse of uniform and small particle size can be burned in suspension in conjunction with pulverized coal if necessary.

Wet wood waste is a more difficult matter, depending upon the moisture content; the combustion of all woods must be arranged on the consideration that up to 80 per cent of the (dry) weight of the wood is volatile matter,

and that complete combustion of the resulting gases is of great importance.

For wet wood waste, the only practicable method is to adopt some form of grate set in an extension or supplementary furnace or "Dutch oven," similar to that used in bagasse burning. This arrangement provides sufficient radiant heat to dry the wood waste and then to distil the volatile matter, which is then burned in the main combustion chamber with an ample supply of secondary air. It is general also to arrange for an excess of primary air through the extension furnace or grate to evaporate the moisture and to cool the grate.

The inclined grates in the extension furnaces of advanced designs of furnace are of steel tubes running into headers, forming a water-cooled type of grate.

#### PROSPECTS OF GREATER SHIP PRODUCTION IN SCOTLAND

From *Trade and Engineering* (LONDON), FEBRUARY, 1942

Although production in shipbuilding and engineering reached very high levels in 1941 there are good prospects that new records of output will be established at the Scottish centres in the present year. The urgent need for still greater production is fully appreciated by employers and workers alike throughout all the essential war industries, more especially since the extension of hostilities to the Far East. Shipbuilders and ship-repairers have begun the year with a heavy programme of work on hand, and there will be practically little to limit production except the building capacity of the yards and perhaps also the supply of skilled labour. In the case of new tonnage construction the measure of standardization of design which has been introduced, coupled with the policy of placing repeat orders with individual firms, are aids to the acceleration of work in the yards. Another factor which helps in the same direction is the adequate supplies of steel and other shipbuilding materials available, notwithstanding the heavy pressure on the steel trade from the munition, tank, and aeroplane factories.

An interesting development under war conditions is the return to the use of timber in the construction of vessels of moderate tonnage. This is a branch of shipbuilding which is necessarily limited in extent, but it is understood that a number of useful craft are being turned out, while, so far as labour is concerned, the work makes little demand on those classes of workmen that are skilled in steel shipbuilding. The timber used is to a large extent home-grown. The available plantations are inspected by experts who mark out oak trees suitable for the "knees" and "heels" for the support of keels and decks, but instead of the timber being laboriously shaped by hand as in former times it is ripped up at high speed by the latest types of band saws electrically driven. When completed the wooden vessels bear little resemblance to those of the sailing-ship days, but at a distance are almost indistinguishable from craft built of steel. In most cases the propelling machinery consists of Diesel engines.

# From Month to Month

## NATIONAL SELECTIVE SERVICE

The long awaited plan for man power mobilization was announced by the Prime Minister in the House of Commons on March 24th. The proposal is of interest to all Canadian citizens, and particularly to engineers. The selection of Elliott M. Little as Director of National Selective Service places an engineer in one of the most responsible positions in Canada. It is his duty to implement the legislation already announced and any subsequent Acts which may be promulgated. This appointment is a further demonstration of the oft repeated statement that "this is an engineer's war."



E. M. Little

This development is of additional interest to members of the Institute in view of the fact that the General Secretary — L. Austin Wright—has been appointed Assistant to the Director. Mr. Little and Mr. Wright were responsible for the organization and operation of the War-time Bureau of Technical Personnel, and the experience gained thereby will be of great assistance to them in dealing with the larger field of man power.

The Council of the Institute has given Mr. Wright leave of absence to carry out this important work, but he will be able to retain contact with Institute affairs by attending Council meetings. He will also be available for consultation with Headquarters whenever required.

It has been arranged that the Assistant Secretary, the Secretary Emeritus, and the headquarters staff will undertake additional duties so as to make up as far as possible for the loss of Mr. Wright's services resulting from his new responsibilities.

Members may rest assured that while every effort will be made to maintain the regular Institute activities, occasional delay or inconvenience may prove to be unavoidable. In such case their indulgence will be appreciated, for they will realize that such occurrences result from the assistance given by their Institute to the country's war effort.

—R.J.D.

## News of the Institute and other Societies, Comments and Correspondence, Elections and Transfers

### APRIL TWENTY-FIFTH

On this date Dean C. R. Young is to be the guest of honour at a dinner jointly sponsored by the Toronto Branch of the Institute and the Association of Professional Engineers of Ontario, to celebrate his appointment as dean of the Faculty of Applied Science and Engineering of the University of Toronto and his recent election to the presidency of the Institute. At the same time it is intended to impress upon the public the great contribution that engineers are making in the present conflict.

The committee in charge of the arrangements, under the chairmanship of S. R. Frost, announces that the dinner is open to all engineers. It is expected that representatives from all branches of the Institute, in the provinces of Ontario and Quebec, will be present.

The dinner will take place at Hart House, University of Toronto. In the afternoon the House will be open to all engineers who may care to go and use the facilities before proceeding to dinner at 6.30 p.m. Visitors may use the swimming pool, play squash, billiards and have afternoon tea. After dinner, there will be special entertainment and music.

The Council of the Institute will be holding a regional meeting in the morning, at the Royal York Hotel, while the Council of the Association of Professional Engineers will meet in their own rooms at Bay Street. The two councils will join for lunch at the hotel.

All members are urged to come to this important gathering and pay honour to one of the great men in our profession.

### THE JOURNAL TRIES ANOTHER INNOVATION

The leading paper in this number of the *Journal* has earned the Gzowski Medal for 1941. It is entitled "The Lions' Gate Bridge" and the author is S. R. Banks, M.E.I.C., of Montreal. The work is a very complete description of all phases of design, fabrication and erection and runs to a length much greater than is normally printed in the *Journal*.

The Publication Committee believes that in the absence of Transactions, the *Journal* should be available as the repository of the records of engineering achievement in Canada. Consequently, Mr. Banks' paper will be printed in full, but it will be broken down into sections and spread out through four numbers of the *Journal*. Members who desire to preserve the complete work may put the four sections together afterward, or may keep the four complete *Journals* together.

The paper is one of the best that has been presented to the Institute in many years, and the *Journal* is pleased to be the medium of bringing it before the profession.

### E.C.P.D. GUIDANCE BOOKLET

Following closely on the heels of the Institute's booklet "The Profession of Engineering in Canada," comes a similar booklet from the Engineers' Council for Professional Development. This latter is somewhat more comprehensive and general in nature, but can be used to advantage with the Institute's publication. Its distribution is in the hands of the chairman of the Institute's Committee on the Training and Welfare of the Young Engineer.

This booklet entitled "Engineering as a Career" is planned to help students decide whether they are fitted to be engineers, by giving them a general picture of the



L. Austin Wright, M.E.I.C.

characteristics and requirements common to all branches of the profession and discussing the qualities and aptitudes needed by engineers.

In the first section, "The Scope of Engineering," are included discussions of what engineering is and what engineers do, the functions of engineering, the "engineering method," as well as answers to the question "who should study engineering?", an outline of the necessary preparation for such a career, and a survey of probable opportunities and earnings. The second section presents more detailed accounts of the activities of engineers in the various branches of the profession. The interrelationships among various types of engineering are stressed, and consideration given to the use of engineering training in other fields of activity.

"Engineering as a Career" is intended to give the high-school student, in language that he can understand, the facts he needs to help him choose his career. A list of vocational-guidance books and pamphlets, also primarily concerned with engineering and related vocations, is included. Copies of the booklet may be obtained from Headquarters at ten cents each.

### EMPLOYERS HELP THE UNIVERSITIES

So great have been the demands for technically-trained personnel in recent months that difficulty has been experienced in finding junior instructors in the universities to carry on effectively the regular work of the engineering courses. These difficulties of providing instruction have been enhanced by the increased registration of engineering students.

The University of Toronto was unable to secure a sufficient number of full-time demonstrators to meet its requirements, and, in the emergency, has been assisted by the employers of technical personnel in the city from whom twenty-one men have been made available for periods averaging about two half-days each per week. While assistance of this type is perhaps not so satisfactory in all respects as full-time assistance would be, there is, on the other hand, the advantage that the men who are giving their services in this manner are in nearly every instance more mature and more experienced than the junior instructors generally engaged for this work by the university. Furthermore, the contacts so formed between industry and the university may be expected to work to the advantage of both the university and the organizations assisting in this manner.

The university is indebted in this connection to the Hydro-Electric Power Commission of Ontario, which has supplied eleven part-time demonstrators, to the Bell Telephone Company of Canada, The Canadian General Electric Company, Limited, the Canadian and General Finance Company, Limited, the Canadian National Railways, the Dominion Bridge Company, Limited, and Mr. E. A. Cross, consulting engineer.

### A LANDMARK DISAPPEARS

Following the last great war, the Federal Government announced that captured German guns were available for distribution to municipalities and certain organizations upon application. The Institute had in the last war over one thousand members, mostly officers, and when the piece allocated to the Institute arrived in the form of a battered machine gun, minus most of its parts, the general secretary of that day, Mr. Fraser Keith, considered that this was hardly appropriate, and an immediate search was made for something that would more adequately represent the contribution which the Institute's members had made.

A heavy German field gun, which apparently had no owner, was located by Mr. Keith on a vacant lot on the corner of Cypress and Stanley streets, embedded in mud to the hubs. The Officer Commanding Military District No. 4 was Brig.-Gen. Charles J. Armstrong, C.M.G.,

C.B., an active member and a warm friend of the Institute. He undertook to find out who owned this gun and see if it could be made available to the Institute. Later he telephoned that it had been given to the 199th Irish Rangers, under the command of the Late Lieut.-Colonel Lord Shaughnessy, who graciously agreed to forgo any further claim to it in favour of the Institute.

As soon as this information was received a telephone call went to the late Mr. Archie Byers, of A. F. Byers & Company, with instructions to have the gun brought to the vacant space to the south of the Institute as quickly as possible. This was done and very shortly afterwards a



The gun is taken away by salvage workers.

concrete bed was put in place and the field piece bolted down securely so that the temptation which would otherwise always have been present to McGill students was removed. Thus we received the familiar field piece which has guarded the Headquarters building for over twenty years. At that time it was complete in every detail, but during the years a large part of the mechanism was removed. The mutilation at the muzzle was said to be due to the fact that the Germans had a habit of inserting a shell at the end of the barrel and afterwards firing by means of a long cord, thus rendering it unfit for further use.

The gun is no longer there—but has come to a not inglorious fate, for it has just been presented to the National Salvage Committee, and it is anticipated that it will return to Germany in a form quite different from that in which it left.

### WARTIME BUREAU OF TECHNICAL PERSONNEL

#### Monthly Bulletin

By far the most important development that has taken place in the history of the Bureau is the inauguration of the Regulations that were announced by the Prime Minister in the House of Commons, on March 24th, 1942, as part of the national man power proposal. These Regulations are known officially as the Essential Work (Scientific and Technical Personnel) Regulations—1942 and are covered by Order-in-Council No. 638.

In essence the Regulations require an employer to secure a permit from the Minister of Labour before engaging technical personnel, and to report the cessation of employment of all such persons. Under certain conditions he is also required to release such persons from his employ and to retain their seniority in the organization.

The complete Regulations are printed on p. 241 in this number of the *Journal* and employees and employers alike are urged to study them. It is to be noted that a

fine of one hundred dollars may be imposed for each failure to comply with the law.

The purposes of the Regulations are several. The increased demand for engineers in civilian and combatant occupations, and the decreased supply of competent persons have made necessary a more rigid system of maintaining contact. It becomes necessary to know where every person is; what he is doing and why he proposes changing employment, also why a prospective employer needs a technical person; is the particular person suited to the opening or would he be more useful to the war effort in another occupation?

This information and more is necessary if there is to be any intelligent control over the scarce commodity of technical skill. It is well known to the Bureau that many engineers, though on engineering work, are not being used to the maximum of their abilities, and others are in tasks that have practically no relationship to engineering. It will be difficult to fully correct the present situation—although a great improvement is hoped for—but surely something can be done to prevent further waste of this same kind. The necessity of obtaining a permit before engaging a technically trained person will make this possible.

A better distribution of this type of man power will be possible under the Regulations. Non-essential industries and other industries that have a reserve—and several have—will be encouraged to aid essential industries that are now suffering from a shortage. An employer is required to release an employee if the Bureau so requests and the employee is agreeable to it, and at the same time preserve his seniority. Every attempt will be made to check the relative importance of the work he is doing, with the work which he might do, before any transfers are proposed. It is expected that, when properly informed, employers will release men without the necessity of invoking the Regulations. It is much better that men be given leave of absence with the blessing of their employers than that they should be taken away by force of law.

This legislation is unique in Canadian history. It is the first attempt to apply compulsion to civilian occupation. It is a modified form of conscription that applies to industry and not to the army, and to the employer rather than the employee. Its enactment is based largely on the fact that seventy-five per cent of all persons completing the Bureau questionnaire, stated that they were prepared to transfer to war work if they were so requested by the proper authority. In other words, they were asking to be told. It is to the credit of this profession, that such a large majority puts the needs of the country ahead of their own particular interests.

Such controls are not going to be easy to administer. To avoid complicated and expensive administration, it will be necessary to have the support of employer as well as employee. With such support, everything will be readily possible; without it, the operations will become difficult, expensive and doubtless less satisfactory to everyone concerned. The Bureau is interested only in the successful prosecution of the war. Any attempt to control technical man power has only this objective in view.

The sympathetic support of all parties is sincerely solicited.

### PIONEER IN THE PROFESSION

The following brief notes were taken from a questionnaire of the Wartime Bureau of Technical Personnel which was submitted by Mr. C. A. E. Shaw. They go back into the history of western Canada and touch on many important developments of those days. With Mr. Shaw's permission, they are being printed herewith, for the benefit of other members of the profession. It is particularly interesting to see that Mr. Shaw took over com-

mand of the training camp of the R.C.E. in 1915 when he was sixty-two years of age. He took the officers' training course at the age of sixty-three and retired in 1918 with the rank of major. He is now eighty-nine years old.

Herewith is his letter and the notes:

Mount Tolmie, B.C.,  
February 6th, 1942.

L. A. Wright, Esq.,  
The Engineering Institute of Canada,  
2050 Mansfield Street, Montreal, Quebec.

My dear Mr. Wright,

Your letter of January 30th came to me as a very pleasant surprise. I have been engaged in trying to prepare a record of my past experiences, quite a big undertaking, as it covers about seventy years of a very active life, mostly pioneering. However, even at my age, I have a wonderful memory and already have a considerable portion of it written down, some of it has already appeared in various papers. As you are now in Montreal you could no doubt procure a copy of C.P.R. Bulletin, No. 10, which gives an account of some of my experiences while on various C.P.R. surveys.

Should I ever get this monumental task I am engaged in completed and typewritten, I will be glad to send you a copy.

Very sincerely yours,

C. A. E. SHAW.

Employed by the Government on first survey of C.P.R. from Prince Arthur Landing to Rat Portage (now Kenora) from 1871 to 1874.

Leveller on survey made by Senator A. B. Foster of railway line from the Georgian Bay to Mattawa on the Ottawa River, 1875-76.

Located and built railway from Picton to Trenton, Ontario, for Alexander Manning of Toronto in 1878-79.

Employed as leveller on survey made by the Government of C.P.R. from Selkirk to west boundary of province of Manitoba, 1879-81.

Located and built under General Rosser, in 1881, fifty miles of C.P.R. from a point near where Brandon now is. (C.P.R. Bulletin, No. 10 gives some account of these various experiences).

Took my party with a train of Red River carts to the south Saskatchewan—chose the crossing at Medicine Hat for the C.P.R., ran a trial line from there to Calgary, and made the final location of the C.P.R. from there to Calgary, 1881-82. Employed by General Rosser and later by Van Horne.

Made preliminary survey and final location of C.P.R. from Calgary to Great Divide in 1883. Employed by Sir William Van Horne.

1892-94. Surveying land in south western Manitoba for the Dominion Government.

Private practice as surveyor and mining engineer at Greenwood, British Columbia, also explored line from Point Roberts, B.C. to Rosland for the Vancouver, Victoria and Eastern Railway—now the Kettle Valley Railway 1896-1912.

Employed by British Columbia Government on land surveys 1913-14.

In command of 6th Field Company Royal Engineers, and instructor of engineers at Vernon Training Camp, 1915.

Took officers training course and appointed to command of Morrissey Internment Camp 1916-18, with rank of major.

Demobilized 1918.

Private practice till 1936.

Mr. Shaw is a member of the Dominion, Ontario, Manitoba and British Columbia Land Surveyors Associations—and is a life member of the Association of Professional Engineers of British Columbia.

## MEETING OF COUNCIL

A meeting of the Council of the Institute was held at Headquarters on Saturday, March 14th, 1942 at ten thirty a.m.

Present: President C. R. Young in the chair; Vice-President K. M. Cameron; Councillors J. E. Armstrong, J. H. Fregeau, E. D. Gray-Donald, J. G. Hall, W. G. Hunt, H. N. Macpherson, C. K. McLeod, G. M. Pitts, and J. A. Vance; Treasurer E. G. M. Cape; Secretary Emeritus R. J. Durely, General Secretary L. Austin Wright and Assistant General Secretary Louis Trudel.

The general secretary announced that in accordance with a previous decision of Council the gun which has been standing on the Institute property since 1919 had been handed over to the National Salvage Committee. The story of the gun, together with a photograph of it in the process of removal is published in this number of the *Journal*.

The general secretary read a letter from Mr. Pitts elaborating on the suggestion which he had made at the last meeting of Council, that arrangements might be made with the Founder Societies in the United States for the distribution in Canada by The Engineering Institute of all their publications, both to their own members and to members of the Institute who might desire to receive them.

Discussion followed, all members agreeing that such an arrangement would have many advantages, although it might be difficult to work out the details of distribution and finance. It was finally decided, on the motion of Mr. Pitts, seconded by Mr. Macpherson, that the matter be referred to the Publication Committee for consideration and report.

In the absence of the chairman, the general secretary presented the report of the Finance Committee. The financial statement for the first two months of the year showed that the income was substantially higher than at the same time last year, and that expenditures were slightly increased.

The general secretary read a letter from the Montreal Branch advising that at a recent meeting of their executive committee, a resolution had been passed to the effect that Council be asked to study the advisability of abolishing the class known as "Branch Affiliate."

The branch found that candidates for the class of Affiliate are inclined to apply for admission as Branch Affiliates rather than Institute Affiliates on account of the much lower cost. The former classification does not entitle them to true membership in the Institute; nevertheless, they may receive the *Journal* and are able to attend branch functions.

Mr. McLeod pointed out that it was entirely up to each branch to decide whether or not they had Branch Affiliates. If the Montreal Branch did not want to have such a classification, they did not need to do so. In Mr. McLeod's opinion, the qualifications for an Institute Affiliate were much higher than for a Branch Affiliate. Mr. Vance pointed out that some of the smaller branches had quite a large number of Branch Affiliates, and he thought that all the branches should be consulted before any action was taken.

Mr. Macpherson drew attention to the wide difference in the definition of a Branch Affiliate and that of an Institute Affiliate. The by-laws require that an Institute Affiliate shall be qualified to co-operate with engineers in the advancement of professional knowledge.

In Mr. Pitts' opinion, the higher entrance and annual

fee for an Institute Affiliate may account for the greater number of Branch Affiliates.

After further discussion, on the motion of Mr. Pitts, seconded by Mr. Hall, it was unanimously resolved that this matter be referred to the Institute's Membership Committee for consideration and report.

The general secretary presented a letter from Mr. Robson Black, vice-president and manager of the Canadian Forestry Association, inviting the Institute to appoint a delegate to their Board of Directors.

The president reported that he had discussed this matter with Mr. Black who had called on him in Toronto the previous day, and he felt that the Institute would be well advised to be represented on this Board. It would provide another contact and increase the influence of the Institute. It was unanimously resolved that such an appointment be made, and it was left with the president and the general secretary to name an appropriate representative.

The general secretary announced that the government had offered the position of Director of National Selective Service to a gentleman who, in turn, had asked the general secretary to go with him on the new work. The secretary was not at liberty to disclose the identity of the person selected as final arrangements had not been completed and only a tentative acceptance had been given the government.

Mr. Wright explained that his purpose in bringing the matter before Council now was in order to get some basis upon which a quick decision could be made without calling Council together again in the event that the present proposal went through to completion. He pointed out that to do this important piece of work it would be necessary for him to devote practically all his time to it. As his time was entirely at the disposal of Council he felt that the decision as to whether or not he could accept this appointment should be made by Council.

Mr. Armstrong reported that the matter had been discussed at a meeting of the Finance Committee and it was the committee's opinion that in view of the compulsory nature of the legislation which is pending and the national importance of the work involved, Council should not hesitate to make Mr. Wright's services available. Several of the councillors spoke on the issue, and it was the opinion of all that the Institute should participate in this effort to organize the man power of Canada by making available any services that the government might need.

In view of the fact that a final decision was not required now, it was moved by Mr. Pitts, seconded by Mr. Vance, and unanimously agreed that Mr. Wright's services should be made available if required, and that final details could be determined by the president and the chairman of the Finance Committee.

The general secretary asked whether the Council had in mind any special policies that might be adopted by the Institute in view of changing conditions. Certain things would eventually happen and he wondered if there was anything the Institute could do about them in advance.

Mr. Pitts thought the Institute should continue its efforts to bind the whole profession together. Through the influence of Mr. Wright the Institute had been of great assistance to the Government since the war started. When the war is over and conditions change, it is hoped that the Institute may continue to be of assistance in the reconstruction programme.

The president thought that if there was anything the Institute could do to further its normal activities without hampering the war effort, this should be done, together with any possible planning for the years following the war. He asked Mr. Cameron if he had anything to report on the work of Dr. James' committee on re-construction.

Mr. Cameron thought the Canadian Government was

wise in taking the stand that it should plan for the post-war period in all its aspects. The engineer is more particularly concerned in post-war reconstruction, which is the function of the sub-committee of Principal James' committee, of which Mr. Cameron is chairman. This sub-committee proposes to make certain recommendations to the main committee with a view to formulating some plan which will line up all the projects that will give employment in Canada after the war. Short time works and extended undertakings will be fitted into one complete programme. Mr. Cameron emphasized the fact that this will not necessarily be a public works programme. Private initiative and private industry will take care of such work as far as it is able, after which the Government will step in. This is as far as the committee has gone at the present time. The president thanked Mr. Cameron for his statement.

Following up on a suggestion made at the Annual Meeting of Council in Montreal on February 4th, Mr. Gray-Donald presented a request from the Quebec Branch that The Engineering Institute of Canada Prize of twenty-five dollars be offered each year to undergraduates at Laval University, Quebec. This suggestion had been approved at the previous meeting of Council, and on the motion of Mr. Gray-Donald, seconded by Colonel Cape, it was unanimously resolved that Laval University be included in the list of Canadian universities now receiving The Engineering Institute of Canada Prize.

Mr. Hunt reported that he had just handed back to the general secretary \$300.00 which the Annual Meeting Committee had received from the Council as an advance on the expenses of the recent meeting. The splendid contributions which the branch had received from certain public-spirited firms in the Montreal district had enabled the committee to finance the meeting without the usual assistance from Headquarters. This was noted with much gratification and Mr. Hunt was instructed to convey the thanks of Council to the Annual Meeting Committee. Mr. Hunt reported also that the committee was compiling a very complete and comprehensive report on the whole meeting, making certain recommendations and suggestions which it was hoped, would be of considerable help to future Annual Meeting Committees.

Mr. Gray-Donald reported that the executive of the Quebec Branch had given further consideration to the proposal to have the next annual meeting of the Institute at Quebec. The committee was not yet clear on all points, but expected that a decision would be reached in time to report to an early meeting of Council.

Mr. Hall stated that from discussions with members of the Toronto Branch executive, it appeared that there is some misunderstanding regarding the last sentence of Section 7 of the by-laws relating to the waiving of examinations for admission to full membership in the Institute. The Toronto executive seems to think that Council should take the initiative whereas, in Mr. Hall's opinion, if the branches think that the examinations should be waived in any particular case, they should make that recommendation to Council. He wondered if all the branches gave the same interpretation to that by-law. The president suggested that it might be desirable to write a letter to all the branches regarding this point, but Mr. Armstrong thought it was a matter that could very easily be taken care of by the Institute Membership Committee.

It had just come to Mr. Cameron's attention that Mr. F. P. Vaughan, a past-chairman of the Saint John Branch, a past member of the Institute Council and a past-president of the Association of Professional Engineers of New Brunswick, was retiring from professional work after fifty years of service. On the motion of Mr. Cameron, seconded by Mr. McLeod, it was unanimously resolved that a letter extending the good wishes of Council be sent to Mr.

Vaughan, and that the event be recorded in the *Journal*.

The general secretary read a letter from the secretary of the American Society of Civil Engineers written in response to greetings from the Institute transmitting the following resolution:

"Whereas, the American Society of Civil Engineers has received the friendly sentiments and offers of co-operation as expressed by L. Austin Wright, secretary, in letter dated December 22, 1941, from The Engineering Institute of Canada; and

"Whereas, the Society has always been proud of the genuine kinship existing between our sister organizations and the members of The Engineering Institute of Canada and the members of this Society;

"Now, Therefore, Be It Resolved, that the American Society of Civil Engineers expresses its sincere appreciation of the good will and spirit of friendliness ever evidenced between our organizations and further assures The Engineering Institute of Canada that the feelings are heartily reciprocated and expresses the hope they will always continue and will grow in strength and vigor."

This was noted with appreciation, and the suggestion that it be published in the *Journal* was approved.

A number of applications for admission and for transfer were considered, and the following elections and transfers were effected:

#### ADMISSION

Members .....	17
Junior .....	1
Students .....	32

#### TRANSFERS

Juniors to Members.....	3
Students to Members.....	2
Students to Juniors.....	5

It was noted that two meetings of Council would be held in the month of April, first, the regional meeting in Vancouver on Saturday, April the 18th, to coincide with the president's visit, and, second, one in Toronto on Saturday, April the 25th, to coincide with a joint dinner being held that evening under the auspices of the Toronto Branch of the Institute and the Association of Professional Engineers of Ontario, to honour Dean C. R. Young as president of the Institute and as dean of the Faculty of Applied Science and Engineering of the University of Toronto.

Mr. Macpherson stated that the members in Vancouver were looking forward with a great deal of pleasure to welcoming the president, and hoped that a number of other members of Council would be able to accompany him.

#### COMING MEETINGS

**American Water Works Association, Canadian Section**—Annual Convention at the General Broek Hotel, Niagara Falls, Ont., April 15-17th. Secretary, Dr. A. E. Berry, Ontario Department of Health, Parliament Buildings, Toronto.

**Dinner in honour of Dean C. R. Young**, April 25th, to be held by Association of Professional Engineers of Ontario and the Toronto Branch of the Engineering Institute of Canada, in Hart House, Toronto.

**American Water Works Association**—Sixty-Second Annual Convention at Stevens Hotel, Chicago, Ill., June 21-25th. Executive Secretary, Harry E. Jordan, 22 East 40th Street, New York, N.Y.

## ELECTIONS AND TRANSFERS

At the meeting of Council held on March 14th, 1942, the following elections and transfers were effected:

### Members

**Clark**, Andrew Tudhope, B.Sc. (Engrg.) (Glasgow Univ.), constrn. plant and salvage engr., Hydro-Electric Power Commission of Ontario, Toronto, Ont.

**Clixon**, William, asst. to elec. engr., National Harbours Board, Montreal, Que.

**Crowns**, Frank Gordon, B.A.Sc., M.A.Sc. (Univ. of Toronto), heating engr., Defence Industries Limited, Montreal, Que.

**Crechette**, Joseph-Alexis, B.A.Sc., C.E. (Ecole Polytechnique), chief of technical bureau, department of colonization, Quebec, Que.

**Gibson**, Cedric Marold, engineer, Link-Belt Ltd., Montreal, Que.

**Johnson**, Howard, (Durham Univ.), general manager, Midland Shipyards, Ltd., Midland, Ont.

**Keckel**, David Lane, B.Sc., M.E. (Haverford Coll.), consultant to the Algoma Steel Corp., Sault Ste. Marie, Ont.

**Radl**, George, B.S. (Mech.), M.E. (Cooper Union), engr. in charge of design, Canadian Copper Refiners Ltd., Montreal, Que.

**Rice**, Malcolm Mackay, asst. bridge and building master, C.N.R., Port Arthur, Ont.

**Stennie**, Robert, surveyor to Lloyd's Register of Shipping, Vancouver, B.C.

**Wanders**, Lionel John Redvers, (Cornell Univ.), manager, Quebec St. Lawrence Divn., Wartime Merchant Shipping Ltd., Montreal, Que.

**Cott**, Robert Govenlock, B.Sc. (Elec.) (Univ. of Alta), sales engr., Winnipeg Electric Company, Winnipeg, Man.

**Littleman**, Morton S., B.Eng. (McGill Univ.), mech. design, Dominion Bridge Co., Montreal, Que.

**Vagner**, Herbert Louis, B.A.Sc. (Univ. of Toronto), asst. engr., Hydro-Electric Power Commission of Ontario, Toronto, Ont.

### Junior

**Educ**, Rene, B.A.Sc., C.E. (Ecole Polytechnique), lands engr. dept., Consolidated Paper Corp. Ltd., Montreal, Que.

*Transferred from the class of Junior to that of Member*

**Wermerson**, Robert Alton, B.Sc. (C.E.) (Univ. of Man.), division engr., Canadian Pacific Railway Co., Brandon, Man.

**Cross**, Hugh Campbell, B.A.Sc. (Univ. of Toronto), testing engr., Hydro-Electric Power Commission of Ontario, Toronto, Ont.

**Ernot**, George Edward, B.Sc. (McGill Univ.), city assessor, City of Montreal, Que.

### Transferred from the class of Student to that of Member

**Hitchell**, William Reginald, B.Sc. (C.E.) (Univ. of Man.), designer and estimator, Canadian Bridge Co. Ltd., Windsor, Ont.

**Vigdor**, Edward Irving, B.Eng. (Elec.) (McGill Univ.), M.Eng. (Elec.) (Renss. Poly. Inst.), resident technical officer for the British Air Comm., Vultee Aircraft, Nashville, Tenn.

### Transferred from the class of Student to that of Junior

**Walderson**, Kenneth Kincaid, B.Sc. (Elec.) (Univ. of Alberta), asst. elec. engr., Trinidad Leaseholds, Ltd., Pointe-a-Pierre, Trinidad, B.W.I.

**Wavey**, Roland Eric, B.A.Sc. (Univ. of Toronto), engr. of works and bldgs., Naval Service, Shelburne, N.S.

**Wardson**, George Ross, grad. (R.M.C.), HQ. 12th Can. Infantry Bde., Sussex, N.B.

**Wohnston**, William David, B.A.Sc. (Univ. of Toronto), sales engr. McGregor-McIntyre Divn., Dominion Bridge Co. Ltd., Toronto, Ont.

Has passed Institute's examinations.

**Sarchuk**, Leon A., B.Sc. (Mech.) (Univ. of Sask.), inspr. of aircraft, A.I.D., R.C.A.F., St. James, Man.

### Students Admitted

**Allaire**, Lucien, (Ecole Polytechnique), 1430 St. Denis St., Montreal, Que.

**Anderson**, Clarence Arthur, (Univ. of Man.), 618 Mulvey Ave., Winnipeg, Man.

**Anglin**, Thomas Gill, (McGill Univ.), 488 Mount Pleasant Ave., Westmount, Que.

**Bennett**, John Robert Gordon, (McGill Univ.), 155 Westminster Ave., Montreal West, Que.

**Bowie**, Ralph Allen, (McGill Univ.), 228-18th Ave., Lachine, Que.

**Cann**, John Alastair Ross, (McGill Univ.), 4277 Western Ave., Westmount, Que.

**Carmichael**, Douglas Alfred, (Queen's Univ.), 194 Stuart St., Kingston, Ont.

**Caverly**, David Sundell, (Univ. of Toronto), R.R. No. 5, Aylmer (West), Ont.

**Chenivesse**, Emile, (Ecole Polytechnique), 366 E Sherbrooke St., Montreal, Que.

**Davis**, Stuart George, B.Sc. (Chem.), M.Sc. (McGill Univ.), 538-12th Street B, North, Lethbridge, Alta.

**Dudych**, Daniel (Univ. of Man.), 178 Spence St., Winnipeg, Man.

**Eisenbauer**, Martin Albert, (Nova Scotia Tech. Coll.), 226 Spring Garden Road, Halifax, N.S.

**Farish**, Frank J., (Univ. of Man.), 260 Ashland Ave., Winnipeg, Man.

**Gabies**, Pierre Maurice, (McGill Univ.), 2407 Coursol St., Montreal, Que.

**Garton**, John McConnell, (McGill Univ.), Boissevain, Man.

**Hamilton**, John C., (Queen's Univ.), Westport, Ont.

**Hopkins**, Herbert Arthur, B.S. (Elec.) (Detroit Inst. of Tech.), 426 Park St., Peterborough, Ont.

**Kerry**, Colin William, (McGill Univ.), 88 Arlington Ave., Westmount, Que.

**Lewis**, George Donald, (Nova Scotia Tech. Coll.), 226 Spring Garden Road, Halifax, N.S.

**Lindsay**, Colin, (Univ. of Man.), 104 Wellington Crescent, Winnipeg, Man.

**MacDougall**, Lorne Wells, (Nova Scotia Tech. Coll.), 331 Spring Garden Road, Halifax, N.S.

**McCallum**, John Francis, (Queen's Univ.), 318 University Ave., Kingston, Ont.

**Nutter**, James Ryan, (Nova Scotia Tech. Coll.), 78 King St., Truro, N.S.

**Ogilvie**, James D. B., B.Eng., M.Sc. (McGill Univ.), 1026 Murdock Road, Calgary, Alta.

**Olynyk**, Alexander, (Ecole Polytechnique), 423 Congregation St., Montreal, Que.

**Parsons**, Robert Lloyd, (Nova Scotia Tech. Coll.), 331 Spring Garden Road, Halifax, N.S.

**Poitevin**, Louis Merrill, (McGill Univ.), 3407 Peel St., Montreal, Que.

**Porter**, William Douglas, (Univ. of Man.), 5 McCulloch Ave., Outremont, Que.

**Pratt**, James Crawford, (Univ. of Man.), 1216 Wolseley Ave., Winnipeg, Man.

**Schafheitlin**, Frederick Blake, (Mount Allison Univ.), 331 Spring Garden Road, Halifax, N.S.

**Thompson**, Alvin Henry, (Nova Scotia Tech. Coll.), Pictou, N.S.

**Tamblyn**, Robert Teudar, (Univ. of Toronto), 80 St. George St., Toronto, Ont.

## MARCH JOURNALS REQUIRED

There has been an unusual demand for extra copies of the March, 1942, issue of *The Engineering Journal* and it would be appreciated if members who do not retain their copies would return them to Headquarters, at 2050 Mansfield Street, Montreal, Que.

**Lieutenant-General A. G. L. McNaughton, C.B., C.M.G., D.S.O., M.E.I.C.,** has recently been elected an honorary member of the Institution of Electrical Engineers of Great Britain, in appreciation of his work on high-voltage research during his presidency of the National Research Council of Canada and for his services in promoting the practical application of science to industry.

**Air Vice-Marshal E. W. Stedman, M.E.I.C.,** was appointed last month to the newly created position of director-general of air research in the Royal Canadian Air Force.

The duties of the director-general will be entirely divorced from routine work of the department and the officer will devote his time entirely to the study of research and development work in close collaboration with the National Research Council. This organization is intended to make possible introduction into service, with a minimum of delay, of new devices and new patterns of weapons.

**Air Commodore Alan Ferrier, M.E.I.C.,** has been appointed a member of the Air Council in the Royal Canadian Air Force succeeding Air Vice-Marshal E. W. Stedman. Air Commodore Ferrier will be responsible for aeronautical engineering. A graduate of McGill University from the class of 1920, he was employed with T. Pringle and Son, Montreal, for sometime after his graduation. In 1922 he was appointed to the staff of the technical branch of the Royal Canadian Air Force at Ottawa and has been in the service of the Government ever since. Before his recent appointment he was chief aeronautical engineer in the Department of Transport.

**Major F. L. C. Bond, M.E.I.C.,** vice-president and general manager of the central region, Canadian National Railways, was in Chicago last month, where he presided over the annual meeting of the American Railway Engineering Association.

**Colonel Arthur L. Bishop, M.E.I.C.,** has been appointed by the Dominion Government to head a new company for manufacturing synthetic rubber. This company, to be called Polymer Corporation Limited, will have its headquarters in Toronto. Born in Brantford, Ont., Colonel Bishop was educated at Brantford Public School and Ridley College, St. Catharines, Ont., and attended the Royal Military College, Kingston, from 1912 to 1914. Colonel Bishop is president of Coniagas Mines Limited, and Consumers Gas Company of Toronto. He is a member of the board of directors of the Consolidated Mining and Smelting Company of Canada Limited.

**A. P. Linton, M.E.I.C.,** has been elected chairman of the Saskatchewan Branch of the Institute for the year 1942. He was chairman of the branch in 1935 and was on the Council of the Institute in 1939. Born at New Hamburg, Ont., he attended the Galt Collegiate Institute and the University of Toronto, graduating from the latter in 1908 with the degree of B.A.Sc. After a few years spent with the Dominion Bridge Company and later with the St. Lawrence Bridge Company, he became, in 1915, chief bridge engineer of the Department of Highways of Saskatchewan, a position which he still holds.

From 1915 to 1919 Mr. Linton was overseas, serving with the 1st Canadian Pioneers, 9th Battalion, Canadian Railway Troops, in France, and commanded the 1st Bridging Company, Canadian Railway Troops, in Palestine. He was promoted to the rank of major, was mentioned in despatches, and received the O.B.E.

**Robert F. Ogilvy, M.E.I.C.,** has recently returned from St. Thomas, Virgin Islands of the United States, where he has been employed with the Aluminum Company of Canada since the summer of 1941. He is now connected with the same company as resident engineer on construc-

tion of the concrete storage dam on the Peribonka river, a hundred miles north of Lake St. John, Que.

**L. M. Howe, M.E.I.C.,** is now with the Bolivian Power Company, La Paz, Bolivia. Since 1930 he had been with the Saskatchewan Power Commission, Regina, Sask., where he had held the position of district superintendent of the rural transmission system, for the past six years.

**R. W. Willis, M.E.I.C.,** formerly associated with the Canadian Bridge Company at Walkerville, Ont., has accepted a position as designing engineer with the Standard Steel Construction Company at Welland, Ont. He had been with his previous employers since his graduation from Queen's University in 1937.

**J. E. Dion, M.E.I.C.,** formerly with the Wartime Merchant Shipping Limited, Montreal, is now with United Tool Engineering and Design Limited, in their Montreal office.

**T. A. Lindsay, M.E.I.C.,** who is with the Canadian Telephone and Supplies, has been transferred from Winnipeg, Man., to their office in Ottawa. He has been with the firm since his graduation in electrical engineering from the University of Manitoba in 1933.

**H. F. Bennett, M.E.I.C.,** district engineer for the Department of Public Works of Canada at London, Ont., and chairman of the Institute's Committee on the Training and Welfare of the Young Engineer, visited the maritime branches of the Institute during the month of February.

At the regular dinner meeting of the Saint John Branch on February 24th, Mr. Bennett spoke on the development in the scheme on vocational guidance for prospective engineers promoted by his committee and its possibilities for local high school students. On February 25th, he spoke on the Great Lakes Waterway System before the Moncton branch of the Institute. Mr. Bennett spoke on February 27th to the Halifax Branch on The Engineer of Tomorrow and stressed the need for increasing co-operation between engineering colleges and employers. In Sydney on March 2nd, he met with the executive of the branch and discussed the work of his committee and the organization in the branch of a students' guidance committee.

Mrs. Bennett accompanied her husband.

**Professor G. Ross Lord, M.E.I.C.,** of the Department of Mechanical Engineering, University of Toronto, was elected councillor in the mechanical branch of the Association of Professional Engineers of the Province of Ontario for the year 1942, being one of the youngest members to be so honoured.

Born in Peterborough, he graduated from the Faculty of Applied Science and Engineering of the University of Toronto in 1929 with the degree of Bachelor of Applied Science. In 1932, he was granted the Master of Science degree from the Massachusetts Institute of Technology. In 1932-33, he was the Freeman Scholar sent to Germany by the American Society of Mechanical Engineers, where he studied at engineering colleges in Berlin, Munich, Karlsruhe. He was awarded the Ph.D. degree from the University of Toronto in 1939 for his original research on cavitation in hydraulic turbines. Since 1934, he has been on the mechanical engineering staff of the Faculty of Applied Science, University of Toronto.

**S. G. Coultis, M.E.I.C.,** has been elected president of the Association of Professional Engineers of Alberta at the annual meeting held last month. Mr. Coultis is also a councillor of the Institute representing the Calgary Branch.

## NEW BRANCH CHAIRMEN



**H. J. McEwen, M.E.I.C.**  
Calgary Branch



**F. T. Julian, M.E.I.C.**  
London Branch



**A. S. G. Musgrave, M.E.I.C.**  
Victoria Branch

**H. J. McEwen, M.E.I.C.**, is the newly elected chairman of the Calgary Branch of the Institute. Born at Brantford, Ont., he received his early education at Brantford Collegiate and his engineering training at the University of Toronto where he graduated in 1911 as Bachelor of Applied Science in electrical engineering. Upon graduation he joined the staff of the Canadian Westinghouse Company, Limited, and went to Hamilton, Ont., where during two years he followed the shop engineering course. In 1913 he was appointed as sales engineer for the company at Calgary, Alta. He later became in charge of the sales of the company in the province, and in 1919 he was appointed branch manager of the company at Calgary. He is at present the district manager. Mr. McEwen is a member of the Association of Professional Engineers of Alberta.

**B. Snape, M.E.I.C.**, has now returned to Jasper, Alta., where he is resident engineer of Jasper Park. For the past five months he had been with the Works and Buildings Department of the naval service at Halifax.

**Alph E. Williams, M.E.I.C.**, has accepted a position with the Demerara Bauxite Company, Mackenzie, British Guiana. He was previously assistant engineer on construction of the cordite plant of Defence Industries Limited at Winnipeg, Man. Since his graduation from the University of Toronto in 1934, Mr. Williams has had extensive construction experience both in the United States and in Canada.

**George N. Richards, M.E.I.C.**, manager of Lee & Nash, consulting engineers and land surveyors, Brantford, Ont., has been appointed city engineer of Brantford. Born in England, he was educated at Derby and he served in the last war with the Royal Canadian Naval Volunteer Reserve. He served his apprenticeship as an engineer with the firm of Lee and Nash of Brantford. From 1924 to 1931 he was employed with Warner and Warner, registered engineers, Detroit, Mich. Since 1933 he has been manager of the firm of Lee & Nash of Brantford.

**E. Armand Dugas, M.E.I.C.**, has accepted a position with R.C.A.F. No. 3 Training Command, Montreal, as assistant electrical engineer in the Works and Buildings Division. He was formerly with the Montreal Light, Heat & Power Consolidated. He is a graduate of the Ecole Polytechnique of Montreal, from the class of 1932.

**Robert A. Kerr, Jr., E.I.C.**, who resigned his position as assistant electrical superintendent at the Montreal Cottons Limited, Valleyfield, Que., is now with the Nichols Chemical

Company as works engineer of the sulphuric acid plant at Valleyfield.

**A. S. G. Musgrave, M.E.I.C.**, municipal engineer at Oak Bay, B.C., is the newly appointed chairman of the Victoria Branch. Born in Cork, Ireland, he was educated at Trinity College, Dublin, where he graduated with the degrees of B.A. and B.C.E. From 1914 to 1919 he was with the Canadian Engineers, 4th Field Company, and later with the Royal Engineers as a captain. From 1919 until 1935 he carried on a private practice as civil engineer and land surveyor at Victoria, B.C.

**P. B. Motley, M.E.I.C.**, has recently been made a Life Member of the American Society of Civil Engineers, as well as Life Member of the Engineering Institute. In 1937 Mr. Motley retired as engineer of bridges for the Canadian Pacific Railway after forty-five years of service with the company.

Born in Calcutta, India, Mr. Motley completed his general and engineering education in England, and joined the engineering department of the Canadian Pacific Railway Company at Montreal in 1892. He occupied the positions of draughtsman and inspector of bridges both in the shops and during erection until 1903 when he became assistant engineer in the department. In 1908 he was made assistant engineer of bridges and on June 1st, 1911, received the appointment from which he has since retired. Among the more important bridges for which Mr. Motley has been responsible may be mentioned the Lethbridge viaduct, the Edmonton City bridge, the crossings of various large rivers on the prairies such as at Saskatoon, Outlook, Nipawin and Winnipeg, besides the bridge at Galt, Ont., and the bridge over the St. Lawrence river near Montreal, which was reconstructed to allow for double tracks, and the Saint John, N.B., cantilever bridge. There were many others of lesser magnitude though of difficult construction, particularly in the Rocky and Selkirk Mountains and on the north shore of Lake Superior.

**Frank P. Vaughan, Hon. M.Sc., M.E.I.C.**, consulting electrical engineer and contractor of Saint John, N.B., has recently retired after a professional career of fifty years. Born at Liverpool, England, he was educated in primary schools and Regent College. His education was completed by extensive lecture courses at the Massachusetts Institute of Technology, Boston. He began his career in 1891 in Vancouver, B.C., where he was engaged with the local telephone corporation, through which he was connected with other British Columbian telephone interests. In 1895 he went to Yarmouth, N.S., with the Yarmouth Street Railway Company. In 1896 he became connected with the

Northern Electric Works at Saint John, N.B. From 1897 until 1900 he was employed with three of Boston's largest electrical engineering firms. From 1900 to 1902 he was in the testing department of the General Electric Company at Schenectady, N.Y. In 1902 he returned to Saint John, N.B., and entered private practice as an electrical engineer and contractor. In 1906 he founded the firm of Vaughan Electric Company, Limited, electrical engineers and contractors at Saint John, N.B., from which he has just retired.

Besides his interest in the electrical contracting business, Mr. Vaughan has been a pioneer in experimental investigation in wireless telegraphy and telephony and high potential high frequency currents. He was granted the first license issued from Ottawa for experimental wireless telegraphy in 1904, and in 1908 talked a distance of three miles by wireless telephone. Mr. Vaughan has read a number of papers before the Institute and other scientific societies and has been a contributor to magazines. As manager of the Vaughan Electric Company Limited of Saint John, Mr. Vaughan was consulting electrical engineer during construction of the Saint John drydock.

Mr. Vaughan has been an active member of the Institute since he first joined in 1919. He was chairman of the Saint John branch, as well as a member of the Council. He is a past-president of the Association of Professional Engineers of New Brunswick.

**D. H. Parker**, Affiliate E.I.C., has enlisted for active service as engineer lieutenant with the R.C.N.V.R. This is Mr. Parker's second term of service with the Navy, since during the last war he was artificer with the Royal Navy. For the past sixteen years he has been mechanical superintendent and production manager with the *Montreal Daily Star*.

**Wm. P. Nesbitt, Jr.**, E.I.C., formerly with the Consolidated Paper Corporation, Limited, at Grand'Mère, Que., has accepted a position with the Howard Smith Paper Mills, Limited, Cornwall, Ont. Since his graduation from Queen's University in 1935 he has been in the paper industry successively with the following firms: Alliance Paper Mills, Merritton, Ont., Fraser Companies, Edmundston, N.B., Canadian International Paper Company, Hawkesbury, Ont., Consolidated Paper Corporation, Limited.

**Charles S. Gorowski**, Jr., E.I.C., who was formerly with Canadian Associated Aircraft Limited, Montreal, as engineer in the modifications department, is now with the National Steel Car Corporation Limited in their aircraft division at Malton, Ont., where he holds the position of electrical engineer in the production engineering department. He was graduated in electrical engineering from the University of Manitoba in 1934.

**Flying Officer Pierre A. Charest**, Jr., E.I.C., is at present stationed at No. 9 Bombing and Gunnery School, R.C.A.F. at Mont-Joli, Que. Previous to his enlistment he was with Fraser Companies Limited at Edmundston, N.B.

**Captain R. C. Lane**, Jr., E.I.C., who was stationed at Camp Borden with the 6th Armoured Regiment (1st Hussars) is now overseas. Previous to his enlistment he was on the staff of International Harvester Company at Toronto.

**Major Alexandre Dugas**, Jr., E.I.C., who returned from overseas a few months ago, is at present stationed at the Officers' Training Centre at Brockville, Ont. He is a graduate of the Ecole Polytechnique in the class of 1933. Previous to his enlistment for active service at the outbreak of war, he was with the Quebec Public Service Board at Montreal.

**Fernand Lecavalier**, S.E.I.C., is now employed at the National Research Council at Ottawa. He graduated from Ecole Polytechnique in 1939.

**A. I. Mendelsohn**, S.E.I.C., is now serving overseas as a captain with the Royal Canadian Ordnance Corps. He graduated in mechanical engineering from McGill University in 1929.

**Captain A. J. E. Smith**, S.E.I.C., is now located at Winnipeg, Man., with No. 10 detachment, Royal Canadian Engineers.

**H. A. G. Kingsmill**, S.E.I.C., has left the Aluminum Company of Canada at Arvida, Que., and is at present with the Royal Canadian Ordnance Corps at Barriefield, Ont.

**Herbert F. Coupe**, S.E.I.C., who was formerly with the Saguenay Power Company, Limited, Isle Maligne, Que., is now with Aluminum Company of Canada, Limited, on construction of the storage dam on the Peribonka river, north of Dolbeau, Que.

**F. R. Park**, S.E.I.C., has joined the National Research Council of Canada, Radio Branch, Ottawa, as junior research engineer. He was formerly with the Northern Electric Company at Calgary, Alta.

**Roger Lessard**, S.E.I.C., who was graduated last spring from the Ecole Polytechnique, Montreal, is now on the staff of Milton Hersey Company, Limited, on construction of the storage dam on the Peribonka river, north of Dolbeau, Que.

**Paul A. Verdier**, S.E.I.C., who formerly was with the Dominion Engineering Works at Longueuil, Que., has taken a position in the engineering department of the Allied Brass Limited, Montreal.

#### VISITORS TO HEADQUARTERS

**F. G. Green**, M.E.I.C., National Research Council, Ottawa, Ont., on February 20th.

**G. A. Sutherland**, Jr., E.I.C., National Research Council, Ottawa, Ont., on March 3rd.

**H. F. Bennett**, M.E.I.C., district engineer for the Department of Public Works of Canada, London, Ont., on March 5th.

**H. Balmforth**, M.E.I.C., Vancouver, B.C., on March 10th.

**Hector Cimon**, M.E.I.C., Secretary, Price Brothers and Company, Quebec, Que., on March 10th.

**J. P. Henderson**, M.E.I.C., Dominion Observatory, Ottawa, Ont., on March 13th.

**W. J. Thomsen**, M.E.I.C., Arvida, Que., on March 17th.

**Adolphe Clairmont**, S.E.I.C., Singer Sewing Machine Company, Thurso, Que., on March 17th.

**Donald Ross**, M.E.I.C., Foundation Company of Canada, Limited, Otter Creek Contract, Mont Laurier, Que., on March 23rd.

**G. G. Murdoch**, M.E.I.C., Saint John, N.B., on March 26th.

**W. A. Ketchum**, M.E.I.C., chief chemist, Fraser Companies Limited, Edmundston, N.B., on March 26th.

**A. E. Tyson**, Jr., E.I.C., Rayner Construction Company, Limited, Geraldton, Ont., on March 26th.

**Ernest F. Brown**, Jr., E.I.C., mechanical engineer, Royal Canadian Mint, Ottawa, Ont., on March 27th.

**D. P. Urry**, M.E.I.C., Dominion Bridge Company, Vancouver, B.C., on March 28th.

# Obituaries

*The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.*

**William Gamble Boyd, Jr.**, E.I.C., died at his home in Kingston on February 5th, 1942. He was born at Teddington, England, on February 10th, 1897, and came to Canada at an early age. He received his education at St. Alban's School and the Toronto Technical School. In 1915 he joined the Signal Section of the 74th Battallion and later followed a course with the Officers' Training Corps at the University of Toronto. He later joined the Royal Flying Corps and was demobilized as a Flight Lieutenant. After the war he joined the staff of the Canadian General Electric Company at Toronto. In 1921 he went with the Northern Development Branch of the Province of Ontario. In 1931 he was general engineer of the Canadian National Carbon Company, Limited, at Toronto. He joined the staff of the Aluminum Company of Canada at Toronto as draftsman in 1935. In 1940, he was transferred to the Kingston plant of the company as safety engineer and security officer.

Mr. Boyd joined the Institute as a Junior in 1922.

**Edward Preston Johnson, M.E.I.C.**, died in Toronto on February 28th, 1942. Born in Ottawa on November 13th, 1873, the son of Edward V. Johnson, inspector for the Department of Railways and Canals, he attended McGill University in the Faculty of Applied Science. From 1901 to 1903 he served as resident engineer, Algoma Central Railway, and assistant engineer in charge of dam construction on the Rideau Canal at Smiths Falls. From 1904 to 1916 he was assistant engineer in charge of Port Colborne harbour improvements, and resident engineer, Section 8 and 9, Welland Ship Canal. In 1917 he was chief field engineer for the Foundation Company of New York, on construction of the International Nickel Company plant at Port Colborne, and on construction of a bag loading plant at Tullytown, Pa., U.S.A. In 1919 when work was resumed,

he returned to the Welland Ship Canal as division engineer, Section 1, then until 1923 he was division engineer, Section 5, and in charge of surveys, Sections 6, 7, 8 and 9. In 1923 he was transferred to Welland as divisional engineer over Sections 5, 6 and 7, where he resided until moving to Toronto in the spring of 1936. As resident engineer during that period he was responsible for all construction work on the canal from Allanburg to Humberstone, including the siphon



**E. P. Johnson, M.E.I.C.**

culvert at Welland, an undertaking of some magnitude involving the carrying of the Welland river under the canal, and requiring several years to complete. He was employed by the Department of Railways and Canals for thirty-five years.

Mr. Johnson joined the Institute as a Student in 1900 and was transferred to Associate Member in 1909. In 1940 he became a Life Member of the Institute. He was chairman of the Niagara Peninsula Branch and in 1927 he represented the branch on the Council of the Institute.

## News of the Branches

### BORDER CITIES BRANCH

J. B. DOWLER, M.E.I.C. - *Secretary-Treasurer*  
W. R. STICKNEY, M.E.I.C. - *Branch News Editor*

Mr. James Livermore of the Engineering Department of the Detroit Edison Company was the guest speaker at the February meeting of the Border Cities Branch held on Friday, February 20 at the Prince Edward Hotel, Windsor. Mr. Livermore, who was introduced by Mr. E. M. Krebsler, is a graduate of Cornell University and is a member of the American Society of Heating and Ventilating Engineers, Michigan Chapter. He has previously given papers on the subject of Air Conditioning and his subject for the evening was **The Adaptation of Air Conditioning to an Existing Office Building**, accompanied by lantern slides.

The speaker pointed out that to establish an air conditioning system in an existing office building involves many problems which are not met with in a new building designed for air conditioning. An example of the former was the installation of an air conditioning system in the existing General Office Building of the Detroit Edison Company, and of the latter the completion of the air conditioning system in their new Service Building. Both of these are located in Detroit, and, as the Detroit Edison Company maintain their own construction department, the design, drawings and installation of both systems were carried out by themselves.

### Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

The new six-story Service Building, has brick walls and glass bloc in place of windows, and in which a mixture of shop and office work is done. The first and second floors are devoted to appliance repairs while the remainder are for clerical and drafting work, but the type of air conditioning is essentially the same for each. Since there are no windows in the building, it may be compared to an automobile exposed to the sun with its windows closed, and therefore air conditioning is absolutely necessary.

To design an air conditioning system it is necessary to estimate the capacity of the equipment required to cool the building in summer and to heat it in winter. This is done by making a balance sheet of the heat sources, internal and external, which affect the building. The external sources are heat from the sun on the glass bloc, and in summer heat from the outside air drawn in to replace loss through doors and openings. The internal sources are illumination and sensible heat of the occupants, and this means that regardless of the season of the year, heat has to be removed from the central portion of the building, at all times. Therefore, the air conditioning equipment must be flexible and able to supply heated and cooled air at the same time to locations where control is required. This is done by what is called the double duct system—two large

fans in the room supply heated and cooled air through hot and cold air ducts as required to maintain room temperature, regulated by a thermostatic control valve. These ducts are installed in what might be termed a false ceiling on each floor of the building and an ingenious arrangement of recessed lights allows the air to be distributed to the room below through perforated acoustic tile board in the ceiling between the lights. This was found to be the best method for eliminating drafts. The air is withdrawn through grills near the floor and taken back to the circulating fans in return ducts, being filtered each trip around the circuit. Heating of the air, when required, is done by passing it over steam coils, and cooling is done by passing the air over coils containing a refrigerant.

The installation of an air conditioning system in the Main Office, an existing ten-storey building, required more than two years to complete since all work had to be done at night, although a cooling system had previously been installed in the basement and on the first floor where the office cafeteria is located.

In the usual commercial installations in old buildings a system of zoning is used, i.e. the temperature for certain sections of similar exposure is controlled by one thermostat in each section, but in this case each office was partitioned off so a means of controlling each one was sought.

For cold weather the heating could be done by existing radiators in each office, but after some experimentation it was found that better results could be obtained by cutting down the capacity of these radiators to about fifty per cent of the heat loss through windows, etc., and supplying heat by warm air from a duct system. Fortunately, in this building there existed a means of drawing off air from the ends of the corridors to the roof, so means were available for establishing a circulatory system.

This led to the installation of a double-duct system again so that dual control of air would be available to each enclosed office. In this case, however, it was necessary to run the hot and cold air ducts beside each other along the top of the corridors and install mixing dampers at openings in the ducts opposite each partitioned office. These mixing dampers are the heart of the double-duct system. They are operated by a small air cylinder which is controlled from a pneumatic thermostat. As the temperature in the office changes, compressed air is fed into or released from the cylinder which operates the damper regulating the supply of hot or cold air as required. The pressure in the ducts is kept slightly higher than room pressure to ensure proper working of the dampers. In this way, the quantity of air supplied to the room is constant and only the temperature of that air varies. These damper boxes had to be well made to prevent leakage of air and ensure accurate control of temperature.

Since air was forced into the offices or rooms from the top, it had to be drawn off somewhere and this was not done by having open windows but by putting openings or outlet ducts in the doors leading to the corridors and drawing the air back to the circulating fans from the ends of the corridors. After several trials it was found that the best position of the thermostats was in these outlet ducts in the doors.

The problem of diffusion into each room required some experimentation and was finally solved by installing ducts from the mixing dampers along the top of each partition and having adjustable openings in these ducts. To prevent drafts the openings were made with perforations similar to those in the new Service Building.

As in the Service Building the equipment consists of two large fans with hydraulic couplings. Thermostats control the supply of water to the cooling coils and also the supply of steam to the heating coils. These thermostats are installed in a control panel in the fan room which enables

the operator to control practically everything from there. It is very necessary to have well trained, competent operators to keep the systems under proper control and secure best results. In conclusion, Mr. Livermore stated that the expense of these installations was well justified by the resultant comfort afforded their employees.

Some discussion took place after Mr. Livermore's talk and a vote of thanks was proposed by Mr. C. M. Goodrich. Mr. H. L. Johnston, Branch Chairman, presided and there were thirty-six members in attendance.

### CALGARY BRANCH

K. W. MITCHELL, M.E.I.C. - *Secretary-Treasurer*  
F. A. BROWNIE, M.E.I.C. - *Branch News Editor*

Mr. Max W. Ball, petroleum engineer, addressed a meeting of the Calgary Branch on **Anglo-American Responsibilities**. Since the topic was non-technical and many visitors were present, the chairman, Mr. J. B. deHart, introduced the speaker, postponing any business until the next meeting.

Mr. Ball, who is a graduate of the Colorado School of Mines in engineering, and of the National University of Washington in law, has served ten years with the United States' Geological Survey and has spent a number of years in exploration work. More recently he came to Alberta, where in 1930 he started the Abasand Oils Ltd., developing Alberta tar sands. Consulting practice, however, frequently takes Mr. Ball across the border, giving him an excellent opportunity to observe public opinion and international developments.

With a strong conviction that the Allies will emerge victorious from the struggle in which they are now engaged, Mr. Ball outlined American and British responsibilities if world peace and order were to be maintained.

Referring to the attitude of the American people, the speaker said.

"Remember Pearl Harbor" is not a slogan, it is a promise and a resolve."

Mr. Ball analyzed our attitude towards war during the period from the last Armistice until the recent invasion of Poland, pointing out that the minds of the Democratic Nations were permeated with pacifism, cynicism, and sentimentality, making this period between the wars more tragic than the wars themselves. In conclusion, the speaker pointed out that our early mistakes must not be repeated, and the English speaking "United Nations" must, united in one spirit, shoulder the responsibility of preserving honest peace in the world after the present conflict.

An interesting paper by a young civil engineer, Mr. B. A. Monkman, J.R.E.I.C., was presented before the Calgary Branch on January 29th, 1942, entitled **Cascade Project**. Projections of sketches and photographs were used to illustrate the progress of construction in its various stages.

An earth filled dam across the Cascade River Canyon will raise the level of Lake Minnewanka 65 ft. providing some 200,000 acre feet of storage in the 30 ft. lake regulation. Water will be conducted along the 2½ mile side hill canal into a 200 ft. length of wood stave pipe, terminating in a surge tank and a steel penstock. The power plant situated at Anthracite, just below the surge tank, will consist of a 20,000 kva. vertical generator driven by a 23,000 horse power reaction turbine, operating under a 325 ft. head. The plant will be operated on base load during winter months and at other times as standby. Large additional amounts of power required by war industries and particularly the Ammonia Plant near Calgary, have necessitated this development, which has the advantages of speed and economy.

Towards the close of the meeting the Ford Motor Co., showed a film entitled "Tools for the Job."

## EDMONTON BRANCH

F. R. BURFIELD, M.E.I.C. - *Secretary-Treasurer*  
L. A. THORSSEN, M.E.I.C. - *Branch News Editor*

The Edmonton Branch held its February dinner meeting in the MacDonald Hotel on February 24th. R. M. Hardy, the branch chairman, conducted the meeting.

The speaker for the evening, Mr. B. A. Monkman, Jr., E.I.C., field engineer, Calgary Power Company, spoke on the company's new power development on the Cascade River in Banff National Park.

Mr. Monkman introduced his topic by mentioning the company's present developments, and showing how the new project tied in with the existing system. He then pointed out the speed with which extra power had to be developed, that together with economic considerations, made it imperative that the Cascade site be used, rather than other proposed sites.

In his paper, the speaker outlined the location and design of the various structures making up the entire plan. These structures included the earth fill dam on the Cascade River, at the outlet of Lake Minnewanka, a spillway structure concrete control dam, two miles of canal, wood-stave pipe line, surge tank, penstock, power house and tailrace. In his discussion of the separate structures, Mr. Monkman described the various problems of design and methods of construction, as well as difficulties encountered during construction. In conclusion he described the method of operating the control dam and canal in the interval between the high and low water levels in Lake Minnewanka.

Mr. Monkman's most interesting paper was well illustrated by lantern slides and was followed by an excellent discussion. Mr. H. R. Webb, chief field engineer for the Calgary Power Company during the summer of 1942, moved a vote of thanks to the speaker.

## HALIFAX BRANCH

S. W. GRAY, M.E.I.C. - *Secretary-Treasurer*  
G. V. ROSS, M.E.I.C. - *Branch News Editor*

Mr. H. F. Bennett, M.E.I.C., of London, Ontario, chairman of the Institute Committee on the Training and Welfare of the Young Engineer, addressed the Halifax Branch on February 27th, at the Halifax Hotel. Mr. Bennett's talk, **The Engineer of To-morrow**, was a review of the work done by his committee and the plans made for future work. The objects are to place before interested high school students the requirements of the profession, the studies that will be met with in college, the branch of engineering most closely related to the field in which the student's interest lies, and to assist the young engineer in shaping his early career.

Considerable work along these lines has been done by various bodies in the United States, and the Institute committee has worked in close harmony with several of these bodies. Increasing co-operation between the colleges and employees of engineers, also between members of the profession and young engineers in another field in which the committee has begun studies.

Mr. Bennett is a former member and chairman of the Halifax Branch, and well known to many members. His enthusiasm for this work seems to know no bounds and everyone hearing his talk was impressed by the great amount of time and study that he and his fellow committee members have devoted to their task.

Dr. H. F. Munro, Nova Scotia Superintendent of Education, and Hon. J. D. MacKenzie, Nova Scotia Minister of Highways, were guests of the branch and spoke briefly.

The branch has grown in membership until it is now the fourth largest in Canada and entitled to representation on

Council by two members. John R. Kaye has accepted the appointment to this office.

R. L. Dunsmore gave a brief outline of the highlights of the recent annual meeting in Montreal.

About fifty members were in attendance with P. A. Lovett as chairman.

One hundred and sixteen members of the Halifax Branch and the Professional Association, attended a special dinner meeting at the Halifax Hotel on March 11th.

The speaker was Professor F. Webster, formerly of the University of Rangoon. He is at present a member of the Research Experimental Staff of the Dept. of Home Security, London, England, and has been engaged in the study of bombing as it affects the design and construction of buildings. His talk was illustrated by a film.

Professor Webster is in Canada on a special mission and this was his first address to any Canadian organization.

The regular March meeting of the branch was held in the auditorium of the Nova Scotia Technical College on March 20th, when a motion picture film entitled **Photo-elastic Stress Analysis** was shown. This film explains the use of polarized light in the analysis of stresses in plastic models of machine parts and structures under load.

A large number of models of various shapes are shown under concentrated, rolling and impact loads and by means of polarized light the distribution of the stresses become visible.

The film has been prepared in the laboratory of the University of Manitoba under the direction of Prof. A. E. McDonald, Dean of Engineering.

## HAMILTON BRANCH

A. R. HANNAFORD, M.E.I.C. - *Secretary-Treasurer*  
W. E. BROWN, JR. E.I.C. - *Branch News Editor*

Professor E. A. Allcut, M.E.I.C., was the guest speaker on the occasion of the branch Annual Meeting held in the Royal Connaught Hotel on January 9th. In discussing his subject **Substitute Fuels for Gasoline**, he not only pointed out the need for a satisfactory substitute due to the present emergency, but also because of the diminishing supply of petroleum. Professor Allcut reviewed the various substitutes which have been tried such as, alcohol from wheat, and compressed gasses such as methane, propane, hydrogen and producer gas. While much work has been done on the question, particularly in Great Britain and Europe, as yet no fuel has been found as economical and as satisfactory as gasoline. J. S. Glover, introduced the speaker and W. L. McFaul, moved the vote of thanks.

We were happy to have the General-Secretary as our guest, his genial presence always adds to the pleasure of a meeting. He gave a very concise and informative report to the members on some of the things that are being done in the interests of the Institute and the country, particularly with regard to Wartime Personnel and post war problems.

The business meeting was short and to the point and when the formalities were concluded our retiring chairman, W. A. T. Gilmour, had the pleasure of installing the new chairman, Stanley Shupe. The meeting was then declared closed.

The American Society for Metals (Ontario Chapter), American Institute of Electrical Engineers (Hamilton Group) and the Hamilton Branch of the Engineering Institute, held a joint meeting in the Westinghouse Auditorium, on February 10th. The chair was held jointly by H. Thomasson, J. T. Thwaites and S. Shupe, chairmen of the three societies respectively.

Dr. H. B. Osborn, Jr., research and development engineer, Tocco Division, Ohio Crankshaft Company, Cleve-

land, Ohio, addressed the meeting on the subject **Surface Hardening By Induction**. Dr. Osborn made it very clear that the surface hardening by induction is not new, but the application and control is new.

Induction hardening means that the core of the material remains the same, by inducing a thermal transformation in the surface a metallurgical change is obtained. The induction involves the use of high frequency current and three sources are available, spark-gap oscillators, motor-generator sets and vacuum tube oscillators. At present the motor-generator is the most satisfactory for the purpose and is therefore used.

Basically the process involves placing the steel article to be hardened within a magnetic field of rapidly changing polarity. The molecules of iron resist this change of polarity and the resultant hysteresis brings about heat in the steel. The temperature rises till the material becomes non-magnetic. At the same time eddy currents flow through the material and cause even greater heat than that due to the change of polarity.

The higher frequency current concentrates on the surface and thus the hardening takes place on the surface where it is required and ductile core is left within the material to withstand impact stress as in gear teeth. When hardening to a greater depth is required, lower frequency current is used and longer time to allow the heat to be conducted towards the centre of the material.

The equipment used involves a motor-generator set either within the unit or one set serving several installations. The unit has an inductor block of suitable design for the material. Part and parcel of the inductor block, there is a system of water spray jets. The heating and quenching cycle is controlled electrically and both are a matter of a very few seconds. Incidentally the time of the piece in the unit is so short, that the feed mechanism becomes quite a problem itself.

Induction hardening for a given carbon, gives slightly higher hardness. The structure for this type of hardening is more finely grained and, therefore, more homogeneous.

The possibilities of this method of hardening are unlimited. Already it is serving the war industry of the United States and Canada, speeding production.

#### MONCTON BRANCH

V. C. BLACKETT, M.E.I.C. - *Secretary-Treasurer*

**The Great Lakes System** was the subject of an address delivered at a branch meeting held on February 25th. The speaker was H. F. Bennett, B.Sc., M.E.I.C., district engineer, Department of Public Works, London, Ont. F. O. Condon, chairman of the branch, presided.

The Great Lakes, together with the canal system connecting them, constitute the greatest international waterway in the world. The volume of traffic is greater than the normal peacetime traffic of the Panama, Suez, Manchester and Kiel Canals combined. Forty million people are dependent on shipping operations in the Great Lakes. The most important freight movement is that of iron ore. 83 million tons are transported annually from the Lake Superior region to ports connecting with industrial centres in Canada and the United States. As the war continues, this figure will probably advance to 90 million tons. Second in importance is the shipment of coal, which in one year amounted to 40 million tons. Stone used in the steel industry and in road building comes third in volume of freight carried. Grain is fourth. Last year 359 million bushels of wheat, mostly Canadian, passed through the Great Lakes. Each year, some 50,000 automobiles are transported from the Detroit area westward. In 1941 this number was cut in half, and this year the movement will probably stop altogether.

Mr. Bennett spoke briefly on the history of the canal system, and referred to some of the physical characteristics of the Great Lakes. Certain weather conditions produce a very considerable tide in Lake Erie, the difference in level at the two ends sometimes being as great as eight feet. Lesser tides occur in Lake Superior, and in the other lakes, the tidal movement is very small.

The speaker related a very curious incident connected with the widening of the channel in the Saint Clair river. It was necessary to cut into the shore of a small unceded island, which was owned by the Indians and did not belong to either Canada or the United States. Before operations could be commenced, he and an American official had to meet with a council of the Indians, obtain their permission and arrange for compensation. Mr. Bennett stated that a number of similar unceded islands existed in the Great Lakes.

A vote of thanks to the speaker was moved by H. J. Crudge and seconded by B. E. Bayne.

#### MONTREAL BRANCH

L. A. DUCHASTEL, M.E.I.C. - *Secretary-Treasurer*  
G. G. WANLESS, J.E.I.C. - *Branch News Editor*

On February 26th, a lecture was given on **Subcontracting** by Mr. F. L. Jeckell, director-general of the Industry and Subcontract Co-ordination Branch of the Department of Munitions and Supply.

The "Bits and Pieces" programme of subcontracting originated in England as a means of decentralization to reduce dislocations from bombing. It was discovered, however, that it also served another very valuable service by making use of the skill and workmanship available in the small shops of the nation.

In Canada, the "I and S.C." Division is efficiently organized to give service, with branches and engineering personnel in principal cities. Among other things, it performs the following services:—

1. It has assembled and keeps revised, cross-indexed files on plant equipment throughout the country. With this, it is in a position to advise prime contractors of companies who may be in a position to accept subcontracts.
2. It has available on request, a manual on munitions subcontracting, giving its recommendations on procedure.
3. It considers applications for capital assistance for new machine tools—which are allowed only if no other comparable equipment is available in any other plant in the country.
4. It offers engineering service from its regional offices to expedite subcontracting and final delivery of the goods.
5. It is devoted to the job of producing as much war material as possible in the shortest time and not to worrying about the consequences of economic post-war dislocations.

From the Division's experience in granting prime contracts it has concluded that a prime contractor should set up a separate department to handle the job. The manager must be competent and on an equal footing with heads of other departments in the company. He must have his production, follow-up, and technical supervisors. The latter must give real engineering assistance to the subcontractor, who should be treated as though he were part of the organization.

Out of the sudden expansion programme, Mr. Jeckell sees a serious management problem, which deserves the serious concern of members of the Institute.

The following points came up during the discussion:—

1. At present, due largely to steel shortages, there are more sources willing to accept subcontracts, than can be given work.

2. At first, generally speaking, sub-contractors' costs run about the same as those of prime contractors, but as experience is gained, lower costs usually result, due to smaller overhead charges.

3. Subcontracts cannot be placed like purchasing requisitions for stock items; instead the prime contractor must co-operate by supplying engineering service. When this is done, percentage rejections run lower, as a rule.

4. It is the responsibility of the prime contractor to follow up the sub-contractor re schedules. If necessary the Division helps out.

5. Where possible the prime contractor is given a unit job; i.e. the Division itself does not usually farm out the components as sub-contracts.

6. There are two types of contracts:—

(a) Fixed price prime contracts.

(b) Cost plus prime contracts. In this latter case, the sub-contracts come under the direct supervision of the Division.

7. Among the most needed machine tools are the following:—

Milling machines

Turret lathes

Cutting tools

Presses, 1,000-ton capacity and up

Large size planers

Broaching machines and honers

External and internal grinders

8. The sub-contractor carries the same allocation and preference rating as the prime contractor. It is up to the latter to help the sub-contractor locate materials and it is advisable for him to supply raw materials to the sub-contractor—thus maintaining a better control over the complete operation.

Mr. Busfield thanked the speaker and suggested that our management committee might take concrete action in response to Mr. Jeckell's request.

On Thursday, March 5th, Dr. R. S. Jane delivered a comprehensive lecture on **Synthetic Rubber**, which was most timely in relation to the present emergency.

Dr. Jane did much of his graduate school work on rubber, and has made a continued study of developments in his and in the synthetic rubber field, in Europe and America. He is presently research chemist of Shawinigan Chemicals Limited, Montreal.

Chemists have for generations sought to produce synthetic rubber by the classical research method of synthesizing and polymerizing isoprene, which is the basic unit of natural rubber. No commercial successes have resulted. After the first World War, Britain abandoned her efforts and emphasized development of her far eastern plantations. Germany, being in less favourable circumstances, was encouraged to continue the synthetic researches, which had produced about 2,000 tons of inferior methyl rubber during the war. About 1930, the development of chloroprene rubber in the United States indicated a new approach to the problem through the polymerization of materials whose structures resemble but are not identical with isoprene. Fruitful results of this work in Germany, Russia, Poland and the United States has given the following general types of synthetic rubbers:—

(a) *Polysulfide rubbers*: (as from condensation of ethylene dichloride and sodium polysulfide)—a class of materials low in tensile strength, but excelling in oil resistance, and therefore desirable for gasoline hose tubes, etc.

(b) *Chloroprene rubbers*: (from polymerization of an acetylene derivative containing a high proportion of chlorine). Tensile strength is quite good, resistance to oil swelling and heat aging is outstanding. It is widely used in mechanical goods but will not likely be used for tire treads.

(c) *Koroseal*: (plasticized vinyl chloride). Really a rubber-like thermoplastic material, low in tensile strength, but of outstanding value in cable insulation.

(d) *Buna S*: (from copolymerization of butadiene and styrene). In Russia and Poland it is produced from by-product alcohol; in Germany from lignite coal; in the United States from petroleum refinery gases. This type is not oil resisting, but is said to equal natural rubber in tire tread performance. It will no doubt be produced on the greatest scale during this emergency.

(e) *Buna N*: (from copolymerization of butadiene and acrylic nitrile). An oil resisting type of Buna. Modifications of this basic type are known as Hycar, Ameripol, Chemigum.

(f) *Vistanx*: (from polymerization of isobutylene—a refinery by-product).

(g) *Butyl Rubber*: (from copolymerization of butadiene and isobutylene). This development is of more recent origin and probably resembles natural rubber most closely in processing characteristics. Coming as it does from refinery by-products, it is a bright hope in the synthetic field.

Following the emergency this range of synthetics, each excelling in one or more properties, will supplement natural rubber on a greater scale. During the emergency it is expected that they will have to supply the major proportion of our requirements, as our rubber stock-piles decrease. America's normal requirements are about 600,000 tons per year, (about 2½ per cent of this is now produced synthetically), and that of all the United Nations is estimated at about 1,000,000 tons per year. The petroleum resources of this continent can supply the necessary raw materials easily, but the production of the chemical plant equipment is a gigantic task which will sorely tax the steel industry. We will be hard pressed for rubber before this synthetic production is achieved.

On March 12th, an address on the subject **An Engineer Looks at Music** was given by Mr. S. T. Fisher, development engineer for Northern Electric Company, Limited. The chairman was Mr. P. B. Motley.

In conjunction with his work on Canadian production of Hammond electric organs, Mr. Fisher has made a study of physical basis of music and harmony, and he believes that such electrical musical instruments provide a means for perfecting the musical scale of keyboard instruments.

As we all know, certain combinations of sounds (chords) are pleasing to the ear (consonant) and others are not (dissonant). Pythagoras observed that the frequency ratios of consonant chords must be small integers. Helmholtz, who did exhaustive research on this subject, also found that these simple ratios were the only ones tolerable to our ears. For the seven major intervals of the octave, these ratios are: 1, 9/8, 5/4, 4/3, 3/2, 5/3, 15/8, 2. If these ratios are applied to the key of C major, the "just" (perfect) scale of C major is obtained, as seen in Fig. 1. It will be observed that the major chords C.E.G., F.A.C., and G.B.D., are all in the ratio 4/5/6 which is essential if they are to be perfectly in tune. But if one attempts to play the scale of D major on this same just scale it will not be in tune, as the ratio A/D will not be 6/4 as required, but instead 426.5/288. Thus it is, that a keyboard string instrument can only be correctly tuned in the perfect (just) scale of one key at a time.

	C	C*	D	D*	E	F	F*	G	G*	A	A*	B	C
<b>Just Scale:</b>													
Ratio to Tonic .....	1		9/8		5/4	4/3		3/2		5/3		15/8	2
Vibrations per sec. ....	256		288		320	341.25		384		426.5		480	512
<b>Tempered scale:</b>													
Ratio to Tonic .....	(Each semitone = previous one $\times \sqrt[12]{2}$ )												
Vibrations per sec. ....	256	271.2	287.3	304.4	322.5	341.7	362	383.5	406.3	430.5	456.1	483.2	511.98

Fig. 1

To overcome this difficulty of retuning keyboard instruments, the composer Bach popularized a scale which was developed in Europe and known as equal temperament. Probably this is the best compromise for a string keyboard instrument, but as can be seen from applying the ratio 4/5/6 to the major chords in the tempered scale, the intervals are not perfectly in tune.

In the new electric organs, the sounds are produced by radio equipment which can be instantaneously readjusted as to pitch. It is conceivable, therefore, that an instrument can be built in which the whole keyboard can be readjusted from one just scale to another just scale, every time the music changes key. This will increase the complexity of playing such an instrument, but the technical difficulties are believed to be not insurmountable. The result would be a perfectly tuned keyboard instrument.

Mr. Fisher illustrated his lecture with some electrical sound-generating equipment and an oscillograph, and was able to demonstrate to the eye and ear, the imperfections of the present tempered scale.

Several ladies were present among the large audience of musicians and engineers. All were keenly interested in the possibility of an improved musical instrument, and an enthusiastic discussion followed. Mr. J. B. Stirling moved the vote of thanks to the speaker.

#### NIAGARA PENINSULA BRANCH

J. H. INGS, M.E.I.C. - *Secretary-Treasurer*  
C. G. CLINE, M.E.I.C. - *Branch News Editor*

The Niagara Peninsula Branch held a dinner meeting in Niagara Falls at the General Brock hotel on February 26th, with an attendance of 50. Mr. C. G. Cline presided, in the absence of the Branch Chairman, Mr. A. L. McPhail. Mr. L. P. Rundle introduced the speaker, Mr. J. P. Skillen, and his assistant Mr. C. Vrooman, both of the Canadian Westinghouse Company. His subject was **Application of Relays and Meters for Industrial Substations and Plants**, and it was illustrated by lantern slides.

Mr. Skillen discussed first the special kinds of relay protection required at different parts of a substation. For a single incoming feeder, no extra protection is needed in addition to that provided by the power company but where there are two feeders in parallel, relays are needed that will clear the line on which a short has developed without tripping the line that is still in good working order. If the transformers are small, they can be protected simply by over-current relays but if they are large, a set of differential relays is warranted. On the out-going feeders, the relay system must be arranged to clear only that feeder on which a fault has occurred and only as much of it as may be necessary to remove the fault. Here again, additional complications occur when there are two feeders working in parallel. Each motor served must be protected against overheating but the extra current required momentarily for starting induction motors should not be interrupted. Synchronous motors require elaborate protection. Throughout this part of the address, various

types of relays suitable for use in each location were shown on the screen as well as explanatory wiring diagrams.

Mr. Skillen concluded by showing various types of meters and meter mountings suitable for use in industrial substations. After an interesting question period, the vote of thanks was moved by Mr. Robert F. Cline.

#### OTTAWA BRANCH

A. A. SWINNERTON, M.E.I.C. - *Secretary-Treasurer*  
R. C. PURSER, M.E.I.C. - *Branch News Editor*

R. E. Hayes, M.E.I.C., of Ottawa, gave an address entitled **Earth Moving Takes Wings**, at the noon luncheon at the Chateau Laurier on February 19. It was illustrated by slides and motion pictures. T. A. McElhanney, immediate past chairman, presided in the absence of Chairman N. B. MacRostie.

Carryall scrapers up to a capacity of 60 cubic yards, costing \$45,000, almost half of which was made up in the cost of the huge rubber tires on which they travel, were some of the items described. They represent a tremendous advance from the methods of former days where manpower with pick and shovel had to do the job. They go a long way, even, from the equipment in use only a few years ago. For highway construction and for the levelling off of airport landing fields they speed up the work and keep the cost down.

Instead of digging into the earth as was the case with the old-time steam shovel, the earth is now shaved off the surface in successive layers and the operation of dumping, or "spoiling," the earth is simplicity itself, taking only a few seconds. The earth load may be transported to its place of deposition at a speed up to 18 or 20 miles an hour and spread, as it were, "on the fly," that is while the whole outfit is moving forward. City streets may readily be negotiated if required and the entire outfit is operated by one man.

In line with this method of treatment there are other modern outfits in which the tractor, a mobile power plant in itself, is an integral part. These include tractor shovels for digging smaller quantities, tractor cranes in which the crane is mounted on the same chassis with the tractor, and various designs wherein power taken off from the tractor is used.

**Engine Testing Tribulations** was the subject of a noon luncheon address on March 5 by M. S. Kuhring of the National Research Council. Mr. Kuhring, after considerable experience in aircraft design and construction, joined the staff of the National Research Laboratories in January, 1930, and has been in charge of the Engine Testing Laboratory there since it was first organized.

Inasmuch as the engines that come up for test may from time to time embody new and radical ideas in design or construction, the laboratory is confronted with a more difficult problem than the ordinary engine manufacturer who need not be prepared for such a wide variation in types. Sometimes, before the tests can be satisfactorily undertaken, adaptations to the mounting have to be provided for, additional parts have to be made

up, and even tools for overhauling and taking the engine apart have to be designed. These latter are often awkward to produce rapidly and it is not unusual for them to cost as much or more than the engine itself. Variations between British and American engine types and parts is another problem, as well as differences in threading and in types of mounting.

Electrical gadgets also cause their share of trouble, stated Mr. Kuhring, who characterized them as "the bane of the engine tester's existence". Differences in voltage have to be taken into account for fear of blown fuses.

Air scoops, exhaust rings and other parts normally supported by the engine cowling often present a problem inasmuch as it is preferred to run the engine test without the cowling. Ingenuity therefore has to be displayed to develop a bracket to hold these parts. Other difficulties that beset the engine tester's work were also described by the speaker.

"It requires a peculiar combination of ability and temperament to carry on efficient tests of airplane engines these days", concluded Mr. Kuhring. "The engine tester must be able to handle any and every type of engine as it comes along. He must instantly be able to detect anything that might vitiate the engine itself. And he must be able to cruise over the engine installation with a pair of binoculars, keeping his eye on all parts at once to see that no particular part is working loose."

### SASKATCHEWAN BRANCH

STEWART YOUNG, M.E.I.C. - *Acting Secretary-Treasurer*

The new president of the Association of Professional Engineers and the Saskatchewan Branch of the Engineering Institute is A. P. Linton, bridge engineer, Department of Highways, Regina. Mr. Linton replaces R. A. McLellan, Saskatoon, now attached to No. 4 Air Training Command, R.C.A.F., Calgary, Alta.

Mr. Linton was elected at the annual meeting of the bodies held in Hotel Saskatchewan, Regina on Friday, February 20th. A. M. Macgillivray, Saskatoon, district engineer of the Canadian National Railway, was elected vice-president and members of the new council are J. G. Schaeffer, Regina, F. C. Dempsey, Regina, and N. B. Hutcheon, assistant professor of mechanical engineering, University of Saskatchewan, Saskatoon.

In attendance at the meeting was G. L. Parkinson, lecturer in civil engineering, Saskatoon. Mr. Parkinson is secretary of the Saskatoon section of the Association and the Institute.

One of the main items of business of the meeting dealt with a scheme to place before high school students a method of approach to their entering the field of engineering. A resolution was passed ordering council and executives to form a committee to take action in approaching principals of collegiates in the larger sections of Saskatchewan to give information to students regarding personal requirements and possibilities of engineering and to advise them.

It is not too early for us to give some serious consideration to the post-war period, said Mr. McLellan in his retiring presidential speech. Engineers were not organized at the end of the first Great War as we are to-day, and little or no interest was taken in the young engineer after he was demobilized. Practically all our graduating engineers to-day are being absorbed in some branch of the

war effort. Some undergraduates are joining up before the completion of their courses. We have a very definite responsibility towards these men in the years immediately following this war, he said.

This study naturally is linked with the future of the profession in Saskatchewan. Unless agriculture can be lifted from the bottom of the heap, or new developments made, our future does not appear very bright. We should, therefore, be vitally interested in making every possible contribution towards the solution of this problem. Apart from our own professional interest, perhaps no greater opportunity exists to enhance the usefulness and determine the necessity of this association in the minds of the public and of the leaders of our national life, said Mr. McLellan.

Seventy or more members of the Association and the Institute attended a banquet in the Hotel Saskatchewan on Friday evening. The speaker was S. J. Latta, commissioner of the Bureau of Publications, Regina. His subject was **Our Way of Life**.

The Saskatchewan Branch, jointly with the Association of Professional Engineers, held their regular monthly meeting in the Kitchener Hotel, Regina, on Tuesday evening, March 10, 1942, with an attendance of 44. The meeting was preceded by the usual dinner.

Two films were shown, one in colour depicting the **Manufacture and Use of Plywood** and the other **Copper Mining and Refining in Arizona**.

Mr. F. C. Leroux explained the various stages in the manufacture of plywood from British Columbia fir giving an outline of the uses to which it is being put and the possibilities for further extension of the field of application. The picture, by courtesy of the British Columbia Plywoods, Ltd., was provocative of considerable discussion, a hearty vote of thanks being tendered to Mr. Leroux.

The second film by courtesy of the Canada Wire and Cable Company, through the local manager, Mr. F. Heseltine, traced the production of copper from discovery and development of the mine to the manufacture of pure copper for industrial purposes. A hearty vote of thanks was tendered Mr. Heseltine.

### SAULT STE. MARIE BRANCH

O. A. EVANS, J.E.I.C. - *Secretary-Treasurer*  
N. C. COWIE, J.E.I.C. - *Branch News Editor*

The branch held its second general meeting of the year on February 28th in the Windsor Hotel. Members and guests numbering fifteen were present.

The speaker of the evening was Fred A. Becker, M.E.I.C., field engineer for Canadian General Electric Company. The subject of his address, **Some Recent Trends in Industrial Applications of Electricity**, was well illustrated with slides showing how utility, flexibility, beauty and conservation has affected the trends in the design of electrical equipment.

At the conclusion of his address, the speaker was thanked by N. C. Cowie, and by the chairman, L. R. Brown, for his inspiring address.

It was announced that at the March meeting of the branch an address would be given on Ferro Alloys by Mr. Udy of the Chromium Mining and Smelting Company.

# News of Other Societies

## QUEBEC PROFESSIONAL ENGINEERS ELECT NEW OFFICERS

J. A. McCrory, M.E.I.C., vice-president and chief engineer of the Shawinigan Engineering Company, Limited, Montreal, was elected president of the Corporation of Professional Engineers of the Province of Quebec, at the annual meeting held at the Headquarters of The Engineering Institute of Canada, in Montreal, on March 28th, 1942.

Mr. McCrory graduated from Pennsylvania State College in 1907 with the degree of B.Sc., in mechanical engineering, and, coming to Canada in 1910, located in Toronto, where he was engaged on the design and construction of the London Hydro sub-station and in general building work. In 1912 he moved to Montreal, and for four years was employed on the design and supervision of reinforced concrete construction. Mr. McCrory joined the staff of the Shawinigan Water and Power Company, in 1916 as designer, and on the formation of the Shawin-



J. A. McCrory, M.E.I.C.

igan Engineering Company, Limited in 1918, was appointed office engineer. He was subsequently engaged on the investigation and design of a large number of hydro-electric developments for the Shawinigan Water and Power Company and others, and in 1935 he was appointed to his present position.

He has been a member of the Corporation since 1923 and has also taken an active interest in the affairs of the Institute since he became an Associate Member in 1921. He was transferred to Member in 1926 and in 1929 he was elected chairman of the Montreal Branch. He represented the branch on the Council of the Institute during the years 1930-1935 and he was a vice-president of the Institute from 1937 to 1940. He is at present a member of the Finance Committee.

Other officers on the Council of the Corporation for the present year are: Vice-president: A. O. Dufresne, M.E.I.C., deputy minister, Department of Mines, Province of Quebec; Secretary-treasurer: C. C. Lindsay, M.E.I.C., consulting engineer of Montreal and member of the Montreal Tramways Commission, Montreal; Councillors: Brian R. Perry, M.E.I.C., consulting engineer, Montreal; J. Omer Martineau, M.E.I.C., assistant chief engineer, Roads Department of the Province of Quebec, Quebec City; P. E. Poitras, M.E.I.C., mechanical engineer, The Steel Company of Canada, Montreal; A. D. Ross, M.E.I.C.,

## Items of interest regarding activities of other engineering societies or associations

manager, Canadian Comstock Company, Limited, Montreal; Adhémar Laframboise, M.E.I.C., chief engineer, Eastern Canada Steel and Iron Works, Limited, Quebec City.

## CANADIAN INSTITUTE OF STEEL CONSTRUCTION OPENS NEW OFFICE

The Canadian Institute of Steel Construction has opened a new Ottawa office at 213 Laurier Avenue, West.

Due to the many regulations which have been brought about by the war, the General Executive of the Institute has decided that an Ottawa office is necessary so that a closer contact can be established with various Government Departments.

The Toronto and Montreal offices of the Institute have been closed, and the staffs have been moved to the new consolidated office.

These new offices will be in charge of Ralph C. Manning, M.E.I.C., formerly of the Toronto office, who is at present engaged in special work for the Director of Engineering Services, Department of National Defence. Ernest S. Mattice, M.E.I.C., formerly of the Montreal office of the Institute, will assist Mr. Manning.

It is hoped that all persons interested in obtaining handbooks or other information on structural steel will continue to make use of the services offered by the Institute.

One of the main objects of the Institute during the present period will be to conduct technical research with a view to more efficient use of steel in construction. This research will cover a wide field including the possibilities of combining structural steel with aluminum, stainless steel and the various types of modern insulating materials.

It is felt that efficiency will be the keynote of construction when the war is over. Many of the older methods of construction using heavy walls and massive interior members will give way before the speed and light weight of newer materials which are being used in large quantities for war purposes. After the war, the vastly increased production for these materials will seek outlets in normal peacetime markets of which the construction field is one of the largest. It is with this in mind that the Canadian Institute of Steel Construction has established a Research Committee consisting of the most widely known engineers of its various member companies to study these problems.

## AN OPPORTUNITY FOR ENGINEERS

The inaugural address of Warren C. Miller, M.E.I.C., president of the Association of Professional Engineers of the Province of Ontario, carries an important message to all engineers. It was delivered at the annual banquet of the Association, at the Royal York Hotel, Toronto, on January 17th, and it is reproduced herewith for the benefit of those who were not present:

"Mr. Chairman, Distinguished Guests, and Members of the Association: For your expression of confidence, I am deeply grateful. To be elected president of a professional body is an appreciated honour that should be repaid by a renewed effort on behalf of one's professional colleagues. This effort I trust that I may be able to give.

"It would be idle at this time to make any extended pronouncement on our Association's affairs or its particular policies. Any work that we may do is so greatly overshadowed by our larger obligation. Our first job is to make whatever contribution our professional attainments permit toward a complete, all-out war effort. We must be prepared, without sacrificing fundamental principles, to

ide our time and be content with a somewhat liberal interpretation of our obligations and our privileges, in the light of their effect on defence production and defence effort generally. This war is being waged by our enemies without the restrictions imposed by laws or rules.

"We must take care that a too-strict insistence on rules is not essential at this time shall not give our enemies any advantage. We are called on to make many sacrifices. This is one for which we must be prepared.

"Some of us may feel that such delays in our programme of public protection and professional advancement are irksome. We may sometimes feel that we are accomplishing little. A great Englishman once said, 'They also serve, who only stand and wait.'

"We engineers have another duty, another opportunity to place our skill at the disposal of our Country and Empire, as so many of our members have already done. Out of this war is going to come a different world, a world so different from that of the 1920's as they were from the 1900's. Necessary war expenditures are going to be of such an order that our existing economy will be strained to the limit, if it manages to survive at all.

"The post-war period is more than ever going to be one where, of necessity, fact and reason must dominate public decisions. Our learned friends of the legal profession already operate in this field, particularly within the realm of those laws, gradually 'broadened down from precedent to precedent,' which are the creation of human agencies at the behest of human nature. We of the engineering profession share with the bar the duty of collect-

ing and evaluating factual evidence and of arriving at conclusions therefrom.

"But we work with the administration of those immutable laws of Nature that are derived by patient investigation and research from the Creator Himself, directly. If His natural laws do not suit our purpose, there is no court where we may argue and persuade that a new shade of meaning should be given to the law of gravity in keeping with changed conditions of modern aerial transportation. We cannot go to a friendly legislature and have Boyle's Law amended.

"Our unique function as engineers is the search for facts and the basing of logical decisions on those facts. We use our specialized study of natural laws and forces to aid us in interpreting facts, evaluating evidence, drawing conclusions and translating the results into physical structures, materials and machines that serve mankind. An appreciation of the fundamental natural laws and their application to the problems of humanity will be of paramount importance when man-made laws of conduct and human relations have of necessity been distorted, possibly out of recognition, by the urgency of the conflict to preserve our rights to live at all.

"This will be a great opportunity for engineers. In rising to meet the country's needs at such a time, our profession, slowly advancing as it has been in the past, with a little acceleration in recent years, will, I am satisfied, find its proper place in the sunlight of a tired but victorious democratic world. It should be one of our principal objectives for the present to prepare for it."

## Library Notes

### ADDITIONS TO THE LIBRARY

#### TECHNICAL BOOKS

##### Continuous Beam Structures:

*Eric Shepley, London, Concrete Publications Ltd., 6½ x 9½ in. 7s. 6d.*

##### American Standards Association:

*List of American standards for 1942. (This list will be sent free of charge to anyone writing in for it. Requests should be addressed to the American Standards Association, 29 West 39th St., N.Y.C.)*

##### Canadian Engineering Standards Association, Specifications:

*Standard specification for alkali sulphate resisting cement, A72t; Construction and test of industrial control equipment for use in ordinary locations (2nd ed.) C22.2—No. 14; Construction and test of receptacles, plugs and similar wiring devices (2nd ed.) C22.2—No. 42.*

#### PROCEEDINGS, TRANSACTIONS

##### Junior Institution of Engineers:

*Journal and record of transactions for the year 1940-41.*

##### National Council of State Boards of Engineering Examiners:

*Proceedings 22nd annual meeting, October 27-30, 1941 and Year book 1942.*

##### Canadian Good Roads Association:

*Proceedings of the 26th annual convention, October 7-9, 1941.*

#### REPORTS

##### American Institute of Chemical Engineers:

*Directory of officers and members and committee appointments for 1942.*

### Book notes, Additions to the Library of the Engineering Institute, Reviews of New Books and Publications

##### Cornell University, Engineering Experiment Station:

*The buckling of compressed bars by torsion and flexure by J. N. Goodier. Bulletin No. 27; Flexural-torsional buckling of bars of open section by J. N. Goodier. Bulletin No. 28.*

##### Ohio State University Studies, Engineering Series:

*Surface and underground waters of Ohio. Engineering experiment station circular No. 43.*

##### Engineering as a Career, a message to young men, teachers and parents:

*Engineers Council for Professional Development.*

##### U.S. Department of Commerce, National Bureau of Standards:

*Report of the 31st national conference on weights and measures. Miscellaneous publication M170.*

##### British Trade and Industry:

*A survey of past achievement and future prospects published by Country Life.*

##### Electrochemical Society:

*Electrolytic polishing of silver. Preprint 81-5.*

##### New C.E.S.A. Electrical Standards

The Canadian Engineering Standards Association has just issued the following ten approvals specifications under Part II of the Canadian Electrical Code, the requirements of which must be met in order to obtain CESA approval of the electrical devices concerned. These standards were prepared in collaboration with interested manufacturers and industrial associations and are based on laboratory tests and record in service.

Copies of these standards may be obtained from the Canadian Engineering Standards Association, National Research Building, Ottawa. The prices are quoted below.

##### C.E.S.A. No. C22.2

##### No. 5—1942 Service Entrance and Branch-Circuit Breakers. 2nd. ed.

*This specification covers the construction and test of circuit breakers rated at not more than 600 amperes or 600 volts, designed to provide service-entrance, meter-service, or branch-circuit protection, in accordance with the rules of Pt. 1 of the Canadian Electrical Code. It does not cover circuit-breakers rated at more than 600 amperes or 600 volts, or switches, or so called "breakers" provided only with overload devices and intended to be protected by overcurrent devices. This specification is effective as of April 30, 1942 for new production. 60c.*

##### No. 9—1941 Electric Fixtures. 2nd ed.

*This specification applies to electric fixtures intended for use in non-hazardous locations, both indoors and outdoors, and for connection to lighting circuits of not more than 250 volts between conductors, in accordance with the rules of Pt. 1 of the Canadian Electrical Code. It includes recessed fixtures and show-window and show-case fixtures, having incandescent and/or electrical-discharge lamps. It does not include troughs exceeding 10 ft. in length, outline lighting, or fixtures of the so-called "vapour-tight" and "explosion-proof" construction or high-voltage gas-tube fixtures (i.e. tubes containing inert gases). This specification is effective as of March 31, 1942 for new production. 75c.*

**No. 11—1942 Fractional-Horsepower Electric Motors for other than Hazardous Locations. 2nd ed.**

This specification applies to fractional-horsepower (electric) motors for use where ordinary conditions prevail and also for use in other locations, except hazardous locations as covered by Section 32 of Pt. 1 of the Canadian Electrical Code where it may be necessary to protect the motor windings, etc., with regard to the atmospheric or other conditions surrounding the motor. It applies particularly to the following types of motors as defined by types of enclosures:—1 open; 2 protected; 3 enclosed; 4 drip-proof; 5 splash-proof; 6 water-tight. It applies to electric motors of fractional horsepower rating, whether self-contained or forming a part of a piece of electrical equipment and whether portable or otherwise, for potentials up to 600 volts inclusive and for either a.c. or d.c. or both. It should be noted that electric clock motors and electric motors built into and forming a part of domestic appliances, fans, dental equipment, and hair dressing equipment are not covered by this specification. It is effective as of April 15, 1942, for new production. 50c.

**No. 21—1941 Cord Sets. 2nd ed.**

This specification applies to cord sets designed to be employed in accordance with the rules of Pt. 1 of the Canadian Electrical Code on circuits operating at not more than 125 volts. This specification is effective as of March 31, 1942, for new production. 50c.

**No. 54—1942 Integral Horsepower Electric Motors for other than Hazardous Locations**

This specification applies to integral-horsepower electric motors for use where ordinary conditions prevail and also for use in other locations (except hazardous locations as covered by section 32 of Pt. 1 of the Canadian Electrical Code) where it may be necessary to protect the motor windings, etc., with regard to the atmospheric or other conditions surrounding the motor. It applies to electric motors of integral-horsepower rating from 1 to 200 horsepower for potentials up to and including 2,500 volts between conductors on ungrounded systems and 4,500 volts between conductors on grounded-neutral systems and intended to be employed in accordance with the rules of Pt. 1 of this code. This specification is effective as of April 30, 1942, for new production. 50c.

**No. 55—1942 Snap Switches**

This specification applies to manually operated snap switches rated at not more than: (a) 60 amperes and 250 volts; (b) 30 amperes and 300 volts and (c) 2 h.p. and 600 volts; and designed to be employed in accordance with the rules of Pt. 1 of the Canadian Electrical Code. It does not cover: (a) Snap switches rated at less than 50 volts unless such rating is used in conjunction with a rating of 125 or 250 volts; (b) Snap switches forming parts either of electro-thermal appliances e.g., "heater switches" or automatic temperature-responsive switches; (c) Slow make and/or slow break switches; (d) So-called "mercury-switches" and (e) Switching mechanism built into lamp-holders. This specification is effective as of April 30, 1942 for new production. 50c.

**No. 66—1942 Specialty Transformers**

This specification contains three sections covering three different types of specialty transformers as follows; 1. Miscellaneous and General Purpose Transformers applies to dry-type, air cooled transformers (including auto-transformers and primary circuit reactors) for use with; mercury

vapor lamps; power operated radio devices (other than the original and authentic transformer designed by the radio manufacturer for his particular radio device and so identified); signalling and control circuits; and high reactance transformers (incapacities of one kva. and less and for primary and secondary potentials of 750 volts and less) intended to be employed in accordance with the rules of Pt. 1 of the Canadian Electrical Code. It does not include transformers intended for the following purposes; testing electrical insulation, electric welding, electric soldering, bell ringing, toys, luminous tubes, oil burner ignition systems, instrument transformers and fluorescent lighting. 2. Bell ringing transformers, applies to dry type, air cooled bell ringing transformers for potentials of 250 volts or less between conductors, and designed to be employed in accordance with the rules of Pt. 1 of the Can. Elec. Code. 3. Toy Transformers applies to dry type, air cooled toy transformers for potentials of 150 volts or less between conductors and designed to be employed in accordance with the rules of Pt. 1 of the Can. Elec. Code. This specification is effective as of April 30, 1942, for new production. 75c.

**No. 67—1942 Portable Electric Vacuum Cleaners.**

This specification applies to domestic and commercial vacuum cleaners of the portable motor operated type for potentials up to and including 250 volts between conductors designed to be employed in accordance with the rules of Pt. 1 of the Can. Elec. Code. This specification is effective as of April 30, 1942. 50c.

**No. 68—1942 Motor operated appliances—Domestic and Commercial (Fractional Horsepowers).**

This specification applies to motor operated appliances both stationary and portable for potentials up to and including 250 volts between conductors designed to be employed in accordance with the rules of Pt. 1 of the Can. Elec. Code. It applies to both domestic and commercial appliances using fractional horse-power motors such as electric shavers, hair clippers, vibrators, massage machines, and food preparing machines (e.g., food and cake mixers, juice extractors, meat slicers, bread slicers, food choppers, peelers, coffee grinders, etc.) It does not include any specific appliances which are covered by individual specifications, e.g., blowers, floor surfacing and cleaning machines, washing machines, vacuum cleaners, hairdressing equipment and tools. This specification is effective as of September 30, 1942 for new production. 50c.

**No. 73—1941 Electrically Equipped Machine Tools.**

This specification applies to both stationary and portable machine tools which may or may not have certain portable parts, having electrical equipment mounted thereon and designed to be installed and employed in accordance with the rules of Pt. 1 of the Can. Elec. Code. It does not apply to: 1. The mechanical features of such machine tools except as these affect the electrical equipment used in connection with such machines; 2. wood-working machines; 3. tools for automobile works (e.g., cylinder borers, valve seat grinders); 4. Small portable tools (e.g., electric drills tappers, grinders, hammers, screw drivers); 5. Welding or gas cutting machines. It should be noted that the approvals laboratory will at its discretion use this specification in the approval of other types of machines not specifically covered by other individual Approvals Specifications of Pt. 11 of the Can. Elec. Code in so far as its requirements may be applicable. Also the CESA Approvals division will con-

sider upon request, any deviations from this Specification if such are due to war conditions. This specification is effective as of December 31, 1941 for new production. 50c.

**BOOK NOTES**

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet the books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

**ELECTRICAL ILLUMINATION**

By J. O. Kraehenbuehl. John Wiley & Sons, New York, 1942. 441 pp., illus., diags., charts, tables, 9 x 6 in., cloth, \$3.75.

The principles underlying the specification and design of electrical lighting for commercial and industrial buildings are presented as an elementary course for architectural and electrical engineering students. Maintenance and economic factors are discussed, and there are special chapters on floodlighting and novelty lighting. A bibliography accompanies each chapter.

**ADVANCES in COLLOID SCIENCE, Vol. 1**

Edited by E. O. Kraemer in collaboration with F. E. Bartell and S. S. Kistler. Interscience Publishers, New York, 1942. 434 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$5.50.

The series which this volume begins is intended to publish recent significant discoveries and advances in our knowledge of colloids, in a more comprehensive and unified form than is possible in periodicals. The present volume contains twelve contributions by well-known workers in this field, each accompanied by a useful bibliography.

**AERIAL BOMBARDMENT PROTECTION**

By H. E. Wessman and W. A. Rose. John Wiley & Sons, New York; Chapman & Hall, London, 1942. 372 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$4.00.

This book is primarily devoted to a detailed discussion of those measures which can and should be undertaken to make building construction resistant to the effects of bombing, at reasonable cost. Characteristics of bombs, air raid shelters, evaluation of shelter zones and camouflage are other topics considered. A brief statement of other engineering problems related to aerial bombardment is also included. The material has been developed with particular regard for American structural and architectural practice.

**AEROPHOTOGRAPHY and AEROSURVEYING**

By J. W. Bagley. McGraw-Hill Book Co., New York and London, 1941. 324 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$3.50.

Broad in scope, logical in arrangement and up to date, this new text covers the fields of standard and exploration mapping. The chief aim of the book is to deal with Aerial photographs, standard laboratory practice and the various methods of utilizing aerial photographs for making standard and exploratory maps, mosaics and engineering surveys.

**AMERICAN HIGHWAY PRACTICE, Vol. 1**

By L. I. Hewes. John Wiley & Sons, New York; Chapman & Hall, London, 1942. 459 pp., illus., diags., charts, maps, tables, 9½ x 6 in., cloth, \$5.00.

This first volume of a two-volume text on current rural highway practice in the United States presents in logical order the topics of highway survey, roadway and landscape design, and grading practice. Succeeding chapters deal with sand-clay, macadam,

avel and intermediate bituminous surfaces. Higher types of surfaces will be covered in the second volume.

#### **AUTOMATIC ARMS, their History, Development and Use**

By M. M. Johnson, Jr., and C.T. Haven. William Morrow and Co., New York, 1941. 344 pp., illus., diags., tables, 9½ x 6 in., cloth, \$4.50.

The five principal sections of this authoritative work deal respectively with the history and development of automatic arms, working principles, requirements for efficient operation, employment in combat, and various miscellaneous considerations. A table of characteristics of the various types and diagrams of operating parts are appended.

#### **DICTIONARY OF RADIO AND TELEVISION TERMS**

By R. Stranger. Chemical Publishing Co., Brooklyn, N.Y., 1941. 252 pp., diags., tables, 9 x 5½ in., cloth, \$2.50.

This dictionary is designed to provide quick reference for students of radio and television. In addition to radio and television terms, a number of scientific terms allied to these subjects are also included. Helpful diagrams and illustrations accompany many definitions.

#### **DIE DESIGNING AND ESTIMATING**

(Based on "Die Designing" by C. Bohmer and "Die Estimating" by G. Dannes). 2 ed. American Industrial Publishers, Cleveland, Ohio, 1941. 160 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$3.00.

The operation, uses and basic principles of design of various kinds of dies are described. In the second section procedures are given for estimating the cost of several dies, with tables of time values for necessary operations in die construction. A section of practical points in die design and construction is appended.

#### **EASTERN PHOTOELASTICITY CONFERENCE, 13th SEMI-ANNUAL PROCEEDINGS**

Held under the auspices of the Department of Mechanical Engineering at the Massachusetts Institute of Technology, Cambridge, Mass., June 12-14, 1941. (Copies may be obtained from W. M. Murray, Room 1-321, Massachusetts Institute of Technology, Cambridge, Mass.) 130 pp., illus., diags., charts, tables, 11 x 8½ in., paper, \$2.00.

Contains the eighteen papers presented. These discuss various applications of the photoelastic method of stress analysis, and some results obtained.

#### **Great Britain, Dept. of Scientific and Industrial Research**

#### **WATER POLLUTION RESEARCH, Technical Paper No. 8.**

#### **THE TREATMENT AND DISPOSAL OF WASTE WATERS FROM DAIRIES AND MILK PRODUCTS FACTORIES**

His Majesty's Stationery Office, London; British Library of Information, New York, 1941. 125 pp., illus., diags., charts, tables, 10 x 6 in., paper, \$1.20.

The results of an intensive investigation of this problem are presented in this report. Methods of reducing the quantity of milk carried away were also investigated. Large-scale experimental plants were constructed and the results obtained, with the conclusions and recommendations derived from them, are given in this report.

#### **Great Britain, Dept. of Scientific and Industrial Research, Building Research, Wartime Building Bulletin No. 18, FIRE STOPS FOR TIMBER ROOFS**

His Majesty's Stationery Office, London, 1941. 13 pp., illus., diags., tables, 11 x

8½ in., paper, (obtainable from British Library of Information, 30 Rockefeller Plaza, New York, \$3.00).

This bulletin describes simple devices that can be erected to check the spread of fire along existing roofs of wood or other combustible materials. Four types are described, and the results of tests given.

#### **HEAT IN THEORY AND PRACTICE ESSENTIAL TO REFRIGERATION AND AIR CONDITIONING**

By S. R. Cook. Nickerson and Collins Co., Chicago, Ill., 1941. 228 pp., diags., charts, tables, 9½ x 6 in., cloth, \$2.00.

The fundamental facts and theories of heat are presented in a simple manner for the student interested in refrigeration and air conditioning. The intent of the volume is to give information essential to the solution of problems which may arise in the study of refrigeration and air conditioning, whether from a text or from actual handling of refrigerating and air conditioning machinery.

#### **HIGHWAY ECONOMICS**

By H. Tucker and M. C. Leager. International Textbook Co., Scranton, Pa., 1942. 454 pp., illus., diags., charts, maps, tables, 8½ x 5 in., cloth, \$4.00.

A considerable range of topics is covered in this book, from financing methods, in which the subject of taxation is particularly important, to technical discussions of power requirements for and the performance of motor vehicles under varying conditions. Equipment rental, the allocation of highway costs, and traffic and accident considerations are other topics dealt with at some length.

#### **HORIZONS UNLIMITED, a Graphic History of Aviation**

By S. P. Johnston. Duell, Sloan and Pearce, New York, 1941. 354 pp., illus., 10 x 6½ in., cloth, \$3.75.

The story of man's conquest of the air is told in words and pictures. The great experiments are described; struggles and desires, successes and failures are discussed; and consideration has been given to the human elements and social consequences of the development of the means of flight. Brief discussions of meteorology and aerodynamics are included.

#### **HOW YOUR BUSINESS CAN HELP WIN THE WAR**

Compiled by the Staff of Industrial Specialists of the Conover-Mast Periodicals, and edited by H. W. Barclay, with an introduction by D. M. Nelson. Simon and Schuster, New York, 1942. 111 pp., charts, maps, tables, 11 x 8 in., paper, \$1.00.

This book is designed to show business men what the government wants to buy, how to bid, and how to get contracts and sub-contracts for government orders. It also shows ways in which time and money can be saved and red tape cut in dealing with government offices.

#### **Industrial Relations Digests**

#### **XI. METHODS OF TRANSMITTING INFORMATION TO EMPLOYEES**

Princeton University, Princeton, New Jersey, January, 1942, 8 pp., 10 x 7 in., paper, \$2.00.

This digest of current practice in methods of keeping employees informed on company policies, mainly through printed material, has been prepared for use in companies facing rapid expansion owing to defense orders. It is based on material received currently from representative companies.

#### **MARINE ELECTRICAL INSTALLATION**

By J. F. Piper. Cornell Maritime Press, New York, 1941. 308 pp., illus., diags., charts, tables, 7½ x 5 in., cloth, \$2.50.

This manual is intended to aid the inexperienced workman to obtain practical insight into electrical marine work. The tools and materials used; the laying out of work; wiring methods; power, lighting and communication systems are described in detail in a practical way and without undue use of technical language.

#### **MATHEMATICS FOR ELECTRICIANS AND RADIOMEN**

By N. M. Cooke. McGraw-Hill Book Co., New York and London, 1942. 604 pp., diags., charts, tables, 9½ x 6 in., cloth, \$4.00.

This book presents a course which is intended to provide adequate mathematical background for solving practically all electrical and radio problems. Elementary algebra through quadratic equations, logarithms, trigonometry, elementary plane vectors, and vector algebra as applied to alternating-current circuits are included. The text follows an electrical rather than a purely mathematical arrangement.

#### **(The) MATHEMATICS OF THE SHOPS**

By F. J. McMakin and J. H. Shaver. D. Van Nostrand Co., New York, 1942. 444 pp., illus., diags., charts, tables, 9 x 5½ in., cloth, \$2.50.

A text for use in vocational high schools and apprenticeship classes. The fundamentals of arithmetic, algebra, geometry and trigonometry are explained in simple language, after which basic problems are discussed which arise in the building trades and in electrical and machine shops. Special consideration is given to acceptable trade and technical practices.

#### **MECHANICAL PROPERTIES OF MATERIALS AND DESIGN**

By J. Marin. McGraw-Hill Book Co., New York and London, 1942. 273 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$3.50.

The primary purpose of this book is to furnish a survey of the mechanical properties of engineering materials and to show how a consideration of these properties modifies design procedure. With this end in view, the author attempts to bridge the gap between books on engineering materials which deal with the manufacture, testing and properties of materials, and those dealing with the stress analysis of machine and structural members.

#### **OPERATION OF WATER-TREATMENT PLANTS**

By W. A. Hardenbergh. International Textbook Co., Scranton, Pa., 1942. 307 pp., illus., diags., charts, tables, 7½ x 5 in., cloth, \$3.10.

General considerations of water-supply systems are first presented, including distribution practice. The requirements with respect to quality of water are stated, and analytical methods for the determination of water quality are fully covered. The last half of the book describes details of plant operation and the types of equipment necessary, with a final section which presents typical data and records for a rapid sand-filtration plant.

#### **PERSONAL LEADERSHIP IN INDUSTRY**

By D. R. Craig and W. W. Charters. 2nd ed. McGraw-Hill Book Co., New York and London, 1941. 245 pp., tables, 8½ x 5½ in., cloth, \$2.50.

Practical methods are given, based on experience, for executives, supervisors and foremen who want aid in managing men. Qualifications and character traits essential to successful personal leadership are described, and the text shows how to use these qualities in getting the right kind and right amount of work done with the least disturbance and friction.

# PRELIMINARY NOTICE

of Applications for Admission and for Transfer

FOR ADMISSION

March 31st, 1942.

The By-laws provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

**Communications relating to applicants are considered by the Council as strictly confidential.**

The Council will consider the applications herein described at the May meeting.

L. AUSTIN WRIGHT, General Secretary.

\*The professional requirements are as follows:—

A **Member** shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupillage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science or engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A **Junior** shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A **Student** shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An **Affiliate** shall be one who is not an engineer by profession but whose pursuits, scientific attainment or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

ALLEN—CHARLES HARRY, of 5553 Queen Mary Road, Montreal, Que. Born at Wells, Somerset, England, Jan. 13th, 1908; Educ.: 1922-27, night classes in engr., Hamilton Technical Institute; with the Canadian Westinghouse Company as follows: 1923-27, student on elec. training course; 1927-30, electric mechanic on install. of elec. machy. and equipment in vertical lift and rolling lift bridges over Welland Ship Canal, also 500 ton capacity electrically operated floating gate-lifter, electrical sub-stations, etc.; 1930-37, foreman, and later engr. in charge of various large electrical installns. incl. major developments at the Ontario Hydro Leaside Sub-station, Queenston plant, H.E.P.C., Chats Falls Power Plant, H.E.P.C., Rapide Blanc Power House of Shawinigan Water & Power Co.; July 1937 to date, sales engr., Montreal office, chiefly concerned with industrial control and secondary switchgear.

References: S. Hairsine, R. Dupuis, G. R. Davis, A. D. Ross, H. A. Cooch, R. Ford.

BELL—CLARENCE WILLIAM, of 17 Birch Ave., Toronto, Ont. Born at Saskatoon, Sask., Sept. 1st, 1912; Educ.: B.Sc. (Civil), Univ. of Sask., 1936; 1935 (summer), Geol. Survey of Canada; 1937-38, bridge engr., Dept. of Highways, Ontario; 1938-42, supervision of constrn. of bituminous roads, and at present, asst. branch mgr., Currie Products Ltd., Toronto, Ont.

References: C. J. Mackenzie, R. A. Spencer, E. K. Phillips, C. F. Morrison, A. H. Douglas.

BOTH—JOHN, of 149 Jameson Ave., Toronto, Ont. Born at Denbigh, Ont., Jan. 20th, 1902; Educ.: I.C.S. Highway Engrg.; 1932-36, instr'man., 1936-39, res. engr. on highway constrn. and survey parties, 1939-40, surveying of proposed sites for airdromes, Dept. of Highways of Ontario; 1940-42, engr. on constrn. of training schools for the R.C.A.F.; at present, res. engr., No. 5 Manning Depot, Lachine, Que.

References: G. R. MacLeod, J. N. Langman, W. J. Bishop, H. D. McMillan, C. K. S. Macdonnell, W. F. Fulton, A. A. Smith.

BURDETT—GEORGE HENRY, of 3801 Botrel Ave., Montreal, Que. Born at Westmount, Que., April 4th, 1905; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1927; R.P.E. of Que.; 1926 (summer), instr'man., Quebec Streams Commn.; Bell Telephone Co. of Canada as follows: 1927-28, plant school instructor, 1928-29, traffic engr., 1929-30, facilities supervisor, 1930-31, Montreal Toll Office traffic supervisor, 1931-32, Montreal Toll Office traffic chief; 1933 (summer), Quebec Paving Company; Imperial Oil Limited as follows: 1934-38, dist. mgr., 1939-40, Prov. of Quebec aviation sales, 1940-41, furnace fuel oil salesman; at present, regional representative, Wartime Bureau of Technical Personnel, Montreal, Que.

References: O. O. Lefebvre, A. Surveyer, L. A. Wright, H. W. Lea, L. A. Duchastel, L. Trudel.

COLLARD—RICHARD REEVE, of Ottawa, Ont. Born at Belmont, Ont., Sept. 30th, 1886; Educ.: Private study; 1906-21, foreman to gen. supt. in various western towns, and 1922-23, pres. and gen. mgr., Honolulu, Hawaii, for Warren Bros. Co., of Boston, Mass.; 1924 to date, with Carter Halls Aldinger Co. Ltd., Winnipeg, from 1927 to date vice-president. In 1933-34, organized Acadia Constrn. Co. Ltd., Halifax, and became managing director, still holding that position. General constrn. work with both companies; at present, Air Commodore, Director of Works and Bldgs., 1/c of all bldgs., design and constrn., R.C.A.F., Ottawa, Ont.

References: A. W. Fosness, H. A. Dixon, C. J. Mackenzie, J. M. R. Fairbairn, K. M. Cameron.

JOHNSON—STANLEY, of 4760 Dagenais St., Montreal, Que. Born at Manchester, England, April 27th, 1880; Educ.: Diploma in Mech. Engrg., School of Technology, Manchester; 1897-98, with John Brown & Son, Shipbldg. Co., Clydebank, Scotland; 1898-1901, Ashbury Rly. Carriage Works, Manchester; 1906 to date, gen. supt. of manufacturing in the two factories of The Johnson Wire Works Ltd., Montreal, Que. (Applying for admission as an Affiliate).

References: J. S. Costigan, E. V. Gage, R. A. Gurnham, B. R. Perry, R. E. Jamie-son.

LORANGER—AIME, of 1426 Theodore St., Montreal, Que. Born at Yamachiche, Que., Aug. 16th, 1898; Educ.: Private study; 1920-25, instr'man. with technical service and sewer commission, City of Montreal; 1926-34, engr. and mgr., specializing in sewers and waterworks, Joseph Loranger, contractors; 1934-38, president, Paquin Constrn. Ltd.; 1941, res. engr., St. Timothee Remedial Works, Beauharnois L.H. & P. Co.; at present, technical work with Canadian Propellers Ltd., Montreal, Que. (Applying for admission as an Affiliate).

References: J. A. Lalonde, L. Trudel, C. G. Kingsmill, L. Laferme, J. Comeau, J. P. Chapeau, G. R. MacLeod.

MORRISON—CHARLES AUSTIN, of Montreal, Que. Born at Arthur, Ont., Aug. 31st, 1902; Educ.: B.A.Sc., Univ. of Toronto, 1927; summer work: 1922-25, transformer assembly and winding, C.G.E.; 1925, Ford Motor Co.; 1926-27, H.E.P.C. of Ontario; 1927-30, Univ. of Toronto, teaching hydrostatics, heat, optics, illumination; 1930-36, lighting engr., and 1936 to date, mgr., lamp sales divn., Can. Gen. Elec. Co. Ltd., Montreal, Que.

References: J. B. Challies, L. A. Wright, L. A. Duchastel, I. S. Patterson, R. N. Coke.

VINET—JACQUES, of Gaspe, Que. Born at St. Johns, Que., March 10th, 1914; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1938; R.P.E. of Que.; 1935 (summer), asst. surveyor, Shaw. Water & Power Co.; 1937 (summer), asst. geologist Dept. Mines & Resources, Ottawa; 1938-39, res. engr., 1939-41, asst. divn. engr. Roads Dept., Prov. of Quebec; Nov. 1941 to date, cost engr., A. Janin & Co. Ltd. on Gaspe projects.

References: P. P. LeCointe, P. P. Vinet, J. M. Pinet.

## FOR TRANSFER FROM JUNIOR

HYMAN—HOWARD DAVISON, of 31 Madawaska Drive, Ottawa, Ont. Born at Montreal, Que., Aug. 30th, 1903; Educ.: B.Sc. (Civil), McGill Univ., 1925; R.P.E. of Ont.; 1923-24-25 (summers), C.N.R. Survey Dept., Bell Telephone Company plant dept., constrn. engr., A. F. Byers & Co. Ltd., Montreal; 1925-26, constrn. engr., Mattagami Pulp & Paper Co. Ltd., Smooth Rock Falls, Ont.; 1926-27, designing engr., Canadian International Paper Co. Ltd., Temiskaming; 1927-28, designing engr., 1928-29, chief draftsman, 1929-32, mtce. engr., respons. for mtce. and constrn. of plant, Spruce Falls Power & Paper Co. Ltd., Kapuskasing, Ont.; 1937, to date, with J. R. Booth Ltd., Ottawa, mfrs. of lumber, pulp, paper and paperboard, as follows: 1932-37, works engr. i/c mtce., design, constrn., etc., 1937-40, production mgr., 1940-42, asst. gen. mgr., and Jan. 1942 to date, general manager. (Jr. 1926).

References: L. S. Dixon, C. W. Boast, W. S. Kidd, A. N. Ball, T. A. McElhanney.

RUGGLES—EDGAR LENFEST, of 4 Adair Apts., Regina, Sask. Born at Regina, Aug. 12th, 1913; Educ.: B.Sc. (Civil), Univ. of Sask., 1935; 1930-1931-1934 (summers), gravel checker, rodman, asst. instr'man, Sask. Dept. of Highways; 1935, Dept. of Mines & Resources, i/c field party—1936-37, in Ottawa compiling data and writing reports on field work; 1937-39, field engr., prescribing, checking, and servicing chemical treatment of water for locomotive boilers on railroads in western Canada and in stationary boiler plants, and from 1940 to date, field engr. in charge of work as above, in western Canada, for The Bird Archer Co. Ltd. (Jr. 1936).

References: R. A. Spencer, I. M. Fraser, E. K. Phillips, B. Russell, J. J. White.

(Continued on page 269)

# Employment Service Bureau

## SITUATIONS VACANT

**MECHANICAL DESIGNING DRAUGHTSMAN**, Graduate preferred, urgently needed for work in Arvida for specification drawings for plate work, elevators, conveyors, etc., equipment layouts, pipe layouts and details. Apply to Box No. 2375-V.

**MECHANICAL ENGINEER**, preferred with experience on diesels and tractors, for work in Mackenzie, B.G. Apply to Box No. 2482-V.

**MECHANICAL DRAUGHTSMEN** and engineers for pulp and paper mill work. Experienced men preferred. Good salary to qualified candidates. Apply to Box No. 2483-V.

**ELECTRICAL ENGINEER**, young French Canadian graduate engineer to be trained on work involving hydro-electric plant operation, transmission lines and construction, meter testing and inspection. Good opportunity to acquire first-hand electrical power experience. Apply to Box No. 2487-V.

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.

**CHEMICAL CONSULTING ENGINEER** with practical experience to advise on efficient management of small plant manufacturing pigments and dry colours for paint and rubber production. Apply to Box No. 2503-V.

**MECHANICAL ENGINEER** with experience in pulp and paper industry for supervision and maintenance work in large paper mill. Must be experienced in machine shop work and the handling of men. Apply to Box No. 2522-V.

experience. Age 30. Married. Transmission line, and distribution, estimating, design, survey and construction three years, (one year acting superintendent), interior light and power wiring design, estimating and supervision one year. Electric meters (AC) six months, electric utility drafting six months, foundation layouts and concrete inspection six months. Steam power plant operation two years. Presently employed but desire advancement. Apply to Box No. 2430-W.

## ENGINEER OFFICERS WANTED

Applications are invited for Commissions in the Royal Canadian Ordnance Corps for service both overseas and in Canada as Ordnance Mechanical Engineers. Since it is probable that several new units will be organized in the near future, a number of senior appointments may be open, and applications from engineers with a good background of military experience would be welcomed in this connection. Applications should be submitted on the regular Royal Canadian Ordnance Corps application forms, which can be obtained from the District Ordnance Officers of the respective Military Districts.

## SITUATIONS WANTED

**MECHANICAL ENGINEER** age 55 years. Married. Available at once. Thirty years experience in draughting and general machine shop and foundry work. Fifteen years as works manager. Considerable experience in pump work, including estimating and inspection. Apply to Box 2427-W.

**ENGINEER ADMINISTRATOR**, experienced in public utilities, shipyard construction, airplane construction, crane construction, general mechanical engineering and inspection work, also sales promotion. Open for appointment. Apply to Box 2429-W.

**GRADUATE ENGINEER** in Electrical and Mechanical Engineering, M.E.I.C., and R.P.E., electric utility

## FOR RENT

### Desirable Location For Engineering Office

Entire ground floor about 30 ft. x 80 ft., 4 large rooms and one small. Suitable for consulting engineering office or similar private professional practice. Garage in back yard.

3425 University St.  
(Opp. Pulp & Paper Laboratory)  
MONTREAL

Apply at above address or telephone  
MA. 2975

## WANTED IMMEDIATELY MECHANICAL ENGINEERS

as managers of divisional offices of corporations handling sub-contracts for war emergency programme.

—to supervise production of machinery and equipment, including direction of staff and relations with contractors. Must have experience in production control, machine shop and foundry practice—preferably in heavy industry. Give credentials, present salary. Do not apply if already engaged in war work.

P. O. Box 170, Station B,  
MONTREAL

## PRELIMINARY NOTICE

(Continued)

### FOR TRANSFER FROM STUDENT

**GIAUQUE—LOUIS FREDERICK**, of Hamilton, Ont. Born at Elbow, Sask., June 25th, 1914; Educ.: has completed 3rd year engrg. and expects to graduate July, 1942 at Univ. of Sask. with degree of B.Sc. (Mech.); 1941, design engr., B. Greening Wire Co. Ltd., Hamilton, Ont., at present on leave of absence, completing engrg. course. (St. 1941).

References: R. A. Spencer, I. M. Fraser, G. D. Archibald, C. J. Mackenzie, W. L. Lovell.

**HARRIGAN—MAYO ARTHUR PERRIN**, of 244½ Barrington St., Halifax, N.S. Born at Halifax, Jan. 19th, 1907; Educ.: B.Sc. (Elec.) 1932, B.Sc. (Mech.), 1933, N.S. Tech. Coll.; 1929, student asst., Geol. Survey; 1931, inspr. of concrete, City of Halifax; 1934-39, marine engr. i/c of watch at sea on govt. and cable ships; 1939-40, shift engr., Canadian Industries Ltd., i/c of elec. and mech. repair (C.I.L. Consolidated and Alkali Works, Shawinigan Falls); 1940, chief engr's staff, at present asst. to the chief engr., H. M. C. Dockyard, Halifax, N.S. (St. 1930).

References: S. J. Montgomery, H. R. Theakston, A. E. Flynn, R. P. Donkin.

**LEROUX—FRED CLEMENTS**, of Vancouver, B.C. Born at Weyburn, Sask., June 13th, 1913; Educ.: B.Sc. (Agric. Engrg.), Univ. of Sask., 1939; 1940-41 (intermittently), Univ. of Miss., preparing for Master's Degree; 1934-36, J. H. Early Motor Co. Ltd., Saskatoon; 1937, serviceman and repairman, J. I. Case Co.; 1939, head of a small survey at the Scott Experimental Station; 1939-40, instructor of mechanics, Extension Dept., Univ. of B.C.; 1940-41, research asst., Dept. of Agric. Engrg., Univ. of Miss., on American Cyanamid Fellowship; 1941 to date, field and agric. engr., B.C. Plywood Ltd., Vancouver, B.C. (St. 1939).

References: I. M. Fraser, C. Neufeld, S. G. Talman.

**NORMAN—RONALD LEE**, of 1 Prince Arthur St., Halifax, N.S. Born at Westville, N.S., July 15th, 1914; Educ.: B.Eng. (E.E.), N.S. Tech. Coll., 1935;

1935, pavement inspr. (junior), and 1935-37, senior inspr., Milton Hersey Co., Ltd., for N.S. Dept. of Highways—asst. to res. engr., i/c of staff inspecting materials, mixing and laying of bituminous pavements; 1937-39, sound engr., Dominion Sound Equipments Ltd., Halifax, N.S.; 1939-40, constr. engr., Fundy Construction Co., Halifax; at present, meter engr., i/c gen. mtce., installns., etc., of metering and control equipment, Imperial Oil Refinery, Imperoyal, N.S. (St. 1932).

References: W. P. Copp, S. W. Gray, P. A. Lovett, I. M. Fraser, R. L. Dunsmore.

**READ—FREDERICK CYRIL**, of Montreal, Que. Born at Cobalt, Ont., Aug. 1st, 1914; Educ.: B.A.Sc. (Chem.), Univ. of Toronto, 1939; with Hollinger Cons. Gold Mines, Timmins, Ont., 18 mos. prior to University, and three summer vacations—10 mos. labour, 8 mos. assaying, and 12 mos. ore dressing lab.; 1939-40, Marks & Clark, patent attorneys, Ottawa; 1940-41, sulphite pulp grader, Spruce Falls Paper & Paper Co., Kapuskasing, Ont.; Sept., 1941 to date, research asst., Dominion Tar & Chemical Co., Montreal, Que. (St. 1938).

References: C. E. Sisson, J. J. Spence, O. Holden, R. S. Walker, D. C. Beam, P. L. Chimo.

**ROGERS—HOWARD W.**, of 210 Carlyle Ave., Town of Mount Royal, Que. Born at Westmount, Que., June 27th, 1908; Educ.: B.Sc. (Elec.), McGill Univ., 1931; 1928-29-30 (summers), dftsmn., Northern Elec. Co. Ltd., timekpr., Dakin Constrn. Co.; instr'man., Montreal L. H. & P.; 1931, instr'man., Rapide Blanc Shaw. Engrg. Co.; 1934 to date, sales engr., asst. to branch mgr., Canadian Blower & Forge Co. Ltd., and Canada Pumps Ltd., Montreal. (St. 1931).

References: G. J. Dodd, L. E. Krebsler, E. A. Ryan, F. A. Combe, I. S. Patterson.

**WIEBE—LESLIE**, of 15 Conway Court, Winnipeg, Man. Born at Herbert, Sask., Sept. 14th, 1911; Educ.: B.Sc. (Mech.), Univ. of Sask., 1940; 1938-40, student demonstrator, Univ. of Sask.; 1940 (3 mos.), dftsmn., (3 mos.), asst. to plant supt., and 1941 (9 mos.), asst. engr., Sutton-Horsley Co. Ltd., Toronto; 1941 to date, chief dftsmn., MacDonald Brothers Aircraft Ltd., Robinson St. Divn., i/c engrg. dept. (St. 1930).

References: I. M. Fraser, W. E. Lovell, N. B. Hutcheon, C. J. Mackenzie, C. Neufeld, N. W. DuBois.

## BLUE PRINT READING

The Lincoln Electric Company, Cleveland, Ohio, have issued the second edition of their 146-page book entitled "Simple Blue Print Reading with Special Reference to Welding." This book is written in simple, practical language, and it is intended that welders, mechanics and others will be enabled, by a few hours' sparetime study, to learn print reading which otherwise might take many months to learn. The text gives the students a clear understanding of symbols used in drawing various types of welded joints, including butt, corner, fillet, lap, etc. The illustrations contained in the book include practical examples of drawings of a number of machine parts, pipe connections, general construction, tanks, etc. A list of questions and answers allows the student to test his knowledge.

## CONSERVATION OF TIRES

"Valuable Hints on How To Make Your Tires Last Longer" is the title of a 12-page booklet recently published by Dominion Rubber Co. Ltd., Montreal, Que. This timely publication is filled with important information on the subject, illustrated with photographs and drawings. Among the subjects treated are: how retreading and re-grooving add mileage; how to "cross-switch tires"; how to guard against blowouts; and many other recommendations and tips.

## ENGINEERING STANDARDS

Bulletin Vol. 15 No. 4, published by Canadian Engineering Standards Association, Ottawa, Ont., gives list of publications, and description of matters dealt with at the 19th ordinary general meeting, and at meetings of committees on steel construction, small rivets, distribution transformers, Canadian Electrical Code parts II and III, and new CESA Standards. Amendments to CESA Standards, committee appointments, report of chairman of approvals division, A.I.S.I. manuals and New British Empire Standards, are also covered.

## EXTRA CARBON TOOL STEEL

Jessop Steel Co. Ltd., Toronto, Ont., are distributing an 8-page Bulletin No. 941 which describes this cold melt electric furnace steel made from the best domestic base. It is this manufacturer's "intermediate" grade of carbon tool steel, being less expensive than "Special" grades, yet of better quality than "Standard" grades. It is intended for applications where both price and service requirements must be considered, and where a tough core with hard surface is desired. Typical applications, with recommended tempers for each, are listed.

## INDUSTRIAL RUBBER PRODUCTS CONSERVATION

The first four of a series of six pamphlets on "How to Get the Most Service Out of Industrial Rubber Products" have just been published by The B. F. Goodrich Rubber Co., Akron, Ohio, and are prepared in a vest-pocket-size format so that they can be easily carried. The series is designed to assist in the tremendous programme of rubber conservation now made necessary by war developments. All four of the first series of pamphlets deal with belting—No. 1 "Transmission Belting," No. 2 "Conveyor Belting," No. 3 "V-Belt Drives," and No. 4 "Belt Salvage." Each of the subjects is subdivided into chapters dealing with the various angles of the topic, and is written in non-technical language so that all can understand how to best maintain and conserve the precious rubber products now in their plants. The company will supply copies of these booklets free upon request. If no figures are given as to the number of copies desired, the company will send only one on each request.

## Industrial development — new products — changes in personnel — special events — trade literature

### THE GEOLOGISTS' PARADISE

The province of Nova Scotia is the geologists' paradise because all ages of rocks from Mesozoic down to Precambrian are predominately displayed within a relatively small area.

Fossil ferns and stems found in the coal measures are the palaeo-botanists' delight.

Pitching anticlines, synclines and anticlinal domes are prominently displayed in the Precambrian sediments.

The rock exposures around Minas Basin are the museum curators' favorite hunting ground for zeolites.

Shortage of gasoline and tires may curtail your proposed motor trip—but come just the same—the province is well served by the two largest railway systems on the North American continent, and interconnecting bus lines.

### THE DEPARTMENT OF MINES HALIFAX, NOVA SCOTIA

L. D. CURRIE                      A. E. CAMERON  
Minister                              Deputy Minister

## CONTROL AND TRANSFER SWITCHES

Booklet No. CGEA 1631D, 20 pp., issued by Canadian General Electric Co. Ltd., Toronto, Ont., describes and illustrates control and transfer switches, type SB-1, for circuit breaker rheostat and governor control, or for instrument transfer. Illustrations of construction show styles of fixed contacts and common uses. Tables give interrupting ratings in amperes. Diagrams are given showing dimensions, specifications, weights, etc., and 10 pages of contact diagrams are included.

## CUTTING TOOLS

Effective January 26, 1942, an 8-page Catalogue CGT-140, made available by Canadian General Electric Co. Ltd., gives specifications, numbers, prices, and illustrations, for various styles of "Carboly" standard tools. Each style of tool is illustrated and a series of drawings show typical adaptations that can be quickly ground in these standard tools.

## DE-HYDRATING HYDRO-BIN

Allen-Sherman-Hoff Co., Philadelphia, Pa., describe de-hydrating hydro-bins for handling ashes, coke, or other materials, which can be hydraulically conveyed, in their 12-page Catalogue No. 1240. Methods for use are fully described, and many illustrations show typical installations. This company is represented in Canada by F. S. B. Heward & Co. Ltd., Montreal, Que.

## DIACTOR REGULATORS

A 16-page Bulletin CGEA-2022D, published by Canadian General Electric Co. Ltd., Toronto, Ont., describes type GDA diactor generator-voltage regulators for alternating current machines, with pictorial diagram of regulator connections, descriptions and diagrams covering methods of mounting, general descriptions of construction design, auxiliary apparatus, accessories and operation. Connection diagrams, tables of dimensions and vector diagrams showing effect of cross-current compensation on voltage are included.

## ENGINEERING PROGRESS—1941

Entitled "Engineering Progress—1941," booklet S.P. 2270A, 40 pp., issued by Canadian Westinghouse Co. Ltd., Hamilton, Ont., contains illustrated articles on hydro-electric power, steam turbine studies, transformers voltage regulators, capacitor potential devices, power factor correction, steel mill developments, dynamometers, mine locomotives, refrigeration, X-rays, fluorescent lighting, sun lamps, electric ranges, and many other subjects.

## FLY ASH ELIMINATION

Precipitation Company of Canada, Ltd., Montreal, Que., have issued a 24-page bulletin which contains illustrations, diagrams and dimension sheets, as well as tube calculation charts, tables of collection efficiencies and other valuable information on the collection of fly ash. While ash cannot be prevented even by the most careful firing, by the installation of a "Multiclone" assembly between the boiler and the stack, all solid particles down to the lower micron brackets are automatically collected with minimum draft loss. Simple duct arrangements minimize installation and operating costs. Automatic volume controls ensure efficiency under all conditions.

## GRINDING CEMENTED CARBIDE TOOLS

Norton Company of Canada Ltd., Hamilton, Ont., have available a 52-page booklet which describes, with illustrations and diagrams, and 14 pages of tables, the construction of and uses for "Norton" green crystalline wheels and "Norton" diamond wheels. Recommendations are given as to types most suitable for various operations and directions for use are included.

## OVERCURRENT RELAYS

A 20-page Booklet No. CGEA 3553, issued by Canadian General Electric Co. Ltd., Toronto, Ont., describes induction-time overcurrent relays type IAC, single-phase and three-phase. Applications are described, with illustrations and connection diagrams. Four graphs of settings, showing characteristics are given, also a table showing volt-ampere burdens for various sizes. Construction and operation are fully described with illustrations. Tables of ratings, dimensions and specifications, and directions for ordering are also included.

## PARTS FOR MAGNETIC SWITCHES

Description of parts, catalogue numbers and quantity per switch, of renewal parts required for CR-7006, size 3, A-C magnetic switches, with an illustration of each part, are given in a 4-page Folder 3008 published by Canadian General Electric Co. Ltd., Toronto, Ont.

## PROLONGING LIFE OF RUBBER PRODUCTS

The B. F. Goodrich Rubber Co., Akron, Ohio, are distributing mimeographed reprints of the text of an article on the subject "Don't Abuse Rubber—How to Prolong Its Life" which was originally published in "Factory Management and Maintenance" and is reproduced with the magazine's permission.

## WIRING DEVICES

Catalogue No. 41WD, 76 pp. and cover, recently issued by Canadian General Electric Co. Ltd., Toronto, Ont., gives tables showing catalogue numbers, capacities, weights, and prices for various wiring devices including lampholders, switches, plates, caps, plugs, connectors, outlets, etc. Typical illustrations are given for each type, with descriptions.

# THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 25

MONTREAL, MAY 1942

NUMBER 5



“To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public.”

★ ★ ★

PUBLISHED MONTHLY BY  
THE ENGINEERING INSTITUTE  
OF CANADA

## CONTENTS

2050 MANSFIELD STREET - MONTREAL

L. AUSTIN WRIGHT, M.E.I.C.  
*Editor*

LOUIS TRUDEL, M.E.I.C.  
*Assistant Editor*

N. E. D. SHEPPARD, M.E.I.C.  
*Advertising Manager*

### PUBLICATION COMMITTEE

C. K. McLEOD, M.E.I.C., *Chairman*  
R. DeL. FRENCH, M.E.I.C., *Vice-Chairman*  
A. C. D. BLANCHARD, M.E.I.C.  
H. F. FINNEMORE, M.E.I.C.  
T. J. LAFRENIÈRE, M.E.I.C.

INTERIOR VIEW OF LA TUQUE POWER HOUSE, QUE. . . . .	Cover
<i>(Photo Shawinigan Water &amp; Power Company)</i>	
SYNTHETIC RUBBER . . . . .	274
<i>Dr. R. S. Jane</i>	
SUBCONTRACTING IN CANADA'S MUNITION INDUSTRIES . . . . .	279
<i>F. L. Jeckell</i>	
LIONS' GATE BRIDGE—II . . . . .	282
<i>S. R. Banks, M.E.I.C.</i>	
DISCUSSION ON THE MANUFACTURE OF THE 25-POUNDER IN CANADA . . . . .	298
DISCUSSION ON THE JUSTIFICATION AND CONTROL OF THE LIMIT DESIGN METHOD . . . . .	303
ABSTRACTS . . . . .	307
FROM MONTH TO MONTH . . . . .	312
PERSONALS . . . . .	321
Visitors to Headquarters . . . . .	324
Obituaries . . . . .	325
NEWS OF THE BRANCHES . . . . .	325
LIBRARY NOTES . . . . .	332
PRELIMINARY NOTICE . . . . .	336
EMPLOYMENT SERVICE . . . . .	337
INDUSTRIAL NEWS . . . . .	338

Price 50 cents a copy, \$3.00 a year: in Canada, British Possessions, United States and Mexico. \$4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, \$2.00 a year. —Entered at the Post Office, Montreal, as Second Class Matter.

THE INSTITUTE as a body is not responsible either for the statements made or for the opinions expressed in the following pages.

# THE ENGINEERING INSTITUTE OF CANADA

## MEMBERS OF COUNCIL - 1942

### PRESIDENT

C. R. YOUNG, Toronto, Ont.

### VICE-PRESIDENTS

\*A. L. CARRUTHERS, Victoria, B.C.  
†H. CIMON, Quebec, Que.

†J. L. LANG, Sault Ste. Marie, Ont.  
†G. G. MURDOCH, Saint John, N.B.

### PAST-PRESIDENTS

†T. H. HOGG, Toronto, Ont.

†C. J. MACKENZIE, Ottawa, Ont.

### COUNCILLORS

†J. E. ARMSTRONG, Montreal, Que.  
\*A. E. BERRY, Toronto, Ont.  
†S. G. COULTIS, Calgary, Alta.  
†G. L. DICKSON, Moncton, N.B.  
\*D. S. ELLIS, Kingston, Ont.  
\*J. M. FLEMING, Port Arthur, Ont.  
\*I. M. FRASER, Saskatoon, Sask.  
\*J. H. FREGEAU, Three Rivers, Que.  
\*J. GARRETT, Edmonton, Alta.  
†F. W. GRAY, Sydney, N.S.  
\*S. W. GRAY, Halifax, N.S.

†E. D. GRAY-DONALD, Quebec, Que.  
†J. HAIMES, Lethbridge, Alta.  
\*J. G. HALL, Montreal, Que.  
†R. E. HEARTZ, Montreal, Que.  
†W. G. HUNT, Montreal, Que.  
†E. W. IZARD, Victoria, B.C.  
†J. R. KAYE, Halifax, N.S.  
\*E. M. KREBSER, Walkerville, Ont.  
†N. MacNICOL, Toronto, Ont.  
\*H. N. MACPHERSON, Vancouver, B.C.  
\*H. F. MORRISEY, Saint John, N.B.

\*W. H. MUNRO, Ottawa, Ont.  
†T. A. McELHANNEY, Ottawa, Ont.  
\*C. K. McLEOD, Montreal, Que.  
†A. W. F. McQUEEN, Niagara Falls, Ont.  
†A. E. PICKERING, Sault Ste. Marie, Ont.  
†G. McL. PITTS, Montreal, Que.  
†W. J. W. REID, Hamilton, Ont.  
†J. W. SANGER, Winnipeg, Man.  
\*M. G. SAUNDERS, Arvida, Que.  
†H. R. SILLS, Peterborough, Ont.  
\*J. A. VANCE, Woodstock, Ont.  
\*For 1942 †For 1942-43 ††For 1942-43-44

### TREASURER

E. G. M. CAPE, Montreal, Que.

### GENERAL SECRETARY

L. AUSTIN WRIGHT, Montreal, Que.

### ASSISTANT GENERAL SECRETARY

LOUIS TRUDEL, Montreal, Que.

### SECRETARY-EMERITUS

R. J. DURLEY, Montreal, Que.

## STANDING COMMITTEES

### FINANCE

DEG. BEAUBIEN, *Chairman*  
J. E. ARMSTRONG  
E. G. M. CAPE  
G. A. GAHERTY  
J. A. McCRORY  
F. NEWELL

### LEGISLATION

J. L. LANG, *Chairman*  
R. L. DOBBIN  
R. J. DURLEY

### PAPERS

J. A. VANCE, *Chairman*  
DEG. BEAUBIEN  
K. M. CAMERON  
A. L. CARRUTHERS  
H. CIMON  
J. L. LANG  
G. G. MURDOCH

### LIBRARY AND HOUSE

W. G. HUNT, *Chairman*  
A. T. BONE  
J. S. HEWSON  
M. S. NELSON  
G. V. RONEY

### PUBLICATION

C. K. McLEOD, *Chairman*  
R. DeL. FRENCH, *Vice-Chairman*  
A. C. D. BLANCHARD  
H. F. FINNEMORE  
T. J. LAFRENIERE

## SPECIAL COMMITTEES

### BOARD OF EXAMINERS AND EDUCATION

R. A. SPENCER, *Chairman*  
I. M. FRASER  
W. E. LOVELL  
A. P. LINTON  
H. R. MacKENZIE  
E. K. PHILLIPS

### GZOWSKI MEDAL

H. V. ANDERSON, *Chairman*

### DUGGAN MEDAL AND PRIZE

J. T. FARMER, *Chairman*  
J. M. FLEMING  
R. C. FLITTON

### PLUMMER MEDAL

C. R. WHITTEMORE, *Chairman*  
J. CAMERON  
R. L. DOBBIN  
O. W. ELLIS  
R. E. GILMORE

### LEONARD MEDAL

JOHN McLEISH, *Chairman*  
A. E. CAMERON  
A. O. DUFRESNE  
J. B. DeHART  
A. E. MacRAE

### JULIAN C. SMITH MEDAL

C. R. YOUNG, *Chairman*  
T. H. HOGG  
C. J. MACKENZIE

### PROFESSIONAL INTERESTS

J. B. CHALLIES, *Chairman*  
J. E. ARMSTRONG  
G. A. GAHERTY  
O. O. LEFEBVRE  
H. W. McKIEL  
J. A. VANCE

### STUDENTS' AND JUNIORS' PRIZES

#### Zone A (Western Provinces)

##### H. N. Ruttan Prize

A. L. CARRUTHERS, *Chairman*  
E. W. IZARD  
H. N. MACPHERSON

#### Zone B (Province of Ontario)

##### John Galbraith Prize

J. L. LANG, *Chairman*  
A. E. PICKERING  
J. A. VANCE

#### Zone C (Province of Quebec)

##### Phelps Johnson Prize (English)

DEGASPE BEAUBIEN, *Chairman*  
J. E. ARMSTRONG  
R. E. HEARTZ

##### Ernest Marceau Prize (French)

H. CIMON, *Chairman*  
J. H. FREGEAU  
E. D. GRAY-DONALD

#### Zone D (Maritime Provinces)

##### Martin Murphy Prize

G. G. MURDOCH, *Chairman*  
G. L. DICKSON  
S. W. GRAY

### THE YOUNG ENGINEER

H. F. BENNETT, *Chairman*  
J. BENOIT  
D. S. ELLIS  
J. N. FINLAYSON  
R. DeL. FRENCH  
R. F. LEGGET  
A. E. MACDONALD  
H. W. McKIEL

### MEMBERSHIP

J. G. HALL, *Chairman*  
S. R. FROST

### INTERNATIONAL RELATIONS

R. W. ANGUS, *Chairman*  
J. B. CHALLIES, *Vice-Chairman*  
E. A. ALLCUT  
C. CAMSELL  
J. M. R. FAIRBAIRN  
O. O. LEFEBVRE  
M. J. McHENRY  
H. H. VAUGHAN  
C. R. YOUNG

### DETERIORATION OF CONCRETE STRUCTURES

R. B. YOUNG, *Chairman*  
E. VIENS, *Vice-Chairman*  
G. P. F. BOESE  
A. G. FLEMING  
W. G. GLIDDON  
O. O. LEFEBVRE  
J. A. McCRORY  
C. J. MACKENZIE  
J. H. MCKINNEY  
R. M. SMITH

### WESTERN WATER PROBLEMS

G. A. GAHERTY, *Chairman*  
C. H. ATTWOOD  
L. C. CHARLESWORTH  
A. GRIFFIN  
D. W. HAYS  
G. N. HOUSTON  
T. H. HOGG  
O. O. LEFEBVRE  
C. J. MACKENZIE  
H. J. McLEAN  
F. H. PETERS  
S. G. PORTER  
P. M. SAUDER  
J. M. WARDLE

# THE ENGINEERING INSTITUTE OF CANADA

## OFFICERS OF BRANCHES

### ORDER CITIES

*Chairman*, H. L. JOHNSTON  
*Vice-Chair.*, G. G. HENDERSON  
*Executive*, W. P. AUGUSTINE  
 J. F. G. BLOWEY  
 W. R. STICKNEY  
 (*Ex-Officio*), E. M. KREBSER  
 G. E. MEDLAR  
*Sec.-Treas.*, J. B. DOWLER,  
 754 Chilver Road,  
 Walkerville, Ont.

### CALGARY

*Chairman*, H. J. McEWEN  
*Vice-Chair.*, J. G. MacGREGOR  
*Executive*, J. N. FORD  
 A. GRIFFIN  
 H. B. SHERMAN  
 (*Ex-Officio*), G. P. F. BOESE  
 S. G. COULTIS  
 J. B. DEHART  
 P. F. PEELE  
*Sec.-Treas.*, K. W. MITCHELL,  
 803—17th Ave. N.W.,  
 Calgary, Alta.

### CAPE BRETON

*Chairman*, J. A. MacLEOD  
*Executive*, J. A. RUSSELL M. F. COSSITT  
 (*Ex-Officio*), F. W. GRAY  
*Sec.-Treas.*, S. C. MIFFLEN,  
 60 Whitney Ave., Sydney, N.S.

### EDMONTON

*Chairman*, D. A. HANSEN  
*Vice-Chair.*, D. HUTCHISON  
*Executive*, C. W. CARRY  
 B. W. PITFIELD  
 E. R. T. SKARIN  
 J. A. ALLAN  
 E. ROBERTSON  
 J. W. JUDGE  
 (*Ex-Officio*), J. GARRETT  
 R. M. HARDY  
*Sec.-Treas.*, F. R. BURFIELD,  
 Water Resources Office,  
 Provincial Government,  
 Edmonton, Alta.

### HALIFAX

*Chairman*, P. A. LOVETT  
*Executive*, A. E. CAMERON  
 G. T. CLARKE G. J. CURRIE  
 A. E. FLYNN J. D. FRASER  
 D. G. DUNBAR J. A. MacKAY  
 J. F. F. MacKENZIE  
 J. W. MacDONALD  
 G. T. MEDFORTH  
 (*Ex-Officio*), S. L. FULTZ J. R. KAYE  
*Sec.-Treas.*, S. W. GRAY,  
 The Nova Scotia Power  
 Commission,  
 Halifax, N.S.

### HAMILTON

*Chairman*, STANLEY SHUPE  
*Vice-Chair.*, T. S. GLOVER  
*Executive*, H. A. COOCH  
 NORMAN EAGER  
 A. C. MacNAB  
 A. H. WINGFIELD  
 (*Ex-Officio*), W. J. W. REID  
 W. A. T. GILMOUR  
*Sec.-Treas.*, A. R. HANNAFORD,  
 354 Herkimer Street,  
 Hamilton, Ont.

### KINGSTON

*Chairman*, T. A. McGINNIS  
*Vice-Chair.*, P. ROY  
*Executive*, V. R. DAVIES  
 K. H. McKIBBIN  
 K. M. WINSLOW  
 A. H. MUNRO  
 (*Ex-Officio*), G. G. M. CARR-HARRIS  
 D. S. ELLIS  
*Sec.-Treas.*, J. B. BATY,  
 Queen's University,  
 Kingston, Ont.

### LAKEHEAD

*Chairman*, B. A. CULPEPER  
*Vice-Chair.*, MISS E. M. G. MacGILL  
*Executive*, E. J. DAVIES  
 J. I. CARMICHAEL  
 S. E. FLOOK  
 S. T. McCAVOUR  
 R. B. CHANDLER  
 W. H. SMALL  
 C. D. MacKINTOSH  
 (*Ex-Officio*), H. G. O'LEARY  
 J. M. FLEMING  
*Sec.-Treas.*, W. C. BYERS,  
 c/o C. D. Howe Co. Ltd.,  
 Port Arthur, Ont.

### LETHBRIDGE

*Chairman*, C. S. DONALDSON  
*Vice-Chair.*, W. MELDRUM  
*Executive*, R. F. P. BOWMAN G. S. BROWN  
 N. H. BRADLEY  
 C. S. CLENDENING  
 (*Ex-Officio*), J. HAIMES  
 A. J. BRANCH J. T. WATSON  
*Sec.-Treas.*, R. B. McKENZIE,  
 McKenzie Electric Ltd.,  
 706, 3rd Ave. S., Lethbridge, Alta.

### LONDON

*Chairman*, F. T. JULIAN  
*Vice-Chair.*, T. L. McMANAMNA  
*Executive*, F. C. BALL  
 V. A. McKILLOP  
 H. F. BENNETT  
 A. L. FURANNA  
 R. S. CHARLES  
 (*Ex-Officio*), R. W. GARRETT  
 J. A. VANCE  
*Sec.-Treas.*, H. G. STEAD,  
 60 Alexandra Street,  
 London, Ont.

### MONCTON

*Chairman*, F. O. CONDON  
*Vice-Chair.*, H. J. CRUDGE  
*Executive*, B. E. BAYNE E. R. EVANS  
 G. L. DICKSON E. B. MARTIN  
 T. H. DICKSON G. E. SMITH  
 (*Ex-Officio*), H. W. McKIEL  
*Sec.-Treas.*, V. C. BLACKETT,  
 Engr. Dept., C.N.R.,  
 Moncton, N.B.

### MONTREAL

*Chairman*, J. A. LALONDE  
*Vice-Chair.*, R. S. EADIE  
*Executive*, R. E. HEARTZ  
 J. B. STIRLING  
 J. M. CRAWFORD  
 J. COMEAU  
 H. F. FINNEMORE  
 R. C. FLITTON  
 G. D. HULME  
 (*Ex-Officio*), DE G. BEAUBIEN  
 J. E. ARMSTRONG  
 J. G. HALL  
 W. G. HUNT  
 C. K. McLEOD  
 G. McL. PITTS  
*Sec.-Treas.*, L. A. DUCHASTEL,  
 40 Kelvin Avenue,  
 Outremont, Que.

### NIAGARA PENINSULA

*Chairman*, A. L. McPHAIL  
*Vice-Chair.*, C. G. CLINE  
*Executive*, L. J. RUSSELL  
 J. H. TUCK  
 A. C. BLUE  
 G. F. VOLLMER  
 G. E. GRIFFITHS  
 D. W. BRACKEN  
 L. L. GISBORNE  
 (*Ex-Officio*), A. W. F. McQUEEN  
*Sec.-Treas.*, J. H. INGS,  
 1870 Ferry Street,  
 Niagara Falls, Ont.

### OTTAWA

*Chairman*, N. B. MacROSTIE  
*Executive*, W. G. C. GLIDDON  
 R. M. PRENDERGAST  
 W. H. G. FLAY  
 G. A. LINDSAY  
 R. YUILL  
 (*Ex-Officio*), K. M. CAMERON  
 C. J. MacKENZIE  
 W. H. MUNRO  
 T. A. McELHANNEY  
 R. K. ODELL  
*Sec.-Treas.*, A. A. SWINNERTON,  
 Dept. of Mines and Resources,  
 Ottawa, Ont.

### PETERBOROUGH

*Chairman*, J. CAMERON  
*Executive*, A. J. GIRDWOOD I. F. McRAE  
 J. W. PIERCE F. R. POPE  
 (*Ex-Officio*), R. L. DOBBIN  
 H. R. SILLS  
 A. L. MALBY  
*Sec.-Treas.*, D. J. EMERY,  
 589 King Street,  
 Peterborough, Ont.

### QUEBEC

*Life Hon. Chair.*, A. R. DECARY  
*Chairman*, L. C. DUPUIS  
*Vice-Chair.*, RENÉ DUPUIS  
*Executive*, O. DESJARDINS  
 R. SAUVAGE G. ST-JACQUES  
 S. PICARD L. GAGNON  
 G. W. WADDINGTON  
 (*Ex-Officio*), E. D. GRAY-DONALD  
 R. B. McDUNNOUGH P. MÉTHÉ  
 H. CIMON  
*Sec.-Treas.*, PAUL VINCENT,  
 Colonization Department,  
 Room 333-A, Parliament Bldgs.,  
 Quebec, Que.

### SAGUENAY

*Chairman*, N. F. McCAGHEY  
*Vice-Chair.*, R. H. RIMMER  
*Executive*, B. BAUMAN  
 G. B. MOXON  
 A. I. CUNNINGHAM  
 W. J. THOMSON  
 (*Ex-Officio*), M. G. SAUNDERS  
 J. W. WARD  
*Sec.-Treas.*, D. S. ESTABROOKS,  
 Price Bros. & Co. Ltd.,  
 Riverbend, Que.

### SAINT JOHN

*Chairman*, F. A. PATRIQUEN  
*Vice-Chair.*, D. R. SMITH  
*Executive*, A. O. WOLFF  
 H. P. LINGLEY  
 W. B. AKERLEY  
 (*Ex-Officio*), J. P. MOONEY  
 H. F. MORRISEY  
 G. G. MURDOCH  
*Sec.-Treas.*, V. S. CHESNUT,  
 P.O. Box 1393,  
 Saint John, N.B.

### ST. MAURICE VALLEY

*Chairman*, VIGGO JEPSEN  
*Vice-Chair.*, J. H. FREGEAU  
*Executive*, E. BUTLER R. D. PACKARD  
 A. C. ABBOTT  
 R. DORION  
 H. J. WARD  
 E. T. BUCHANAN  
 J. JOYAL  
 H. G. TIMMIS  
 (*Ex-Officio*), A. H. HEATLEY  
*Sec.-Treas.*, J. B. SWEENEY,  
 Consolidated Paper Corporation,  
 Grand'Mère, Que.

### SASKATCHEWAN

*Chairman*, A. P. LINTON  
*Vice-Chair.*, A. M. MacGILLIVRAY  
*Executive*, F. C. DEMPSEY  
 N. B. HUTCHEON  
 J. G. SCHAEFFER  
 R. W. JICKLING  
 H. R. MacKENZIE  
 B. RUSSELL  
 (*Ex-Officio*), I. M. FRASER  
*Sec.-Treas.*, STEWART YOUNG  
 P. O. Box 101,  
 Regina, Sask.

### SAULT STE. MARIE

*Chairman*, L. R. BROWN  
*Vice-Chair.*, R. A. CAMPBELL  
*Executive*, N. C. COWIE  
 C. O. MADDOCK  
 C. R. MURDOCK K. G. ROSS  
 (*Ex-Officio*), J. L. LANG  
 E. M. MacQUARRIE  
 A. E. PICKERING  
*Sec.-Treas.*, O. A. EVANS,  
 159 Upton Road,  
 Sault Ste. Marie, Ont.

### TORONTO

*Chairman*, W. S. WILSON  
*Vice-Chair.*, W. H. M. LAUGHLIN  
*Executive*, D. FORGAN  
 R. F. LEGGET  
 S. R. FROST  
 F. J. BLAIR  
 E. G. HEWSON  
 C. F. MORRISON  
 (*Ex-Officio*), C. R. YOUNG T. H. HOGG  
 A. E. BERRY N. MacNICOL  
 H. E. BRANDON J. J. SPENCE  
*Sec.-Treas.*, S. H. deJONG  
 Dept. of Civil Engineering,  
 University of Toronto,  
 Toronto, Ont.

### VANCOUVER

*Chairman*, W. O. SCOTT  
*Vice-Chair.*, W. N. KELLY  
*Executive*, H. P. ARCHIBALD  
 I. C. BARLTROP  
 H. C. FITZ-JAMES  
 H. J. MacLEOD  
 R. E. POTTER  
 (*Ex-Officio*), J. N. FINLAYSON  
 T. V. BERRY  
 H. N. MacPHERSON  
*Sec.-Treas.*, P. B. STROYAN  
 2099 Beach Avenue,  
 Vancouver, B.C.

### VICTORIA

*Chairman*, A. S. G. MUSGRAVE  
*Vice-Chair.*, KENNETH REID  
*Executive*, A. L. FORD  
 B. T. O'GRADY  
 J. B. PARHAM  
 R. BOWERING  
 (*Ex-Officio*), A. L. CARRUTHERS  
 G. M. IRWIN  
 E. W. IZARD  
*Sec.-Treas.*, J. H. BLAKE,  
 605 Victoria Avenue,  
 Victoria, B.C.

### WINNIPEG

*Chairman*, D. M. STEPHENS  
*Vice-Chair.*, J. T. DYMENT  
*Executive*, C. V. ANTENBRING  
 N. M. HALL  
 T. H. KIRBY  
 E. W. R. BUTLER  
 H. B. BREHAUT  
 (*Ex-Officio*), J. W. SANGER  
 V. MICHIE  
 C. P. HALTALIN  
*Sec.-Treas.*, THOMAS E. STOREY,  
 55 Princess Street,  
 Winnipeg, Man.

# SYNTHETIC RUBBER

DR. R. S. JANE

*Department of Research and Development, Shawinigan Chemicals Limited, Montreal, Que.*

Paper presented before the Montreal Branch of The Engineering Institute of Canada, on March 5th, 1942, and before a joint meeting of the St. Maurice Valley Branch of the Institute and the Shawinigan Chemical Association at Shawinigan Falls, Que., on April 22nd, 1942.

During the past few months our attention has been focused on the East Indies, now completely overrun by the Japanese. While the threat to India, Australia and New Zealand is uppermost in the minds of most of us, those responsible for supplies of vital raw materials for carrying on the war look upon the Eastern catastrophe from another point of view altogether. When one considers that 97 per cent of our crude rubber is imported from the East Indies, the seriousness of our position with regard to this vital raw material is at once apparent. The gravity of the situation is reflected in the action of our Government in placing rubber and rubber products under control in order to conserve the supplies of crude rubber now in this country, and at the same time to build up a reserve against the threat of a complete stoppage of shipments from the Orient. This, as we now realize, is only a stop-gap measure and eventually, in the not too distant future, we shall be compelled to develop to gigantic proportions our small but rapidly expanding synthetic rubber industry.

Naturally technical men throughout the country are very much concerned over the rubber situation and are wondering where the supply for industry and commerce is to be obtained during the next few years if this war continues, as it is almost certain to do.

The uncertainty of this situation naturally gives rise to a number of questions, the answers to which are a matter of some importance to those of us engaged in industry where rubber in some form or other is a vital material. For instance, among the questions which immediately come to mind are the following:

1. How is synthetic rubber made?
2. Approximately how much synthetic rubber is now being produced on this continent?
3. What raw materials are being used to produce synthetic rubber and are these available in sufficient quantity to enable the existing plants to expand?
4. To what extent can synthetic rubber be used to replace natural rubber?
5. How long will it take to build synthetic rubber plants to satisfy our numerous demands?
6. What is to be the cost of plant and production for large scale operation?

In the following paragraphs an attempt is made to answer these questions as far as the answers can be found in the current literature on the subject.

In order to get a clear picture of the present status of the synthetic rubber situation it is necessary to review briefly the developments of the industry in this and other countries.

Even before the time of Goodyear's historic discovery of the vulcanization process, chemists were searching for a synthetic substitute for rubber. Faraday analysed crude rubber and found it to be a hydro-carbon having the empirical formula  $C_8H_8$ . Greville Williams, another Englishman, later in 1860 subjected rubber to destructive distillation and obtained a water-white liquid of the same composition as rubber which he called isoprene. Later still a Frenchman, Boucharat, converted isoprene into a rubber-like mass which while like rubber in appearance was very much inferior to the natural product in physical properties.

During the decade prior to the first World War, British and German research groups worked feverishly for the honour of being the first to obtain a satisfactory synthetic product. The wide fluctuation in price of crude rubber in this period spurred them on, but all attempts to obtain a product comparable to natural rubber resulted in failure.

The British soon lost heart and concentrated their efforts on building up the efficiency of production in the plantations in the East Indies. The Germans too were more or less discouraged and did not take up the search again until they were forced into it by the British blockade in 1915. Faced with a critical shortage of rubber in Germany they built a plant in Cologne to produce 150 tons of synthetic rubber per month based on dimethyl butadiene or methyl isoprene from acetone derived from calcium carbide and acetylene. The product turned out from this plant was definitely inferior to natural rubber and consequently its production was discontinued immediately after the armistice.

After the war the British introduced the Stevenson Restriction in order to raise the level of crude rubber prices. While this arrangement no doubt materially aided plantation owners and probably saved the industry in the East it had the effect of reviving the search for a synthetic substitute in Germany and also this time in the United States. The search continued until 1931 when the DuPont Company announced the first successful synthetic rubber which they called polychloroprene. In chemical composition polychloroprene is different from natural rubber in that it contains 40 per cent chlorine, but in its physical properties it is more nearly like the natural product than many of the synthetic rubbers discovered before or since. When announced by the DuPont Company the new rubber was called Duprene but it has since been called Neoprene, the name which it still bears.

A year later, in 1932, Thiokol, the polysulphide rubber, was discovered and this was followed by the Goodrich Koroseal, which is a plasticized polyvinyl chloride. In 1935 the I. G. Farben Company, in Germany introduced a series of Buna rubbers based on butadiene, styrene, and acrylonitrile. The year 1938 was an important one for synthetic rubber when Hitler rolled the German army into Austria on Buna tires, a performance which convinced the world that synthetic rubber was no longer a laboratory curiosity but an industrial product that had come to stay.

The spread of the war in 1940 and 1941 with a possibility of the East being involved sooner or later finally caused the United States to become concerned over its supply of crude rubber. As if in answer to our second question above there followed announcements in quick succession that the Goodrich Rubber Company, the Goodyear Tire and Rubber Company, the Firestone Company and the Standard Oil of New Jersey were building or had already built educational plants to produce new variations of the butadiene type rubbers. This then brings the development up to the beginning of this war and well into 1940.

Now to go back to the first question, how are the synthetic rubbers made? First let us consider the German Bunas. Everyone is more or less familiar with the name Buna as being the trade name for the synthetic rubbers developed in that country during the last decade. Buna S, the most important one, is a copolymer of butadiene and styrene. Buna N, another synthetic rubber, is made in a similar manner by copolymerizing butadiene and a compound called acrylonitrile, or vinyl cyanide. The process of copolymerization is a German invention whereby mixtures of butadiene and other hydrocarbons of the same family are brought together under certain conditions to form rubber-like masses which they call copolymers.

The theory is that certain hydrocarbon molecules link up into long chains attached end to end forming what is called a macromolecule. When a substance is composed of

macromolecules of this type it generally possesses plastic or elastic properties more or less resembling natural rubber. Apparently when butadiene and styrene are linked up into long chains (copolymerized) the resulting product is extremely like natural rubber in its behaviour. However our knowledge of the macromolecular structure of natural and also synthetic rubber is far from complete and consequently the picture of these polymers in the form of chains of various complexities may not be entirely a true one.

In Germany all these materials are made from acetylene derived from calcium carbide and from coal tar derived from distillation of coal. The sequence of steps that is used in manufacturing these materials is shown in Chart I.

### CHART I

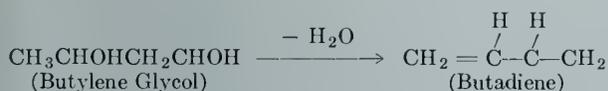
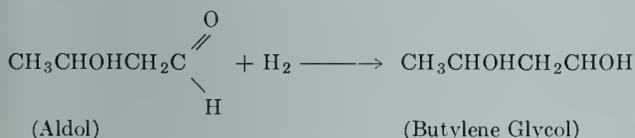
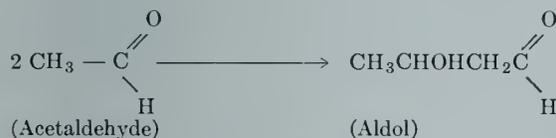
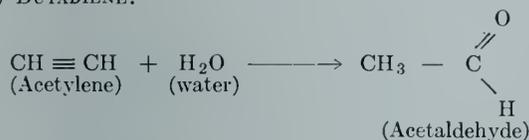
#### THE GERMAN BUNAS

Buna S: Butadiene + Styrene (Copolymer)  
(20%—40%)

Buna N: Butadiene + Acrylonitrile (Copolymer)  
(20%—40%)

Method of Manufacture of:

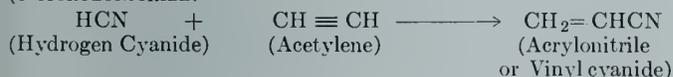
(1) BUTADIENE:



(2) STYRENE:



(3) ACRYLONITRILE:



American Bunas are similar in composition to their German counterpart but on this continent the raw materials or their manufacture are quite different. The butadiene, styrene, etc., can be made from crude petroleum and petroleum refinery gases much more cheaply than from carbide and acetylene as is done in Germany. Chart II is a summary of the methods used in the United States for the manufacture of butadiene, styrene and acrylonitrile from petroleum.

It is seen from this chart that most of the raw materials for the American Bunas stem from petroleum. The Butyl rubber of Standard Oil Development Co. which is the subject of much comment in the daily press at present, is a copolymer of isobutylene and butadiene with the isobutylene comprising the greater part of the copolymer. Since isobutylene is a cheaper material than butadiene it is reasonable to assume that Butyl would constitute a lower priced rubber than Buna S or N. However, little has yet been published regarding the price and properties of Butyl and in the absence of such data it is difficult to make comparisons.

### CHART II

#### THE AMERICAN BUNAS

Buna S: Butadiene + Styrene (Copolymers)  
The Buna S of Standard Oil and Firestone (under license from German I. G. Farben).

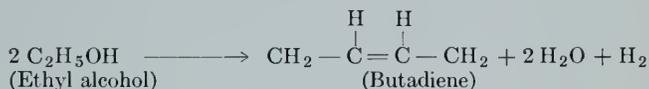
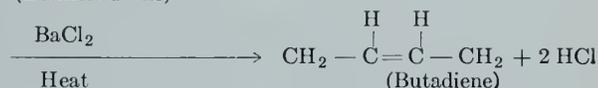
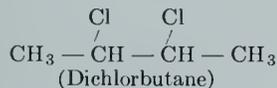
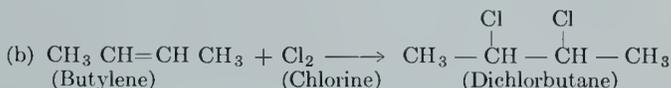
Buna N: Butadiene + Acrylonitrile (Copolymers)  
The Buna N of Standard Oil and Firestone.  
The Hycar or Ameripol of Goodrich.  
The Chemigum of Goodyear.

Butyl Rubber: Isobutylene + Butadiene (Copolymers)  
Standard Oil Development Co.

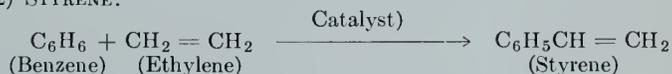
Method of manufacture of:

(1) BUTADIENE:

(a) Petroleum + special cracking  $\longrightarrow$  5-12% Butadiene.



(2) STYRENE:



(3) ACRYLONITRILE:



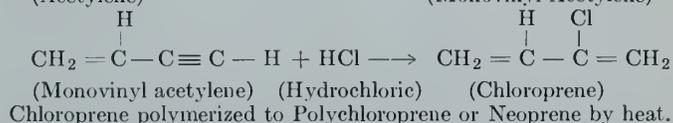
It is worthy of note that in spite of the fact that the search for a suitable synthetic rubber was pursued for more than thirty years in Germany, the first synthetic rubber worthy of the name was discovered and developed on this continent. The DuPont Neoprenes were among the first synthetics to be put on the market in the United States and since that time their outstanding properties have won for them a wide acceptance in industry even before the present crisis arose. The method of manufacturing the Neoprene is shown in Chart III.

### CHART III

#### THE DUPONT NEOPRENES

Several types are on the market each having its own industrial application.

Method of manufacture:



Neoprene like the German Bunas is made from acetylene gas but, as will be noted from the chart, by a very much

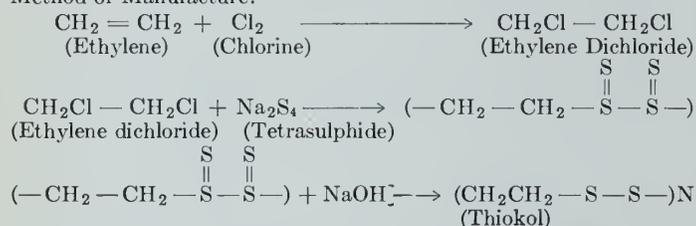
simpler process. If acetylene could be produced readily from petroleum or refinery gases, producers of Neoprene like the producers of American Bunas would look to the oil industry for their raw material. Up to the present however, calcium carbide seems to be by far the cheapest and most suitable source of acetylene gas.

Another important synthetic rubber which is used to replace rubber in certain applications is the organic polysulphide known on this continent as Thiokol. Its method of manufacture is shown in Chart IV.

CHART IV  
THE THIOKOLS

ORGANIC POLYSULPHIDES—THIOKOL CORP.

Method of Manufacture:



In addition to its many interesting properties which will be shown later in this paper, Thiokol is probably the simplest of all synthetic rubbers to produce. The equipment is simple and inexpensive and the separating and treatment of the product is not involved.

One of the most interesting developments in the field of rubber substitutes is that of the thermoplastic substance called polyvinyl chloride. As it is made polyvinyl chloride is a hard, horn-like material, having not a vestige of rubber-like properties, but when plasticized or softened (elasticised is more appropriate), it possesses many of the excellent qualities of vulcanized rubber. Its method of production and raw materials involved in its preparation are set out in Chart V.

CHART V

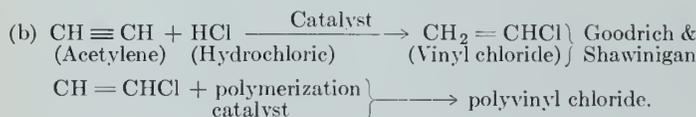
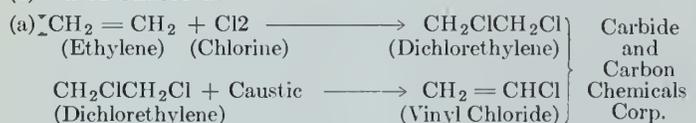
KOROSEAL AND THE VINYLITES

KOROSEAL: polyvinyl chloride + plasticizer — Goodrich.  
(Tricresylphosphate)  
(20-40%)

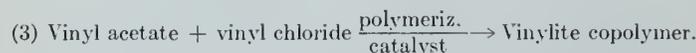
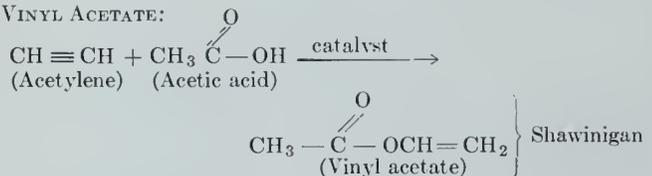
VINYLITES: polyvinyl chloride + polyvinyl acetate (Copolymers)  
+ Plasticizer. (Carbide and Carbon Chemicals Corporation).

Method of manufacture:

(1) VINYL CHLORIDE:



(2) VINYL ACETATE:



#### PROPERTIES AND APPLICATIONS

It is beyond the scope of this paper to describe in detail the numerous properties and applications of the synthetic rubbers. There has accumulated over the last ten years an extensive literature on the subject to which the reader must be referred for a complete treatise on properties.

The properties of the synthetics, like natural rubber, depend to a large extent on their response to compounding—that is, the art of selecting the kind and quantity of the various ingredients added to rubber in order to vulcanize it and impart to the product specific desired properties. In the case of the Bunas, natural rubber compounding practice is followed fairly closely. Sulphur is used for vulcanization but much less amount is necessary in order to give satisfactory properties. So far the existing organic accelerators have met with fair success but more active ones may yet be demanded. The usual rubber anti-oxidants are not so effective as with rubber because synthetics themselves are quite resistant to oxidation. The customary reinforcing agents (for example, carbon black) are even more effective in the case of the Bunas. On account of the hard and tough internal structure of the Bunas, a very considerable proportion of oils, plasticizers and softening agents are required in order to process them. Because of their resistance to oxidation and cross-linked type of structure, they do not soften or break down on milling to the same extent as rubber, and consequently it is more difficult to disperse in them pigments, fillers, etc. Plasticizers are added to overcome this deficiency, but the physical properties of the resulting product suffer correspondingly.

Neoprene is unique among the butadiene type rubbers in that sulphur is not required for vulcanization, the application of heat being sufficient. Magnesium, zinc and lead oxides function as vulcanization agents and sulphur as an accelerator. Some rubber accelerators exhibit the same effect in Neoprene; others have a retarding action; while still others are efficient plasticizers. The usual reinforcing powders increase the elasticity but not the tensile strength of Neoprene.

Thiokols can be made to undergo a change similar to vulcanization in spite of the fact that one would not expect it from their chemical structure. As in the case of Neoprene, the metallic oxides act as vulcanizing agents and sulphur as an accelerator. Reinforcing agents, particularly carbon black, are required to bring about the maximum tensile strength.

Koroseal does not vulcanize. The optimum properties of polyvinyl chloride can be brought out only by suitable plasticizing. It is possible to use plasticizers which themselves may be vulcanized and thus impart to the Koroseal some outstanding properties.

Extensive experimental work, involving road tests has been done on synthetic rubber in tires. In Germany the Buna S type has been used almost exclusively. In this country satisfactory tire tread stocks have been developed from all the Buna types and Neoprene. The wear resistance of synthetic tire treads in road tests has been comparable with the best natural rubber and in some cases superior to it. Two major difficulties with synthetic still remain:

- (1) The unvulcanized synthetic rubber—carbon black stocks cannot be processed without using excessive amounts of softeners.
- (2) The use of synthetics in the carcass of the tire has not proved satisfactory on account of poor adhesion.

How serious these two defects are is difficult to ascertain from authorities in this field. There is no doubt that difficulties of varying degrees have been encountered. But it is certain that the rubber processors will find a way around these difficulties in the course of time.

Chart No. VI, taken from Dr. Greer's excellent paper on "Elastomers in the Nation's War Program" published in the January issue of *Chemical Industries*, contains an extremely clear and simple summary of the properties of a number of synthetic rubbers now being used to an increasing extent on this continent. The chart is self-explanatory and requires no comment.

#### ECONOMICS OF SYNTHETIC RUBBER PRODUCTION

The prime consideration in discussing the economics of synthetic rubber is the cost and availability of raw mate-

CHART VI

PROPERTIES OF SYNTHETIC RUBBERS\*

E = Excellent; G = Good; F = Fair and P = Poor.

PROPERTY	Rubber	Neoprene	Thiokol	Koroseal	Perbunan	Oil Resistant Ameripol
Abrasion and Tear Resistance.....	E	G	P	E—if heat is not generated	E	E
Adhesion to Metals.....	E	E	F	F	E	E
Aging in Storage.....	E	E	E	E	E	E
Chemical Resistance:						
Oxidizing Solutions.....	P	P	P	E	P	P
Ozone.....	P	E	E	E	F	F
Solutions of Salts, Alkalies and Acids.....	G	G	G	G	G	G
Color Range.....	E	G	P	E	F	G
Resistance to Cutting.....	G	G	P	E	G	G
Resistance to Diffusion of Gases.....	F	G	E	E	G	G
Elasticity and Rebound.....	E	G	P	F	G	F
Electrical Properties:						
Conductivity.....	F	F	F	F	F	F
Resistance to Corona Cracking.....	P	E	E	E	P	P
Dielectric Strength.....	E	F	F	E	F	F
Flame Resistance.....	P	G	P	E	P	P
Resistance to Flex-cracking.....	G	G	F	E	G	G
Resistance to Flow: Cold.....	E	G	P	F	E	E
Hot.....	E	F	P	P	E	E
Hardness Range—Durometer A.....	20-100	10-90	20-80	10-100	10-100	10-100
Low Heat Generation through Hysteresis..	E	F	F	—	F	F
Freedom from Odor.....	G	F	P	E	F	F
Resistance to Swelling:						
Chlorinated or Aromatic Solvents.....	P	P	G	Shrinks because of extraction plasticizer	P P G to E	F F E
Lacquer Solvents.....	P	P	G			
Mineral Oil or Gasoline.....	P	G	E			
Water.....	F	G	—	E	E	E
Resistance to Deterioration by Mineral Oil..	P	E	F	G	E	E
Specific Gravity of Basic Material.....	0.93	1.25	1.35	Ave. Plasticizer Content 1.30	0.98	1.00
Range of Stretchability.....	E	G	F	F	G	G
Resistance to Checking in Sunlight.....	F	E	E	E	F	G
Stability of Properties with Change of Temperature:						
Cold.....	E	F	E	F	G	G
Heat.....	G	E	P	P	E	E

\*Published with the permission of the Institute of the Aeronautical Sciences, Inc.

MAXIMUM TENSILE STRENGTHS AND CORRESPONDING ELONGATIONS\*

	UNVULCANIZED		VULCANIZED PURE-GUM COMPOUND		VULCANIZED CARBON BLACK COMPOUND	
	Tensile Strength, psi.	Elongation per cent	Tensile Strength, psi.	Elongation per cent	Tensile Strength, psi.	Elongation per cent
Natural rubber.....	355	1200	4125	710	5000	650
Buna S.....	.....	.....	.....	.....	4200	650
Perbunan.....	.....	.....	2130	900	5000	600
Chemigum.....	.....	.....	.....	.....	4425	630
Hycar OR.....	.....	.....	.....	.....	3500	450
Neoprene.....	425	1100	4265	820	4125	760
Thiokol A.....	.....	.....	.....	.....	855	370
Vistanex MM.....	285	1000	nonvulcanizable		nonvulcanizable	
Koroseal, 30% plasticizer.....	3840	170	nonvulcanizable		nonvulcanizable	

\*Published by permission of the American Society for Testing Materials.

rials. Since the Buna types will most likely be used extensively for tire treads, the availability of butadiene is obviously the critical factor. This turns our attention to the petroleum industry, where the butadiene and styrene are produced. What is the position of the petroleum industry in this respect? Before answering this question we must ask another—what quantity of rubber do we require per year on this continent for the duration of the war? It is difficult to get reliable data on the point at the present time, but from recent press reports it will require upwards of one million tons per year to supply the demands of the United Nations.

If then we need one million tons of crude rubber per year, is the petroleum industry able to supply the raw materials? The answer is definitely in the affirmative. Few of us realize the tremendous extent of the petroleum industry on this continent. It seems almost incredible, but is true nevertheless, that the United States refines over 200 million tons of crude oil per year, from which is produced 90 million tons of gasoline. The steel industry in the United States, which is generally described as gigantic, has a capacity of only 80 million tons. Dr. Egloff, Director of Universal Oil Products Laboratories, states that the United States petroleum industry could supply raw materials to produce butadiene and styrene at the rate of 85 billion pounds per year—that is, approximately 40 million tons—without lessening production of any of their other products required for peace times or national defence. This completely dwarfs the one million tons of rubber that the United Nations require per year. Even two million tons of rubber would not seriously affect our raw material supply.

The cost of plants to produce one million tons of synthetic rubber per year is a more serious matter than the raw materials but it is by no means hopeless. Rough estimates have been made by reliable people for 400 thousand tons capacity amounting to approximately a half billion dollars. This cost while obviously out of the reach of private enterprise is well within the range of a government expenditure. Apparently neither the availability of raw materials nor the cost of plant need be considered a deterrent to our synthetic rubber programme, but to obtain the equipment necessary to put these plants in operation from our already overburdened equipment industries is entirely another matter. Those of us who are building war plants at the present time know a little of the difficulty of procuring the ordinary mechanical and chemical equipment. What the situation will be like when there is superimposed on the present chaotic condition another billion dollar chemical project, is beyond prediction.

As for production cost, small-scale plants are turning out butadiene for 20c to 25c per lb. and styrene for about the same. The cost of the polymers being produced from these monomers is correspondingly high. When the industry gets into large tonnage production it is reliably estimated that butadiene will be produced for 10c to 15c with the finished rubber at 20c to 25c per lb.—which is comparable with natural rubber at 23c per lb. In Chart VII, taken from Cramer's excellent paper in the February 1942 issue of *Industrial and Engineering Chemistry*, the present prices of several synthetic rubbers are given, and for comparison the prices at which these synthetics must be sold in order to compete with rubber at 23c per lb., are also included.

CHART VII  
SYNTHETIC VS. NATURAL RUBBERS—PRICE COMPARISONS

	August, 1941		Equivalent Price
	Price	Density	
Natural Rubber.....	\$0.23	0.92	\$0.23
Neoprene S.N.....	0.65	1.24	0.17
Buna S.....	0.60	0.96	0.22
Perbunan.....	0.70	0.96	0.22
Thiokol.....	0.45	1.38	0.15
Vistanex.....	0.45	0.90	0.24
Koroseal (30% Plasticizer) ..	0.60	1.33	0.16
Hycar OR.....	0.70	1.00	0.23

Whether or not the synthetics will be able to compete with natural rubber particularly after the war is a question that cannot be answered completely at the present time. Up to the present, manufacturers of rubber goods have regarded the synthetics as supplementary to, rather than competitive with natural rubber. It would seem that this is the most reasonable attitude to take when considering the future of the synthetic rubbers in this country.

The question of present and future synthetic rubber production on this continent can best be answered by referring to Charts VIII and IX reproduced also from Cramer's paper.

CHART VIII  
SYNTHETIC RUBBER PRODUCTION CAPACITY

1939	All types.....	2,500 long tons
1940	" ".....	4,000 " "
1941	" ".....	17,000 " "
1941 Production broken down:		
	Buna types.....	4,000 long tons
	Neoprene.....	6,500 " "
	Thiokol.....	1,500 " "
	Polyvinyl chloride types.....	5,000 " "
TOTAL.....		17,000 long tons

CHART IX

PRESENT AND PROJECTED PRODUCTION OF SYNTHETIC RUBBER IN THE UNITED STATES

(Data in long tons)

	July, 1941	January, 1942	January, 1943
Buna types.....	5,000	10,750	60,000
Neoprene.....	6,500	9,000	19,000
Thiokol.....	1,750	1,750	2,650
Polyvinyl Chloride...	5,000	6,000	18,000
TOTAL.....	18,000	27,500	99,650
Percentage of normal requirements.....	3%	4.6%	16.6%

It is seen from Chart VIII that considerable progress has been made between 1939 and 1941, an increase in production of almost 800 per cent. The projected production for January 1943 of nearly 100,000 tons, representing almost a four-fold increase over January 1942, is another tremendous advance when considered in terms of normal peace time industrial growth. But faced as we are with a complete stoppage of crude rubber imports, this figure of 100,000 tons per year, large as it is, is not at all reassuring. The projected capacity for January 1943 is only 16.6 per cent of our peace time requirements and only 10 per cent of the estimated war time consumption.

However, more encouraging are recent reports that a 400,000-ton project is now under consideration in the United States, and in Canada our own situation is to be improved to the extent of approximately 20,000 tons of synthetic rubber, probably Buna S.

It has been estimated that to complete the 400,000-ton project will require at least three years. This does not mean that no synthetic rubber from this particular project will be available for three years. Super plants will no doubt be erected at strategic locations from the standpoint of raw materials, and after approximately one year has elapsed these plants will come into production one by one depending on local conditions, until the project has been completed. From information available at the present time it appears that the economic plant has a minimum capacity of approximately 25,000 tons per year, but as the engineer will readily appreciate, time and experience may alter this figure considerably.

With strict civilian conservation which is now getting into full force, and with the help of 200,000 to 300,000 tons of reclaim rubber capacity in the United States which can be used in the fabrication of many forms of rubber goods as well as up to 50 per cent in tires, the outlook is reasonably bright for future supplies of rubber, for war purposes and vital industries.

# SUBCONTRACTING IN CANADA'S MUNITION INDUSTRIES

F. L. JECKELL

*Director-General of the Industry and Subcontract Co-ordination Branch of the Department of Munitions and Supply, Ottawa, Ont.*

**An address presented before the Montreal Branch of The Engineering Institute of Canada,  
on February 26th, 1942.**

This is a welcome opportunity to give to engineers an explanation of the work which the Industry and Subcontract Co-ordination Branch performs in aiding Canada's war production. Actually, subcontracting is no new thing in Canada. In its essentials, it has been practised, widely, in the automotive industries.

Before the organization of the I.S.C. Branch by Mr. Howe, several of Canada's war industries were subcontracting large numbers of parts. Methods of administering subcontract departments were, however, of widely varying types, while methods of discovering sources for the manufacture of these parts were equally varied. When the "Bits and Pieces" programme was inaugurated last October, we undertook to co-ordinate subcontracting in Canada's munition industries. Since then we have been through the period of defining our task, breaking it down into workable units and finding the men to do the job.

It is now possible to tell you what the Industry and Subcontract Co-ordination Branch is, what it does and how it can be used. This is essential information for all organizations engaged in the production of war materials because the "Bits and Pieces" programme is now an integral part of our war production system.

The Industry and Subcontract Co-ordination Branch, which for brevity will be referred to as the I.S.C. Branch, is a service organization. It was organized by the Minister of Munitions and Supply to assist the production and purchasing branches of the Department and also all manufacturers. Its purpose is to speed the manufacture of all war materials by obtaining the maximum use of Canada's facilities.

The policy of the I.S.C. Branch is one of help and co-operation, governed by eight guiding principles which are named in the following paragraphs and are all based on the necessity for making as much war material as possible—as soon as possible.

With this main purpose in mind, we undertake to see first that, when efficiency can be maintained, all available machines are put to work before more of the same type are recommended for purchase.

Second, it is important that, when feasible, plants which have been shut down due to war restrictions should be put into war production as rapidly as possible.

Further, whenever possible and advisable, we try to have contracts broken down into sizes to suit the production units available.

Next, whenever possible, shops are recommended for work similar to that to which they are accustomed and for which their machines and tools are adapted.

We also see that good machines with skilled operators under experienced direction are employed before work is given to less efficient organizations.

We keep watch to see that shops are not overloaded when idle capacity is available and we encourage modern and efficient methods of production.

Our last principle, which is not the least important nor the easiest to carry out, is this:

Every possible service must be rendered with the utmost despatch and with a minimum of formality.

If it can be shown that any one in the I.S.C. Branch is violating these principles, prompt action will be taken on the information.

It must be noted, however, that we interpret our ruling

principle ruthlessly and without friendship. We must make as much war material as possible—as soon as possible. Everything else is secondary.

Now a word about our organization. The I.S.C. Branch is organized on a nation-wide scale. The head office is in Ottawa.

District offices are maintained in Saint John, N.B., Montreal, Toronto, Winnipeg and Vancouver. Wherever necessary in highly industrialized areas sub-offices will be set up.

Our Head Office organization in Ottawa co-ordinates the activities of the district offices and it maintains a constant liaison with the Production and Purchasing Branches of the Department of Munitions and Supply and all Government departments.

Through this service we know in advance approximately what is going to be purchased and so we are able to accumulate up-to-date information regarding production facilities about to be required.

Each district office is fully equipped to give complete service. In this part of our organization the engineer plays a leading role.

He interprets blueprints in terms of the machines required to produce the wanted article. When these machines are located field engineers check their condition and availability.

When a subcontractor goes into production one of our engineers often helps to promote efficiency and quality.

So well equipped are these offices that they have produced one very interesting result. It is now unnecessary for manufacturers to travel to Ottawa for the purpose of offering their facilities or to obtain service. All of our services are based on the information which we have at our disposal.

We have in our files complete surveys of practically every machine shop and factory in Canada. This information is classified as to type, grade and location of facilities. The shops themselves as a whole are also graded.

This information has been cross-indexed and we can locate quickly any machine or facility that is available in Canada.

A great deal of this information is constantly being worked over. It is being brought up-to-date by interviews with shop and factory owners and it is also brought up-to-date by "checking" surveys which are made before we make any recommendation to a prime contractor or a Government department.

In fact our files are live files and the more use that is made of them the better they become.

Through experience and reports from prime contractors and Government departments we have also accumulated a great deal of information as to the management and financial condition of these organizations. In the district office nearest you, this information is available and the staff of the district office is at your service at all times. Should you call upon one of our district offices to get some service, you will get that service promptly and the information given you will be reliable. If we cannot supply your demand, we will tell you so promptly.

We do not wish to convey the impression that this is a perfect organization. We make mistakes of course—but we are getting work done. We welcome constructive criticism and sincerely want our mistakes pointed out to us—so that they will not be repeated.

We have spent a great deal of time in investigating the various ways for handling subcontracts by a prime contractor and we have arrived at certain conclusions, which may be of interest to those of you who are responsible for the administration of the affairs of manufacturing companies holding Government prime contracts.

These conclusions have been checked by able and experienced heads of businesses who are themselves skilled in subcontracting.

Here then, are some of the conclusions in question:

First, if the subcontracting effort is to be of any size and importance, it is essential that a separate department be set up to handle subcontracts.

The manager of this department should be on a level in authority with the purchasing department, the planning department and the plant manager, and should be in direct communication with the general management of the company.

This subcontract-manager has a tough job. He not only has to reconcile the differences of interests between the various departments of his own company, but he also has to get production out of a group of small and large shops that vary widely in their conceptions of the ways of doing business. So this man should be one who is not afraid of responsibility and one with plenty of patience. He should have no fear of the unorthodox nor should he be a worrier. He should be diplomatic enough to obtain co-operation from the other department heads. Once you have picked this kind of a man hang the responsibility around his neck and leave him alone to work it out.

One of the problems that he has is maintaining liaison with the I.S.C. Branch but fortunately this has been formalized to such an extent that it is only one of his minor troubles.

Now in the large type of subcontract department, the subcontract manager should have under his direction three supervisors—one in charge of technical operations, one in charge of pricing and the other a follow-up supervisor. The duties of these three men are obvious from their titles.

The technical supervisor should be a top-grade practical production man. He need not be an engineer, but if he is, so much the better. He is the man who is primarily responsible for the selection of subcontractors. This includes the making of shop surveys. He studies tooling requirements, sees that proper jigs and fixtures are made and maintains a record of them. He also reports if the subcontractor needs the odd machine to round out production. Operation and tool records, progress sheets, rejections, raw material changes and quality are all his responsibility.

He must anticipate delays or raw-stock shortages and must prevent the subcontractor from taking more work than he can handle efficiently. He must act as the interpreter between the subcontractor and the subcontract manager. In an expanding operation the technical supervisor may employ shop layout men, machine tool experts, tool designers and jig and fixture designers. The net of all these duties is, that the prime contractor treats the subcontractor as if he were a part of his organization and thus obtains efficient production in outside shops.

In dealing with a large number of manufacturing plants of all sizes, some astonishing variations in cost accounting methods are met with. As one of the problems of subcontracting is obtaining accurate costs, it is easy to see that the task of the pricing supervisor is one requiring a certain amount of ingenuity. Very often he will find that he has to go right to the beginning and establish a simple cost system in the shop itself in order to have an accurate record of the hours.

In large operations he will probably have under his direction other men whose purpose it is to increase the efficiency of the shop from a cost standpoint. These are

such types as time-study men and experts on shop practices. In smaller operations these men can be employed from organizations who specialize in rendering this type of service.

Now we come to the man who keeps the whole thing moving. He is the follow-up supervisor. He has only one job and that is to see that the work is delivered to the prime contractor on time.

When anywhere from fifty to two hundred items are being subcontracted in fifty to a hundred different shops, it is easy to see that this man must be one who can keep his head under pressure, who has infinite patience and one who will not take "No" for an answer. At the same time he should not be a bully.

Two things should be maintained as a guide to the follow-up man and as a check on his operations.

One is a card file on each subcontractor which will carry a history of deliveries made by this subcontractor. This, as it grows, indicates whether the shop is reliable in its deliveries or whether it has to be watched all the time.

The other, and this is most essential, is a big wall chart with every part plotted on it and its exact delivery status and its raw material position shown up prominently. This chart has the effect of keeping the whole subcontracting organization on its toes because, as time goes on, the items that are behind schedule become more and more conspicuous and are harder and harder to explain. This wall chart also enables the subcontract manager to see at a glance how his organization is functioning.

With these three divisions manned by the right type of individuals the subcontract department can handle a large amount of material and do it promptly and efficiently.

The I.S.C. Branch is rapidly establishing its contracts with prime contractors. Naturally, it has its best contracts with those prime contractors whose subcontract departments are functioning in a systematic manner.

Some of the services which the I.S.C. Branch is set up to render are these:

We can provide verified information regarding idle machine capacity of the type desired, if it is available.

We can assist greatly in placing subcontracts. We can assist in organizing subcontract departments. For this purpose we have prepared a manual entitled "Subcontracting in Canada's Munition Industries" which gives the essence of all the results of our investigations about subcontracting methods.

Copies of this manual may be obtained by persons interested, on request through the general secretary of the Institute.

Another service that the branch can give to prime contractors is helping them to avoid placing subcontracts with poorly managed shops. We think that we have discovered most of them. It is of no help to Canada's war effort to let a whole programme bog down on account of one inefficient subcontractor.

We keep in touch with prime contractors on another point and that is the overloading of any subcontractor. Sometimes a subcontractor is a little over-ambitious and takes on subcontracts from several different prime contractors. He soon finds himself in a jam and cannot make deliveries on any of his subcontracts. We are getting records of all subcontracts placed by all prime contractors and so we can watch this situation and notify the subcontract managers concerned if necessary.

It is another of our functions to prevent the placing of subcontracts with shops which have not all of the necessary machinery when there are complete shops available.

On the other hand we examine applications from subcontractors for machines to round out production and make such recommendations as the situation calls for.

Another service that we are very often called upon to

render is to furnish technical assistance in getting subcontractors into production.

These services, naturally, are rendered most effectively when a close liaison is maintained between the subcontract manager of the prime contractor and the nearest district office of the I.S.C. Branch.

Much depends on the degree of reliability of our recommendations of possible subcontractors. Here is what happens.

When you send us a blueprint and state that you want to find a shop that can make some particular part, we first uncover all of the possible sources and check them on the telephone to make sure that they have the time available. Those that appear to be available are then checked in person by a field engineer to make sure that everything is all right.

Then, and only then, do we advise the prime contractor that this is a recommended source for the part he wishes to have made. We do not tell the subcontractor who the prime is.

Another important matter is the responsibility of the branch as regards the purchase of additional machinery, involving what is commonly referred to as capital assistance.

When a manufacturer wishes to increase his production and he decides that he needs additional equipment to execute the programme, he may make an application for capital assistance to the Department. This application is then checked by the I.S.C. Branch to make sure that equipment is not available to do the job.

If the I.S.C. Branch finds that equipment is available that will do this sort of job satisfactorily and efficiently then we recommend that the application be denied and that subcontracting be resorted to in its stead. The reasons for this course are obvious to all.

At this point let me leave the subject of subcontracting for a moment, and draw attention to a situation that is affecting our whole war effort. The point is that Canada has a serious management problem.

Apparently the tremendous expansion of our production machine has not been accompanied by a corresponding expansion in our production brains.

Here is an example of what is happening.

A firm that was doing a nice, comfortable business of about 250,000 dollars a year now has orders on its books running into three to four million dollars. Instead of one shift, the plant is operating three shifts, seven days a week. Four times as many machines are working.

All the problems of management are correspondingly greater, but those in charge have failed to make a bold onslaught on them. Timidity and fear of the unknown have made cowards of the men at the top.

Take the case of a purchasing agent whose job is more than ten times as big as it was in peace time. He has not been able to rise to the responsibility. He is becoming a nervous wreck.

Yet the management of this concern hesitates to put a senior man over him who could handle the job—difficult organization problems would result and reorganization would be troublesome after the war.

In another instance, the works manager's job has increased out of all recognition, but he has risen to the demands of the job magnificently. He has grown as fast as his responsibilities.

Yet the management has hidden behind the wage legislation and refuses to raise his pay. Of course he is not feeling very pleased with this situation.

In this case, it came out that if he were paid a salary comparable with that of other works managers doing similar work, he would be getting more than the general manager. That was regarded as impossible. But there's another firm that places a proper value on him—and he will move.

This is not the spirit that wins wars. We must have courageous management that will go forward. We must eliminate the small men in the big jobs. We must give the doer his day.

Our desperate ills demand a speedy cure. Our time is short and our obligations infinite. Long contemplation of the post-war effect of our actions to-day cannot be tolerated.

We have single-purpose machines and we must have single-purpose management, whose only purpose is to make as much war material as possible as soon as possible. Must Canada have long casualty lists before we wake up?

This management problem is brought before you in the hope of receiving some assistance in the matter from the influence of your organization.

Are these good men at the top of many medium sized organizations to be crushed in health and in spirit by this great machine that war has raised up, or is there a way to educate them, give them courage and a place in the great plan?

There are dozens of ways in which the I.S.C. Branch can serve industry in this time of stress and strain. Speaking not as an engineer but as a business man who has spent a great deal of time studying the subcontract method of increasing production, I have tried to give you some of the background of our operations and to leave you with the feeling that the entire I.S.C. organization is devoted to anything that will accomplish our purpose, which is to get more production as quickly as possible.

---

## INDUSTRY AND SUB-CONTRACT CO-ORDINATION BRANCH DEPARTMENT OF MUNITIONS AND SUPPLY

385 Wellington Street, Ottawa, Ont.

Director-General . . . . . F. L. JEKELL  
Associate Director-General . . . . . DRUMMOND GILES  
Montreal Office, 625 Dominion Square  
Building . . . . . RAYMOND A. ROBIC  
Toronto Office, 34 Adelaide Street West . . . B. T. RIORDON  
Winnipeg Office, 310 Electric Railway Chambers . R. A. PYNE  
Vancouver Office, Marine Building . . . . . W. C. BLUNDELL  
Saint John, N.B., Office, Trade Building . . . . W. F. KNOLL

---

# THE LIONS' GATE BRIDGE—II\*

S. R. BANKS, M.E.I.C.

General Engineering Department, Aluminum Company of Canada, Limited, Montreal, Que.  
Formerly with Messrs. Monsarrat and Pratley, Consulting Engineers, Montreal, Que.

This paper was awarded the Gzowski Medal of the Institute for 1941

## SUPERSTRUCTURE: DESIGN AND FABRICATION

### CLEARANCES, GRADIENTS AND ELEVATIONS

The terms of the Order-in-Council prescribed 200 ft. of clearance over a central fairway of 200 ft. (Fig. 22). Computations, continually revised as the design progressed, established the maximum central-span deflection as 8.14 ft. (to which the temperature-contribution is approximately 2.25 ft.), and the corresponding figure for the critical points 100 ft. from the centre at 8 ft. The final roadway-elevation at span-centre was derived as follows:

Elevation of highest tides . . . . .	97.77
Stipulated clearance . . . . .	200.00
Calculated maximum deflection (at 100' from span-centre) . . . . .	8.00
Vertical distance from crown of roadway to bottom of lowest rivet-head . . . . .	4.34
Rise of roadway in 100 ft. from critical point to span-centre (based on final profile) . . . . .	1.98
	<hr/>
	312.09
Arbitrary allowance for contingencies . . . . .	2.91
	<hr/>
Elevation of crown of road at centreline . . . . .	315.00

The level of the roadway at the outer ends of the suspension-bridge, while not susceptible of equally precise determination, was nevertheless set within narrow limits by the conditions obtaining at these points, and by the symmetry of the two side-spans. At the south end of the bridge, limits were imposed by the restricted choice of a suitable anchorage-site, while at the north end of the bridge, the viaduct-grade was the ruling consideration. The elevation finally chosen, as a satisfactory compromise between the several requirements, was 262.00, applying to the crown of road at the two points that are located 614 ft. shoreward of the main towers.

For the general profile of a suspension-bridge, the usual procedure is to provide a constant side-span gradient, with a parabolic transition across the central span. In the present case, however, it was decided to provide a camber in the side-spans, sufficient to prevent the occurrence of unsightly sag in warm weather; and therefore a single continuous curve was employed over the entire extent of the suspended roadway. The requirements to be met by such a curve were; that it should have the above definite elevations at points 100 ft. and 1,389 ft. from the highest point (at bridge-centre); that its tangent should be horizontal at mid-span; and, finally, that its maximum slope should present a reasonable roadway-gradient.

That maximum slope was based on the arbitrary selection of five per cent for the ruling gradient under any ordinary conditions. The general effect of uniform live loading is a reduction in gradients, but such reduction, amounting to about one per cent, is evidently not significant. Under conditions of non-uniform loading, however, (as, for example, when the central span and one side-span are loaded, the other side-span being empty; or when the central span is loaded over half its length only), local upward deflections may take place, causing increases of gradient; but the occurrence of such loadings in any appreciable magnitude is extremely unlikely, and in any case the adverse effects are of a transitory nature. Further, those effects are much

more pronounced in the central span (in which the cable-polygon is comparatively sensitive to load-variations) than in the stiffer side-spans (where the cable-curvature is slight); whereas it is in the latter, where the normal gradient is steepest, that they have the greater significance. For the above reasons, the effects of live-loading were neglected.

Temperature-variations, on the other hand, set up definite changes in the geometry of the structure. Deflections from this cause are, similarly to those due to live-loading, greatest in the central span, but are only of significance in conjunction with the steeper gradients in the side-spans. The deflection of the side-span at the specified extremes of temperature is plus or minus 0.26 ft., and the corresponding change of end-gradient amounts to approximately 0.2 per cent. The maximum normal roadway-gradient, occurring at the shoreward end of the side-spans, was consequently established at 4.8 per cent, thus giving the final requirement for the profile-curve.

In the search for a continuous curve that would meet the said requirements it was found that none of the conic sections was adaptable to the purpose. The semicubical parabola came more nearly to meeting the case, and this fact led to the adoption of a modified parabola possessing the formula  $y = 0.00625x^{1.25}$ . This curve has its origin at the centre-line of the bridge, and yields a maximum slope of 4.79 per cent at the ends of the side-spans. The camber in the side-spans amounts to approximately six inches, and their resulting appearance is good. In the case of the central span (with a camber, incidentally, of 25.6 ft.), the appearance of the profile in general is also satisfactory, though a foreshortened view of the rapidly-changing gradient near the bridge-centre gives the effect of rather too rapid a transition in that vicinity (Fig. 11). The phenomenon, however, is not apparent from points of broader view.

In the case of the north viaduct, the necessity for an adequate stretch of level roadway at the toll-collection plaza, together with that for bringing the roadway to the desired height at the end of the suspension structure, dictated that the maximum permissible gradient should be employed. The gradient was therefore set, with due deference to considerations of detail, at 4.836 per cent over the whole viaduct.

The roadway-profile having thus been settled, that of the cables was established therefrom. The relation of span to sag for the central span is a more-or-less arbitrary quantity that may vary considerably without serious effects upon either economy or appearance. A sag of 150 ft. was adopted in the present instance, and the consequent ratio of 10.33 is in accord with the modern trend towards securing additional vertical and lateral stiffness by exceeding the commonly-accepted ratio of 10.

Depending on the cable-diameter, on the shortest practicable length of a suspender-rope, and on the depth of truss and floor beam, the elevation of the centre-line of the cable at the mid-point of the central span was established at 331.5 ft. above datum; and the elevation of the intersection of cable-tangents at the main saddle became accordingly 481.5. The top of the tower was then fixed (at elevation 478.0) in accordance with the height of the saddle-assembly.

The elevation of the cable-intersection at the north cable-bent, also established at the lowest practicable level, is 276.0, and that at the saddles of the cable-posts at the south end is 272.0, the latter figure deriving from the former in order to preserve symmetry in the suspender-lengths of

\*Part I of this paper, dealing with the substructure, appeared in the April issue of the *Journal*.



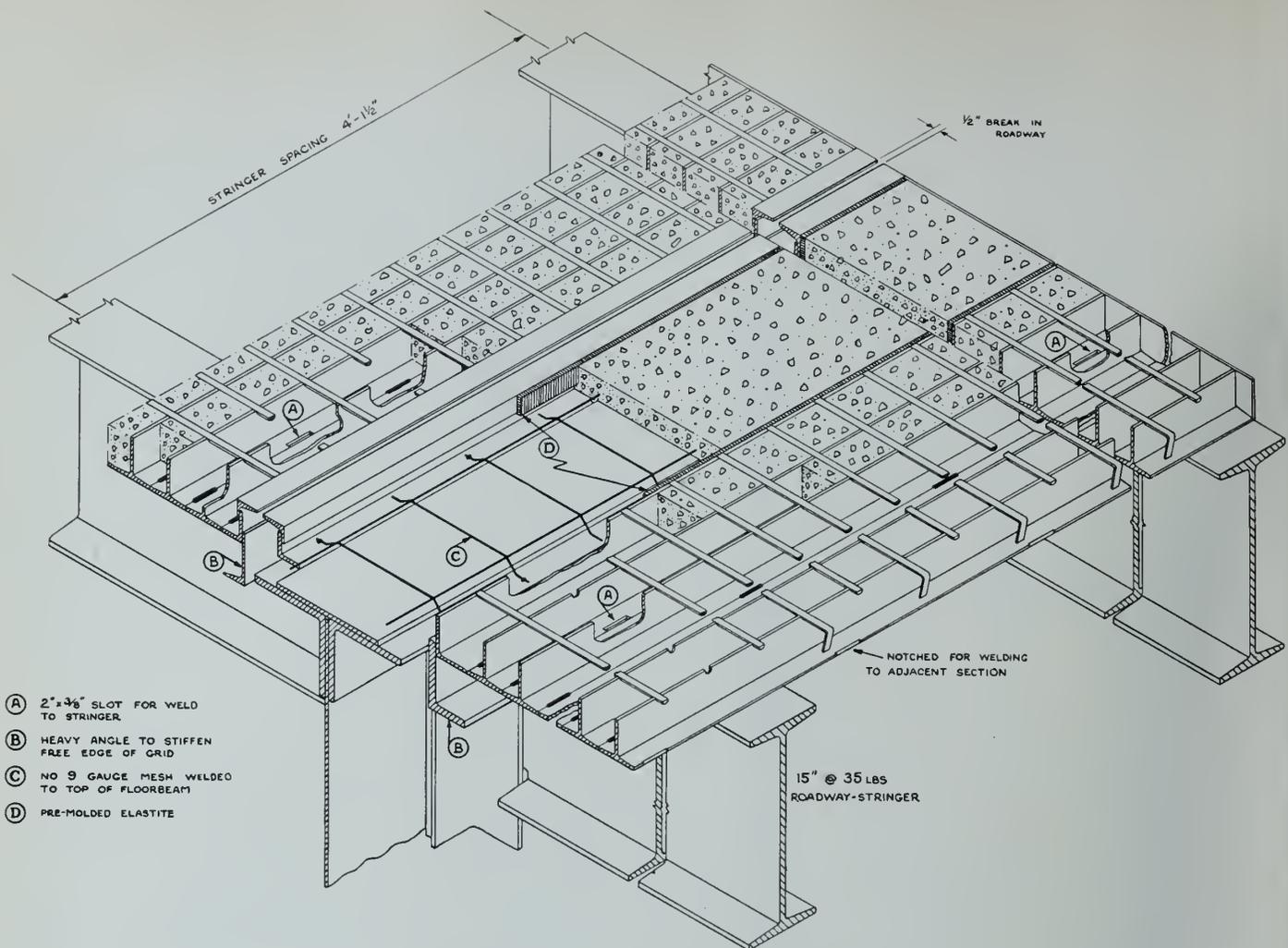


Fig. 23—Isometric view of Teegrid slab.

medium-carbon steel (C.E.S.A. S-40) with a copper-content of 0.25 to 0.30 per cent.

The grid-sections (weighing 2,000 to 2,600 lb. each) lie athwart the roadway and rest directly on the stringers, each section being welded in three places to each stringer and, at 16½-in. intervals, to the contiguous sections. The cross-bars are not continuous at the junctions of the sections, but alternate ones are bent down as indicated in the figure. The weight of the Teegrid slab after receiving its concrete filling is 52 lb. per sq. ft., whereas that of an ordinary concrete deck would be 80 to 90 lb. A valuable incidental advantage of the Teegrid slab is that the grids, before concreting, are capable of supporting considerable traffic-loads without damage, so that a roadway suitable for the passage of erection-equipment becomes available as soon as the steel sections are in place, and prior even to their welding to the stringers. Another advantage is that, since the grid itself acts as a container for the fresh concrete, a good deal of what might well be hazardous work in the placement and removal of forms is avoided.

As shown in Figs. 23 and 24, the Teegrid is not continuous over the floorbeams, the top flanges of which are ½ in. above the stringers. The pavement of the floorbeams consists of a 2⅞-in. depth of concrete, reinforced by steel mesh welded to the flange. To avoid cracking of this slab at its junction with the adjoining grids it is separated therefrom by a ⅜-in. pre-moulded filler ("Givantake") cemented to the grid before pouring the concrete. The figure also shows the arrangement whereby (at intervals of approximately 97 ft.) the continuity of the deck is deliberately broken to prevent its participation in the action of the stiffening-trusses to the detriment of the latter. Such breaks occur at every sixth floorbeam, and the stringers

at those points are provided with sliding-connections.

The sidewalk is constructed of a similar slab, known as "Anglgrid," the steelwork of which consists of a series of ¼-in. angles, 1½ in. deep, welded together in the same fashion as the tees of the roadway-grids, and similarly reinforced (but at 6-in. intervals) with half-round bars. It was fabricated in sections 4 ft. wide and 16 ft. 1½ in. long, one section (weighing approximately 600 lb.) thus providing the sidewalk between two adjacent floorbeams. The sidewalk-grids are field-welded to transverse tees located immediately over, and midway between, the floorbeams. These tees are carried on brackets riveted to the outer stringer of the roadway and to an 8-inch sidewalk-beam which rests on pedestals riveted to the floorbeams. The continuity of the sidewalk-slabs is, like that of the roadway-slab, interrupted at intervals.

The fabrication of the grid-sections was successfully accomplished in the Dominion Bridge Company's structural-steel shops in Vancouver, the chief problem encountered being the selection of welding-rods best adapted for use in the confined spaces presented by the grid-assembly. The tee-grid-sections were built without camber, and were sufficiently flexible to bed down to the camber of the roadway. The Anglgrid-sections were found to warp during welding, but were satisfactorily straightened in the plate-rolls. Slight variations (within the rolling-tolerance) in the depths of the tees and angles were accommodated by punching the half-round holes with reference to the back of the section.

#### FLOOR-SYSTEM AND ROADWAY

The floorbeam-and-stringer system on which the deck rests is, in the main, of conventional construction, as may be seen from the typical cross-section shown in Fig. 25.

The floorbeams, spaced 16 ft. 1½ in. apart, are hog-backed to suit the camber of the roadway: and, for the same reason, the 15-in. I-beam stringers, which frame into the floorbeams immediately below the top flange-angles, are variously inclined to the vertical. The floorbeams are necessarily normal to the changing roadway-grade, and their end-connections accordingly make varying angles with the truss-verticals into which they frame. The end-connections are designed to resist distortion of the bridge cross-section due to unequal loading of the two sides of the deck. End-moment stress of the bottom flange is transferred to the truss-chord (and thence to the vertical) through a horizontal tie-plate, and the complementary top-flange stress passes through a vertical gusset into a welded insert in the truss-vertical.

The 29-ft. roadway, having a 3-in. elliptical camber (giving a four per cent drainage-slope at the gutter), is bounded by steel kerbs, 10 inches high, and the sidewalks have a drainage towards the kerb of one in. in their 4-ft. width. The kerb, consisting of a tee made by halving a 15-in. British standard beam, derives its support from the same brackets that carry the sidewalk cross-tees. The 6-in. back of the tee slopes away from the side-walk at an inclination of one in five and its upper edge forms the boundary of the sidewalk-slab. The 4-in. space between the roadway-surface and the lower edge of the tee performs the function of a continuous open scupper, simplifying cleaning and drainage of the roadway and obviating any need for catch-basins (see Fig. 24). The kerb-tees are discontinuous at every sixth floorbeam.



Fig. 24—Grid deck before concreting.

Owing to the proximity of the comparatively heavy and continuous steel-work of the trusses (which, together with the high kerb, presents an effective obstacle to prevent a vehicle from falling overboard), there is no necessity for heavy fences. The fence (Fig. 28) consists of galvanized 2-in. diamond wire-mesh of No. 6 gauge. The mesh for each 16-ft. panel of fence is woven onto a frame of 1½-in. channels and is bounded top and bottom by 1½-in. pipe, to which the longitudinal channels are bolted. The height of the top rail above the sidewalk is 3 ft. 8 in., the fence proper having a depth of 3 ft. 4 in. The fence is supported by welding the pipe-rails to angle-posts which themselves are welded to the trusses. The end-channels of adjoining fence-panels are connected with galvanized bolts. The weight of each fence, including posts and brackets, is approximately 17 lb. per ft.

The steelwork of the suspension-bridge deck was fabricated in Vancouver. All the stringers, together with a number of floorbeams, were fabricated by Western Bridge Company, while the majority of the floorbeams, together with the sidewalk-supports, kerbs, and fence-posts, were made by Dominion Bridge Company.

#### STIFFENING-TRUSSES: DESIGN

The function of the stiffening-trusses is to distribute local live-loading amongst all the suspender-ropes, so maintaining the parabolic shape of the cable, and eliminating uneven roadway-gradients such as would occur if the cable were the sole restraining influence. In comparison with that of the loaded cable, however, the stiffness of the long truss is comparatively small, and deflections in general are but little affected by its presence. The stiffening-trusses are thus of hardly any assistance as load-carrying members (the cables taking something more than 95 per cent of live-loads) except insofar as they span between adjacent suspenders. Chord-stresses are thus to all intents and purposes directly related to the moment of inertia of the truss, and it would seem that the optimum truss-depth is therefore the minimum consistent with efficacious control of deflections. On the other hand, however, it is increasingly apparent (and particularly since the lamentable failure of

Tacoma Bridge) that the use of an unduly light and limber truss is likely to be attended by dangerous oscillations of the structure. In the present state of knowledge there is no clear ruling for establishing truss-depth, and the engineer is perforce guided by past experience, the trends of current practice, and by the circumstances of the project in hand.

In the present case, an examination of the span-depth ratios of various existing bridges led to the selection of a depth of 18 ft. between chord-centres

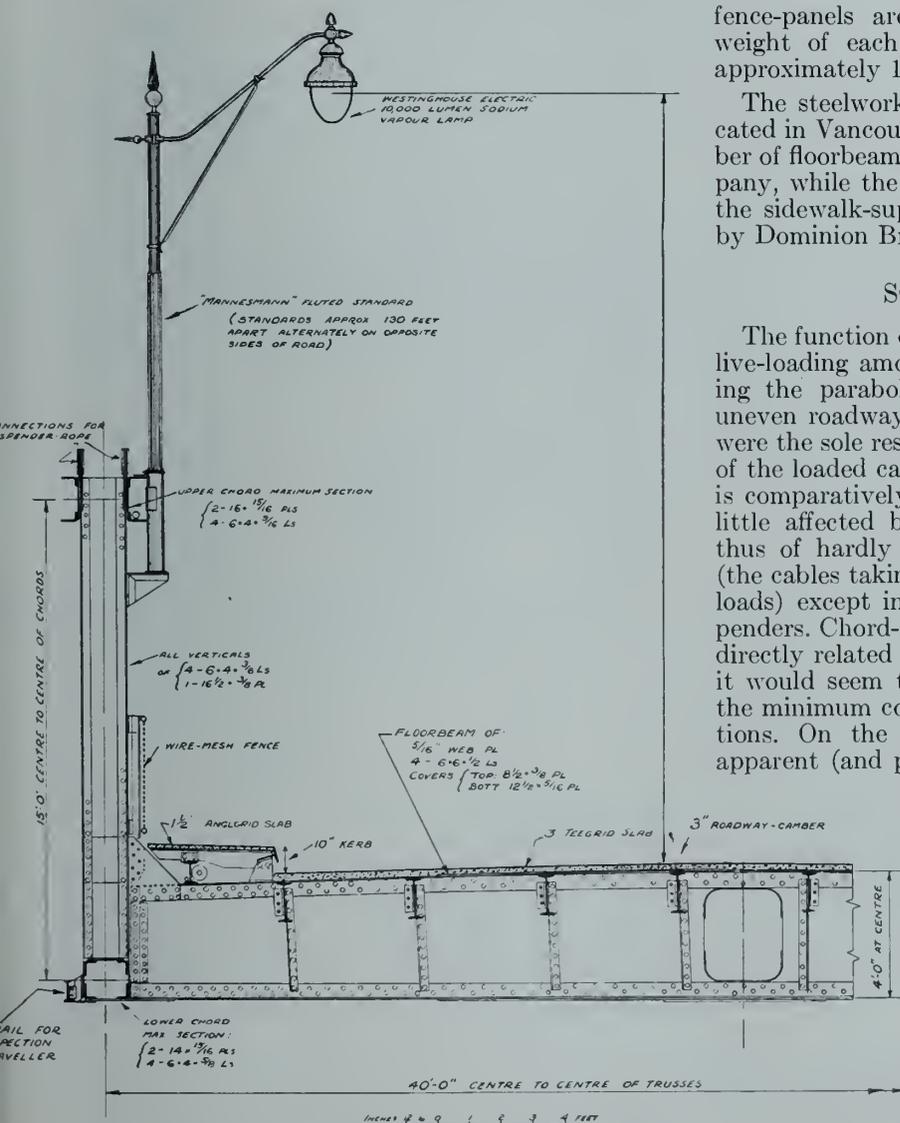


Fig. 25—Typical cross-section of suspended spans.

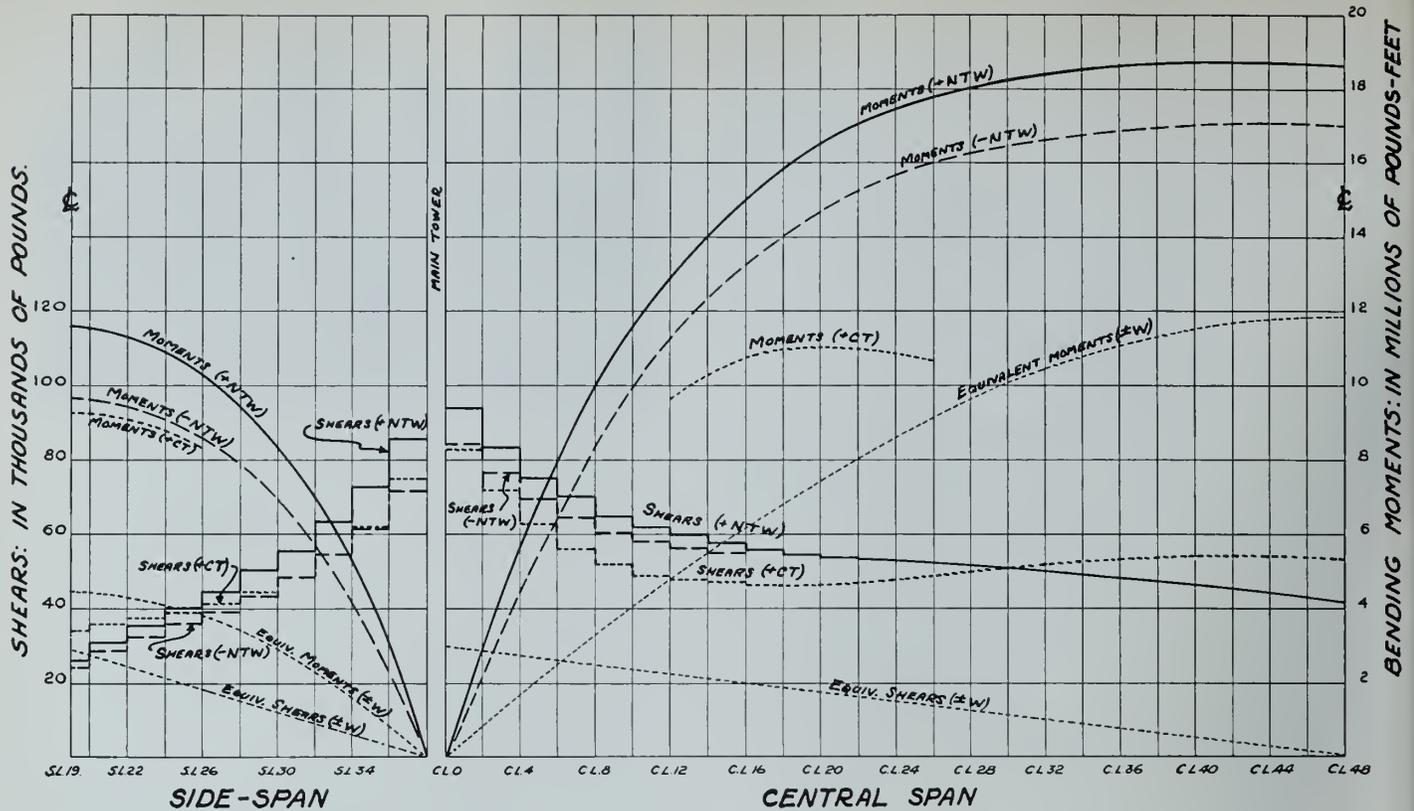


Fig. 26—Bending-moments and shears in stiffening-trusses.

as a preliminary figure, the span contemplated at that time being 1,500 ft. The depth was subsequently reduced to 16 ft.; and ultimately a depth of 15 ft. was adopted, for the 1550-ft. span.

Contributing to this decision were studies of panel-length, suspender-spacing, and of overall-sizes and weights for shipment and erection. The spacings chosen are seen in the general diagram of Fig. 22, the panel-length being 16 ft. 1½ in. (varied slightly in the special cases of the end-panels), and suspenders being located at alternate panel-points. The web-system is of the Warren type, with a vertical member at each panel-point, the diagonals being sloped at approximately 45 deg. The trusses are two-hinged, but for aesthetic reasons the physical discontinuity at the towers has been largely concealed by the extension of the upper chords as far as the ends of the trusses. The trusses, 40 ft. apart, hang in the planes of the cables, and lateral X-bracing is provided between the lower chords.

With regard to stress-computations, theories have been advanced for direct solutions by approximate methods,\* but it is by no means certain that accurate results are available any more swiftly thereby. While an approximate method is of great value in setting up initial assumptions, the author believes that the continued use of the "deflection" theory thence onwards until accord is reached between assumption and result, is the most satisfactory routine to follow. This latter procedure was employed in the present instance, use being made of Mr. L. S. Moisseiff's stress-analysis. Maximum bending-moments and shears were evaluated (involving the theoretically-worst distributions, in any pattern of discontinuity, of the specified live-loadings), at frequent intervals throughout the spans; and curves of the maxima were prepared (see Fig. 26) for the governing conditions of loading. The usual assumptions, of uniform dead-loading and of an equivalent mean truss moment of inertia, were made.

In dealing with resistance to lateral loads, the participation of the upper chords was recognized, and wind-

pressures were translated into equivalent vertical loads in the trusses. Furthermore, in the case of the central span, the lateral wind-unit of 380 lb. per linear ft. (together with an assumed unit of 36 lb. per ft. on the cables) was divided between trusses and cables by use of the ingenious method of Messrs. Moisseiff and Lienhard\*\*, the resulting lateral load on the trusses amounting to 210 lb. per linear ft. For the side-spans such a distribution is not operative, and the full lateral load of 500 lb. per linear ft. was applied to the trusses.

The following are the properties of the interacting truss-and-cable system that finally emerged from the design-calculations:

Truss-depth.....	15'-0" c. to c. chords
Cable-area.....	71.1 sq. in.
Total dead load—central span.....	2,300 lb. per lin. ft.
Total dead load—side-span.....	2,104 lb. per lin. ft.
Truss M.I. —central span.....	5,250 in <sup>2</sup> ft <sup>2</sup>
Truss M.I. —side-span.....	2,900 in <sup>2</sup> ft <sup>2</sup>
Lateral M.I. —central span.....	83,000 in <sup>2</sup> ft <sup>2</sup>

From the following tabulation it will be seen that the actual weights of the suspended structure exceeded those

Item	Total weight (kips) suspended from one cable	
	Estimated	Actual
Cable, wrapping, fillers.....	788.88	783.866
Cable-bands, bolts.....	46.36	47.186
Suspenders, Sockets, rungs.....	86.74	84.018
Trusses, laterals, all field rivets..	1,495.86	1,477.862
Floorbeams.....	567.92	590.272
Stringers, kerbs, sidewalk-supports, fences, traveller-rails....	589.52	615.386
Deck-slab (grids and concrete)...	2,306.22	2,330.112
Electrical and water services, lamp-standards.....	61.16	51.450
Paint.....	12.56	included in other items
<b>TOTAL.....</b>	<b>5,955.22</b>	<b>5,980.152</b>

\*Preliminary Design of Suspension Bridges: Hardesty and Wessmann. Trans. Am. Soc. C. E. Vol. 104: Discussion.

\*\*Volume 98. Trans. Am. Soc. C. E.



estimated by 0.40 per cent. In determining the geometry of the cable-polygon, loads were computed separately for each suspender, and the range of error in these individual weights was from  $-0.32$  per cent to as much as  $+1.17$  per cent.

The subsequent addition of four observation-platforms and of the signal-station (the weights of which were not anticipated in the estimated figures), however, increased the dead load in several of the suspenders. That of the central suspender (the most severely affected) became 14 per cent in excess of the design-load; but, as will be seen



Fig. 28—Arrangement of observation-platform.

by reference to Part III, the safety-factor was not appreciably reduced. Correspondingly the general overrun of total suspended dead load increased by 1.13 per cent, but, in view of the ample provision for live load, it was not necessary to make any changes.

#### STIFFENING-TRUSSES: WORKING-STRESSES

Comparatively high unit-stresses are permissible in the stiffening-trusses. The reason for this is two-fold. In the first case, each member is designed to resist forces that are set up by the most severe arrangement of live-loading possible for the member in question. It is highly improbable that such peculiar patterns of live loading will ever obtain, while the possibility of their occurrence in conjunction with high wind and extreme temperature may be discounted altogether. Secondly, as has already been pointed out, the trusses are not primary supporting-structures, and truss-members could sustain relatively severe damage without jeopardising the safety of the roadway.

The trusses are built of medium-carbon steel, and the basic unit-stresses adopted were as follow:

Tension: 20,000 lb. per sq. in.

Compression:  $\frac{20}{18} (18,000 - 60 \frac{L}{r})$  lb. per sq. in. (maximum 16,200).

In proportioning the chord-members, these units were used for stresses due to D or W alone. They were increased in the ratio 25/20 for cases DW or DNT, and in the ratio 30/20 for DCT or DNWT. For the upper chord, the compressive units were arbitrarily reduced by 2,000 lb. per sq. in. For vertical members, the basic units were specified for all cases not involving W, and were increased in the ratio 25/20 when effects due to W were involved. The same increased units were employed for all cases of loading in the truss-diagonals. The basic shear-unit for shop rivets was 13,500 lb. per sq. in., and, for field rivets, 12,000 lb. per sq. in.; and these were increased respectively to 15,000, 17,000 and to 13,000, 14,000 in accordance with the tensile and compressive units. Rivets were manufactured to comply with C.E.S.A. specification S-42.

#### STIFFENING-TRUSSES: DETAIL

Typical details of the trusses are given in Figs. 25 and 27. The chords each consist of two vertical web-plates and four flange-angles with horizontal legs turned outwards

in the case of the upper chord and inwards in the lower. Double lacing is used for the upper chord; but for the narrower lower chord, single-lacing becomes obligatory and, for the heavier sections, wider bars with two-rivet connections are necessary. The 16½-in. width of the truss was determined mainly by the exigencies of the suspender-connection.

All vertical members of the trusses are truly vertical under "normal" conditions, and are of the same built-up H-section throughout. The governing loading occurs in the case of the hanger-vertical, and this member, as well as being designed for the maximum direct tension from the suspender, is calculated to withstand bending-stresses from the floorbeam-connection and also to provide lateral stiffness for the upper chord in addition to that deriving from the suspender-pull. Connection of the truss to the suspender is made directly to the hanger-vertical, as shown in Fig. 43.

The diagonals, except for the end-posts (which are of double-channel section for stiffness and for connection to the chords), consist of two angles the backs of which are braced together with batten-plates and the toes with light welded angles. These members, receiving stress from live-load, temperature, wind, and from local loadings between suspenders, are of varying cross-section, becoming lighter towards the centres of the spans. Lateral-bracing members, apart from those in the end panels, consist each of a pair of angles with the shorter legs downstanding and riveted in contact. Connection to the trusses is made through gusset-plates riveted to the undersides of the lower chords. Gussets at the intersections of the braces are riveted to the bottoms of the floorbeams, and additional support is given to each member by a 7/8-in. rod-hanger which hangs from the lower flange of the appropriate roadway-stringer. Studies indicated that greater economy of material was effected by such a tension-system than by one of K-bracing.

The lateral system terminates, at either end of each of the three suspended spans, with two heavier latticed-channel members (designed for compression as well as tension), through which the whole wind-reaction is delivered into a suitable "nose" detail.



Fig. 29—Signal-station: Steel structure.

The trusses and bracing are riveted with 7/8-in. rivets. The C.E.S.A. highway-bridge specification was referred to for workmanship and detail.

#### STIFFENING-TRUSSES: FABRICATION

In order to achieve the anticipated balance of interdependence between cables and trusses wherein the latter are unstressed under dead load at normal temperature, it is essential that the field-geometry of the structure shall conform closely to the theoretical dimensions. The lengths of cables and suspenders were obtained very accurately, and every effort was made to attain equal precision in the profile of the long trusses.

The contractor made complete detail drawings of the trusses from the end of the side-span to the middle of the

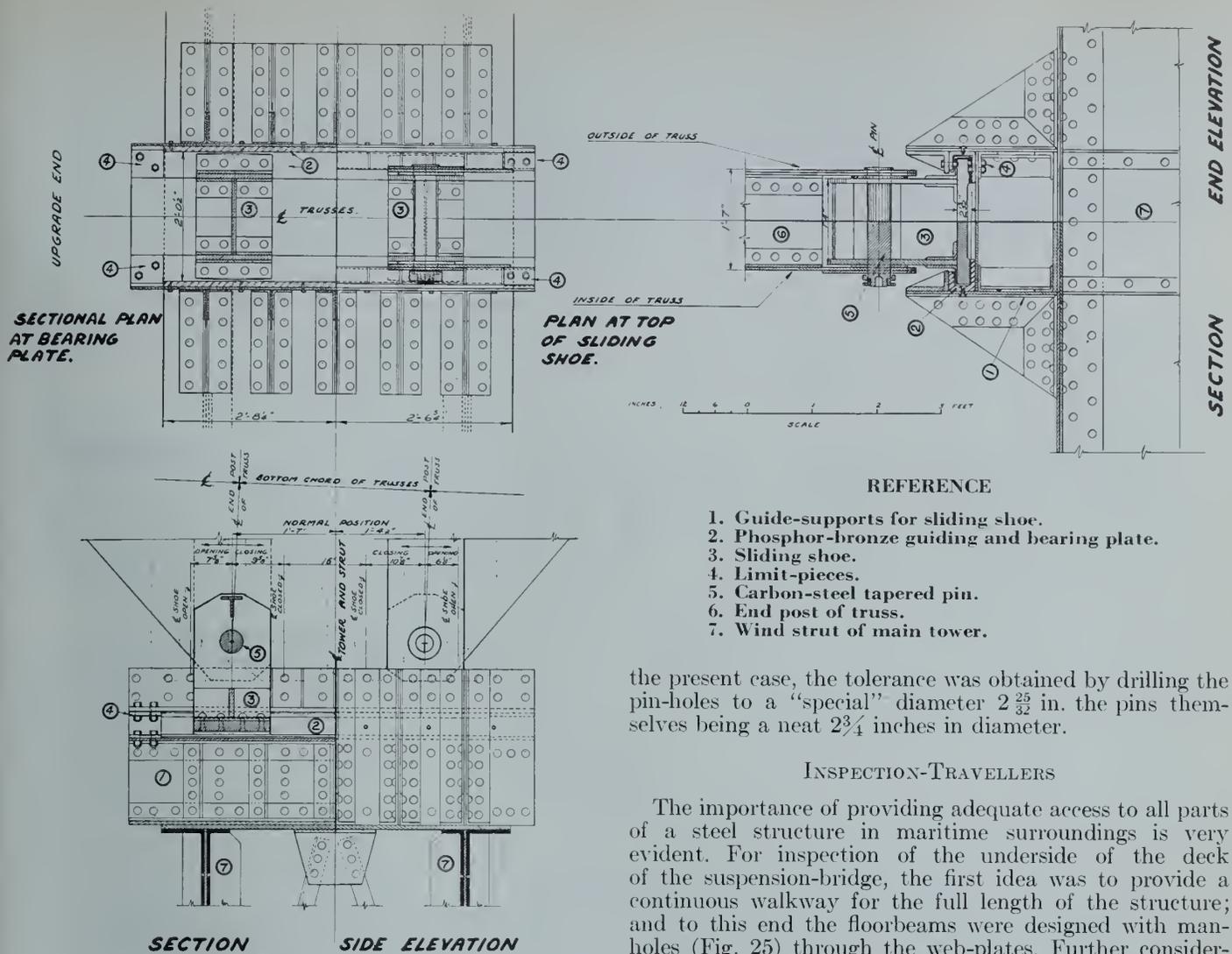


Fig. 30—Sliding shoes at main towers.

central span, and each section was fabricated individually. On account of the constantly-changing gradient of the suspended structure, the only repetitive details were those of the vertical members. The engineers required accurate facing of the ends of chord-members at all splices, and the varying angles of these members necessitated extremely precise workmanship. As an instance, the bevel to which one of the lower-chord splicing-faces was successfully machined is stated on the detail drawing to be  $\frac{9}{32}$ -in. in 4 ft.

The trusses were fabricated in sections of approximately 48 ft. in overall length, each shipping-piece comprising two adjacent vertical members, two diagonals, and two panels of each chord. Upper chord splices were made midway between suspenders, the faced ends of the material being at the panel-point. The lower chord splices were made a little to one side of the alternate panel-points, so that adjoining sections might be bolted together in the field without complicating the subsequent connection of the floorbeam.

The trusses were built in the Burnaby plant of the Dominion Bridge Company. They were shop-assembled, four at a time, and bevels and dimensions were checked before reaming or riveting took place. The main production-problem encountered was that of so ordering the sequence of fabrication of the 170 pieces as to anticipate the shipment-programme and to avoid as far as possible any unproductive sorting in the yards.

A recommendation made by the fabricating-shop was that pin-holes (for suspender-lugs) should be made to suit a standard drill, since it is simpler to allow for the necessary fitting-tolerance in the diameter of the machined pin. In

the present case, the tolerance was obtained by drilling the pin-holes to a "special" diameter  $2\frac{25}{32}$  in. the pins themselves being a neat  $2\frac{3}{4}$  inches in diameter.

#### INSPECTION-TRAVELLERS

The importance of providing adequate access to all parts of a steel structure in maritime surroundings is very evident. For inspection of the underside of the deck of the suspension-bridge, the first idea was to provide a continuous walkway for the full length of the structure; and to this end the floorbeams were designed with man-holes (Fig. 25) through the web-plates. Further consideration, however, led to the adoption of movable underslung platforms, giving convenient and safe access to all underneath parts. The three travellers each consist of two light welded trusses, spanning the full width of the bridge. The trusses are braced apart by 4-in. cross-channels welded under the lower chords, the channels functioning also as supports for a plate platform, 4 ft. wide. The top angles of the trusses (which are 3 ft. 6 in. deep) constitute handrails for the walkway, while the truss-webs form protective fencing. At each end is a widening of the platform (to 7 ft. 6 in.), from which a crank can be operated for moving the traveller by hand. The cranks at the two ends of the traveller operate on a full-length shaft, from which the manpower is transmitted at each end by a chain-gear to one of the wheels. The two wheels at each end are spaced 6 ft. apart and, double-flanged, run on the flange of a standard 7-in. I-beam which is supported from the lower chord of the truss at every panel-point. The travellers are equipped with hand-brakes, and there are safety-bolts which lock into holes punched at 4-ft. intervals in the webs of the rail-beams. The primary purpose of these travellers is for regular maintenance of the bridge, but they were found invaluable during construction for work that otherwise would have necessitated the use of elaborate scaffolding. Each traveller weighs approximately  $4\frac{1}{2}$  tons.

#### OBSERVATION-PLATFORMS

At the instance of the owners, four observation-platforms for the use of pedestrians were incorporated into the structure of the central span. These are steel structures, sustained, at sidewalk-level, on cantilever-brackets outside the trusses. Each is about 6 ft. wide and 32 ft. long, extending between panel-points 2 and 4 (i.e., about 30 ft. from the

main tower in each case), and commands an extensive view of the surrounding scenery. The platforms are floored with chequered plating and are protected by stout fences 4 ft. 6 in. high. Uninterrupted access is obtained from the sidewalk, two openings in the fence (Fig. 28) being provided for each platform. Fixed steel benches are also furnished.

The signal-bridge and the observation-platforms were fabricated in Vancouver by Western Bridge Company and Dominion Bridge Company respectively.

#### SIGNAL STATION

In accordance with a stipulation of the Federal Government, provision was made for the replacement of the marine signal-station on Prospect Point by a new structure situated at the middle of the bridge. This new station was put into operation on January 15th, 1939, and its location affords a considerably more extensive view both seawards and into the harbour.

The steel structure consists of a light cross-bridge over the roadway at span-centre, giving a 20-ft. clearance over the roadway-crown. The  $\frac{1}{4}$ -in. chequer-plate deck of the "signal-bridge" is supported on 5-in. channels (spaced 2 ft. 9 in. apart) which in turn are carried on two light welded trusses, 10 ft. apart and of such depth (4 ft. 6 in.) as to permit of their functioning as handrails. The trusses are supported by framework built onto the stiffening trusses, and the signal-bridge deck, with an overall length of 48 ft., is cantilevered out at either end, where suitable railing is provided. A steel stairway connects the east end of the signal-bridge with a small platform at sidewalk-level, access to that platform being given by a gate in the fence.

The signal-bridge carries two cabins (9 by 8 ft. in plan, and 8 ft. high), one near either end (Fig. 29), and a 36-ft. steel mast with 10½-ft. cross-arms is set in the middle of the deck. The cabins are of welded construction, with walls of No. 12 gauge steel plate lined with 5-ply wood veneer. The ceilings are finished with "Masonite" and the floors are of oak. Generous window-space is provided. The western cabin serves as office and control-room, and the eastern contains batteries, machinery, meters and switch-gear, storage-space, and toilet accommodation, the soil-pipe from the latter discharging directly over the water. Water is provided by an insulated copper pipe from the south bridge-head.

Ancillary to the signal-station (but not comprising part of the main contracts as administered by the engineers) is a cottage-dwelling built near the south anchorage, for the resident personnel.

#### PROVISIONS FOR EXPANSION

In the case of the main suspension-system, thermal and elastic variations in the lengths of the cables are self-accommodating. The cables are free to adjust themselves by alterations in sag, and the cable-saddles are also to all intents and purposes free to move within the limited ranges involved.

Provision is essential, however, to cater for changes in the long horizontal length of the truss-and-deck system of each span, and for angular end-movements both lateral and vertical.

The linear movements are provided for at the points where the trusses take their end-bearing on the two towers, the outer ends of the side-spans being "fixed." This arrangement, although it has the disadvantage of concentrating the expansion-movement of the whole 2,778 ft. of structure at only two points, was resorted to in order to avoid the effects of flexure on the shorter suspender-ropes and rather to make use of the freer support of the very long ropes in the vicinity of the towers.

The other movements, caused by lateral or vertical deflections, demand articulation of the suspended structure at each end of each span. The lateral-bracing system in all cases terminates in a central intersection at which the

reaction is delivered. At the shoreward end of the south side-span this intersection is connected by a vertical pin to a wind-anchorage secured into the front face of the pedestal; and, in the case of the north side-span, to the cable-bent. Thus at these two shoreward ends of the bridge the trusses are fixed in regard to longitudinal movements (excepting those due to deflections of the cable-bent) but are free to deflect laterally by rotation of their ends about the wind-pins. The accompanying small to-and-fro movements of the truss-ends are accommodated by sliding details, the trusses bearing on horizontal pins that permit of angular movement due to vertical deflections but which restrict vertical movements to the small clearance needed for sliding. Expansion-details at the south end of the bridge are shown in Fig. 27, while those at the north end are discussed in connection with the cable-bent (p. 296).

At the towers, provision is made for similar movements, and, in addition, for longitudinal expansion of the suspended spans. The wind-reaction of each truss is delivered through a sliding "nose" (riveted to the end floorbeam at the intersection of the terminal lateral-members) which can move longitudinally between phosphor-bronze guides mounted on the top of the wind-strut immediately under the roadway. The rubbing surfaces of those bronze guides are curved to a radius of 3 ft., and are spaced to give  $\frac{1}{16}$ -in. clearance for sideways motion of the nose.

The possible extent of movement of the ends of the trusses at these expansion-points is considerable, such movements emanating from various sources. Thus, at the north tower, the side-span truss, in addition to its alteration in length owing to stress-and-temperature-variations, moves bodily with deflections of the cable-bent, to which it is fixed. At the same time the northerly half of the central span contracts and expands, with its natural fixed point at span-centre. Furthermore, wind-loads, in bowing the spans sideways, cause rotation of the end floorbeams about the wind-pins, so that the leeward truss-ends of adjacent spans approach each other, while the windward ends retreat. Further, there is to be considered the elastic deflection of the tower itself due to displacement of the saddle on account of cable-adjustments. Movements at the south tower are smaller in extent, but the same expansion-assembly is provided in both cases.

The arrangement of the truss-shoes at the main expansion-joint is shown in Fig. 30. The end of each truss is pin-connected (with a 4½-in. horizontal pin) to a sliding shoe which moves between upper and lower bronze guides. In this manner no resistance is offered to longitudinal movements or to vertical angular motion, but the truss-end is constrained against movement due to positive or negative reaction. Weather-protection for the shoes is afforded by light articulated steel frames with canvas covers.

Traction-forces in the suspended structure are transferred from the trusses into the main cables at the low points of the latter. In each span, as shown in Fig. 27, two points of the upper chord (some 30 ft. apart) are connected to the lowest cable-band, which is specially adapted for the purpose, by a pair of 1⅞-in. high-tensile rods. The lengths of these are adjustable by turnbuckles, and their outer ends are forged and bored to receive 2½-in. pins. Each of the six assemblies is designed to withstand a traction-force (see Part III) of 51 kips. In this manner the three spans are severally prevented from bodily movements longitudinally, and expansion of the central span is constrained to take place equally at both ends.

#### EXPANSION-JOINTS IN ROADWAY

The engineers' drawings in the first place called for a conventional type of expansion-finger joint: such a detail comprises two sets of narrow steel bars set on edge, attached respectively to the ends of the adjoining deck-slabs, the bars of one set meshing with those of the other. Owing, however, to the large movement to be accommodated, the

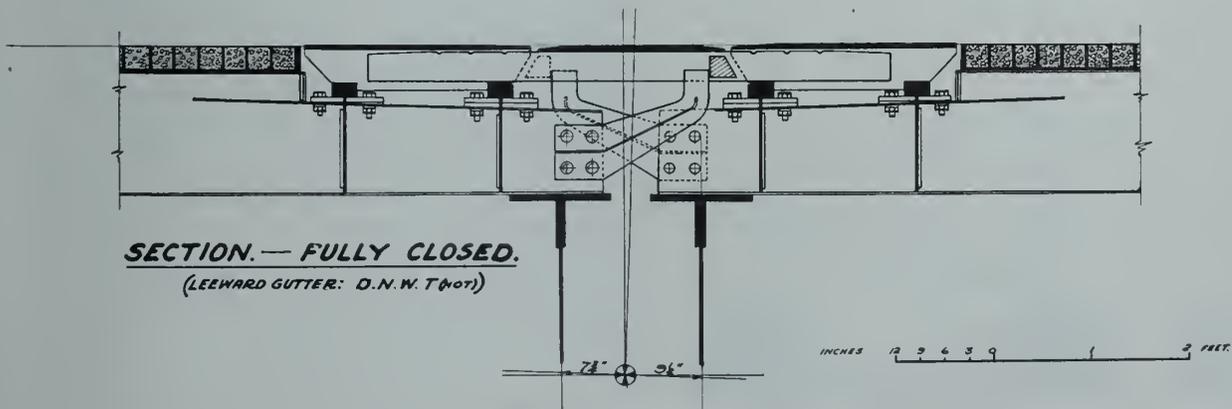
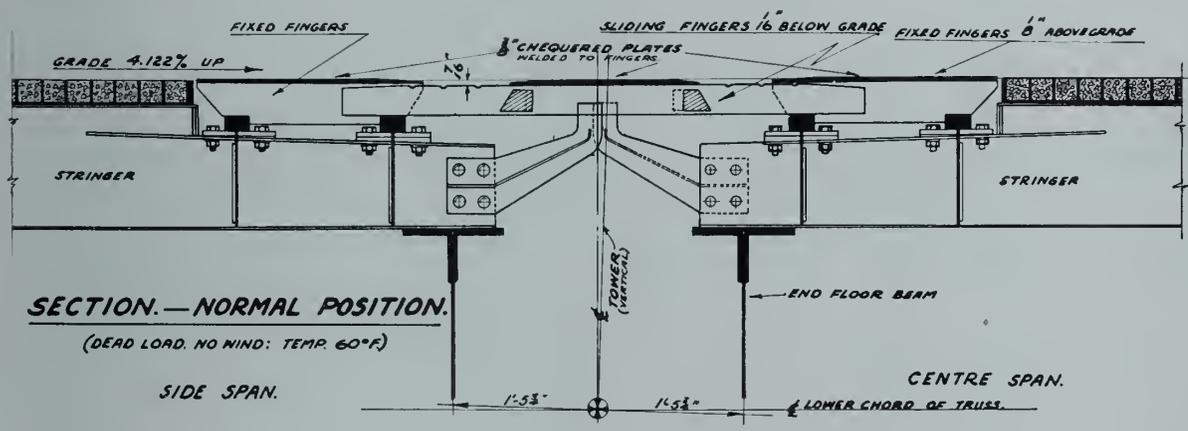
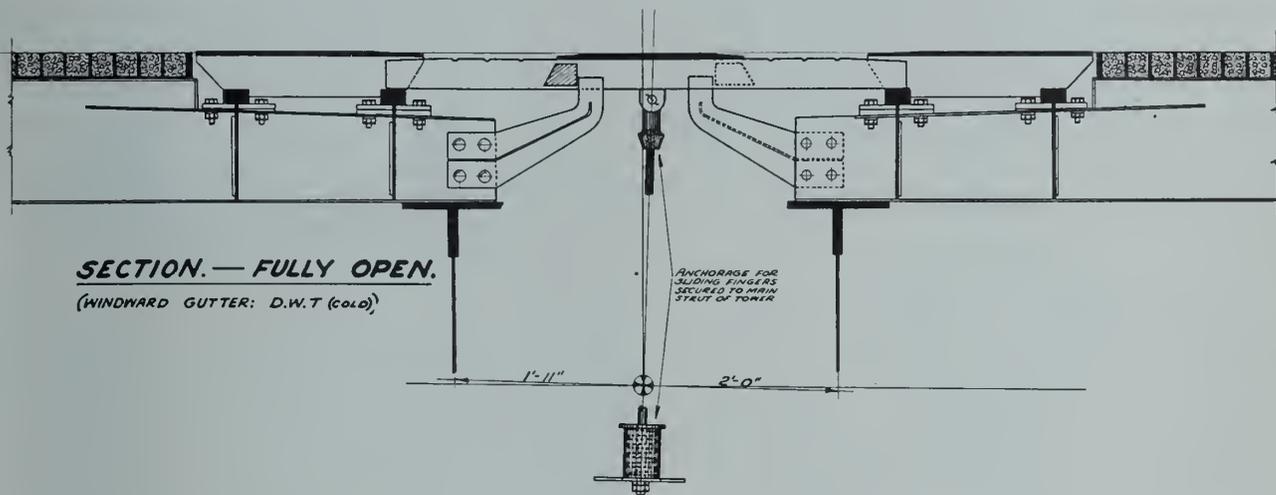
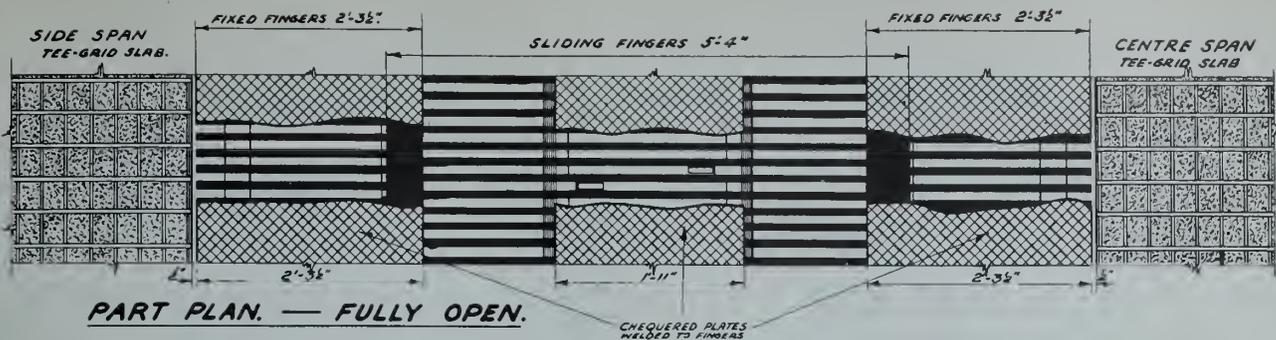


Fig. 31—Main expansion-joint for roadway.

consequent abnormal overhang ( $17\frac{3}{4}$  in.) and depth (6 in.) of the fingers, and the wide finger-spacing needed to prevent binding due to rotation of the span-ends, the contractor suggested an alternative in which the total movement is divided into two parts that occur at separate finger-meshings. This amended design utilised smaller bars for the fingers, eliminated the cantilever feature, and offered certain

advantages in fabrication. In spite of additional complication, the design was accepted by the engineers on account of its superior qualities of stability and rigidity, and the details were duly approved.

The joint is shown in Fig. 31. Rigidly attached to the end-stringers of the adjacent spans, and thus forming in each case an extension of the deck-slab proper, are two "fixed" sets of  $5\frac{1}{2}$  by  $\frac{13}{16}$  medium-steel fingers set up on edge at  $1\frac{15}{16}$ -in. centres. The fingers of each set are welded to two transverse supports (each made up of a 3 by 2 bar welded to a  $9\frac{3}{4}$  by  $\frac{3}{8}$  web-plate) that span between the stringers, the latter being cut down and strengthened to receive them. The supports are curved so that the top surface of the finger-assembly, which extends across the road, follows the roadway-camber. A third set of fingers ( $4\frac{1}{2}$  in. deep and tapering in thickness from  $\frac{13}{16}$ -in. at the top to  $\frac{7}{16}$ -in. at the bottom to prevent accumulation of road-debris), spaced similarly to those of the "fixed" sets and welded with spacers to form a single cambered unit, intermeshes with the two fixed units, and bears and slides on the outer supporting-bars of the latter.

In Fig. 31 are shown the relative positions of the three sets of fingers under normal conditions and also when the gap between the two adjoining deck-slabs is at its maximum and its minimum. It will be noted that the anticipated range of movement at the edges of the roadway amounts to as much as 30 inches. It will also be seen that the central (or "sliding") fingers are free, except in the extreme cases (when their movement is controlled by "stops" which, connected to the stringer-ends, engage with choeks welded between the fingers), to move independently. The weight of the sliding-fingers is probably sufficient to prevent any vertical movement or "chattering," but, as a safeguard, they are held down positively by two one-in. steel rods whose lower ends are secured to the main tower-strut. The rods are pin-connected, and tension is maintained by coil-springs.

In order to maintain an unbroken roadway-surface as far as possible, both sets of fixed fingers, together with the central portion of the sliding fingers, are covered over with welded chequer-plating. Also, to accommodate angular movements due to deflections of the spans, the sliding fingers are set at a lower level than the fixed ones, and the latter are sloped slightly downwards. The sliding-surfaces of the support-bars are rounded for the same reason.

A conventional assembly, of two intermeshing sets of fingers, is provided at the cable-bent, where relative movement of side-span and viaduct may amount to 9 in. At the south end of the bridge there is no provision for expansion, but a sliding-plate assembly is furnished to take care of deck-movements due to rotation about the wind-pin.

#### MAIN TOWERS: DESCRIPTION

The two main towers are shown in outline in Fig. 32, and pictorially in Fig. 33. Each tower, which is 364 ft. in height from the top of masonry (elevation 117.5) to the theoretical intersection of the cable-curves, consists of a pair of slender columns carrying the main cable-saddles and thus providing primary support for the suspension-system. The tower is braced to resist transverse loads, and derives its longitudinal stability from the fixity of its base and from the restraint afforded at the top by the cables themselves: the saddles are attached positively to the towers. The two columns of each tower are battered at 1 in 24, the cable-saddles being 40 ft. apart and the centres of the pier-shafts 69 ft.  $9\frac{1}{2}$  in.

The importance of the appearance of the towers was realized from the outset, and every effort was made by the engineers to render these dominating structures pleasing to the eye. To this end the form and arrangement of the tower-bracing were carefully considered, the X-type being deliberately selected as possessing those satisfactory aesthetic qualities which normally derive from a "functional" design.

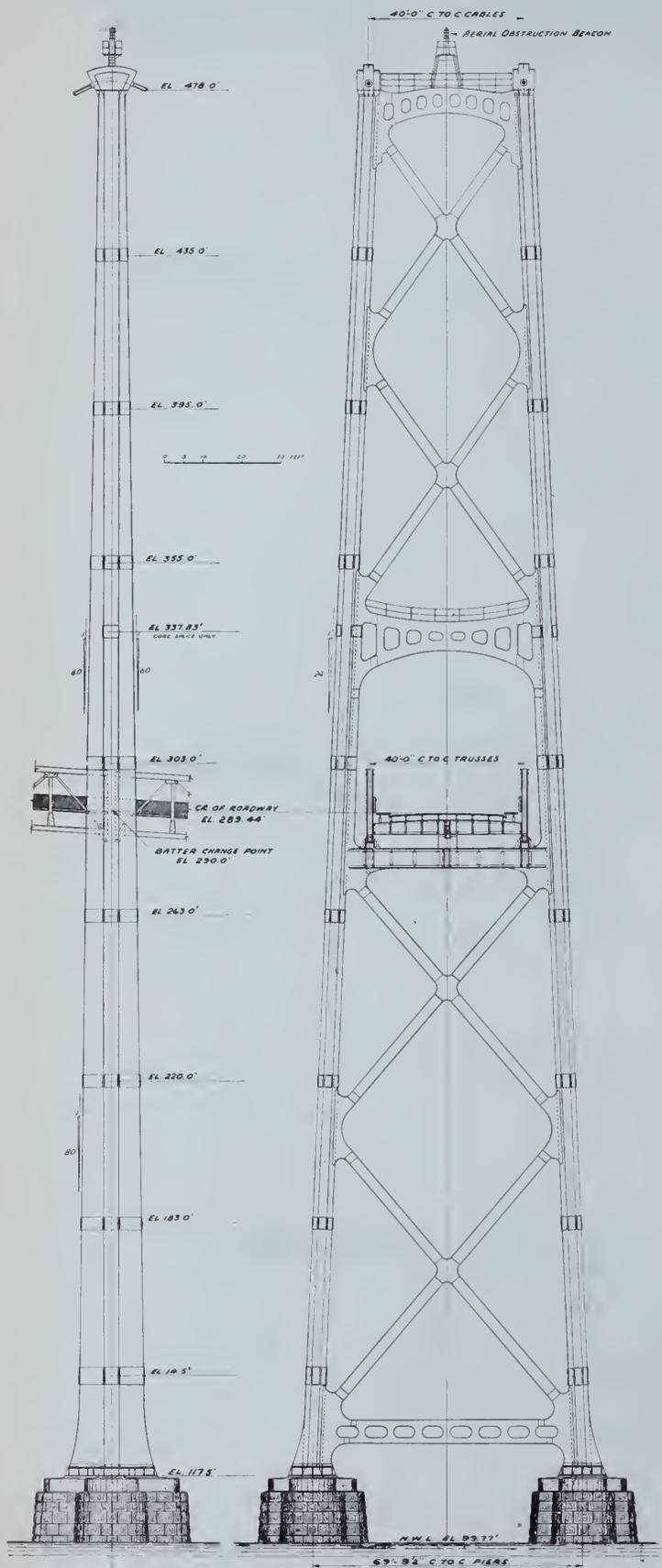


Fig. 32—Main tower.



Fig. 33—South main tower.

The bracing is continuous except for the portal-opening through which the roadway passes. Each diagonal is built up of four angles and two vertical webplates, and is braced with two planes of angle-latticing. The gusset-plates at all bracing-intersections and connections are rounded, and the three visible cross-struts (at the top and bottom of the tower, and over the roadway-portal), which would otherwise be oppressive in appearance, are "lightened" by a series of carefully-spaced piercings of the web-plates. The crown- and portal-struts are also shaped in a manner as to emphasize the functions which are implied by their locations. The fourth strut, which receives the wind-reactions from the suspended spans and on which the sliding end-bearings of those spans are mounted, is rendered inconspicuous by its position immediately below the deck of the bridge, and consequently did not receive any special architectural treatment.

The cross-section of the tower-column (Fig. 34) is governed principally by structural requirements. Cruciform in general outline, and built up of plates and angles, it consists of a rectangular core flanked by two symmetrical wings.

The core-section is of constant size and material throughout. Stiffening-diaphragms, with a vertical spacing of about 6 ft., consist of peripheral angles only, leaving a clear central shaft 4 ft. by 2 ft. 6 in. This shaft is large enough to accommodate an electric elevator in the event, at one time probable, of a signal-station being required at the top of the tower. The two wing-sections are also rectangular. They are of constant width, but their depth increases (apart from the entasis introduced by a change in the side-batter from 1 to 60 in the upper part of the column to 1 in 80 from the roadway downwards) regularly from the underside of the cable-saddle to a point about 19 ft. above the masonry. Below that point the wing-sections are flared out in order to accentuate the appearance of stability of the fixed base. For the greater portion of its length, each wing is subdivided into two parts by a latticing-system connecting two vertical angles, the whole tower-column thus comprising five separate chambers. The wing-sections are stiffened by U-shaped diaphragm-angles, the spacing of these being as for the core, again leaving clearance for continuous access. The material of the wing-sections is also, as far as possible, constant throughout.

An inspection-ladder is provided in each chamber of the tower-column. These ladders (there are ten to each tower)

are continuous for the full length of the chambers, and manholes give access from one chamber to another at various levels. Entrance to the interior of the columns is effected by doors (equipped with locks) at roadway-level and at the base of the tower. Other doors are located at the tops of the columns, and also at every bracing-connection, the latter connecting with the ladders that are provided inside all of the diagonal members. There are also fenced walkways along the tops of the crown-strut and portal-strut. Electric lighting is installed in all the chambers, the controlling switches being situated near the principal points of entrance.

#### MAIN TOWERS: DESIGN

Under any condition of bridge-loading, the cables assume a position of equilibrium so that the horizontal component of tension is constant throughout the system. Since, however, the reaction-pressure of the cables on the main saddles is sufficiently great to preclude cable-slip at those points, and as in any case it would be undesirable to permit such sliding to occur, any balancing-movements are accommodated by longitudinal displacements of the tower-tops. The range of these displacements being of definite and limited

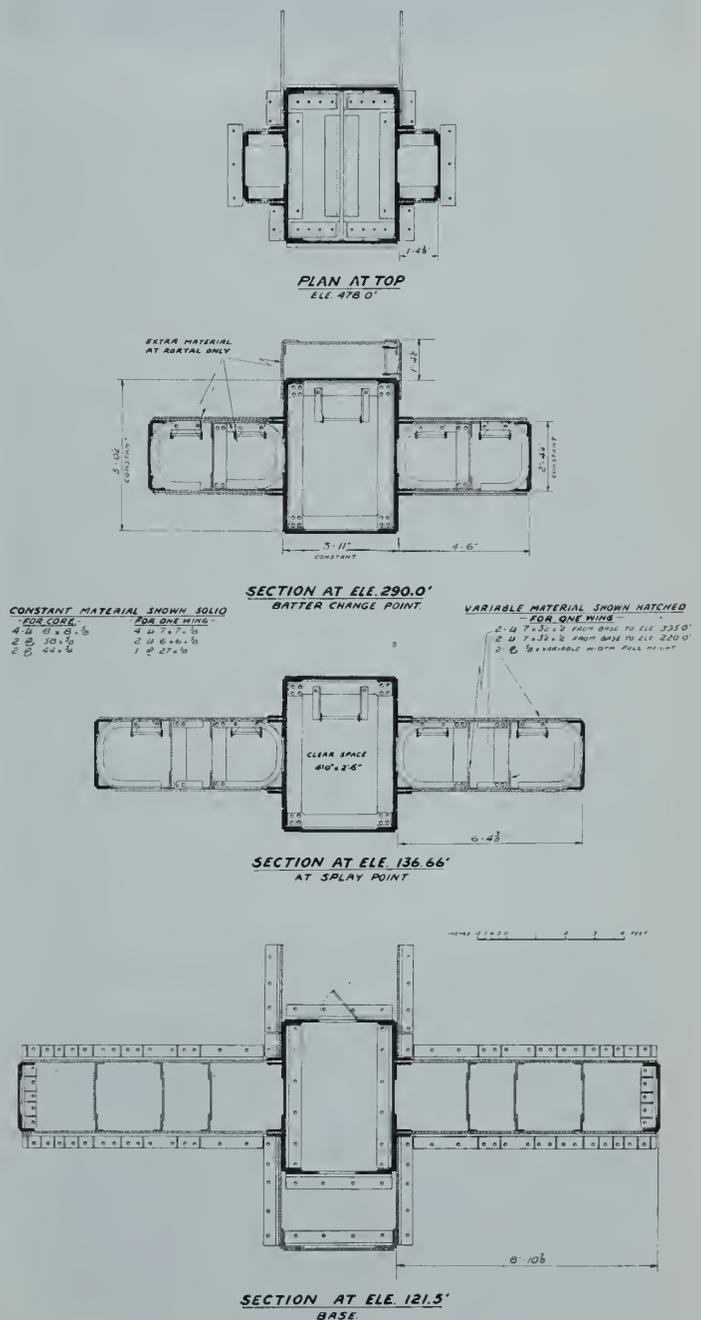


Fig. 34—Cross-sections of tower-column.

extent, it has, in modern practice, been found\* both convenient and practicable to provide for them by invoking the inherent flexibility of the tall tower-columns, assuming that the latter are free to adopt any position dictated by the pull of the cables.

The conditions of loading which govern the design of the towers are apparent from inspection. Thus, the heaviest cable-reaction will occur when all three suspended spans

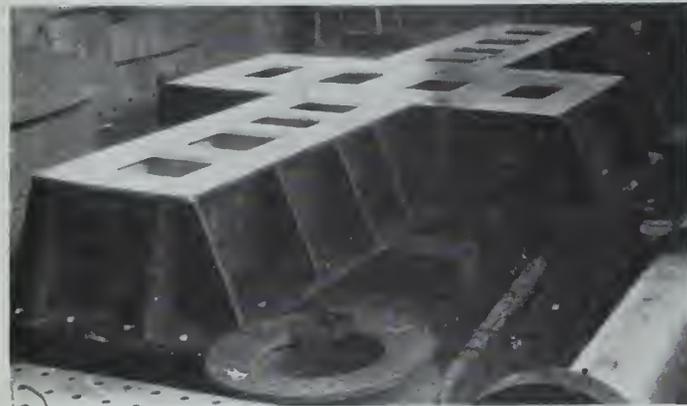


Fig. 35—Main shoe.

are fully loaded and minimum temperature obtains. The greatest saddle-movement, however, will take place when the central and far-side spans are loaded, and at maximum temperature. The latter case, together with wind-loading, was found to control. It may be noted here that, owing to the greater length of the north back-stay, deflections are larger at the north tower, which is thus the more severely loaded. The towers were, however, made identical in structure, being designed for the worse case.

For each condition of loading investigated, the amount of the cable-reaction at the saddle, and its simultaneous displacement, were first determined. The cable-reaction bears a fixed relation (approximately 82 per cent) to the horizontal component of cable-tension, which latter is arrived at by the relevant deflection-theory computation. The displacement of the saddle, or departure of the tower from verticality, is obtained from consideration of the changes in length and shape of the cable between the saddle and the nearest anchorage. For the case of DCT (as given in the tabulation below), for instance, the total riverward movement is comprised of 0.454 ft. due to thermal elongation of the cable, 0.606 ft. due to elastic lengthening of the cable from stress, and 0.460 ft. due to upward deflection of the unloaded side-span.

The first step in design was the assumption of a suitably-tapered "trial" column, capable of withstanding the loading from the cable with the saddle in its deflected position. The physical properties of cross-sections about 20 ft. apart were evaluated, and the elastic curve due to a hypothetical unit load acting horizontally on the saddle was computed, establishing the relation between the horizontal load and the movement of the saddle. In the final design, the deflection of the top of the column due to a load of 1,000 lb. was calculated to be 0.0564 ft.

The second step was the assumption of an elastic curve for the column when subjected to a particular loading and simultaneously deflected by the appropriate amount (first and second columns of the tabulation). With this assumption, the stresses in and deflections at the various sections were figured, and it was naturally found that the top deflection differed, one way or the other, from the original amount, owing to the moments caused by the eccentricity of the vertical loads. That original amount, however, which is a definite quantity, is entirely independent, for all practical

\*The first use of fixed flexible towers with immovably-connected saddles was in the Manhattan Bridge, built 1909. Such towers have since been invariably used for bridges of long span.

purposes, of the dimensions of the column. Accordingly, the next step was the evaluation (from the unit-load deflection previously obtained) of the induced horizontal load necessary to maintain the status quo. The elastic curve due to this induced load was then superimposed on that due to the vertical loading-condition, and the resulting composite curve gave the required actual saddle-deflection but did not necessarily agree throughout its length with the assumed curve. New assumptions for the curve were then tried until such agreement occurred. The stresses over the various sections were then inspected, and suitable alterations in size and disposition of metal were made. The argument was then repeated to determine the new elastic curve. Similar computations were performed for all important loading-conditions including those involving longitudinal wind-loads, which set up a cable-pull in addition to the above induced load.

The tabulation given below summarizes the cable-reactions, saddle-offsets, and induced cable-pulls for the principal conditions of loading, applied to the column finally adopted.

TOWER LOADINGS AND DEFLECTIONS

Loading	Vertical Load (Kips)	Deflection of Saddle Riverward (feet)	Induced Horizontal Load (Kips)
DNT.....	4,582	1.249	+ .286
DCT.....	4,790	1.520	- .648
DNTL (offshore).....	4,582	1.249	+2.151
DNTL (onshore).....	4,582	1.249	-1.581
DNTW.....	4,582	1.249	-1.623

NOTE:—Figures are for high temperature (120°).

The bracing of the tower, which is stressed only by lateral loads, was designed independently (except insofar as the rigid-frame moments around the portal influenced and were dependent on the column-sections over that length) as a simple framework. The determining factor, however, was that of appearance, the members in question being in general of considerably heavier section than is necessary to fulfil the minimum requirements. An approximate estimate of stresses in the bracing due to its participation in the main function of the tower-structure indicated that such were not of significance.

#### LOADING AND WORKING-STRESSES

The loadings D, N, C, T, which are described on p. 283, were used also for the towers. The lateral load  $W$  was extended to include the effect of  $1\frac{1}{2} \times 30$  lb. per sq. ft. of vertical projection of the tower. A longitudinal wind load  $L$  of 300 lb. per ft. of height on each column was also considered, this being effective either off-shore or on-shore; and a further wind-load  $W_1$ , of  $1\frac{1}{2} \times 50$  lb. per sq. ft. of column, operative on the unloaded tower, was the controlling factor in the bracing-design.

The normal compression-unit, for medium-carbon steel (C.E.S.A.: S-40), was specified to be  $\frac{20}{18} (17000 - \frac{240h(358-h)}{358r})$  lb. per sq. in., with an upper limit of 16,222 lb. per sq. in., where  $h$  is the height above elevation 120 of the section in question, and  $r$  is its radius of gyration. This formula is an adaptation of the common mild-steel formula  $f_c = (17000 - 60\frac{l}{r})$ . It was designed to permit higher working-stresses near the restrained ends of the column, and the units are also increased in accordance with the higher quality of the material. The upper stress-limit corresponds to a "cut-off" at  $\frac{l}{r} = 40$ .

The above unit was used for stresses due to D, W, DW, or DNT, and a 15-per-cent increase was permitted in the

case of DCT, DNTW, or DNTL. It was found that the column-section up to roadway-level was governed by loading DNTW, and thence to the top by loading DNTL (on-shore) except for some 30 ft. of the portal, where the effects of DNT preponderated.

The bracing was designed to a working-stress of 20,000 lb. per sq. in. in tension and  $\frac{20}{18} (17000 - 60 \frac{l}{r})$  in compression.

The unit-stresses for rivets throughout were 15,000 lb. per sq. in. for shop-rivets and 13,500 for field-rivets, the rivet-material according with C.E.S.A. specification S42.  $\frac{1}{8}$ -in. rivets were used.

#### TOWER-SHOES

Satisfactory experience with this type of fabrication for the Island of Orleans Bridge, together with the fact that the contractor possessed complete and modern facilities (including stress-relieving furnaces of adequate size) for such work, led the engineers to adopt without hesitation an all-welded construction for the base-pedestals of the towers, although these members are considerably heavier than were those of the earlier bridge.

The tower-shoe (seen in Figs. 32 and 35) is built up entirely of heavy plates of medium steel. In plan it is shaped to conform with the outline of the base of the column, its overall dimensions being 23 ft. 7 in. and 12 ft. 1 in. The top and bottom slabs which provide the bearing-surfaces are respectively  $1\frac{1}{4}$  and  $1\frac{1}{2}$  in. thick after machining, the former being smooth and the latter rough-planed. The bottom slab is horizontal, to rest on the dressed concrete, while the top slab is inclined to match the 1-in-24 batter of the tower-leg. The central depth of the shoe is



Fig. 36—Main saddle.

2 ft. 6 in. The slabs each consist of three sections (corresponding with the core and wings of the tower-column) which are heavily butt-welded together, and openings are provided in the top slab for access during fabrication.

Separating the bearing-slabs is a series of transverse and longitudinal vertical webs of mild steel. Of these, the heavier ones (2 in. thick) supply direct support under the main material of the column; while lighter ones ( $1\frac{1}{2}$  in. thick) function as subsidiary supports and as stiffeners for the former. Semi-circular drain-holes, 2 inches in diameter, are cut at the bases of the webs to prevent accumulation of water inside the member. The shoe is fabricated with  $\frac{1}{2}$ -in. fillet welds throughout (apart from the heavier welding of the butt-joints to which reference has been made) and the whole assembly was stress-relieved before bearing-surfaces were planed. The weight of each shoe is 18 tons.

The tower-column is riveted to the shoe with fifty-two  $\frac{7}{8}$ -in. rivets and sixty-two  $1\frac{1}{4}$ -in. rivets to resist wind-loads during erection, and the shoe is anchored to the pier by twelve  $2\frac{1}{2}$ -in. bolts 18 ft. 6 in. long and twenty  $1\frac{1}{2}$ -in. bolts 9 ft. long. The anchors functioned during erection only: under working-conditions there is no uplift.

The cable-saddles for the towers are also all-welded. The bearing-surface for the strands is a billet of medium steel 19 in. wide,  $9\frac{1}{2}$  in. deep, and approximately 10 ft. long. Its top surface is at the level of the centre-line of the cable, and is curved to a radius of 10 ft. 4 in. The billet is machined out to receive the lower half of the cable, and the bottom and sides of the cut are grooved to seat the individual strands (Fig. 36). The billet is supported from a base-plate (2 in. thick and of the same plan as the top of the tower-column) by two main longitudinal webs 2 in. thick and battered inwards to give lateral stability: five transverse 2-in. webs are also provided (Fig. 61). Continuous  $\frac{1}{2}$ -in. fillet-welds are employed except in the connections of the main webs to the base-slab and to the saddle forging, those joints being made with  $\frac{5}{8}$ -in. continuous reinforced fillet-welds. There are no caps (such as are necessary at the cable-bent saddles) for the main saddles since the frictional component of the cable-reaction suffices to prevent slipping; but six "keepers" are provided to obviate the possibility of the upper strands of the cable being displaced from any cause. Each saddle is secured to the tower by thirty-four  $1\frac{1}{4}$ -in. rivets, and each assembly weighs six tons.

#### FINIALS AND AERIAL-BEACON SUPPORTS

Three purposes are served by the finials which surmount the tops of the main-tower columns. Weatherproof protection is afforded to the important saddle-and-cable assembly; a satisfactory architectural termination is provided for the tower-column; and the aesthetically-awkward conjunction of the slender tensile lines of the cable with the comparatively heavy profile of the post itself is adequately masked.

The column-finial, seen in detail in Fig. 37 and as part of the tower-assembly in Fig. 72, is a light welded box of simple outline, fabricated from  $\frac{1}{4}$ -in. mild steel. The top plate is curved to a radius struck from the centre of the saddle-curve, and the planes of the end plates through which the cable passes are normal to the respective cable-tangents. The open bottom of the "box" fits neatly over the saddle-base, and the outline of the core-section of the tower is continued to form a buttress on either side of the finial.

The finial stands six ft. high above the top of the column, and has a door that gives access from the top strut of the tower. Zinc flashings with painted canvas gaskets are provided at the points of entrance of the cable. The weight of each of the four finials is 2,900 lb.

In accordance with a requirement of the Department of Transport, aerial-obstruction beacons were placed on the tops of the towers. To elevate the lights above the top of the finials, a structural-steel support, 13 ft. 6 in. high (weight 1,100 lb.), and comprising a small platform carried on an A-frame made of two light stairs, is riveted to the crown strut of each tower (Fig. 32).



Fig. 37—Finial over main saddle.

The towers, each containing some 1,000 tons of steel, were fabricated by Dominion Bridge Company. The welded saddles and bases, together with the three lower sections of each column (Fig. 32), were made up in Lachine, but the greater part of the fabrication was done in Vancouver; the company's Burnaby shops were supplied with a detailed programme of the operations entailed, and the major machinery was overhauled prior to the start of work.

In view of the importance of precise alignment of the tower-columns to ensure their verticality when erected, great care was taken in the fabrication of the 112 pieces (not including bracing and struts) involved. Facing of material was done with the utmost precision and every joint was shop-assembled for checking and for reaming splice-holes. In the course of joint-assembly at Burnaby, some difficulty was encountered owing to "growth" of the main angles of the wing-sections (which had been assembled and milled with the core-sections) relative to the core material, during riveting. The growth, partly due to temperature-variations in the shop and partly the effect of riveting, did not, however, exceed a few thousandths of an inch, and was rectified by filing the angles flush where necessary. That the accuracy achieved in the shop-work was of a very high order was borne out by the subsequent speed and facility of erection.

The length of the tower-columns as detailed and fabricated was  $1\frac{5}{16}$ -in. longer than the theoretical, that amount representing the normal compressive strain when in service. The long and relatively light braces, however, were built to uncambered dimensions, and their assembly under the necessary slight tension presented no difficulty.

An interesting feature of the lower sections of the towers is that the contractor obtained from the engineers permission to use cold-driven rivets. This was the first use of this comparatively new process on major bridge-work in Canada, and it was successful in all particulars.

#### NORTH CABLE-BENT

This structure serves the dual purpose of supporting the cables and the suspended-span bearings at the end of the

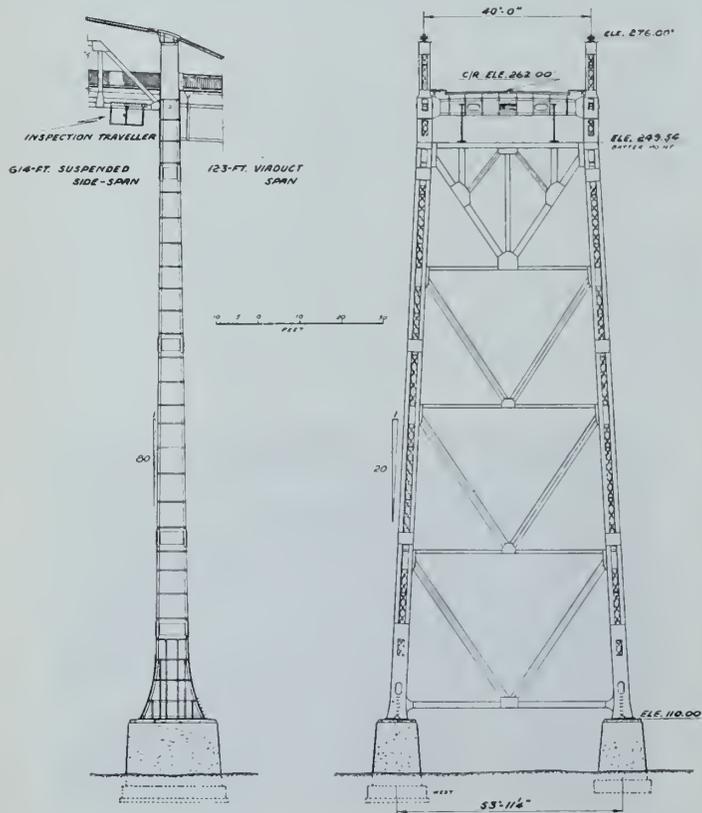


Fig. 38—Cable-bent.

side-span, and of providing bearing for the expansion-end of the most southerly of the approach-spans. Support for the cables is required at this point in order to deflect them towards the anchorage at a slope approximating to the maximum inclination already established near the tower-saddles.

The cable-bent (Fig. 38) has a height of 166 ft. from the pedestal-concrete to the cable-intersection. Below the level of the approach-span bearings, the two columns are connected by lateral K-bracing (harmonizing with that of the viaduct-bents), and are battered at a slope of 1 in 20, that batter being selected as midway between the 1-in-24 of the tower-legs and the 1-in-16 of the viaduct-columns. Above that level, however, the columns are vertical and 40 ft. apart centre to centre, the final 12 ft. of each column being self-supporting.

Two load-bearing cross-struts (Fig. 39) are provided. The lower of these receives the heavy reactions (amounting to 246 kips from each girder under full load) from the 123-ft. viaduct-span, and is stiffened by incorporation into a truss-system which includes the upper members of the K-bracing. The upper strut, situated below the roadway, functions as an end-floorbeam for the suspended span and also supports the vertical pin which receives the wind-reaction of the suspended span. The upper strut has substantial connections to the columns, designed to resist lateral forces from the cable-saddles.

The lower chords of the stiffening-trusses are each pin-connected to a pair of bronze slabs which can slide horizontally (the end of the span rotating about the wind-pin) inside the column of the cable-bent. The ends of the trusses are thus free to move to accommodate both vertical and horizontal rotations of the span, though they are restrained against vertical movements. The reaction at either pin may range between a maximum of 95 kips and a minimum of -77 kips. Movements of the end-stringers of the side-span are permitted by sliding shoes on the floorbeam-strut.

The cable-bent saddles, like the main saddles, are of all-welded construction and are rigidly attached to the supporting columns. Subjected to much smaller loads (the maximum reaction to one saddle is 1,463 kips) however, they are smaller than the tower-saddles, the overall size of the  $1\frac{1}{2}$ -in. base-plate being 4 ft. 1 in. by 3 ft. 6 ins., and the length of the grooved billet being 5 ft. 2 in. In order to prevent slipping of the cables and consequent forward-movement of the bent (the reaction-friction being insufficient for that purpose, on account of the relatively small change in cable-direction), the saddles are equipped with heavy curved covers which are bolted down with sixteen  $1\frac{1}{4}$ -in. high-tensile bolts each. The complete saddle weighs three tons, and is shown in Fig. 66. (Part IV.)

Each of the two cable-bent columns is composed of a pair of plate-girder sections braaced together by two planes of heavy latticing, the lattice-bars being connected to four longitudinal angles, two of which are riveted to the inside of each main web. The girders are spaced 2 ft. 8 in. apart throughout; and the distance between latticing-planes is 3 ft. The width of the girders, which is presented in a side-view in Fig. 38, increases (with side-batters of 1 in 80) from 4 ft. under the cable-saddle to 7 ft. 8  $\frac{1}{2}$  in. at the top of a basal flare that is modelled from the formula used for the viaduct-columns. The sectional area of the column varies from 121 sq. in. at the top to 299 sq. in. at the base. Horizontal diaphragms are located at approximately 6-ft. intervals throughout the length of the column, and each is flanked by a pair of stiffening-angles on the outsides of the main webs. The outstanding legs of the stiffeners are dished to facilitate drainage. The central space of the column is uninterrupted except where the truss-bearings are housed, and contains an inspection ladder, access to which is gained from the ground or from the roadway. Other ladders, and platforms, are provided for inspection of the various articulated connections. Each column bears on a steel slab 16 ft. 6 in. by 5 ft. in extent and planed to

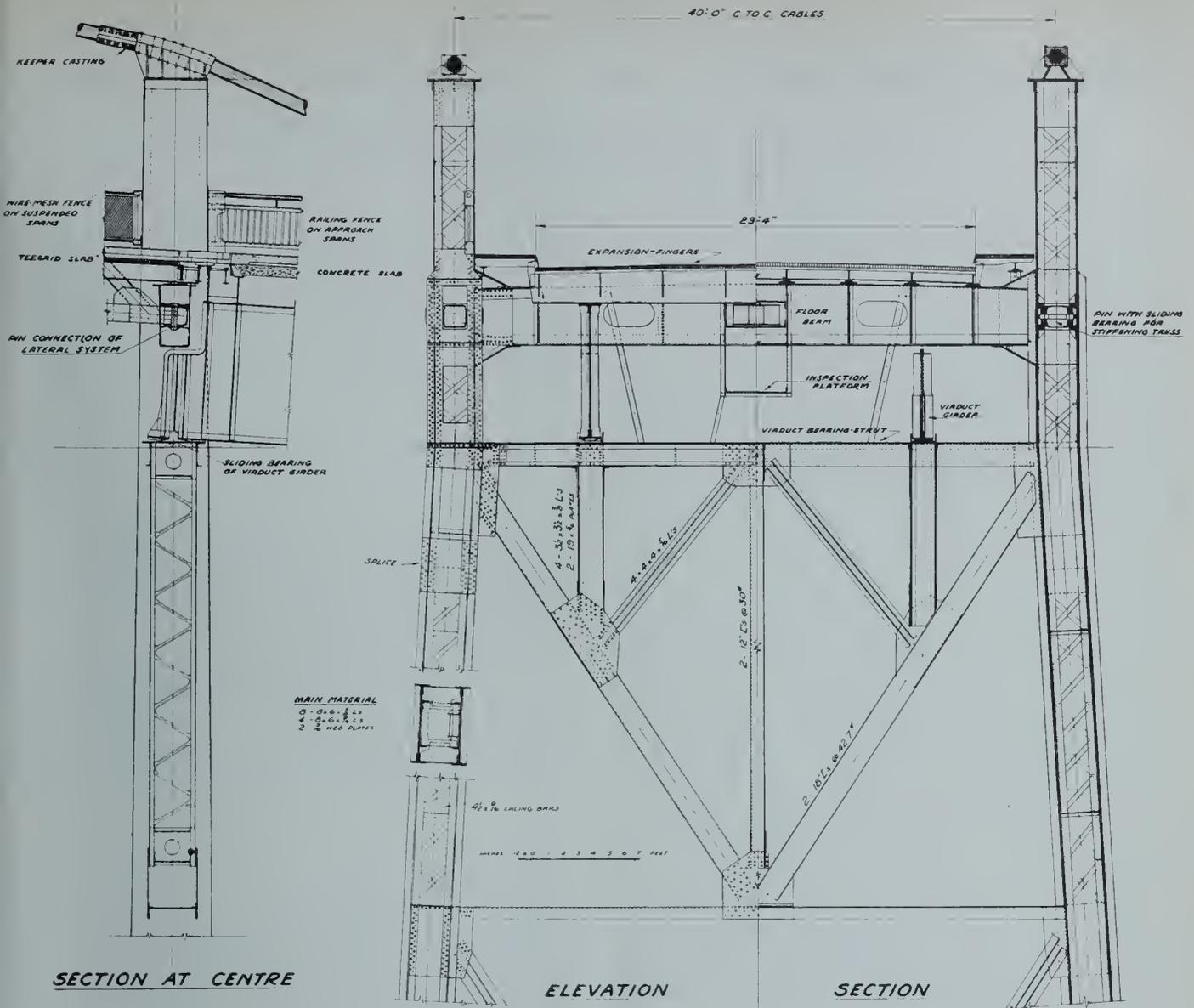


Fig. 39—Cable-bent: detail of upper part.

the appropriate batter from an original thickness of  $4\frac{1}{2}$  in. The column is anchored by sixteen  $1\frac{1}{2}$ -in. anchor-bolts. There is no uplift of any part of the base under service-conditions.

The cable-bent, fixed at the base and subjected to known loadings simultaneously with known saddle-movements, is susceptible to the same analytical process of design as the tower. Saddle-movements, being influenced by the backstay-length alone, are small, the range of movement being  $5\frac{1}{2}$  in. from normal. Loading-conditions, on the other hand, are more complicated, owing to the presence of the sliding-bearings of the approach-girders, and to the horizontal friction-force developed by these under the influence of expansion-movements. The governing case of loading for the lower part of the posts is that due to D.N.T.W.; while, for the upper part, the same loading, but with the addition of the frictional force due to contraction of the girders, produced the worst stresses. For the former case, the basic unit-stresses were increased by 15 per cent; and for the latter, by 25 per cent.

The material is medium steel, and permissible stresses were similar to those for the tower, the compression-formula being adapted to suit the shorter length of the column.

The cable-bent was fabricated at Burnaby, and was joint-assembled for reaming the connection-holes. The planing of the base-slabs from  $4\frac{1}{2}$  in. to a thickness varying from 4 in. to 1 in. proved a costly procedure, but it is doubtful whether alternative base-details could ensure equally efficient bearing for these important members.

#### SOUTH CABLE-POSTS

At the south end of the bridge the cables are deflected to the backstay-gradient by means of saddles carried on short rocker-posts which bear on a pedestal in front of the anchorage-pier. The cable-reaction to each post amounts to 1,234 kips under the severest loading-conditions. The post is inclined (at 17 deg.) in order to equalize the tension on either side of the saddle, and thus there is no need for special anchoring of the cable such as is essential at the vertical cable-bent. The small cable-movements at the saddle, due to changes in the backstay-length of 68 ft., are accommodated by the 6-in. pin at the foot of the post. The cable-saddle, (Fig. 67), which, like the other saddles, is weld-built, is a relatively small structure, the size of its 1-in. base-plate being 2 ft. 2 in. by 2 ft.  $2\frac{1}{2}$  in. Together with its cast-iron cover, which is protective only and does not bear on the strands, its weight is 1,600 lb.

EDITOR'S NOTE:—Part III of this paper will appear in the June issue.

# DISCUSSION ON THE MANUFACTURE OF THE 25-POUNDER IN CANADA

Paper by W. F. Drysdale<sup>1</sup>, M.E.I.C., published in *The Engineering Journal*, January, 1942, and presented before the General Professional Meeting of The Engineering Institute of Canada, at Montreal, Que., on February 5th, 1942.

W. D. BLACK,<sup>2</sup> M.E.I.C.

A mechanical analysis such as Mr. Drysdale's on the 25-pounder gun is both timely and significant. It points to the fact that engineering in Canada has entered a new phase in its development.

History and Hitler have brought about an era when the first requisite of Canadian life is a virtually unlimited supply of complicated mechanisms, lethal and otherwise. The day of the mechanical engineer has arrived. The fourteen acre plant at Sorel producing 25-pounders is one of many huge new establishments in which the engineering problems to be solved are almost exclusively of a mechanical nature.

It is to be noted, however, that gun designers are largely guided by military and ballistic considerations in originating ordnance. Such study as is devoted to speed and facility of production (there is undoubtedly some) is a secondary consideration. This can be seen by comparing the component parts of any considerable artillery piece with those of a commercial mechanism designed for quantity production. The complexity, and, from an operational viewpoint, the greater all-round difficulty of the gun parts are immediately apparent. Further, there is the fact that, due to the high stresses to be provided for, the use of materials having high physical properties beyond the range of ordinary commercial machine shop practice is necessary. If the gun is of an automatic type, the permissible manufacturing tolerances for much of the assembly will be such as to demand the best of any commercial shop, however well-equipped and manned it may be. These are some of the difficulties connected with the problem of producing modern guns with the available equipment and with labour that may be ninety per cent lacking in any previous mechanical training, as was the case at Sorel.

In his final paragraphs, the author alludes to some aspects of the Sorel project that are not, in the technical sense, engineering matters. But, to-day, such questions as employee training, housing hostels, morale, and other human factors have to be dealt with. It is regrettable that Mr. Drysdale could not take the additional space to enlarge somewhat on these important problems, as encountered at Sorel. We may hope that he will take a future occasion to do so, for the size, success and peculiar circumstances of the project would render such a discussion of exceptional interest.

It is a matter of common report that the housing provided at Sorel is of a high standard. Some description of this would have been of interest to many, like myself, who feel much of our wartime housing, designed on the assumption that it is entirely temporary in character, will in fact have to be used for a long period. If the occupants of this housing are to be dispossessed after the war, other accommodation must be found for them. There is nothing to indicate that the field of low cost housing will be any more attractive to private enterprise after this war than it was previously. Consequently, the betterment of mass housing which must ultimately come, will prob-

ably have to be undertaken on a community basis. Without criticizing the excellent work done under great pressure by the Wartime Housing Board, I am of the opinion that, at least in the cities, our wartime housing should be recognized and accepted as permanent and designed accordingly. For this reason information concerning the housing provision made at Sorel would be of exceptional interest.

At this time it seems impossible to plan any large scale manufacturing project apart from the personnel and labour relations problems which it involves. When we consider the peculiar circumstances of Sorel Industries, with its bi-racial and bi-lingual problems, its importation of supervisory personnel and the almost complete absence of local skilled labour, we may safely assume that personnel and employee relations required a high degree of judgment and discretion. I, for one, should certainly like to hear more of this phase.

Employee training is another element of war industry that must have been of exceptional consequence in the production of the 25-pounder. Behind the author's brief intimation that not more than ten per cent of employees had previous mechanical training, there must lie a story of employee training under emergency conditions. Let us hope we may have a future opportunity of hearing it.

JAMES CRONE<sup>3</sup>

It is a great pleasure to receive an invitation from your Institute to join in this discussion. It gives me an opportunity to extend hearty greetings as a member of the Institution of Mechanical Engineers of the United Kingdom. Having had a fairly long experience connected with armament production, I would like to state how proud I am to be associated with the progress that has been made in Canada, generally, with particular reference to Sorel. Mr. Drysdale's paper, so ably presented, is a full record of a great Canadian accomplishment. May I pass a few general remarks, which, although not directly concerned with the production of 25-pounder equipment, are applicable to such a project.

The manufacture of a gun and carriage has always been regarded as embracing work requiring the highest technical skill. In times of peace we, in the Old Country, have always had available a plentiful supply of highly skilled mechanics. It has been very illuminating to help in this case of successful production of high class equipment by practically unskilled labour. That success has been due to very efficient jiggging and tooling, whereby complicated machining operations are reduced to those of a repetition nature, and here I will stress the point referred to by the author, viz:—that something in the region of 90 per cent of the workers at Sorel were unskilled and now can probably be classed as semi-skilled. The aptitude with which these employees have learned to perform intricate operations is creditable and speaks highly for Canadian initiative, and enterprise, and, in this connection, tribute must be paid to the great Canadian family of the Simards, particularly to my good friends, Messrs. Joe and Edouard Simard, without whose initiative the Sorel plant would not exist.

<sup>3</sup>Special Adviser to the Minister, Department of Munitions and Supply, Ottawa, Ont.

<sup>1</sup>Director-General of Industrial Planning, Department of Munitions and Supply, Ottawa, Ont.

<sup>2</sup>President, Otis-Fensom Elevator Co. Ltd., Hamilton, Ont.

The author has drawn attention to the hearty co-operation and efficient service given to this development by the Chrysler Corporation, who have, to a great extent, introduced automobile production methods in gun and carriage manufacture. This is particularly noticeable in the arrangement of the machine tools in the shops. Each major component has its own special machine tools allocated and congregated around the production of that component. This method of layout is perfectly correct and leads to efficiency in cases where, as at Sorel, a particular equipment is being manufactured in large quantities, but is not so suitable in a plant engaged on work of a general nature. Having been trained and associated with shops of the latter class it has been very pleasing to note the increase in efficiency resulting from the system adopted at Sorel. Although a large office technical personnel is required, the ultimate cost production figures will justify the methods that have been introduced. After all, the test is in the number of guns on the assembly line and this line is daily increasing in length.

There is no doubt that the introduction of this and other work of a similar nature will improve manufacturing technique in Canada. Such was undoubtedly the case in the Old Country after the last war. Changes in production methods in the general engineering industry are taking place due to the efforts of the automobile, aircraft and other similar industries. The old-fashioned ideas, practised in general engineering, are now giving way to ideas based essentially on mass production practice.

To maintain position in the markets of the world economic production is a necessity and production, without system, will not attain cheap manufacture. To take an example, consider the many firms here and elsewhere which have been built up on the production of specialties. A firm of this type, if successful and in operation for a number of years, finds itself in the position of having a minimum number of executives and an efficient workshop staff who, in many cases, can be classed as the equivalent of working foremen. The development staff is neglected and dwindles in numbers, which fact becomes very apparent when a new proposition is submitted for the firm's consideration. Without labouring this point I would sum up by pointing out the danger of such a state of things and stress the importance both of the maintenance of a full engineering staff, capable of tackling any class of manufacture, suitable for the plant, and also the necessity for the introduction of system methods to effect cheap manufacture.

COLONEL F. M. GAUDET,<sup>4</sup> M.E.I.C.

Will the author add to the value of his interesting paper by giving information on the following points:—

- (1) What is the life of the inner tube in rounds?
- (2) What is the action of the recuperator.
- (3) What are the physical properties of the steel in the finished inner tube?
- (4) Describe the heat treatment and normalizing of the steel.
- (5) Describe the sighting arrangements of the gun, and the range of elevation provided.
- (6) What is the rate of fire?

CHESTER B. HAMILTON, JR.,<sup>5</sup> M.E.I.C.

I should like to ask for a little more explanation on the application of the straight line production method—the use of specific machines for specific operations on only one kind of part as it moves along. With a production of only fifty units per month, or about one per twelve-hour

shift, this arrangement is not at all easy for the many short operations. How is it accomplished without idle machine intervals or much changing over of machines from one operation and set of jigs to another different set up.

COLONEL J. B. HOWARD<sup>6</sup>

There appears to be little to add to Mr. Drysdale's paper. With characteristic modesty, however, he has not mentioned the part he and his associates of the Department of Munitions and Supply, and of the Ministry of Supply in England, have had in bringing about this important achievement.

It may be that the difficulties involved in initiating gun and carriage manufacture in Canada are not realized by those who have not been concerned with that phase of armament manufacture. The most exacting material specifications must be met, to begin with. These specifications were, in many cases, based on British materials and practice; consequently, materials to meet them had to be specially produced, or alternatively, the specification amended to permit the use of what was available here.

On the machining side, close tolerances must be maintained to ensure satisfactory performance of the weapons. Any laxity in this respect can only lead to functioning failure.

Mr. Drysdale has mentioned the advantages of the loose barrel type of gun construction as compared to the wire-wound guns. In the former case, the allowable clearance between the exterior of the barrel and the interior of the jacket is very small, since the latter takes up part of the firing stresses. This entails precise finishing of that part of the barrel inside the jacket. This finish was unnecessary with wire-wound or built-up guns.

Many other difficulties were encountered, the details of which are probably of less interest. The fact that they have all been met successfully is a tribute to the teamwork shown by all who had to do with this project.

As far as quality is concerned, it is certain that the guns and carriages which reach the service from the hands of our French-speaking Canadian workmen of Sorel are fully up to standard, and wherever they meet the enemy, they will give a good account of themselves.

J. G. NOTMAN,<sup>7</sup> M.E.I.C.

Mr. Drysdale in his paper mentions the fact that the barrels of 25-pounder guns made from steel having a yield point in the neighbourhood of 40 to 45 long tons per sq. in. are auto-frettagged. I heard this word during the early months of the war and my curiosity was aroused when our firm, Dominion Engineering Works, Limited, was called upon to make up the intensifiers for converting triplex pump pressure into the necessary pressures for auto-frettage work.

It is known that pressure in the internal bore of heavy walled cylinders will set up stresses in the walls, having their maximum intensity in the innermost layers and gradually reducing towards the outside, and that when pressure is applied which will exert in the innermost layers stresses beyond the elastic limit of the material that is being used, the mere addition of extra thickness does not help. Therefore, one of three alternative methods must be adopted: either the built-up method, where one tube is shrunk on to another, or wire-winding, or auto-frettage.

Auto-frettage may be defined in general terms as the process of automatically setting up the effects of shrinking a number of infinitely thin hoops on one another to make

<sup>4</sup>Deputy Inspector General, (Canada).

<sup>7</sup>Manager of Manufacturing, Dominion Engineering Works, Limited, Montreal, Que.

<sup>5</sup>Canadian Car Munitions Limited, Montreal, Que.

<sup>6</sup>President, Hamilton Gear and Machine Company, Toronto, Ont.

up the wall thickness of a cylinder or tube in such a manner that when the internal pressure is removed the inner layers are in a state of residual compression and the outer layers in a state of residual tension. These effects are produced in a monobloc cylinder or tube by the application and release of a radial pressure (auto-frettage pressure) on the bore, which pressure during its application sets up over-tension in some or all of the layers in the wall.

Each layer of steel from the bore to the exterior being subjected to tensile stress set up by the radial bore pressure will behave in accordance with the stress-strain relationship of the class of steel used, that is, as the internal pressure applied increases continuously from zero, the bore layer will, in turn, be stressed in the elastic range through the slip and yield ranges into the semi-plastic range. The layer next to the bore layer will in its turn be stressed in these ranges but here the permanent deformations will be less than in the bore layer. Layers in sequence more remote from the bore will be over-tensioned to graduated lesser degrees until a layer or diameter is reached where the stress set up is just equal to the elastic limit of the steel. Layers more remote from the bore than this particular layer will be stressed in the elastic range of the steel.

When the auto-frettage pressure is removed the steel in the inner layers is left in a state of residual compression while the outer layers are in tension, and show some residual expansion.

In the auto-frettage process, 0.025 strain of the bore layer under load has been considered the limit for the manufacture of guns, closed vessels, etc. The selection of this degree of over-tension was also made from consideration of impact qualities which were practically unaltered after 2.5 per cent over-tension, whereas after a greater over-tension they were markedly lowered.

Formulae have been developed which enable radial pressures, stresses and strains set up at any diameter in the wall of a monobloc steel cylinder to be determined within a limit under load of 0.025 strain at the bore.

To produce stability, low temperature heat treatment is a part of the auto-frettage process. In general, the effect of low temperature treatment on a cylinder which has been subjected to auto-frettage pressure is to increase the elastic limit of the material.

In the application of the auto-frettage process to gun construction, three gun steels have been considered: nickel, nickel-chromium and nickel-chromium-molybdenum.

Cylinder experiments show that provided the compressive stress in the bore layer after the first auto-frettage does not exceed 15 tons per sq. in., one low temperature treatment in producing new tensile elastic limits and restoring compressive elastic limits insures that the cylinder is elastic for a bore pressure equal to the auto-frettage pressure.

If the compression is between 15 and 20 tons per sq. in. after the first auto-frettage, the first low temperature treatment must be followed by reapplication of the pressure equal to the auto-frettage pressure and a second low temperature treatment.

If a second application of auto-frettage pressure and second low temperature treatment does not produce stability for this pressure, the requisite elastic strain range must be obtained by subsequent applications of the auto-frettage pressure and low temperature treatments.

If for any practical reason it is necessary to remove metal from the bore of the stabilized cylinder or tube, the requisite treatments must be based on the compression in the finished bore.

The test for stability is the reapplication of a pressure

equal to the auto-frettage pressure. If the cylinder or tube is stable (a) the pressure expansion curve of the exterior of the cylinder is a straight line graph, (b) the expansion of the exterior diameter is the same each time the pressure is applied, (c) there is no alteration in the bore or exterior diameters as shown by measurements taken before and after test.

Low temperature heat treatments are carried out at temperatures ranging from 250 degrees C. to 400 degrees C., allowing a soaking time of two hours after the piece is up to heat.

Commercial glycerine has been found to be the most suitable liquid for applying auto-frettage pressure. At pressure of 42 long tons per sq. in., the compressibility of glycerine is approximately 10.7 per cent.

I am indebted to Major General A. E. Macrae and to his book for such limited knowledge as I may have of the subject.

P. E. POITRAS,<sup>8</sup> M.E.I.C.

The subject treated by Mr. Drysdale is of great interest to all engineers—and in particular to industrial engineers.

Of the many recent developments mentioned by him, one of the most notable is the auto-frettage of the gun barrel. By this operation the metal is pre-stressed so that in action the strain of the explosion is distributed over the entire cross section of the barrel.

By this auto-frettage operation, the manufacture of a gun barrel shows important economics in time, labour, and materials, and the use of single forgings. Furthermore, the increased elastic strength enables the weight of the piece to be reduced, thus offering greater mobility for a given service.

The recuperator is an important component of the gun that requires very accurate machining and specialized workmen for its fabrication. A brief description of the hydraulic principle used in the recuperator would be appreciated.

Noting the author's remarks about the distribution of work to different sub-contractors for the manufacture of some 700 different components, was it really necessary to have a Rolling Mill installation in Sorel Industries? Saving in waste of crop ends from the ingots and the ability to get at wish stock bars for bolts, studs and small forgings must have been the dominant points in the recommendation of such an installation. Would Mr. Drysdale give us some information on the size and capacity of the projected Rolling Mill installation?

Thanks are due to him for his tribute to the French-speaking Canadians of Sorel who, like all other Canadians, will never shirk their responsibilities, and will always answer the call of their country.

HAROLD J. ROAST,<sup>9</sup> M.E.I.C.

The author should be complimented on the clarity of his presentation and the pertinence of his illustrations. Undoubtedly the Sorel people have done a marvellous job in this connection and their success is a tribute to the 85 per cent of labour which was French-Canadian, and 75 per cent of which had had no mechanical training beforehand.

In the ramifications brought about by distributing work to the 80 sub-contractors, I am glad to know that in a very modest way I was able to assist the production of gun parts in one plant as their consulting metallurgical adviser.

<sup>8</sup>Mechanical Engineer, The Steel Company of Canada, Limited, Montreal, Que.

<sup>9</sup>Vice-President, Canadian Bronze Company, Limited, Montreal, Que.

The opportunity of discussing Mr. Drysdale's excellent paper is particularly appreciated by me as I am now connected with an ammunition filling project which produces the finished ammunition for this particular gun. The paper points out that actual operational work had to be performed by untrained labour on very fine machine tools to the limit of accuracy which the machines are capable of producing. This somewhat paradoxical condition had to be faced by training the labour available and providing the necessary jigs and gauges to ensure the accuracy and speed of production required. Mr. Drysdale has been very modest in his treatment of this phase of the Sorel operation.

In an operation of this kind, the rapid assembly of such a fine piece of precision equipment as a gun, it is necessary that the accuracy of preceding machining operations is assured. It should be remembered that the designer of the gun has decided on the type of fit which any two mating parts require, which fits may be push, drive, running or shrinkage and each type of fit has its own definite clearance. It should also be remembered that it is practically impossible to turn or bore a piece to mathematically correct dimensions so that the machined parts must be gauged by limit gauges. These consist of—

Snap gauges for outside diameter checking.

Plug gauges for inside diameter checking.

Thread gauges, both internal and external, for sizing.

Thread gauges for form (usually now checked by comparators).

Receiver gauges for locating a number of holes in different planes in a machined forging or casting.

Length, ring, profile, depth and many other types.

The material to be assembled is checked by the British inspectors, whose gauges are set to the limits shown on the drawings; it follows that the manufacturers' gauges must be set to even closer limits in order that the individual parts will pass the final British inspection.

When the Sorel plant was first started I was concerned with the manufacture of several hundred snap and plug gauges for use in the gun shops, which gauges, of course, had very small differences between the "go" and "no-go" dimensions; that is the tolerances of the parts gauged were very close. Thus the dimensions of the "go" and "no-go" gauges themselves had to be held within much narrower limits, the permissible error in the gauges being of the order of approximately .0001 inch. Before these gauges could be used they had to be checked by the standards of the National Research Council at Ottawa.

When it is considered that each gun has such a large number of pieces and that each piece may require as many as a dozen different types of gauges, the magnitude of the task is evident.

Anyone associated with the production of large quantities of parts to very close dimensions will fully understand the difficulties which can well be encountered if proper gauges and jig facilities are lacking. The management of Sorel and its associate, The Chrysler Corporation are to be commended for the splendid manner in which they jointly have mastered the situation.

#### THE AUTHOR

The mechanical engineering of manufacture began to develop in Canada about forty years ago. The majority of our designs had to be imported and also the mechanics to carry out the instructions contained in the specifications. There were exceptions, but at that time most large engine, electrical, mining and other machinery

<sup>10</sup>Executive Assistant to General Manager, Canadian Car Munitions Limited, Chertier, Que.

manufacturers dealt chiefly with the replacement and repair of imported parts; apart from certain types of slow reciprocating engines, locomotives, marine reciprocating engines, very little original design and manufacture was done in Canada. With the advent of hydro electric power, and the motor car, and the use of internal combustion engines, a limited programme began, and it was to the nucleus of mechanical engineers then starting that we went when, in World War I, we undertook to make shells, cartridge cases, and fuses. Canada then found herself as a manufacturing nation. Development was rapid in the twenties, but came to an abrupt stop which lasted through the thirties.

When World War II started a certain amount of preparatory work was commenced. However, in May, 1940, an intensified programme of manufacture of aerial bombs, aeroplanes, and guns was started. This period is the cycle of Canadian engineering to which Mr. Black refers. Two large operations on shell and guns were soon underway, largely due to the initiative of certain manufacturers who anticipated a demand which came in volume many months after they started.

When a demand came for skilled help at Sorel, employee training received attention. Night classes were started and elementary training in use of chisel and hammer, filing, scraping and surfacing, reading drawings, were given in the shops. Elementary as this was it helped to familiarize the youths with the general idea of the handling and processing of metal. From then on progress has been rapid and we have developed and trained a large percentage of our skilled and semi-skilled help.

Housing was a serious problem from the start, and will continue to be as the work expands. A separate and interesting paper could be prepared on that alone. Briefly it may be said that the management, in close co-operation with the Government, decided to provide accommodations of three classes:

1. Single men's accommodation,
2. Married men's accommodation,
3. Inspectors' accommodation.

Old warehouses were converted, new extensions made to existing facilities, and new structures with communal dining accommodations were provided, so that 2,500 men and their families could be accommodated in existing and recently constructed buildings.

It did not make matters easier when we had to bring skilled English-speaking help, into an area where French only had been spoken for many years.

The cottages put up in a plot adjoining the city are of a type, which although low in cost, are intended for permanent occupancy; and as Sorel is located in a strategic commercial situation, we have every reason to believe that after the war is over these buildings will not only be used, but will, in the meantime, have set a style which will, if emulated, raise the standard in adjoining parts, and emphasize the importance to health and happiness of ample air, small garden plots, and sanitation.

The management has made a point of giving talks to the workers, with an occasional party. The various contacts of the Simard Brothers with their help have been close and democratic. The good relations established over many years between Protestants and Catholics remain excellent, and we trust this will set a good example to other similar localities in building up a united community truly Canadian in the broadest sense.

Mr. Crone has been of inestimable value in the Sorel effort. Having a lifetime of experience in armament manufacture, he has encouraged us from the start. It is a great satisfaction to know that his confidence was well placed and that we have been able to deliver the goods. We reached and exceeded our production goal this month of February, 1942.

Answering Colonel Gaudet's questions:

(1) The normal life of an inner tube varies between 2500 and 3000 rounds, this, however, depends entirely on the rate of fire, and varies according to the charge being used.

(2) The object of the recuperator is to control the recoil of the gun when fired. In a 25-pdr. gun the recuperator is provided with four bores—air cylinder, buffer cylinder, recuperator cylinder and the storage tank, which is also a cylinder designed to receive the recoil dampening liquid when the gun is fired. The recuperator block is submitted to a hydraulic pressure test. Test pressures on the various cylinders range from 3000 to 5000 lb. per sq. in., except for the storage tank which is only tested to 40 lb. per sq. in. The buffer cylinder is rifled, the grooves having a slight helix angle, and serving to operate the valve mechanisms.

(3) Cannot answer.

(4) Taking barrels for example. After forging, these are normalized. They are then rough turned and bored, following which they are heat treated and annealed. The barrels are then machined for auto-frettage. After auto-frettage they are submitted to a low temperature treatment. This completes the heat treating operation.

(5) Cannot answer.

(6) Cannot answer.

Referring to Mr. Hamilton's query as to lining up specific machines for specific operations on a single component. I may say that when laying out the machining operations a ten-hour, two shift basis was established.

In selecting the machine tools required for the different operations the actual machining times were so broken down that each machine is fully occupied. Where several identical operations are involved the work returns to the same machine twice and in certain cases, three times.

For instance, in machining the breech block, the first operation is a milling operation requiring a vertical milling machine, the second a grinding operation, the third a lathe operation, the fourth a milling operation on a horizontal miller. The fifth operation is a further milling operation executed on the same vertical milling machine as the first milling operation. The sixth is a plano-milling operation and the seventh a further milling operation requiring a vertical miller so that the work returns to the first machine for the third time.

The machines have, of course, been laid down in sequence of their operations and so as to reduce handling to a minimum. Thus one can safely say that no machine is ever idle.

For the machining of the breech block there are 16 machines, at least eight of which perform more than one operation.

It is a great satisfaction to note Colonel Howard's

appreciation of the many difficulties encountered and successfully overcome.

Regarding the team work to which he refers and which enabled us to achieve success, I wish to take this opportunity of paying tribute to the wonderful co-operation of every one associated with the enterprise. By their united work and unswerving loyalty they did their best to bring the plant to early production without sacrificing quality.

The comments of Mr. Notman are well timed as the art of pre-stressing metals has not been used as much on this Continent as has been the case in Europe.

His qualitative description of auto-frettage follows substantially that of Major General A. E. Macrae's book, "Overstrain of Metals" (His Majesty's Stationery Office, 1930).

It may be of interest to know that the cost of manufacturing the twenty-five pounder gun barrel is being further reduced and production rate increased at Sorel by a concession on the part of the Government Inspection Board, who are now willing to eliminate auto-frettage provided the quality of the steel is raised to 60 tons per sq. in. yield point.

Re auto-frettage, I would call Mr. Poitras' attention to the discussion on this subject contributed by Mr. J. G. Notman, which is a clear exposé of the method enabling us to use a 40-ton steel to do the work of the more expensive and difficult 60-ton steel.

The recuperator operation has been described in answering Colonel Gaudet.

The rolling mill is a great advantage at Sorel, particularly as it enables us to speed up delivery of rounds and square bars made of special steel which is produced at Sorel. We are installing a 16 in. roll with two 3 roll stands and one 2 roll stand. Also we have in operation a 14 in. roll with one 3 roll stand.

This will enable us to reduce from an 8 in. x 8 in. billet to 1½ in. on the large roll and from 2 in. x 2 in. to ⅝ in. on the smaller roll.

The sub-contractors of Ontario and Quebec have contributed greatly to the success of Sorel's operations, saving skilled men, machines, and housing. Sub-contracting systems developed here have been used as a pattern for the enlarged Canadian sub-contracting effort.

Mr. Whitcomb has pointed out the size of the task of providing the shop gauges for the inspection of the 25-pdr. parts. What this means can more easily be appreciated when one considers that for the gun, 150 different gauges are required, and for the carriage, more than 300.

It must be further borne in mind that some of the gauges are of a complicated type, such as the gauge for checking blow and concentricity of striker, and the turn-over gauges for measuring the bore and depth of rifling. His tribute to the management will be appreciated.

## SAVE FOR VICTORY

If you do not keep your *Journals* do not burn or destroy them. Give them to a salvage organization. They are needed for victory.

# DISCUSSION ON THE JUSTIFICATION AND CONTROL OF THE LIMIT DESIGN METHOD

Paper by F. P. Shearwood,<sup>1</sup> M.E.I.C. published in *The Engineering Journal*<sup>2</sup> June, 1941.

W. P. COPP,<sup>3</sup> M.E.I.C.

It is a fact that in fabrication and erection many parts of structures are strained beyond the elastic limit. I remember in my experience of years ago certain I-beam stringers which were badly bent when used for erection purposes. They were condemned but because they were needed immediately in the permanent structure they were straightened for temporary use and placed in position. As far as I am aware they are still there, carrying the same loads as the stringers which were not damaged. However, these stringers, no doubt, would be stressed beyond their elastic limit at local points only, while, if I follow Mr. Shearwood's reasoning, the whole outer flange layers would be stressed to the elastic limit at least, if designed by the limit design method. An overload therefore would stress these outer layers beyond their elastic limit. It would be interesting to know what would be the distribution of stress on the next application of a severe load and whether a designer could compute the strains with any feeling of security under these conditions. At the end of his paper Mr. Shearwood states that the limit design method is less safely justifiable for structures supporting their full load or those subjected to severe vibration, but might properly be used to the design of structures which will probably seldom or never be loaded to their designed capacity and to those carrying an immovable load. It seems to me that for such structures the mistake is not in designing by the elastic theory but in the choice of loadings that are altogether excessive.

With respect to fatigue it is common knowledge that material will fail at stresses far below the elastic limit, after many repetitions. Except in limited cases it seems to me impossible always to restrict uniformly the strain as suggested in the paper and thus avoid fatigue failure in every part of a structure. I remember at one time observing a swing bridge in the process of being dismantled. When one of the end diagonals was cut free at its top it had not enough strength to support its own weight and failed by bending near its bottom connection, presumably from fatigue stresses set up during the years of service. At the time it seemed fortunate that there were unused paths along which the stress must have acted since it would appear evident this particular diagonal could not have functioned for some time. In a case of this kind would the limit design method result in these other paths being able to carry extra stress without serious damage?

From Mr. Shearwood's paper I gather that some members of a structure would be designed by the limit design method, while others would be designed by the elastic theory method depending upon whether or not there were portions of the members that could not be stressed fully until other parts had been overstressed. Would not this somewhat complicate the design?

For some time it has appeared to me that in many cases steel designers are excessively cautious in their choice of loadings and factor of safety, particularly in the case of static loading. It would seem that to design by the limit design method while using excessive loadings would result in many cases in members being strained elastically only

<sup>1</sup>Consulting engineer, Dominion Bridge Company, Limited, Montreal, Que.

<sup>2</sup>The paper as it appears in the June 1941 issue of the *Journal* was laid out with two galley's interchanged with the result that the continuity is badly broken. Corrected copies have been made and are available at Headquarters.

<sup>3</sup>Professor of Civil Engineering, Dalhousie University, Halifax, N.S.

since the loads used with the large factor of safety are so greatly in excess of actual conditions. The use of more practical loads and the elastic theory of design would accomplish the same end, namely saving of material.

The thanks of the Institute are due Mr. Shearwood for his paper because it represents a real effort to avoid a waste of material by suggesting a line of study and research to that end. No doubt models could be made and tested by modern methods to show the stresses and strains suggested in the paper. The fact that an engineer with the experience and prestige of the author suggests a study of the limit design method is proof to the writer that it deserves careful thought and consideration.

HARDY CROSS<sup>4</sup>

It is not at all difficult to recognize the mathematical theory of elasticity as an intriguing, highly skilled, and frequently illuminating field of study. It is doubtful whether any structural engineer in America ever thought that steel structures—or concrete structures either for that matter—fail elastically. We have always recognized that plasticity was an important element to be taken into account. I have always, I believe, emphasized that evidence from the theory of elasticity is merely some of the evidence to be considered in judging structural parts and is often not the most important source of evidence.

It is important to point out that there are two objectives of what is called structural theory. One objective is to predict action of structures as they exist, each structure being to some extent a different problem. The other objective, which some seem to think is the only purpose, is to set up specifications or their equivalent so that not too much judgment is left to the individual designer. The author has recognized this and has tried in a practical way to set up some "acceptable tests" for a structure based upon conditions at failure. He has also clearly recognized that this is very difficult to do. It is perhaps unfortunate that our specifications in the past have been directed primarily to structures which were statically determined. We all hesitate to break abruptly with our traditions in regard to such matters because our experience and the experience of the profession is correlated with these traditions.

I do not differ from the author in our ideas in regard to these questions. I have been a little annoyed, I confess, by the suggestion that the idea of considering structural action beyond the elastic stage originated on the continent of Europe in recent years. Certainly we built enough Whipple trusses and double intersection trusses in pioneer days in this country. It is, I suspect, the concept of structural engineering as a branch of mathematics which has come from the continent of Europe.

EDWARD GODFREY<sup>5</sup>

The subject of the paper is a matter that has interested me for many years. It is epitomized in the statement, "Steel must be recognized as a material not perfectly elastic." There are many cases where this fact can be taken advantage of and where perfectly safe design can be effected—cases where perfect elasticity in the steel would mean sure failure.

A few years ago, Prof. J. A. Van den Broek called my

<sup>4</sup>Chairman, Department of Civil Engineering, Yale University, New Haven, Conn., U.S.A.

<sup>5</sup>Civil Engineer, Pittsburgh, Pa., U.S.A.

attention to the fact that a publication of the Royal Institute of Engineers of the Hague, The Netherlands, consisting of specifications for steel structures, refers specifically to an article of mine in *Engineering News Record*, May 13, 1920, which deals with the subject and emphasizes the paucity of information and instruction on the benefit derived from a knowledge that steel is ductile as well as elastic.

The author, in his paper, cites some cases where the property of ductility in steel is an advantage in the matter of safety of design. One case is in pins for pin-connected structures. In girders, particularly continuous girders, doubtless advantage could safely be taken of ductility, if experimental tests could be devised to determine to just what extent rules could be relied on.

In the author's hypothetical example of several rods of different lengths taking the same load jointly, it would be hazardous to let the stress of one of these approach near the elastic limit, unless the load were to be permanently static. For such load the condition would resemble a bent rod carrying a static load. I have more than once found that loading, releasing and reloading rods, where loads approach the elastic limit leads to disaster. Static loads do not produce this effect.

If several rods carried the same dynamic or oft-repeated load, and one were stressed near the elastic limit by reason of its shorter length, that rod might fail by fatigue and thus put added stress on the others.

Recently a paper was published which aimed to show that punched holes in riveted plate girders do not weaken the girder, and the method of design which uses the gross section is therefore justifiable. It was stated that stresses beside the holes in excess of the elastic limit of the steel serve to raise the elastic limit and thus the strength of the steel. This is false reasoning, for it is only when the subsequent applications of stress are much less than that which exceeded the elastic limit that integrity is assured. Fatigue is almost sure to follow repeated loads of the same intensity as those that permanently stretch the steel.

C. M. GOODRICH,<sup>6</sup> M.E.I.C.

The author, in his discussion of the limit design method offers interesting examples, in particular the one of the three rods. The points wherein one agrees are many, those wherein one differs are few; but the differences offer ground for discussion.

He proposes (a) to consider the sum of all resisting paths at normal unit stresses when treated independently; (b) to stress no path above the elastic limit when treated elastically. The writer would prefer to examine what happens when the structure as such is loaded increasingly, to determine as limit that point where something detrimental to the appearance, integrity, or use of the structure occurs, and to take such a portion of the loading as safe loading as may be consonant with the duty of the structure. The limit may be strength as such, it may be deflection, it may be appearance, it may be the psychological effect on the user of too much shake; other elements may enter as well, such as the very important one of reversal of stress, which in many cases would be the determining factor.

In certain mill buildings in the United States, stiffness has been secured by adding weight, while comparable buildings of half the weight and of greater stiffness have been built, by designing to this end. This, in the writer's opinion, is limit design; the limit here is a matter of stiffness.

Most telephone and telegraph lines, and many transmission lines as well, are supported on wood poles. Every year stretches of them are blown down. Yet we continue to build them. Presumably we think that practice economically

<sup>6</sup>Consulting engineer, The Canadian Bridge Company, Limited, Walkerville, Ont.

correct; and in many instances this is true, while in others it is untrue. It depends on a good many factors. Mr. Shearwood's criteria do not apply.

Take the case of the three rods of different lengths supporting a vertical load. If the load is suddenly applied and released, there would be an unpleasing sight to see if the longest rod shook and shuddered too violently. If the load were a steady load that would not happen. In that case, if deflection were not objectionable, there is no reason the short rod should not be allowed to stretch.

In the case of the beam fixed at both ends, if the loading is from one side only, let the fibres stretch if they want to do so; the centre deflection will be smaller in any normal case than that of the alternative simple beam. If the loading is reversed, then one should stay inside the elastic limit.

There are in existence structures where a stiff bent is guyed with ropes. Here it often happens that the guy will stretch say ten times as far, before it is doing its figured duty, as the stiff bent will deflect before it is in trouble. Here one may say that the limits have not been properly correlated.

In many cases it would cost more to figure stresses in a frame, or in certain of its parts, than it would to make it amply strong. Here the limit is set by the cost of the design work.

Limit design invites us to face all the facts we can gather together, and then throw away those we believe non-essential, employing the least amount of design work economically consistent with the character and importance of the work in hand, and producing a result which will be adequate to all its uses.

KENNETH W. LANGE<sup>7</sup>

What has been referred to in recent papers as limit design has been used by engineers for a considerable time. Mr. Shearwood's paper is of value as it reopens discussion of many problems of importance to structural engineers.

It occurs to the writer that any discussion of limit design also should involve careful consideration of what is meant by factor of safety. Without discussing here what the factor of safety against failure should be, and why it is provided, it can be said that many older structures are in use to-day because the safety factor used in their design renders them useful under present day overloads.

Many of our existing structures, designed by the so-called elastic theory, when analyzed by the method outlined in this paper, will show usefulness under loads considerably in excess of those for which they were designed. Had these same structures been designed by the principles of limit design, the useful loads which they could withstand would be proportionately less. The same result might be achieved by raising the allowable stresses and continuing to design under the elastic theory, which is in effect what some writers on the subject propose to do.

It is interesting to note that the hanger of Fig. 3 will withstand a load of some 110 kips or more when analyzed by the theory of the paper. Elastic analysis at design stresses with a safety factor of three permits a load of 36.7 kips. Actually then the factor of safety is  $\frac{110}{36.7} = 3$ . By allowing a load which will induce yield point stress (or strain) in one member, the capacity of the hanger is 55 kips with a safety factor of  $\frac{110}{55} = 2$ . In any case, the failure of the hanger will follow the rupture of the shortest bar.

In the design of concrete slabs, it has long been recognized that any reasonable distribution of reinforcing steel across a section is satisfactory, so long as the amount of this reinforcing is sufficient to withstand the statical moment on this section. Tests have shown that generally a slab so

<sup>7</sup>Research engineer, Chicago Bridge and Iron Company, Chicago, Ill.

designed will not fail until all of this reinforcing has been stressed beyond the yield point.

The accepted practice of proportioning foundations for some average bearing pressure, presupposes that before any one region of the soil under the foundation fails completely, the remaining part will act to resist the applied load.

The design of steel structures without regard to locked up rolling, fabricating and sometimes welding stresses, recognizes and utilizes the ductility of steel.

It is intended to point out here that the philosophy of limit design is not new in engineering. Perhaps the use of a formal theory of limit design will lead to some revisions in current practice. The contemplation of such a theory requires a reconsideration of the reasons for some of our present design requirements.

I. F. MORRISON<sup>8</sup>, M.E.I.C.

In this paper there appears to be a certain amount of misunderstanding especially of fundamental facts, which has led the author to present his argument perhaps not quite so soundly and clearly as might have been the case. To be sure, the paper is purely theoretical, based on hypothetical thinking, but it is intended that its method could be applied to practical design. This being so, one is led to question the propriety of applying an hypothesis beyond the point at which it comes into conflict with natural phenomena. After all, nature does not recognize hypothesis.

In order to make clear the discussion that follows, it is proposed just to set down in review certain well established facts. Whatever theories we may propose and put to use, these facts must not be disregarded and any application of our theory must not lead to results contrary to them.

In Fig. 9 is shown the usual graph based on the results of a tension test on a bar of mild steel. The characteristics of this graph to which the writer wishes to direct attention are as follows:

1. The curve rises as a straight line from 0 to some point F after which it bends over slightly to point A.

The unit stress—load divided by the original cross-sectional area—at F is called the proportional limit because for stresses larger than it the load-stretch relationship is no longer linear, i.e., Hooke's law ceases to exist. This linear relationship is assumed by the author to hold for all stresses with utter disregard of the existence of a proportional limit.

2. At A, which is called the upper yield point, there is a sudden yielding. If the load be of the reaction type, a decrease will take place and a considerable amount of stretch will follow until it rises again to B due to the strain hardening of the material. On the other hand, and this is extremely important in what follows, if the load be of the gravity type the complete stretch takes place continuously, with no diminution of load, from A to B and its advance cannot be checked at any intermediate point between A and B, i.e. when a unit stress corresponding to point A is attained a large unit strain of amount AB is suddenly developed. The author disregards this fact or fails to recognize the horizontal portion A-B of the stress-strain graph. He assumes that the process of stretching under a gravity load will stop at some strain lying between A and B. This is contrary to the fact as established by experiment.

3. After the point B is passed, a region of gradually increasing load is experienced until the maximum load corresponding to point C is attained. During this region of loading the entire specimen has gradually increased in length and decreased in diameter by the process of plastic deformation.

4. At the load C, a constriction at some point along the specimen starts to develop and continues to do so through the region CD. At D, fracture takes place. If the load be of

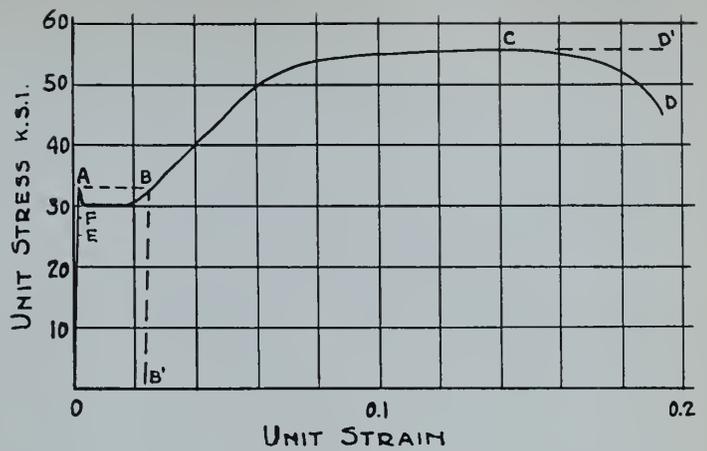


Fig. 9

the gravity type, when point C is reached the fracture process goes forward continuously to point D' and it cannot be stopped between C and D'. The total unit stretch of the piece up to point D is by definition the "elongation."

5. At some point E on the graph the material passes gradually from the elastic to the plastic state. It must be recalled that the concept of elasticity demands that the specimen return to its original size and shape whenever the stress-causing loads are removed. To determine the position of E is a difficult and time consuming process, which depends on the sensitivity of the instruments used to measure the stress and the strain. Some doubt may be cast on the actual physical existence of such a change point. The unit stress corresponding to the point E is called the "elastic limit." This term is often misused and confused with the proportional limit. It appears to be so misused in the paper.

6. If, when the unit stress corresponding to point B is attained, the load be subsequently released and then reapplied the graph retreats to B' and returns to B along the straight line B'B. In this way B becomes the new yield point and also the proportional limit.

These, then, are the physical facts. Let us see now how some of the statements in the paper compare with them. In order to build up a theory, certain hypotheses must be made and in the present case these are concerned primarily with the relationship between unit-stress and unit-strain of the material. This is done by the usual process of abstraction and the results may best be shown by the graph of Fig. 10 in which the corresponding points are similarly lettered. The line OA is straight, i.e., the material obeys Hooke's law for the stress range OA. The points F and E now coincide with A, i.e., the proportional limit, the yield point and the elastic limit now have the same numerical value. The meanings of these terms however, are still quite

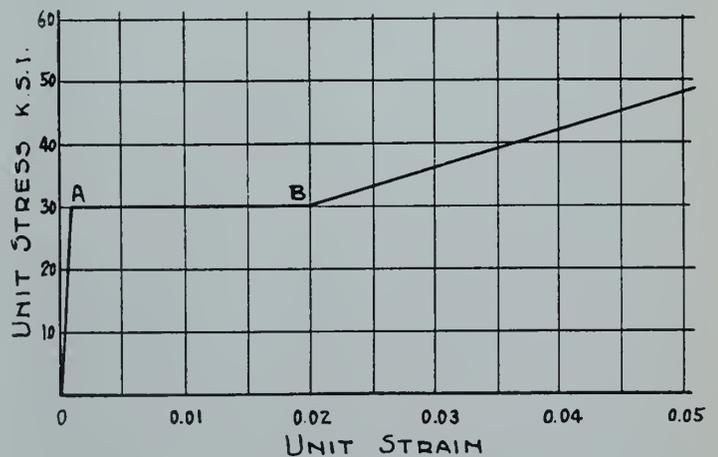


Fig. 10

<sup>8</sup>Professor of Applied Mechanics, University of Alberta, Edmonton, Alta.

different and in any rational argument cannot be interchanged indiscriminately. The load is assumed to be of the gravity type.

In order to confine this discussion within reasonable limits, it is proposed to discuss only the first part of the paper. Figure 11 corresponds to Fig. 3 of the paper redrawn for the sake of simplicity. Three steel rods, all of the same unit cross-sectional area, support a gravity load,  $W$ . The lengths are  $l_1 = 100$  in.,  $l_2 = 200$  in.,  $l_3 = 300$  in. A load  $W = 36.7$  kips is applied. The total stresses and, therefore, also the unit stresses, in kips per square inch, in the rods then are  $p_1 = 20$ ,  $p_2 = 10$ ,  $p_3 = 6.7$ , computed on the basis that each rod behaves according to Hooke's law. Assuming  $E_s = 30 \times 10^6$  lb. per sq. in., the amount of stretch is 0.067 in. for all rods. Now suppose that  $W$  be gradually increased, a value will be reached at which the unit stress in rod No. 1 will correspond with the yield point, A of Fig. 10, not the elastic limit<sup>9</sup>, i.e.  $p_1 = 30$  kips. The value of  $W$  for this condition will be not less than 55 kips and the stretch will be 0.1 in. As the load increases from 55 kips, a value will finally be attained at which the unit stress in rods Nos. 1 and 2 is 30 kips per sq. in. respectively and the minimum value of  $W$  is 90 kips, and the stretch will be 0.3 in. Any load  $W$  greater than 90 kips will cause a sudden, and rather disconcerting total stretch of 2.0 in. Such a performance would cause alarm on the part of the most ardent proponent of the limit design process.

It will be noted that the combination of  $p_1 = 35.25$  kips,  $p_2 = 22.9$  kips,  $p_3 = 15.25$  kips, as shown in the paper (Fig. 3c), is not possible if we are to be consistent with the load stretch curve shown in Fig. 10, for these values are based on the incorrect assumption that Hooke's law holds beyond the physical yield point of the material.

It is apparently anticipated, in the limit design process as set forth in the paper, that the limiting carrying capacity will be 90 kips and that for design purposes the safe load would be obtained by applying a factor of safety, although no indication is given of what a reasonable value for it would be in this case. Let us suppose, however, the factor to be 1.5. Then with the load at 60 kips, the total stresses will be  $p_1 = 30$  kips,  $p_2 = 18$  kips and  $p_3 = 12$  kips with total stretch of 0.12 in. This does not agree with Fig. 4b. The numerical values given in that figure are inconsistent with the facts as determined by test. If the stretch of 0.12 in. is satisfactory the design might be accepted as quite safe.

A little careful consideration, along with Fig. 10, will convince the reader that such combinations of stresses as shown in Fig. 4e are quite incompatible until the second rising part of the load stretch curve has been reached

and therefore only after a considerable amount of stretch has occurred. The impracticability of basing any design on such figures is at once apparent.

If the factor of safety were taken at 1.8, then  $p_1 = 27.3$  kips,  $p_2 = 13.6$ ,  $p_3 = 9.1$ . This would be equivalent to assuming a maximum allowable unit stress of 27.3 kips per sq. in., and we are simply back to the classical theory with a higher than usual allowable stress. If limit design leads back to the customary process, why not simply adopt higher allowable stresses?

One can hardly give serious consideration to such remarks as are found on pages 3 and 4 of the paper to the effect that "medium steel specification calls for an elongation of 22 per cent or equivalent to a stress of 6,600,000 lb. per sq. in." Such astronomical flights of the imagination find no place in such a paper and can add nothing to it. The author has apparently overlooked the technical meaning of the

<sup>9</sup>The tone elastic limit lies slightly below A and it is relatively important in this discussion.

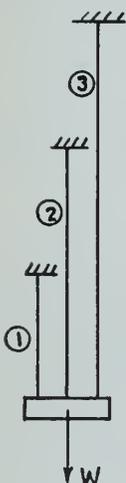


Fig. 11

word "elongation" as applied to the standard test, as well as the facts as set forth in Fig. 9 of this discussion.

The writer must confess he is surprised at the author's remarks under the heading of Fatigue. The most striking single fact concerning fatigue is that it takes place without plastic straining of the metal. The cause of a fatigue failure is not "progressive creep," which is a different phenomenon in no way related to cyclic stressing. Just why a restriction of the strain should inhibit fatigue failure is most certainly not clear.

#### THE AUTHOR

The general principle of limit design is the recognition that yield can be safely counted on to equalize the distribution of stresses in steel frames. Many claim that this has already been in use which is, no doubt, true (sometimes deliberately or more often by accident). It is not, however, an accepted standard practice to allow for the influence of yield when designing new structures.

Mr. Goodrich very rightly emphasizes the fact that the designer should always consider the character and importance of the work in hand, but the first and the absolutely essential condition which must be fulfilled in all cases is that of adequate strength. Other items which he mentions require supplementary consideration. In order to simplify this discussion it must be confined to the essential requirement.

There was not in the paper any intention to advocate the discarding of elastic computations, but rather to suggest a more perspective use of them in conjunction with the effect of deformation, and to realize what an extremely minute adjustment of strain is being pursued by these intricate and laborious calculations, and to judge whether simpler computations giving perhaps less theoretically exact distribution of strain (interpreted as stress), would not actually provide as safe a structure.

The stress equivalent of the elongation requisites of standard specifications (22 per cent) was referred to in order to show that the ratio of strain to stress varies so greatly as it reaches the ultimate strength and that such a very minute portion of the specified deformation can insure advantageous readjustment of the stresses.

Fatigue is referred to by nearly all those discussing the paper. It is of course an all important matter for structures supporting intermittent forces, but with quiescent loading repetition does not occur and therefore, fatigue cannot affect the main question.

The discussion by Professor Morrison is very welcome, since it views the problem from the testing laboratory angle, whereas the author may have been too greatly influenced by his observations in the erection and fabrication of steel work.

Professor Morrison claims that there is a long flat portion in the stress-strain diagrams of structural steel. This is generally true of small test coupons but may not be the case with shapes in which the yield point may vary throughout their section, and with built up members which generally have some assembling inaccuracies. The exact length of the straight portion and as to whether it is exactly horizontal appear to be somewhat doubtful.

The error or difference in the stress-strain ratios used on Figs. 2, 3 and 4, does not materially alter the comparisons of these examples. The intention was to compare the strengths as calculated by the elastic theory and the limit design method of a hanger having no unequally strained rods (Fig. 2) with one having unequally strained rods (Figs. 3 and 4). Professor Morrison takes no notice of these comparisons and only compares Fig. 4 with Fig. 3.

Revising the stresses given in Figs. 2, 3 and 4 for the stress-strain conditions given by Professor Morrison's Fig. 9, the working value of the member with equal lengths (Fig. 2) when computed by either the elastic or by the limit design methods is 60 kips. The member having three rods of different lengths has a working value of 36.7 kips

(Fig. 3) when computed by the elastic theory and of 55 kips (Fig. 4) when computed by the tentative method of this paper. If these loads are increased by 50 per cent, the rods of Fig. 2 will all reach the yield point, and, according to Professor Morrison, a sudden deflection of four inches will take place, certainly rather alarming! In the case of Fig. 3 only one rod will reach the yield point and the deflection will be limited to 0.2 in. because of the elastic resistance of the other two rods. The load in Fig. 4 will be 83 kips and the two shorter rods will reach their yield point, but the longer rod is still within its elastic stage and it will limit the deflection to 0.23 in. If the working loads are doubled the deflections will be about as follows:—

Fig. 2.....	about	7 in.
Fig. 3.....	“	0.26 in.
Fig. 4.....	“	4.8 in.

If the stresses and distortions of the hangers having equal and unequal length rods are compared, it is evident that any partially unstressed material should add to their strength and possibly justify the values given in Fig. 4 being nearer the relative safety than those given by Fig. 3 when compared with the standard given by Fig. 2.

Professor Morrison states that fatigue occurs without plastic straining (i.e. yield) but many tests have shown that it takes a repeated stress greater than the yield stress to produce a fatigue failure (see Morley's "Strength of Materials" and others). Therefore, if deformation only occurs after the yield point is reached, there must be some deformation when a repeated stress is applied which is great enough to fracture the metal.

Mr. Godfrey points out that perfect, i.e. the complete elasticity would mean sure failure in many cases. It would certainly bring trouble to the fabricating shops, since they could not straighten any steel without fracturing it. This must prove that much of the material in steel structures has been strained beyond its yield point, and yet can function as if undamaged.

Professor Copp and some others infer that it is a good practice to neglect any strength not shown by the primary elastic computations and use it as an extra means of meeting possible future increase in loading or abuse. This would be a

very inconsistent provision; e.g. in a simple span structure there would be no excess strength, while in many other types the excess might be as much as 30 per cent.

To merely increase the unit stress and use the elastic theory would not achieve the same objective as the limit design method because that would merely reduce the figured margin of safety, instead of taking credit for the proportionately greater participation of under stressed paths coming into effect as the primary paths yield, which must happen before there is any danger of failure.

Mr. Lange points out that failure will probably be in the shortest rod (Fig. 3) but owing to the changes in the modulus of the rods as they pass their yield point, the distribution of stress between the rods will be constantly more nearly equalized after the yield point of the shortest rod is passed, and the loading is increased.

Mr. Lange's remarks regarding locked up stresses (strains) are certainly important in these days when plates and shapes are being bent, formed and welded so frequently during fabrication and so generally put into use without stress relief. These everyday practices must indicate that the small amount of yield required to redistribute the stresses as called for by the limit design method can be accomplished without harming the material at least for those structures which support quiescent loads.

Professor Hardy Cross has aptly drawn the author's attention to the fact that the modern specifications, which so autocratically govern most of the commercial designing were originally written for simple or assumedly simple structures, but are now rigidly applied to all steel structures, whether they have all their strength in one brittle path or in several ductile ones.

The discussion as a whole is rather non-committal but while admitting that yield cannot be avoided during fabrication and has often secured the safety of many severely over-stressed structures, there is a reluctance to count on it officially in designing new work. It was to assist in correcting these inconsistent conditions that this paper was written.

The author wishes to thank those who have contributed to this purpose.

## Abstracts of Current Literature

### TORPEDO AIRCRAFT

From *The Engineer*, (LONDON), MARCH 20, 1942

There was healthy rivalry in the days before the war between those in the Royal Air Force who flew bombers and the crews of torpedo aircraft. Which form of attack upon hostile warships would prove the more effective? Many practical exercises were carried out to throw light on this question. The bombers relied on the use of heavy bombs of high penetrative power and flew at the greatest possible height they could to ensure that the striking velocity of the falling bomb should be high enough to be effective, as much as 20,000 ft. of altitude being necessary. Such high-altitude flying led, of course, to an acceptable lessening of the danger from A.A. fire, but there was the risk lest it should nullify accuracy of aim. If it be admitted, as it must, that doubling the height is likely to halve the accuracy, other things being equal, it must be remembered that careful training can go far to reduce bombing errors and that at the worst a battleship is always a satisfactorily large target. Moreover, the bigger the ship the slower will it be in taking avoiding action, although such action at the best of times is not found to be a grave hindrance to the bomb aimer. Low-height bombing, on the other hand, is most risky to the

### Abstracts of articles appearing in the current technical periodicals

aircraft, and if it has to be done at all it had better be on the dive than by a level attack. The dive sometimes produces very remarkable accuracy, even when carried out in the face of active defence; on the other hand, it can never give high striking velocity, hence the penetration will be slight. Nevertheless, it can disorganize A.A. fire, and by doing so enable its fellows, the torpedo bombers, to have a better opportunity to dash in to the attack. Unless they have assistance of this kind torpedo aircraft have a difficult and dangerous task. They have to fly very low to release their torpedoes and they must come in close to the target if they are to get accurate aim. They have, of course, a far better chance both of success and of survival when they attack in numbers and from various directions, since the A.A. guns, even when they are not being attacked by bombers, cannot deal with numerous torpedo craft all at once and a single torpedo hit may prove disastrous to the ship. A single torpedo, it is true, is hardly likely to sink a modern warship, but it may easily wing it and so render it a prey to other forces.

The damage done by missile attack on a ship is of two chief kinds: damage to the effectiveness of its means of

propulsion and damage to its buoyancy. The armour penetrating bomb aims at the former; the bomb which just misses the ship—the “near miss”—may achieve the latter if it detonates closely alongside, but it is the torpedo which is much the most effective weapon, since it explodes in actual contact. But whether by “near miss” or by torpedo the mechanism of the resulting damage is much the same. The exploding mass creates two things: a great sphere of very high-pressure gas, and in the sea an intense pressure wave of the water hammer variety. The bomb may detonate too far from the ship for the blast of the explosive gases to reach it, but the compression wave in the water rushes outwards at a speed of over a mile a second and may smash its way right into the hull of the ship unless the latter is of such carefully chosen construction as to prevent any great degree of damage from resulting. In the case of the torpedo attack both gas blast and detonation wave act together and very precisely thought-out defence measures are needed if this powerful combined effect is to be neutralized.

The first constructional step in the direction of defence against torpedoes was made long ago by the addition of the so-called “bulge,” since absorbed by the methods of construction used in initial design. The traditional remedy, and it has a scientific basis, against any fiercely sudden attack is the interposition of a cushion of some sort. The fiercer the attack the more effective must be the cushion. Our naval architects are second to none in the world and we have in our councils, potentially at any rate and we hope actually, scientific men who are expert in hydrodynamic phenomena and who can advise as to the nature and amount of these impulsive pressures and of the probable lessening of the damage they can do when suitable precautionary actions are taken. These are matters which cannot be probed in public, but we hope, as we little doubt, that the authorities are fully alive to the position. One has an impression that the German warships have proved themselves able to stand up well to punishment, and it is up to us to show that we can do still better.

## WAR OUTPUT UP 2,000 PERCENT

FROM ROBERT WILLIAMSON\*

Output of shell fuse cases in a British munitions factory was increased twenty-fold after industrial psychologists had suggested improvements in methods of working.

The job required careful hand-soldering of seams, and as the factory had lost most of its experienced solderers the weekly output was only 1,000 good cases, with several thousand rejects. But after various changes of which the most important was a systematic training scheme, based on careful study of hand and body movements, the output was raised to 20,000 cases a week, passed by the inspectors.

This is only one of the cases in which trained psychologists from Britain's National Institute of Industrial Psychology have helped to speed up production in Britain's war factories. Although the results are sometimes startling there is no particular magic about their job. It is based rather on a careful study of the physical movements entailed, on proper methods of instruction, and above all on interesting the trainee in the work.

Hours of wasted time have been saved by getting the trainees into the habit of arranging their tools around them in an orderly way and replacing them after use. More subtle are devices whereby both hands can be used instead of one. For example, if a screw has to be placed on either end of an article, instead of holding it in one hand and then transferring it to the other it is held in

\*London Correspondent of *The Engineering Journal*.

a vice and both screws are put on simultaneously. Then to save the trouble of picking it up a foot pedal may come into operation and drop it into a box.

Training is made interesting by interspersing hand-work with general instruction so that trainees understand how their work fits into the general scheme. In weaving, for example, they are told about the types of thread used, the use of the cloth which is being woven, and so on. In tank factories they not only see their particular part assembled into the completed job, but are shown the tank in action.

Coil winding operatives trained by these methods were found to reach a standard of proficiency in only five days which previously had taken five weeks. Moreover, this was not achieved at the expense of output, for a 65 per cent increase in the average output of good pieces was obtained, while the scrap rate fell from 5 to 2 per cent.

Apart from this, the psychologists have increased production by suggesting improvement in working condition amenities and by investigating and smoothing grievances.

## SAND IN THE GEARS

EDITORIAL COMMENT

FROM *New Equipment News*, (MONTREAL), MARCH, 1942

There is a substantial undercurrent of gossipy criticism of our government, the country's war effort and, in fact, almost anyone or anything connected with any part of the war activities of Canada and the Empire. This situation is not serious in itself but it is undoubtedly affecting our unity of effort and, if permitted to gather momentum, it will pave the way for disunity within this country and even within the Empire itself. It is not the idle talk of really ignorant persons but the growing theme of conversation of educated people to whom we should look for “all out” (in its truest sense) support and personal effort.

Much of this criticism is based upon what might be termed apparent facts—things that have actually happened—things that are happening—conditions that exist—decisions and rulings of the government—actions and orders of government departments and boards—appointments to war organizations—selection of army recruits—government administrative expenses—and a thousand other major and minor subjects. These are general subjects but more specific items of conversation include: lack of production in some war industries, overstaffing of government war-time offices, excessive expenditures in newly established boards, absence of co-ordination of effort in special war-time organizations, and many others. In fact, there are few, if any, of the war activities that are not ruthlessly pulled to pieces, and at times even ridiculed, in these conversations. And, remember, this endless stream of gossipy criticism is the theme of conversation of “educated people.”

“Educated people”—but thoughtless ignorant people—who perhaps think it is smart to “know it all.” Thoughtless, because they do not realize the damage they are doing. Ignorant, because obviously they cannot know what is really happening, or the reason for things, or the wider plan and strategy, which are the reasons for the “apparent facts” they so carelessly discuss. Their greatest sin is “thoughtlessness.”

All this does not emanate from any particular centre. It is not an organized effort in any sense. It may be fostered or encouraged by enemy propagandists but, if so, there does not appear to be any evidence to that effect. Certainly not among the people to whom the above statements are attributed. In fact, these Canadians are, in their hearts, among the most loyal of our citizens. But, through their ignorance and their carelessness, bolstered

by their egotism and their superiority complex, they are playing into the hands of the enemy and leading to the one goal—disunity. They talk of “an all-out war effort” but apparently do not know the real meaning of the phrase, otherwise they would support, rather than discredit, the endeavours of those guiding and carrying on Canada’s and the Empire’s plans to defeat the enemy.

We have witnessed an untimely political flurry in Ontario and Quebec, when much was said in the heat of the campaign. That’s over—it’s time to discard politics for the duration. Now it is urgent that the people of Canada, from coast to coast be cemented into one single unit with only one motto—“no effort in thought, word and deed that will help the cause of freedom shall be left undone until the enemy is vanquished.” Anything less than this is criminal negligence.

Never in the history of Canada—never in the history of our Empire—has there been a time when it was so vitally important for us to all stand together—work together—and face the enemy with a solid united front. Never were the minutes passing more quickly—to-day we can cast aside all selfishness and save all—to-morrow it may be too late.

This is not a message from our government, or our churches, or any group of our leaders. It is not for the purpose of supporting any political party, any creed, any race, or any of our special war efforts. It is a plea to every Canadian, whether he be in a position of authority, or in some important war work, or simply performing his regular daily duties, to face the facts and to do his little bit to prevent the terrible catastrophe that is so steadily and rapidly moving towards us.

What the individual is doing, or can do, at this critical time depends very largely upon circumstances and to some extent upon opportunity. It is not possible to marshal millions of individuals in a few short months and allocate some obviously important duty to each. But each, on his own initiative, can make a contribution of inestimable value to our cause by standing back of those in authority; by refraining from idle chatter and gossip; and above all, by openly squelching that simple but dangerous fool, the “scandal monger”—the “know-it-all.”

## BRITISH AIRCRAFT PRODUCTION

From *Engineering* (LONDON), FEBRUARY, 1942

Addressing a press conference in London last February, Lieut.-Colonel J. T. C. Moore-Brabazon, then Minister of Aircraft Production (in which position he has now been succeeded by Colonel J. J. Llewellyn, M.P.), gave some indication of the changes that were being gradually effected in the output of bombers. Construction of the Hampden and Whitley types was being reduced and would eventually cease, the productive capacity thus released being devoted to increasing the output of long-range four-engined machines. The Wellington would remain in production, however; it had proved to be a most serviceable machine, especially for medium-range work, and would still be used in considerable numbers. The Minister recalled that questions had been asked in the House of Commons last year, before the United States came into the war, regarding the delays caused by the various modifications required by the Royal Air Force to American machines. Experience had shown the American manufacturers the wisdom of these alterations, and they were now being incorporated in the designs; the output of American machines, in operationally complete form, would thus be appreciably accelerated, apart from the speeding-up that would result from the full mobilization of the vast motor-car industry of the United States. Machines were coming from Canada also, at a rate which

was most gratifying, and their quality was fully comparable with that of the machines constructed in this country. Supplies of aircraft to Russia continued on a considerable scale; under the agreement made at Moscow, they were not to fall below the figure then promised, though that figure might be exceeded. Developments in aircraft engines were progressing satisfactorily. The Rolls-Royce Merlin engine was still the best liquid-cooled engine manufactured anywhere in the world, but the types at present in operational use did not represent the last word; new models were in hand which would certainly provide the enemy with some surprises. The production of fighters had been speeded up by simplifying manufacturing processes and so reducing the number of man-hours required per machine; in the case of one type, the total of man-hours had been halved. The American fighters which were now coming into service in useful quantities were in the forefront of their class, and in this connection Colonel Moore-Brabazon mentioned particularly the Mustang and Kittyhawk machines. In conclusion the Minister stated that the formation of works committees, which were helping materially to increase the production of aircraft and engines, was being pressed forward throughout the industry; but he pointed out that the change-over of factories to the construction of new types must always involve a certain amount of idle time for the relatively unskilled labour now being employed in large numbers, which could not be rapidly switched on to unfamiliar work without further training in the new processes thus rendered necessary.

## CONCRETE ARCHED AEROPLANE HANGARS

From *The Engineer*, (LONDON), MARCH 20, 1942

Among the numerous types of hangars built for the aeroplane services of the American Army and Navy are concrete barrel arch hangars, springing from the ground level, with a span of 294 ft. and a height of 81 ft. at the centre. They are built in pairs, side by side, with a single central footing, the narrow space between the two arches being utilized for repair shops. The arched roofs are built in sections, separated by expansion joints. Each section consists of two arched ribs with a thin roof between them and a stretch of thin roof cantilevered on each side. The edges of these cantilevered stretches are thickened and are stiffened by small ribs in which the expansion joints are formed. Brackets on the outer sides of the arch ribs carry longitudinal beams and framing for two-storey offices and quarters. On the inside, or intrados, the roof is smooth and unbroken, the ribs rising on the outside. For the foundations, where rock cannot be reached, the vertical arch reaction is taken on wood piles, while the horizontal thrust or tension is taken by tie bars composed of steel cables, each member having eight strands of 1 1/16 in. diameter. These ties are anchored in the footings and the cables are pre-stressed, so that under dead load the horizontal thrust is taken by the ties and the footings take only the vertical reaction. The arch ribs are designed as two-hinged arches, with hinges of the Mesnager type. Each hinge consists of thirty-two vertical 1 1/4 in. steel bars and twenty bars of one in. diameter arranged in fan shape to take the horizontal reaction. In order to resist overturning moments, such as might be caused by earthquakes, bars of high yield point strength are used at the outside of the hinges. In construction, a timber falsework was used, long enough for one section, and mounted on rollers so as to be moved to each section in turn. When in position it was adjusted and supported by screw jacks and blocking. The concrete, designed for a strength of 3,500 lb. per square inch, was prepared in two mixers, which fed a double pump having two 8 in. pipe lines that discharged directly into the forms.

## REVERSIBLE MAGNETIC COUPLING DESIGNED FOR USE IN MARINE ENGINES

From *Overseas Daily Mail*, (LONDON), OCTOBER 25, 1941

Magnetic couplings have been employed in geared oil-engine installations for marine use, and they have several advantages. The couplings act as a truly flexible and resilient member between engine and gear, for there is no mechanical connection between the engine and the pinion shaft of the gear drive.

This benefits design in several ways, especially as regards fluctuations of the engine speed being transmitted to the gears, misalignment, and torsional oscillations between engine and pinion shaft, which may, unless damped, lead to severe wear on the gear teeth. The engine can be started under no load, and speeded up, when torque is applied gradually by exciting the coupling.

During reversal the coupling is de-excited, the engine reversed under no-load, and the coupling excited again to pick up the torque.

In the ordinary non-reversing type of coupling one member carries a squirrel-cage winding and the other a salient-pole magnet wheel—it is immaterial to the principle whether the squirrel-cage winding is attached to the engine or the pinion shaft or whether it is the inner or outer member of the coupling.

More usually the salient-pole magnet wheel rotates with the engine shaft around the squirrel-cage winding which is attached to the pinion shaft. The salient-pole magnet wheel is excited by D.C. current.

The rotating field produced by the D.C. magnet wheel drags round the rotor after it; there is a little slip, very similar to that between the rotating field and the rotor in a squirrel-cage motor.

To reverse the propeller, it is necessary to reverse the rotation of the D.C. field, and this can only be done by reversing the engine. This reversal is, in fact, more easily permitted because, as stated above, the load may be disconnected at the coupling and the engine reversed under no-load conditions.

None the less, it remains that reversal of the propeller means reversal of the engine, and this in turn, means complications in engine design, and especially the provision of ample compressed air equipment and storage.

A design has been proposed and patented by The General Electric Co. Ltd., in which it is possible to effect reversal of the propeller without reversal of the engine, if necessary at full torque. The basis of this design is to use D.C. operation in the normal way for forward running, but to substitute three-phase A.C. current to excite the rotating field member in such a way as to produce a rotating field in the opposite sense to the engine rotation.

The frequency of the three-phase exciting current is double that corresponding to the engine speed so that the field rotates backwards at twice the engine speed with regard to the engine member. As the latter is rotating "forwards" at engine speed, the net result is that the speed of the rotating field in space is the normal speed backwards. The propeller, therefore, is reversed and runs at normal speed astern.

To enable this to be done the exciting winding must be designed to be suitable both for D.C. excitation when running ahead, and A.C. excitation when running astern. The magnet wheel with salient-poles is therefore replaced in the reversing coupling by a laminated core with star-connected three-phase winding.

In ahead running the exciting winding is fed by D.C. current through two phases in series or through two phases in parallel and the third in series, in either case producing alternate poles as with a salient-pole design.

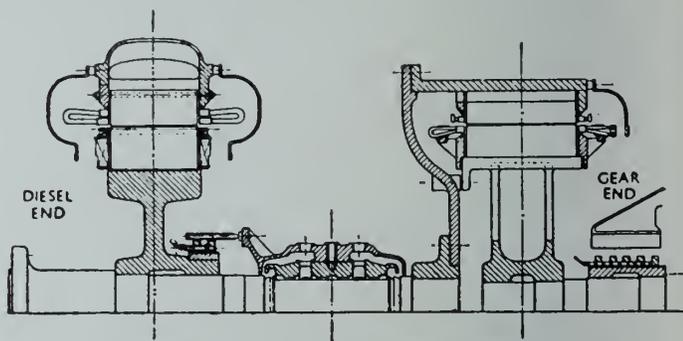
It is also necessary to provide a supply for the A.C. excitation for running astern, and this may most con-

veniently be obtained from an alternator incorporated in the coupling. The alternator takes the form of a salient-pole rotor with a three-phase stator surrounding it, the rotor being excited with D.C., and the stator then producing A.C. which is used to excite the winding of the coupling.

Since the frequency of the alternating current required is double the normal frequency the number of poles in the salient-pole alternator is double those in the exciting winding. Consideration will show that there will be an inner circulation of power resulting in the alternator having to supply twice the full power of the engine. It might be thought that this would call for a disproportionately large and heavy alternator, but this is not so severe a limitation as might be assumed, because the duration of full torque reversal is usually very limited and an alternator designed for a very short time rating can be used.

The reversing coupling described consists, therefore, of the alternator and the coupling proper, which behaves very much like an induction motor. It may very well be asked what advantage this has over the ordinary form of Diesel-electric propulsion where generators and motors have to be provided in much the same way.

The reply to this is that the alternator required, though it has to carry twice full load power for astern running at full power, is of very short-rated design, since these conditions are infrequent and of short duration. During ahead running the alternator is completely idle.



An arrangement of G.E.C. reversible magnetic coupling for geared Diesel vessels.

The efficiency for ahead running is exactly the same as for a simple magnetic coupling—not less than 98 per cent., and considerably higher, therefore, than a Diesel-electric scheme. The amount of switchgear is at a minimum as only two field switches and two regulators are required, none of which is required to carry heavy currents owing to the special arrangements described below.

In starting and ahead running, the control is precisely the same as with the non-reversing magnetic coupling. The engine is started and runs up to speed under no-load, when the D.C. exciting current is switched on and the propeller picks up to a speed corresponding with that of the engine, which can then be set to run at any required speed.

In reversing, the D.C. excitation is switched off, the engine speed reduced, and the alternator stator winding connected to the exciter winding, the alternator rotor-winding being itself excited with D.C. The coupling then reverses and the vessel moves astern, the engine speed being as required, but the engine still running in the forward direction.

Since power has to be transmitted by this method between the two windings and heavy-current switches would be necessary, special methods of connection have been devised which avoid this difficulty. These include the division of the exciter winding into two separate parts, one permanently connected to the alternator stator winding, and the other carrying the D.C. excitation for forward

running. When running ahead, the part connected to the alternator stator carries no current.

In running astern, special precautions are taken to avoid a voltage being induced in the exciter winding by the rotating field produced by the A.C. This refers particularly to a design of coupling whereby the alternator is mounted on the outside of the coupling, the order of the windings from the outside being then: alternator stator, alternator salient-pole rotor attached to the engine, coupling exciting member attached to the engine, squirrel-cage rotor attached to the pinion shaft.

This arrangement is apt to be of large overall diameter, and an alternative arrangement is to arrange the alternator separately on the engine shaft by the side of the coupling, introducing a bearing if necessary. The squirrel-cage member can be attached to the engine shaft if necessary, and the exciter winding to the pinion shaft; this arrangement reduces the overhanging weight, and is the one illustrated in the diagram.

It has been assumed in the above that the ratio of poles in the alternator to the coupling is 2 to 1. Special advantages may be obtained by departing slightly from this ratio, say 1.8 to 1 or even 1.6 to 1, according to the reversal torque required when the ship is still moving at full speed ahead at the moment of reversal.

In the case of these fractional ratios, the reversed coupling acts as a reduction gear between engine and propeller; with a pole ratio of 1.8 to 1 the gear ratio is 1 to 0.8; with a pole ratio of 1.6 to 1 the gear ratio is 1 to 0.6. With a normal pole ratio of 2 to 1 the gear ratio is 1 to 1, and in forward motion the ratio is always 1 to 1, apart from the slight slip in the coupling.

### LARGER WELDING ROD

From *Mechanical Engineering*, (NEW YORK), APRIL, 1942

If instead of continuing arbitrarily to use the smaller diameter rods, industry would employ just one size larger, there would be a tremendous increase in speed of welding and, consequently, much faster production of vitally needed welded war products, according to J. F. Lincoln, president of The Lincoln Electric Company. For example, every welder working to-day who would start using 1/4-in. electrode in place of the 3/16-in. size, could, in six hours, do the same amount of welding he now does in eight. The total saving in man-hours, if only half the 200,000 welding operators were to make this change on only 50 per cent of the war welding jobs being done to-day, would be equivalent to 25,000 welders. This army of workers would thus be made immediately available for other, or additional work.

Electrodes of larger diameter, says Mr. Lincoln, make for faster welding because they deposit more metal in a given time than the smaller sizes. Larger electrodes simply "pour" the metal into the weld faster than small ones.

Not only would adoption of larger electrodes give industry a new and vast army of skilled welders, but it would relieve a threatened bottleneck in electrode production. According to Mr. Lincoln, it takes just as long to produce small-size electrodes as it does large ones. The controlling factor is the application of the coating which allows the modern electrode to produce the much higher quality of weld than was possible with old-type uncoated rods. If the welding industry could concentrate on producing larger size electrodes the availability of electrode metal would be greatly increased, since the larger sizes contain proportionately more metal for welding than the smaller.

### TO-MORROW MAY BE TOO LATE

C. D. Howe, Hon.M.E.I.C., Minister of Munitions and Supply

From *Industrial Canada*, APRIL, 1942

These are dangerous days. Never before in the history of mankind has there been such universal havoc. The proportions of this bloody battle are beyond the comprehension of peace-loving citizens who have spent their lives creating a new world where men could look forward with confidence to a future of comfort.

This war has rudely upset all of our calculations. Yet an alarmingly large proportion of our citizens cannot even yet realize that we face now, to-day, at this very hour, the awful crisis in our history.

It is not a question for armies or navies or airmen to decide. It is not within their sole power to turn the tide of battle. The crisis rests right on the shoulders of the average citizen—the workers in the plants, the women in the homes—the executives who control the productive capacity of our industries big and little.

To-morrow it may be too late to discover the ways and means of speeding up production, and then our future is an uncertainty too awful to contemplate.

Is it then too much to expect that every man in Canada who has productive capacity at his command, will forget self and profit, will overlook rights and privileges and turn his whole thought to the production of the war materials so sorely needed by those who face the enemy on none too distant battle fields and on oceans shockingly near our own shores?

This is the story that the Department of Munitions and Supply has been endeavouring to bring home to the citizens of Canada in the daily press, in the magazines and by the radio during recent weeks. Shall Brave Men Die Because YOU Faltered?

### THE R.A.F.'S TWENTY-FOURTH BIRTHDAY

From *The Engineer*, (LONDON), APRIL 3, 1942

Twenty-four years ago, on April 1st, 1918, the R.A.F. was first officially formed, under the terms of the Air Force (Constitution) Act of 1917. The amalgamation of the R.F.C. and the R.N.A.S., recommended by the Air Organization Committee under General Smuts, became an accomplished fact, Britain's two air arms being merged into a single fighting Service. An Air Council had been set up in January, 1918, under the first Air Minister, Viscount Rothermere. He was succeeded, on the creation of the R.A.F., by Viscount Weir. Shortly afterwards, in January, 1919, Mr. Winston Churchill became Secretary of State for War and Air, a post he held for two years. The Chief of the Air Staff at the time of the R.A.F.'s formation was Major-General Sir Hugh (now Viscount) Trenchard. Following the creation of the Force, Major-General Sykes took over for a year; then in April, 1919, Lord Trenchard again became C.A.S., holding the post for ten years—the longest tenure of any holder of that key position in the Empire's defence. At the time of the Armistice Britain's R.A.F. comprised 188 operational squadrons with a first-line strength of 3,300 aircraft. Altogether, the R.A.F. possessed 22,647 aeroplanes, 103 airships, and had a total personnel strength of 291,175, including over 27,000 officers, of whom more than one half were trained pilots. This mighty force was backed by the world's greatest and most efficient aircraft industry, with an output of about 3,500 airframes a month, and an even larger output of aero-engines. To-day, the R.A.F. faces the greatest test of all. With a strength now equalling that of its most powerful enemy, the German *Luftwaffe*, it is fighting offensively on several air fronts.

## ARE ENGINEERS INARTICULATE?

It would be interesting to trace the origin of the idea held by some that engineers as a class are inarticulate; a statement which unfortunately is even heard from engineers themselves. The dictionary tells us that the term implies inability to speak distinctly or even inability to speak at all. Thus an inarticulate person is presumably one who is unable to give effective expression to his ideas, even if he has any, and the circulation of the statement is certainly not a compliment to our profession.

Perhaps as a class, engineers do not like talking about subjects on which their knowledge does not qualify them to speak, or on which they have nothing to say. In this respect they differ entirely from, shall we say, certain types of professional politician. But engineers as a class are able and willing to express themselves, both in writing and orally, on subjects with which their training enables them to deal. As a rule they do not care for speeches or written communications which carry no definite message and employ a multitude of words in doing so. Few engineers are orators in the politician's or lawyer's sense of the word.

The engineer usually has to address hearers or readers who, like himself, wish to base their conclusions on ascertained facts and reasoned argument, not on impassioned appeals to sentiment, emotion, or prejudice. There are persons in all walks of life who seem to think that the announcement of a fact taking five hundred words is ten times as forceful as the same statement made in fifty words, but not many of these people are engineers. It may even be that the legend of the inarticulate engineer was put forth in an attempt to explain why so few engineers are given to the outpouring of words.

Bodies like the Engineering Institute have as one of their main purposes the encouragement of communications by and between their members. As a matter of fact the professional publications—or literature—of the engineer compare very favourably in quality and amount with the corresponding output of sister professions. If a criticism is permissible at this point, it would be that too many engineers are silent because they do not realize that their own individual work or experience covers much which would be of interest to their fellows, and that therefore they have a message to deliver.

In addition to the preparation of papers, and taking part in spoken or written discussion on professional matters, the average engineer is occasionally called upon to address a professional or social gathering, sometimes without time for preparation. Those of us who have had the opportunity to attend Institute and branch meetings in various parts of the Dominion, and over a period of years, cannot fail to have been struck with the large number of Institute members who can think on their feet, take an active part in debate, preside at meetings, and prove effective—in some cases even brilliant—as extempore speakers.

There were outstanding examples of the last named ability at our recent annual meeting. No one who had the privilege of seeing and hearing General McNaughton when he delivered his address without manuscript or notes, to Canadian engineers at this year's annual dinner will forget that stirring call to the Canadian people, the eloquence of its words, or the sincerity and deep emotion of the speaker.

On the same occasion the speeches of the outgoing and incoming presidents of the Institute were noteworthy. Dean Mackenzie's efficiency as a presiding officer was evident throughout the evening and everyone was delighted by the agility with which he glided over a momentary check by suddenly awarding an "honorary" doctorate to an American guest whose turn had been omitted. Dean Young's happy

## News of the Institute and other Societies, Comments and Correspondence, Elections and Transfers

address on his induction as president for 1942 was a model. Brief and to the point, it shed light on the traditions and history of the Institute, touched on the part played by our French-speaking members, and gracefully welcomed our distinguished guests.

Surely a series of speeches such as these—and there are many other examples—should finally dispose of the rumour or legend that the engineer is inarticulate.

## PRESIDENT'S TRIP TO THE WEST

An account of the president's visit to the Sault Ste. Marie and the Lakehead Branches is published in the News of the Branches section of this *Journal* and it is expected that detailed reports from other branches will appear in the next issue. In the meantime, it may be of interest to present a general outline of the presidential tour to the western coast.

Dean Young left Toronto on March 31st and returned on April 23rd after having visited all branches from Sault Ste. Marie westward, a total of eight. In addition, he was the guest speaker at a meeting of the Sudbury Branch of the Canadian Institute of Mining and Metallurgy on his way west.

The presidential party, up to Winnipeg, included Vice-Presidents K. M. Cameron of Ottawa and J. L. Lang of Sault Ste. Marie, and Past Vice-President R. L. Dobbin of Peterborough. At Winnipeg, the president was also accompanied by Past Vice-President Fred Newell of Montreal who joined him again at Vancouver. The general secretary, who had expected to accompany Dean Young on his tour, was detained at Ottawa by his new duties in the National Selective Service.

Dinner meetings were held at all branches except at Winnipeg where the function was a luncheon. In his addresses, the president described the responsibilities of the engineer in the war and reviewed the active part played by the Institute in the national effort. He outlined also the duties which would fall on the profession in the reconstruction of a new world.

At Vancouver, on April 18th, a regional meeting of Council was held and was attended by several councillors representing the western branches. Among past officers present were, Past-Presidents G. A. Walkem and E. A. Cleveland of Vancouver and Past Vice-President Fred Newell of Montreal. In the absence of an official from Headquarters, the secretary-treasurer of the Vancouver Branch, P. B. Stroyan, acted as secretary of the meeting. The proceedings were recorded in a very able manner and the minutes which appear in another column show that most of those present took part in the discussion. This is further evidence of the wisdom of the policy established in recent years of holding regional meetings of the Council; they afford an opportunity for an exchange of views with branches away from Headquarters and stimulate the interest in Institute affairs.

Besides meeting with branches of the Institute during his trip, Dean Young addressed groups of the University of Toronto Alumni Federation in all cities where he stopped.

The fact that the president now contemplates visiting the Quebec and the Maritime Branches during the summer is the promise of another brilliant year in the records of the Institute.

## BIG WEEK

A fortunate combination of events in Toronto made the week of April 20th outstanding in Institute history. First there were three days devoted to the Webster lectures, then a regional meeting of Council and a concluding event in the form of a tribute to Dean C. R. Young.

### THE WEBSTER LECTURES

For some time the Institute has wanted to give assistance to various parts of the country in the matter of civil defence. It was felt that many phases of this topic were entirely engineering, and therefore lay directly in the path of Institute interests and policy. Certain approaches to government officials has not produced encouraging results, and for some time it appeared as if little could be done.

It was, therefore, a great pleasure to have the Institute's proposal to give a series of lectures, accepted by Professor Fred Webster, Deputy Chief Engineer of the Ministry of Home Security, who is in Canada temporarily — on a special mission. Prof. Webster has made a study of the effects of bombing on structures, and is the outstanding expert on these matters in the British Empire. No more competent person exists, and it was a wonderful piece of good fortune that he was available in this country at this time. The Institute is indeed proud to be the means of bringing such valuable information to the Canadian people.

The lectures occupied three days — April 22, 23, and 24th, and consisted of a two and a half hour session each morning and afternoon. There is no description that will do justice to the value of the information distributed by Professor Webster. Only those who attended have any conception of its volume and importance, but the following time-table will indicate the breadth of field that was covered.

#### APRIL 22ND:

*Morning* —The background—Bombing action and its effects.

*Afternoon*—Air Raid shelters in general.

- (a) Trenches.
- (b) Surface shelters.
- (c) Semi-sunk shelters.

#### APRIL 23RD:

*Morning* —Shelters and protected working spaces within buildings.

The strengthening of floors above basements and other floors.

The problem of the multi-storeyed building.

General discussion on shelters.

*Afternoon*—(a) Bomb-proof tunnels.  
(b) Bomb-proof structures above and below ground.

#### APRIL 24TH:

*Morning* —(a) Fire protection.  
(b) Protection of buildings against high explosive effects.  
(c) Window protection.  
(d) Factor in design in new buildings for war-time purposes.

*Afternoon*—(a) Factory protection.  
(b) Protective walls for machinery and assembly line protection.  
(c) Public utilities.

*Evening* —General discussion.

Invitations to attend were sent by the Institute to those persons or organizations proposed by the branches, al-

though in all instances it was not possible to include the full list. It was felt that the lectures would be of most benefit to organizations such as public utilities, public works, municipalities, transportation companies, war industries, active service units, structural steel firms, architects and consulting engineers.

These lectures were given without charge to anyone, and were not restricted to members of the Institute. Employers were told to send their best man, irrespective of whether or not he was a member. In matters of such great national importance, the Institute did not think it wise to restrict the dissemination of the knowledge to its own members. The Royal Architectural Institute of Canada was also invited to send representatives, and did avail itself of the opportunity.

It was the opinion of many people that the Institute has never rendered a greater service to the profession or to Canada than was given by these lectures. One hundred and eighty engineers are now aware of the damage that can be done by bombs, and of methods of protecting people, buildings and production from the devastating effects. The information given by Professor Webster is official—it's new, it's specific, and it's largely confidential. It does not just come out of books, but out of field experience and laboratory tests, and from a man whose chief duty it has been to study such matters day and night in all parts of his own country.

The only condition attached to the lectures was that each person would act as a consultant, so that others who could not attend, and who needed the information, could secure it in their own locality and with little difficulty. To this end, those who heard the lectures are being formed into committees right across the country, not only to be consultants but to adapt to local conditions those things which they learned at Toronto, and to study methods by which the greatest use can be made of the material which is now available.

Professor Webster deserves the thanks of every member of the Institute—in fact of every Canadian citizen. He was not sent here to give lectures, and yet he undertook this arduous assignment, as well as certain other lectures at Institute branches, solely to give the Canadian people that information which he knows will aid in the preservation of life and property.

His audience was very appreciative of what they were privileged to see and hear. No one missed a single lecture, and no one left before each lecture was concluded. At the final lecture they presented Professor Webster with a wrist watch suitably engraved and a purse of money. The latter was turned over to the High Commissioner to purchase chocolate and milk for English children. Professor Webster was greatly affected by the unexpected presentation, and afterward said it was one of the most pleasing things that has happened to him in a long time.

The lectures were held principally in the theatre of Hart House at the University of Toronto, and luncheon was served in the Great Hall. People were there from all over Canada—from coast to coast, and from Washington, D.C. It was indeed an important occasion, a great privilege, and a real experience.

### REGIONAL MEETING OF COUNCIL

The Webster lectures had brought to Toronto several members who had been at one time or another active in Institute affairs. Following the established practice they were invited to the regional meeting of Council on April 25th and a very representative attendance resulted. Among those who had come from distant branches were Vice-President J. L. Lang of Sault Ste. Marie, Past Councillor D. A. R. McCannel of Regina, who is also president of the Dominion Council of Professional Engineers, Past

# TESTIMONIAL DINNER TO DEAN C. R. YOUNG

HART HOUSE, TORONTO



Professor R. W. Angus addresses the meeting. On the right is M. B. Hastings, president of the Toronto Alumni Federation.



President Warren C. Miller speaks for the Association of Professional Engineers of Ontario in praise of Dean Young.

First graduate in engineering, Dr. J. L. Morris, presents the illuminated address to Dean Young. Past President F. A. Gaby looks on.



Below: William Storrie makes an excellent chairman. On his left is President H. J. Cody, on his right Dean Young and Warren C. Miller.



From right to left, Dean Arthur L. Clark of Queen's, Professor F. Webster of London, England, General C. F. Constantine, Dr. Cody and Mr. Storrie.



General picture of the group before entering the Great Hall.



Chairman Storrie leads the cheering for the guest of honour. Left to right, Messrs. Morris, Gaby, Miller, Young, Storrie and Cody.



### TAKEN AT THE JOINT LUNCHEON

President C. R. Young presents the Duggan Medal to O. W. Ellis



From left to right: Past President F. A. Gaby, D. A. R. McCannel, Dean C. R. Young, Warren C. Miller and I. P. MacNab.

Councillor Ira P. MacNab of Halifax and D. R. Smith, vice-chairman of the Saint John Branch.

The discussion of the items on the agenda developed to a point where it was necessary to adjourn for lunch and reconvene immediately after. When the meeting concluded in the afternoon it was nearly five o'clock. Coming one week after another regional meeting held in Vancouver, the Toronto meeting allowed comparison between the views of members from different sections of the country on matters of importance to the membership at large. The president who had been present at Vancouver was able to interpret the sentiments of the western branches and it was felt after the meeting that the decisions arrived at were well representative of the opinion of the membership in general. The usual report of the proceedings will appear in the June *Journal*.

Members of the Council of the Association of Professional Engineers of Ontario joined with the Council of the Institute for lunch. At the end of the luncheon Dean Young presented the Duggan Medal of the Institute for 1941 to O. W. Ellis, Director of the Department of Engineering and Metallurgy, Ontario Research Foundation.

#### TRIBUTE TO DEAN C. R. YOUNG

Three hundred and fifty friends and admirers of C. R. Young gathered in the Great Hall of Hart House on the evening of Saturday, April 25th, to do him honour. The Association of Professional Engineers of Ontario and the Toronto Branch of the Institute combined to arrange a banquet which would be the medium by which engineers could acknowledge and celebrate his election to the Deanship of Engineering at Toronto, and to the Presidency of the Engineering Institute of Canada.

William Storrie was in the chair, and very acceptably filled the office. The speaker list included C. M. Goodrich, Professor R. W. Angus, M. B. Hastings, Warren C. Miller and F. A. Gaby. D. A. R. McCannel read the illuminated address, which was later presented by J. L. Morris to C. R. Young. The address, which was bound in a tooled leather jacket, the handiwork of A. E. Berry, reads as follows:

CLARENCE RICHARD YOUNG  
B.A.S.C., C.E.

WE the Members of the Toronto Branch of The Engineering Institute of Canada, and of the Association of Professional Engineers of Ontario, extend Greetings and Best Wishes on your accession to the Presidency of The Engineering Institute of Canada, and to the Deanship of the Faculty of Applied Science and Engineering, University of Toronto.

Your friends and fellow engineers gathered here in the Great Hall of Hart House ask you to accept our Sincere Congratulations. We acknowledge with appreciation the Honour that we share in your appointment to these high offices.

W. C. MILLER,  
President, Association of  
Professional Engineers of Ontario.

W. S. WILSON  
Chairman, Toronto Branch,  
The Engineering Institute of Canada.

Toronto, April 25th 1942.

Dean Young spoke of his trip to the west coast and of his splendid reception at all branches of the Institute and at the Alumni luncheons. He dwelt on the engineers' part in the war and in post war reconstruction, pointing out the greater responsibility that now lies before the profession because of its special training and its assumption of responsibility in carrying on the war.

After the dinner there were special features to entertain the guests—displays in the pool and feats of legerdemain, music, dancing and so on. It was a great day, thoroughly enjoyable. Everyone was happy to participate in a demonstration of affection and respect for the guest of honour.

#### ENGINEERING AND ENGINEERS

Warren C. Miller, M.E.I.C., president of the Association of Professional Engineers of Ontario, was the guest speaker at the meeting of the Border Cities Branch of The Engineering Institute of Canada held on March 13th.

Taking as his topic "Engineering and Engineers," he defined engineering "as a system of logical reasoning based on established facts with a definitely practical application to the effective production and distribution of materials, machines and structures."

Mr. Miller was of the opinion that the engineer is primarily an economist rather than a technician. His technical training and experience is for the purpose of enabling him to establish definite facts that will form the basis of economic decisions. While his particular field in the first instance is the production and distribution of materials, machines and structures, the engineering approach to the solution of this type of problem can be applied effectively to a wider field.

The substance of Mr. Miller's address appears in this issue under the News of the Branches heading.

## PUBLICATIONS OF AMERICAN ENGINEERING SOCIETIES

From time to time announcements have appeared in the *Journal* regarding the exchange arrangements which exist between The Engineering Institute of Canada and the founder engineering societies of the United States, whereby members of the Institute may secure the publications of the American societies at special rates which in most instances are the same as charged to their own members. A list of these publications with the amounts charged is given below, and subscriptions may either be sent direct to New York or through Headquarters of the Institute.

	Rate to E.I.C. Members	Rate to Non- Members
<b>AMERICAN SOCIETY OF CIVIL ENGINEERS</b>		
Proceedings, single copies.....	\$ 0.50	\$ 1.00
Per year.....	4.00*	8.00†
Civil Engineering, single copies.....	.50	.50
Per year.....	4.00	5.00
(Plus \$.75 to cover Canadian postage.)		
Transactions, per year.....	6.00‡	12.00¶
Year Book.....	1.00	2.00
(Other publications 50 per cent reduction on catalogue price to E.I.C. members.)		
* If subscription is received before January 1st, otherwise \$5.00.		
† If subscription is received before January 1st, otherwise \$10.00.		
‡ If subscription is received before February 1st, otherwise \$8.00.		
¶ If subscription is received before February 1st, otherwise \$16.00.		

<b>AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS</b>		
Electrical Engineering, single copies.....	\$ 0.75	\$ 1.50
Per year.....	6.00*	12.00*
(* Plus postage \$1.00.)		
Transactions—annual, bound.....	6.00*	12.00*
(* Plus postage \$1.00.)		
(The single copy price for Electrical Engineering includes postage charge.)		

<b>THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS</b>		
Mechanical Engineering, single copies.....	\$ 0.50	\$ 0.60
Per year.....	4.00*	5.00
(* Additional Postage to Canada \$.75, Outside United States and Canada, \$1.50.)		
Transactions, bound, published annually, about March 1st (price of current volume).....	10.00	15.00
(Other publications, same rate to E.I.C. members as to A.S.M.E. members.)		
Journal of Applied Mechanics—Quarterly publications.		
Dates of issue: March, June, Sept., Dec.....	4.00	5.00

<b>AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS</b>		
Mining and Metallurgy, single copies.....	\$ 0.50	\$ 0.50
Per year.....	3.00*	3.00
(* Plus \$1.00 for foreign postage.)		
Metals Technology, single copies.....	1.00	1.00
Per year.....	7.00*	7.00
(* Plus \$.50 for foreign postage.)		
Transactions, per volume.....	5.00*	7.50
(* Plus \$.60 for foreign postage.)		
Technical publications: Supplied at \$.01 per page, with a minimum charge of \$.25 for single copies, or at a subscription rate per year of...	7.00*	7.00
(* Plus \$1.00 for foreign postage.)		

### BRITAIN'S EXPORT TRADE

The maintenance of British overseas trade under war conditions is a matter of prime importance, for the export of British products has to furnish as far as possible the foreign exchange which is required to pay for food and materials which she must import. The situation has been somewhat relieved by the generous action of the United States in passing the Lend-Lease Act of 1941, although this arrangement has necessarily had the effect of limiting the export from Britain of certain lines of manufacture.

We are so accustomed to think of Britain's constantly increasing production of munitions of war, and the complete change in industrial conditions which her war effort

has involved, that it is almost a surprise to find that the total war effort has not put an end to her export trade, although no doubt her enemies hoped it would. The necessities of war production, especially as to the distribution of labour and the allocation of available materials, of course override all other requirements, but within the limits thus imposed, customers abroad are being served with goods whose quality fully maintains British traditions as to craftsmanship and reliability. This is in spite of the restriction of manufacturing space, the enforced shifting of population, the rationing of supplies of almost every kind and the action of the King's enemies.

It is true that in some industries, production for export has had to be suspended owing to lack of shipping space or labour shortage. But in others, especially in products such as textiles or dyestuffs, the exports permitted are of great value to the country—wool, for example, is not a lease-lend material—pottery and glass ware exports are among those strictly controlled and allocated.

A recent publication—"British Trade and Industry"\*—has come to the Institute which gives an absorbing picture of the growth of industrial Britain, and—what is of even greater interest just now—of the present activities of the industrial organization in the beleaguered island. Its advertisements are as interesting as its wealth of illustrations, and (perhaps looking forward to post war developments) the letterpress is in English and Spanish. The book is lavishly produced: its articles cover twenty-two of the main divisions of British industry and are written by acknowledged leaders in each field.

The advertising matter seems to be prepared with the general aim of stating what the industry is prepared to supply, either now or after the war, and giving a clear idea of the advertisers' status and resources. A characteristic attitude is taken by one company which simply names the various wars which the concern has survived. Its business began at the time of the War of the Austrian Succession in 1740 and is now affected by the war of 1940!

As an example of British foresightedness and craftsmanship the publication is both interesting and unusual. "British Trade and Industry is a record of creative effort, eagerly initiated and long sustained. It is a reminder of what British enterprise has done to unlock for all the treasure-house of the earth's bounty. It can need no other justification for appearing now, when the powers of Order and Anarchy, as we see them, are clenched in the bitterest struggle of all time."

### REGIONAL COUNCIL MEETINGS

The policy of holding council meetings away from Headquarters as often as possible has been followed for some years past, and the results have been so satisfactory that its continuance seems assured. Last year half the total number of council meetings were of the regional type; thus enabling many members to take part in the debates of Council who would otherwise have been prevented from doing so, unless they could attend the sessions at the Annual General Meeting. This year two such regional meetings have already taken place.

Regional meetings plus the general council meeting at the time of the Institute annual meeting, have thus replaced the plenary meetings of council which were held annually from 1927 to 1937. These plenary meetings had the disadvantage of involving the Institute in considerable expense and did not bring out so clearly the decentralized nature of the Institute's organization as regards zones and branches.

The effective working of a body whose most easterly and westerly branches are more than three thousand miles

\*British Trade and Industry—a survey of past achievements and future prospects. By various authors. Published by *Country Life*, London. 332 pp. illus. advts. 14½ x 9¼ in. paper. 21s.

apart gives rise to many problems which can only be solved satisfactorily by regional action. This has been the case, for instance, in the negotiations leading to agreements with the several provincial professional associations, and in other questions where diversity of outlook and differences in local conditions have had to receive special consideration. Regional council meetings meet these conditions, and also enable practically all councillors to become more familiar with the details of management and administration of the Institute; giving them also an opportunity to observe at first hand the results of the work of the headquarters staff, particularly as regards correspondence, committees, finance, and the admission and transfer of members.

Probably few of our members realize the amount of work undertaken by councillors in the interest of their branches and the Institute as a whole. It must be remembered that these duties are performed by men who carry at the same time the burden and responsibility of their own particular jobs. Attendance at regional meetings means increased demand on their time but, as council records show, this is willingly met by practically all councillors who can travel to the meetings. They realize that their participation in such sessions helps them to obtain that general knowledge of the Institute's work and activities which they need in explaining Institute problems to their branch committees and branch members.

Another feature of such meetings is that they enable past councillors to keep in touch with activities and to lend the benefit of their experience to new Councils. It is important that the interest of active members be maintained even after they leave office. The regional meeting is ideally suited to such purposes.

## CORRESPONDENCE

Toronto, Ontario, April 14th, 1942.

The Editor,  
The Engineering Journal.

Dear Sir,

### POST WAR RECONSTRUCTION

In the February issue of the *Journal* it was intimated that the Council of the Institute had been asked to enquire as to the progress made by a Committee appointed by the Federal Cabinet to consider the problems of reconstruction after the war. As a result of this request the Council of the Institute arranged for an interview with Dr. Cyril James, the Chairman of the Committee, and a "release" was furnished and printed in the *Journal* to publicize the establishment and work of the Committee.

In May last I addressed an enquiry to a Deputy Minister of the Federal Government to ask if the problem of post-war immigration, and in particular rural settlement, would be considered by this Committee. I was advised that "as Crown lands are now vested in the Provinces, the matter is somewhat outside Dominion jurisdiction." From the "release" published in the *Journal* it does not appear that immigration had up to that time been considered either by the Advisory Committee, or by the two supplementary committees appointed later, which it is stated are composed of ranking civil servants.

Shortly after the Confederation of the Dominion the surveyors of that time, who were also the engineers of the country, were commissioned to survey the prairie provinces and subdivide the land on a system of square miles, with road allowances at stated intervals, very similar to that adopted by the United States. This system greatly facilitated settlement on the land and the granting of homesteads. As the population increased trading posts developed into towns which were subdivided into rectangular parcels or lots to fit within the square miles already established by the survey. On this land pattern policies both of rural and

urban settlement have been based, and for long years were considered to be satisfactory, but now it is seen that there is need for a radical revision.

This is an engineering problem of the first order far too great to be left in the hands of ranking civil servants in Ottawa however able they may be, and "as Crown lands are now vested in the Provinces" is one that must be considered by the Provinces, whereas immigration policies will be determined by the Dominion government.

National planning is now a subject of much concern in Great Britain, and some of the best minds are working on a new "Ground Plan for Britain." A new Minister has replaced Lord Reith in the Ministry of Works, and Lord Portal is now in charge of the Ministry of Works and Planning. But before this change took place Lord Balfour of Burleigh, the Chairman of the 1940 British Council, presented to Lord Reith a series of maps on which to base a National Plan. The letter which was transmitted with this gift is perhaps too long for your columns, but the latter half is, in my opinion, well worth serious consideration by the engineers of the Dominion and all interested in planning for a better Canada. The last paragraph clearly indicates that a Central Planning Authority must seek information from many sources and secure co-operation by taking the people into their confidence. Extracts from the letter follow.

Yours truly,

ARTHUR G. DALZELL, M.E.I.C.

Extracts from the letter to Lord Reith from Lord Balfour, in reference to a suggested new Ground Plan of Britain:

"You may say, perhaps, that the maps provide you with a chess-board on which the pawns can be moved to suit the game, but planning is not a game of chess and the pawns are not inanimate chessmen. They are flesh and blood, living organisms, of tender and vigorous growth, deep-rooted in soil, tradition and daily rounds. The area of the chessboard is not neatly squared out. It is a lovely countryside, on which the development of the past has sprinkled small towns, and in more recent years has spilled congested cities and sprawling suburbs bound together by the steel and concrete chains of transport.

These represent some of the capital that has been put into the country to assist its growth. If we have accepted national planning, it is because we are aware that this capital has not, in the past, been laid out in such a manner as best to serve the needs of the population, that our towns are not what they should be as dwelling places for citizens, that much of our countryside has been despoiled, that our industry is not able to give a balanced living to its work-people, nor is the soil able to support them. We must organize it to give freedom for work, for home, for leisure and for movement.

If future development is to be organized, it must spring from knowledge of the land, of how it is now used and how it might be used, of its industries and of the needs, habits and desires of those who live on it.

Not only is knowledge necessary, there must also be co-operation between industrialists, agriculturists, economists, sociologists and planners in all walks of life before a national scheme can be evolved. Planning means Direction, it does not mean Dictation. Planning will develop in relation to the intensity of search and sharing of experience. There will never be one final completed national plan. There must be flexibility to meet changing circumstances. The plan will develop as a result of patient co-operation, careful experiment and just administration, based on a knowledge and understanding of the facts.

Time may well be short. The concept of planning has hardly yet touched the main body of the public, and it is important that the assembly of greater knowledge and greater experience in planning matters be considered at the first opportunity. One of the most urgent tasks of a Central Planning Authority would be the collection of a body of

information flowing to it from the experience of all concerned, affording a set of values by which the full effect of plans and proposals can be judged and their repercussions analysed. In this manner, there would arise a form of co-operation between Government and people, between administrators and administered, which would savour not of control or restriction, but of welcomed initiative and shared experience."

### VANCOUVER MEETING OF COUNCIL

A regional meeting of the Council of the Institute was held at the Hotel Vancouver, Vancouver, B.C., on Saturday, April 18th, 1942, convening at ten o'clock a.m.

*Present:* President C. R. Young (Toronto) in the chair; Councillors S. G. Coultis (Calgary), I. M. Fraser (Saskatoon), J. Garrett (Edmonton), J. Haimes (Lethbridge), and H. N. Macpherson (Vancouver). There were also present by invitation—Past-Presidents E. A. Cleveland and G. A. Walkem of Vancouver; Past Vice-President Fred Newell of Montreal; Past-Councillors I. C. Barltrop (Vancouver), P. H. Buchan (Vancouver), A. R. Greig (Saskatoon), H. J. MacLeod (Edmonton), W. H. Powell (Vancouver), and A. S. Wootton (Vancouver); W. O. Scott, chairman, W. N. Kelly, vice-chairman, P. B. Stroyan, secretary-treasurer, H. Fitz-James, member of executive, J. N. Finlayson and C. E. Webb, past chairmen, and T. V. Berry, immediate past secretary-treasurer of the Vancouver Branch.

In the absence of the general secretary, Mr. P. B. Stroyan, secretary-treasurer of the Vancouver Branch, was appointed acting-secretary of the meeting.

The president explained that in accordance with the usual practice, invitations to attend this regional meeting of Council had been sent to all past-presidents, to past-vice-presidents and past councillors in the western zone, to members of the Vancouver Branch executive, and to other members who had been active in Institute affairs.

He welcomed all councillors and guests, and asked each person present to rise and give his name, place of residence and Institute affiliation. He invited everyone to take part in the discussion. The opinions of non-members of Council would be very helpful to the Council in reaching decisions.

The secretary read a letter from the acting-secretary of the Association of Professional Engineers of Saskatchewan suggesting amendments to the Saskatchewan agreement which would make the provisions of the agreement applicable only to members while resident in the province of Saskatchewan.

Following some discussion, on the motion of Mr. Macpherson, seconded by Mr. Fraser, it was unanimously resolved that this meeting of Council approve the principle of the proposed amendments, and that the Committee on Professional Interests be authorized to conduct the necessary negotiations with the Association of Professional Engineers of Saskatchewan.

There was a discussion about the possibility of giving wider distribution to Institute members of the publications of the Founder Societies.

At the March meeting of Council a letter had been presented from the Montreal Branch suggesting that Council study the possibility of abolishing the class of membership known as "Branch Affiliate." Following discussion, the matter had been referred to the Institute's Membership Committee for consideration and report. That committee hoped to present its report to the Council meeting to be held in Toronto on April 25th, but the chairman had indicated that in the meantime any suggestions received from the members attending the Vancouver meeting would be well received by the committee.

Letters were read from the Calgary and Edmonton

branches requesting that the decision as to whether or not there should be Branch Affiliates be left with the individual branches. The Calgary Branch was desirous of retaining the classification.

Speaking on behalf of the Lethbridge Branch, Mr. Haimes endorsed the requests made by Calgary and Edmonton. The Lethbridge Branch could not carry on without its Branch Affiliates. They experienced great difficulty in obtaining speakers, and unless they could have an audience of at least twenty or twenty-five people, it was not worth while getting speakers.

As councillor from the Calgary Branch, Mr. Coultis pointed out that the number of Branch Affiliates had increased considerably during his term of office as chairman, principally due to the efforts of the Membership and Attendance Committees. They had had a number of good speakers and had an excellent attendance of Branch Affiliates which was the means of bringing together in the west those who were interested in engineering but who do not have the same opportunity as those in the east of contacting other engineers. These Branch Affiliates are not permitted to vote on any matters pertaining to by laws, election of officers, etc., but it was felt that Institute members could transmit certain knowledge to these men who could not become full members. The fee is \$3.00 without the *Journal*, or \$5.00 if they desire to subscribe to the *Journal*. No complaints had been received from the regular members of the branch. If a Branch Affiliate does not pay his fee promptly he is not carried any further.

Mr. Scott stated that the Vancouver Branch had only four Branch Affiliates, who were charged only for the *Journal*. Like the Calgary Branch, the Vancouver Branch also desired to have a large attendance at their meetings, particularly when they had an out of town speaker. He was unable to see any reason for a change at the present time.

In response to an inquiry from the president, Mr. Newell stated that he had no knowledge of the discussions which had taken place in Montreal on this subject. He was in sympathy with the speakers who had presented the views of the various western branches. The Montreal Branch probably did not realise the difficulties under which the smaller and outlying branches operated. He was of the opinion that if the branches could bring into their organization as Branch Affiliates men who are in some way connected with the engineering profession, but who have not the qualifications to become full members of the Institute, they were doing a good thing. He considered that the professional engineer could learn a lot from these men, and they, in turn, could learn a lot from the professional engineers. He would be very sorry to see the classification of Branch Affiliate abolished.

It was moved by Mr. Garrett, and seconded by Mr. Haimes, that it is the opinion of this Council meeting that the classification of Branch Affiliate be retained. This was carried unanimously.

The President pointed out that in addition to being carried unanimously by Council, the amendment covered the unanimous opinion of those present other than councillors. It was also supported by Past Vice-President Newell of the Montreal Branch.

The president reported that at the last meeting of Council in Montreal the Canadian Forestry Association had asked that the Council appoint one of its members to their Board of Directors. This organization has for its objects the general promotion of the forest welfare of this country. The Council had appointed as its representative, Mr. John Stadler, of Montreal, who, last year, was treasurer of the Institute, and who is well acquainted with the forest reserves of the Dominion. He believed Mr. Stadler would be a very creditable representative of the Institute. This was noted.

The president reported that post-war reconstruction had been discussed at several meetings of the Council. Proposals had been made from time to time that the Institute branches should take an active and leading part in the planning for post-war reconstruction. This whole matter is under consideration by a government committee under the chairmanship of Principal James of McGill University. In the opinion of Vice-President K. M. Cameron, the Institute should work very closely within the frame-work set up by Principal James' committee. The Institute's interest centres largely around the work of a sub-committee on post-war reconstruction projects, of which Vice-President Cameron is chairman, and to which other members of the Institute have been appointed, including President Young and Vice-President Beaubien. This is a very complicated problem involving financial, economic and other considerations.

Past-President Cleveland felt that all members of the Institute were vitally interested in this question, and he favoured the most active support and co-operation on the part of the Institute in helping to solve these tremendous problems.

Mr. Coultis asked if the branches would be kept posted on all activities and advised of any service they could render in their particular districts. The President assured the meeting that from time to time communications would be sent to all the branches which would keep them informed as to the policy of the Council on this important question.

The financial statement to the end of March had been examined and approved, and showed that income was higher than for the same period last year. Although there was also an increase in expenditure, the net result indicated a substantial improvement in position.

The Finance Committee cannot recommend to Council the acceptance of the proposal contained in Serial Letter No. 45, dated April 7th, 1942, from the Canadian Chamber of Commerce, regarding the collection of personal income tax at the source. It was the opinion of the committee that the multitude of deductions already being made from payrolls by employers was a sufficient burden without adding to it by the deduction of income tax. The Institute's interest in the proposal would come simply as an employer, and the committee felt that it would not be justified in supporting a recommendation that affects other employers. This was noted, and the secretary was directed to so advise the Canadian Chamber of Commerce.

As a member of the Finance Committee, Mr. Newell asked permission to speak on the committee's report. During the past few years the financial condition of the Institute had been improving very steadily. He regretted that owing to other activities it had not been possible for the general secretary to visit all the branches during the past year. He did not know whether it would be possible for Mr. Wright to visit the branches this year, but in his opinion, it was vital to the life of the outlying branches that either Mr. Wright or the assistant general secretary should visit some, if not all, of the branches. It would be a good thing for the Institute, and particularly so from the financial point of view. It is realised that the work Mr. Wright is now doing is for the benefit of the country, and that is why the Council has granted him leave of absence. It may be necessary to slow down on some of the Institute activities, but personally he did not wish to see the interest in the Institute lowered in any way. For that reason he was anxious that either the general secretary or his assistant should visit the branches.

The president explained that at the Council meeting held in Montreal on March 14th, Mr. Wright had given preliminary information with respect to the position he now occupies, that of assistant to the director of National Selective Service. Council was then asked whether or not

it would be prepared to release Mr. Wright for practically full time service in this capacity. Council very generously approved of the proposal, feeling that it was one way in which the Institute could render a very valuable service to the country. Detailed arrangements had not yet been completed, but it has been agreed that Mr. Wright will be able to attend Council meetings in central Canada at least, and give such general guidance and assistance as he can. The president hoped to have Mr. Trudel accompany him on his visits to the branches, particularly in Quebec and the Maritime provinces.

The secretary read a memorandum on the question of life membership which had been presented to the annual meeting of the Institute by Mr. P. B. Motley, and which had already been discussed at one meeting of Council. The matter had been referred to the Finance Committee for consideration and report, and the Finance Committee had requested that the matter be discussed at the Vancouver and Toronto meetings so that the committee might have the benefit of any opinions expressed.

Following some discussion, it was agreed that the opinion of this Council meeting is that some steps should be taken to place life membership in the category of an honour rather than a concession. It was hoped that this expression of opinion would be of some assistance to the Finance Committee in dealing with the matter.

The president outlined the events which had led up to the Institute sponsoring a series of lectures on the effects of bombing to be given in Toronto on April 22nd, 23rd and 24th, by Professor F. Webster, Deputy Chief Engineer of the Ministry of Home Security of Great Britain. The officers of the Institute had felt that it would be a distinct contribution to the war effort if the Institute would sponsor these lectures, and he asked for an expression of opinion from the meeting as to whether or not Council approved of this action on the part of its officers.

On the motion of Mr. Macpherson, seconded by Mr. Garrett, it was unanimously resolved that the officers of the Institute be commended for their prompt action in sponsoring the lectures to be given by Professor Webster. The president thanked the meeting for the resolution.

The secretary read a progress report from the chairman of the Committee on the Training and Welfare of the Young Engineer. It outlined the progress which had been made in distributing the booklet "The Profession of Engineering in Canada," and also reported that counselling committees had already been appointed in several of the Institute branches. The reaction to the booklet had been most encouraging. Many favourable comments had been received. The report was noted with interest, and on the motion of Mr. Coultis, seconded by Mr. Haines, it was unanimously resolved that the thanks of Council be extended to Mr. Bennett and his committee for their splendid work.

As the consideration of applications was largely a routine matter and need not take up the time of non-members of Council, it was decided to adjourn for lunch and ask members of Council to reconvene afterwards in order to consider the applications.

It was noted that the next meeting of Council would be held in Toronto on Saturday, April 25th, 1942.

Mr. Webb expressed his personal appreciation of being able, for the first time, to attend a regional meeting of Council. He considered Vancouver had been honoured in having been chosen as the meeting place.

Mr. Kelly also expressed his appreciation at being invited to attend the meeting.

Mr. Coultis expressed the thanks of the visiting members for the kindly care and entertainment that had been tendered to them by the Vancouver Branch.

The president stated that it had also been a source of great pleasure to him that the visiting members had been

so well looked after by the Vancouver Branch. To those who had come from distant parts it had been an inspiration and a revelation, and they would return to their homes with renewed enthusiasm for the work of the Institute. They were all very grateful to the Vancouver Branch.

The meeting adjourned for lunch, and reconvened in the afternoon, with the president in the chair.

A number of applications were considered, and the following elections and transfers were effected:

#### ADMISSION

Members .....	7
Affiliates .....	4
Students .....	11

#### TRANSFERS

Juniors to Members.....	3
Student to Member.....	1
Students to Juniors.....	5

The Council rose at three thirty p.m.

### ELECTIONS AND TRANSFERS

At the meeting of Council held in Vancouver on April the 18th, 1942, the following elections and transfers were effected:

#### Members

**Allan**, George William, (Tech. Coll., Glasgow), president and mgr., Canadian Sumner Iron Works, Ltd., Vancouver, B.C.

**Bourgeois**, J. A. A. Paul, B.A.Sc., C.E. (Ecole Polytechnique), asst. hydrometric engr., Dominion Water & Power Bureau, Montreal, Que.

**Dyer**, William E. S., constltg. engr., Algoma Steel Corp., Sault Ste. Marie, Ont.

**Geddes**, Alvin Brooks, B.Sc. (Elec.), (Iowa State Coll.), sales engr., Canadian Westinghouse Co. Ltd., Calgary, Alta.

**McDiarmid**, Frederick John, B.Sc. (Queen's), field engr., asst. to W. E. S. Dyer, constltg. engr., Sault Ste. Marie, Ont.

**McIntyre**, Vernard Howard, B.A.Sc. (Univ. of Toronto), president, V. H. McIntyre, Ltd., Toronto, Ont.

**Tubby**, Allan, B.Eng. (Civil), (Univ. of Sask.), mgr., Ottawa Branch and Plant, Currie Products Ltd., Ottawa, Ont.

#### Affiliates

**Auger**, J. B. Gerard, School of Engineering, Milwaukee, chief operator, rectifier stn., Aluminum Co. of Canada Ltd., Shawinigan Falls, Que.

**Goldstein**, Abraham, dftsman., Defence Industries Ltd., Verdun, Que.

**Key-Jones**, Gilbert, mgr. and owner, The Key Agencies, Calgary, Alberta.

**Roberts**, John David, sales engr., Farand & Delorme Ltd. Divn., United Steel Corp. Ltd., Montreal, Que.

#### Transferred from the class of Junior to that of Member

**Fuller**, Harold Alexander, B.Sc. (Civil), (Univ. of Man.), engr., Tropical Oil Co., Barranca Bermeja, Colombia, S.A.

**Leroux**, Jacques, B.A.Sc., C.E. (Ecole Polytechnique), res. engr., air services branch, Dept. of Transport, Mont Joli, Que.

**Ryder**, Frederick James, B.Sc. (Civil), (McGill Univ.), sales engr., i/c Toronto office, Canadian Bridge Co. Ltd., Toronto, Ont.

#### Transferred from the class of Student to that of Member

**Sentance**, Lawrence Crawley, B.Eng., M.Sc. (Mech.), (Univ. of Sask.), mech. engr., Canadian Westinghouse Co. Ltd., Hamilton, Ont.

#### Transferred from the class of Student to that of Junior

**Cuthbertson**, Wellington B., B.Sc. (Elec.), (Univ. of N.B.), instr'man., Dept. of Transport, Moncton, N.B.

**Fraser**, Frederic Walter, B.Sc. (Civil), (Univ. of Sask.), civil engr., Sault Structural Steel Co. Ltd., Sault Ste. Marie, Ont.

**Sicotte**, Jean, B.A.Sc., C.E. (Ecole Polytechnique), asst. mgr., Armand Sicotte & Sons, constrtg. engrs., Montreal, Que.

**Wallman**, Clifford George, B.Sc. (Elec.), (Univ. of Man.), B.Eng. (Mech.), (McGill Univ.), mech. engr., Canada Starch Co. Ltd., Cardinal, Ont.

**Weber**, Peter Albert, B.Sc. (Civil), (Univ. of Sask.), instr'man., Land Surveys Dept., C.N.R., Toronto, Ont.

#### Students Admitted

**Bain**, Frederick Archibald, (McGill Univ.), 4644 Oxford Ave., Montreal, Que.

**Beckett**, Donald Russell, (Queen's Univ.), 327 S. Mark St., Fort William, Ont.

**Bogert**, Frank Godard, (McGill Univ.), 103 Drayton Road, Pointe Claire, Que.

**Hudson**, George Waugh, (McGill Univ.), Montreal, Que.

**MacAulay**, Roy D., (Nova Scotia Tech. Coll.), 174 South St., Halifax, N.S.

**Mason**, Vere K., (McGill Univ.), 2101 University St., Montreal, Que.

**Newman**, Frederick Herbert, (Univ. of Toronto), 1 College St., St. Catharines, Ont.

**Norton**, Howard William, (McGill Univ.), 4165 Marcell Ave., Montreal, Que.

**Rogers**, Frank K., B.Sc. (Univ. of Man.), (McGill Univ.), c/o Shawinigan Chemicals, Ltd., Shawinigan Falls, Que.

**Scott**, Richard, B.A.Sc. (Univ. of Toronto), 471 St. Clements Ave., Toronto, Ont.

**Timms**, Reginald Harold, (Univ. of Toronto), 66 Randolph St., Welland, Ont.

At the meeting of Council held in Toronto on April 25th, 1942, the following elections and transfers were effected:

#### Members

**Bentley**, William Alexander, (Univ. of Toronto), struct'l. designer, Dominion Bridge Co. Ltd., Toronto, Ont.

**Grey**, Noel William, (Regent St. Polytechnic, London), gen. supt., gasoline dept., and chem. engr., Lobitos Oilfields, Lobitos, Peru.

**Harisay**, Vito, B.Sc. (Mech.), (Royal Hungarian Polytechnicum), mech. designer, Longueuil plant, Dominion Engineering Works Ltd.

**Harris**, John Thomas, (Battersea Polytechnic, London), plant engr., Sorauren Ave. Plant, Dominion Bridge Co. Ltd., Toronto, Ont.

**Holsten**, Alfred, (Trondheims Tekniske Skole), electrical chief operator, Hudson Bay Mining & Smelting Company, Flin Flon, Man.

**Maclaren**, William Officer, asst. director of aircraft production factories, Ministry of Aircraft Production, London, England.

#### Juniors

**Miles**, Charles William Edmund, (Grad., R.M.C.), asst. to chief works officer, Eastern Air Command, Halifax, N.S.

**Padley**, Gilbert, B.Sc. (Elec.), (Queen's Univ.), asst. elec. engr., Trinidad Leaseholds Ltd., Pointe-a-Pierre, Trinidad, B.W.I.

#### Affiliates

**Houde**, J. Oscar, cost and quantity analysis, Shawinigan Water & Power Company, Montreal, Que.

**Josslin**, James Alexander, asst. chief dftsman., Ont. Divn., Dominion Bridge Co. Ltd., Toronto, Ont.

**McKerlie**, Jardine, (Royal Tech. Coll., Glasgow), mgr., Ontario-Great Lakes Divn., Wartime Merchant Shipping Ltd., Toronto, Ont.

#### Transferred from the class of Student to that of Junior

**Hobbs**, George Hugh, B.Eng. (Elec.), (McGill Univ.), elec. engr., Defence Industries Ltd., Nobel, Ont.

#### Students Admitted

**Buhr**, Richard K., (Univ. of Man.), 2nd-Lieut., R.C.C.S., Officers' Training Centre, Brockville, Ont.

**Flay**, Alfred David, (Queen's Univ.), 386 Sunnyside Ave., Ottawa, Ont.

**Fraser**, William Mitchell, (N.S. Tech. Coll.), 331 Spring Garden Road, Halifax, N.S.

**Skelton**, Eric Tudor, (Univ. of N.B.), 2112 Vendome Ave., Montreal, Que.

### COMING MEETINGS

**Canadian Electrical Association**—52nd Annual Convention at the Log Chateau, Seigniory Club, Que., on June 11-12, 1942. Secretary, B. C. Fairchild, Room 804, Tramways Building, Montreal, Que.

**Eastern Photoelasticity Conference**—Fifteenth Semi-Annual Meeting at the University Club, 40 Trinity Place, Boston, Mass., on Saturday, June 20, 1942, Chairman, W. M. Murray, Room 1-321, Massachusetts Institute of Technology, Cambridge, Mass.

# Personals

The recent announcement of the formation overseas of a Canadian Army of two corps has been received with enthusiasm by all Canadians. It is of particular interest to note that several members of the Institute have received high appointments on the staff of the Army Headquarters under command of **Lieutenant-General A. G. L. McNaughton**, C.B., C.M.G., D.S.O., M.E.I.C.

**Major-General G. R. Turner**, M.C., D.C.M., M.E.I.C., has been promoted from the rank of brigadier and appointed to the army staff. He was born at Four Falls, N.B., in 1890 and was educated at Andover, N.B. He enlisted at sixteen in the 3rd Field Company, Royal Canadian Engineers, and served in France as a sergeant and sergeant-major, being commissioned in September, 1915. He was promoted to captain a year later.

His subsequent appointments included regimental and staff service and in May, 1918, he was promoted to major. He was mentioned in dispatches, awarded the Distinguished Conduct Medal and the Military Cross and bar.

## News of the Personal Activities of members of the Institute, and visitors to Headquarters

In 1918 he was placed in command of the 2nd Field Company, Royal Canadian Engineers, with the rank of major, and in 1926 he was made lieutenant-colonel, commanding the non-permanent engineers. At the end of his tenure of command he was transferred to the reserve of officers in 1930.

At the outbreak of this war he went overseas as officer commanding 1st Divisional Engineers and was promoted to the rank of brigadier and made chief engineering officer at Corps Headquarters.

General Hertzberg has acquired a very wide experience in the construction field with the Trussed Concrete Steel Company of Canada and the Bishop Construction Company. He has been a member of the firm of James, London and Hertzberg, consulting engineers and he is at the present



**Major-General G. R. Turner,**  
M.E.I.C.



**Major-General C. S. L. Hertzberg,**  
M.E.I.C.



**Brigadier J. E. Genet,**  
M.E.I.C.

In 1920 he was appointed to the permanent force with rank of captain, and studied at the School of Military Engineering, Chatham, England. Returning to Canada, he became an instructor in military engineering at the Royal Military College, Kingston. In 1924 he attended the Staff College at Quetta, India, and in 1927 he was appointed district engineer-officer of Military District No. 10, Winnipeg, Man. In 1929 he became assistant director of engineer services, National Defence Headquarters, Ottawa, Ont. In 1938 he attended a course at the Imperial Defence College, London, England, and on his return in 1939 he was on the General Staff at M.D. No. 11 Headquarters, Esquimalt, B.C.

At the outbreak of this war he went overseas as general staff officer, grade 1, with the 1st Division. He was promoted to colonel and later brigadier, and on formation of the Canadian Corps was appointed deputy adjutant and quartermaster-general of the corps.

**Major-General C. S. L. Hertzberg**, M.C., V.D., M.E.I.C., has been promoted from the rank of brigadier and appointed to the army staff. He was born at Toronto in 1886 and received his education at the University of Toronto where he graduated in 1905.

During the first world war he served overseas with the 7th Field Company, Royal Canadian Engineers. He was wounded in January of 1917, a month after winning the Military Cross at the Somme, and was invalided to Canada. In October, 1918, he joined the Canadian Expeditionary Force to Siberia, serving there until June, 1919, and winning the Czecho-Slovakian war medal for valour.

time a partner of Harkness and Hertzberg, consulting engineers of Toronto.

**Brigadier J. E. Genet**, M.E.I.C., has been promoted from colonel and appointed to the Army Staff. He was born at Brantford, Ont., in 1891 and was educated in the local schools. He served four years in the ranks of the 38th Regiment before being commissioned in that N.P.A.M. unit in 1912. In 1915 he went overseas as a lieutenant and served in France and Belgium with the 2nd and 1st Canadian Divisional Signal Companies. He was promoted to captain before the war ended.

In 1924 he was appointed to the Royal Canadian Corps of Signals, permanent force, after serving with the Princess Patricia's Canadian Light Infantry and for a period was district signals officer at Headquarters of M.D. No. 2 (Toronto). He was promoted to major in 1932 and became chief instructor, Royal Canadian School of Signals, Camp Borden, Ont. In 1935 he was appointed superintendent of the Northwest Territories and Yukon Radio System for the Canadian Government and was stationed at West Edmonton, Alta. In 1939 he was promoted to lieutenant-colonel and attended the Senior Officers School at Sheerness that year. Shortly after the outbreak of the present war he was appointed officer commanding the 1st Division Signals and in July, 1940, was appointed chief signal officer of a corps with rank of colonel.

**Brigadier J. L. Melville**, M.C., M.E.I.C., has been promoted from colonel and is posted at Corps Headquarters in England. He was born at Glasgow, Scotland, in 1888 and came

to Canada in 1913. In the last war he went overseas with the engineers as lieutenant and was promoted to captain in May, 1918. He served in France and Belgium from August, 1916, to April, 1919. He was in command of the 3rd District Engineers from 1934 to 1936 after which he was transferred to the Corps Reserve of Officers, Royal Canadian Engineers. In 1941 he was promoted from lieutenant-colonel when appointed to command R.C.E. Headquarters Corps Troops.

At the outbreak of the present war Brigadier Melville had resigned his position as commissioner on the War Veterans Allowance Board in the Federal Department of Pensions and National Health to command the 1st Canadian Pioneer Battalion, Royal Canadian Engineers, C.A.S.F.

Word has just been received that the 1st Canadian Armoured Divisional Ordnance Workshop C.A. (Reserve) has been organized with the following members of the Institute as officers: Officer Commanding, Captain Charles E. Garnett, M.E.I.C.; Captain George H. N. Monkman, M.E.I.C. Lieutenant Ralph R. Couper, M.E.I.C.; and 2nd Lieutenant Charles W. Carry, M.E.I.C.



H. W. Lea, M.E.I.C.

**H. W. Lea, M.E.I.C.**, has been appointed director of the Wartime Bureau of Technical Personnel at Ottawa, succeeding E. M. Little who was recently made director of National Selective Service. Mr. Lea had joined the staff of the Bureau last summer and was its chief executive officer.

Born at Victoria, P.E.I., in 1898, he received his early education at Charlottetown and at the age of eighteen he joined the Canadian Expeditionary Force and served in England and France until 1919. He also served with the Royal Air Force during the last war. Returning to Canada in 1919 he entered McGill University at Montreal and graduated in civil engineering. He spent several years in Montreal working on design and construction for the Montreal Sewers Commission. At various periods he has also been employed with R. S. and W. S. Lea, Montreal, on hydraulic investigation and preparation of reports on hydro-electric power projects.

In 1937 he joined the Phillips Electrical Works Limited at Brockville, Ont., later being transferred to Montreal as district manager of the affiliated company, Canadian Telephones and Supplies Limited. Mr. Lea was granted leave of absence from this company last year to join the Wartime Bureau of Technical Personnel.

**L. E. Westman, M.E.I.C.**, former assistant director of the Wartime Bureau of Technical Personnel, has been transferred to National Selective Service as assistant to the director, E. M. Little. Born at Granton, Ont., he was educated at the University of Toronto. During the last war he was employed by the Dominion Government on



**Air Commodore Alan Ferrier, M.E.I.C.**, who succeeds Air Vice Marshal E. W. Stedman, M.E.I.C., as member of the Air Council in the Royal Canadian Air Force.

chemical control work and inspection. In 1918 he returned to the University of Toronto as chief demonstrator in the Department of Chemistry and was charged with the training of undergraduates for war industries. In 1919 he became editor of the *Canadian Chemical Journal* now *Canadian Chemistry and Process Industries*, which position he still holds. He was secretary of the Canadian Institute of Chemistry from 1921 to 1936.

**I. S. Patterson, M.E.I.C.**, industrial control specialist with the Canadian General Electric Company, Limited, at Montreal, has been loaned to the Wartime Bureau of Technical Personnel at Ottawa. Born at Thomson, N.S., he received his education at the Nova Scotia Technical College where he graduated in electrical engineering in 1928. Upon graduation he joined the Canadian General Electric Company at Peterborough and after a period of training in Peterborough, Toronto and Schenectady, N.Y., he was appointed in 1930 to the Montreal office of the company as sales engineer.

Mr. Patterson will be missed from the Montreal Branch where he was particularly active, having been on the executive for the past few years.



H. N. Macpherson, M.E.I.C.

**H. N. Macpherson, M.E.I.C.**, has been appointed regional representative of the Wartime Bureau of Technical Personnel in the Vancouver area. Mr. Macpherson is particularly well equipped to carry out these duties in British Columbia, where war industries have been expanding rapidly during recent months. Though born and raised in Ontario, Mr. Macpherson has obtained most of his business

experience in the West. An honour graduate of the University of Toronto in engineering he obtained his first position with the Saskatchewan Department of Highways.

During the Great War Mr. Macpherson served with the Imperial Ministry of Munitions at Moose Jaw, Sask., Edmonton, Alta., and at Montreal. After the war he spent a short time in Quebec as chief engineer for a road construction firm, but returned to the West and Regina in 1924. In 1927 he moved to Calgary as engineer and sales manager for the Alberta Wood Preserving Company and five years later started his own company, Permanent Timber Products Limited, at Vancouver. He is at present councillor of the Institute for the Vancouver Branch.

**Professor L. M. Arkley**, M.E.I.C., is retiring from Queen's University after acting as Head of the Department of Mechanical Engineering for twenty-two years; besides service at Queen's he was nine years in the Mechanical Engineering Department of the University of Toronto and one year at McGill, five years at Swarthmore College in Swarthmore, Pa., and five years as Director of the School of Machine Design at the Franklin Institute of Philadelphia, Pa.

**J. J. Spence**, M.E.I.C., has retired from the office of secretary-treasurer of the Toronto Branch of the Institute after having served for the past five years. He is a graduate of the University of Toronto from the class of 1909. For three years after graduation he was with Smith, Kerry and Chace, consulting engineers, Toronto, and from 1912 to 1923 he was plant manager of Woodturning Products Limited, Toronto. In 1923 he became demonstrator in the Faculty of Applied Science at the University of Toronto and has been on the teaching staff ever since. He is now a lecturer in engineering drawing at the University of Toronto.

**S. H. de Jong**, M.E.I.C., is the newly appointed secretary-treasurer of the Toronto Branch. He was educated at the University of Manitoba where he received his degree in civil engineering in 1931. For three sessions after graduation he was employed as a demonstrator at the University of Manitoba. In 1935 he was draughtsman and office manager with Fort Garry Motor Body and Paint Works Limited at Winnipeg. The following year he was a night school instructor with the City of Winnipeg School Board and Department of Education of Manitoba. He went to Ottawa



**Lieutenant-Colonel W. S. Wilson,**  
M.E.I.C.



**S. H. de Jong, M.E.I.C.**



**Jules Archambault, M.E.I.C.**

He was graduated as a B.Sc. from McGill University in 1900 and as an M.Sc. in 1910. Besides the teaching experience mentioned, Professor Arkley has had about ten years of practical experience in designing and operating steam power plants and has written many reports and papers on engineering subjects.

He joined the Institute as a Student in 1899 and has been a member ever since. He is also a member of the Association of Professional Engineers of Ontario and a member of the American Society of Heating and Ventilating Engineers.

Professor Arkley expects to live in Toronto.

**W. S. Wilson**, E.D., M.E.I.C., is the newly elected chairman of the Toronto Branch of the Institute. Born at Louise, Ont., he received his education at the University of Toronto where he graduated in 1921. In 1921-1922 he was engaged on estimating and supervising construction work with Wilson and Falconer, and in 1922-1923 was estimator with Dowling-Williams Limited. From 1923 until 1926 he was demonstrator in the Department of Engineering Drawing, University of Toronto, and in the following year was with R. W. H. Binnie, general contractor, as estimator. In 1927 Mr. Wilson was appointed secretary of the Faculty of Applied Science and Engineering of the University of Toronto, which position he still holds, along with that of assistant dean.

During the last war Mr. Wilson was overseas with the Canadian Expeditionary Force from 1915 to 1919, holding the ranks of lieutenant and captain. He is now a lieutenant-colonel, and is the officer commanding the Training Centre Battalion of the University of Toronto C.O.T.C.

in 1937 as compiler in the Topographic and Air Surveys Branch of the Department of Mines and Resources. Since 1940 he has been a demonstrator in the Department of Civil Engineering at the University of Toronto.

**Jules Archambault**, M.E.I.C., has recently been appointed associate transit controller with the Department of Munitions and Supply. He was educated at McGill University, Montreal where he received his engineering degree in 1926. Upon graduation he went with the Aluminum Company of Canada at Arvida as technical assistant. In 1927 he was transferred to the Duke-Price Power Company as engineer. In 1929 he joined the Bell Telephone Company of Canada at Montreal as an engineer in the transmission and foreign wire relations division. He became district manager at St. Hyacinthe in 1935. In 1937 he received the appointment of chief engineer of the Montreal Tramways Commission, a position which he still holds.

**E. M. Proctor**, M.E.I.C., is now head of the scrap rubber division of the Department of Munitions and Supply at Ottawa. Previously he was representing the Canadian government on the Bureau of Industrial Conservation at Washington, D.C. Mr. Proctor is president of the firm James Proctor and Redfern Limited, consulting engineers, Toronto.

**A. G. Graham**, M.E.I.C., city engineer of the City of Nanaimo, B.C. for the past twelve years, has been granted leave of absence by the city council and has taken up engineering duties under the chief works officer of the Western Air Command with headquarters at Victoria, B.C.

**Dugald Cameron**, M.E.I.C., formerly vice-president of John T. Hepburn Limited, Toronto, has joined the staff of the Citadel Merchandising Company, a government-owned company, and is in charge of the Toronto office. He has also been appointed secretary of a Technical Advisory Committee to Citadel.

**Flying Officer J. M. Walker**, M.E.I.C., engineer and designer with Gore and Storrie, consulting engineers, Toronto, has been granted a commission as flying officer in the R.C.A.F. and is at present stationed as works and building engineer officer at No. 31 Operational Training Unit, Royal Air Force Station, Debart, N.S.

**Sarto Plamondon**, M.E.I.C., has recently been appointed engineer in the Division of Industrial Hygiene of the Department of Health of the Province of Quebec, at Quebec. He was educated at Mount Saint Louis College and Ecole Polytechnique of Montreal, where he graduated in 1936. He joined the staff of the Department of Health on his graduation and became assistant sanitary engineer at Amos, Que. He left this position to accept his new appointment.

**Major J. P. Carrière**, M.E.I.C., of the Royal Canadian Engineers, has recently returned from overseas to attend the Staff College at Kingston, Ont.

**Norman D. Wilson**, M.E.I.C., prominent consulting engineer of Toronto, has been elected a councillor for the Civil Branch of the Association of Professional Engineers of the Province of Ontario for the year 1942.

**Major G. W. F. Ridout-Evans**, M.C., M.E.I.C., who was formerly stationed at M.D. No. 5, Quebec, Que., has been on the staff of the Inspection Board of the United Kingdom and Canada for several months past.

**Flying-Officer Ronald G. Archer**, M.E.I.C., has been commissioned in the R.C.A.F., Works and Buildings Branch and is at present stationed at Charlottetown, P.E.I. Previous to his enlistment he was assistant engineer of the Works Department, City Hall, Toronto, Ont.

**Hugo B. R. Craig**, M.E.I.C., has joined the staff of the Fraser-Brace Engineering Company, Limited, in Montreal. Before coming to Montreal he had been with the Hydro-Electric Power Commission of Ontario in Windsor.

**E. V. Gage**, M.E.I.C., is the new president of A. F. Byers Construction Company, Limited, Montreal, formerly known as A. F. Byers and Company, Limited. He fills the position held by the late A. F. Byers, M.E.I.C. Born at Peareton, Que., Mr. Gage attended McGill University and graduated in civil engineering with the degree of B.Sc., in the class of 1915. Upon graduation he joined the organization of which he is now president.

**William M. Harvey**, M.E.I.C., who for the past year has been on the staff of Rhokana Copper Corporation at Nkana, Northern Rhodesia, has returned to Canada and is now with the Aluminum Company of Canada at Arvida, Que.

**Henry M. Howard**, M.E.I.C., has accepted a position with the Eldorado Gold Mines, Limited, Port Hope, Ont., manufacturers of radium and uranium products. He was formerly with E. Long Limited, Orillia, Ont., as metallurgical sales engineer. Mr. Howard graduated from the University of Toronto with the degree of B.A.Sc., in the class of 1940.

**R. A. McLellan**, M.E.I.C., is now attached to No. 4 Air Training Command, R.C.A.F., at Calgary, Alta. He is the recent past-chairman of the Saskatchewan Branch. Before joining the R.C.A.F. he was a partner in the firm of Underwood and McLellan, Saskatoon, Sask.

**Sidney Phillips**, M.E.I.C., has received a commission in the R.C.N.V.R., as engineer lieutenant. Born in England, he came to Canada in 1940 from Talara, Peru, where he had been employed since 1933 by the Lobitos Oilfields as assistant electrical engineer and later as chief electrical engineer.

**L. G. Scott**, M.E.I.C., has been given leave of absence from the Hudson's Bay Company and has been appointed plant engineer at Boeing Aircraft in Vancouver, B.C. Mr. Scott graduated in electrical engineering from the University of Manitoba with the degree of B.Sc., in 1932, and joined the Hudson's Bay Company in the autumn of the same year.

**W. Grey Stuart**, M.E.I.C., of Vancouver, has accepted a position with the Demerara Bauxite Company, Mackenzie, British Guiana.

**L. A. Wilmot**, M.E.I.C., is with the Commodity Prices Stabilization Corporation Limited at Ottawa, having joined the Foreign Exchange Control Board in 1940. Before the war he was customs consultant at Toronto.

**Edgar H. Davis**, Jr. E.I.C., who has been in Guayaquil, Ecuador, S.A., for the past two years with the International Petroleum Company as party chief, has returned to Canada and has accepted a position as designing engineer with the Canadian Dredge and Dock Company, Limited, at Toronto.

**Lieutenant W. A. Nelson**, Jr. E.I.C., is now attached to the Royal Canadian Ordnance Corps and is stationed at Campbellford, Ont. Before his enlistment, Mr. Nelson was sales service engineer with the Bailey Meter Company, Limited, Montreal. He graduated from Queen's University with the degree of B.Sc., (Hon.) in the class of 1937.

**G. G. Wanless**, Jr. E.I.C., has recently accepted a position in the National Research Council laboratories at Ottawa. He was educated at the University of Alberta and at McGill University where in 1934 he graduated with the degree of B.Sc. with honours in chemistry.

Upon graduation he returned, as an assistant chemist, to the Dominion Rubber Company, Limited, where he had been previously employed during his college vacations. Until 1937 he was in charge of a group of development workers on latex rubber. The following year he was transferred to the mechanical department in the Montreal office. He also spent a few months in the Winnipeg and the Vancouver offices of the company, returning to Montreal in 1940.

Until his transfer to the Capital, he was on the executive of the Junior Section of the Montreal Branch of the Institute, as well as the Branch News Editor.

**N. J. Paithouski**, S.E.I.C., is a lieutenant with the Royal Canadian Engineers and is attached to the training centre at Brockville, Ont. Before his enlistment, Mr. Paithouski was with the Canadian Kellogg Company in Sarnia, Ont. He graduated in civil engineering from Queen's University with the degree of B.Sc., in the class of 1940.

#### VISITORS TO HEADQUARTERS

**Rosaire Saintonge**, S.E.I.C., Consolidated Paper Corporation, Limited, Port Alfred, Que., on March 30th.

**Frank O. White**, M.E.I.C., chief engineer, Fraser Companies Limited, Edmundston, N.B., on April 1st.

**J. W. Wright**, S.E.I.C., Toronto, Ont., on April 4th.

**Sarto Plamondon**, M.E.I.C., Ministry of Health, Department of Industrial Hygiene, Quebec, Que., on April 8th.

**Gustave St. Jacques**, M.E.I.C., Public Service Board, Quebec, Que., on April 14th.

**Ira P. MacNab**, M.E.I.C., commissioner, Board of Commissioners of Public Utilities, Halifax, N.S., on April 20th.

**D. R. Smith**, M.E.I.C., director of works, Saint John, N.B., on April 20th.

**J. W. Sanger**, M.E.I.C., chief engineer, Hydro-Electric System, Winnipeg, Man., on April 20th.

**J. W. Porter**, M.E.I.C., chief engineer, western region, Canadian National Railways, Winnipeg, Man., on April 20th.

# Obituaries

*The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.*

**Robert McDowall, M.E.I.C.**, died in Toronto on March 29th, 1942. He was born on June 8th, 1864 in the township of Sydenham, Ont., and received his early education at Owen Sound Collegiate Institute. He entered the School of Practical Science at Toronto in 1885, having previously taught in public schools from 1883 to 1885. Graduating in 1888, he was employed for a year as an engineer by the contractor on the construction of piers and abutments of the bridges for the Canadian Pacific Railway entrance to Toronto, down the Don river valley. In 1889 he entered private practice as a civil engineer in Owen Sound and the following year he was commissioned as an Ontario land surveyor.

During the period from 1890 to almost the present time Mr. McDowall has acted as engineer for Owen Sound, Collingwood, Meaford, Wiarton, Chesley, the counties of Grey and Bruce, and many villages and townships. His engineering work included sewers, waterworks, bridges, pavements, grading, harbour works, dams, tunnels, and many minor works. As a pastime he constructed the framework of the first aeroplane ever seen in Owen Sound, and would have flown in it if he could have had a little financial help to complete the machinery. His surveying activities embraced railways, subdivisions in cities, towns, and waterfronts, mining claims in Rainy river, and many other assignments. Mr. McDowall received the degree of C.E. from the University of Toronto in 1901.

Mr. McDowall was one of the oldest members of the Institute having joined as a Student in 1887, the year of

its foundation. He was transferred to Associate Member in 1892 and in 1935 he became a Life Member.

**John Palmer, M.E.I.C.**, died in the hospital at Montreal on April 20th, 1942. Born in London, England, on June 20th, 1881, he received his education at the University of London where he was graduated as a Bachelor of Science in engineering in 1909. Before taking the engineering course at the University he had been for several years an articled pupil with the firm of Messrs. Johnson and Phillips, electrical contractors, London, England. He came to Canada in 1910 and joined the Canadian Westinghouse Company as erecting engineer. In 1912 he became district engineer at Calgary.

When war broke out he enlisted with the 102nd Infantry Battalion and became an officer and went overseas in March, 1916. After service in England and France he returned to civil life in October, 1919, and resumed his duties as district engineer of Canadian Westinghouse Company at Calgary. In 1920 he was transferred to Montreal, also as district engineer, a position which he held at the time of his death.

Mr. Palmer joined the Institute as an Associate Member in 1923 and he became a Member in 1940.

**Russell Henry Swingler, S.E.I.C.**, died as a result of an accident at Ottawa on March 21st, 1942. Born at Port Arthur, Ont., on June 4th, 1913, he received his primary education at the local technical school. In 1933 he went to Queen's University and was graduated in mechanical engineering in 1937. In the fall of the same year he joined the Civil Aviation Branch of the Department of Transport at Ottawa as junior engineer, a position which he held at the time of his death. During his stay in Ottawa, Mr. Swingler had been active in the Ottawa Sea Cadets and at the time of his death he was commanding officer.

Mr. Swingler joined the Institute as a Student in 1937.

## News of the Branches

### BORDER CITIES BRANCH

J. B. DOWLER, M.E.I.C. - - - Secretary-Treasurer  
W. R. STICKNEY, M.E.I.C. - - - Branch News Editor

The March meeting of the Border Cities Branch was held on Friday, the 20th at the Prince Edward Hotel. The guest speaker, who was introduced by J. Clark Keith, was Warren C. Miller, city engineer of St. Thomas and recently elected president of the Association of Professional Engineers of the Province of Ontario, who spoke on the subject **Engineering and Engineers**.

Mr. Miller, who has been a member of both The Engineering Institute of Canada and the Association of Professional Engineers for many years and has been on the council of both bodies, has had a better than average opportunity of appreciating that these two organizations are not competitive but complementary. Each has its own field and in some provinces agreements for joint membership have been reached. Up to the present it has not been possible to do this in Ontario, but there is no reason why the Institute and the Association should not work together in harmony and complete co-operation.

One of the most active Association committees is the Publicity Committee. Their work deals with publicity of two kinds: publicizing among its own members the work of the Association, and, through press releases publicizing the work and position of the engineer insofar as his work creates news that reacts to his professional benefit.

A great many people, including a minority of our own profession, have a very narrow idea of engineers and engineering. This conception seems to indicate that the engineer is only a technician—one step ahead of a skilled mechanic—who puts into operation the ideas of the executive. In the past there have been short-sighted gradu-

### Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

ates of the university who looked on it as a glorified trade school and went out into industry believing they were indeed technicians. Such men do not see any value in professional organizations, they think that if we used trade union methods we would get further; in general such men do not advance in station and they help contribute to the fiction that lawyers, financiers and business men are the only ones from whose numbers executives are selected. We should all be engaged in our business or profession for the ultimate purpose of making some contribution towards improvement in our way of life. This is our duty as members of the society in which we live, and we are only able to make a contribution to the general good so long as we think and act as one member of a great social fabric.

Engineering may be defined as "a system of logical reasoning based on established facts with a definitely practical application to the effective production and distribution of materials, machines and structures." This is what the professional economist considers his field, but there is a distinction based in the four words—"Based on Established Facts." Such men have been known to produce erroneous answers to industrial problems because they did not start from established facts.

Now in order to evaluate the evidence of established facts, sometimes to establish those facts themselves, and in order to reason logically from those facts, an intimate knowledge of the forces of nature is essential. Facts are elusive things and evidence is often conflicting, so a knowledge of natural law helps us when we are sorting out the facts from the guesses and opinions. An engineer, however,

must not be misled by assuming that because he works with facts his work is an exact science. He must keep in mind that his profession, while based on established fact, is engaged always in the solution of problems that involve human judgment and all his computations must be corrected by the human coefficient.

The engineer must realize, if he has a conception of the very fundamentals of his profession, that he is first, last and always an economist, with his feet firmly planted on solid ground, the ground of established facts. What then does the engineer, whether in training or practice, owe to society and how shall he repay to society the great part of the expense of his education that his fees do not cover?

The engineer's debt may be considered a fourfold obligation that is due to himself, his professional colleagues, his clients and society generally. He must prepare himself by observation, application and continual study for his life's work. If he is to be able to exercise that sound judgment that should characterize the engineer he must have a firm grounding in the essential mathematics and practical sciences that are the distinguishing marks of the engineer. He must not only know how but why; he must never cease studying to keep step with new methods and a changing technology. He should keep in mind at all times that his engineering training and experience can make a real contribution to administration and management, but if he expects to become a part of management he must not only know engineering as it is applied to the problems of business, but he will have to have in addition a working familiarity with the function of all other branch departments, and to understand in a general way what they contribute to the enterprise as a whole.

Secondly he has a duty to his professional colleagues. They have made it possible for him to have the benefit of their experience in orderly fashion. He owes it to them to practice his profession in accordance with the golden rule as explained to him in the code of ethics. Gentlemen do not need a code to define their duty but codes do give the public a knowledge of how engineers interpret the golden rule in their relations to one another. The code of ethics enables the young engineer to see how his older confreres with a high sense of ethical values act in a given situation.

He has another obligation to his fellow engineers. Just as he himself in his education has profited from their experience in the text books, the technical press and in the proceedings of technical societies so he in his turn has a duty to contribute to the general knowledge by a similar presentation of papers and articles on work in which he has had special experience. He should in addition contribute to the intelligent discussion of the papers of his fellows before meetings of engineers, and make, when he can, an intelligent contribution to the matters under debate. Such a participation in proceedings of this kind are among the distinguishing marks of the professional man. When two men each have a dollar and exchange them they still have a dollar each. However, if each has an idea and they exchange them then each has two ideas.

Finally, the engineer has a duty to his country. This he shares with all citizens but the country that has given him his education and his professional preparation has a special claim on his services. It has a right to expect that these abilities which it has helped to cultivate will at the proper time be made available for the general good. It is entitled to the benefit of that reasoned and orderly consideration of her problems that can so well be given by the trained and orderly mind of the experienced engineer. He has a duty, therefore, to unselfishly offer himself for service in elective public office so far as his daily work does not seriously conflict. The engineer of all men should be the last to complain of mediocrity in government if he is not making his training available for the solution of public

questions. Some men are, by nature of their employment by government itself, prevented from actively engaging in politics. There are other outlets available, boards of trade, chambers of commerce, service clubs, church organizations. These all have their effect on public opinion and in the creating of public opinion through these mediums the same orderly process of thought and reasoning that characterize his daily work can be of great value.

In times like these there is also the urge to enter the armed forces, especially among the undergraduates and more recent graduates. Both the Government and the Association of Professional Engineers advise completion of courses in engineering so that men entering industry shall be best enabled to serve it and through it, in turn, the country it serves. Engineers are performing a very essential part in producing the tools of war, in building facilities for training and in addition constructing those works that are necessary for the defensive and offensive strategy of our armed forces, and every decision they make should be measured up in the light of its most effective contribution to the war effort.

If the engineer is then to persuade his employers and the public generally that he has a definite contribution to make in economic public decisions, it is his duty in some such way as outlined to make the public aware that he is more than just a skilled technician. It is one of the objects of the Association to encourage a professional attitude and to this end the speaker referred to the forthcoming report of the Committee on Remuneration of Engineers, known as "Job Evaluation." He asked that engineers study it, criticize it, and be sure to send in their criticisms so that weaknesses of the idea might be studied.

In conclusion Mr. Miller invited all members of the Association to visit its office in Toronto and bring in their ideas and reactions to the activities of the Association.

After a period of discussion a vote of thanks was moved by Mr. T. Jenkins and the meeting adjourned.

## HAMILTON BRANCH

A. R. HANNAFORD, M.E.I.C. - *Secretary-Treasurer*  
W. E. BROWN, JR., E.I.C. - *Branch News Editor*

The Annual Student and Junior Night was held at McMaster University on Friday March 20th. 1942. There were three contestants for the two branch prizes:

Mr. R. J. G. Schofield, J.E.I.C., on **Cotton Yarn Dyeing.**

Mr. Andrew M. Swan, S.E.I.C., on **The Application of Electric Drive to Machine Tools.**

Mr. K. R. Knights, S.E.I.C., on **A History of Water Power Developments on the Saguenay River.**

Mr. Schofield is chemist and assistant dyer for the Canadian Cottons Limited, Hamilton. He graduated from McGill University in chemical engineering in 1935.

Mr. Swan is with the Canadian General Electric Company, Hamilton. He graduated from the University of Manitoba, in electrical engineering in 1939.

Mr. Knights, unfortunately, was unable to present his own paper as he is at Chute-à-Caron. The paper was read by the secretary, on behalf of Mr. Knights.

After the chairman had outlined the object of this annual affair, Norman Eager, chairman of the Papers Committee, introduced the speakers, after which they presented their papers. The judges, Dr. A. H. Wingfield and W. J. W. Reid will report in time for the next meeting. After the papers, our guest speaker, Chancellor G. P. Gilmour, M.A., B.D., gave us a very interesting talk on **Useful and Useless Learning** the text of which is given below.

Col. E. G. Mackay introduced the chancellor, and chairman, S. Shuppe thanked him.

"I sometimes envy men like yourselves who, as chemical, electrical, civil or mechanical engineers, are devoted to 'useful learning.' You have the satisfaction at a

year's end of seeing definite and sometimes fairly permanent results of your labors; and you can so harness the forces with which you work that people without professional accomplishments can use them or direct them by pushing buttons here and there or throwing a lever or reading a gauge. There is, however, a double disadvantage or danger in this: on the one hand, that you should become insular in your own outlook and too often be made the tool of designing men who work in the realm of ideas; and on the other, that the people who use your tools have no outlook at all, or become the dupes of demagogues and fanatics, or lose their moral balance through sheer boredom.

There is, therefore, much to be said for 'useless learning,' to which I have devoted myself since I turned from mathematics and physics to work in history and theology. Such useless learning is sometimes regarded with contempt by the engineering undergraduate; and when in maturer years such professional men turn to an intellectual hobby or strive to appreciate the fields of human relations or religious findings, they too often pay the penalty of unadmitted ignorance or find themselves unable to move happily in the fields of culture or religion. Engineers, for instance, who become fascinated by certain aspects of religion, can be fanatically certain of a deterministic view of history, as though God were an engineer rather than a Father, or less a Father than a remorseless engineer. But more often the penalty is not so much of uninformed certainty in a foreign field as it is the lack of such achievements in life as make a man a good companion (not boon companion) for himself, or his wife, or a wise father to his children, or a sympathetic director of those whose labour he controls.

Two proverbs need criticism because they express only a half-truth. One is the ancient "Let every man be faithful to his own mystery," and the other our familiar, "Let the cobbler stick to his last." These are both true, but they are both defective.

"Let every man be faithful to his own mystery" is a saying from ancient times, when different "mysteries" competed for the allegiance of the serious, and offered ethical principles and religious promises of various kinds. A man was allowed by his fellows, even expected by his fellows, to be true to the ideals he had adopted, even though they cut him off from life here and there. Of course, many men diversified their risks by belonging to several "mysteries." But the word mystery is also applicable to the esoteric learning which a man is allowed to have in his guild or profession, which in old days was carefully guarded. A man had to serve his apprenticeship and fulfil his calling. Life, however, demands that we should not be confined to our own mystery, monopolized by the esoteric learning by which we earn our bread. We must have more catholic interests than any "useful learning" can give.

Similarly, a cobbler who sticks too closely to his last is in the end not the best cobbler. To use the pun that Shakespeare employs in *Julius Caesar*, he is a mere cobbler or dabbler, having no harmony, no wholeness, to his life. Many a specialist loses his influence and effectiveness because he is too much a specialist.

I run over such obvious comments not solely because my own training has taken me into the fields of culture and religion, and not solely because a technical expert may be ill-fitted for the real living that is the main part of life, but because, as I mentioned earlier, the devotee of useful learning who excludes useless learning or thinks he has mastered it when he has only misunderstood it may become himself the slave of designing men of ideas, or may be unaware of how terribly he stunts the growth of his underlings if he is content to see them pushing buttons and caring for automatic devices.

Learning may become the slave of fanaticism, as is very

evident now, and the unlearned may become the slaves of the machines. From such slavery only useless learning can deliver us, the hunger for things that are right as well as for things that are measurable, the desire for cultivated imagination, the development of sympathy and charm, the patient inquiry into the things of the soul. It takes more maturity to be the master of useless things than of useful.

I hope that the connection between this Institute and this University may keep us both alive to the place of the other, that we may be grateful for what the engineer can do and that you may be aware of those vaster resources of the mind and the spirit which a true university exists to guard and to convey. This is a field in which nothing can be reduced to push-button efficiency. It can never be "worked" by slaves. It demands and develops a freedom that the mechanical world cannot give and dares not ignore."

On March 31st, the branch held its monthly meeting in the auditorium of the Delta Collegiate School. Mr. E. Arthur Pinto, of Montreal, addressed the branch on the subject **Essential Air Raid Precautions**. Introduced by Norman Eager, Mr. Pinto gave a most valuable address on the precautions that should be taken, for he said, "even if it does never happen to us, we must be fully ready and organized in case it does happen, and why shouldn't it?" Lieut.-Col. Robinson, in moving a vote of thanks to the speaker, said that the address was the most complete and carefully prepared paper he had ever heard on this important subject.

The guests of the branch on this occasion were, the Hamilton Civil Guard, the Army Trades School Officers and Instructors, the Women's Auxiliary Defence Corps, the Auxiliary Firemen and A.R.P. Wardens and workers. Members of the Hamilton Board of Education, who kindly gave the free use of the hall, were also present. The audience numbered over eleven hundred persons.

First and second prizes were presented to the winners of the Students and Juniors papers competition held on March 20th. They were Andrew M. Swan, S.E.I.C., for his paper "The Application of Electric Drive to Machine Tools," and R. J. G. Schofield, Jr.E.I.C., for his paper on "Cotton Yarn Dyeing."

Mr. T. S. Glover, the Hamilton representative of the Wartime Bureau of Technical Personnel gave a short outline on the importance of this work.

The executive wishes to thank the members for the presence of so many lady guests of the branch at the meeting.

#### LAKEHEAD BRANCH NEWS

W. C. BYERS, Jr.E.I.C. - *Secretary-Treasurer*  
A. L. PIERCE, M.E.I.C. - *Branch News Editor*

The Annual Dance of the Lakehead Branch was held on Friday February 13th in the Norman Room of the Royal Edward Hotel in Fort William.

The ballroom was gaily decorated and at intermission a midnight supper was served. There were seventy couples present, several of whom were guests which added to the enjoyment of the annual ladies night.

The patrons and patronesses were: Mr. and Mrs. B. A. Culpeper, Mr. and Mrs. J. M. Fleming, and Mr. and Mrs. S. T. McCavour.

A special dinner meeting was held by the branch in the Prince Arthur Hotel in Port Arthur on April 4th at 6:30 p.m. to welcome the president of the Institute, Dean C. R. Young.

K. M. Cameron of Ottawa, J. L. Lang of Sault Ste. Marie, and R. L. Dobbin of Peterborough accompanied the president on his visit.

In the absence of the chairman, B. A. Culpeper, the

## LONDON BRANCH

H. L. STEAD, Jr. E.I.C. - - *Secretary-Treasurer*  
A. L. FURANNA, Jr. E.I.C. - *Branch News Editor*

vice-chairman, Miss E. M. G. McGill, presided at the meeting.

The meeting was opened with the singing of "O Canada" and grace was said by G. R. Duncan. Following the dinner the toast to the King was given.

The chairman called on K. M. Cameron, who spoke on his Institute visits to the Ontario branches and of his renewed friendships with the Lakehead Branch. He extended an invitation to the members to visit the Ottawa Branch when in that city. He recommended that more of the young engineers should try for the John Galbraith Prize.

J. L. Lang then expressed his appreciation at being present at the meeting and thought that the work of the Institute helped a great deal to bring about a better unity through Canada.

R. L. Dobbin spoke amusingly about the trip from the east and brought greetings from the Peterborough Branch.

R. B. Chandler then introduced Dean C. R. Young.



**THE PRESIDENT VISITS LAKEHEAD BRANCH**

*From left to right: R. L. Dobbin, R. B. Chandler, J. L. Lang, C. R. Young, K. M. Cameron, and G. H. Burbidge.*

Dean Young gave a very interesting account of the work of the Institute since its founding in 1887. He told of the contribution engineers are making to the war effort in all branches of the service. The international relationships of the Institute were mentioned and the close co-operation with United States engineering societies.

At present, he said, the Institute is co-operating with British and Polish engineers in Canada on war work. There are now 112 Polish engineers in Canada.

Dean Young mentioned how the Institute is constantly making efforts on the behalf of young engineers to enable them to get placed.

The work of the Wartime Bureau of Technical Personnel was reviewed. Air raid precaution was another phase of the Institute's work and at present Professor Webster of England will hold a course of lectures at Toronto commencing April 22nd and lasting for three days. A committee on post war reconstruction has been set up to work with a committee set up to repatriate men returning from the war and to place them in employment.

In closing, Dean Young stated that the engineer should give service and show interest in his work rather than remuneration and that professional status should be based on trusteeship.

S. T. McCavour gave a vote of thanks to the president and the visiting speakers. J. Antonisen seconded the vote of thanks and expressed his appreciation.

G. R. Duncan and W. L. Bird expressed their appreciation of the president's visit and extended the goodwill of the Lakehead Branch.

At its regular monthly meeting on February 27th, the London Branch had as its guest speaker Mr. Otto Holden, M.E.I.C. Mr. Holden is the chief hydraulic engineer of the Hydro-Electric Power Commission of Ontario. His subject was the **Madawaska River Development**.

The speaker began his talk by presenting a general picture of the entire Southern Ontario system. This comprises three co-operative sub-systems namely the Niagara, Georgian Bay and Eastern Ontario. These are interconnected through a network of tie lines and frequency changer sets which permit the interchange of substantial blocks of power between systems. Thus the diversity in time of peak loads, fluctuating load requirements and variations in power supply from different plants may be co-ordinated to the common good. Besides, if the ties and frequency changers are of sufficient capacity, individual plant reserves become available to the whole system and thus the total amount of plant reserve required is reduced.

The Madawaska river empties into the Ottawa river some forty miles above the city of Ottawa, with its head waters composed of many lakes high in the wooded country south of Pembroke. These lakes provide an excellent natural storage. The river has several possible development sites with a total capacity of approximately 100,000 hp. for continuous use or 200,000 hp. for use during the winter season only. The first of these developments, which is to be in operation in July of this year, is at Barrett Chute about twenty-five miles southeast of Pembroke. This plant will develop 56,000 hp. in two 28,000 hp. units under a head of 154 ft.

A dam is also being built at Bark Lake, sixty-seven miles up stream from Barrett Chute, in order to control and regulate the flow. The dam will provide a storage of 300,000 acre-ft. of water.

It is proposed to use this plant as an auxiliary of the Niagara system in that the plant is to be operated only during the winter season when the flow available to the Niagara system is reduced. The possible use of the plant in this way is another strong point in favour of all electrical developments being under one control so that all plants may be used to the greatest advantage of the entire system.

To illustrate his narrative Mr. Holden showed many slides and moving pictures of the development sites and the Barrett Chute plant in the various stages of its construction thus far.

Mr. Holden was introduced to the meeting by Mr. E. V. Buchanan and was thanked for his interesting and instructive address by Mr. W. G. Ure.

On March 18th, Mr. Geo. A. McCubbin, M.E.I.C., O.L.S., drainage consulting engineer of Chatham, Ont. addressed the branch on **The Drainage System of Kent County**. He has had a long career as a civil engineer and for many years has specialized in drainage problems.

In his address Mr. McCubbin showed how the work of a drainage engineer not only involves the technical problems of hydraulics but also the complicated workings of the drainage laws. The speaker stated and discussed the two fundamental drainage laws, firstly the Ditches and Water-courses Act which applies to all small drains, and secondly the Municipal Drainage Act applying to all large drainage projects. The latter requires a petition to Council and a majority vote. Mr. McCubbins chose several cases from his practice to illustrate the engineering principles involved and the effects the above laws had upon the individuals, roads and railways concerned. These cases were described with the use of slides showing the location and other features of the drainage work.

Also through the medium of his hobby, photography, Mr. McCubbin achieved a very pleasing and personal contact between the engineers present and those engineers and lawyers who are responsible for the drainage practice and laws as they are to-day. These slides were part of a prized possession containing the photographs of all the members of the Ontario Land Surveyors' Association.

The keen interest aroused by the speaker was evidenced by the large number of questions asked by those present.

Mr. McCubbin was introduced by Mr. W. G. Ure of Woodstock, and a vote of thanks was tendered by Mr. W. C. Miller of St. Thomas.

### MONCTON BRANCH

V. C. BLACKETT, M.E.I.C. - *Secretary-Treasurer*

Films dealing with **Photoelastic Stress Analysis** were shown at a meeting of the branch held on March 24th. H. J. Crudge, vice-chairman of the branch, presided. C. S. G. Rogers briefly reviewed the subject of the analysis of stress by the photoelastic method and gave a running commentary as the films were screened.

A discussion followed, and some doubts were expressed as to the suitability of visual methods in the determination of stresses in structures composed of two or more materials having different moduli of elasticity. In the case of reinforced concrete, the problem was further complicated by the fact that tensile stresses are arbitrarily compelled to follow the reinforcing steel.

With regard to rivetted joints, it was also pointed out that there are undoubtedly local stresses set up, due to imperfections in workmanship, and which cannot be calculated. It would be very desirable to find out more about these freak stresses but that would not be possible using a "monolithic" model of material such as bakelite.

Attention was drawn to the fact that the use of scale models and proportionate loads does not always accurately disclose conditions in the full size structure. The Quebec Bridge was cited as an example.

The opinion was expressed that the value of the films would be enormously increased if they were accompanied by an exact statement of the method by which the magnitude of a stress may be calculated, and the type (e.g. tensile, compressive or sheer) determined.

A vote of thanks to Professor MacDonald and the University of Manitoba, for the loan of the films; to Mr. Rogers for his commentary, and to the Reid Studio for the loan of a projector, was moved by A. S. Gunn, seconded by G. E. Smith.

### MONTREAL BRANCH

L. A. DUCHASTEL, M.E.I.C. - *Secretary-Treasurer*

On March 19th, Mr. John T. Farmer and Mr. E. A. Goodwin of the Montreal Engineering Company, Limited, presented a paper entitled **The Modernization of a Puerto Rico Electric Generating Station**.

The Montreal Engineering Company, Limited, manage a number of public utilities in Central and South America, one of which is the Puerto Rico Railway, Light and Power Company. The speakers described their work in the remodelling of this company's Santurce steam generating station.

Mr. Farmer gave design figures on the boilers, turbines, condensers, pumps and other equipment in use at the plant. Latest design high pressure oil-fired boilers and modern turbines have been installed in the expansion programme, which has during the last six years increased installed generating capacity from 3000 kw. to 6000, 11,000, 18,500 and finally 26,000 kw. in 1942. Part of this increase has been necessitated by the expansion of United States army and airforce bases in Puerto Rico.

Mr. Goodwin, who was resident engineer on the job, described the installation work, including several ingenious methods devised for getting the job done.

Mr. Moore moved the vote of thanks to the speakers.

On March 26th, Mr. Samuel G. Hibben addressed the branch on the subject of **Blackouts and Protective Lighting**. Mr. Percy Varley was chairman.

The speaker is director of applied lighting, Lamp Division, Westinghouse Electric and Manufacturing Company. New applications of lighting have been his constant specialty and he has been responsible for many innovations, particularly in the field of airport illumination and floodlighting.

Mr. Hibben is in close touch with the defence services on requirements for blackout protection, and was able, during the discussion, to offer numerous practical suggestions in regard to protection of important industrial plants. Mr. Hibben is a representative of the Illuminating Engineering Society on the United States National Civil Protection Committee.

The eastern portion of our continent is especially vulnerable to bombing, and token raids on military objectives are considered a real possibility during this year. An examination of the globe to indicate shortest routes, shows that Montreal is actually closer to German-held bases in Norway than is Washington. Since it is expected that these raids will be intermittent and of short duration, the blackout problem is different to that in London where long alert periods are the rule when heavy raids are in progress there.

The maximum light concentration for good blackout is about 0.0002 ft. candles and compares with the English blackout street lighting. It requires time to become accustomed to such dim light and it is not practical for the short alerts which we expect in this hemisphere.

The British have found total continual blackout to result in a high proportion of street accidents. Our cue from their experience would be to have lights on full until the alert is sounded and then to have total blackout for the period of the actual raid.

We are chiefly concerned with preventing the enemy from locating important military objectives, and this requires blackout co-ordination over whole provinces or states.

The speaker gave various suggestions for blackout and ARP work:

(a) In the dark the eye becomes better able to see blue sources than yellow and red. Therefore blue should be avoided. Similarly it is unnecessary to repaint a red roof on a barn.

(b) Blackout paint on windows is not very useful. Loose curtains are more desirable. Open windows are necessary to equalize pressure after bomb explosions.

(c) Shiny tops of cars parked near a plant, flat roofs and wet roofs give away a location to the pilot. So do traffic signs on wet streets. On wet nights such signs must be turned off during a raid.

(d) Fluorescent and luminescent paints are very useful for making signs which become quickly changed and can in some cases continue to glow for a number of hours. Numerous examples were shown by Mr. Hibben.

(e) Various types of emergency lamps were demonstrated. They are not officially approved yet and the use of any one requires judgment.

Members of the Illuminating Engineering Society, Government and ARP officials were present. All appreciated Mr. Hibben's timely and interesting discussion of this subject.

## NIAGARA PENINSULA BRANCH

J. H. INGS, M.E.I.C. - - *Secretary-Treasurer*  
C. G. CLINE, M.E.I.C. - - *Branch News Editor*

The Niagara Peninsula Branch held a joint dinner meeting with the Buffalo Section of the American Society of Civil Engineers on March 19th at the Mather Arms, Fort Erie, Ont., with an attendance of 70. W. T. Huber, A.S.C.E., and A. L. McPhail, M.E.I.C., acted as co-chairman. Mr. W. R. Manock, past councillor, welcomed the members of the Buffalo section and expressed the hope that such joint meetings might be held more frequently. Mr. N. Stone introduced the speaker, Mr. W. T. Niederlander, vice-president of the John W. Cowper Co., Buffalo, who gave an interesting paper on **Cantonment Construction at Pine Camp, New York**. Col. R. E. Smythe introduced Major Frank Milligan, district engineer officer, Military District No. 2, who opened the discussion on the paper with references to conditions at Canadian military camps. Col. Geo. W. Miniss, of Buffalo, showed some interesting pictures of camp life on the Mexican border 25 years ago. Mr. W. Jackson proposed a vote of thanks to the speakers.

## OTTAWA BRANCH

A. A. SWINNERTON, M.E.I.C. - - *Secretary-Treasurer*  
R. C. PURSER, M.E.I.C. - - *Branch News Editor*

At the noon luncheon Thursday, March 26, at the Chateau Laurier, members of the Ottawa Branch were treated to a screening of a remarkable film covering all phases of the construction of the **Portland-Montreal Oil Pipe Line**, which was completed and delivered its first drop of oil to the Canadian metropolitan city on November 16, 1941.

Paul Lebel, asphalt technologist for the Imperial Oil Company of Canada, Limited, who was camera man for the documentary film, contributed a few explanatory remarks. The building of the line took 142 days and was completed one month ahead of schedule. The line cost \$10,000,000, utilized 35,000 tons of steel tubing, and extends over a distance of 236 miles.

The members were shown all forms of mechanical apparatus in actual use in the coloured sound film. Mr. Lebel was heartily congratulated on achieving a photographic work of art as well as for recording in fine sequence the engineering problems involved and the methods utilized for their solution.

In the absence of the chairman, N. B. MacRostie, the speaker was introduced and thanked by T. A. McElhanney, immediate past chairman of the branch.

At the noon luncheon on April 9, W. R. Campbell, city traffic manager for the Trans-Canada Airways at Ottawa, gave an address on air transportation, accompanied by a technicolour sound film, **Skyway Across Canada**. Norman M. MacRostie, chairman of the Ottawa Branch, presided.

Referring to the extensive changes in air transportation brought about by the war, the speaker said that fully 80 per cent of the passengers now carried by the T.C.A. planes on their regular schedules are connected with the war. The extension of services to Newfoundland by May 1st was announced.

The meeting was also addressed by Captain John Riddeil, 3rd Field Company, Royal Canadian Engineers, who asked the support of the members in recruiting men for the reserve forces. "We can no longer take a man off the street, put a rifle in his hands and in a few days have a soldier. To-day we have to give the man an even break against the highly-trained enemy," he said.

## ST. MAURICE VALLEY BRANCH

C. G. DE TONNANCOUR, S.E.I.C. - - *Secretary-Treasurer*

Over four hundred residents of Three Rivers, Grand'Mère, and Shawinigan Falls were guests of the St. Maurice Valley Branch in the auditorium of the High School on Friday evening, March 20th, to see the recently completed film of the La Tuque power development **From Rapids to Electricity** and hear Guy Rinfret, the resident engineer during construction of the project, give a most interesting talk and vivid picture of the vast undertaking.

Dr. A. H. Heatley, chairman of the branch, presided at the meeting and expressed the appreciation of the members to the Shawinigan Water and Power Company for loaning them the film for the occasion.

In addition to the film there were on view a handsome oil painting of the development, four water-colour drawings of the landscaping of the property in the vicinity of the power house and a number of enlarged photographs of the work in its different stages.

Both the film and photographs were outstanding and well worth seeing and the La Tuque development was a revelation to many of the guests.

During the showing of the film a local orchestra rendered a number of popular selections and when the film had been shown Mr. Rinfret kindly answered a number of questions asked by the audience. Following the programme the guests were served coffee, sandwiches and cakes by the wives of members of the Institute.

The film was shown on Friday afternoon to the High School pupils and again on Saturday evening when the public was invited.

The speaker was introduced by M. Eaton and thanked by H. G. Timmins of Grand'Mère.

## SAULT STE. MARIE BRANCH

O. A. EVANS, J.E.I.C. - - *Secretary-Treasurer*  
N. C. COWIE, J.E.I.C. - - *Branch News Editor*

The third general meeting for the year 1942 was held in the Grill Room of the Windsor Hotel on April 2nd. On this occasion the branch had as its guests the president of the Institute, Dean C. R. Young of Toronto, and Vice-President K. M. Cameron of Ottawa. The branch also had as guests for the evening Judge J. K. MacDonald, W. C. Franz and C. McCaffery of Sault Ste. Marie.

Before the forty-three members and guests sat down to dinner, they met informally in the Grill Room where the majority had an opportunity to meet the president and vice-president.

Mr. J. L. Lang a member of the branch and a vice-president of the Institute introduced the speakers, the first being Mr. Cameron, who pleaded for active support of the Institute as he felt that engineers would need an organization to represent them after the war. He also asked the branch to organize a meeting in a district outside the Sault. Mr. Cameron then invited any member who might be in Ottawa to visit the branch there and he was sure that branches in other cities would welcome visitors.

In his opening remarks, Dean Young expressed the regret of the general secretary, Mr. L. Austin Wright, who was unable to be present. The president told his audience that there were now 5,500 members of the Engineering Institute. He spoke of the early history of engineering societies, the first, the Engineering Society of Britain was organized about 1770. It was very exclusive as it had only seven members. The latest developments of The Engineering Institute of Canada were the co-operative agreements with the Professional Societies of Engineers and the establishment of certain new committees, such as

the Committee for the Training and Welfare of the Young Engineer.

The president announced that Professor Webster of England would give a series of lectures on Air Raid Precautions for industries. The course would be given in Toronto.

There were large numbers of engineers serving in the armed forces in Canada and overseas. The president said one of the qualities of an engineer was his adaptability in adjusting himself to different situations. In dealing with the war situation the president said that there were eight to ten times the mechanical equipment of the last war, and a division controls one hundred and nineteen times the horse power. The mechanical equipment of a division was equivalent to four million men. A soldier needs eighteen civilians to supply him with the necessities to fight.

After the war the restoration of democracy would be necessary and the abolition of controls, although he felt that the price ceiling control would stay on for some time.

Canada is now building and manufacturing large ships, armour plate, plastics, instrument glass and pre-fabricated buildings. He predicted that there would be more mechanization of agriculture and improvements in the art of welding, great reconstruction of houses, slum clearances, new highway construction, both urban and rural, and railway rehabilitation. The president said, however, that we must win the war first.

Mr. C. Stenbol thanked the speakers on behalf of those present and Chairman L. R. Brown gave the thanks of the branch.

### TORONTO BRANCH

S. H. de JONG, M.E.I.C. - *Secretary-Treasurer*  
D. FORGAN, M.E.I.C. - - *Branch News Editor*

On February 19th, the Toronto Branch held one of the most interesting meetings of the current season. Mr. Forrest Nagler, chief engineer, Canadian Allis-Chalmers, was the speaker for the evening and was introduced by Mr. Otto Holden, chief hydraulic engineer, Hydro-Electric Power Commission.

Mr. Nagler's subject **Hydraulic Misbehaviour in Water Power Units** was illustrated with very interesting films taken of actual flows in a transparent model draft tube. The disturbances in draft tubes and their results

could easily be seen and were explained by the speaker. In his preliminary comments Mr. Nagler made some very interesting and enlightening remarks about the natural resources of the Great Lakes basin and their relation to any world war. The speaker also showed how natural resources when developed will draw industry to them as illustrated in the case of Grand Coulee Dam. They had no market for their power before the project was started, yet the generators have not been stopped since the day they started on test. Mr. Nagler was one of the most interesting speakers we have had for a long time.

On March 2nd the branch was favoured with a visit from Lt.-Col. W. E. Phillips. Colonel Phillips repeated the paper which attracted so much interest when he presented it at the Annual Meeting of the Institute held in Montreal in February last, on **The Organization and Work of Research Enterprises, Limited**. The paper has been published in the March issue of the *Journal*.

Two speakers presented papers for the regular branch meeting on Thursday, March 9th, held in Hart House, University of Toronto. These were Mr. C. F. Publow, assistant electrical engineer, and Mr. A. E. Davison, transmission engineer, both of the Hydro Electric Power Commission of Ontario. Mr. Publow's subject was **Power Transformer Station Problems**. Mr. Davison's subject was **Transmission Line Problems**, both of which were discussed with particular reference to the Burlington 220 kv. station and associated lines.

Both speakers have had a wide and long experience in the electrical engineering field, and have made many contributions to engineering publications. Their addresses, which were illustrated by lantern slides, were of special interest not only to electrical engineers, but to those in other branches of the profession. In addition, Mr. Davison presented an exceptionally attractive and beautifully coloured movie entitled "Spanning the Miles" which dealt with the construction of the 220,000-volt steel tower transmission lines.

Mr. H. E. Brandon's reminiscences in his introduction of the speakers were much appreciated by the large audience and the thanks of the gathering were presented by Mr. W. E. Bonn.

## SAVE FOR VICTORY

If you do not keep your *Journals* do not burn or destroy them. Give them to a salvage organization. They are needed for victory.

### AMERICAN STANDARD DEFINITIONS OF ELECTRICAL TERMS, C42

A new American Standard known as Definitions of Electrical Terms, C42, sponsored by the American Institute of Electrical Engineers, is now ready for general distribution. The issue of this volume of electrical definitions as an American Standard should mark an epoch in the literature of the electrical art in America, as it is the first time the definitions of the important terms common to all branches of the art as well as those specifically related to each of the various branches have been assembled and printed under one cover.

This glossary is the result of more than twelve years' work of a sectional committee of 46 members having 18 subcommittees drawn from available specialists. More than 300 individuals have given material assistance and many others have assisted in specific instances. The 34 organizations represented on this sectional committee include the national engineering, scientific and professional societies, trade associations, government departments and miscellaneous groups.

The story of the origin of this work is as follows:

The International Electrotechnical Commission in 1910 appointed a committee on Nomenclature, for the purpose of drafting an international list of terms and definitions. As standardization, both national and international, was at that time very much in its infancy, the work progressed very slowly for some years.

The first work of the IEC Advisory Committee on Nomenclature, under the chairmanship of the late Dr. C. O. Mailloux, consisted of making an exhaustive study of all the recognized systems for classification and numbering of terms in a technical glossary. The system employed in the new American Standard is that adopted at the Bellagio meeting of 1927 and employed in the international vocabulary of some 1,860 terms issued in 1938. Its adoption was based on the belief that it permits the greatest possible latitude for interpolation of terms necessitated by future developments without requiring change in established group and term arrangements and numbering.

For some time before the 1927 meeting of the IEC the U.S. National Committee IEC had been working toward the organization of a committee for the formulation of an American vocabulary, recognizing that the international list would inevitably cover but a fraction of the terms required for a serviceable American vocabulary.

The American Standards Association approved the initiation of the work in 1928 on the recommendation of the Standards Committee of the American Institute of Electrical Engineers, the scope being outlined as follows:

"Definitions of technical terms used in electrical engineering, including correlation of definitions and terms in existing standards."

Under this authorization, the Sectional Committee on Definitions

of Electrical Terms, C42, was organized during the same year, under the sponsorship of the AIEE and chairmanship of Dr. A. E. Kennelly. In 1932 the first report was printed, and 3,000 copies were distributed for comment and criticism. In 1937 the second general revision was compiled and distributed. Early in 1940, C. H. Sanderson was appointed chairman (vacated in 1938 by the death of Dr. Kennelly) and the final preparation of the work for approval and publication as an American Standard was brought to a close in the spring of 1941.

The primary aim in the formulation of the definitions has been to express for each term the meaning which is generally associated with it in electrical engineering in America. The definitions have been generalized wherever practicable to avoid precluding the various specific interpretations which may be attached to a term in particular applications. It has been recognized that brief, simplified phrasing usually presents the clearer word picture. Amplifying notes accompany certain definitions when the added information is particularly helpful, but those notes are not a legitimate part of the standard phrasing. Words used in the definitions have been employed in the accepted meaning as given in the recognized dictionaries, unless they have been defined specifically in this glossary. Specialized definitions for common words have been discouraged.

Prior to the inception of this work the definitions to be found in the literature of the electrical art were comparatively few, were very widely scattered and their formulation as to substance and expression was generally the work of individuals or small groups. Many of these had gained some measure of approval in that branch of the art responsible for their formulation, but were practically unknown elsewhere. Some groups of general terms had long been the subject of much controversy. The engineer or scientist or student who wished to have ready access to the definitions actually existing in printed form was faced with the necessity of assembling a sizable library. Moreover, in some cases he then had to choose between two or more definitions of the same term.

This new American Standard has unified and perfected the existing groups of definitions and has rounded out these groups and added many new groups. Its coverage is more than three times that of this field in any other language. It should prove of great value to the general public as well as to scientists and engineers for it is an extension of the function of the recognized dictionaries into specialized fields not hitherto covered.

The "Definitions" book is a handsome sturdy volume of some 300 pages, 8 x 11 inches; high quality paper and printing; dark blue fabrikoid binding, gold lettering, thoroughly indexed. Price is \$1.00 net each in U.S.A. to all on single copies or in quantity. \$1.25 outside U.S.A. Make checks or money orders payable to AIEE. Address AIEE Headquarters, 33 West 39th St., New York, N.Y.

### ADDITIONS TO THE LIBRARY TECHNICAL BOOKS

#### Canadian Trade Index 1942:

*Canadian Manufacturers' Association Inc., Toronto. 6½ x 10 in. \$6.00.*

#### Elastic Energy Theory:

*2nd. ed. J. A. Van Den Broek. N.Y., John Wiley and Sons, Inc., 1942. 6 x 9¼ in. \$4.50.*

#### The Airplane and Its Components:

*William R. Sears. N.Y., John Wiley and Sons, Inc., 1942. Galcit Aeronautical Series. 6 x 9¼ in. \$1.25.*

#### Scientists Face the World of 1942:

*Essays by Karl T. Compton, Robert W. Trullinger and Vannemar Bush. N.J., Rutgers University Press, 1942. 6 x 9¼ in. \$1.25.*

#### Canada Moves North:

*Richard Finnie. Toronto, Macmillan Co., c. 1942. 5¾ x 9 in. \$4.00.*

#### Teelmi Data:

*Handbook on Engineering, Chemistry, Physics, Mechanics and Mathematics by Edward Lupton Page. N.Y., Norman W. Henley Pub. Co., 1942. 5½ x 8½ in. \$1.00.*

#### Electric Circuits and Machinery:

*Vol. II Alternating Currents by Frederick W. Hehre and George T. Harness. N.Y., John Wiley and Sons, Inc., 1942. 6 x 9 in. \$6.00.*

#### Uniformity in Highway Traffic Control:

*William Phelps Eno. Conn., Eno Foundation for Highway Traffic Control Inc., 1941. 5¼ x 7¼ in. \$1.00.*

#### Canadian Engineering Standards Association:

*Standard specification for Concrete and Reinforced Concrete, 2nd. ed. A23-1942. \$1.00.*

#### Gate Brands:

*3rd. ed. Commercial Standard CS8-41 (supersedes CS8-33) Washington, U.S. Bureau of Standards, 1941. 15c.*

#### Australian Standard:

*Engineering drawing practice. Australian standard No. CZ. 1-1941. The Institution of Engineers, Australia, 1941.*

### PROCEEDINGS, TRANSACTIONS

#### American Society of Mechanical Engineers:

*Transactions vol. 63, 1941.*

#### American Institute of Electrical Engineers:

*Transactions vol. 60, 1941.*

### REPORTS

#### Canada—Department of Mines and Resources—Surveys and Engineering Branch:

*Arctic and Western Hudson Bay Drainage in Alberta, Manitoba and Saskatchewan for 1935-37. Ottawa, 1942. \$1.00 (Water resources paper No. 82).*

#### Quebec—Bureau of Mines:

*The mining industry of the Province of Quebec in 1940.*

#### Quebec—Bureau of Mines—Geological Surveys:

*Matapedia Lake Area. Geological report No. 9.*

#### The Engineering Foundation:

*Annual report 1940-41.*

#### Nova Scotia Power Commission:

*Twenty second annual report for the period ended November 30, 1941.*

#### U.S. Geological Survey—Professional Papers:

*Geology and biology of North Atlantic deep-sea cores: pt. 3 Diatomaceae pt. 4 Ostracoda. Professional paper No. 196B and C.*

#### U.S. Geological Survey—Water Supply Papers:

*Surface water supply of the U.S. in 1939;*

pt. 3 Ohio river basin; pt. 5 Hudson Bay and Upper Mississippi river basins; pt. 10 The Great Basin (Nos. 873, 875, 880). Surface water supply of the U.S. 1940; pt. 10 The Great Basin; pt. 11 Pacific slope basins in California; pt. 12 Pacific slope basins in Washington and Upper Columbia river basin; pt. 13 Snake river basin; pt. 14 Pacific slope basins in Oregon and lower Columbia river basin; (Nos. 900-904). Water levels and artesian pressure in observation wells in the U.S. in 1940 (No. 910).

#### U.S. Geological Survey—Bulletins:

*Spirit leveling in Texas*; pt. 4 North central Texas and pt. 5 South central Texas 1896-1938 (Nos. 883D and E). Nickel-gold deposit near Mount Vernon, Skagit county, Washington (No. 931D).

#### Quebec—Association of Architects:

*Register 1942.*

#### Institution of Structural Engineers:

*Year book and list of members 1940-41.*

#### Nova Scotia—Association of Professional Engineers:

*Engineering profession act and by-laws; amended to April, 1941.*

#### Alberta—Association of Professional Engineers:

*Engineering profession act, by-laws and code of ethics; amended to date.*

#### Bell Telephone System—Technical Publications:

*Contribution of statistics to the science of engineering; Theory of antennas of arbitrary size and shape; The thermal expansion of pure metals, copper, gold, aluminum, nickel and iron; A visual test for calcium in lead; The reliability of holding time measurements; Television—the scanning process; Monographs B-1319-1324.*

#### Bell Telephone Laboratories:

*The mobilization of science in national defense by Frank B. Jewett. February, 1942.*

#### American Institute of Consulting Engineers:

*Constitution, by-laws and list of members 1942.*

#### Iowa State College—Bulletin:

*The Structural design of flexible pipe culverts. Bulletin No. 153, December, 1941.*

#### University of Illinois—Engineering Experiment Station:

*A study of the collapsing pressure of thin walled cylinders; Bulletin No. 329. The suitability of stabilized soil for building construction; Bulletin No. 333. Papers presented at the 28th annual conference on highway engineering held at the University of Illinois, March 5-7, 1941; Circular No. 42.*

#### Port of New York Authority:

*21st annual report 1941.*

#### University of Minnesota—Engineering Experiment Station:

*Predicting dust concentration; Technical paper No. 26.*

#### Canadian General Electric:

*Electrical developments for 1941.*

#### Buenos Aires—Transport Control Committee:

*New principles in urban transportation economy. 2nd ed. rev. 1941.*

#### Electrochemical Society:

*Nickel plating magnesium alloys; New work on tin plating from ammonium stannous oxalate; The rate of film formation on metals; The rate of oxidation of copper at room temperature; Some unusual over-*

*voltage phenomena; Long time charge and decay phenomena; Some corrosion characteristics of high purity magnesium alloys; Electrophoretic dewatering of clay; Preprint Nos. 81-6 to 13.*

### BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet the books are not in The Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

#### AIR PILOT TRAINING

By B. A. Shields. McGraw-Hill Book Co. (Whittlesey House), New York and London, 1942. 602 pp., illus., diags., charts, maps, tables, 9½ x 6 in., cloth, \$4.00.

The four sections of this book cover the essential material required for private and commercial pilots' licenses. They deal respectively with aircraft and the theory of flight, aircraft engines, meteorology, and air navigation. Elementary principles are fully explained and are tied in with their applications to appropriate types of flight problems or procedures. Previous technical education is not required.

#### AIRCRAFT HANDBOOK

By F. H. Colvin. 5 ed. McGraw-Hill Book Co., New York and London, 1942. 784 pp., illus., diags., charts, tables, 8½ x 5½ in., lea., \$5.00.

The new edition of this handbook presents detailed and considerably expanded information about all types of airplane engines, propellers, instruments, and other equipment. In order to provide such a manual, of particular assistance to the ground mechanic, previously included material on flight theory, airplane design and construction, etc., has been omitted. Inspection and maintenance work have been emphasized.

#### AIRCRAFT LAYOUT AND DETAIL DESIGN

By N. H. Anderson, with a foreword by C. T. Reid. McGraw-Hill Book Co., New York and London, 1941. 306 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$3.00.

The three main objects covered in this text are descriptive geometry, detail design and fitting analysis. Only those portions of descriptive geometry that have common application to aircraft structures are considered. In detail design, fundamentals are emphasized rather than specific shop methods, although the guiding principles are so laid out that any part should be practicable to produce. Sufficient stress analysis is presented for an intelligent determination of minimum weight for required strength.

#### (The) AIRPLANE AND ITS COMPONENTS (Galcit Aeronautical Series)

By W. R. Sears. John Wiley & Sons, New York; Chapman & Hall, London, 1942. 75 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$1.25.

A condensed general survey of the field of airplane design is presented as an introduction for students and workers with some technical knowledge. Airplane types, their external and internal components, aircraft radio and instruments, engines and propellers are briefly discussed, with emphasis on basic engineering principles. Characteristic problems are pointed out and typical solutions indicated.

#### AIRPLANE METAL WORK, Vol. 4. Airplane Pneumatic Riveting. 103 pp.

#### AIRPLANE METAL WORK, Vol. 5. Airplane Sheet Metal Repair. 94 pp.

By A. M. Robson. D. Van Nostrand Co., New York, 1942. illus., blueprints, diags., tables, 9½ x 7 in., paper, \$1.25 each.

These volumes continue a series intended for mechanics actively engaged in the aircraft industry and for prospective mechanics in training. Volume 4 contains first a general discussion of work habits and operations related to riveting, and then descriptions of actual jobs occurring in pneumatic riveting shop practice. Volume 5 presents a section of related trade information for sheet metal repair and, as before, follows with detailed descriptions of actual jobs in the sheet metal repair shop. There are also in each volume full lists of necessary tools and miscellaneous equipment and tables of useful data.

#### CHEMICAL ENGINEERING FOR PRODUCTION SUPERVISION. (Chemical Engineering Series.)

By D. E. Pierce. McGraw-Hill Book Co., New York and London, 1942. 232 pp., diags., charts, tables, 9½ x 6 in., cloth, \$2.50.

A simple explanation is given of the fundamental chemical engineering principles upon which the successful operation of plant equipment depends. The book presents those basic principles of chemistry, physics and thermodynamics most useful to the operating man, together with their application to five unit operations: heat transfer, evaporation, distillation, drying, and flow of fluids.

#### CHEMICAL ENGINEERING PLANT DESIGN. (Chemical Engineering Series)

By F. C. Vilbrandt. 2 ed. McGraw-Hill Book Co., New York and London, 1942. 452 pp., diags., charts, tables, maps, 9½ x 6 in., cloth, \$5.00.

This volume analyzes the fundamental principles and factors that are involved in the development of a technically and economically efficient plant process from the laboratory stage through the pilot plant stages to the unit of commercial size. The author discusses such topics as foundations, drainage, piping, pumps, flow diagrams, equipment selection, plant layout, and power. The last two chapters deal with preconstruction cost accounting and plant location.

#### ELASTIC ENERGY THEORY

By J. A. Van den Broek. 2 ed. John Wiley & Sons, New York; Chapman & Hall, London, 1942. 298 pp., diags., charts, tables, 9½ x 6 in., cloth, \$4.50.

The theory of elastic energy as an instrument for the solution of problems involving statically indeterminate structures is presented as a text for an elementary course in strength of materials. The graphical summation method is used, because of its more general character and ease of application. The book is designed to be of use to practical engineers as well as to college students.

#### ENGINEERING ECONOMIC ANALYSIS

By C. E. Bullinger. McGraw-Hill Book Co., New York and London, 1942. 359 pp., diags., charts, tables, 9½ x 6 in., cloth, \$3.50.

The chief aim of this tract on cost analysis as applied to engineering projects is to give students an understanding of the economic factors which are present in the engineering process. The four main parts of the book deal respectively with: the economy analysis, probable yield on the investment; the intangible analysis, consideration of human relationships; the financial analysis, provision of funds; and special methods and applications.

#### FLUORESCENT CHEMICALS and Their Applications

By J. De Ment, with a Special Chapter on Ultraviolet Radiation Sources, by H. C. Dake. Chemical Publishing Co., Brooklyn, N.Y., 1942. 240 pp., illus., diags., charts, tables, 9 x 5½ in., cloth, \$4.25.

The general foundations of luminescence having been discussed in a previous book, the

chief concern of the present work is the fluorescent chemicals and their uses in the industries, arts and sciences. There is a brief discussion of fundamentals, and the basis for fluorescence analysis is presented. Nearly 3,000 chemicals are listed, including a number which are comparatively rare. There is also a special chapter on sources of ultraviolet radiation.

#### GAGES AND THEIR USE IN INSPECTION

By F. H. Colvin. McGraw-Hill Book Co., New York and London, 1942. 157 pp., illus., diags., charts, tables, 7½ x 5 in., cloth, \$1.50.

A complete introduction to the use of gages, this book is especially valuable for those who wish to become inspectors. It points out why gages are made, describes all types, and shows plainly how they are used in a variety of work. Tolerances, limits and allowances are covered, with discussion of the proper use of these terms.

#### Great Britain, Department of Scientific and Industrial Research

#### INDEX TO THE LITERATURE OF FOOD INVESTIGATION, Vol. 13, No. 2, Sept., 1941

Compiled by A. E. Glennie and others. His Majesty's Stationery Office, London, 1941. 155 pp., tables, 9½ x 6 in., paper, (obtainable from British Library of Information, 30 Rockefeller Plaza, New York,) \$1.35.

This publication provides abstracts of the literature of the food industry as it appears in periodicals. All phases of the subject are covered, including such problems of engineering as temperature and humidity control, transportation methods, insulation, refrigeration and air conditioning. There is an author index.

#### Great Britain, Department of Scientific and Industrial Research, BUILDING RESEARCH

#### WARTIME BUILDING BULLETIN No. 19. Economy of Timber in Building

His Majesty's Stationery Office, London, 1942. 16 pp., diags., tables, 11 x 8½ in., paper, (obtainable from British Library of Information, 30 Rockefeller Plaza, New York), 30c.

This bulletin discusses ways in which further economy can be achieved in the use of timber in building. Recommendations for the guidance of designers, manufacturers and contractors are set out with several detail sketches illustrating particular points.

#### Great Britain, Mines Department. SAFETY IN MINES RESEARCH BOARD, Nineteenth Annual Report, 1940

His Majesty's Stationery Office, London, 1942. 36 pp., illus., tables, charts, 9½ x 6 in., paper, (obtainable from British Library of Information, 30 Rockefeller Plaza, New York), 50c.

The report summarizes the results of researches in progress during the year. Among matters discussed are: incombustible dust for prevention of coal-dust explosions; rapid analysis of mine dusts; firedamp explosions; flameproof electrical machinery; properties of timber, steel and concrete mine props; deterioration of wire ropes.

#### HEATING, VENTILATING, AIR CONDITIONING GUIDE 1942, Vol. 20

American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York, 1942. 1,160 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$5.00.

The new edition of this valuable reference work follows the pattern of preceding ones. Section one presents the essential technical

data for heating, ventilating and air conditioning. This section has been thoroughly revised and largely rewritten to include recent information. Section two contains catalogue data by many manufacturers of equipment. Section three is the membership list of the Society.

#### HYDRAULICS

By G. E. Russell. 5 ed. Henry Holt & Co., New York, 1942. 468 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$4.25.

The fundamental principles of hydraulics are presented in a clear, logical manner for students and for use as a reference book by engineers. Although the text is devoted mainly to hydraulics, the flow of other liquids and of compressible fluids is briefly discussed. The basic text material has been completely revised for the first time since 1925, and the chapters on hydraulic turbines and centrifugal pumps, added in the previous edition, have been brought up to date.

#### INDUSTRIAL ACCOUNTING

By S. W. Specthrie. Prentice-Hall, Inc., New York, 1942. 243 pp., charts, tables, 9½ x 6 in., cloth, \$3.75.

This volume is intended as a text for engineers, engineering students and industrial administrators who wish to gain an understanding of the processes and executive uses of industrial accounting. The early chapters present basic accounting principles and book-keeping procedures. This is followed by a course in the theory and practice of cost accounting. Finally, the executive use of accounting data is discussed.

#### INDUSTRIAL CHEMISTRY OF COLLOIDAL AND AMORPHOUS MATERIALS

By W. K. Lewis, L. Squires and G. Broughton. The Macmillan Co., New York, 1942. 540 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$5.50.

The introductory chapters of this text are intended to present basic material on the subject of colloids, with emphasis on those phases which are now or likely to be of major importance in industry. Succeeding chapters demonstrate the relation of these principles to various fields and their application in the development of processes in the glass, paper, rayon, leather, rubber, ceramic, textile, paint and synthetic industries. A brief bibliography accompanies each chapter.

#### INDUSTRIAL ELECTRICITY, Part 2. (Electrical Engineering Texts)

By C. L. Dawes. 2 ed. McGraw-Hill Book Co., New York and London, 1942. 523 pp., illus., diags., charts, tables, 8½ x 5½ in., cloth, \$2.75.

The primary object of this text is to develop in a simple manner the principles of alternating currents and alternating-current circuits, and to show their applications to electrical machinery, rectifiers, electron tubes, etc., and also to power transmission. The book has undergone extensive revision throughout, major changes being the inclusion of a new chapter on rectifiers and the omission of the previous brief chapters on illumination and interior wiring.

#### INDUSTRIAL SUPERVISION, CONTROLS. (Pennsylvania State College, Industrial Series). 267 pp.

#### INDUSTRIAL SUPERVISION, ORGANIZATION. (Pennsylvania State College, Industrial Series). 283 pp.

By V. G. Schaefer, W. Wisaler and others. McGraw-Hill Book Co., New York and London, 1941. Diags., charts, tables, 8 x 5 in., cloth, \$1.75 each.

These two volumes deal with the problems of the foreman in industry. The one on controls discusses the various methods of control by which morale and safety are promoted, and waste and turnover are lessened. The volume

on organization considers what can be done with the worker and in coordinating workers with jobs in order to increase efficiency in production.

#### INDUSTRIAL WASTE TREATMENT PRACTICE

By E. F. Eldridge. McGraw-Hill Book Co., New York and London, 1942. 401 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$5.00.

Until now, the available information on the treatment of industrial waste has been widely scattered and badly in need of organization. The present work endeavors to do this, on the basis of the author's experience and the literature. The general principles of waste treatment methods and equipment are first discussed, after which specific industries are considered, such as beet-sugar, milk products, canning, tanning, pulp and paper making, meat packing, oil refining, etc.,. Prominence is given to the design of structures for full-scale treatment.

#### INTERPRETATION OF GEOLOGIC MAPS AND AERIAL PHOTOGRAPHS

By A. J. Eardley. Edwards Brothers, Ann Arbor, Mich., 1941. 99 pp., illus., diags., charts, maps, tables, 9 x 6 in., paper, \$1.50.

This textbook, based upon a course given in the University of Michigan, provides an undergraduate course in the interpretation of geological maps and aerial photographs. It aims to present briefly the principles of map interpretation by means of realistic illustrations with short explanations; upon that study as a basis, to present the principles of geologic interpretation of aerial photographs; to describe the use of such photographs in field mapping.

#### AN INTRODUCTION TO HISTORICAL GEOLOGY, with Special Reference to North America

By W. J. Miller. 5 ed. D. Van Nostrand Co., New York, 1942. 499 pp., illus., diags., charts, maps, tables, 9½ x 6 in., cloth, \$3.50.

Extensive revision has again modernized this standard text, which is a companion volume to the author's "Introduction to Physical Geology." Beginning with a general treatment of fundamentals (fossils, rock formations, etc.) the author proceeds to develop the physical history and corresponding life of the successive geological divisions. Of great assistance to the layman or student are the many illustrations and the appended "Outline Classification of Plants and Animals".

#### INTRODUCTION TO MODERN PHYSICS

By F. K. Richtmyer and E. H. Kennard. 3 ed. McGraw-Hill Book Co., New York and London, 1942. 723 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$5.00.

This work, based upon a series of lectures given at Cornell University, is intended to meet the needs of students who wish a survey of the origin, development and present status of physics, either as an introduction to specialized graduate study or as a supplement to the usual elementary physics courses. The present edition, rewritten after the death of the original author, has been considerably changed in order to conform to its title, noteworthy additions being the chapters on the relativity theory and cosmic rays.

#### MANUFACTURE OF SODA with Special Reference to the Ammonia Process. (American Chemical Society Monograph Series No. 65)

By Te-Pang Hou. 2 ed. rev. and enl. Reinhold Publishing Corp., New York, 1942. 590 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$9.50.

Based mainly upon the author's own experience, this monograph presents a detailed practical account of the ammonia soda industry. The preparation of the raw materials, the manufacture of sodium bicarbonate and caustic soda, and the recovery of by-products are thoroughly covered. In addition to the general extensive revision in this edition, there are new chapters on plant equipment and on modifications and new developments in the industry.

## MANUFACTURING PROCESSES

By M. L. Begeman. John Wiley & Sons, New York; Chapman & Hall, London, 1942. 579 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, \$4.50.

This book includes the technical fundamentals of important manufacturing processes, engineering materials and equipment used in processing them. It is intended for use by engineering students to supplement shop laboratory practice or as a text where these courses are omitted. Foundry practice, pattern work, metal casting, plastic molding, heat treatment and welding are discussed. Machine tools and accessories are considered, and their applications and limitations considered.

## MODERN PLYWOOD

By T. D. Perry. Pitman Publishing Corp., New York and Chicago, 1942. 366 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$4.50.

All phases of the plywood industry are covered in this comprehensive work. A brief history of the development of plywood precedes sections dealing with the advantages and characteristics of modern plywood and the adhesives used in its construction. The manufacture of veneers and plywood is covered in detail, and industrial uses are described. Grading rules, a glossary of trade terms and an extensive classified bibliography are also included.

## MODERN PULP AND PAPER MAKING, a Practical Treatise

By G. S. Witham. 2 ed. Reinhold Publishing Corp., New York, 1942. 705 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$6.75.

The purpose of this treatise is to give a general, practical account of the equipment and processes used in American pulp and paper plants. The new edition has been thoroughly revised to include developments since the first edition appeared in 1920, and the material has been arranged more logically.

## THE MODERN STRIP MILL

Edited by T. J. Ess and J. D. Kelly. Association of Iron and Steel Engineers, Empire Bldg., Pittsburgh, Pa., 1941. Two parts bound in one. Pt. 1, 358 pp.; Pt. 2, 127 pp., illus., diagrs., charts, tables, blue-prints, 12½ x 9 in., leather, \$15; to libraries \$10; outside of United States \$20.

This important volume, based upon articles that have appeared in the "Iron and Steel Engineer," provided a detailed, complete review of the development of the continuous wide-strip mill. The first section discusses mill equipment, unit by unit, with a great fund of operating data for each group. The second section contains descriptions, with layout drawings, of the twenty-eight mills now operating in the United States. An immense amount of information, based upon actual operation, is supplied.

## OPERATION OF SEWAGE-TREATMENT PLANTS

By W. A. Hardenbergh. International Textbook Co., Scranton, Pa., 219 pp., illus., diagrs., charts, tables, 7½ x 5 in., cloth, \$2.50.

In part one of this practical text, the author discusses general considerations of sewage treatment and procedures for sewage analysis. In parts two and three, the equipment and processes for primary and secondary treatment are described in detail. The final chapter presents operating data, with sample report sheets, for a trickling-filter treatment plant in a city with a population of 80,000.

## PILOTS' AND MECHANICS' AIRCRAFT INSTRUMENT MANUAL

By G. C. DeBaud. Ronald Press Co., New York, 1942. 490 pp., illus., diagrs., charts, tables, maps, 9 x 6 in., cloth, \$4.50.

This textbook on aircraft instruments is designed to meet the requirements of thorough, systematic courses in technical and aviation schools, and the needs of those who wish to acquire an understanding of instruments without an instructor's guidance. The chapters of the book are so arranged that the user will progressively understand the construction, purpose and necessity of the instrument, likely errors with their remedies, installation and maintenance. There is also a brief outline of instrument flying training.

## PLASTICS IN ENGINEERING (Machine Design Series)

By J. Delmonte. 2 ed. Penton Publishing Co., Cleveland, Ohio, 1942. 601 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$7.50.

Intended for the machine designer and manufacturer rather than the chemist, this work aims to present the data needed by designers in convenient form for reference. The opening chapters review the various types of plastics, methods of compounding, and physical and chemical properties. Succeeding chapters discuss methods of molding, uses for bearings, gears and other machine parts, engineering applications, fabrication and finishing of plastic parts, etc. The revision in the new edition has been influenced by the increasing need of substitutes for many strategic metals.

## POSSIBLE ALTERNATES FOR NICKEL, CHROMIUM AND CHROMIUM-NICKEL CONSTRUCTIONAL ALLOY STEELS (Contributions to the Metallurgy of Steel, No. 5)

(Contributions to the Metallurgy of Steel, No. 5.) American Iron and Steel Institute, 350 Fifth Ave., New York, Jan., 1942. 143 pp., charts, tables, 9 x 6 in., paper, 50c.

This timely pamphlet presents four new series of alloy steels designed to preserve our reserves of strategic metals, especially chromium and nickel. The steels developed embrace a series of carbon-molybdenum, manganese-molybdenum, low chromium-molybdenum and low nickel-chromium-molybdenum steels. Data are given about hardenability and other physical properties.

## POWER PLANT ENGINEERING AND DESIGN

By F. T. Morse, 2 ed. D. Van Nostrand Co., New York, 1942. 703 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$6.50.

The aim of this book is to present in one volume a study of electric generating stations, including public service, industrial and institutional plants. Attention is paid to both mechanical and electrical features and to economic factors. Steam plants are given most attention, but hydroelectric and Diesel-engine plants are also considered. The comprehensive nature of this one-volume text has been attained by assuming a basic knowledge of thermodynamics and mechanics and by omitting minor details of plant equipment and layout.

## PRINCIPLES OF MECHANICS

By J. L. Synge and B. A. Griffith. McGraw-Hill Book Co., New York and London, 1942. 514 pp., diagrs., tables, 9½ x 6 in., cloth, \$4.50.

This textbook in theoretical mechanics covers the usual range of theory and applications, up to and including an introduction to Lagrange's Equations, with emphasis on general principles and underlying philosophical ideas. Vector notation and the complex variable are used wherever they provide the most efficient tools. A chapter on the special theory of relativity is included.

## PRODUCTION CONTROL

By L. L. Bethel, W. L. Tann, F. S. Atwater and E. E. Rung. McGraw-Hill Book Co., New York and London, 1942. 276 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$2.75; accompanying Teachers' Manual, by L. L. Bethel, 19 pp., 8 x 5½ in., paper, 10c.

The principles and procedures for planning and controlling industrial production are covered. Broad factors of production management and of operation control are also included. Case problems, taken from current industrial practices, illustrate the applications of principles. Appendices contain a portion of the written standard practice of an actual company, sample production-control forms, and an example of a typical job order production-control system.

## PRODUCTION ENGINEERING

By E. Buckingham. John Wiley & Sons, New York; Chapman & Hall, London, 1942. 268 pp., tables, 9 x 6 in., cloth, \$2.50.

Under three main headings—preparation for production, production operation and control, and supporting activities—the author co-ordinates the information presented to the production engineering student in his various technical courses. He points out the relationship of these technical details, and emphasizes the importance of active co-operation among the individuals who perform the separate functions involved.

## (The) RADIO AMATEUR'S HANDBOOK (Special Defense Edition)

Published by the American Radio Relay League, West Hartford, Conn., 1942. 288 pp., illus., diagrs., charts, tables, 9½ x 6½ in., paper, \$1.00.

In this special edition for training courses, the nine basic theoretical chapters of the standard edition are retained intact, and the constructional chapters have been condensed into one which describes representative types of radio equipment. The section on measurements remains, and an introductory chapter covering the necessary elementary mathematics has been added. The material on the construction of amateur equipment and the operation of amateur stations have been omitted completely.

## (The) REFINERY CATALOGUE

A Composite Catalogue of Oil Refinery Equipment, including Process Handbook and Engineering Data; published by Refiner and Natural Gasoline Manufacturer, Houston, Texas, 1940. 9 ed. 529 pp., illus., diagrs., charts, maps, tables, blue-prints, 12 x 8 in., cloth, apply.

The Catalogue presents data on equipment for oil refineries and natural-gasoline plants supplied by over two hundred manufacturers. In addition the book contains a section on processes, which contains descriptions and flow sheets for many important processes used in refining and treating petroleum and natural gasoline, and a collection of tables frequently wanted in refinery operation.

(Continued on page 337)

# PRELIMINARY NOTICE

of Applications for Admission and for Transfer

April 25th, 1942.

The By-laws provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.\*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

**Communications relating to applicants are considered by the Council as strictly confidential.**

The Council will consider the applications herein described at the June meeting.

L. AUSTIN WRIGHT, General Secretary.

\*The professional requirements are as follows:—

A **Member** shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupillage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science or engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A **Junior** shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A **Student** shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An **Affiliate** shall be one who is not an engineer by profession but whose pursuits, scientific attainment or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

## FOR ADMISSION

DAVIS—ROBERT, of 846 Broadview Ave., Toronto, Ont. Born at Duntocher, Dumbartonshire, Scotland, Aug. 25th, 1894; Educ.: Royal Technical College, Glasgow—1913-17, naval architecture, 1919-21, advanced maths., 1939, struct'l. design (2nd year); 1911-17, ap'ticeship as ship f'tsman., John Brown & Co., Clydebank; 1917-19, f'tsman., Royal Naval Air Service; 1919-23, ship f'tsman., John Brown & Co.; 1923-27, struct'l. f'tsman. (Lachine), 1927-29, checker (Toronto), 1929-34, checker (Lachine), Dominion Bridge Co. Ltd.; 1934-39, checker, Sir Wm. Arrol & Co., Glasgow; 1939-42, checker, Dominion Bridge Co. Ltd., at present, on loan as hull engr., to Wartime Merchant Shipping Ltd.

References: D. C. Tennant, G. P. Wilbur, G. J. Price, N. Cageorge, R. H. Irwin.

HAILEY—ARTHUR ROBERTS TRAIL, of 515 Bolivar St., Peterborough, Ont. Born at Vancouver, B.C., Nov. 15th, 1914; Educ.: B.A.Sc., Univ. of B.C., 1941; 1941 to date, testman, Can. Gen. Elec. Co. Ltd., Peterborough.

References: G. R. Langley, W. M. Cruthers, D. V. Canning, W. T. Fanjoy, J. Cameron.

LAMBERT—NOEL DUDLEY, of Ottawa, Ont. Born at Vancouver, B.C., Dec. 26th, 1896; Educ.: B.Sc., Univ. of B.C., 1920; R.P.E. of B.C.; 1921-23, transitman; 1923-26, engr., field supt., Pacific Construction Co.; 1926-27, inspr., C. D. Howe & Co.; 1927 to date, with Northern Construction Co. & J. W. Stewart Ltd., 1927-29, engr., grain elevators, docks, warehouses, etc., 1929-30, supt., 1930-38, gen. supt., and from 1938, vice-president and gen. mgr. in general charge of works; at present, Director of Engineer Services (Army), National Defence Headquarters, Ottawa, Ont.

References: J. M. R. Fairbairn, K. M. Cameron, W. Small, J. B. Stirling, H. N. Macpherson.

SLATER—JAMES, of Arvida, Que. Born at Sydney, N.S., Dec. 27th, 1911; Educ.: Eight terms of engrg. study at Sydney Technical School; 1934-35, rodman and chairman, 1935-36, instr'man., Dept. of Highways of N.S.; 1936-40, surveys and constrn., Dept. of Mines & Resources, Cape Breton Highland National Park; 1940-41, Standard Paving Co. (Maritimes) Ltd., constrn. engr., R.C.A.F. Airport, Sydney, N.S.; 1941, Dept. of National Defence, senior asst. engr., R.C.A.F. Airport, Gander, Nfld.; at present, constrn. engr., field engr., Foundation Company of Canada, Arvida, Que.

References: J. Wilson, T. S. Mills, W. M. B. Musgrave, W. H. Nixon.

STEVEN—JAMES HARRY ALEXANDER, of 112 St. Paul St., West Kamloops, B.C. Born at Killin, Perthshire, Scotland, June 15th, 1893; R.P.E. of B.C.; 1912-13, rodman, 1913-15, instr'man and f'tsman., Can. Nor. Pacific Rly.; 1915-19, overseas, C.E.F.; 1919-20, res. engr., C.N.R., Kamloops-Kelowna Branch; 1920-28, asst. engr., Dom. Water Power & Reclamation Service, Dom. Govt.; 1930-34, mining recorder, Dept. of Finance, Govt. of B.C.; 1935-38, private practice, gen. engrg., Cariboo district; 1939 to date, locating engr., survey branch, Dept. of Public Works, Prov. of B.C., on highway location projects.

References: W. Ramsay, W. G. Swan, G. P. Stirett, H. L. Hayne, H. L. Cairns.

## FOR TRANSFER FROM JUNIOR

BENJAFIELD—PHILIP GRANT, of 36 Balsam St., Copper Cliff, Ont. Born at London, Ont., July 15th, 1907; Educ.: B.Sc. (Civil), Queen's Univ., 1932; 1929 (5 mos.), rodman, Mich. Central Rld., St. Thomas; 1930-31-34 (summers), f'tsman., instr'man., checker, Ont. Dept. of Highways; 1934 to date, junior engr. and instr'man., International Nickel Co. Ltd., bldg. constrn. and mtce., track work, etc. (St. 1928, Jr. 1938).

References: C. O. Maddock, W. J. Ripley, J. F. Robertson, F. A. Orange, W. C. Miller.

MALBY—ARTHUR LESLIE ERNEST, of 303 Rubidge St., Peterborough, Ont. Born at London, England, Aug. 5th, 1907; Educ.: B.Sc. (Elec.) Univ. of Man., 1934; R.P.E. of Ont.; 1934-35, test course, 1935 to date, asst. industrial control engr., Can. Gen. Elec. Co. Ltd., Peterborough, Ont. (Jr. 1930).

References: G. R. Langley, D. V. Canning, J. Cameron, R. L. Dobbin, I. F. McRae

## FOR TRANSFER FROM STUDENT

McCRADY—DONALD CARMAN, of Peterborough, Ont. Born at Montreal, Que., Dec. 17th, 1914; Educ.: B. Eng., McGill Univ., 1936; with the Can. Gen. Elec. Co. Ltd., as follows: 1936-38, test course, 1938-39, commercial dept., 1939-41, sales engr., and at present, gen. engr. dept. (St. 1935).

References: D. J. Emery, J. Cameron, W. T. Fanjoy, G. R. Langley, B. Ottewell, H. R. Sills.

McGREGOR—DOUGLAS ROBERT, of Peterborough, Ont. Born at Sherbrooke, Que., May 2nd, 1914; Educ.: B. Eng., McGill Univ., 1935; R.P.E. of Ontario; 1935-36, test. dept., 1936 to date, engrg. dept., Can. Gen. Elec. Co. Ltd. (St. 1933).

References: J. Cameron, R. L. Dobbin, H. R. Sills, D. V. Canning, W. T. Fanjoy, B. I. Burgess, I. S. Patterson.

TAYLOR—CHARLES GRAY, of 112 William St., Arnprior, Ont. Born at Braeside, Ont., Jan. 31st, 1913; Educ.: B.Sc. (Civil), Queen's Univ., 1940; 1936 (summer), Sylvanite Gold Mines, Kirkland Lake; 1938 (summer), Long Lac Diversion, H.E.P.C. of Ont.; 1940-41, instr'man., f'tsman., etc., Beatty & Beatty, Pembroke, Ont.; Jan. 1941 to date, instr'man. in charge of party, right of way and property dept., H.E.P.C. of Ontario. (St. 1940).

References: A. L. Malcolm, N. Malloch, N. B. MacRostie, J. B. Baty, R. A. Low.

VATCHER—CHESLEY HOLMES, of Toronto, Ont. Born at Freshwater, Nfld., June 6th, 1917; B.A.Sc. (Elec.), Univ. of Toronto, 1939; summers—1936-37, Nfld. Airport constrn., H.E.P.C. of Ontario; 1939-40, demonstrator, dept. of elec. engrg., Univ. of Toronto; 1940-41, sales promotion, Vancouver, and 1941 to date, sales engr., Toronto, Canadian National Carbon Co. Ltd. (St. 1938).

References: H. G. Aeres, W. A. Duncan, R. K. Northey, E. G. Hewson, J. J. Spence.

# Employment Service Bureau

## SITUATIONS VACANT

**MECHANICAL DESIGNING DRAUGHTSMAN**, Graduate preferred, urgently needed for work in Arvida for specification drawings for plate work, elevators, conveyors, etc., equipment layouts, pipe layouts and details. Apply to Box No. 2375-V.

**MECHANICAL ENGINEER** with machine shop experience, required for work in South America on important war contract. Apply to Box No. 2441-V.

**MECHANICAL ENGINEER** preferred with experience on diesels and tractors, for work in Mackenzie, B.G. Apply to Box No. 2482-V.

**CHEMICAL CONSULTING ENGINEER** with practical experience to advise on efficient management of small plant manufacturing pigments and dry colours for paint and rubber production. Apply to Box No. 2503-V.

**MECHANICAL ENGINEER** with experience in pulp and paper industry for supervision and maintenance work in large paper mill. Must be experienced in machine shop work and the handling of men. Apply to Box No. 2522-V.

**EXPERIENCED CIVIL ENGINEER** to act as resident engineer on huge power development. Must have had five to ten years field experience on heavy construction. Apply to Box No. 2535-V.

**ELECTRICAL ENGINEER** for testing and maintenance of system relays, short circuit studies and preparation of wiring diagrams. Apply to Box No. 2536-V.

**MECHANICAL DESIGNING DRAUGHTSMAN** on permanent moulds and die casting dies. Apply to Box No. 2537-V.

**CIVIL ENGINEER** with actual pile driving experience required for work in British Guiana. Apply to Box No. 2538-V.

**YOUNG GRADUATE ENGINEER** required by machinery supply firm located in Montreal. Some selling experience preferred. State military status. Apply to Box No. 2539-V.

## ENGINEER OFFICERS WANTED

Applications are invited for Commissions in the Royal Canadian Ordnance Corps for service both overseas and in Canada as Ordnance Mechanical Engineers. Since it is probable that several new units will be organized in the near future, a number of senior appointments may be open, and applications from

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to **THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.**

engineers with a good background of military experience would be welcomed in this connection. Applications should be submitted on the regular Royal Canadian Ordnance Corps application forms, which can be obtained from the District Ordnance Officers of the respective Military Districts.

## SITUATIONS WANTED

**INDUSTRIAL PLANT ENGINEER**. Age 47. M.E.I.C. wide experience general plant engineering, responsible charge maintenance, production efficiency, supervision, layout and design, alterations and additions, mechanical, structural, civil engineering, material handling. Available June 1st in compliance with regulations of the Wartime Bureau of Technical Personnel. Apply to Box No. 1027-W.

**ENGINEER ADMINISTRATOR**, experienced in public utilities, shipyard construction, airplane construction, crane construction, general mechanical engineering and inspection work, also sales promotion. Open for appointment. Apply to Box 2429-W.

**GRADUATE ENGINEER** in Electrical and Mechanical Engineering, M.E.I.C., and R.P.E., electric utility experience. Age 30. Married. Transmission line, and distribution, estimating, design, survey and construction three years, (one year acting superintendent), interior light and power wiring design, estimating and supervision one year. Electric meters (AC) six months, electric utility drafting six months, foundation layouts and concrete inspection six months. Steam power plant operation two years. Presently employed but desire advancement. Apply to Box No. 2430-W.

**DESIGNING DRAUGHTSMAN**, M.E.I.C. Age 47. Married. Location immaterial. Experienced in

estimates, design, layouts and details of industrial buildings. Presently employed but desirous of change with prospects of advancement. Apply to Box No. 2439-W.

## AN APPEAL!

One of our members who has just returned from overseas reports that there is an urgent need of surveying instruments in the Canadian Corps in England. Some organizations have already supplied a few instruments on loan but many more are needed.

Any members who would be willing to loan such instruments to our fighting forces should address them to:

**THE CHIEF ENGINEER**  
Headquarters 1st Canadian Corps  
Canadian Army Overseas

The need is mostly for transits and measuring tapes.

## WANTED

Someone to back up my chemical engineering education. Have saved eight hundred dollars to start on, need someone to help from there on. Age 21, army (reserve) discharge. Good references for repayment plus interest, plus promise to loan to another student as you have to me. S.E.I.C. Apply to Box No. 40.

## LIBRARY NOTES

(Continued from page 335)

### REINFORCED CONCRETE, Theory and Design

By J. E. Kirkham. *Edwards Brothers, Inc., Ann Arbor, Mich., 1941. 428 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$3.75.*

Fundamental principles involved in the designing of reinforced concrete structures are presented in a simple, practical manner. By the direct application of simple mechanics in terms of known loads and strengths, the author provides design procedures for beams, slabs, columns, retaining walls, tanks, bridges and buildings. The book is intended for both students and practicing engineers.

### SAFETY SUPERVISION (Pennsylvania State College, Industrial Series)

By V. G. Schaefer. *McGraw-Hill Book Co., New York and London, 1941. 352 pp., tables, 7½ x 5 in., cloth, \$2.50.*

The purpose of this book is to discuss the human element involved in the problems of the supervisor who must promote the safety of the workers in his division. It presents the duties, responsibilities, methods and techniques of safety supervision as elements of personnel management, and makes no attempt to discuss engineering problems of safety or the making of accident records and reports.

### (The) SCIENCE AND PRACTICE OF WELDING

By A. C. Davies. *The Macmillan Co., New York; University Press, Cambridge, England, 1941. 436 pp., illus., diags., charts, tables, 8 x 5 in., cloth, \$2.25.*

This text provides a concise, yet comprehensive, account of the basic theoretical principles underlying the various processes of welding and of the practical methods of applying them. Both gas and electric methods are covered, and there are chapters on gas cutting and on inspection and testing.

### SCIENTISTS FACE THE WORLD OF 1942

*Essays by K. T. Compton, R. W. Trullinger and V. Bush, Rutgers University Press, New Brunswick, New Jersey, 1942, 80 pp., tables, 9½ x 6 in., cloth, \$1.25.*

The three essays by eminent scientists which are contained in this volume present respectively; an integration of the fundamental sciences of physics, chemistry and biology as they are applied to engineering in a time of national emergency; a discussion of the philosophy and technique of biological engineering as applied to the problems of food, health, etc.; and a description of the application of the well-known principles of engineering to the complex phenomena of the farm. Commentaries are appended.

### SIHOP THEORY, revised edition, prepared by the Shop Theory Department, Henry Ford Trade School, Dearborn, Michigan

*McGraw-Hill Book Co., New York and London, 1942. 267 pp., illus., diags., tables, 11 x 9 in., paper, \$1.25.*

The various tools and machines used in a machine shop, and the operations which can be performed by them are described in detail. Heat treatment, abrasives and the routing of bench tool work are other topics covered. The manual is profusely illustrated, and problems and review questions are included in many of the chapters.

### SOLUBILITIES OF ORGANIC COMPOUNDS, Vol. 2

By A. Seidell. 3 ed. *D. Van Nostrand Co., New York, 1941, 926 pp., tables, 9½ x 6 in., cloth, \$10.00.*

The second volume of this edition is confined to organic compounds. It includes the data of the second edition and supplement which have not been superseded, together with the new determinations published since 1928. The work is the most complete available and will be welcomed by chemists.

### THIS CHEMICAL AGE, the Miracle of Man-Made Materials

By W. Haymes. *Alfred A. Knopf, New York, 1942. 385 pp., illus., charts, maps, tables, 8½ x 5½ in., cloth, \$3.50.*

The reader without a chemical background will find this an interesting account of modern developments in this field. The ways in which laboratory discoveries have been developed into such industrial products as dyes, drugs, plastics, nylon, cellophane and synthetic rubber are described clearly and dramatically, with scientific accuracy: a thoroughly readable book.

### TRANSIENTS IN ELECTRIC CIRCUITS Using the Heaviside Operational Calculus

By W. B. Coughard. *Pitman Publishing Corp., New York; Sir Isaac Pitman & Sons, London, 1941. 203 pp., diags., charts, tables, 9 x 5½ in., cloth, \$3.50.*

Dealing especially with electrical engineering problems, this book utilizes the Heaviside operational methods rather than the formal mathematical treatment. Chapters I-VI constitute a section treating of the theory of lumped circuits. Subsequent chapters deal with smooth circuits or repeated lumped circuits. In the last two chapters, some methods for dealing with variable circuits are discussed. A brief bibliography accompanies each chapter.

### WAGE INCENTIVE METHODS, Their Selection, Installation and Operation

By C. W. Lytle. rev. ed. *Ronald Press Co. New York, 1942. 462 pp., diags., charts, tables, 9½ x 6 in., cloth, \$6.00.*

The aim of this book is to facilitate the selection of the best wage plan for any business, by providing means for comparison of possible methods. It presents all the basic incentive plans in use, with their variations and modifications. Some two dozen different plans are described and analyzed in detail, and their strong and weak points presented impartially. This edition has been further revised.

### CLEANING SMALL TUBES

Elliott Company, Tube Cleaner Dept., Springfield, Ohio, have issued a four-page bulletin, No. Y-10, featuring "Elliott-Lagonda" outside suspension type tube cleaners for small tubes such as condensers and other types of heat exchange apparatus. This bulletin contains a number of action photographs in addition to a general description of the equipment. Illustrations of direct-driven and geared air or steam and electric driven cleaners and various types of drills, cutter heads and brushes are also included.

### ELECTRIC STARTERS

An eight-page bulletin, CGEA-1979A, published by Canadian General Electric Co. Ltd., Toronto, Ont., features G-E reduced voltage manual and magnetic starters, for squirrel-cage induction motors. Illustrations, specifications, general descriptions of the construction and operation features of each type are included.

### COMPRESSED AIR LEAKAGE

Saunders Valve & Supply Co., Ltd., Montreal, Que., have available a fifth edition of a 96-page book which was issued in England, by Saunders Valve Co. Ltd., primarily to point out where and how wastage of compressed air power occurs and how losses from resistance and leaks may be eliminated. It contains five chapters: (1) Terminology and Definitions; (2) Theoretical Compression; (3) Air Leakage; (4) Measurement of Leakage; and (5) Valves and Compressed Air. Chapter three is subdivided into sections dealing with pipe line troubles, friction resistance, cost of leakage and prevention of leakage. Illustrations, diagrams, curves and tables are used throughout and two appendices furnish tables and other data of interest.

### OIL CIRCUIT BREAKER

Bulletin CGEA-2165A, eight pages, recently issued by Canadian General Electric Co. Ltd., Toronto, Ont., gives description of General Electric type FK-142 oil circuit breaker. Lists and illustrates features, telling how they help to improve operation and reduce maintenance. Also included is a page of line diagrams showing typical mountings.

### PACKING IN BULK, RINGS OR COIL

Entitled "Anchor Kurlite the Complete Packing," a four-page pamphlet, published by The Anchor Packing Co. Ltd., Montreal, Que., illustrates and describes "Anchor Kurlite," a shredded metal packing made from crimped ribbons of low friction alloy, coated with high temperature grease and fine flake graphite. This packing is available in bulk, molded ring, and coil form and in seven types according to service requirements. It is suitable for temperatures up to 450° F.

### CONVEYORS

An 18-page catalogue, No. 761, being distributed by Jeffrey Mfg. Co. Ltd., Montreal, Que., illustrates many uses for "Jeffrey" portable scraper conveyors both of wheel- and crawler-mounted types, for handling all kinds of bulk materials into or out of trucks or railway cars. Diagrams showing dimensions are given for each type, together with general specifications. Sketches for unloading pits are shown, and descriptions of "Jeffrey" car puller and other types of portable loading and unloading equipment are also included.

### ASBESTOS PACKING AND GASKETS

Advantages claimed for "Durabla" asbestos sheet packing and gaskets are listed in a leaflet recently issued by Canadian Durabla Ltd., Toronto, Ont. Sizes, thicknesses and weights of standard sheets are tabulated, also stock sizes of gaskets. Information about "Durabla" high pressure gauge glasses is also included.

### INDUSTRIAL SAFETY EQUIPMENT

Mine Safety Appliances Co. of Canada Ltd., Toronto, Ont., have published a 142-page catalogue, No. 5-B, which describes the comprehensive line of MSA safety equipment developed to promote the welfare and safety of the industrial worker. Each article is amply illustrated, and its construction and method of use or operation are given, with mention of special features, specifications and catalogue number. Among the items included are surgical and first aid supplies and equipment, medical supplies, safety devices, clothing and equipment, alarms, recorders, indicators, consumable supplies for listed equipment, bulletins, posters, instructions. Safety devices for mines are not included but contained in a separate volume.

### POTENTIOMETER INDICATORS

Bulletin No. A-305, being distributed by The Foxboro Co. Ltd., Montreal, Que., presents the complete line of Foxboro potentiometer temperature indicators and indicating resistance thermometers. The instruments illustrated and described include single-point and multiple-point models, models equipped with selective key-switches for as many as 82 contact points, as well as the popular portable models. Single range and double range dials are shown in full-size reproductions and a complete list of standard ranges is given. Constructional features of the instruments are shown and described, many of these features being exclusive in Foxboro design.

### REFRACTORY LAGGING

Bulletin No. 327E, eight pages, published by Quigley Co. of Canada Ltd., Lachine, Que., tells how plants are solving plastic insulating problems by using "Insulag" plastic refractory lagging. Illustrations show applications for the oil industry, oil burners, boilers, ovens, furnaces, coke ovens, watercoolers. Charts give outside face temperatures for varying insulation thickness, and heat savings for varying hot surface temperatures.

### TYPICAL DESIGNS OF TIMBER STRUCTURES

Timber Engineering Co., Washington, D.C., have issued a reference book, 11 ins. by 17 ins., as a service to architects and engineers and which is in no sense a "plan service." It presents 48 detailed drawings selected by the "Teco" engineering staff from the collection of several hundred designed in the course of practical work on actual timber engineering problems. These plans cover 14 different types of timber design such as trussed rafters for housing projects, trusses for hangars, factories, and markets; grandstands, distillery racks, bridge and towers. Each group is introduced by a photograph of an actual structure in which that type of design was employed and an explanation of its use. Also included are "Handy Tables for use in Timber Design," taken from the National Lumber Manufacturers Association publication "Wood Structural Design Data." V. H. McIntyre Ltd., Toronto, Ont., are the Canadian representatives.

### SAFETY EQUIPMENT

Covering the company's wide range of safety clothing and equipment, Catalogue No. 42, 110 pages, issued by Safety Supply Co., Toronto, Ont., contains descriptive information, specifications and illustrations of each type of equipment. Among the many items are goggles for every purpose, face shields, welders safety equipment, respiratory devices, hoods, masks, helmets, gas detectors and alarms, clothing, shoes, gloves, hats, ladders, safety cans and tank seals, etc.

### PROCESS INDUSTRIES EQUIPMENT

Jeffrey Mfg. Co. Ltd., Montreal, Que., have available a 20-page catalogue, No. 765, devoted to specialized equipment used in the process industries. This booklet contains brief information and illustrations covering feeders, conveyors, elevators, coolers, dryers, screens, crushers, pulverizers, shredders, packers, chains and sprockets, power transmission machinery, bin valves, and portable units of the belt, bucket and scraper types for loading and unloading operations and stackers for bags, boxes, etc. Various types of each class of this equipment are shown and described and while a comprehensive idea of the wide range of equipment available is provided, the company states that more complete details are available in separate catalogues dealing with each item.

### SELF-ACTING TEMPERATURE CONTROLLER

Catalogue No. 36R, published by Taylor Instrument Companies of Canada Ltd., Toronto, Ont., describes "Taylor" self-acting controllers, and lists the conditions for which they are recommended. Diagrams show the installation of these controllers on hot water tanks, Diesel engine water jackets and other equipment. The selection of the proper controller is featured and a temperature range and sensitivity chart is included. Construction features are described and illustrated.

### GRINDING CUTTING TOOLS

A 32-page booklet being distributed by Norton Co. of Canada Ltd., Hamilton, Ont., has an introductory article on the economy of properly sharpened tools and then tells about "Haynes Stellite" "J-metal" and the more recently developed alloy "2400." Alundum abrasives for grinding and sharpening tools made of "J-metal" and "2400" are then described, giving recommendations for various types of tools and describing the sharpening operation in each case.

### 1942 THE YEAR TO WIN OR LOSE

This concise statement of the war situation is the title of a 32-page booklet which has been reproduced by Canadian Westinghouse Co. Ltd., Hamilton, Ont., with the permission of "Business Week," New York. It presents facts relating to the five "fronts": The Middle East Front, The Atlantic Front, The Russian Front, The Far East Front, and The Home Front. Maps are included together with a table showing the distribution of available world production of key commodities in 1938 and in 1942.

### SPUN ROCK WOOL INSULATION

"Atlas Spun Rock Wool Insulation" is the title of an eight-page booklet, published by Atlas Asbestos Ltd., Montreal, Que., in which the subject is treated under the following six headings: General characteristics and advantages; forms of manufacture; typical installations; thermal conductivity; general notes covering selection, application, and finish; "Cork type" for low temperature brine and ammonia lines; and prices and data. The product in its various forms is well illustrated and there is appended a list of "Atlas" products for industrial and home use.

### STEAM-JET EJECTORS

Bulletin, No. W-205-B9, eight pages, made available by Worthington Pump & Machinery Corp., Harrison, N.J., contains details of applications, installations and special developments of the company's two general types of three-stage steam-jet ejectors, the condensing and non-condensing. Full details are given accompanied by illustrations.

(Continued on page 34)

# DOMINION STANDARD

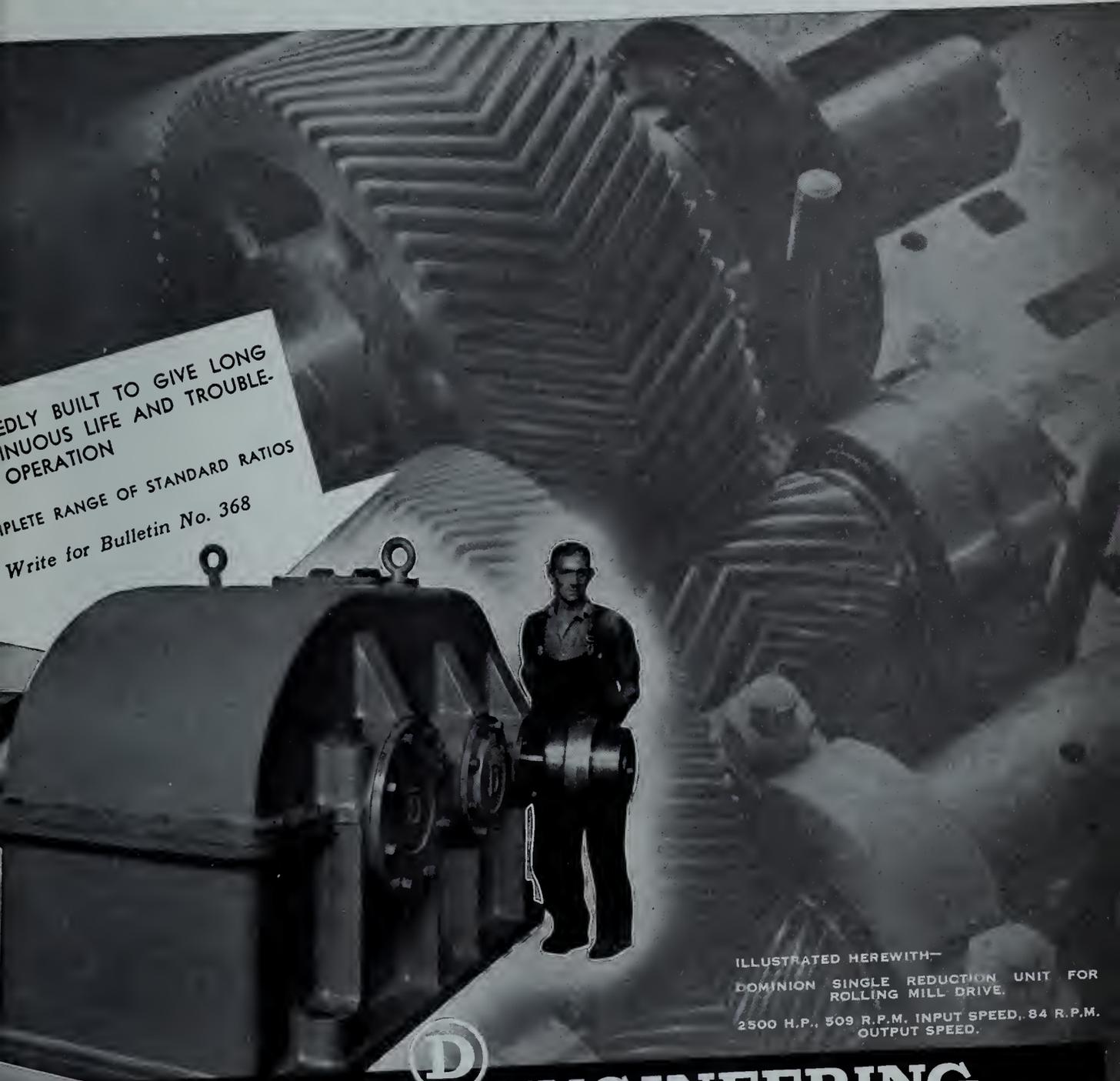
*Speed Increasing and Reducing*

# GEAR UNITS

EDLY BUILT TO GIVE LONG  
INUOUS LIFE AND TROUBLE-  
OPERATION

COMPLETE RANGE OF STANDARD RATIOS

Write for Bulletin No. 368



ILLUSTRATED HEREWITH—  
DOMINION SINGLE REDUCTION UNIT FOR  
ROLLING MILL DRIVE.  
2500 H.P., 509 R.P.M. INPUT SPEED, 84 R.P.M.  
OUTPUT SPEED.

**DOMINION**  **ENGINEERING**

P.O. BOX 220 *Company Limited*

MONTREAL, P.Q.

TORONTO

WINNIPEG

VANCOUVER

# I.C.S.

## SPECIALIZED TRAINING

FOR

## THE ENGINEERING PROFESSION

International Correspondence Schools are equipped to provide the non-university man with the specialized training necessary to enable him to study for the examinations of engineering societies and associations. I.C.S. Home Study Courses are of particular interest to prospective applicants for membership in any of these organizations.

I.C.S. courses for examinations are arranged with the object of preparing the candidate for his examinations in the shortest possible time, while omitting no features of his training conducive to thoroughness and diversity of knowledge.

Each candidate will receive the individual attention of a vocational and educational specialist. The candidate's examination courses will be arranged to comply with his individual requirements and his rate of progress will be affected by no other student. He will proceed as rapidly as his ability, his study time and his application will permit. He will be allowed ample time to complete his I.C.S. course and will receive full answers to any questions he may need to ask which come within the scope of his course.

The subjects in which I.C.S. training is available include:

- High School Subjects
- Elementary Physics and Mechanics
- Strength and Elasticity of Metals
- Drawing
- Chemistry
- Chemical Engineering
- Civil Engineering
- Electrical Engineering
- Mechanical Engineering
- Mining Engineering
- Structural Engineering

**AN INVITATION**—You are invited to send for information about I.C.S. training. You incur no obligation. Just mark and mail the coupon.

International Correspondence Schools,  
Canadian Limited,  
Department H-3,  
Montreal, Canada.

Please send me complete information on I.C.S. training for engineering.

Name.....

Address.....

Employed by.....

# Industrial News

(Continued from page 338)

## TIME SWITCHES

The type T-44 automatic general-purpose time switches are described and illustrated with general and sectional views in a four-page bulletin, No. CGEA-1427M, issued by Canadian General Electric Co. Ltd., Toronto, Ont. A list of the principal features of these switches is given together with a table of ratings. The T-44 switch has a wide range of applications where it is desired to open and close electric circuits at predetermined times on a daily repeating schedule.

## PRESSURE RECORDER

The Foxboro Company Limited, Montreal, Que., have available a 32-page Catalogue No. 22-A in which factual information is arranged so as to be of greatest convenience to the reader in selecting the pressure recorder best suited to his particular needs. The "Foxboro" line is well illustrated and described, covering instruments for the measurements and recording of industrial pressures of all kinds, in ranges from 1 inch of water to 20,000 lbs. A complete list of standard ranges is given, accompanied by full-size reproductions of specimen charts. In addition to other construction features, the various types of pressure measuring elements are illustrated. Other sections describe methods of instrument mounting, types of cases available, integral electric signal systems, accessory equipment, and give brief mention of other types of Foxboro pressure measuring instruments.

## TANTALUM-TUNGSTEN CARBIDE TOOLS

A 24-page catalogue and price list, issued by Carbide Tool & Die Co. Ltd., Hamilton, Ont., lists 22 typical styles of Vascoloy-Ramet single point tools, together with a grade selector chart recommending the grade of Ramet Carbide for practically every cutting condition in steels, cast iron and abrasive materials. Included are instructions for ordering tools and blanks, also tables for computing costs of standard tools and blanks and special blanks.

## SAFETY AND FIRST AID EQUIPMENT

A 110-page catalogue issued by Safety Supply Co., Toronto, Ont., illustrates and describes a very comprehensive range of all types of safety equipment and first aid materials. Among the items covered are goggles of all kinds, respirators, gas masks, gas detectors, safety shoes, asbestos gloves and suits, Steelgrip gloves, fire extinguishers, safety ladders, safety guards, safety belts, safety signs, safety hats, welders helmets, hospital equipment, first aid supplies, etc.

## STEAM CONDUIT

Bulletin 4202, published by the Ric-wiL Company, Cleveland, Ohio, illustrates uses for pre-fabricated insulated pipe units for underground steam lines, and gives diagrams with dimensions of fittings and parts. These units are of basically correct design, including all parts, which are standardized and machine-made with precision workmanship. Construction of "Ric-wiL" fits into the working practice of various trades in the field, cutting time and cost on the site.

The result is a pre-sealed underground steam pipe system, in the form of a truckable unit, completely finished in the shop, with nothing extra to buy, ready to install. Units come in pipe sizes from 1 in. to 16 ins. in diameter with complete instructions and service drawings with each order. The company's representatives in Canada are F. S. B. Heward & Co. Ltd., Montreal, Que.

## STEEL ROLLING DOORS

A 40-page booklet issued by The Kinnear Manufacturing Co., Columbus, Ohio, features upward-acting types of doors under two classifications based on type of service and degree of protection. Specifications and illustrations of service doors for stores, warehouses, piers, garages, hangars, industrial and mercantile buildings are given. Fire doors for openings in shafts, stair wells, corridors, etc., and in hotels, hospitals, warehouses or other buildings are also included. Other products include rolling grilles, "Rol-top" doors, "Bi-folding" doors, sliding, barrier and wood rolling doors.

## THERMOSTATS

Canadian General Electric Co. Ltd., Toronto, Ont., have issued a 4-page Folder CGEA-1265D which describes the G.E. "CR2992-R1" Thermostats for use with small heating units. Its operation, application, dimensions, specifications are included together with ordering directions for G.E. thermostats CR2992-R1, for use with small heating units.

## V-TYPE WATT HOUR METERS

Bulletin CGEA-2669B, 8 pp., published by Canadian General Electric Co. Ltd., Toronto, Ont., describes V-Type watt-hour meters, two-element and three-element. Classification charts, application diagrams, and general descriptions of construction and performance are given with illustrations. Diagram of dimensions is also shown with shipping weights and net weights for various sizes.

## POWER PLANT EQUIPMENT

A series of articles feature installations of "Elliott" power plant equipment in hospitals, ferries, barges, steam generating plants, hydro-electric plants, and cargo vessels in Vol. 20, No. 1, of "Powerfax" published by Elliott Co., of Jeannette, Pa., who are represented in Canada by F. S. B. Heward & Co. Ltd. These articles appear under the following titles: "Georgia Power Company's Plant Arkwright," "Fast Boats for Ferry Land," "Manteno State Hospital Adds Turbine-Generating Unit," "Barging on the Mississippi," "An Unusual Feedwater Heater Arrangement," "A Deaerator Installation Job," "Canadian Hydro Plants Use Self-Cleaning Strainers," etc.

## POWER LINE EQUIPMENT

The leading article in the recent issue of "The Line" (Vol. 20, No. 2), published by Canadian Line Materials Ltd., is on resuscitation after electric shock and is illustrated. Another article deals with reclosing fuse cutouts under to-day's emergency conditions. The "MK-39" high pressure contact is described, with table of catalogue numbers for parts, giving general specifications and constructions. The "LM Controlite Luminaire" installation at Miami Beach is the subject of another illustrated article, and shorter descriptive matter tells about isolators, wishbone clamps, versilugs, and fuse cutouts. Finally an article on guying gives tables of loading and strength data for various types of conductors.

## REPAIRS WITH METALLIZING

"Metco News," Vol. 1, No. 9, of Metallizing Engineering Co. Inc., Long Island City, N.Y., features the use of metallizing for repairs in a rubber heel factory, and for speeding mass production in an aircraft plant. How metallizing equipment is used by a transit company in New York city for maintenance of buses and trucks is the subject of another story. Also included are articles on machining with carbonyl tools, giving diagrams and a table of recommended speeds and feeds, and on the strength of sprayed metal bushings.

# THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 25

MONTREAL, JUNE 1942

NUMBER 6



"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

★ ★ ★

PUBLISHED MONTHLY BY  
THE ENGINEERING INSTITUTE  
OF CANADA

2050 MANSFIELD STREET - MONTREAL

## CONTENTS

	CANADIAN NAVY GUNNER BEHIND THE SIGHTS OF A MULTIPLE POM-POM ANTI-AIRCRAFT GUN . . . . .	Cover
	<i>(Photo Public Information, Ottawa)</i>	
L. AUSTIN WRIGHT, M.E.I.C. <i>Editor</i>	THE MODERNIZATION OF A PUERTO RICO STEAM PLANT . . . . .	342
	<i>J. T. Farmer, M.E.I.C.</i>	
LOUIS TRUDEL, M.E.I.C. <i>Assistant Editor</i>	THE LIONS' GATE BRIDGE—III . . . . .	347
	<i>S. R. Banks, M.E.I.C.</i>	
N. E. D. SHEPPARD, M.E.I.C. <i>Advertising Manager</i>	DISCUSSION ON RATIONAL COLUMN ANALYSIS . . . . .	360
	ABSTRACTS OF CURRENT LITERATURE . . . . .	376
	FROM MONTH TO MONTH . . . . .	378
	PERSONALS . . . . .	386
	Visitors to Headquarters . . . . .	389
	Obituaries . . . . .	389
	NEWS OF THE BRANCHES . . . . .	390
	LIBRARY NOTES . . . . .	395
	PRELIMINARY NOTICE . . . . .	397
	EMPLOYMENT SERVICE . . . . .	398

Price 50 cents a copy, \$3.00 a year: in Canada, British Possessions, United States and Mexico. \$4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, \$2.00 a year. Entered at the Post Office, Montreal, as Second Class Matter.

THE INSTITUTE as a body is not responsible either for the statements made or for the opinions expressed in the following pages.

# THE ENGINEERING INSTITUTE OF CANADA

## MEMBERS OF COUNCIL - 1942

### PRESIDENT

C. R. YOUNG, Toronto, Ont.

### VICE-PRESIDENTS

\*A. L. CARRUTHERS, Victoria, B.C.  
†H. CIMON, Quebec, Que.

†J. L. LANG, Sault Ste. Marie, Ont.  
†G. G. MURDOCH, Saint John, N.B.

### PAST-PRESIDENTS

†T. H. HOGG, Toronto, Ont.

†C. J. MACKENZIE, Ottawa, Ont.

### COUNCILLORS

†J. E. ARMSTRONG, Montreal, Que.  
\*A. E. BERRY, Toronto, Ont.  
†S. G. COULTIS, Calgary, Alta.  
†G. L. DICKSON, Moncton, N.B.  
\*D. S. ELLIS, Kingston, Ont.  
\*J. M. FLEMING, Port Arthur, Ont.  
\*I. M. FRASER, Saskatoon, Sask.  
\*J. H. FREGEAU, Three Rivers, Que.  
\*J. GARRETT, Edmonton, Alta.  
†F. W. GRAY, Sydney, N.S.  
\*S. W. GRAY, Halifax, N.S.

†E. D. GRAY-DONALD, Quebec, Que.  
†J. HAIMES, Lethbridge, Alta.  
\*J. G. HALL, Montreal, Que.  
†R. E. HEARTZ, Montreal, Que.  
†W. G. HUNT, Montreal, Que.  
†E. W. IZARD, Victoria, B.C.  
†J. R. KAYE, Halifax, N.S.  
\*E. M. KREBSER, Walkerville, Ont.  
†N. MACNICOL, Toronto, Ont.  
\*H. N. MACPHERSON, Vancouver, B.C.  
\*H. F. MORRISEY, Saint John, N.B.

\*W. H. MUNRO, Ottawa, Ont.  
†T. A. McELHANNEY, Ottawa, Ont.  
\*C. K. McLEOD, Montreal, Que.  
†A. W. F. McQUEEN, Niagara Falls, Ont.  
†A. E. PICKERING, Sault Ste. Marie, Ont.  
†G. McL. PITTS, Montreal, Que.  
†W. J. W. REID, Hamilton, Ont.  
†J. W. SANGER, Winnipeg, Man.  
\*M. G. SAUNDERS, Arvida, Que.  
†H. R. SILLS, Peterborough, Ont.  
\*J. A. VANCE, Woodstock, Ont.  
\*For 1942    †For 1942-43    †For 1942-43-44

### TREASURER

E. G. M. CAPE, Montreal, Que.

### GENERAL SECRETARY

L. AUSTIN WRIGHT, Montreal, Que.

### ASSISTANT GENERAL SECRETARY

LOUIS TRUDEL, Montreal, Que.

### SECRETARY-EMERITUS

R. J. DURLEY, Montreal, Que.

## STANDING COMMITTEES

### FINANCE

DEG. BEAUBIEN, *Chairman*  
J. E. ARMSTRONG  
E. G. M. CAPE  
G. A. GAHERTY  
J. A. McCRORY  
F. NEWELL

### LEGISLATION

J. L. LANG, *Chairman*  
R. L. DOBBIN  
R. J. DURLEY

### PAPERS

J. A. VANCE, *Chairman*  
DEG. BEAUBIEN  
K. M. CAMERON  
A. L. CARRUTHERS  
H. CIMON  
J. L. LANG  
G. G. MURDOCH

### LIBRARY AND HOUSE

W. G. HUNT, *Chairman*  
A. T. BONE  
J. S. HEWSON  
M. S. NELSON  
G. V. RONEY

### PUBLICATION

C. K. McLEOD, *Chairman*  
R. DEL. FRENCH, *Vice-Chairman*  
A. C. D. BLANCHARD  
H. F. FINNEMORE  
T. J. LAFRENIERE

## SPECIAL COMMITTEES

### BOARD OF EXAMINERS AND EDUCATION

R. A. SPENCER, *Chairman*  
I. M. FRASER  
W. E. LOVELL  
A. P. LINTON  
H. R. MacKENZIE  
E. K. PHILLIPS

### GZOWSKI MEDAL

H. V. ANDERSON, *Chairman*  
T. H. JENKINS  
V. A. McKILLOP  
W. H. POWELL

### DUGGAN MEDAL AND PRIZE

J. T. FARMER, *Chairman*  
J. M. FLEMING  
R. C. FLITTON

### PLUMMER MEDAL

C. R. WHITTEMORE, *Chairman*  
J. CAMERON  
R. L. DOBBIN  
O. W. ELLIS  
R. E. GILMORE

### LEONARD MEDAL

JOHN McLEISH, *Chairman*  
A. E. CAMERON  
A. O. DUFRESNE  
J. B. deHART  
A. E. MacRAE

### JULIAN C. SMITH MEDAL

C. R. YOUNG, *Chairman*  
T. H. HOGG  
C. J. MACKENZIE

### PROFESSIONAL INTERESTS

J. B. CHALLIES, *Chairman*  
J. E. ARMSTRONG  
G. A. GAHERTY  
O. O. LEFEBVRE  
H. W. McKIEL  
J. A. VANCE

### STUDENTS' AND JUNIORS' PRIZES

#### Zone A (Western Provinces)

H. N. Ruttan *Prize*

A. L. CARRUTHERS, *Chairman*  
E. W. IZARD  
H. N. MACPHERSON

#### Zone B (Province of Ontario)

John Galbraith *Prize*

J. L. LANG, *Chairman*  
A. E. PICKERING  
J. A. VANCE

#### Zone C (Province of Quebec)

Phelps Johnson *Prize (English)*

DEGASPE BEAUBIEN, *Chairman*  
J. E. ARMSTRONG  
R. E. HEARTZ

#### Ernest Marceau Prize (French)

H. CIMON, *Chairman*  
J. H. FREGEAU  
E. D. GRAY-DONALD

#### Zone D (Maritime Provinces)

Martin Murphy *Prize*

G. G. MURDOCH, *Chairman*  
G. L. DICKSON  
S. W. GRAY

### THE YOUNG ENGINEER

H. F. BENNETT, *Chairman*  
J. BENOIT  
D. S. ELLIS  
J. N. FINLAYSON  
R. DEL. FRENCH  
R. F. LEGGET  
A. E. MACDONALD  
H. W. McKIEL

### MEMBERSHIP

J. G. HALL, *Chairman*  
S. R. FROST

### INTERNATIONAL RELATIONS

R. W. ANGUS, *Chairman*  
J. B. CHALLIES, *Vice-Chairman*  
E. A. ALLCUT  
C. CAMSELL  
J. M. R. FAIRBAIRN  
O. O. LEFEBVRE  
M. J. McHENRY  
H. H. VAUGHAN  
C. R. YOUNG

### DETERIORATION OF CONCRETE STRUCTURES

R. B. YOUNG, *Chairman*  
E. VIENS, *Vice-Chairman*  
G. P. F. BOESE  
A. G. FLEMING  
W. G. GLIDDON  
O. O. LEFEBVRE  
J. A. McCRORY  
C. J. MACKENZIE  
J. H. McKINNEY  
R. M. SMITH

### WESTERN WATER PROBLEMS

G. A. GAHERTY, *Chairman*  
C. H. ATTWOOD  
L. C. CHARLESWORTH  
A. GRIFFIN  
D. W. HAYS  
G. N. HOUSTON  
T. H. HOGG  
O. O. LEFEBVRE  
C. J. MACKENZIE  
H. J. McLEAN  
F. H. PETERS  
S. G. PORTER  
P. M. SAUDER  
J. M. WARDLE

## OFFICERS OF BRANCHES

### BORDER CITIES

*Chairman*, H. L. JOHNSTON  
*Vice-Chair*, G. G. HENDERSON  
*Executive*, W. P. AUGUSTINE  
 J. F. G. BLOWEY  
 W. R. STICKNEY  
 (*Ex-Officio*), E. M. KREBSER  
 G. E. MEDLAR  
*Sec.-Treas.*, J. B. DOWLER,  
 754 Chilver Road,  
 Walkerville, Ont.

### CALGARY

*Chairman*, H. J. McEWEN  
*Vice-Chair*, J. G. MacGREGOR  
*Executive*, J. N. FORD  
 A. GRIFFIN  
 H. B. SHERMAN  
 (*Ex-Officio*), G. P. F. BOESE  
 S. G. COULTIS  
 J. B. DEHART  
 P. F. PEELE  
*Sec.-Treas.*, K. W. MITCHELL,  
 803—17th Ave. N.W.,  
 Calgary, Alta.

### CAPE BRETON

*Chairman*, J. A. MacLEOD  
*Executive*, J. A. RUSSELL M. F. COSSITT  
 (*Ex-Officio*), F. W. GRAY  
*Sec.-Treas.*, S. C. MIFLEN,  
 60 Whitney Ave., Sydney, N.S.

### EDMONTON

*Chairman*, D. A. HANSEN  
*Vice-Chair*, D. HUTCHISON  
*Executive*, C. W. CARRY  
 B. W. PITFIELD  
 E. R. T. SKARIN  
 J. A. ALLAN  
 E. ROBERTSON  
 J. W. JUDGE  
 (*Ex-Officio*), J. GARRETT  
 R. M. HARDY  
*Sec.-Treas.*, F. R. BURFIELD,  
 Water Resources Office,  
 Provincial Government,  
 Edmonton, Alta.

### HALIFAX

*Chairman*, P. A. LOVETT  
*Executive*, A. E. CAMERON  
 G. T. CLARKE G. J. CURRIE  
 A. E. FLYNN J. D. FRASER  
 D. G. DUNBAR J. A. MacKAY  
 J. F. F. MacKENZIE  
 J. W. MacDONALD  
 G. T. MEDFORTH  
 (*Ex-Officio*), S. L. FULTZ J. R. KAYE  
*Sec.-Treas.*, S. W. GRAY,  
 The Nova Scotia Power  
 Commission,  
 Halifax, N.S.

### HAMILTON

*Chairman*, STANLEY SHUPE  
*Vice-Chair*, T. S. GLOVER  
*Executive*, H. A. COOCH  
 NORMAN EAGER  
 A. C. MACNAB  
 A. H. WINGFIELD  
 (*Ex-Officio*), W. J. W. REID  
 W. A. T. GILMOUR  
*Sec.-Treas.*, A. R. HANNAFORD,  
 354 Herkimer Street,  
 Hamilton, Ont.

### KINGSTON

*Chairman*, T. A. McGINNIS  
*Vice-Chair*, P. ROY  
*Executive*, V. R. DAVIES  
 K. H. McKIBBIN  
 K. M. WINSLOW  
 (*Ex-Officio*), A. H. MUNRO  
 G. G. M. CARR-HARRIS  
 D. S. ELLIS  
*Sec.-Treas.*, J. B. BATY,  
 Queen's University,  
 Kingston, Ont.

### LAKEHEAD

*Chairman*, B. A. CULPEPER  
*Vice-Chair*, MISS E. M. G. MacGILL  
*Executive*, E. J. DAVIES  
 J. I. CARMICHAEL  
 S. E. FLOOK  
 S. T. McCAVOUR  
 R. B. CHANDLER  
 W. H. SMALL  
 C. D. MACKINTOSH  
 (*Ex-Officio*), H. G. O'LEARY  
 J. M. FLEMING  
*Sec.-Treas.*, W. C. BYERS,  
 c/o C. D. Howe Co. Ltd.,  
 Port Arthur, Ont.

### LETHBRIDGE

*Chairman*, C. S. DONALDSON  
*Vice-Chair*, W. MELDRUM  
*Executive*, R. F. P. BOWMAN G. S. BROWN  
 N. H. BRADLEY  
 C. S. CLENDENING  
 (*Ex-Officio*), J. HAIMES  
 A. J. BRANCH J. T. WATSON  
*Sec.-Treas.*, R. B. McKENZIE,  
 McKenzie Electric Ltd.,  
 706, 3rd Ave. S., Lethbridge, Alta.

### LONDON

*Chairman*, F. T. JULIAN  
*Vice-Chair*, T. L. McMANAMNA  
*Executive*, F. C. BALL  
 V. A. McKILLOP  
 H. F. BENNETT  
 A. L. PURANNA  
 R. S. CHARLES  
 (*Ex-Officio*), R. W. GARRETT  
 J. A. VANCE  
*Sec.-Treas.*, H. G. STEAD,  
 60 Alexandra Street,  
 London, Ont.

### MONCTON

*Chairman*, F. O. CONDON  
*Vice-Chair*, H. J. CRUDGE  
*Executive*, B. E. BAYNE E. R. EVANS  
 G. L. DICKSON E. B. MARTIN  
 T. H. DICKSON G. E. SMITH  
 (*Ex-Officio*), H. W. MCKIEL  
*Sec.-Treas.*, V. C. BLACKETT,  
 Engr. Dept., C.N.R.,  
 Moncton, N.B.

### MONTREAL

*Chairman*, J. A. LALONDE  
*Vice-Chair*, R. S. EADIE  
*Executive*, R. E. HEARTZ  
 J. B. STIRLING  
 J. M. CRAWFORD  
 J. COMEAU  
 H. F. FINNEMORE  
 R. C. FLITTON  
 G. D. HULME  
 (*Ex-Officio*), DE G. BEAUBIEN  
 J. E. ARMSTRONG  
 J. G. HALL  
 W. G. HUNT  
 C. K. McLEOD  
 G. McL. PITTS  
*Sec.-Treas.*, L. A. DUCHASTEL,  
 40 Kelvin Avenue,  
 Outremont, Que.

### NIAGARA PENINSULA

*Chairman*, C. G. CLINE  
*Vice-Chair*, G. E. GRIFFITHS  
*Executive*, A. G. HERR  
 R. T. SAWLE  
 G. F. VOLLMER  
 W. D. BRACKEN  
 J. W. BROOKS  
 J. H. TUCK  
 D. S. SCRYMGEOUR  
 (*Ex-Officio*), A. L. McPHAIL  
 A. W. F. McQUEEN  
*Sec.-Treas.*, J. H. INGS,  
 1870 Ferry Street,  
 Niagara Falls, Ont.

### OTTAWA

*Chairman*, N. B. MacROSTIE  
*Executive*, W. G. C. GLIDDON  
 R. M. PRENDERGAST  
 W. H. G. FLAY  
 G. A. LINDSAY  
 R. YUILL  
 (*Ex-Officio*), K. M. CAMERON  
 C. J. MACKENZIE  
 W. H. MUNRO  
 T. A. McELHANNEY  
 R. K. ODELL  
*Sec.-Treas.*, A. A. SWINNERTON,  
 Dept. of Mines and Resources,  
 Ottawa, Ont.

### PETERBOROUGH

*Chairman*, J. CAMERON  
*Executive*, A. J. GIRDWOOD I. F. McRAE  
 J. W. PIERCE F. R. POPE  
 (*Ex-Officio*), R. L. DOBBIN  
 H. R. SILLS  
 A. L. MALBY  
*Sec.-Treas.*, D. J. EMERY,  
 589 King Street,  
 Peterborough, Ont.

### QUEBEC

*Life Hon.-*  
*Chair*, A. R. DECARY  
*Chairman*, L. C. DUPUIS  
*Vice-Chair*, RENÉ DUPUIS  
*Executive*, O. DESJARDINS  
 R. SAUVAGE G. ST-JACQUES  
 S. PICARD L. GAGNON  
 G. W. WADDINGTON  
 (*Ex-Officio*), E. D. GRAY-DONALD  
 R. B. McDUNNOUGH P. MÉTHÉ  
 H. CIMON  
*Sec.-Treas.*, PAUL VINCENT,  
 Colonization Department,  
 Room 333-A, Parliament Bldgs.,  
 Quebec, Que.

### SAGUENAY

*Chairman*, N. F. McCAGHEY  
*Vice-Chair*, R. H. RIMMER  
*Executive*, B. BAUMAN  
 G. B. MOXON  
 A. I. CUNNINGHAM  
 W. J. THOMSON  
 (*Ex-Officio*), M. G. SAUNDERS  
 J. W. WARD  
*Sec.-Treas.*, D. S. ESTABROOKS,  
 Price Bros. & Co. Ltd.  
 Riverbend, Que.

### SAINT JOHN

*Chairman*, D. R. SMITH  
*Vice-Chair*, A. O. WOLFF  
*Executive*, H. P. LINGLEY  
 C. D. McALLISTER  
 C. C. KIRBY  
 (*Ex-Officio*), F. A. PATRIQUEN  
 V. S. CHESNUT  
 G. G. MURDOCH  
 H. F. MORRISEY  
*Sec.-Treas.*, G. W. GRIFFIN  
 P.O. Box 220,  
 Saint John, N.B.

### ST. MAURICE VALLEY

*Chairman*, VIGGO JEPSEN  
*Vice-Chair*, J. H. FREGEAU  
*Executive*, E. BUTLER R. D. PACKARD  
 A. C. ABBOTT  
 R. DORION  
 H. J. WARD  
 E. T. BUCHANAN  
 J. JOYAL  
 H. G. TIMMIS  
 (*Ex-Officio*), A. H. HEATLEY  
*Sec.-Treas.*, J. B. SWENEY  
 Consolidated Paper Corporation,  
 Grand'Mère, Que.

### SASKATCHEWAN

*Chairman*, A. P. LINTON  
*Vice-Chair*, A. M. MacGILLIVRAY  
*Executive*, F. C. DEMPSEY  
 N. B. HUTCHEON  
 J. G. SCHAEFFER  
 R. W. JICKLING  
 H. R. MacKENZIE  
 B. RUSSELL  
 (*Ex-Officio*), I. M. FRASER  
*Sec.-Treas.*, STEWART YOUNG  
 P. O. Box 101,  
 Regina, Sask.

### SAULT STE. MARIE

*Chairman*, L. R. BROWN  
*Vice-Chair*, R. A. CAMPBELL  
*Executive*, N. C. COWIE  
 C. O. MADDOCK  
 C. R. MURDOCK K. G. ROSS  
 (*Ex-Officio*), J. L. LANG  
 E. M. MacQUARRIE  
 A. E. PICKERING  
*Sec.-Treas.*, O. A. EVANS,  
 159 Upton Road,  
 Sault Ste. Marie, Ont.

### TORONTO

*Chairman*, W. S. WILSON  
*Vice-Chair*, W. H. M. LAUGHLIN  
*Executive*, D. FORGAN  
 R. F. LEGGET  
 S. R. FROST  
 F. J. BLAIR  
 E. G. HEWSON  
 C. F. MORRISON  
 (*Ex-Officio*), C. R. YOUNG T. H. HOGG  
 A. E. BERRY N. MacNICOL  
 H. E. BRANDON J. J. SPENCE  
*Sec.-Treas.*, S. H. deJONG  
 Dept. of Civil Engineering,  
 University of Toronto,  
 Toronto, Ont.

### VANCOUVER

*Chairman*, W. O. SCOTT  
*Vice-Chair*, W. N. KELLY  
*Executive*, H. P. ARCHIBALD  
 I. C. BARLTROP  
 H. C. FITZ-JAMES  
 H. J. MacLEOD  
 R. E. POTTER  
 (*Ex-Officio*), J. N. FINLAYSON  
 T. V. BERRY  
 H. N. MACPHERSON  
*Sec.-Treas.*, P. B. STROYAN  
 2099 Beach Avenue,  
 Vancouver, B.C.

### VICTORIA

*Chairman*, A. S. G. MUSGRAVE  
*Vice-Chair*, KENNETH REID  
*Executive*, A. L. FORD  
 B. T. O'GRADY  
 J. B. PARHAM  
 R. BOWERING  
 (*Ex-Officio*), A. L. CARRUTHERS  
 G. M. IRWIN  
 E. W. IZARD  
*Sec.-Treas.*, J. H. BLAKE,  
 605 Victoria Avenue,  
 Victoria, B.C.

### WINNIPEG

*Chairman*, D. M. STEPHENS  
*Vice-Chair*, J. T. DYMENT  
*Executive*, C. V. ANTENBRING  
 N. M. HALL  
 T. H. KIRBY  
 E. W. R. BUTLER  
 H. B. BREHAUT  
 (*Ex-Officio*), J. W. SANGER  
 V. MICHIE  
 C. P. HALTALIN  
*Sec.-Treas.*, THOMAS E. STOREY,  
 55 Princess Street,  
 Winnipeg, Man.

# THE MODERNIZATION OF A PUERTO RICO STEAM PLANT

J. T. FARMER, M.E.I.C. and E. A. GOODWIN, M.E.I.C.  
*Montreal Engineering Company, Limited, Montreal, Que.*

Paper presented before the Montreal Branch of The Engineering Institute of Canada on March 19th, 1942.

The Porto Rico Railway, Light and Power Company serves the City of San Juan, the capital of Puerto Rico, as well as some thirty-five towns in the contiguous territory embracing nearly half the area of the island with a population of close to a million inhabitants.

While far below the consumption of a similar population in either the Continental United States or Canada, the use of electricity has shown a continuous growth in the last decade throughout the area and more particularly in San Juan itself. The outstanding industry of the country is sugar growing and processing, which, from its nature, does not make any direct demands on a central power supply. Other activity on the island is mainly agricultural, and such manufacturing as exists is on a relatively small scale.

The Island of Puerto Rico is the most easterly United States territory of any size. Its strategic importance as an outpost of the Panama Canal and an operating centre for the Caribbean area and the north coast of South America is evident from a cursory inspection of the map. The United States has established a large army post on the island, and extensive army and navy air bases are under construction, as well as an important naval base on the east coast of Vieques Sound.

All this construction has brought a business boom to the island and this, combined with the influx of people to carry out the work, has imposed on the company a heavy demand for electrical service.

In the early days of this utility, the main source of power was from hydro-electric plants in the interior of the island. The drainage area of the small rivers on the island is naturally limited, but the annual rainfall is fairly heavy; so that from this source it was possible to meet the then moderate demands of the territory. Besides the limited volume of run-off however, its intermittent character, coupled with the absence of any extensive storage facilities, has always been a difficulty; so that even from early days it was necessary to maintain a small steam plant in reserve, to make up temporary deficiencies in the available hydro supply.

Prior to 1936 this steam plant consisted of three steam turbines of 500, 1000 and 1500 kw. capacity respectively, a total of 3000 kw. which could be stretched to 3500 kw. Steam was generated in five boilers from 20 to 35 years old at a working pressure of 160 lb. gauge and about 100 deg. of superheat. The fuel used was Bunker C fuel oil obtained from Venezuela; and the overall fuel rate was about 1.85 lb. per kw.h. The building housing this equipment was of steel and wood framing, with sheet iron roofing and siding. Natural draft was furnished by two 125-ft. steel stacks, already showing the ravages of time and the damp salt air.

This plant, known as the Santurce Steam Plant, is located in the principal suburb of San Juan, about three miles from the centre of that city. It is on the shore of the Condado lagoon, an extension of the inner harbour of San Juan, from which a supply of cooling water is obtainable. A pipe line connects the plant with an oil depot in the city.

This location is near the load centre of the city of San Juan and its suburbs, and is connected directly with the transmission lines from the hydro plants. It was considered the best site for further development.

The building runs almost due north and south. The eastern portion forms the turbine room, while the boilers occupy the western section of the building. (Fig. 1).

Early in 1936 it became apparent that the capacity of the existing plant was barely sufficient to meet the immediate and prospective demands of the system. It was decided to provide additional capacity by enlarging the Santurce Station. With some hesitation, it was decided to double its capacity, with the idea that, if not immediately necessary, this would take care of any likely demands for a long time to come. So far from this enlargement not proving justified, it turned out to be merely the first of a series of extensions which have resulted in the complete modernization of the station.

This 3500 kw. extension had hardly been put into operation before a further extension on a larger scale was found necessary. This took the form of a 5000 kw. unit, installed in 1938, and was followed by the installation of a 7500 kw. turbine and boiler plant which went into service in the latter part of 1941. A duplication of this last addition is now in hand, and is expected to be in operation by the summer of 1943.

The modernization of the station has thus been carried out in four stages, of which three have been completed, and the fourth partially so. As typical of the general scheme, the third stage recently completed will be described in some detail.

The first extension in 1936-37 consisted of a 3500 kw. turbine-generator and a Foster-Wheeler boiler with a steam capacity of 60,000 lb. per hour. Following the trend of present day practice, but without going to extremes, it was decided to install equipment designed to operate with steam at 400 lb. gauge pressure and 700 deg. F. total temperature. These characteristics once established were adhered to in the subsequent additions.

The new units were considerably larger than those of the original plant, so the building was extended to the south, utilizing as much as possible of the original structure, but increasing the width and also the height of the roof. The foundations of the main columns and the major pieces of equipment were set on piles. In the new section of the turbine room, a 20-ton travelling crane was installed on crane rails carried on the building columns, which necessitated a higher roof. The boiler replaced an old boiler in the southern end of the boiler room, and the roof was raised to match that in the turbine room.

In connection with this 3500 kw. addition, an improved cooling water intake was put in. The only provision for the older turbine condensers was a cold water well which was fed by an underground conduit from the shore of the lagoon, which naturally drew on the warmer surface water from near inshore. For the new unit a pump house was built on piles some 250 ft. out from the shore, so that water could be pumped from a greater depth (Fig 2). This water was conveyed through a 30 in. cast iron pipe carried on a series of piers and so delivered into the turbine room. This pipe was branched so as to supply two turbines. This pump house was later enlarged and two pumps were installed to serve the two 7500 kw. units. In this case individual 24-in. pipes were led to each of the units, these pipes being supported on the piers already in place.

As further additions were proceeded with, the old building was remodelled and enlarged to match the first extension in order to accommodate each successive instalment

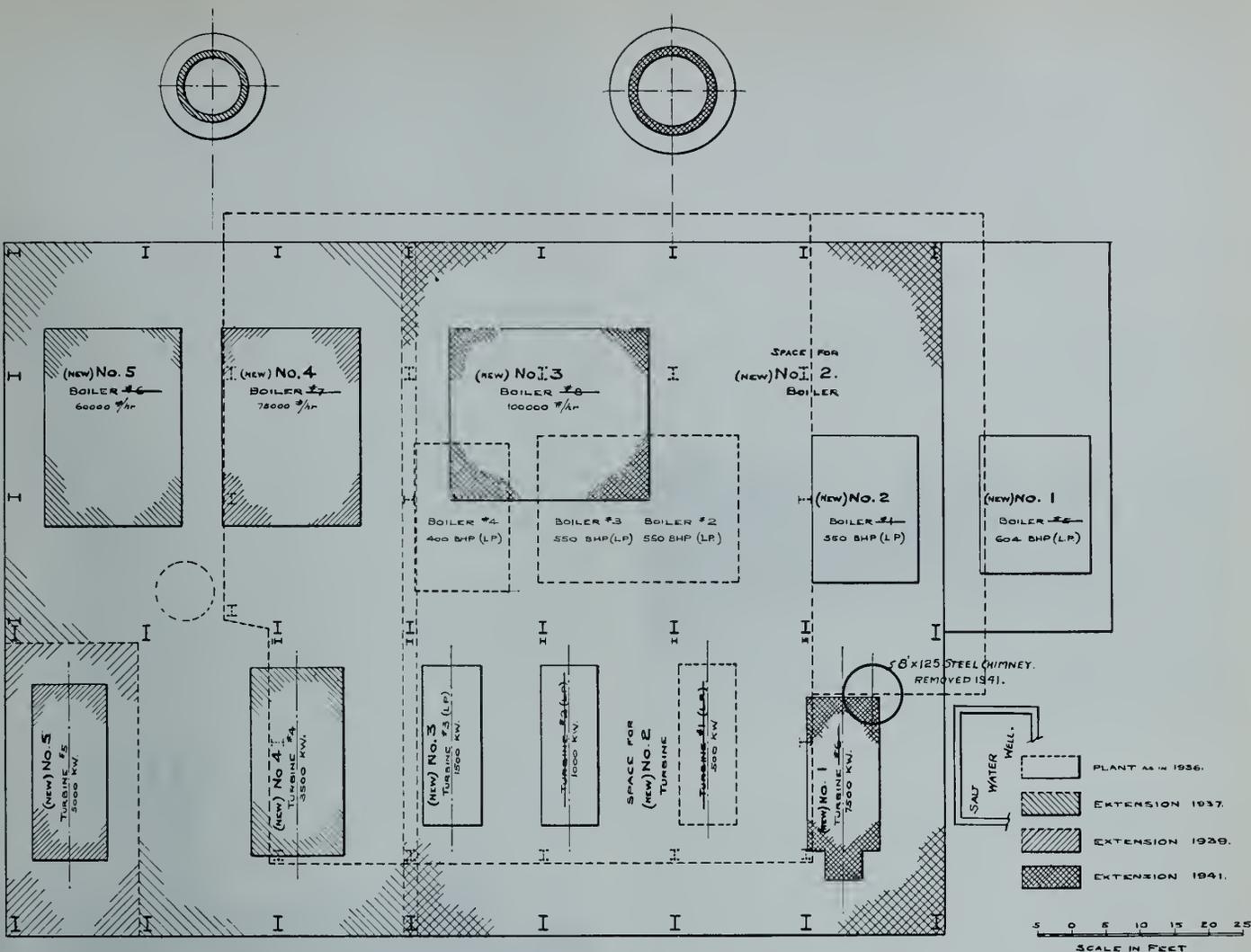


Fig. 1—Progressive development of Santurce steam station.

of equipment. At the third stage the original structure was entirely replaced on the new lines so as to provide space for the fourth and last addition of equipment.

The remodelled building consists of a steel frame with corrugated asbestos roofing and siding. The steel columns were in some cases built up on the original columns; in other cases they were entirely new. The crane rails were continued the whole length of the turbine room so that the crane can serve any of the turbine units. It is capable of lifting and transporting any of the pieces of equipment ordinarily requiring handling during erection or overhaul.

When the first high pressure unit was installed, the boiler was connected up to one of the two steel stacks previously mentioned. With the advent of a second boiler, additional chimney capacity became necessary; and a reinforced concrete chimney 150 ft. high by 8 ft. diameter was built outside the boiler room, to serve both boiler units. This permitted the demolition of the steel chimney in the south end of the boiler room, releasing some space for other purposes. On proceeding with the third extension, a second concrete chimney formed part of the programme. This was similar to the first except that the diameter was increased to 10 ft. On the completion of this chimney, the last of the two steel stacks was dismantled.

In carrying out these extensions, it was considered essential to keep the older low pressure units available for service as long as possible. In fact, it has only been necessary to retire the smallest of the three old turbines to make room for the first of the 7500 kw. units. Even after the erection of the second 7500 kw. unit it will still

be possible to retain the old 1500 kw. turbine as an emergency unit.

The retention of these low pressure units, with low pressure boilers to serve them, made necessary a considerable amount of preliminary work in the way of changing over piping to clear the way for the new high pressure installation.

The prime mover equipment selected for this addition consists of a Westinghouse condensing turbine rated at 7500 kw. but capable of generating continuously 9375 kw. at unity power factor. The operating conditions are, as previously established for the earlier units operating in parallel, steam pressure 400 lb. gauge and 700 deg. F. total temperature, and vacuum 2.5 in. of mercury absolute. The turbine speed is 3600 revolutions per minute. The turbine is of the single cylinder, impulse-reaction type, arranged with three bleed points; and is fitted with the usual accessories. These include a hydraulically operated combination steam and throttle valve with integral steam strainer; hydraulic oil relay governor operating steam admission valves, and equipped with a motor-operated speed changer; over speed and low oil pressure trips; impeller type main oil pump driven from turbine spindle, and turbine driven auxiliary oil pump with automatic regulator to start it up in case of failure of oil pressure. Oil coolers in duplicate are provided, using cooling water tapped off the condenser supply.

The generator is a 9375 kva., 7500 kw. at 80 per cent power factor, three-phase, 60 cycle, 8300 volt generator. Internal ventilating fans are mounted on the generator

rotor. The generator air cooler built into the foundation block has 2,130 sq. ft. of cooling surface. It is supplied with cooling water taken from the main condenser supply. A field discharge resistor is provided, and a motor-operated generator field rheostat.

A 45 kw. 125 volt exciter is directly connected to the generator shaft and is equipped with a hand-operated exciter field rheostat.

The total weight of the turbine unit is about 142,000 lb.

The condensing equipment consists of a Westinghouse two-pass radial flow type surface condenser fitted with



Fig. 2—Pump house.

Muntz metal tube sheets and aluminum brass tubes, having an effective cooling surface of 6,800 sq. ft. The water boxes are divided so that either half of the condenser can be opened up for inspection or cleaning while the other half remains in service. Inlet valves are provided to shut off the cooling water from either half of the condenser.

The condenser body is suspended directly from the exhaust flange of the turbine, and is fitted with jack screws to take the weight in case of the condenser being filled up with water for testing. To relieve any stresses due to temperature variations, expansion joints are provided on the water, air and atmospheric exhaust connections. A 16-in. atmospheric relief valve is provided.

The air released in the condenser is exhausted by a two-stage steam jet ejector, the steam used in the process being largely condensed in the inter and after condensers, the heat being applied to the condensate. The air ejector is in duplicate to minimize the risk of any shut down due to failure of this apparatus.

The supply of cooling water for condensing, as already mentioned, is obtained from the lagoon alongside the plant, in which the only change of water is that due to the tidal ebb and flow. The water temperature in this latitude is naturally high, ranging from 80 to 86 deg. F., so this limits the vacuum attainable. The condenser is designed to maintain a vacuum of 27.5 in. of mercury at normal load. In the existing units the vacuum ranges from 27 to 28 in.

The cooling water after passing the condenser is discharged into a canal on the east side of the building, and thence back to the lagoon (Fig. 3). The point of discharge of the canal is some little distance from the intake at the pump house; and the lagoon is so large that the continuous discharge of warm water does not appear to appreciably affect the temperature of the incoming water. Some observations made some years ago, when the station load was much lighter than at present, failed to detect any appreciable warming of the main body of water, and in fact indicated practically the same temperature as in the open sea along the nearby coast. However, it was felt

that the return of an increasing volume of warm water was bound to have some effect in raising the temperature of the lagoon water locally. With a view to minimizing this, a line of sheet piling was driven forming a curtain wall between the warm water discharge and the pump house location. The idea was that this would tend to deflect the current of warm water along the north shore of the lagoon, and keep it from mixing with the cooler water approaching the pump inlet.

The circulating water pump for this unit is installed in the pump house out in the lagoon, alongside the pumps for the earlier high pressure units, which were of the conventional horizontal centrifugal type. The water is drawn from several feet below the surface, from a suction box arranged with screens to catch any coarse debris floating on the water.

The pump adopted is of the vertical axial flow type. This pump is set on the floor of the pump house with its vertical casing extending to well below low water mark, and housing the propeller and guide vanes. The propeller being always submerged, no priming is required. The pump is designed to deliver 7,650 U.S. gallons per minute against a total head of 25.4 ft., this being the head loss incurred in the passage of the water through the intake pipe and condenser. The characteristics of this pump are such that if this head loss is moderately increased, due to marine growth in the pipe, or fouling of the condenser tubes, the quantity of water pumped will



Fig. 3—Plant seen from lagoon.

not be very seriously curtailed. The pump is equipped with a 75-hp. squirrel cage motor mounted directly on the pump casing.

The water is conveyed to the turbine room through a 24-in. cast iron pipe, supported on the same piers as the pipe serving the earlier machines. A similar pump and pipe will be provided for the second 7500-kw. unit.

One difficulty which is encountered in this intake system is the rapid fouling of the interior surface of the pipe, on which a layer of shellfish builds up, sometimes inches in thickness. In the past this has been held in check to some extent by intermittent injections of chlorine, but some mechanical cleaning has also been necessary. In order to facilitate this operation, the individual pipes for this latest installation were laid out with removable joints at intervals; so that, when necessary, short lengths of the pipe can be opened up and a scraper hauled through.

The condensate discharge from the condenser is handled by a vertical two-stage centrifugal pump, motor driven, capable of pumping against a total head of 140 ft. The condensate is passed through the air ejector condenser and a low pressure closed heater taking steam from the low pressure bleed point of the turbine, and is delivered into the de-aerating heater at a temperature

approaching 200 deg. F. Here it receives additional heat abstracted from the intermediate bleed point of the turbine; and any feed make-up required is automatically added at this point. The de-aerated water is then pumped by the motor driven centrifugal feed pump through the high pressure heater to the boiler. The high pressure heater steam is taken from the high pressure turbine bleed point.

The feed delivered to the boiler is controlled by a Copes feed water regulator with differential pressure valve. A surge tank, situated underneath the de-aerating heater, forms a reservoir of heated de-aerated water to take up any fluctuations in the boiler demand.

The steam generating equipment for this extension consists of a Babcock & Wilcox Integral Furnace Boiler with a normal rated capacity of 100,000 lb. of steam per hour at a pressure of 425 lb. per sq. in. gauge, and a total temperature of 710 deg. F. at the superheater outlet. This output can, if desired, be increased to 110,000 lb. per hour for short periods, all auxiliary equipment being designed to meet this condition. This steam output is sufficient to cover the maximum requirements of the 7500 kw. turbine at its maximum overload of 25 per cent over its rated capacity.

The boiler proper and superheater are of the makers' standard design for this type of boiler, having 8421 and 1758 sq. ft. of heating surface respectively. The boiler is equipped with an air heater of the tubular type, the air circulating through two passes of tubes arranged horizontally while the gas passes vertically upwards through a single pass on the outside of the tubes. A motor driven forced draft fan equipped with inlet vane control delivers air directly to the air inlet of the air heater. The gas passing from the air heater is handled by an induced draft fan driven by a squirrel cage motor through a hydraulic coupling. From the fan it is discharged into the reinforced concrete chimney.

While this boiler is primarily designed to serve the 7500 kw. turbine unit, the steam piping is interconnected so that it can supply steam to the other units in the station; or conversely, the steam required by the 7,500 kw. unit can be obtained from other boilers. Thus in the event of the forced stoppage of a major unit for any reason, the load being carried by it can be transferred to another unit with a minimum of disturbance of the routine of the rest of the plant.

The fuel used in this plant is fuel oil of the class known as Bunker C from the Venezuela oil field. It has a heat value of 18,300 to 18,800 B.t.u. per lb.

The boiler is equipped with six air registers, and combination steam and mechanical burners. Under normal running conditions, mechanical atomization is employed, but for starting up or to meet variable or otherwise abnormal load demands, the use of steam for atomization can be resorted to. Each burner burns 1,200 lb. of oil per hour at the rated load of the boiler, and can considerably exceed this amount during periods of overload. The boiler furnace is completely watercooled, and has a volume of 3,422 cu. ft., which gives a heat liberation of 37,500 B.t.u. per cu. ft. per hour when the boiler output is 100,000 lb. of steam per hour.

The battery of burners is completely enclosed in an insulated sheet steel casing or windbox, to which heated air is supplied through a short duct from the air heater outlet. The pressure set up in this windbox at full rated boiler output is slightly over two in. water gauge.

The waste gases are finally discharged through the second of the concrete chimneys earlier referred to. This chimney was designed to take the gases from a second boiler, a duplicate of that described, still to be installed. For the present it is arranged to take the products of combustion from two old low pressure boilers still retained

to furnish steam on occasion for the low pressure turbines held in reserve. One of these boilers will be displaced to make room for the new high pressure boiler.

The concrete chimney, like its predecessor, is built on a piled base some 30 ft. in diameter. Both these chimneys were designed with specially heavy reinforcement, to withstand the effects of extreme wind velocities: as Puerto Rico is situated in the hurricane belt, and such visitations must be expected at infrequent intervals. Since their erection these two chimneys have not been put to this test; but a number of chimneys on the island, designed on similar lines, successfully stood up to the hurricanes of 1928 and 1932.

These high chimneys were built to lessen the nuisance of smoke and dust in the residential area in the vicinity of the plant. Complaints are still heard, however, as to dust and dirt in the atmosphere, which is attributed to the operation of this Santurce plant. The problem is not an easy one, as the unconsumed solids resulting from oil burning are of such a light impalpable nature that it is very difficult to eliminate them by the ordinary methods of dust collection. In carrying out this last extension, a large chamber was introduced at the entrance to the induced draft fan, with a hopper and spout for discharging any fine dust that would collect therein. This chamber was so designed that a battery of cyclone collectors could be later installed, if found desirable, to assist in the separation of the dust particles.

With perfect combustion in the furnace, however, there should be no carry over of any solid matter when burning oil. With this in mind, in this instance particular attention has been given to the matter of combustion, and a system of automatic control has been adopted affecting both the air supply and the gas discharge, as well as the supply of oil to the burners, so as to maintain at all times and under all changing conditions as nearly perfect combustion conditions as possible. This it is hoped will result in largely preventing the emission of unburnt carbon from the furnace. Up to the present, it has been difficult to determine whether this aim has been realized, as the use of the same chimney by the older low pressure boilers, in which the combustion conditions are admittedly not so good, has tended to confuse the issue.

The boiler is fitted with the usual instruments, including a steam-flow air-flow meter, which is interconnected with the combustion control mechanism to maintain a correct relation between fuel and air admission. A two-pen instrument records steam pressure and temperature. A multi-pointer draft gauge indicates the pressure in the windbox, the furnace and at the boiler uptake. Provision is made for obtaining other secondary readings from indicating thermometers and gauges. A bi-colour water gauge is arranged with mirrors to bring the water level indication into convenient view of the operator. These accessories are believed to include everything necessary to maintain intelligent supervisory control of the boiler operation.

Fuel oil is pumped to the station through a six-in. supply line from the pumping plant at the oil storage depot about a mile and a half distant. At the plant it is stored in two medium sized tanks which have been carefully calibrated so that by means of float indicators a close estimate can be arrived at of the quantity of oil received, and that used in the boilers. The oil is pumped to the burners by motor driven screw type pumps through heaters. These pumping sets are equipped with pressure and temperature regulators.

The present pipe and storage facilities have been found ample to supply the fuel requirements of the plant up to the present time. However with increasing plant output, and with some apprehension as to the regularity of supplies under present conditions, it has been thought pru-

dent to enlarge the storage facilities at the plant itself. Arrangements have been made to erect a tank of 10,000 barrels capacity in the grounds adjacent to the power house as a safeguard against any prolonged interruption of the supply.

This series of changes have thus transformed the plant from an antiquated model of thirty years ago to one that will compare in its essential components, if not in size, with the best of present day practice (Fig. 4).



Fig. 4—Plant after third extension. Looking west.

It is interesting to note the outstanding results of this remodelling. It was mentioned that in 1935 it took about 1.85 lb. of oil to produce one net kw.h. of energy. In the first two months after the last unit was put in operation late in 1941, the fuel consumption averaged 1.05 lb. per net kw.h. Credit for the improvement is of course due, firstly, to the inherent economy of the higher steam pressure and temperature in the prime mover with stage heating of the feed water; and secondly, to the much improved efficiency of the boiler, furnace and burner equipment with its accompanying heat recovery equipment.

An appreciation of the value of this reduced fuel con-

sumption can be gained from the general statement that it represents a saving of \$27 in the fuel cost of running the 7500 kw. turbine for one hour at its rated capacity. Carrying the comparison a stage further, it appears that this steam plant, in conjunction with the hydro generating facilities, can be operated at an annual capacity factor of about 45 per cent, which is equivalent to running at rated capacity for 3,900 hours in the year, thus showing a fuel saving of \$100,000 for the year, as compared with the 1935 performance. At this rate, the fuel saving alone would pay for the installation cost of the improved plant in about six years.

Obviously it does not pay as a general rule to discard and replace old plant, every time some improvement in economy becomes available; but this appears to have been a case where the substitution was fully justified.

This improved efficiency, however, was only a secondary consideration. The main incentive was the necessity of providing for increased output. The original plant had a nominal capacity of 3,000 kw. with rather liberal overload capacity. A heavy days output ran as high as 75,000 kw.h., equivalent to a capacity factor of over 100 per cent. When the second 7500 kw. unit is ready for operation, the plant will have an installed capacity of 25,000 kw., including the old 1500 kw. low pressure unit still remaining.

With one of the largest units out of service, the firm capacity of the plant comes down to 17,500 kw. At 50 per cent capacity factor this corresponds to a 24-hour output of 210,000 kw.h. Already the daily average for a month has exceeded 213,000 kw.h. with single days running over 220,000 kw.h. So the station cannot be said to be over extended.

The question naturally occurs whether the increased power demands could not have been met more economically by the development of more hydro power. The answer is that a stage has been reached at which the water power resources in the limited area of the island, susceptible of economic development, have been practically exhausted and that any further energy requirements must be obtained from fuel. Thus in the last few years, from being essentially a hydro system with a small steam auxiliary, it has become a steam power system with hydro figuring as a secondary source of supply.

## THE WILL TO WIN

From an address by Brigadier-General Earl McFarland

*Mechanical Engineering*, MAY, 1942

Most important of all factors at the moment, and greater than any I have yet spoken of, is the will to win. Unless we are determined, our effort lacks half its energy and our results may be half as great as are required for victory. What I am saying was said by Napoleon, in a simple phrase and one more striking than I might coin. He said, "In battle, the morale is to the material as three is to one." Translated into the vernacular, that simply means that no matter how great our material strength, our determination to win is three times more important. How will that determination be brought about? This is a field somewhat beyond the mechanical engineer and the Ordnance officer, but I venture to state a belief which I hold to be basic to success: Our people must still develop a sense of righteous anger against a contemptible enemy whose actions deserve the sternest treatment. Until we know what it means to have a total hate for an unremitting foe and until we are willing to discipline ourselves and sacrifice our strength in order that we may inflict the

greatest of damage upon such an enemy, our fighting forces and our material strength will not speak the kind of language a ruthless fighter understands. For make no mistake about it, we are face to face with as ruthless an enemy as the world has ever known. Until we are ready to meet that kind of fighting with the intense hatred it deserves, we will never be able to reach the goal for which we are striving.

I wish it were possible for me to conclude my remarks on a more kindly note. But we are at war, the worst war the world has ever known. We will not win it by a lackadaisical attitude in the factory, on the farm, or anywhere else. We must realize that we have a job to do—the greatest job in the history of the world. And until we get mad about it and fight with a hatred as deep as our enemies' cunning and ruthlessness, we can not exert our full strength. The day has come to match our engineering power with the will to fight—to fight hard at all costs—and to win.

# THE LIONS' GATE BRIDGE—III\*

S. R. BANKS, M.E.I.C.

General Engineering Department, Aluminum Company of Canada, Limited, Montreal, Que. Formerly with Messrs. Monsarrat and Pratley, Consulting Engineers, Montreal, Que.

This paper was awarded the Gzowski Medal of the Institute for 1941

## SUPERSTRUCTURE: DESIGN AND FABRICATION (Continued)

### MAIN CABLES: DESIGN

The maximum tension in the cables of a suspension-bridge occurs when all the spans are loaded, the temperature being at its lowest. Throughout the cable, for any given loading, the horizontal component of the tension is constant, the tension itself varying with the angle of slope.

In the present case, the heaviest loading of the cables takes place when the three spans are covered with the "congested" loading (C) of 615 lb. per lin. ft. (on each side of the bridge), the temperature being the selected minimum of 0 deg. F. Under those severe conditions, the horizontal component was computed to be 5,778 kips. The steepest part of the cable is where it enters the shoreward side of the tower-saddle, and the corresponding maximum cable-tension is 6,400 kips at that point.

Decision had first to be made regarding the general type of cable to be used, the choice lying between a cable composed of individual parallel wires and one consisting of a limited number of parallel pre-fabricated strands. The former type was introduced in America nearly a century ago by J. A. Roebling, and, displacing the once-common eye-bar cable almost entirely, has served more frequently than any other. Its advantages lie in that comparatively small weights of material are handled in the field, the wires (shipped directly from the manufacturer) being placed individually; and in that there is no socketing involved in the anchorage-assemblies. Parallel-wire cables have been invariably employed in spans of great length, where stranded cables would be out of the question because of the impracticability of manufacturing, pre-stressing, and handling very heavy strands.

Cables of pre-fabricated strands (in which groups of individual wires are spun into units whose length is that of the cable itself) were introduced only some fifteen years ago\*\*, and have steadily gained in favour for bridges of short and medium spans. Although with this kind of cable there is a considerable amount of shop-work additional to that involved in the actual wire-drawing, the extra cost thereof is more than offset by the expedition of the field-assembly and adjustments, and by the simplicity of the erection-equipment compared with that needed for wire-by-wire erection\*\*\*. There is the further advantage that most of the handling takes place under "shop" conditions, where the control and inspection are superior to those obtainable in the field. The process of pre-stressing also provides opportunity for close inspection and positive testing of the finished strands. The size of such strands is, however, limited both in length and sectional area by the factors previously mentioned, and also by the rapidly-increasing cost of unspliced wires of more than the normal ingot-weight of about 380 lb. (representing about 3,500 ft. of No. 6 S.W.G. galvanized steel wire). Yet another limit is imposed by the difficulties associated with anchoring numerous and heavy strand-sockets.

Study of the above considerations, made in the light of the engineers' experience with 2,570-ft. strands at the

Island of Orleans, led to decision in favour of stranded cables. The decision was supported by the knowledge that the wire-length required was not abnormal from the manufacturer's point of view, and also by the successful development of a suitable anchorage.

The Lions' Gate bridge cables are the longest yet to have been constructed of prefabricated strands, and in only one instance (the St. John's bridge at Portland Oregon: central span 1,207 ft.) have stranded cables of greater cross-section been used. The cable in that case was 16¾ in. in diameter, consisting of 91 strands 1½ in. in diameter and about 2,600 ft. in length.

The working-unit adopted for the cables was 90,000 lb. per sq. in. This high stress is justified by the excellent and uniform quality of bridge-wire that is nowadays available; by the equally satisfactory physical properties exhibited by the cable-strands under test and during pre-stressing; by the comprehensive nature of the routine-testing throughout; and by the fact that, in a bridge of this magnitude, the range of stress-variation tending to set up conditions of fatigue is not great, the dead-load stress amounting to more than 80 per cent of the maximum under the worst



Fig. 40—Cross-sections of cable and cable-strand.

conditions. The required cross-sectional area of the cable was thus 71.11 sq. in.

The natural grouping of parallel strands lying compactly in contact is hexagonal, and that optimum shape demands that the number of strands shall be one of the series 1, 7, 19, 37, 61, 91, 127, etc. In order to avoid undue stiffness and weight of strand on the one hand, and too cumbersome an anchorage-assembly on the other, the number in this case was selected as 61, the corresponding strand-diameter being approximately 1-7/16 in. (with a steel-area of about 1.17 sq. in.). The build-up of the cable is shown in Fig. 40. In the final assembly, the hexagonal form is rounded out by the six oil-impregnated cedarwood fillers shown, the whole being tightly bound together by a continuous serving of No. 9 S.W.G. soft steel galvanized wire. The finished diameter of the cable is 13¼ in. The weight per running foot of the cable (estimated at 284 lb.) is 283 lb. The length of the strand was calculated to be 3,391.490 ft. between faces of sockets under dead load and at normal temperature.

### SPECIFICATIONS FOR CABLE-STRANDS

A very complete specification was drawn up covering the manufacture and fabrication of the cables. The clauses pertaining to the cable-strands may be summarized as follows:

The approximate length of each of the 122 strands was stated to be 3,400 ft., this figure including allowance for socketing and for test-samples.

1.1875 sq. in. was specified as the ungalvanized or net area of the strand cross-section.

\*Parts I and II appeared respectively in the April and May issues of the *Journal*.

\*\*One of the earliest bridges carried by a stranded cable was that at Grand'Mère, Que. (1929).

\*\*\*It was also borne in mind that no such equipment was in existence in Canada.

The strand was to be built of galvanized wires, the diameter of none of which was to exceed 0.192 in. in the "green" or ungalvanized state.

All wires were to be of the full length of the strand, no splicing whatever being permitted.

In order to obviate twisting of the strand when under load, it was specified that the outer gallery of wires in each strand should be of opposite lay to that of the inner wires.

Strands in respect to their outer wires were to be of right- or left-hand lay according to their positions in the cable, so as to avoid excessive bearing pressures in the saddles due to point-contact between wires of successive layers of strands.

The strand was to possess an ultimate strength of not less than 230,000 lb., with a modulus of elasticity of at least 25,000,000 lb. per sq. in. (of ungalvanized area) over a range of loading up to 50 per cent of that ultimate strength. Forty 100-in. specimens (cut from as many strands) were required to be tested, half of that number for modulus and yield-point, and half to destruction.

The specifications for the wire followed well-established precedent, the steel being required to be acid open-hearth cold-drawn bridge-wire, manufactured in accordance with the best current practice, and the product of works of established reputation. Apart from the engineers' subsequent acceptance of some 150 tons of stock-material (that had been manufactured, to precisely the same specifica-

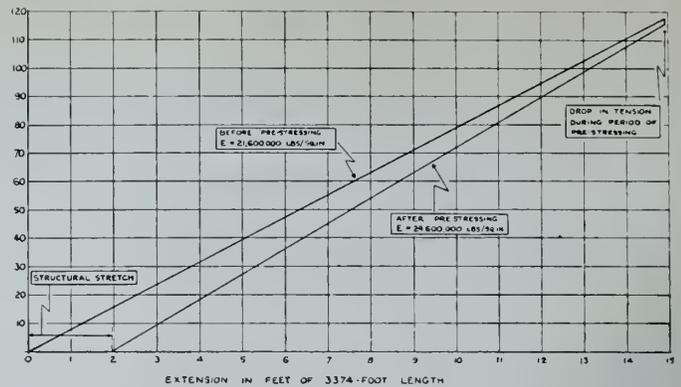


Fig. 42—Typical stress-strain graph of strand pre-stressing.

strength was set at 215,000 lb. per sq. in. of gross area, the permissible average minimum for any one heat, however, being 220,000 lb. per sq. in.

The minimum stress at the yield point (at an elongation of .75 per cent in the gauge-length of 10 in.) was set at 165,000 lb. per sq. in., and the minimum elongation of the same 10-in. test-piece at four per cent (with an area-reduction of not less than 30 per cent).

The wire, before and after galvanizing, was required not to fracture on coiling cold around a mandrel of one and one-half times its own diameter.

Stipulations were made concerning the precise number of tests of each kind to be made, and it was specified that all tests should be made prior to strand-fabrication.

#### CABLE-STRANDS: FABRICATION

Considerable interest in the cable-strands was evinced by wire-rope manufacturers both in Britain and in Canada, and several tenders, from both countries, were eventually received by the contractor. The successful bid was based on the acceptance of the strand shown in Fig. 40. The engineers' approval of this was readily given, since tests of a preliminary sample had already demonstrated its satisfactory properties. The strand is built up of a Seale core of 7/7/1 with two outer galleries of 13 and 19 wires respectively; and it will be noted that 39 of the total of 47 wires are of .196-in. diameter, this being the maximum permitted by the specification. This preponderance of No. 6 gauge wire is due to the fact that the low bid was that of John A. Roebling's Sons Company (of U.S.A.), which firm has had long experience in the development of, and is particularly well-equipped to pro-

duce, a specialized bridge-wire of this particular size. It is of interest to note, however, that the several other designs put forward were all based on a larger number of rather smaller wires, and that such designs would have been at least equally acceptable to the engineers.

The fabrication of the strands (by Anglo-Canadian Wire Rope Company, at Rockfield, Que.) did not present any great problem. They are, of course, of larger and stiffer wire than is met with in ordinary practice; and they required the use of a very sturdy machine for the final closure, working under an estimated tension of about 20 to 25 tons. The strands were spun in two operations, the first of which consisted in laying up the core of 15 wires together with the intermediate gallery of 13 wires, all in the same direction. In the second operation, this assembly of 28 wires became the core onto which, but in opposite



Fig. 41—Closure of cable-strand.

tion, for the Golden Gate bridge, San Francisco) all wire was required to be made especially for this job, and to be properly tagged and identified as such throughout all stages of manufacture. The general substance of other requirements, which applied equally to the stock-material, is given below.

A gauge-tolerance for the ungalvanized wire was established at .003 in. plus or minus, and the increase in diameter due to galvanizing was limited to .005 in. The galvanizing was required to pass a standard Preece test.

The maximum permissible percentage of certain elements in the steel were specified as follows: carbon .08, phosphorus .04, sulphur .04.

A test-piece was to be cut from each end of every coil of wire, and the minimum acceptable ultimate

direction, were laid the 19 outer wires (Fig. 41). A tribute to the quality of the wire and to the skill of the fabricators is implied in the fact that on only two or three occasions did a wire break during the strand-fabrication; such wires were replaced. Great care was taken to preserve the galvanizing. Linseed oil was at first used as a lubricant for that purpose, but it was later found that careful shaping of the dies in the machines would almost completely obviate abrasion.

The nominal gross area of the strand, which was used as a basis for all computations, is 1.2363 sq. in., the ungalvanized or net area being 1.1905 sq. in. From the latter figure, it will be noted that the actual cable-stress under the worst loading-condition is 88,000 lb. per sq. in. The average strand-diameter, obtained from a great number of measurements, is 1.443 in., which is very close to the engineers' assumption of  $1\frac{1}{16}$  in.

#### CABLE-STRANDS: SOCKETING

The strands were made to a length in excess of that finally required, and were socketed at both ends in readiness for pre-stressing. One end of each was fitted with its permanent socket and the other with a temporary one, the latter being removed after the strand had been pre-stressed and later replaced as a permanent fitting. As a matter of convenience, this replacement, together with the final cutting, was done at the pre-stressing plant. The strands were cut neatly and expeditiously by a high-speed cutting-disc.

The specifications relating to the attachment of sockets required primarily that the full strength of the strand should be developed without injury to the socket, and provision was made for the testing of socketed specimens. The socketing-material was to be commercially-pure (99.75 per cent) zinc. Emphasis was placed upon the desirability of a straight lead into the socket, and of the preservation of the lay of the strand right up to its entrance.

The strand-socket (Fig. 46) consists of a steel cylinder (S.A.E. 1030, forging quality) 7 in. in diameter and 16 in. long, part of which is cored out and threaded internally for attachment to the anchor-bolt, the other part being bored to form the conical cavity or basket in which the broomed end of the strand is held. That cavity is 9 in. long, tapering from  $3\frac{3}{4}$  to  $1\frac{9}{16}$  in. in diameter. Three  $\frac{1}{4}$ -in. annular grooves are cut in the inside surface to assist the bond between that surface and the zinc mould. In the case of the temporary sockets, however, the grooves were not machined until the sockets had been removed prior to use as permanent fixtures.

The details of the socketing-process formed the subject of considerable study and experimentation by both the contractors and the engineers, and the following were features of the procedure adopted. The outer wires, after the ends had been seized and evenly broomed, were slightly bent so as to contact the basket at their extremities only, thus ensuring the flow of zinc completely around them. The broomed end was then agitated for about 10 minutes in a clean solution of caustic soda, after which it was washed in boiling water. To facilitate drying, it was dipped into methylated spirits. It will be noted

that no acid was used in the cleaning-process and that none of the ends of the wires were turned back upon themselves.

In order to permit of leading the strand squarely into the socket, the pouring of the zinc took place on a platform elevated some 10 ft. above floor-level. The socket was clamped vertically in an apparatus which at the same time held the end of the strand in its correct position. The socket (the inside of which had been tinned) was pre-heated by blow-torches to about 200 deg. F, and the zinc was introduced in one single pour at a temperature of 850-875 deg. F.: during the pour, the socket was vibrated with wooden mallets to prevent the inclusion of gas-bubbles. After pouring, the assembly was left undisturbed for at least 20 minutes. The metal remaining in the ladle after the pour was cast into a small ingot: this was immediately broken and inspection of the fractured metal made.

Owing to the fact that the ends of the sockets were not invariably true and square (and also on account of the inherent curve in the strand consequent on the tension under which it was reeled), it was found impossible to guarantee that the strand would, after socketing, lead perfectly normally into the socket. To investigate the effect of discrepancies of this nature, test-lengths of strand were equipped with sockets placed deliberately out of alignment by amounts of  $\frac{3}{16}$ ,  $\frac{1}{4}$ , and  $\frac{1}{2}$  in 12. These specimens all broke well away from the socket, at loads of 279, 277, and 280 kips respectively. A tolerance of  $\frac{1}{8}$  in 12 was therefore permitted in the alignment, and the contractors found it possible to keep within this limit.

The whole operation of socketing was subjected to constant inspection by the engineers, and the paramount importance of absolute cleanliness of all parts coming into

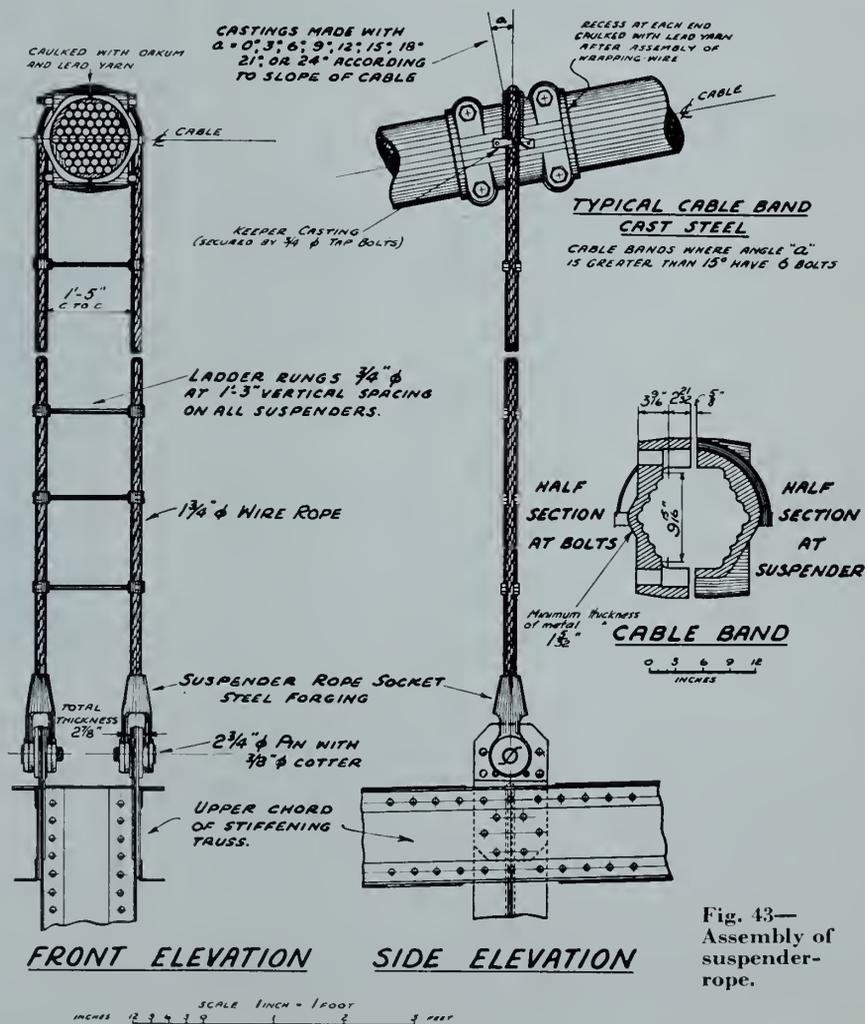


Fig. 43— Assembly of suspender-ropes.

contact with the zinc was continually impressed upon the workmen.

#### CABLE-STRANDS: PRE-STRESSING

In the cable of a suspension bridge it is of evident importance that the tensile stress should be as nearly uniform as possible over the whole cross-section, since any departure from such uniformity means that certain of the component wires or strands are receiving more than their share of the load. In the case of a parallel-wire cable, even stress-distribution is assured by the uniformity of the wire-material, which is attained by careful manufacture and stringent inspection; and by the method of erection, whereby the individual wires are all assembled to a common sag. With a stranded cable, however, as in the present case, two further considerations are involved. It is desirable, in the first place, that the component wires of any one strand shall share the strand-load equally; and, secondly, that the strands themselves shall possess uniform elastic properties in order to participate equally in the cable-tension. The first of these requirements depends upon the design and fabrication of the strand, and the degree of its achievement may be demonstrated by tests to destruction. In an ideal strand all the component wires would fail simultaneously, but, owing to the slight additional stress in some of those wires due to their helical shape, the "efficiency" of the strand—which may be defined as the ratio of its ultimate tensile-strength to the aggregate of the ultimate strengths of the actual wires used in its composition—can never attain to the ideal value of unity. It is satisfactory to record that the efficiencies computed for six random specimens of the Lions' Gate bridge strands were respectively 96.8, 96.5, 96.9, 96.9, 96.9, and 97.1 per cent.

The second requirement is obtained by pre-stressing the strands before their assembly into the bridge-cable. Al-

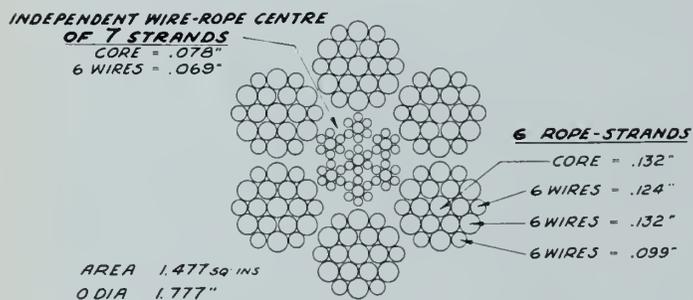


Fig. 44—Cross-section of suspender-rope.

though during fabrication the wires are laid into the strand under considerable tension, further consolidation of the assembly is needed in order to obviate the gradual lengthening, of uncertain amount, that ordinarily occurs when a wire rope is first put into service. The process of pre-stressing consists essentially in the subjection of each strand to considerable tension, the strand being laid out at full length for the purpose. That tension is maintained until such time as stretching has ceased or has become negligible, the effect upon the strand being to increase its modulus of elasticity from a comparatively low figure which varies somewhat for different strands, to a higher and much more uniform value. While the strand is thus unreeled it is the practice to reduce the tension to a figure approximating to the normal dead-load tension, when it is accurately measured and marked for cutting and socketing.

The pre-stressing process provides, incidentally, an opportunity for inspection of the strand; and it also positively demonstrates its capacity to support loads greater than those it will be called upon to carry in service.

The specification regarding pre-stressing and measurement of the strands reads as follows:

"Each  $1\frac{7}{16}$  in. diameter strand shall be finished to a length in excess of the final length of the strand in place and then pre-stressed to a tension of at least one-half of the specified ultimate strength of the strand (i.e. to 115,000 lb.), and held at this tension until stretching has ceased, but in no case for less than 30 minutes. The tension shall then be decreased to about 80,000 lb., at which load the strand shall be measured and the necessary reference points established for use during erection. The marking tension shall be maintained while a suitable mark is painted along the strand as a tell-tale in case of any subsequent twisting.

"Tests for modulus of elasticity shall be made on long lengths of all strands during the pre-stressing process."

"Every effort shall be made to secure measured lengths between sockets precisely equal to the lengths finally specified and approved. Particular precautions shall be taken to avoid any error due to change of length of the strand on account of reeling, subsequent to marking."

"The accuracy of the marking process shall be such as to produce a measured length within one inch of the required length."

The pre-stressing was done at Dominion Bridge Company's plant at Longueuil, Quebec. This pre-stressing plant is the only one in Canada, and, as far as the author is aware, the only one in existence that is not operated by a wire-rope manufacturer. In the former employment of the plant, which was built for the Island of Orleans strands, each 2,470-ft. strand had been laid out at full length in a straight line, with one end fastened to a heavy concrete anchorage and the other attached to the straining-machinery: each strand was in turn unrolled, pre-stressed, and reeled in again.\* Sufficient space was not, however, available for treating strands 3,400 ft. long in this manner, and permission was granted by the engineers to lay each strand out in two parallel parts, the bight passing around a horizontal sheave. Essentially, then, the plant consisted of two massive concrete foundations,



Fig. 45—Assembly of cable-band.

spaced at about 1,750 ft. apart, on one of which was mounted the roller-bearing sheave, and on the other the two hydraulic rams employed for the adjustable anchoring of one end of the strand and for the application of loading to the other. The sheave, by means of interchangeable tread-sections, could be arranged to suit a rope or strand of any given diameter. The diameter of the sheave was 14 ft., so that the strand (which coiled without difficulty

\*A description, by Mr. D. B. Armstrong, M.E.I.C., of the pre-stressing of cable-strands for the Island of Orleans bridge, may be found in *The Engineering Journal* for July, 1938.

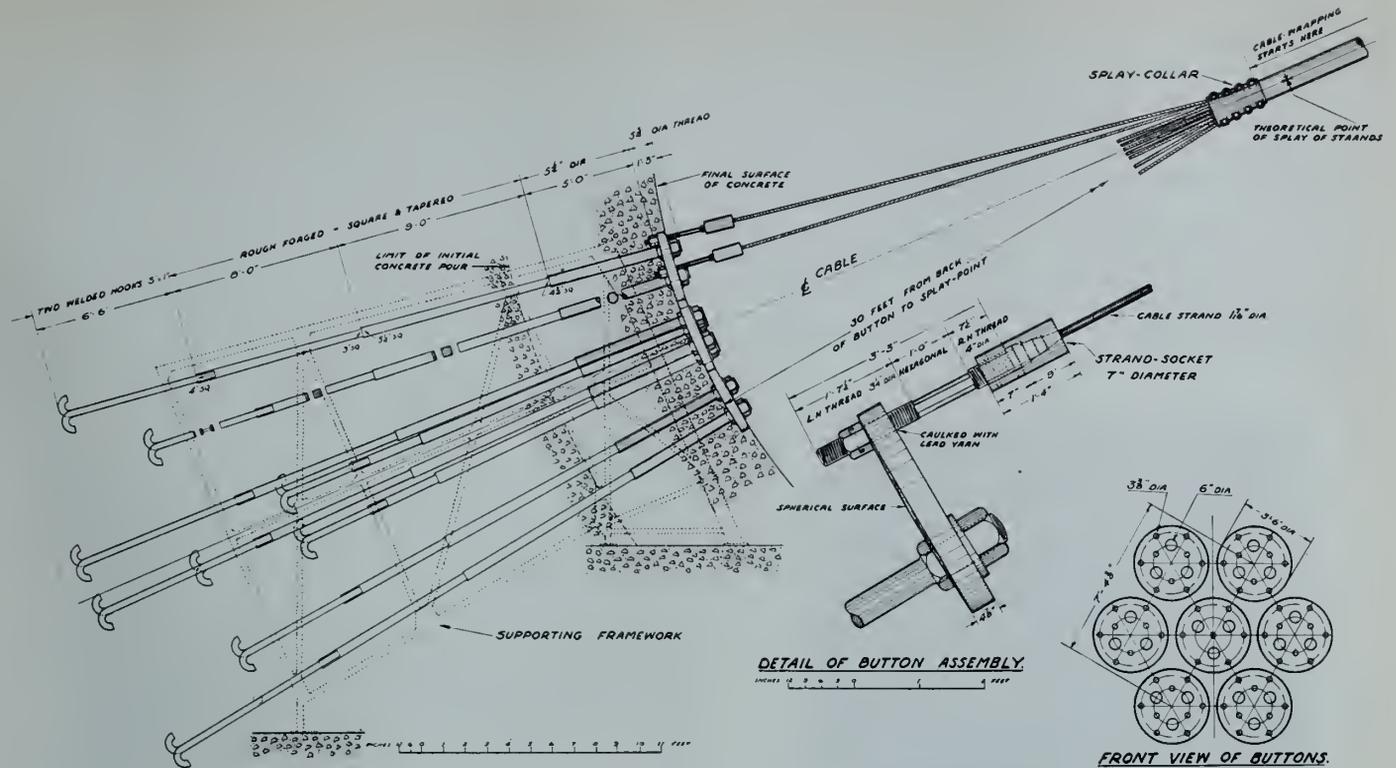


Fig. 46—Anchorage of cable.

over the 3½-ft diameter of the reel) was not subjected to any undue bending. The two parallel parts of the strand were thus 14 ft. apart, and the hydraulic rams were similarly spaced. The long lengths between the two anchorages were carried on stout timber benches (known as "troughs," guard-timbers being secured along the sides to prevent the strand from rolling off) 18 in. wide and about 2 ft. above wooden walkways which ran alongside. The sheave and the rams were at such levels that the whole of the strand lay in a horizontal plane. The troughs were illuminated at night, and a field-telephone was installed between the ends of the plant to facilitate control of the reeling-operations, and for transmittal of temperature-readings.

The two rams, each of about 80-ton capacity, were operated by electrically driven oil-pumps, the working-pressure being about 1,600 lb. per sq. in. The ram for application of the load had an effective stroke of 12 ft.; and, by means of a series of adjustable links and a locking-device, advantage was taken of a second stroke of the ram, so that a total stretch of as much as 22 ft. could be applied to the strand. A further set of links was arranged for dealing with variations in the delivered lengths, which ranged from 3,396 to 3,435 ft.

The smaller ram (installed in the first place as a safeguard against excessive differences between the tensions of the two parts of the strand owing to its passing around the sheave), with a stroke of only 28 in., was used chiefly in making adjustment to the position of the other end of the strand, its value lying in the fact that such movements could be made under load. This ram, like the straining-ram, could be locked at any point of its travel, so that any given stretching of the strand could be maintained indefinitely.

Accurate measurement of the tension applied by the rams was made by means of two extensometer-gauges designed for that purpose. Each of these consisted essentially of a heat-treated nickel-alloy steel bar, about 5 ft. long and with a circular cross-sectional area of 2 sq. in. The rod was upset and threaded at both ends; and the ends were screwed into heavy links for connection, respectively,

to the strand-socket and to the adjustable links of the ram in question. The tension in the bar was measured by observation of the extension of a 30-in. gauge-length, by means of micrometer-dials reading to the ten-thousandth part of an inch. The gauges were calibrated in a laboratory testing-machine.

Stout wooden reels, 78 in. in diameter and 51 in. wide, having a core-diameter of 42 in., were used for shipping the strands by rail to the pre-stressing plant, and also, at a later date, for transportation to Vancouver. Each strand was reeled with the permanent socket on the outside, so that when the reel (fitted with a removable steel axle) was lifted onto bearings mounted near the straining-ram, that socket could be coupled to the temporary socket of a strand already in the trough. The permanent socket of the latter strand was then secured to the inside of its own reel, which was for the purpose mounted on another set of bearings established near the dead-end ram. That (empty) reel was then set in motion by electrically-driven machinery operating by a chain-drive to the shaft; and as the pre-stressed strand was rolled up, the new strand was simultaneously hauled into place in the trough. The speed attained during this reeling-operation amounted at times to 200 ft. per minute. The two coupled sockets were set in a steel sled for passage along the trough. The weight of a strand together with its reel was just short of 8 tons (the weight of the reel alone being 950 lb.), and it was handled at the plant by a derrick-car.

The strand having been laid out in the trough in the manner described, and its ends duly connected to the appropriate extensometer-gauges and loading-rams, an initial tension of about 5 tons was applied in order to ensure its straightness. At this load a temporary reference mark was painted on the strand at a convenient point 3,374 ft. from the "dead-end" socket. The tension was then increased to the specified pre-stressing load (approximately 118,000 lb.), the corresponding lengthening of the strand (some 13½ ft) being meanwhile indicated by the movement of the painted reference-mark. The straining-links were then locked, and the strand remained in the strained condition for half-an-hour. During that time the load

was found to drop by about 1,500 lb., that decrease being due to a further bedding-down of the wires, and taking place principally during the first 20 minutes. At the end of the half-hour the ram was again actuated and tension was removed in decrements of 20,000 lb., observations of stress and strain being recorded for each stage. When the tension had decreased to the original amount of 5 tons it was found that the reference mark had moved back only about 11½ ft., indicating that a permanent set of some 2 ft. had taken place. At the same time there was an increase in the elastic modulus of the strand from an average value of 21.6 million lb. per sq. in. (varying from 20.7 to 22.2 among the 122 strands) to an average of 24.6 million lb. per sq. in. (varying only between 24.3 and 24.9),



Fig. 47—Anchorage: Button-assembly.

these moduli being based on the gross area of the strand. Based on the ungalvanized area, the final modulus was 25.5 million lb. per sq. in., a figure in accordance with the specified requirement. A typical stress-strain graph for the pre-stressing of a strand is shown in Fig. 42. In no case was there a failure of any wire during the heavy loading associated with pre-stressing, and the strands exhibited little or no tendency to twist when loaded.

The strand was next subjected to a tension of 79,000 lb., that being the computed average dead-load tension; and this load was maintained while the strand was marked for cutting and while painted reference-marks were established for use in the field.

For experimental purposes, one of the strands was pre-stressed under a tension of 140,000 lb. (one-half of the actual ultimate strength), and the results were not found to differ from those obtained under the usual 120,000-lb. tension.

The pre-stressing of the cable-strands started on October 15th and was completed on December 30th, 1937. The number of strands treated in any one night varied, mainly in accordance with temperature and weather-conditions, from one to as many as five, though four was the usual number.

#### PRECISION OF MEASUREMENTS DURING PRE-STRESSING

The specification permitted a tolerance of only plus or minus one inch in the strand-length of 3,391,490 ft. A high degree of accuracy was therefore essential in all operations to do with measurement of the strands. Such accuracy depended on four factors: the precision of the actual measuring, of prime importance; the close estimation of the temperature at the time of marking, since a variation of one deg. F. represented a change in length of approximately ¼ in.; the precision of the marking-tension, an error of 1,000 lb. in which would correspond to a length-error of about 1 in.; and, finally, the elimination of subsequent errors in reeling-up and socketing and unreeling again at the bridge-site. These four considerations, in view of the paramount importance of the cable-length,

whereon depends the field-geometry of the bridge, will be discussed in detail.

Since all of the 122 strands were required to be of identical length, the procedure consisted in the establishment of a single set of marking-points along the pre-stressing trough, to which each strand in turn was referred while under the proper tension. Steel plates mounted on independent concrete bases were set up at intervals along the trough, and on these plates marks were scribed corresponding with the positions of the sockets and of the centre-lines of the several saddles. The distances between the marks were chained with the utmost care, at night-time during periods of steady temperature: a government-calibrated 500-ft. tape was used (under appropriate tension), and the measuring was repeated until an overall accuracy probably within ⅛ in. was assured. Where the measurement passed around the sheave, allowance was made for the small elastic movement of the latter towards the rams when marking-tension was applied. Careful observations, repeated at intervals during pre-stressing, proved the immovability of the foundation-masses at the ends of the plant.

All pre-stressing and marking was done at night, commencing some time after sunset to ensure that uniform temperature obtained throughout the strand. The thermometers were laid against the strand, approximately at the quarter-points, and the mean of their readings was taken as the temperature of the strand. Measurements were not made except when the temperature was reasonably uniform and steady.

Frictional resistance along the trough was minimized by the provision of ball-bearing rollers placed at such intervals that the strand when under tension rested on them alone. The amount of this friction was represented by the difference between the gauge-readings at the ends of the strand, and it commonly ranged from 1,000 to 2,000 lb. The friction was assumed to be uniform along the strand, the resistance of the 14-ft. sheave being negligible. Each strand was marked twice, the second application of tension being so arranged that the direction of the friction-drag was reversed; and further measurement was made in the rare cases when the two sets of marks did not agree within half-an-inch. A reference-line, to show up any subsequent twisting, was painted on the strand while under the marking-load.

It was anticipated (from experience with the Island of Orleans strands) that reeling, together with subsequent unreeling at the site, would cause some alteration in strand-length. In order to make due allowance for this variation, a number of the strands were unreeled and re-measured. They were found to have shortened by amounts ranging from .031 to .168 ft., and the average shortening of ten such strands (amounting to approximately one inch) was used as a correction to be applied to the marking of every strand.

#### TESTING OF WIRE AND STRANDS

The wire was delivered in coils of 4-ft diameter from the manufacturer in Trenton, N.J., the coils having an average weight of about 380 lb. In compliance with the specification, some 11,500 separate tensile tests were made, prior to shipment. The ultimate wire-strength (based on the measured gross area of the test-piece) was found to vary from 215,000 to 260,000 lb. per sq. in. The great majority of the results, however, fell between 230,000 and 245,000 lb. per sq. in., so that there was ample margin above the requirement. The stipulated yield-point stress was also invariably surpassed, in approximately the same proportion. The elongation at failure averaged at about six per cent, the area-reduction being some 33 per cent. There was no difficulty in meeting the requirements of the bend-tests, and the cover afforded by the galvanizing was found to be slightly in excess of the specification. The

number of rejections from any cause was negligible. The average chemical composition of the wire was indicated by the following percentages of elements: carbon .80, manganese .65, silicon .22, phosphorus .023, and sulphur .029. There was no specification relating to the modulus of elasticity of the wire, but tests made by the manufacturer showed that it was close to 28 million lb. per sq. in. of gross area.

The tests of specimens cut from the finished strands revealed uniformly high quality. The average ultimate strength of the 40 specimens was 281,160 lb., the minimum being 274,700 lb. The modulus of elasticity averaged at 25.2 million lb. per sq. in. of gross area; as compared, incidentally, with the somewhat lower figure of 24.6 obtained for the 3,374-ft. gauge-length used during pre-stressing.

#### SUSPENDER-ROPES

The governing suspender-load was arrived at by consideration of two adjacent 32-ft. panels of the bridge-deck, assumption being made that the trusses were discontinuous at the ends of each panel and therefore capable only of bridging the space between one suspender and the next. Three 20-ton trucks were then placed, abreast, to deliver the worst possible reaction at the middle pair of the six suspenders involved in this hypothetical case; and both sidewalks at the same time were loaded with 100 lb. of live load per sq. ft. The resulting suspender-load was made up as follows:

Dead load .....	64.0 kips
Load, including 30 per cent impact, from trucks	75.1 kips
Live load on sidewalk .....	12.9 kips
Total .....	152.0 kips

The type of suspender selected consists of a wire rope the ends of which are attached to lugs on the trusses while the bight passes over a casting on the main cable (Fig. 43.) The load is thus shared by two parts of rope. The sockets are of standard open type, each having a pair of lugs which straddle that of the truss and which like the latter are bored to receive a 2 $\frac{3}{4}$ -in. pin which in turn is secured by a  $\frac{3}{8}$ -in. bent cotter. The length of the socket-basket is 6 $\frac{1}{2}$  in., and its internal diameter increases from 1 $\frac{5}{16}$  to 3 $\frac{1}{4}$  in.

A feature of the suspender-assembly is the provision of ladder-rungs, fixed at 15-in. vertical intervals between the two parts of the rope. These rungs are steel forgings,  $\frac{3}{4}$  in. in diameter, with the ends upset to form jaws which are hammered on to the ropes. The rungs serve the double purpose of providing inspection-access to each rope and cable-band and of causing the suspenders themselves to assume a heavier appearance more in keeping with the importance of their function. The provision of these ladders rendered unnecessary the usual expedient of a walkway (with somewhat unsightly hand-lines) along the top of each cable. Some 8,800 rungs in all were used, having a total weight of approximately 12 tons.

The critical stress in the suspender-rope depends on the radius of its curve of contact with the cable-band casting, and occurs at the tangent-point where that curve commences.\* Although there are in existence many formulae which aim at establishing the reduction in strength of a stationary wire rope when subject to bending as well as to tension, the results of such loading nevertheless remain somewhat conjectural, and it was deemed advisable to specify that samples of a suspender-rope should be tested to destruction over a sheave of the same diameter as the actual cable-band. The required ultimate tension in such a test was set at 230,000 lb. for either part of the rope, the suspender thus having a factor of safety of three.

\*It was noted, however, that in the tests of suspender-rope specimens, the fracture invariably did not occur at this point (page 354).

In estimating the size of the rope, the engineers' experience suggested a permissible working unit of 55,000 lb. per sq. in. in direct tension, this unit being low, to allow for the weakness caused by bending. On this assumption, the required metallic area of the rope was 1.38 sq. in., and the diameter about 1 $\frac{3}{4}$  in.

The following is a summary of the specifications relating to the suspender-ropes:

The rope was to be manufactured of galvanized wire, made to the same specification as the cable-wire (see page 348).

With a nominal diameter of 1 $\frac{3}{4}$  in., the rope was to consist of six strands (of 19 wires each) arranged around either an independent-wire-rope centre or around a core-strand of approved construction;

The splicing of individual wires by brazing was permitted, with the proviso that such splices should be as far apart in the rope as practicable.

Pre-stressing was specified, a tension of 115,000 lb. to be maintained for a minimum period of two hours.

The ropes were to be measured and marked at their dead-load tension of about 32,000 lb., and the length of any rope was required to be within  $\frac{1}{4}$ -in. of the specified length.

Seven test-pieces (one from each pre-stressing length) were to be tested to destruction over a 15 $\frac{1}{4}$ -in. sheave, and two 100-in. specimens were to be broken in direct tension for general information.

The rope was to be manufactured in as long lengths as possible, such lengths to be multiples of a length suitable for pre-stressing.

The sockets were required to develop the full strength of the rope.

The cross-section of the suspender-rope is seen in Fig. 44. The rope is built up of seven 19-wire strands of War-

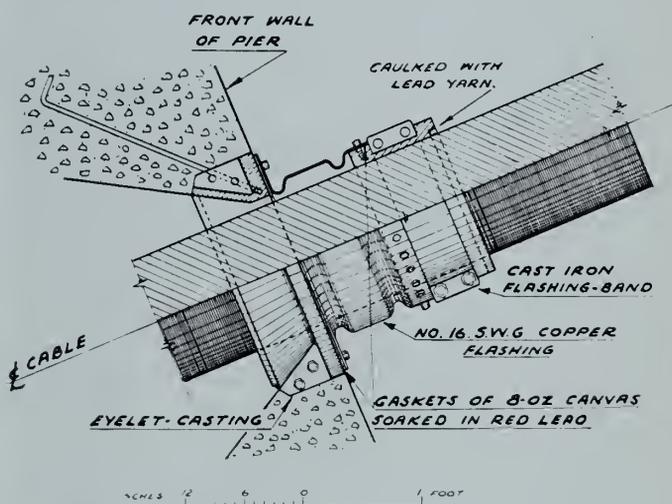


Fig. 48—Flashing at entrance of cable into anchor-pier.

ington type laid around an independent wire-rope centre of seven strands of seven wires each. Five sizes of wire are involved, the total number of wires being 163. In accordance with common practice, both the outer strands and those of the core are on left-hand lay, the core and the rope itself being of right-hand lay. The nominal gross area of the rope was 1.477 sq. in., but, owing to slight overrun of the wire-sizes, the measured gross area was 1.492 sq. in. The average diameter was 1.77 in.

The total length of suspender-rope was about 22,800 ft., and it was fabricated in three lengths of about 6450 ft. and one of 3500 ft. It was shipped to Longueuil on seven reels, each of the longer pieces being cut in half. Temporary sockets were attached prior to shipment.



tension of 36,000 lb. each. The bands on the flatter parts of the cables are fastened with four bolts each, but six bolts are required where the cable is steeper and the tendency to slip is consequently greater. The number of bolts was computed on the conservative assumption that there would be available a frictional resistance amounting to 30 per cent of the aggregate of the bolt-tensions. The six lowest bands, at the ends and the centre of the suspension-structure, are, further, designed to transfer traction-forces from the roadway to the cables, being cast with lugs on their undersides for connection to the traction-rods described elsewhere (Fig. 27) and are also secured each by six bolts. There are 166 cable-bands. Of this total, 64 are of the 4-bolt type, each weighing 485 lb., including bolts; while the remainder, of the 6-bolt type, weigh 615 lb. each.

Experiments were made to find a practical method of applying the specified tension to the bolts. A specimen-length of cable was prepared from 61 short pieces of strand, and onto this was assembled a cable-band. (Fig. 45). The bolts were tightened by men of different weights pressing downwards on the end of a wrench of known length, and the tension of selected bolts was measured by noting their overall extension, indicated by a sensitive extensometer. A reasonable approximation to the prescribed tension was obtained when two 150-lb. men pressed downwards without jerking on the end of a 6-ft. wrench. That procedure was consequently adopted in the field, neither bolt nor nut-face receiving any special lubrication.

The same experiment also demonstrated that, owing to slight overrun (within the tolerance) of the internal dimensions of some of the castings, together with the elastic distortion produced by tightening, the two halves of the band approached to within less than  $\frac{1}{4}$  in. when squeezed onto the cable. To prevent the two halves of any band coming into actual contact during field-assembly, it was deemed wise to plane  $\frac{1}{16}$  in. off each casting already manufactured and to make appropriate change to the moulds for those yet to be made.

#### CABLE ANCHORAGES

The decision to use stranded cables was subject to solution of the problem of anchoring 61 separate strands within a reasonable space. The type of anchorage adopted is quite novel in several respects and was, in common with several other features of the bridge, the outcome of close collaboration between the engineers and the contractors.

The main feature of the anchorage (Fig. 46) is a group of seven circular steel slabs ("buttons"), symmetrically arranged normally to the direction of the cable, whereby the load from the cable is concentrated into seven parts, each of which is then delivered into the concrete anchorage-mass by three heavy anchor-bars.

The buttons, burned from 6-in. slabs of medium steel, are 3 ft. 6 in. in diameter, that size being determined by the clearances required between strand-sockets for field-assembly. The front face of each is plane, but the rear, or shoreward, face is machined to a spherical radius of 30 ft., the central thickness being  $5\frac{1}{2}$  in., and that at the edge  $4\frac{7}{8}$  in. Each button is perforated by three 6-in. holes for the admission of the main anchors; and attachment of the strand-sockets is effected by bolts passing through a further set of nine (or, in the case of the central button, seven)  $3\frac{3}{8}$  in. holes. The buttons are so arranged on the main anchors that their rear faces all lie on the surface of a sphere, the centre of which is 30 ft. away and on the centre-line of the cable. That same point is made the theoretical origin of the splaying-out of the strands from their compact hexagonal formation in the cable proper, with the result that the splayed strands are radial to the spherical surface.

The 21 primary anchors, embedded into the pier, during

its construction, are medium-steel forgings ranging in length from 21 to 31 ft. They are, except for a fish-tail welded to the lower end, and for a length of about 5 ft. which was not embedded until after assembly of the cable, square in cross-section and were forged into a series of tapered lengths in order to secure positive bond by wedge-action. The lower ends of the anchors are spread to engage an adequate mass of concrete, and the upper ends, which are upset and finished to screw-threads  $5\frac{3}{4}$  in. in diameter, converge to the larger holes in the buttons. A heavy bevelled washer is introduced between the plane face of the button and the tilted bearing-surface of each nut in order to allow for the inclination of the anchor.

The anchorage as so far described was assembled on a structural framework sufficiently robust to maintain alignment during its incorporation into the pier. The framework was furnished with adjustable anchor-bolts for precise location. The appearance of the anchorage, thus built into the pier and ready for connection to the cable, is shown in Fig. 47.

Connection of the strands to the buttons is effected by bolts 3 ft. 3 in. long. Each bolt is screwed into the strand-socket (Fig. 46), and its other end is secured by a nut which bears on the spherical rear surface of the button. The threads on the ends of the bolt being of opposite hand, and the bolt shaft being of hexagonal section, the bolt could be used for adjusting the position of the socket during cable-assembly (Part IV). This device was also designed to compensate for the fact that the inclination of the backstays (the strands being all of the same length) caused the upper sockets to be further from the buttons (by some 5 in.) than are those of the lower strands.

The splay of the strands is controlled by a heavy col-

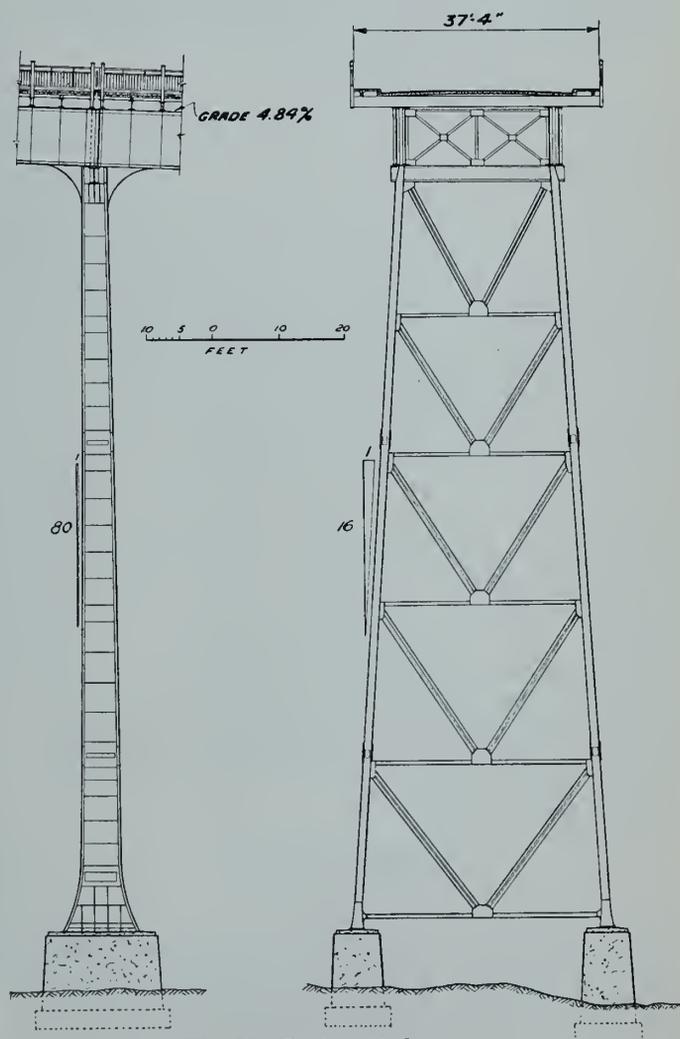


Fig. 50—Typical viaduct-bent.

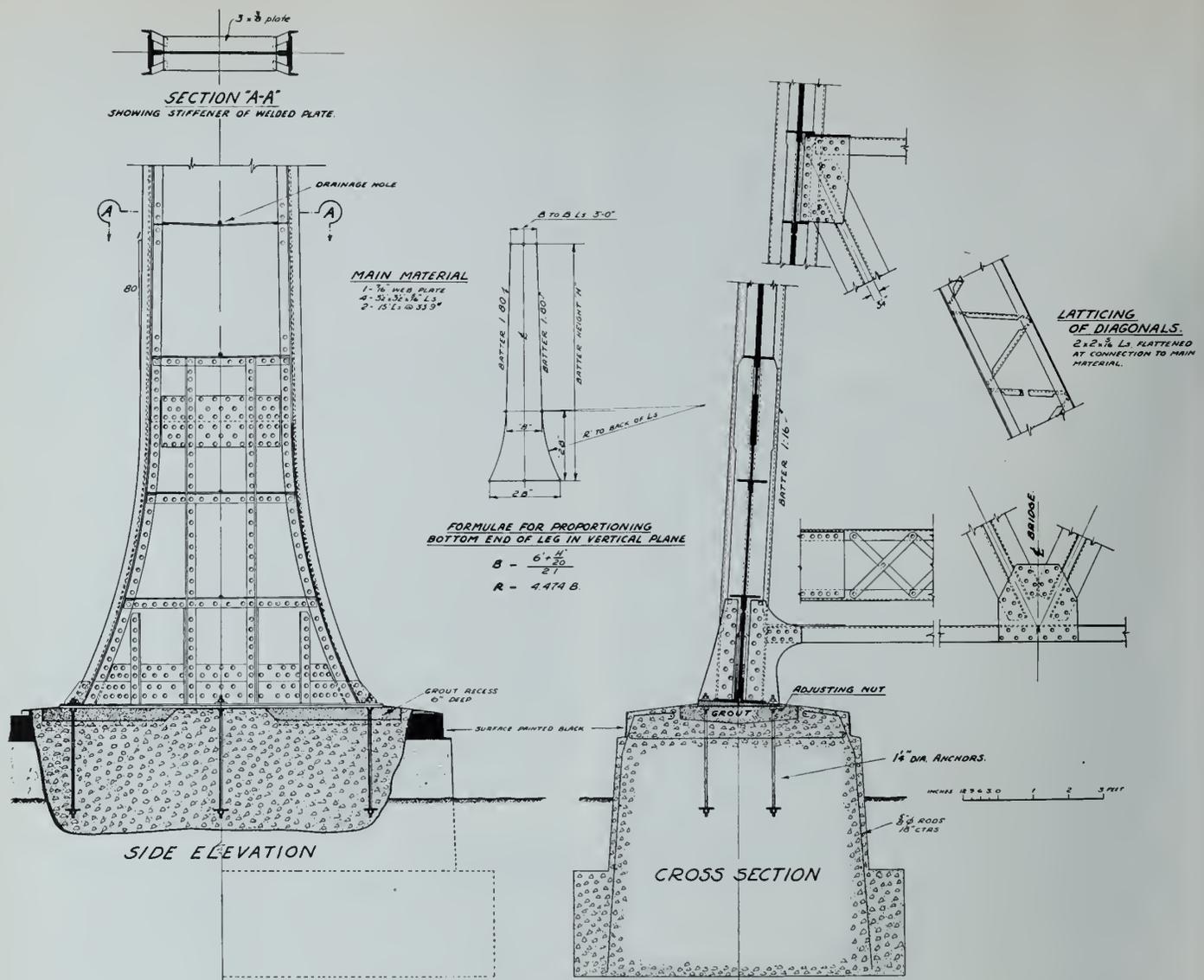


Fig. 51—Detail of viaduct-bent and pedestal.

lar, part of which fits tightly to the profile of the compacted cable, and the remainder of which is shaped to lead the strands into their radial positions without abrupt changes in alignment. Each of the four splay-collars consists of two steel castings 2 ft. 6 in. long, bolted together onto the cable with eight 2-in. high-tensile-steel bolts. The castings are 2 in. thick, and the weight of each assembled pair is 900 lb. The splay-collars are located in open chambers inside the anchor-piers, so that they, together with the splayed strands and socket-assembly, are always accessible for inspection. The wrapping of the cable commences at the smaller end of the collar, which is counterbored for its reception.

Fig. 48 shows the flexible copper flashing at the egress of the wrapped cable from the anchor-pier. The entrance of moisture into the piers is prevented by watertight connection of the tubular flashing to a cast-iron collar on the cable and to an "eyelet-casting" built into the wall.

The cable-anchorage were fabricated by Dominion Bridge Company in Lachine.

## NORTH VIADUCT

### DESCRIPTION

For this portion of the bridge, the relative merits of reinforced concrete, of structural steelwork, and of the combination of steel spans with concrete towers, were carefully weighed by the engineers, with the result that unhesitating decision was made in favour of an all-steel via-

duct. From the point of view of propriety it was evident that the steelwork-design, with its slender support-bents repeating in a diminishing series the general motif of main tower and cable-bent, would minimize rather than accentuate the unavoidable disparity (dictated by the profile of First Narrows) in appearance of the two ends of the bridge. From the standpoint of strength and permanence it was argued that, notwithstanding the need for careful maintenance of the paintwork, the precision and certainty with which steelwork could be designed and fabricated outweighed the advantages claimed for concrete. And in the matter of economy it was definitely demonstrated that for this structure the cost of concrete-work would be considerably greater than that of steelwork, a liberal allowance for the regular maintenance of the latter being included in the comparative figures.

Consisting of 25 deck-plate-girder spans, the north viaduct, 2196 ft. 6 in. long between centres of end-bearings, is shown in elevation in Fig. 49. There are expansion details at either end and also at the tops of bents Nos. 5, 9, 13, and 19; so that the structure really consists of five distinct self-supporting groups of connected bents. The four southerly of these units derive their stability each from a stiff tower formed by the bracing together of two adjacent bents, while, for the most northerly group, reliance is placed on the stiffness of the relatively short and sturdy bents that sustain it. Throughout the viaduct, the girders are simply-supported, and the columns are rigidly fixed at their bases.

In order to give satisfactory proportions to the structure, the lengths of the spans increase as the roadway rises, logical exceptions to this rule, however, being the shorter girders of the four tower-spans. Apart from these, the span-lengths thus vary from 81 ft. 6 in. at the lower end of the viaduct to 123 ft. at the higher end. Two depths of girder are employed, the 15 lower spans being 7 ft. deep and the remainder 9 ft. deep. The lateral spacing of the girders in alternate spans is respectively 22 ft. and 25 ft. 11 in., so that the bearings rest side-by-side on the supporting bents and deliver their vertical reactions without eccentricity. A third spacing, of 24 ft. 8 in., is used for the short tower-spans.

The 24 bents which, together with the cable-bent, carry the viaduct are each composed of two inclined plate-girder columns, battered at 1 in 16 and separated by K-bracing and also by a stout top strut that supports the span-bearings. The columns themselves are uniform in appearance and, as far as possible, in actual detail. Each is 3 ft. wide at the top and increases (with side-slopes of 1 in 80) regularly towards the base, where it is flared out for æsthetic reasons as well as to provide adequate bearing upon the concrete pedestal. At the top of each column, the otherwise crude appearance of its conjunction with the adjacent girders is masked by a pair of quadrant-shaped knee-brace plates, which are connected only to the column and which do not carry any stress. The general appear-

ance of the bents is shown by the two elevations given in Fig. 50, and typical details, together with the formula chosen for the basal flare of the columns, are shown in Fig. 51. The cross-section of each column comprises a single  $\frac{7}{16}$ -in. web-plate, with flanges made up of two small angles and a channel, the latter facing outwards. The flange-channels are 15-in. standard American sections except in the cases of the two longest and most heavily-loaded bents, where 18-in. channels are employed. Four of the shorter columns are further reinforced for bending by the addition of flange cover-plates. Stiffeners at the more important parts of the columns are of riveted angles, but the majority consist of flat plates welded to the web and to the flanges. These flats are dished for drainage, and the rainwater from the outer flat spills through a half-round hole cut through the web plate. Each column (except in the case of the shortest bent, where  $1\frac{3}{4}$ -in. bolts are required) is anchored to its pedestal by six  $1\frac{1}{4}$ -in. anchor-bolts.

The majority of the horizontal cross-struts of the bents consist each of a pair of angles connected by a system of single-latticing. For the bottom struts of the heavier columns, and for the diagonal members throughout, a 4-angle section is employed, latticed by a single 2 by 2 by  $\frac{5}{16}$  angle bent into a 60 deg. zig-zag (Fig. 51). This angle, flattened at the bends, is welded to the main angles, which are spaced  $3\frac{1}{4}$  in. back to back. This type of lacing offers the economy deriving from a comparatively large radius of gyration, and has the advantage of easy access for painting: there are no water-pockets.

The plate-girders are of ordinary design, with lateral (lower-flange) and vertical bracing of single-angle sections. As for the columns, intermediate stiffeners consist of welded plates: these bear against the upper flanges only.

The viaduct-deck is supported by transverse beams at 4-ft. 6-in. centres, riveted to the top flanges of the girders and cantilevered beyond them. The cross-beams are 21-in. "CB" sections, and are alternately 30 ft.  $4\frac{1}{2}$  in. and 37 ft.  $3\frac{1}{2}$  in. in length, the shorter ones supporting the roadway-slab and kerbs only, and the longer ones continuing far enough to carry the concrete sidewalk-stringer, the fence, and the lamp-standards. It was found convenient and practicable to employ only two weights of cross-beam, those athwart

the narrow-spaced girders being 59-lb. beams, and the remainder 73-lb. Rivets throughout are  $\frac{7}{8}$ -in. Typical sections of girders and deck are shown in Fig. 52.

The roadway-slab is 7 in. thick, reinforced with  $\frac{5}{8}$ -in. deformed bars. It is haunched over each cross-beam, bond being insured by long bolts passing through the beam-flanges and extending well into the slab. The original intention had been to bulldoze the crossbeams to the road-camber, thus dispensing with the haunching, but upon the insistence of the contractor the engineers finally acceded to his request for permission to use straight beams. The sidewalk-slab is 4-in. thick, reinforced with "Truscon" mesh, and is supported by the 10-in. integral kerb (pierced at  $4\frac{1}{2}$ -ft. intervals by open drain-holes 4 in. deep and  $3\frac{1}{2}$  ft. long), by an integral reinforced beam which rests on and is anchored to the longer cross-beams, and by transverse walls also carried on the beams.

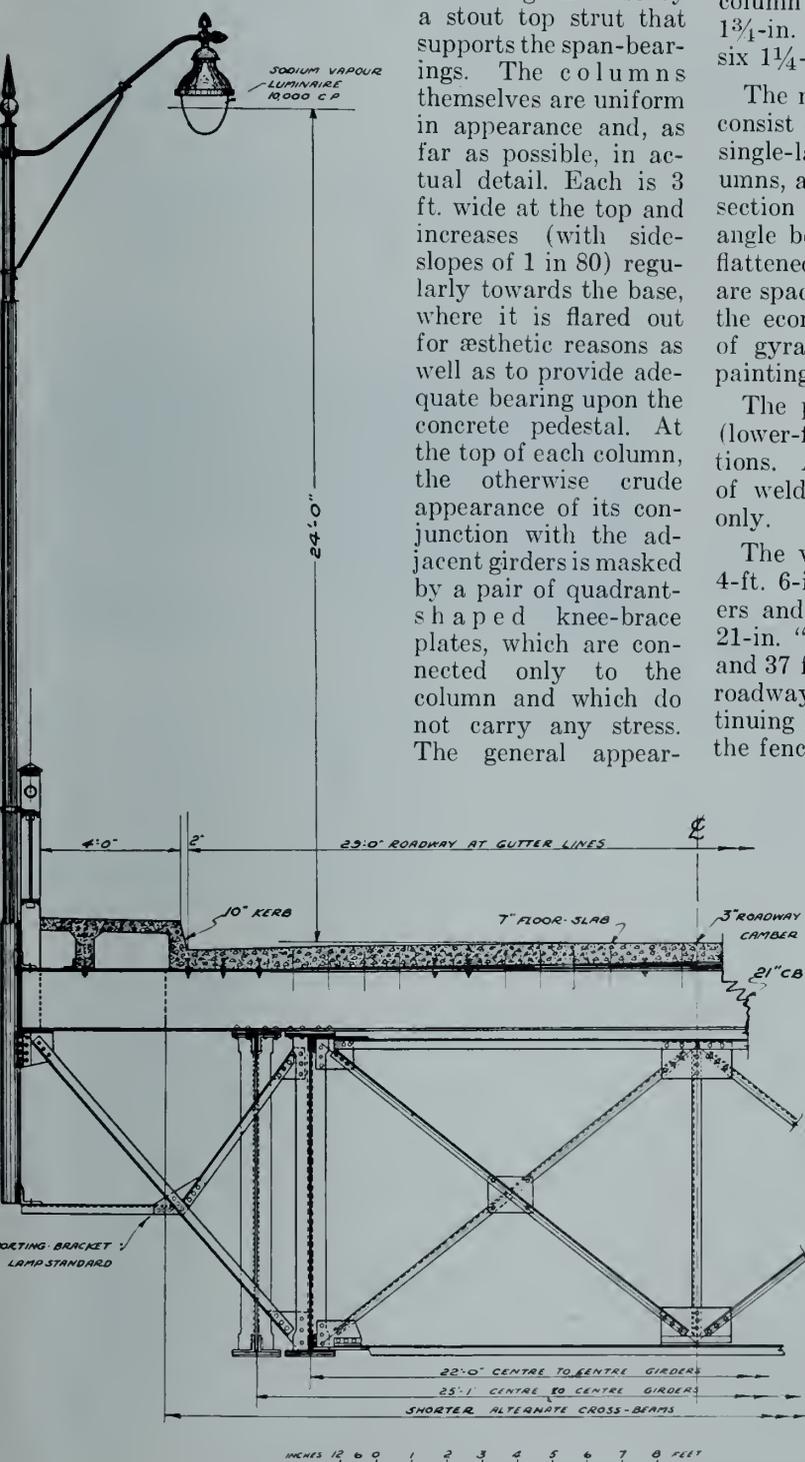
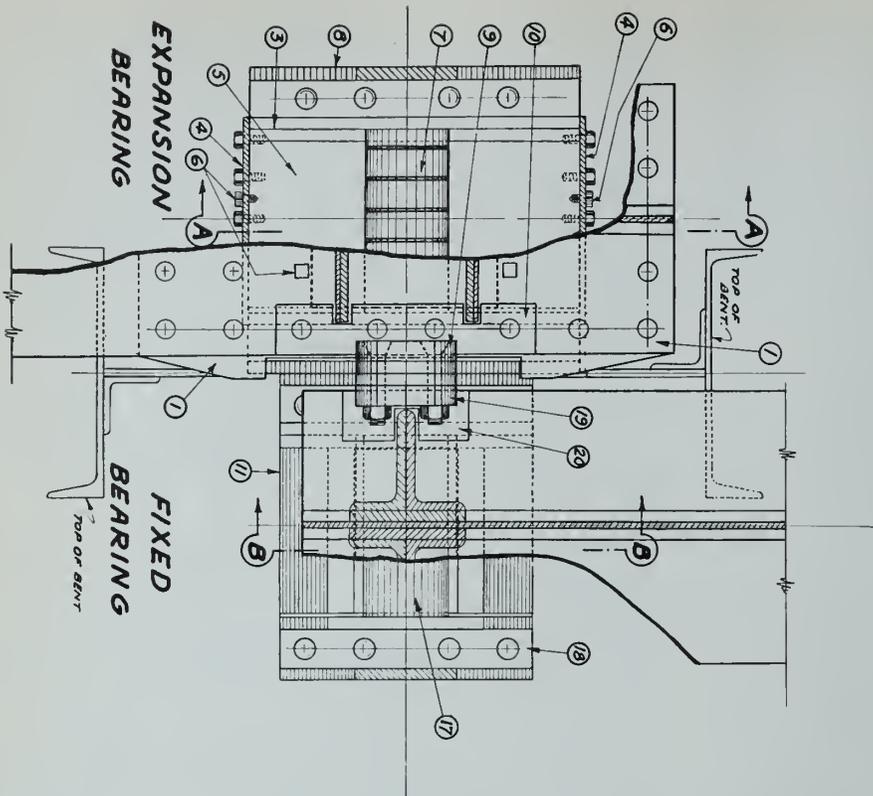
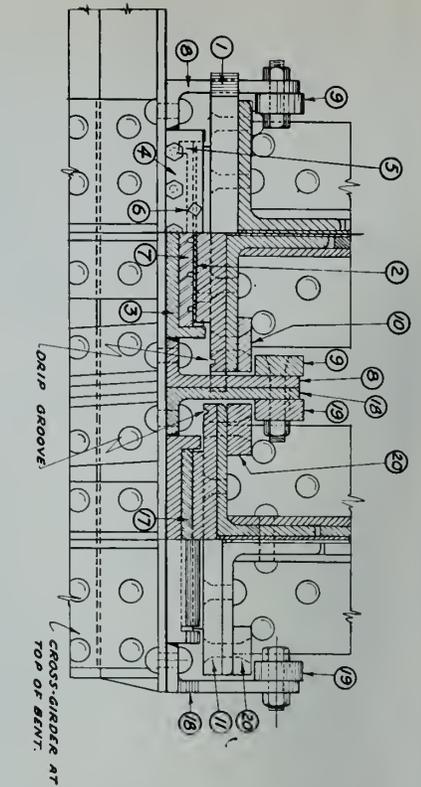


Fig. 52—Cross-section of viaduct.



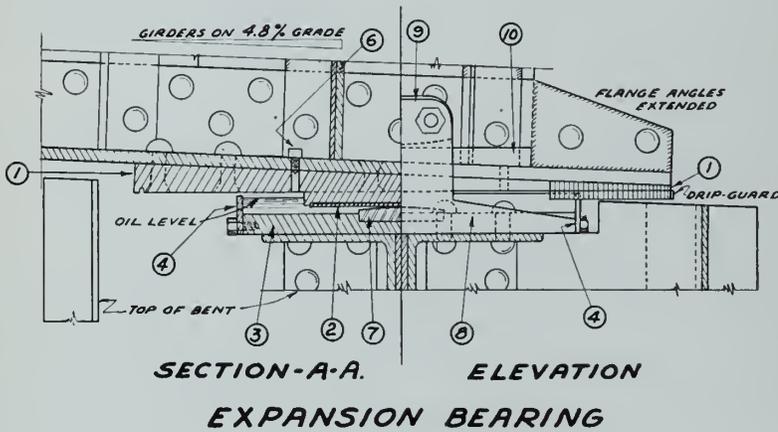
ELEVATION - SECTION AT CENTRE - ELEVATION



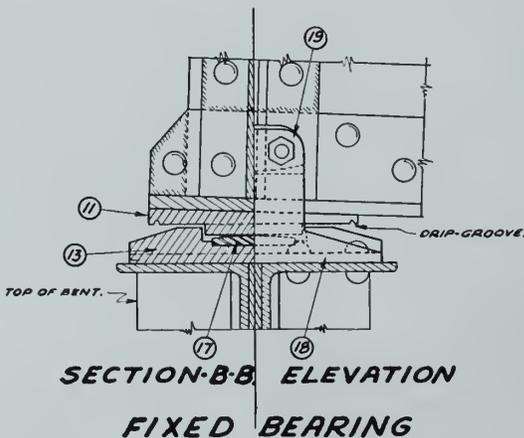
- EXPANSION BEARING**
- ① SHOE-PLATE, BEVELLED TO PROVIDE HORIZONTAL SLIDING-SURFACE AND RIVETTED TO FLANGE OF GIRDER. NOTE LATERAL PROJECTIONS WHICH LIMIT EXTENT OF SLIDING.
  - ② SAW-STEEL PLATE, RIVETTED INTO SHALLOW RECESS IN PROJECTION ON UNDERSIDE OF SHOE-PLATE.
  - ③ BED-PLATE (RESTING ON TOP OF BENT), MACHINED TO SHALLOW U-SHAPED, AND WITH CENTRAL RECESS.
  - ④ END-PLATES, BOLTED TO BED-PLATE TO FORM OIL-BATH.
  - ⑤ OIL-BATH.
  - ⑥ FILLING AND DRAINING PLUGS FOR OIL.
  - ⑦ BEARING-PLATE (.45% C), MACHINED TO 20" RADIUS AND WITH OIL-GROOVES, SET INTO RECESS IN BED-PLATE.
  - ⑧ ANGLE, WELDED TO BED-PLATE AND PROVIDING RIVETTED CONNECTION FOR SAME, AND SHAPED TO FUNCTION AS A "STOP"-ENGAGING WITH PROJECTIONS ON ①.
  - ⑨ LOCKING-PLATE BOLTED TO ⑧, PREVENTING VERTICAL MOVEMENT. BEVELLED PLATE RIVETTED TO FLANGE, MAKING HORIZONTAL SURFACE TO ENGAGE WITH ⑧.

- FIXED BEARING**
- ⑪ BEVELLED SHOE-PLATE, RIVETTED TO FLANGE OF GIRDER. BEARING OCCURS DIRECTLY UPON PROJECTION ON UNDERSIDE.
  - ⑬ BED-PLATE, SIMILAR TO ③, BUT WITHOUT OIL-BATH. SLIDING PREVENTED BY ENGAGEMENT OF PROJECTIONS ON ⑪ AND ⑬.
  - ⑭ BEARING-PLATE AS ⑦, BUT WITHOUT OIL-GROOVES.
  - ⑮ ANGLE AS ⑧, BUT NOT OPERATING AS LONGITUDINAL "STOP".
  - ⑯ LOCKING-PLATE AS ⑨.
  - ⑰ BEVELLED PLATE AS ⑨.

INCHES 2 3 4 5 6 7 8 9 10 11 12  
1 FEET



SECTION-A-A ELEVATION  
EXPANSION BEARING



SECTION-B-B ELEVATION  
FIXED BEARING

Fig. 53—Bearings for viaduct-girders.

The fence (Fig. 54) is fabricated in panels 8 ft. 6 in. long. The posts are  $6\frac{7}{8}$  in. square, welded from  $\frac{3}{16}$ -in. plate, and crowned with welded cast-iron caps. Two horizontal 6-in. channel-rails support 1-in. square pickets at 4-in. intervals, and the fence is finished off with a 4-in. pipe-rail at the top, the overall height being 3 ft. 9 in. The fence-sections are bolted to lugs on the posts, but the fence is otherwise of welded construction.

Expansion-joints are provided in the deck-slab at the expansion-ends of the girders. The pavement at each joint is supported over the variable gap by a  $1\frac{1}{4}$ -in. plate tapered so that its lower surface is horizontal, the upper surface being on the grade. This plate, like the channel on whose horizontal back it slides, is connected to the end cross-beam; and exposed portions of the supporting-brackets are treated with "Oxoseal" protective metallic coating. The expansion-plate is separated by a  $\frac{1}{2}$ -in. space from the end of the concrete, the latter terminating in a 3 by  $1\frac{1}{2}$  steel bar which is also attached to the end cross-beam. The purpose of that  $\frac{1}{2}$ -in. gap, which is on the upgrade side of the joint, is to protect the moving parts from road-debris. Half-inch deflection-breaks are provided at all the remaining junctions of spans and also at intermediate points of the longer girders. At each deflection-joint the slab on either side terminates in a 3 by  $1\frac{1}{2}$  steel bar which is attached to the appropriate crossbeam



Fig. 54—Viaduct fence.

and against which the slab is poured. The sidewalks have similar provision for expansion and deflection.

To facilitate inspection below the deck of the viaduct, manholes in the sidewalks are provided at frequent intervals. These are 2 ft. square, bounded by angle-kerbs and equipped with light chequered-plated hinged covers with locks. From each hole a short ladder gives access to a light platform at the lower flange of the girder.

#### VIADUCT: DESIGN

The live loading adopted for the viaduct is that due to a reasonable arrangement of automobiles, with heavy trucks interspersed, and is expressed by the following arbitrary formula:

$$29w = \frac{1200(L + 160)}{L}$$

where  $w$  is the equivalent uniform live load, including impact, in lb. per sq. ft. of roadway surface, and  $L$  is the span-length. The sidewalk unit was taken as  $\frac{w}{3}$  lb. per sq. ft. Members loaded locally were designed to carry 20-ton trucks (C.E.S.A.) together with 100 lb. per sq. ft. on the sidewalks.

The lateral loading specified was 200 lb. per lin. ft. applied 6 ft. above the roadway to represent wind on the live load, together with 30 lb. per sq. ft. on the vertical projection of floor and girders, and on twice the vertical projection of the bents. An alternative of 50 lb. per sq. ft. on the unoccupied structure was also specified. Long-

itudinal forces were represented by a horizontal load of 5,100 lb., applicable to either side of any unit of the viaduct. This load represents the force required to bring an arbitrary combination of two heavy trucks and four automobiles travelling at about 30 m.p.h. downgrade along two adjacent roadway-lanes, to rest in two seconds.

For the viaduct-bents, an exact analysis was made of the effects of temperature and traction-forces, the movements of the tops of the bents of each group depending upon the elastic properties of every one. Trial column-sections (corrected later) were first set up, and the deflection-curves for unit horizontal load at the top were computed for each bent and each tower.

Equations for each group were then established to express the simultaneous facts that the tops of the bents must remain at definite distances apart (depending on the temperature) and that the sum of the deflecting forces must be equal to the applied traction-load, and from these equations emerged the movements of the bents required to fulfil the conditions. Further analysis took into account the small resulting eccentricities of the vertical loads consequent on the deflections of the bents; and equations were written to determine the additional deflection of all the bents, and the force evoked in each by such eccentricity.

The material specified for the north viaduct was C.E.S.A. medium steel, with permissible unit stresses as follows:

Tension: 20,000 lb. per sq. in.

Compression (axial):  $\frac{20}{18}(17,000 - 60\frac{l}{r})$  lb. per sq. in.

Compression (bending):  $\frac{20}{18}(18,000 - 170\frac{l}{r})$  lb. per sq. in.

For combinations of axial and flexural stress, a formula similar to that subsequently adopted in the C.E.S.A. specification S6-1938 was employed.

#### VIADUCT: FABRICATION

The viaduct, except for the fence-posts, which were made by Hamilton Bridge Company in Hamilton, was fabricated by Western Bridge Company. The main difficulty encountered was that of controlling distortions of the deep girder-webs during the welding of the plate-stiffeners, and it is the opinion of the fabricator that better results would have been achieved by the use of riveted angle-stiffeners.

A further disadvantage of the welded stiffeners (both on the girders and on the columns) is due to the practical impossibility of maintaining full contact between stiffener and web-plate in the intervals between welds. The small openings are inaccessible for painting, and there is consequently a tendency to rusting, with unsightly stains of the field-paint in the vicinity of such spots.

In the course of fabrication it was discovered that many of the heavy flange-angles (8 by 6 by  $\frac{1}{16}$ ) were rolled with the angle somewhat less than 90 deg. Many of the girders were shipped with the angles so distorted, and it became necessary to introduce tapered shims under the cross-beams before riveting in order to ensure proper bearing and to prevent the occurrence of rust-pockets.

#### BEARINGS OF VIADUCT-GIRDERS

The side-by-side arrangement of girder-bearings—a typical case comprising both a fixed and a sliding end—on the tops of the bents is shown in Fig. 53. This figure is largely self-explanatory, but attention may be drawn to some of the details. Anchor-bolts are not employed, so that the common troubles due to rusting and overtightening of such bolts (working in slotted holes) are avoided. Any tendency towards uplift is controlled by the locking-plates (9 and 19) which in the event of vertical movement will

bear on the horizontal upper surfaces of plates 10 and 20.

The lower bearing-plates (7 and 17) are of high-carbon steel, and their upper surfaces are machined to a 20-in. cylindrical radius. The upper bearing-plates (2 and 11; a saw-steel inset being used for the sliding bearing) are wedge-shaped so that their undersides are horizontal. Girder-deflections are accommodated by insignificant adjustments in the positions of the lines of bearing between the curved lower plates and the flat upper ones.

Longitudinal movement at the fixed ends is confined to the small play afforded by the  $\frac{1}{8}$ -inch clearance between the lower projection of the shoe-plate (11) and the machined recess of the bed-plate (13), the latter being rivetted to the top strut of the bent. Expansion-movements are limited in extent by the engagement of the vertical stop-

angles (8) with lateral lugs forming part of the sliding shoe-plate (1). The greatest range of movement, occurring at the top of bent no. 5, is  $8\frac{3}{16}$  in. Lateral girder-movements are controlled by the upstanding sides of the bed-plates (3 and 13), these side-walls coming into contact, when need arises, with the sides of the projecting parts of the shoe-plates (1 and 11).

A further feature of interest is the provision of an enclosed oil-bath for each sliding bearing, the lower bearing-surface (7) having  $\frac{3}{8}$ -in. grooves to facilitate circulation of the lubricant when movements take place. Screw-plugs for filling and drainage (6) are provided, and precautions are taken to prevent direct ingress of water, dripping from the shoe-plate. A heavy "summer" grade of track oil was used for filling the oil-baths.

EDITOR'S NOTE:—The concluding part of this paper which deals with the erection of the superstructure will appear in the July issue of the *Journal*.

## DISCUSSION ON RATIONAL COLUMN ANALYSIS

Paper by J. A. Van den Broek<sup>1</sup>, published in *The Engineering Journal*, December, 1941, and presented before the General Professional Meeting of The Engineering Institute of Canada, at Montreal, Que., on February 6th, 1942.

DR. FRIEDRICH BLEICH<sup>2</sup>

Almost all papers concerning the design of columns in the last half century considered the problem of buckling as one of stability in which the relationship between load and stress is never linear. Engesser and von Kármán developed the theory of unelastic buckling based upon the actual stress-strain diagram of structural steel. They demonstrated that the analysis of elastic stability also held true in principle in the case of unelastic buckling. Tests made by Kármán (1910), Roš and Brunner (1926) showed the effect of the eccentricity of the load on the carrying capacity of the columns. But the various factors involved in a design of structural steel columns subjected to an eccentric axial load or to a transversal load complicates the investigation. Several attempts to develop rational design formulae were made in order to simplify the computations. The analysis presented by the author defines the maximum load the column can carry as that load producing a stress in the most compressed extreme fibre equal to the yield point. It will be interesting to consider this criterion in the light of the results of exact investigations concerning the behaviour of columns of structural steel loaded by an eccentric axial force.

The load-deflection diagram of a medium long column eccentrically loaded is shown in Fig. 27<sup>3</sup>. At any value of the stress  $S = \frac{P}{A}$  there is a deflection  $y$  due to the moment  $Pe$ , first increasing slowly and then rapidly as  $S$  approaches the maximum value  $S_{cr}$ . The equilibrium between internal and external forces becomes unstable when  $S$  reaches the critical value  $S_{cr}$  because in this state of loading the deflection further increases even when the average pressure  $\frac{P}{A}$  decreases. It should be noted that two values of the deflection  $y$  belong to every value of  $S$  below  $S_{cr}$ . The equilibrium is stable in the case of the smaller value of  $y$  and unstable in the other case.

<sup>1</sup>Professor of engineering mechanics, University of Michigan, Ann Arbor, Mich.

<sup>2</sup>Detroit, Mich.

<sup>3</sup>Th. von Kármán, Untersuchungen über Knickfestigkeit. Forschungsarbeiten, 1911.

The maximum of  $\sigma_{cr} = \frac{P_{cr}}{A}$  belongs to a state of stress, in which a bounded area of yielding arises in the most compressed edge in that region of the column where maximum stresses during buckling occur. This area of yielding extends more or less deeply into the interior of the column. (Fig. 28a). It is evident that a load  $P'_{cr}$  producing a maximum fibre stress equal to the yield point, (Fig. 28b) is less than  $P_{cr}$  and therefore  $S'_{cr} = \frac{P'_{cr}}{A}$  represents a lower limit of  $S_{cr}$ . The difference  $S_{cr} - S'_{cr}$  depends on the shape of the cross section of the column. It is very small for a I-section bent in the direction of the web and bigger for a + - section. For the most frequently used I-section the difference is only a small percentage. The computation of the load  $\mu P$  ( $\mu$  = factor of safety) producing the yield point stress in the most compressed fibre is a simple method of determining the carrying capacity of a column subjected to bending moments with a

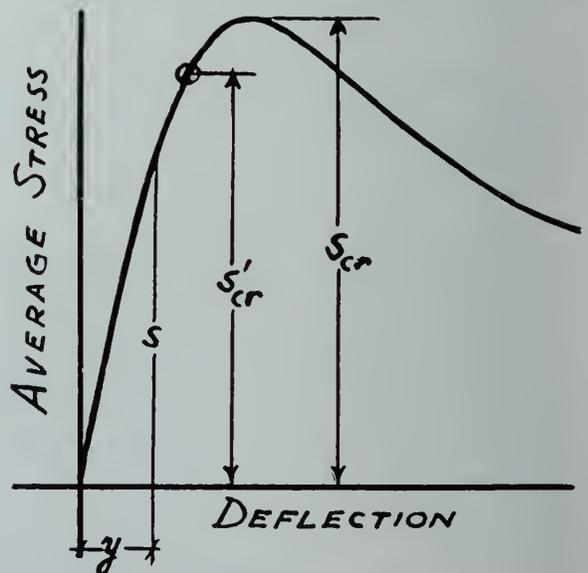


Fig. 27.

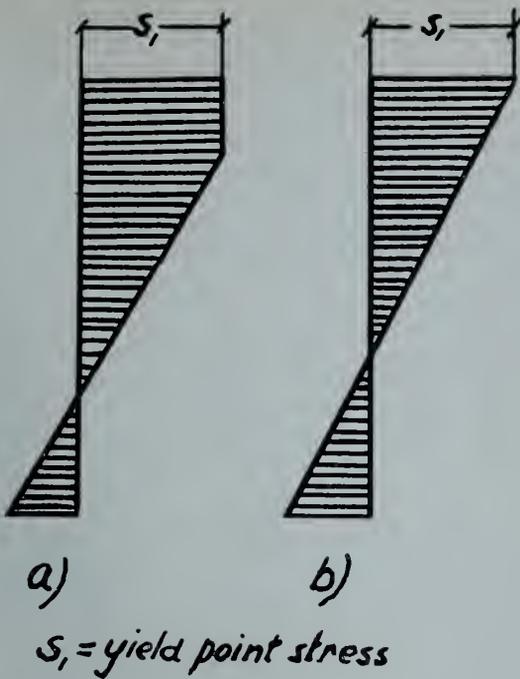


Fig. 28.

sufficient degree of accuracy and with a small surplus of safety.

As far as is known to the writer, it was Müller-Breslau who initiated 30 years ago the same criterion determining the stability of eccentrically loaded columns and of those with initial curvature. It must be emphasized that this criterion can be applied to all problems of stability. For instance, in a recent paper on the Stability of Arch Ribs which will be issued in the near future, the writer applies the condition: maximum fibre stress = yield point stress to determine the critical load of the arch rib which produces buckling.

The writer agrees in all points with the author's considerations of the question of initial crookedness. The suggestion of the author to make the analysis fit ordinary practice conditions by proper selection of the length reduction factor  $n$  deserves serious attention. It is not difficult to determine the value of  $n$  for the conditions of end restraint as found in the common practice of steel structures by theoretical investigations and to verify the results by tests<sup>4</sup>

DR. HANS BLEICH<sup>5</sup>

The author has made a successful attempt to explain the essential facts of the theory of columns in a simple manner. These facts are, unfortunately, not yet generally known and appreciated. His paper will help greatly to improve this state of affairs.

The example of the frame, shown in Fig. 12 of the paper, is very instructive and the writer would like to demonstrate, using the same example, what he considers another important aspect.

In the said example the side legs have been assumed straight; let us now assume these legs to be initially curved in the shape of a sine curve  $x_0 = e_0 \sin \frac{\pi y}{l}$ .

One would expect that the reduction in carrying capacity due to this initial curvature should be approximately as shown in Fig. 3. It is obvious that one should not introduce the ratio  $l/i$  of the actual slenderness but the ratio  $L/i$  of the effective slenderness.

Table II contains the capacity loads  $P$  for several values  $l/i$ , the corresponding values  $L/i$ , and the reductions  $\Delta P$

<sup>4</sup>See the writer's book: *Theorie und Berechnung der eisernen Brücken*, 1924.

<sup>5</sup>Birmingham, England.

due to a curvature  $\frac{e_0 c}{i^2} = 1$  calculated in the manner indicated above.

TABLE II

$l/i =$	60	100	150	200
$P =$	97T	102T	97T	80T
$L/i =$	106	103	106	117
$\Delta P =$	50%	51%	50%	43%

The use of Fig. 3 in connection with the example in the paper is not quite correct, because unfortunately different values for  $E$  have been used. The last line in Table II shows, however, the percentage reduction and the influence of the change in  $E$  on this percentage can only be very small.

In order to see if this simple procedure is justified the writer has made an exact calculation for the same problem.

Using the same notations as the paper the differential equation for the deflection  $x$  of the column is

$$EI \frac{d^4 x}{dy^4} + P \left( \frac{d^2 x}{dy^2} + \frac{d^2 x_0}{dy^2} \right) = 0.$$

The boundary conditions are  $x=0$  and  $M = -EI \frac{d^2 x}{dy^2} = eP$  at both ends,  $x=0$  and  $x=l$ .

This differential equation can be solved easily and the values of the angle  $\phi_2$  and of the stress  $s_1$  can be determined. The results are

$$\left. \begin{aligned} \phi_2 &= e \sqrt{\frac{P}{EI}} \tan \frac{l}{2} \sqrt{\frac{P}{EI}} + \frac{\pi}{l} e_0 \frac{P}{P_E - P} \\ s_1 &= \frac{P}{A} \left( I + \frac{ec}{i^2} \sec \frac{l}{2} \sqrt{\frac{P}{EI}} + \frac{e_0 c P_E}{i^2 (P_E - P)} \right) \end{aligned} \right\} \quad (A)$$

$P_E$  is the Euler load  $P_E = \frac{\pi^2 EI}{l^2}$ .

Compared with the original formulae for  $\phi_2$  and  $s_1$  equations (A) each contain an additional member depending on  $e_0$ .

Finally two equations for  $e$  are obtained,

$$e = \frac{\frac{w_l I^3}{24 EI_1} - \frac{\pi}{l} \frac{e_0 P}{P_E - P}}{\frac{Pl_1}{2 EI_1} + \sqrt{\frac{P}{EI}} \tan \frac{l}{2} \sqrt{\frac{P}{EI}}}, \quad e = \frac{A s_1 - P - \frac{P}{P_E - P} \frac{e_0 c}{i^2} P_E}{\frac{c}{i^2} P \sec \frac{l}{2} \sqrt{\frac{P}{EI}}}, \quad (B)$$

The two equations (B) can be solved by trial and error. The numerical result is shown in Table III.

TABLE III

$l/i =$	60	100	150	200
Frame $e_0 = 0, P =$	97T	102T	97T	80T
Frame $e_0 = 0,6'', P =$	82, 5T	78T	70T	60T
Reduction $\Delta P =$	15%	23%	28%	25%

The reductions shown in Table III are much smaller than those in Table II. The assumption that the influence of an initial curvature on a strut hinged on both ends and on a strut forming part of a structure is equal is not justified.

This is rather an important conclusion because it shows that all formulae based on calculations for two-hinged columns tend to overestimate considerably the influence of initial curvature on actual structures.

The writer cannot suggest a reasonably simple solution for this or similar problems and thinks that there is scope for further investigations as the application of formula (B) in practical design is out of the question.

The majority of engineers use column formulae without any understanding of the questions involved and the specifications, although made by experts, are obsolete. I particularly appreciate the impressive explanation that eccentricities can only be determined after the buckling problem has been solved and that therefore the usual formulae for the carrying capacity of columns under eccentric loads are valueless.

The chapter on elastic deformations of columns under critical load had been of much interest to me because of its applications on the theory of limit design. I should like to see these investigations extended to shorter columns  $l/r=40$  to 100; theoretical values in this area are difficult to obtain and probably not very reliable.

H. J. DURANT<sup>6</sup>

Probably no problem in science has engaged the attention of so many eminent men as the mathematical analysis of struts. The problem was thoroughly analysed nearly two hundred years ago by the famous mathematician Euler, and succeeding analyses are variations of the analysis of that great man.

Engineers need data on the magnitude of the end moments, initial curvatures, eccentricities of end thrusts, and the effect of the shape of the cross sections of members in frames. The author appreciates this.

Such necessary and sufficient data can be obtained only from experiments on the prototype or from experiments on dynamically similar models, because most analysis on struts are based on the assumptions that the struts are prismatic, isotropic, and the amplitudes small.

The writer considers the value of the paper would have been increased by a more general approach. A writer on engineering science now need have no fear that his analysis will be beyond the readers' mathematical attainments.

The formulae in the paper are derivable from a single differential equation, and all that is necessary to obtain a particular formula is to put zero for all unwanted quantities in the particular integral.

The author has assumed equal end moments producing single curvature, but most members in a bridge truss are subjected to moments unequal in magnitude and sign.

A further generalisation would be effected if the moment of inertia were assumed to vary according to some law. In this case, however, the problem could only be solved by means of Bessel Functions.

The author states: ". . . the secant formula is perfect, it is beautiful, yet the formula is futile." Formula 2 is given as an approximation to it.

The secant formula for the design of struts in structural steel of a 23 ton yield stress has been in use by the Government of India for about ten years, and the same formula, with changes in the parameters for mild steel, for a shorter time.

The phenomenon of shear which is important in struts of non-prismatic form, especially in built-up members, has not been dealt with in the paper.

C. M. GOODRICH,<sup>7</sup> M.E.I.C.

Professor Van den Broek's paper "Rational Column Analysis" appears to deserve its title. It gives us the engineer's approach instead of the mathematician's; the philosophy of the problem, the common sense of it, is given rather fully; the new proof of the secant formula makes this formula seem more reasonable, even if this formula is a criterion rather than a working tool for the profession; the final formulae for columns are units instead of the trichotomy, the three dissimilar formulae stuck together at arbitrary joints, usual for the three column phases—philosophically silly even if practically useful—and give us

<sup>6</sup>Senior engineer, Rendel, Palmer and Tritton, London, England.

<sup>7</sup>Consulting Engineer, Canadian Bridge Company, Limited, Walkerville, Ont.

a smooth curve, instead of one with a hump in it. They are excellently well adapted to use in limit design; they indicate the feasibility of reforming the expression factor of safety, of making it mean something definitely useful.

Further, the formulae include the effect of cross bending. In Trans. ASCE 1926, page 210 von Abo treats this problem in a most mathematical manner; the writer reduced it to two lines, and then was equally surprised and amused to be told by a friend that the same solution was made by Fidler sometime in the seventies. One wonders why the textbooks were not aware of it. Now the Van den Broek formula is better.

Note should be made of Professor Van den Broek's use of graphical integration. This tool includes Greene's Area Moment and Mohr's Elastic Weight Theorems, and proceeds to cover with equal simplicity (all things being relative) such matters as frames and arches. Perhaps some day one of our members who teaches elasticity will give the *Journal* a paper on the subject; no written discussion directly *ad hoc* is known to the writer outside of notebook sheets. Its speed and simplicity commend it greatly.

The experiments are the first since von Kármán's that fulfil theoretical requirements; and they not only fulfil these requirements more completely, but go well beyond those experiments as regards the data sought.

One incidental point of great practical importance may well be noted. In a long latticed column we have two ratios of slenderness, that of the column as a whole, and that of the piece between two stayed points. If the  $L/r$  of this piece is less than the  $L/r$  where the Van den Broek formula gives us the horizontal line in the diagram of Fig. 3, we need not consider any correction in the strength as figured from the  $L/r$  of the whole column, since in a normal column of such a character there is no eccentricity, so far as concerns the panel. Engesser treats long laced columns (see Mayer, *Knickfestigkeit* page 342) but his treatment merely shows that in all normal cases the designer is not interested therein; it fails to discuss what needs discussion. This gap is filled by the present paper in a manner as simple as it is satisfactory. Friedrich Bleich gives a solution in his *Theorie und Berechnung Eisernen Brücken*, but its derivation is formidable, and its application involves quite a bit of calculation. His analysis of battened columns with its resulting definite thumb rules for their spacing should be in all drafting room manuals. Dr. Bleich's work is by far the best book in its field that the writer has ever seen, taking up as it does a host of problems which other books in the field lightly omit.

In Fig. 16 the axial deformation curves suggest a field of inquiry in connection with the distribution of stresses in X-braced panels. Usually the shear is either taken as carried exclusively by the tension member, or as divided 50-50 between tension and compression diagonals. Nothing but simplicity recommends either practice, and in many cases simplicity and economy are incompatible. The method of limit design accents the need for considering the probable distribution.

E. C. HARTMANN<sup>8</sup>

The author has emphasized many points to which all structural engineers should give careful consideration. The writer was especially pleased with his treatment of the framed column and the excellent manner in which he has demonstrated that, depending on the relative proportions of members, the beam can partially fix the column or can cause it to fail at a lower load than if it were pin connected.

Dr. Van den Broek has treated his subject throughout strictly from the standpoint of solid members made from materials which have a definite yield point, such as structural steel. Many materials, particularly the aluminum alloys with which the aircraft designer deals principally, exhibit no definite yield point but have stress-strain curves which depart gradually from the modulus line. For such

<sup>8</sup>Research Engineer, Aluminum Company of America, New Kensington, Pa.

materials Dr. Van den Broek's concept of a definite limiting stress,  $s_1$ , is difficult to interpret.

Furthermore, the effective modulus of elasticity of the materials which have no definite yield point does not remain constant up to the limiting stress, but begins to decrease gradually before the material has reached its load-carrying capacity. Therefore, unless one is to ignore the extra load-carrying capacity of such materials above the strictly elastic range, one must take into account the concept of reduced or effective modulus of elasticity.

The concept of reduced modulus can readily be applied to structural steel and other materials which exhibit a definite yield point, simply by assuming the modulus of elasticity to be constant up to the yield point, beyond which it is considered to be reduced abruptly to an effective value of zero. This simple concept, when applied to the Euler column formula, gives the same column curve that the author arrives at in his Fig. 7.

#### MARSHALL HOLT<sup>9</sup>

The author is to be commended for his terse statement of "Objectives and Sense of Values." Certainly in problems where the principle of superposition does not apply, for example, in the field of long columns, the factor of safety should be applied to the ultimate load of the member rather than to the specified strength of the material.

The weakening effect of initial crookedness is shown in Figs. 3 and 4. Can one say this effect is insignificant for slender columns when for a slenderness ratio equal to 200 the average stress at failure is reduced from about 7,300 lb. per sq. in. for zero eccentricity to about 6,400 lb. per sq. in. for a ratio of length to eccentricity equal to 600? This decrease is only about 900 lb. per sq. in. but it is also about 12 per cent. For shorter columns the weakening effect is greater. The author concludes that these effects of initial crookedness should be covered by the factor of safety, whereas it is the writer's thought that the more the uncertainties are isolated and dealt with separately the greater and faster will be the advance in the art of structural analysis. Obviously such isolation of uncertainties leads to longer and more impressive-looking formulae, but it also gives the engineer some idea as to the relative importance of the various factors. It would then be left to his judgment which of the factors should be considered and the relative importance to be attached to each. After a table or curve of column strengths has been prepared, the work of the designer is no more complicated than it is when a simple column formula is used.

The writer agrees with the statement that when theory and practice are said to be in conflict there is a contradiction, but rather than showing a deficiency in the theory or its worthlessness the contradiction may show that the technician is misapplying the theory. Most of the mathematical theories in structural analysis are necessarily limited to rather simple structures. It is the duty of the stress analyst to use the theory that most nearly applies to his problem and if necessary make allowances for the differences in the structural behaviour assumed in the theory and that to be expected in the structure at hand. For example, it seems absurd that a designer should proportion the columns of a riveted structure only on the basis of the Euler formula for columns with round ends. The fact that the theory used does not agree with the behaviour of the structure is evidence, not of the worthlessness of the theory, but of its misapplication.

The testing of complete structures or units of structures would tend to make design procedures more or less empirical, and the testing procedures would be complicated with choosing the proper loading conditions. It is highly improbable that the loading condition and distribution of load selected for the test would be the controlling condition for every member in the test specimen. Thus duplicate speci-

<sup>9</sup>Research Engineer, Aluminum Company of America, New Kensington, Pa.

mens would be required for each loading condition. The loading conditions themselves would be subject to a great deal of compromise, especially if uniformly distributed horizontal forces should be encountered. Uncertain and unknown foundation conditions would still necessitate the exercise of considerable judgment on the part of the designer.

The flat portions of the curves of Figs. 16 and 17 are as might be expected from the theory of the elastica,<sup>10</sup> which deals with large deflections of purely elastic members. The analysis uses the exact expression for curvature, given by the author as the third expression following equation (a), and indicates a determinable lateral deflection after the Euler load has been reached. On the other hand, the Euler column formula for which the expression for the curvature is taken merely as the second derivative indicates an indeterminable deflection at the Euler load. These data are indeed interesting.

Whether or not the load-carrying capacity of a column is suddenly destroyed when the column buckles depends upon the conditions of loading. The data given in the paper show that the column is able to support some load after buckling, but the load-deformation curves shown in Figs. 16 and 17 are possible because the specimens were loaded in a screw-type machine that controls not the load on the specimen but only the over-all deformations. If column tests were made in a machine using dead weights as the loading medium, which approximates the conditions for pin-connected statically determinate structures, then when the column buckled the collapse would be complete. In some statically indeterminate structures the buckling of a compression member may merely cause a redistribution of stress in the other members with consequent large deformations but not complete collapse; however, in some cases the collapse would be complete.

The analysis of the columns of square bents is certainly a valuable contribution to the study of columns as parts of structures.

#### BRUCE JOHNSTON<sup>11</sup>

In a recent report<sup>12</sup> of the American Society of Civil Engineers Committee on "Design Of Structural Members," the following factors affecting the strength of a column were listed:

- (1) Non-linear shape of stress-strain relationship
- (2) Accidental imperfections
- (3) Known end eccentricity
- (4) Shape of cross-section
- (5) Torsional behaviour
- (6) Shearing deformation
- (7) Local buckling or crippling
- (8) Method of fabrication
- (9) Continuity of action in a frame

Professor Van den Broek discusses items (2), (3), and (9). The writer believes that the author is correct in ignoring item (1) in the case of structural steel, which usually has a very linear stress-strain relationship up to the yield point. The stress-strain relationship should be considered more carefully in the case of non-ferrous alloys, however.

Salmon's book on columns, to which the author refers, lists 375 references to previous analytical and experimental works on the subject of columns, and this book was published in 1920. It takes a whole book, indeed, to do the entire subject justice. Nevertheless, Professor Van den Broek approaches the subject with a refreshing viewpoint and touches on some important aspects of the problem, particularly in regard to the column acting as a part of a frame.

The writer agrees with and wishes to re-emphasize Professor Van den Broek's remarks near the bottom of page

<sup>10</sup>S. Timoshenko, "Theory of Elastic Stability," McGraw-Hill (1936), p. 74.

<sup>11</sup>Associate Director, Fritz Engineering Laboratory, Lehigh University, Bethlehem, Pennsylvania.

<sup>12</sup>Preliminary Progress Report, A.S.C.E. Committee on Design of Structural Members, presented at the Annual Meeting, January 22, 1942.

574, to the effect that column tests as made in a laboratory "fail effectively to simulate end conditions of restraints—such as are met in practice." Considerations of this sort led the American Institute of Steel Construction to approve and sponsor a programme of tests at Lehigh University in which columns will be tested as part of a frame. This programme has been unavoidably delayed for more than a year but is now getting under way.

In the analysis of the culvert problem illustrated in Fig. 12 the author's purpose is partly to show the relationship to the Euler column curve. When the problem is simply one of analysis for maximum stress, or eccentricity, the writer prefers to apply the principles of Hardy Cross' method of moment distribution which are so familiar to structural engineers. The moment distribution method as ordinarily encountered in structural frame analysis may be modified easily to include the effects of axial compression or tension. Lundquist<sup>13</sup> has used the method to determine critical buckling loads of frames and has prepared tables of moment distribution factors.<sup>14</sup>

The solution of the author's culvert problem is particularly simple by the moment distribution method because symmetry of the problem makes it unnecessary to use the carry-over part of the process. The reader familiar with moment-distribution will recall that the moment or rotational stiffness of a member at one end is equal to the moment required to produce unit angle change at that end. In application to the present problem, by symmetry, the angle change at the far end of each member is equal and opposite to the angle change at the near end. In this special case, the general relation between moment and angle change<sup>15</sup> at the end of a compressed member reduces to:

$$M = \phi \left[ \frac{2EI}{l} \left( \frac{l}{2} \sqrt{\frac{P}{EI}} \cot \frac{l}{2} \sqrt{\frac{P}{EI}} \right) \right]$$

Hence, by definition, the expression in brackets represents the modified column rotational stiffness in this special case. When  $P$  approaches zero, in the limit, the column stiffness becomes  $\frac{2EI}{l}$ . This may be recognized as one-half the rotational stiffness of a beam with far end fixed. By the moment distribution procedure the moment at the top of the column of any culvert loaded as shown in Fig. 12 is:

$$M_C = M_F \left[ \frac{K_C}{K_C + K_B} \right]$$

where

$M_C$  = moment at top or bottom of column

$M_F$  = fixed end moment in uniformly loaded beam =  $\frac{wl_1^2}{12}$

$$K_C = \text{column stiffness} = \frac{2EI}{l} \left[ \frac{\frac{l}{2} \sqrt{\frac{P}{EI}}}{\tan \frac{l}{2} \sqrt{\frac{P}{EI}}} \right]$$

$$K_B = \text{beam stiffness} = \frac{2EI_1}{l_1}$$

The equivalent eccentricity at the end of a column in the culvert is:

$$e = \frac{M_C}{P} = \frac{2M_C}{wl_1} = \frac{l_1}{6} \left[ \frac{1}{1 + \frac{K_B}{K_C} \left[ \frac{\tan \frac{l}{2} \sqrt{\frac{P}{EI}}}{\frac{l}{2} \sqrt{\frac{P}{EI}}} \right]} \right]$$

When the particular values in the author's solution are substituted in the foregoing formula the result checks exactly with the expression for  $e$  as given by the author.

The culvert problem discussed by the author is a special case of a similar illustrative example used by the writer in an unpublished memorandum<sup>16</sup>. Fig. 29, taken from this memorandum, shows graphically how the initial eccentricity

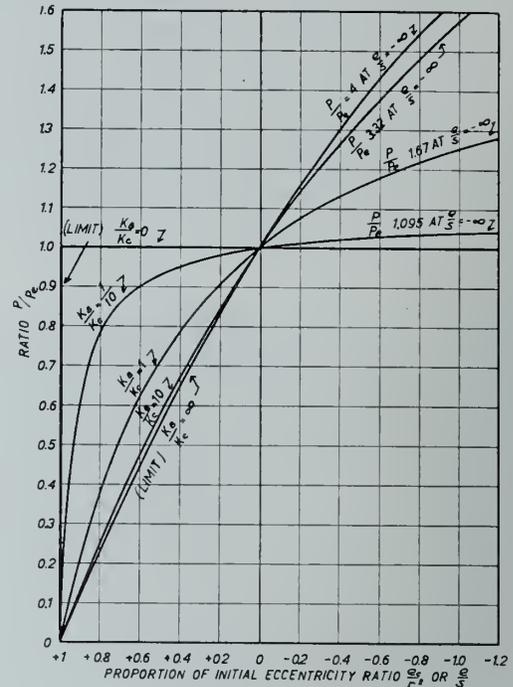


Fig. 29.

varies with increasing column load  $P$ , for various ratios of beam-to-column stiffness. In this example the column load  $P$  was considered to act independently. The equation plotted in Fig. 29, in this case, is:

$$e = \frac{M_C}{P} = \frac{wl_1^2}{12P} \left[ \frac{1}{1 + \frac{K_B}{K_C} \left[ \frac{\tan \frac{l}{2} \sqrt{\frac{P}{EI}}}{\frac{l}{2} \sqrt{\frac{P}{EI}}} \right]} \right]$$

The preceding reduces to the culvert problem when  $P = \frac{wl_1}{2}$ .

Figure 29 shows that in this particular problem, for all ratios of beam-to-column stiffness, the initial eccentricity is reduced to zero when the Euler load for a pin-ended column is reached. Above the Euler load the eccentricity is negative and increases rapidly until the column yields or until deflections are so large that the structure is useless. Theoretically, the pure buckling load is approached as an asymptote, as the eccentricity approaches  $-\infty$ , but it should be remembered that the theory is valid only for deflections that are small in comparison with the column length.

It is of interest to note that above the Euler load, when the eccentricity becomes negative, the rotational stiffness of the column also becomes negative. That is to say, that whereas at low loads it was necessary to apply a certain moment to produce unit angle change, it is now necessary to apply a holding moment of opposite sign to keep the column from buckling. This concept of stiffness is the key to the Lundquist<sup>13</sup> method for determining the buckling strength of a frame. The criterion for pure buckling is as follows: "When the summation of stiffness of the members entering a joint becomes equal to zero, the frame will buckle." This criterion applied to the writer's equation

<sup>16</sup>Memorandum on Steel Column Formulas and Tests, Fritz Engineering Laboratory, Lehigh University, January 28, 1941.

<sup>13</sup>"Principles Of Moment Distribution Applied To The Stability Of Structural Members," by Eugene E. Lundquist, Proceedings, Fifth International Congress for Applied Mechanics, 1938, pp. 145 to 149.

<sup>14</sup>"Tables Of Stiffness And Carry-Over Factors For Structural Members Under Axial Load," by E. E. Lundquist and W. O. Kroll, Technical Note No. 652, N.A.C.A., June 1938.

<sup>15</sup>See, for example, Timoshenko's "Elastic Stability," page 13, or refer to the original work by Manderla, "Die Berechnung der Sekundärspannungen," Allgemeine Bauzeitung, 1880, pp. 34 to 44.

leads at once to the following condition for "pure" buckling.

$$\tan \frac{l}{2} \sqrt{\frac{P}{EI} + \frac{K_C}{K_B}} \left( \frac{l}{2} \sqrt{\frac{P}{EI}} \right) = 0$$

The foregoing checks the pure buckling solution of this problem as given in Timoshenko's "Elastic Stability," page 91, Eq. 68.

The foregoing discussion simply gives added weight to the author's criticism of the "secant" formula, insofar as it might be unintelligently applied to a frame problem. There are cases, however, in which the eccentricity is not entirely a function of the load, i.e., columns supporting an eccentrically loaded bracket, or derrick booms.

The author points out the illogical misuse that has sometimes been made of the secant formula, applying it to a column in a frame, and introducing the low load eccentricity  $e_0$  as well as a length reduction factor  $n$ . The eccentricity is a weakening factor whereas the factor  $n$  may be a strengthening factor. Illogical as this may be, it gives a fairly reasonable answer in some cases. Fig. 30 shows the length reduction factor which could be used in the author's illustrative culvert example, column load being considered independent of beam load. (In this case the author's statement that the most unfavourable column load condition was considered would not be correct). The initial eccentricity  $e_0$ , would be calculated as

$$e_0 = \frac{wl_0^2}{12P} \left( \frac{1}{1 + \frac{K_B}{K_C}} \right)$$

In Fig. 30, the curves for  $P = 0$  and  $P = P_{cr}$  (pure buckling) represent extreme limits between which a reasonable length reduction factor could be chosen, depending primarily on the ratio of beam-to-column stiffness. The secant

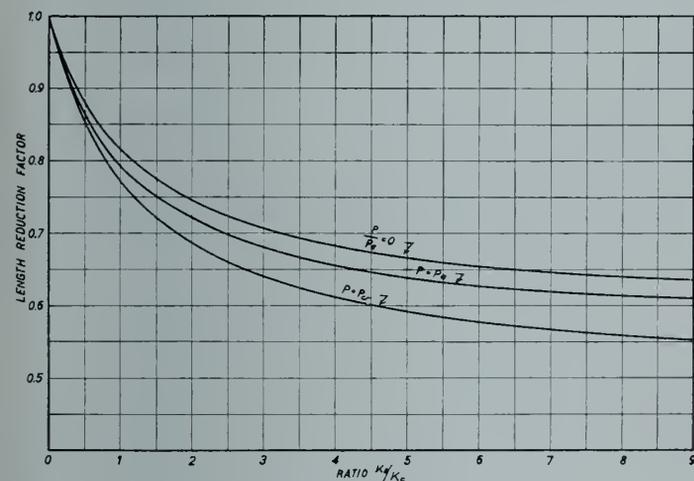


Fig. 30.

formula when used in this illogical fashion will nevertheless give an answer as to when the maximum stress in the framed column reaches the yield point. It should not be concluded that the secant formula could be applied with the same success to other more unusual frame problems.

Although the initial eccentricity in a framed column has no numerical equivalence with the actual eccentricity at failure, it nevertheless does represent an initial starting point and is therefore not unrelated to eccentricities at higher loads.

One of the author's final conclusions infers that the load is maintained constant above the Euler buckling load, for a considerable amount of increasing deformation. However, the author's curves in Fig. 16 show that this occurred in his experiments only for  $l/i$  above 150. This conclusion is therefore limited to structures with very slender columns, in which case considerable bowing may take place in compression members without exceeding the yield point of the material.

In 1920, Salmon wrote in his book on "Columns" ". . . at

present the designer has no real data whatsoever regarding practical end conditions." Much work has been done since then, for example, by the British Steel Structures Research Committee, but the question is still a most important one. The author's paper shows that thoughts are taking the right direction, and the writer looks forward hopefully to the possibility that at some future date "Rational Column Analysis" may become a practical reality.

S. D. LASH,<sup>17</sup> M.E.I.C.

This paper provides a comprehensive review of the column problem and is assured of a prominent place in the very extensive literature of the subject. The following comments are intended to be supplementary to the information given in the paper.

No better example of the need for co-operation between engineers and mathematicians can be found than in the history of column formulae of the eccentricity and curvature types. In 1807 Dr. Thomas Young, a mathematician, developed correct expressions for the lateral deflection of a strut having initial curvature and for a straight strut having an eccentric load.<sup>18</sup> These results apparently did not come to the attention of engineers and were rediscovered later in the 19th century by two professors of engineering, W. H. Smith and John Perry.

The secant formula was derived by W. H. Smith in 1877 in a paper presented to the Edinburgh and Leith Engineers Society. Its use was subsequently extended by Professor Smith in a series of articles published in *The Engineer* ten years later.<sup>19</sup> Professor Smith pointed out that the eccentricity was to be thought of, not only as the result of lack of axiality in application of load but also that  $e$  may be due to imperfection of workmanship, want of elastic homogeneity in the material or journal friction. One other quotation may be considered apt "Engineers not infrequently simply stare in amazement or else laugh derisively at any proposal that they should use an equation whose algebraic solution is either complicated and difficult or 'transcendental' in the technical sense." Apparently engineers continued to stare in amazement for some time, for it is only in recent years that the Committee on Steel Column Research of the American Society of Civil Engineers expressed its approval of the secant formula and recommended a parabolic formula intended to give similar results within certain limits. Thus there was a delay of about 125 years in taking advantage of Dr. Young's results. This delay seems excessive.

It is perhaps worth observing that the approximate eccentric loading formula proposed by Professor Van den Broek (formula 2) leads to a slight overestimation of the strength of the column. This will always be the case when an approximate elastic curve is assumed, since the curve selected will not be that corresponding to the minimum strain energy in the column. Timoshenko has developed a more general method in which the elastic curve is represented by a sine series.<sup>20</sup>

Engineers will, I feel sure, be grateful to Professor Van den Broek for giving the term 'wow' a respectable place in their vocabulary. Formula (3) the 'wow' formula is well known to readers of British literature under the name of the Perry formula. Professor Perry was presenting it to second-year students at the Finsbury Technical College in 1886. The derivation of the formula and its extension to various conditions is given in a paper by Ayrton and Perry<sup>21</sup> published in the same year. On the basis of mathematical studies and an examination of the results of tests the authors made the following statement: "The conclusion at which we have arrived is, then, that any want of straight-

<sup>17</sup>Department of Civil Engineering, Queen's University, Kingston, Ont.

<sup>18</sup>Young, T., *Natural Philosophy*, Vol. 2, 1807.

<sup>19</sup>Smith, W. H., *Struts—Their working strength and stiffness*, *The Engineer*, Vol. XIV., 1887.

<sup>20</sup>Timoshenko, S., *Theory of Elastic Stability*, p. 82.

<sup>21</sup>Ayrton, W. E., and Perry, J., *On Struts*, *The Engineer*, XII, 1886.

ness in the unloaded strut, or want of homogeneity in the material, may be allowed for by a term "c" such that it may be taken on the lateral deflection of a homogeneous carefully loaded strut. In more recent years the formula has been associated with the work of Professor Andrew Robertson.

Professor Robertson's paper on "The Strength of Struts"<sup>22</sup> has not received the attention which it deserves. He showed that the eccentricity formula fits experimental results, not only for steel specimens of various types, but also for specimens of wood, cast iron, wrought iron and duralumin. It is interesting to note also that there is a close correspondence between the results given by this formula and those given by the Forest Products Laboratory formulae for wood column. The Building Research Station have shown that the formula can also be applied to reinforced concrete columns. For each material and column a choice of suitable values of  $s_1$  and  $e^1$  must be made. For the term  $\frac{e^1 c}{i^2}$

Professor Robertson, following Perry, proposed to substitute  $\frac{L}{i}$ , thus making the 'wow' proportionate to the slenderness ratio. In this form the Perry formula was incorporated in the British Standard Specifications for Steelwork in Buildings (1934) and has subsequently been adopted by a number of other countries in the Empire. In Canada, following extensive discussion a similar formula was included in the section on Steel Construction of the National Building Code. The formula is also included as an alternative to the straight line formula in the C.E.S.A. specification for Steel Structures for Buildings (1940).

The close similarity between the secant formula and the eccentricity formula was first pointed out by Professor Perry who proposed to substitute for an eccentricity  $e^1$  an initial curvature represented by a sine wave with a value at mid-height of  $\frac{6}{5} e' \frac{S}{S_c - S}$  where  $S_c =$  Euler stress,  $S = \frac{P}{A}$ . Timoshenko has suggested a value of  $\frac{4}{\pi} c' \frac{S}{S_c - S}$  for the same fraction. The important point, as Professor Van den Broek has shown, is that similar results can be obtained from the eccentricity and curvature formulae and consequently the eccentricity formula is to be preferred since it is somewhat more convenient. On the other hand, a column formula does not have to be worked out very often and it may be mentioned that D. H. Young<sup>23</sup> has presented families of design curves based on the secant formula.

In considering columns with restrained ends, it does not appear that Professor Van den Broek's statement that eccentricity, partial restraint, end moments and the  $L/i$  ratios are the same in every conceivable respect, is true. Would it not be more accurate to say, that, following the principle of St. Venant, the result of either eccentricity, partial restraint or the application of end moments may be expressed by considering the effective length of the column to be reduced.

The subject of columns forming members of continuous frameworks cannot be considered in general terms. Each type of structure presents its own difficulties and Professor Van den Broek wisely leaves these for future consideration. The problems are inherently complex, much more so than the problems of finding column formulae, and the difficulty of determining the eccentricity (or end moments) when the fibre stress reaches some pre-determined value is not necessarily greater or lesser than the difficulty of finding the effective length.

Extensive studies of columns in building frameworks have been made by Professor Baker.<sup>24, 25</sup> He showed first, that, by making a number of simplifying assumptions, it is possible to develop curves representing the effective lengths

<sup>22</sup>Robertson, A., The Strength of Struts, Selected Engineering Paper, No. 25, Inst. Civil Engineers.

<sup>23</sup>Young, D. H., Rational Design of Steel Columns, Proc. Am. Soc. Civ. Eng., 1934, p. 1421.

of axially loaded columns with semi-rigid beam connections. Professor Baker found that this method would not work in the case of eccentrically loaded columns, but he found it possible to extend a graphical method by Howard to cover certain cases.

Professor Baker's later studies lead him to the following conclusions "The process of designing a pillar . . . is made no more simple or accurate by first considering the pillar as pin-ended and then applying a connection to allow for the restraints existing at the ends. Much more than this can be said of the pillar in an unsymmetrical frame or where beams are unsymmetrically loaded. The very factor, which, in the symmetrical case produces restraint will, in the unsymmetrical, be responsible for large bending moments which alter the effective length making rules so inaccurate as to be potentially dangerous."

Among other things, Professor Baker pointed out that it is impossible to tell, without an elaborate analysis, whether the maximum stress in a column in a building will occur at the middle or the ends. On the basis of Professor Baker's work, the Steel Structures Research Committee recommended a method of column design in which no mention is made of a column formula. This method did not receive wide acceptance, partly because, with the unit stresses proposed it did not lead to any saving in weight, and partly, it is thought, because the method, though simple to use, is difficult to derive and explain.

If we do not use some such rational method, the alternative appears to be to keep on guessing. It is difficult to see any advantage in consolidating our guesses into one or two variables as proposed by Professor Van den Broek. It seems more reasonable to try to make separate estimates of the effects of initial crookedness and end restraint than it does to try to make one guess as to the combined effect of these two variables. Thus I cannot agree with Professor Van den Broek's criticism of the recommendations of the Committee on Steel Column Research of the American Society of Civil Engineers.

We must realize that the process of designing columns as commonly practised is an extremely crude procedure. The consequence is that in some cases columns are made too strong and in other cases too weak. Thus, without questioning Professor Van den Broek's statement that for many types of construction, our column formulae are too conservative, it may be suggested that the opposite is also true. In the course of comparatively few years the assumed live loads on buildings have been reduced by about 50 per cent, allowable working stresses have increased by about 25 per cent, materials of little strength have been used for fire protection in place of concrete or brickwork and many dubious assumptions have been made about effective lengths. Thus, in building frameworks, it is not believed that any further reductions in the factor of safety are justifiable on the basis of our present knowledge and methods of design.

This contribution to the discussion may well close with a quotation from the Report of the Quebec Bridge Inquiry (1908) "We think that, in popular engineering opinion, the ultimate strength of steel columns is largely overestimated."

J. S. NEWELL<sup>26</sup>

Rational methods of analysis for long slender columns were established two centuries ago when the Euler formulae for critical compressive loads and stresses were developed. Rationalization of methods for predicting the allowable loads on short columns and on those of intermediate length has been the aim of engineers and mathematicians for many years, but whether or not complete rationalization can ever

<sup>24</sup>Baker, J. F., A note on the effective length of a pillar forming part of a continuous member in a building frame, 2nd Report, Steel Structures Research Committee, 1934.

<sup>25</sup>Baker, J. F., The behaviour of a pillar forming part of a continuous member in a building frame. Final Report, Steel Structures Research Committee, 1936.

<sup>26</sup>Professor of Aeronautical Structural Engineering, Massachusetts Institute of Technology, Cambridge, Mass.

be achieved seems doubtful. It appears that certain factors for short columns must always be established by empiricism or experience, hence that the formulae containing them cannot be classified as being completely rational.

That such factors may have greater effect on the results obtained for a given column than does the choice of design formula is indicated by the author's Fig. 3. The difference in  $P/A$  obtained by the author's Formula 3 and the secant formula are shown to be insignificant when compared with small changes in the non-dimensional quantity  $ec/i^2$ . The quantity  $c$  represents the distance from the centroidal axis to the extreme fibre, while  $i^2$  is the ratio of moment of inertia to area of the member. For a rectangular section  $c/i^2 = 3/c$ , whereas for a circular member of radius  $r$ ,  $c/i^2 = 4/c$ , and for I-beams of average proportions it is about  $1.5/c$ . The "effective eccentricity" for any member may be expressed as  $e = ki^2/c$ , where  $k$  is established for various types of member by tests or experience. It cannot be obtained rationally, and while the above relations may be helpful to the engineer when he chooses a value for  $ec/i^2$ , or when he is co-ordinating test data, they do not of themselves yield unique values for the eccentricity. Engineers using the secant formula, or the author's "Initial Crookedness Formula," must bear this fact in mind and must realize that the accuracy of the predicted allowable load for a given column obtained by either formula depends upon the accuracy with which the assumed value of  $ec/i^2$  represents the actual effective eccentricity in the column.

As stated by the author, eccentricity of end loading, initial crookedness, end moments or partial restraints, and ratios of effective to geometrical length produce similar effects on column strength. Eccentricity due to non-homogeneity of material in any cross section is in the same category. Each represents a factor which is unpredictable for any given member, but one which may be combined with others to give an overall effective eccentricity which may be determined by actual test on a member even though it cannot be predicted. Kármán, and other investigators,<sup>27</sup> have evaluated such eccentricities, or eliminated their effects, by moving the ends of the member undergoing test with respect to the knife edges or hemispherical blocks through which the loads were applied. When a load approaching the Euler critical could be applied to a column undergoing test without producing buckling, the effective eccentricities were considered to have been removed. A predetermined eccentricity could then be introduced and the behaviour of the member noted.

It is interesting to observe how closely the Euler load was approached during the tests described in the appendix to the author's paper without adjustment of the end loads to offset the eccentricities of the specimens. The excellent results obtained can probably be explained by the slenderness of the specimens used, most of them having  $L/i$  values above 100. Since many building and bridge columns have slenderness ratios between 50 and 100, it would be interesting to have test data on members in that range.

Figure 19 does get down to an  $L/i$  of about 60, and it shows excellent accord between experimental data and the stresses predicted by the secant formula for a rather large value of  $ec/i^2$  on a round rod. Similar data on the angle sections would, perhaps, have been more illuminating. They certainly would have if the angles had had wide, thin legs, say a ratio of width to thickness between 20 and 25 instead of 12, as the failures would then have resulted from a combination of torsional and bending instability and would have occurred at loads less than those indicated by Euler's formula even for the long slender members. This more general form of instability has been treated by Wagner<sup>28</sup> and Kappus,<sup>29</sup> and has been utilized by aeronautical

engineers who must guard against failures involving torsional buckling as well as those caused by bending instability or local buckling. Civil engineers normally avoid such columns and many are unaware that means are available for analyzing them.

The author's development of the secant formula is clear, and his development of the initial crookedness formula is also simple and easy to follow. The latter is obviously superior to the secant formula for practical use since it does not involve a trial and error solution. Each of these formulae and the more general Formula 5, depends upon the  $ec/i^2$  term, however, hence gives results which are functions of the engineer's experience and judgment. They are interesting, and the conclusions drawn from them appear correct, but the writer cannot concede that their use in design will insure safer or more economical structures than can be obtained by other expressions. Euler's formulae are certainly satisfactory for long slender members, that is, for members where the critical stress is less than half the yield point of the material, or less than half the crushing stress on sections subject to local buckling. For short columns, and those of intermediate length, the engineer has a choice between empirical straight lines, the J. B. Johnson parabola, and the more rational reduced-modulus formulae such as those depending on the tangent modulus of elasticity.

Whatever formula is used for the shorter members, be it complex or simple, requires some degree of empiricism. Some term is included which is not predictable by mathematics for any given member, or which is modified to conform with the results of tests. Whether it be  $ec/i^2$ , the ratio of effective to actual length, or the manner in which  $E$  is varied in a reduced-modulus formula, something must be contributed by the engineer and, in this writer's opinion, it is far more important that he be familiar with several formulae and their limitations than that he accept any one and use it blindly.

Many engineers deal only with columns composed of standard I, channel, or angle sections, none of which contain elements subject to local buckling failures. Under the economic system which will probably exist after the war, the demand will be for lighter and cheaper structures. Materials lighter than steel may then be cheap enough to compete with it. Such materials have lower moduli of elasticity than steel, are more susceptible to local buckling and to buckling as complete units, and sections fabricated from them will involve numerous problems of stability not encountered in older types of members. Structural designers may follow the aeronautical engineer's lead in solving some of their problems, but they cannot follow him blindly since stiffness is of greater importance to them than to him.

They can follow him and improve the economy of systems of members by broadening their knowledge of the stability of frames. The author touches upon this phase of the design of compression members, but he was obviously forced by space requirements to touch it but lightly. Much has been learned in this field in the past few years. A great deal more remains to be learned and it is hoped that civil and aeronautical stress analysts may explore the problems together.

Dr. Van den Brek's paper covers a breadth of material and problems, and it should serve as a challenge to young engineers to explore some of the methods he suggests. As such it is a contribution for which the engineering profession as a whole owes him a debt of gratitude, and one for which the members of the profession who accept the challenge will, as individuals, never be able to repay him.

J. M. OXLEY,<sup>30</sup> M.E.I.C.

Professor Van den Broek's paper is of great interest, due to both the ground covered and the clarity of the presentation.

The ultimate value of any such study is in the effect it may have on actual design practice.

<sup>30</sup>Chapman and Oxley, Architects, Toronto, Ont.

<sup>27</sup>See Chapter III, "Theory of Elastic Stability," S. Timoshenko, McGraw Hill Book Co., 1936.

<sup>28</sup>H. Wagner, "Torsion and Buckling of Open Sections," N.A.C.A. Tech. Memo. No. 807.

<sup>29</sup>R. Kappus, "Twisting Failure of Centrally Loaded Open-section Columns in the Elastic Range," N.A.C.A. Tech. Memo. No. 851.

For the reader, digestion of the argument would have been easier if the author had included a table of notation, and if the symbols employed in the present paper and his paper on a similar subject in the March, 1941, issue of the *Journal* had corresponded with each other. In the following discussion all symbols used have the same significance as in the paper except that the radius of gyration is denoted by  $r$  instead of  $i$ .

The author's distinction between "stress" and "strength" is particularly valuable in that it reinforces the present tendency toward consideration of the *strength* of a structure as a whole, as contrasted with the *stresses* in its component parts at working loads. The author states that he regards the use of "design formulae which are too safe, too conservative, as the greatest engineering sin second only to that of not being safe enough." I would award that distinction to "unbalanced" design—not safe enough in one part or too safe in some parts but not in all. On the one side danger, on the other, waste.

It is only by applying a given factor of safety or load factor to the ultimate strength of the complete structure that this sin can be avoided. One can agree in principle with the author's opinion that the emphasis on working stress is, in many types of structures, "archaic, confusing and often misleading," and yet face with some apprehension the thought of applying limit design to all of these problems.

To the designing engineer the important question is how to apply analysis in the design of actual structures. Useful leads are given in Figs. 8 to 11, and 12 to 14 and the accompanying discussion. A valuable addition to the first group would be the case of the column having end moments both in the same sense but different in amount—the column resisting side thrust from wind or other source by means of rigid connections.

Referring to the culvert frames illustrated in Figs. 12 to 14, the application to an actual design problem is difficult. Such a frame would probably have to resist side sway and moments from distributed side loads, in addition to the vertical loads indicated. To obtain results by the indirect or trial and error method given would then become difficult, if not impossible, because the unrelated load conditions would also have to be considered.

The author refers to these examples having been "selected with a view to giving to the column a loading pattern as unfavourable as we can imagine." Surely, if the column is merely turned to have its web in the same plane as that of the beam we get a more unfavourable condition. That is, the column will be capable of supporting a lesser axial load because it will resist a greater portion of the moment from the beam at all column lengths. Also the critical  $r$  may still be the minor one, which is not influenced favourably or otherwise by the bending moments, so that, for all values of  $l/r$  greater than the point of intersection with the Euler curve for this smaller  $r$ , the latter will fix the limit load.

There are several general considerations to which further emphasis should be given in any discussion of column analysis.

First, there is the question of effective length, the  $L/l$  ratio, in application to actual design. There are three specifications for design of steel structures in general use in Canada to-day—the Canadian Engineering Standards Association 1940, the National Building Code 1941, and the American Institute of Steel Construction 1937. Not one of these makes any suggestion that the effective length of a column is anything but the "unbraced length," except that the C.E.S.A. specification gives a hint in defining  $L$  as the "equivalent free length" but gives no indication as to how this equivalent length may be ascertained.

The reason is simple enough but does not reflect credit. It is that any attempt made so far to set forth an accurate method of determining the  $L/l$  ratio is so complicated that it is not practicable to include such a method in a specification. The "recommendations for practice" of the British Steel Structures Research Committee as given in their final

report are an example of the complications involved even in their "simplified" method.

In effect, the present position is that the able and experienced authorities chosen by various groups have let this question go by default, to be worried over or ignored by their possibly less able and experienced confreres who design to comply with the specifications. A column may be designed for an  $l/r$  ratio double the true one with a resulting waste of over 40 per cent of the material used. Considering the approximations we already apply in our assumptions regarding live loads, the allowance for or ignoring of initial crookedness, and other elements, it would appear that a set of diagrams similar to those of the author's Figs. 8 to 11 could be prepared covering all the usual cases with sufficient proximity to the theoretical truth, and a clear cut statement could be given showing the method of dealing with unusual cases.

Another question which has seldom been considered is that of the effect of the location of the point of maximum stress. When a member in compression buckles at the critical load a new set of conditions arises. In a round ended column this buckling is a maximum at or near the centre of the length. In a column with restrained ends and end moments, the combined bending and axial stresses may reach a maximum at one end of the column or at some other point depending on the sense and amount of the moments. If this maximum occurs near one or both ends the buckling tendency of the column may cease to be a critical factor.

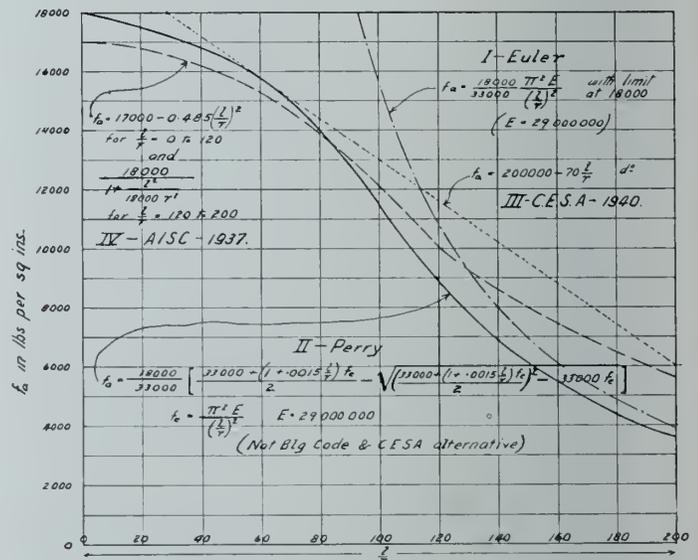


Fig. 31.

Under our present specifications the location of the point of maximum stress has no influence on permissible combined stress.

It would appear that the decision as to when to consider compression members as beams rather than columns and apply the principle of superposition, should depend on the location of maximum stress more than on the slenderness ratio of the member.

The most general, and possibly most important, point is the wide diversity of opinion as to basic working stresses in columns, particularly in those with a slenderness ratio of from 100 to 200. All of the specifications mentioned agree in permitting a basic working stress of 20,000 lb. per sq. in. for members in tension or in bending, yet note the diversity in compression. (Fig. 31).

These graphs show the permissible working stresses for columns under the three specifications mentioned and also the Euler curve for round ended columns for similar constants. (The curve for the Perry formula shown corresponds with the author's Formula 3 for a column with  $c/r^2 = 1$  and an initial eccentricity of  $l/1333$ ).

The three specification curves hang together fairly well for the range from 40 to 80  $l/r$ , but note the relation at 140  $l/r$ . Curves II and III represent alternatives permitted under one specification without any indication as to preference. At 140  $l/r$  III gives a working stress 50 per cent higher than II. Either the designer who chooses II is wasting a lot of material, or the one who prefers III is running close to danger.

Certainly, one is inclined to agree with the author that there is little purpose in taking account of such niceties as initial eccentricity when so much latitude is permitted for more important elements, and when no guidance is given as to effective length.

The simple fact is that these specifications are used by many who may lack time, experience or ability to do more than accept them at their face value. They may be used by a few who are interested chiefly in producing the cheapest possible design regardless of its all-round efficiency. At present the problems of column design are the ones in which most indefiniteness and uncertainty exist, and therefore most in need of further research and analysis.

It is not the primary purpose of these comments to criticize the framers of specifications and codes. I have had enough experience on working committees to have deep sympathy with, and sincere appreciation of those who devote their knowledge, time and labour to such work.

I present a plea that the author, with his ability and facilities, and others in a like position, do not—"leave to the engineer in any special field the problem of determining the coefficient  $n$ "—or other equally important elements, without giving more light on methods of practical application, and, in general, guiding us farther through this tangled growth.

P. L. PRATLEY,<sup>31</sup> M.E.I.C.

These notes were first drawn up for use in verbal discussion, but the writer was unable to reach the meeting in time to take part. They will appear somewhat disconnected as written discussion, but pressure of work prevents re-editing. They are therefore offered with apologies.

The writer's general view is that the paper is not clear in its statements and many claims are made which have no substantial basis either in fact or in the argument presented. The true value of the assumption is not always stated or admitted, and certain conclusions are, therefore, misleading.

1. Page 570—In the discussion of the Secant Formula, the author states that when the eccentricity approaches zero, the elastic curve approaches a sine curve and when the eccentricity approaches infinity, the elastic curve approaches a circle. These statements are not proved and in fact are not true. One valid conclusion can however be drawn from the next sentence wherein the author states the true curve falls between the sine curve and an arc of a circle. This obvious conclusion is that the curve is not a sine curve, and this conclusion has the virtue of being true.

In the author's earlier paper entitled "Euler's Column Formulae" he is on surer ground in that he frankly states he is merely assuming the equation of the elastic line to be a sine curve and on this assumption proceeds to develop what appears to be Euler's Formula. He notes that "the value of  $P$  obtained by this formula is the critical value which initiates the buckling of the column. Equilibrium would be obtained for any value of delta provided the column is not stressed beyond the elastic limit." To the writer, this phrase raises the question as to what precisely is meant by the Euler value. The writer was taught, as far as he remembers, to regard the Euler value as that load which a perfectly straight and pin-ended column of uniform cross-section and uniform elasticity, could resist without starting to buckle. The first half of the above quotation from the author's earlier paper would seem to support this view. But according to Bauschinger, quoted in Huette, the

<sup>31</sup>Consulting Engineer, Montreal, Que.

Euler value is that value at which the deflection of the ideal column which heretofore has grown steadily and proportionately with the increasing load, will suddenly exceed any measurable value. The second half of the author's statement above quoted would seem to adopt this interpretation. In his present paper the usage in general seems inclined to the second view, that is, the load which would keep the ideal column in equilibrium regardless of deflection. The expression itself  $\pi EI/L^2$  is obviously independent of deflection and dependent only on the physical and geometrical properties of the column.

The writer thinks it would be worth while to refer to the method of its derivation. The ideal pin-ended column is presumed bent by some agency and to be in equilibrium under the axial load  $P$ . If the deflection at any point distant  $y$  from the mid-point be  $x$  then the bending moment at this point is  $P.x$ . Now at any point whatever along the column under the usual assumptions upon which the theory of elastic bending is based,  $1/R = M/EI$ , and at the centre point where  $dx/dy = 0$ , the curvature  $1/R$  is equal to  $d^2x/dy^2$ . This is only true at the centre point, but the convenient assumption is now made that  $1/R$  at any point may be equated, without appreciable error to the second differential, which is equivalent to assuming  $1 + (dx/dy)^2 = 1$ . It will readily be seen that this equation can only be strictly true if the elastic curve is at all points parallel to the axis, as it is at the mid-point. Therefore the assumption is only an approximation, growing in closeness as  $dx/dy$  decreases. As long as we confine ourselves to very small deflections, the first differential is also very small, its biggest value being at the ends of the ideal column. The assumption is a convenient one, mathematically, and is reasonably legitimate, as long as it is properly appreciated. The assumption having been made (ablative absolute)  $1/R = d^2x/dy^2$  and  $= P.x/EI$  arithmetically and a differential equation results:

$$\frac{P}{EI} x + \frac{d^2x}{dy^2} = 0$$

The solution proper to the boundary conditions is

$x = \Delta \cos \sqrt{\frac{P}{EI}} y$ ; where  $\Delta$  is the central deflection,  $L$  the length of the column,  $y$  being measured from the mid-point and  $x$  from the axis of action of  $P$ . At the ends of the column where  $y = L/2$  and  $x$  must  $= 0$ ,  $\cos \sqrt{\frac{P}{EI}} \cdot \frac{L}{2}$  must also  $= 0$ .

Therefore  $\sqrt{\frac{P}{EI}} \cdot \frac{L}{2} = \frac{n\pi}{2}$ ; where  $n$  is an odd integer, and for our simple case is unity. Thus  $\sqrt{\frac{P}{EI}} \cdot \frac{L}{2} = \frac{\pi}{2}$  or  $P = \frac{\pi^2 EI}{L^2}$

2. The author in his earlier paper, by assuming the sine curve, and obtaining the deflection geometrically from the moment curve, arrives at this same result and calls it Euler's formula. If he had assumed some other form of curvature he would not have obtained this value, but he does not seem to assert clearly anywhere that this second interpretation of the meaning of the Euler value depends entirely on the assumption of a sine curve as the elastic line. The correct curve is known to investigators and is termed the "Elastica." This curve is free from the restriction that deflections must be kept very small, and is therefore true for very slender columns, such as strips of spring steel. It is, however an awkward thing to handle as it involves elliptic integrals, and is obtained by intrinsic co-ordinates. Generally:

$$s = \sqrt{\frac{EI}{P}} \int_0^\phi \frac{d\phi}{(1 - \sin^2\theta \sin^2\phi)^{3/2}} = \sqrt{\frac{EI}{P}} (F. \theta. \phi.); \text{ where}$$

$$\phi, \text{ the amplitude} = \cos^{-1} \frac{x}{\Delta} = \text{and } \theta, \text{ the modulus}$$

$$= \sin^{-1} \frac{\Delta}{2} \sqrt{\frac{P}{EI}}, s \text{ being the length along the curve,}$$

measured from the mid-point either way. For  $S$ , the length from mid-point to end,  $x=0$ ;  $\phi = \frac{\pi}{2}$ , and  $S = \sqrt{\frac{EI}{P}} (F_1, \theta)$ , the symbol  $F_1$  denoting the complete elliptic integral.

The interesting feature of this curve for our present purpose is that if  $\Delta = 0$ , the modulus  $\theta = 0$  and  $S = \sqrt{\frac{EI}{P}} \times \frac{\pi}{2}$  or  $P = \pi^2 EI / 4S^2$ , and, as this  $S$  is half the length of the column, we have the Euler value  $P = \pi^2 EI / L^2$ . Note that this value only obtains for zero deflection or the unbuckled column. If  $\Delta$  has some small value greater than zero, so does the modulus  $\theta$ , and  $S$  is slightly greater than  $\sqrt{\frac{EI}{P}} \times \frac{\pi}{2}$  which means that  $P$  must be slightly less than the Euler value, if equilibrium is to be maintained.

This was the writer's original understanding of the Euler theorem, and it is his opinion that the author should express himself clearly on this point as will be referred to again in paragraph 5 of these notes.

3. Also in the derivation of the Secant Formula, the writer would regard the author's procedure as more clear were he to introduce an extra line or two in order to state that only at the mid-point of his column is the curvature equal to the second differential, because only at this point is the first differential equal to zero. In the true curve of the column, as already explained, the equation  $\frac{1}{R} = \frac{M}{E \cdot I}$  holds for every point, which is the basis upon which the "elastica" is built and which fact demonstrates that the sine curve is only a convenient approximation.

4. No worthy object is apparent in the statement that the relationship given at the top of page 571 throws no light on the strength of the column, and it again seems misleading to suggest that this formula is of no value except when the stress in question is the elastic limit stress and the corresponding load is the critical load. If the derivation is justified, then it must be true that for any value of  $s$  up to the elastic limit,  $P$  is the corresponding load, or vice versa, for any load  $P$  less than the critical load, the resulting maximum fibre stress is as evaluated by the formula. This remains true down to and including equation (b).

5. The author then introduces the Euler value for  $P$  without saying when this value is good and in the next expression actually has two meanings for  $P$ , firstly that value of the load which causes or produces the elastic limit stress  $s_l$  and secondly the Euler value of  $P$ . He uses the first significance when dividing the load by the area and the second in both the other occurrences. His Secant Formula (1) needs therefore, to be explained much more fully and its assumptions and limitations honestly described instead of being quoted as "quite exact." The inverting of  $\frac{P}{EI}$  in two cases is manifestly a printer's error.

6. It is now pertinent to enquire into the soundness of the argument leading up to the statement that initial crookedness is insignificant. This argument is introduced by a straight honest-to-goodness admission that the curvature is assumed to be initially and continually a sine curve. This assumption permits the integration of the area of the moment diagram and leads to the establishment of equation (c) which in turn shows that  $\Delta$  depends on  $e^t$ .

The legitimacy of the statement that the difference in curvature between the initial and final states represents the additional moment divided by the stiffness factor ought to be established and it should again be noted that the identity of the rate of curvature with the second differential only holds at mid-point where the first differential is zero. The author states that the stress due to the increase in curvature is  $s = \frac{\pi^2 \Delta \cdot c \cdot E}{l^2}$  and that the resulting extreme fibre stress on the inside of the curve is this same quantity plus the average compression unit. The question arises where is the

stress due to the initial curvature? However small the increase in curvature, the bending moment is  $P(\Delta + e^t)$ , and the fibre stress from bending must be a function of this total deflection. The fact that the column is initially crooked suggests to the writer that there is no bending stress at the mid-section under no-load when  $P$  is zero even though there is the deflection  $e^t$ , but as soon as a load is applied, a bending moment equal to  $P \cdot e^t$  exists. This moment causes further deflection, equilibrium being reached when sufficient energy has been expended to deflect the column  $\Delta + e^t$ . It seems therefore that equation (d) needs some substantiation.

7. Accepting (d) as presented for the moment, the elimination of  $\Delta$  from equations (c) and (d) produces a relationship between  $P$  and  $s$  which relationship depends upon the sine curve assumption. Nothing appears to be gained at this stage by introducing the Euler value of  $P$  and the solution of the equation might just as well be stated simply as

$$\frac{P}{A} = \frac{1}{2} \left\{ s + \frac{\pi^2 E}{\left(\frac{l}{i}\right)^2} \left(1 + \frac{e^t c}{i^2}\right) \right\} - \sqrt{\left\{ s + \frac{\pi^2 E}{\left(\frac{l}{i}\right)^2} \left(1 + \frac{e^t c}{i^2}\right) \right\}^2 - 4 \frac{\pi^2 E \cdot s}{\left(\frac{l}{i}\right)^2} \right\}, \text{ thus}$$

omitting two lines of text.

8. This relationship between  $P$  and  $s$  is described by the author as "purely academic and of no interest to the designer." Such a statement seems fantastic as it is of extreme interest to the designer if it is true, and moreover is the basis for the author's formula 3 at the top of page 572. The statement is, therefore, not only superfluous but definitely misleading. It accomplishes nothing and raises doubts in the mind of the reader as to the sense displayed in any effort to determine the relationship. While it is quite true, assuming the equation to be mathematically correct, that if we define  $s^l$  as being the elastic limit stress, the load  $P$  becomes a symbol for the corresponding load producing the elastic limit stress, it is equally true that if we define  $s$  as 16,000 or 20,000, or whatever we choose as a working unit, the symbol  $P$  expresses the load that the column can carry without exceeding such permissible unit; and this is equally useful.

9. Still accepting tentatively Fig. 3, it is of course visible that the introduction of the term involving crookedness makes only a slight difference in the capacity of the column, but why does the author introduce the term "slender"? The sturdier the column, the smaller the absolute difference and it would appear from the curves that the slender columns suffer about the same proportional change as the medium columns.

10. On page 572 the author takes advantage of the opportunity to inject the idea of designing to a factor of safety on the limit load as distinguished from the general practice of designing to a factor of safety on the limiting fibre stress. Dismissing the latter as archaic, etc., he then makes the sensational statement that the term  $P/A$  has no physical significance. This statement must be energetically opposed, as it is grossly untrue. It appears to be introduced, as are many other statements in the text, as the thin edge of a wedge intended to discredit all previous methods of analysis and design, and to establish the so-called limit design as the only sound, safe, and proper method. In the vast majority of structural members met with in practice, the term  $P/A$  means exactly what it expresses, namely, the average stress per unit of area. It expresses this quantity regardless of whether  $P$  is the maximum capacity load or any other load less than the capacity load. It cannot be avoided as an essential and often the governing portion of the total stress, and in all the author's formulac, he is compelled to acknowledge this fact and to introduce the quantity. Most of the ordinarily

accepted formulae for column design state that the extreme fibre stress for any section consists of two parts, one being this average stress and the other being an additional term imposed by one or more of a variety of influences, principally bending from some cause or other. In straight tension or compression, the term  $P/A$  stands alone as the indicator for intensity of stress or for the capacity of the member. Notwithstanding the author's statement that there is no reason for invariably interpreting the term as stress, it always is stress and all that the author is entitled to say, is that it is not always the maximum or the extreme or the governing intensity of stress, which again is almost axiomatic.

11. Objection must also be taken to the finality with which the author states that crookedness or eccentricity determine the direction in which the column deflects. This statement should at least be reduced to "may determine" as it is quite evident that the geometrical properties of the column very frequently have a controlling influence.

12. The use that is made of Fig. 5 at the top of page 573 is also open to question and the statement that the point of deflection always coincides with the quarter point, is inclined to be misleading unless it is duly emphasized that complete fixity at both ends of the column is maintained and unless it is appreciated, that this result accrues from the convenient assumption that the column bends as a sine curve.

13. The author's excursion into logic seems to be particularly unfortunate. While it is quite easy to see the drift of his argument, the statement that "eccentricity, partial restraint or end moments, and the ratio  $L/l$ , are identities" is far from logical. It is obvious that they cannot be identities "the same in every conceivable respect" because the measure of eccentricity is a length, the measure of end moments is length multiplied by force and the ratio  $L/l$  is simply a number. It would be much clearer although less sensational, if the author were to state what he means, which is "that the equilibrium condition of a column, bent under load can be clearly expressed if we can determine any one of these three functions, namely, eccentricity of applied load, degree of end restraint, or length of the elastic line between points of contraflexure." No system of logic can admit that these three things are identical. The only identical thing about them is that they are equally useful under the sine curve assumption in establishing desired relationships between load, deflection and fibre stress.

14. Under the heading "General Column Formula," the author makes two statements to both of which reference has previously been made. He says that very satisfactory results are obtained if the analysis is based on the assumption that the column assumes the shape of a sine curve. With this the writer fully agrees but the author also says that the characteristic of the pin ended column is that when it deflects it assumes the shape of a sine curve which, of course, it does not and it must again be regarded as unfortunate that the language should be so inconsistent and misleading. Furthermore, the author says in the same paragraph "if the elastic curve assumes the shape of a sine curve under any one of these loadings individually, it will do so under the action of any combination of these loadings collectively." This again is untrue, for only if the curve follows the sine curve for each of the individual influences, will it do so under the action of any combination of these influences.

15. Under the same heading in the second column of page 573 the author proceeds to deal with the case of a column subject to compression load, a uniformly distributed lateral load, and an initial deflection. He quotes the fundamental elastic energy equation but without defining  $F$  and without mentioning the further assumptions that have to be made in order to obtain the expression

$$\Delta = \frac{\text{Area} \times \bar{x}}{EI}$$

Incidentally it would have been clearer had he maintained

$y$  as the running dimension of his column instead of changing to  $x$ , which had previously been his lateral dimension. The paragraph which follows seems to be lacking in clarity principally because the terms introduced are not defined. The bending moment diagram expresses the fact that the bending moment at any point includes the joint effects of the compression load multiplied by the actual deflection at the point, and of the lateral load with its reactions. The area of the bending moment diagram may thus truly be said to consist of two parts namely the part due to the load  $P$  and the part due to the lateral load. The deflection consists of three parts, namely the part due to the initial crookedness which is assumed to lie in the plane of the lateral load, secondly, the part due to the strain from the lateral load and thirdly, the part due to the effect of the compression load  $P$ . If it be imagined that the loads are applied in that order then the column will continue to deflect from the position it occupied under the initial crookedness and the lateral load, until equilibrium is established, when the bending moment from the compression load will be the product of  $P$  and the final deflection. Thus in Fig. 6 the maximum deflection ( $\Delta + e'$ ) includes all these effects and the author's equation (e) is approximately true. It ought to be noted however, in obtaining this expression he still assumes that the final elastic curve of the column is a sine curve although it is quite manifest that the deflection from the lateral load contributes a parabolic portion, which may under suitable circumstances be the controlling feature. When re-arranging equation (e) the author introduces  $s$  taken from his earlier equation (d) where it was defined as the stress due to the increase in curvature plus the stress due to the direct load. His equation (f) therefore states that the total increase of curvature arising from both the lateral and the vertical load, bears a linear relation to the total bending stress or vice versa. Following equation  $F$  he proceeds to eliminate the deflection and in so doing introduces again the Euler value of  $P$  which is confusing because the expression  $\frac{\pi^2 E I}{L^2}$  really originates from the geometrical properties of the assumed sine curve deflection diagram.

16. The interesting case of the quadratic equation for  $\frac{P}{A}$  is that given in formula 5, when the lateral load and the initial deflection are both zero, and in expressing this formula both roots of the radical should be retained. Figure 7 would then be readily explained, as the plus sign produces  $s'$  everywhere and the minus sign produces the Euler curve everywhere, so that it can be said quite simply that the formula yields the Euler curve except where artificially prevented by the introduction of the limiting fibre stress  $s_l$ . The figure also indicates that for values of  $l/i$  less than the critical  $\frac{l}{i} = \pi \sqrt{\frac{E}{s}}$  the introduction of the limiting fibre stress means that the capacity of the column is  $P = s \times A$ . For values of  $l/i$  greater than the critical, that is to say, where buckling would occur before  $s_l$  is reached, the Euler value is the value consistent with equilibrium.

17. Page 574. Theory and practice would not conflict if both were perfect. But surely as an alternative to the author's conclusion that theory is usually worthless, there lies the possibility, elsewhere admitted by him, that practice falls short of perfection. Here again he misleads in his desire for the sensational. What he means and could rightly state, is that theoretical studies do not and cannot always appraise the practical departures from idealism. And everybody knows that.

Without expressing any particular fondness for the Secant Formula, the writer fails to see that anything is accomplished by classing it as futile, merely because some empirical value must be introduced for the item  $e$ .

This earlier and more academic part of the paper has proved so provocative that the later and more original part has not yet received the attention it deserves, and the

present writer must confess that although he has read it thoroughly several times, he has not found time to give it the necessary study. He must therefore regretfully leave it for later consideration as opportunity may offer.

F. R. SHANLEY<sup>32</sup>

The writer has always been interested in Dr. Van den Broek's clear approach to problems that are usually handled in an academic manner, and has noted below a few comments that may be of interest.

The author is correct in pointing out that the conception of  $P/A$  as a true stress has been very misleading, as applied to columns. In a paper on buckling (*Engineering Aspects of Buckling*, *Aircraft Engineering*, January, 1939), the writer tried to show the importance of load, rather than stress, by comparing the critical column load with the side load required to deflect the column a certain distance. The term  $P/A$  might be thought of as a measure of the resistance against end load, per unit cross-sectional area.

In this same paper it was suggested that the radius of gyration might be thought of similarly as "a measure of the bending stiffness per unit cross-sectional area." To be more exact, we should say that the radius of gyration squared is a direct measure of the bending stiffness per unit cross-sectional area and unit length.

It is encouraging to see more emphasis placed on the load-deflection curves, such as shown in Fig. 16. In our stress analysis work we have found an increasing need for such information, particularly in redundant structures. Some of the applications of load-deflection data in aircraft work are given in the above mentioned paper, under the heading "Restrained Buckling."

It would seem that a paper on the subject of rational column analysis should at least mention the important work that has been done to correlate column failure with the shape of the stress-strain diagram in the "plastic" range. This subject is well covered by many papers and is substantiated by actual tests (see paper by Templin, Sturm, Hartmann, and Holt, *Column Strength of Various Aluminum Alloys*, Aluminum Research Laboratories). Dr. Van den Broek's paper, through omission of this point, might give the misleading impression that the use of the eccentric loading theory is the only rational explanation of column behaviour. As a matter of fact, a column curve such as shown (in the author's Fig. 4) for zero eccentricity is far from rational, as it implies that the stress-strain diagram is elastic up to the yield point, then a horizontal line to failure.

Neglecting the influence of the actual stress-strain characteristics may also lead to other erroneous conclusions in other respects. In Fig. 13a for instance, the curve indicates practically zero column resistance for very short lengths. Actually the material would simply readjust itself by slight plastic deformation and would probably still be capable of withstanding a high column load, due to the existence of a reasonably high "tangent" modulus in the plastic range.

The use of a pin-ended Euler column curve for comparison, in Fig. 13a, is perhaps misleading, as a coefficient of fixity greater than unity would have been used for analysis purposes, at least in aircraft work.

The points on end restraint (page 6) are well taken, although they would be somewhat unfair if applied to airplane structural analysis. A great deal of work has been done to correlate column test conditions with actual conditions occurring in the airplane structure. Although much remains to be done, the need for such knowledge has long been recognized by aircraft engineers and many papers have been written in this connection. As a typical example, tests were conducted some years ago (at Consolidated Aircraft) in which compression panels for the top of a wing structure were tested over several supports, to obtain a direct correlation with routine panel tests. The effect of wing curvature under bending loads was also evaluated by

displacing the supports to simulate actual conditions. More recently similar work has been done by the NACA and other investigators.

J. C. TRUEMAN<sup>33</sup>

The identity of  $n$  and end moment is an interesting development in column theory. The problem will be to determine the coefficient. This could no doubt be figured in many cases by the elastic theory. The writer wonders whether the author would consider that the effect of deflections past the elastic limit should be taken into account when evaluating  $n$ . Such a procedure would probably be very involved and might yield results quite different from the calculation within the elastic limit. A case in point might be the effect of joint rotation and displacement on the co-efficient for a strut in a truss.

#### THE AUTHOR

It is extremely gratifying to find so serious and generous an interest taken by the numerous discussers in the paper on "Rational Column Analysis." The discussion high lights the extreme divergence of views relative to sense of value, objectives and proper assumptions, in connection with the column problem. The day before the paper was to be presented I pointed out that if all the mathematics were deleted from the paper, what I regard as 97 per cent of its real value would still be intact. If anyone was unduly impressed with the formulae in the paper, he missed the point that the purpose of all the mathematics was to show that all the formulae converge to one simple and well known formula, Euler's formula.

Mr. Pratley lists seventeen separate items of disagreement with my views. With one point which he makes I might almost agree. In his item 10 he says,

"It appears to be introduced, as are many other statements in the text, as the thin edge of a wedge intended to discredit all previous methods of analysis and design, and to establish the so-called limit design as the only sound, safe and proper method."

Quite evidently Mr. Pratley and I understand each other on this point, but, I would not say that I am disgruntled with "all previous methods." I have yet to find anything in August Föppl's methods of analysis, for one example, to which I can take serious objection.

Professor Lash says, "Timoshenko has developed a more general method in which the elastic curve is represented by a sine series." The test of our philosophy is: How is it going to facilitate the design of columns in engineering structures? If we have a load-stress relationship expressed in the form of an infinite series, the question then is, how are we going to use this series? We shall probably agree to ignore all but the first one or two terms of the series. Then our labour begins and by numerous cuts and trials and successive approximations we attempt to find a solution. After a few trials we say that we have obtained sufficient accuracy for our purpose. When Mr. Lash refers to a more general theory, does he not also mean a more exact theory? The relationship may be exact, but the results are approximate, because, first, we ignore all but the first one or two terms of a series, second, because we get tired of trial and error solutions since they must be continued for an infinite length of time in order to obtain infinite accuracy. I would like to suggest that the next time Mr. Lash wants to solve Professor Timoshenko's infinite series, he first solve for the value of  $P$  by means of one of my formulae, substitute it in the series, and satisfy himself that no further trial and error solution of the series is necessary.

While I acknowledge that there is a widespread agreement with Mr. Pratley's view, I must register one serious exception to this statement. In his item 8 Mr. Pratley states,

"It is equally true that if we define  $s$  as 16,000 or 20,000, or whatever we choose as a working unit, the symbol  $P$

<sup>33</sup>Designing Engineer, Dominion Bridge Company Limited, Winton, Man.

<sup>32</sup>Chief Structures Engineer, Lockheed Aircraft Corporation, Burbank, California.

expresses the load that the column can carry without exceeding such permissible unit; and this is equally useful."

Without fear of serious contradiction I claim that Mr. Pratley is unique in holding to this view.

Mr. Pratley regards some of my views as fantastic. He appears to dwell in the past, unaware that the era which formulated such ideas as working stresses, and factor of safety applied to elastic limit or ultimate stresses, is a closed era. If column analysis means anything it means that a conventional working stress in a column offers no criterion of its strength. In deference to some old-fashioned traditions we may juggle a factor of safety and thus arrive at something which we may call a new working stress, that is, if we sacrifice all attempts to be rational. But such a new working stress will then be different from our conventional working stress. In column analysis I believe we are all agreed, all except possibly Mr. Pratley, that our criterion of strength is the capacity strength of the column. Column analysis always has been a phase of limit design. It was so long before the phrase, "limit design" was coined and I see no evidence of any trend toward a change.

In his item 13 Mr. Pratley questions the soundness of my logic when he says,

"The statement that 'eccentricity, partial restraint or end moments, and the ratio  $L/l$  are identities', is far from logical. It is obvious that they cannot be identities . . . because the measure of end moments is length multiplied by force," etc.

In this remark Mr. Pratley avowedly touches a very sensitive spot. Engineering philosophy is my major interest in life and if I should prove vulnerable on this point it might well constitute a mortal blow. Let me ask Mr. Pratley whether, when he speaks of the velocity of a train or an automobile, he is always sure to specify that he means a velocity parallel to the surface of the earth? Surely a velocity is a vector quantity and has two attributes of equal importance, magnitude and direction. In speaking of the velocities of trains and automobiles, the direction is implied as being one parallel to the surface of the earth. The reader or listener draws the obvious conclusion that, if the velocity of an automobile in a direction other than one parallel to the surface of the earth were meant, some other information would be added in the nature of doctors, nurses or ambulances, and numbers of people killed or injured. In writing on columns I assumed a familiarity with columns equal to the average man's familiarity with trains and automobiles. I thought that, by mentioning eccentricity in connection with columns, everyone would know that I meant a *load eccentrically applied to a column*. And certainly, a load multiplied by a distance is equivalent to an end moment. Technically, I acknowledge I stand convicted, but no more so, I believe, than Mr. Pratley would be convicted of an inaccurate statement if he should speak of a train's velocity without specifying its direction.

Mr. Bruce Johnston lends a measure of support to Mr. Pratley's claim regarding the irrationality of my writing when he says,

"the writer looks forward hopefully to the possibility that at some future date, 'Rational Column Analysis' may become a practical reality."

He does not, however, point to anything irrational in my paper. But then, Mr. Johnston tells us he is engaged in column research. Possibly this rational column analysis may be looked for in his forthcoming report.

Mr. Durant joins Mr. Pratley in the defence of the secant formula. To this I will reply by quoting from the discussion by Dr. Hans Bleich, who says:

"I particularly appreciate the impressive explanation that eccentricities can only be determined after the buckling problem has been solved and that therefore the usual formulae for the carrying capacity of columns under eccentric loads are valueless."

For the benefit of Mr. Lash, who knows his English tech-

anical literature so well, and possibly for the benefit also of others, I would like to record the fact that Dr. Hans Bleich has an impressive list of publications on engineering philosophy, in German, to his credit, and that I, personally, value his opinion as much as that of any other living man.

Mr. Hartmann criticizes me for making no reference to the tangent modulus, thus invalidating my treatise insofar as aluminum alloys are concerned. Mr. Shanley supports Mr. Hartmann in this view. Mr. Hartmann and Mr. Shanley may be of the opinion that the steel era belongs to the past and that the future belongs to aluminum. But how about magnesium, which manifests a much more nearly straight line stress-strain curve than does aluminum? Who knows—magnesium may replace aluminum before long. This, however, is not the real answer to Mr. Hartmann and Mr. Shanley. I grant that aluminum fails to exhibit a linear relation between stress and strain. Many of us may be more or less confused about the column phenomena, but I dare say we all fully understand and appreciate the simple bend-

ing formula  $s = \frac{Mc}{I}$ . This formula is predicated on the two major assumptions, that a transverse plane before bending remains plane after bending and that the stress-strain relation is linear. If hairsplitting refinement is necessary, why not start modifying and improving that formula, which is as important as any column formula. If such refinement is justified, are we not amiss in first directing it to the subject of columns, which to me appears as still in a state of near confusion? Mr. Hartmann and Mr. Shanley might feel that I could have used my opportunity to better advantage, had I confined my remarks to aluminum. The tangent modulus I personally regard as a minor detail. Possibly in the future I may want to express myself on that subject, but for the present I must dismiss it as nearly irrelevant.

Professor Newell's discussion is valued highly as an original contribution to the column problem. In one respect, if I understand him correctly, Professor Newell and I do not agree. He says, "as stated by the author, eccentricity of loading, initial crookedness, end moments or partial restraints, and ratios of effective to geometrical length produce similar effects on strength." To be correct, I dismissed *wow* as negligibly small in my tests on run of the mill specimens, and as probably of still less consequence in larger-size columns, but of the other phenomena I did not speak as producing similar effects. On the basis of the laws of static equilibrium, I called them identities. Thus, my

ratio  $n = \frac{L}{l}$  and Professor Newell's factor  $k = \frac{ec}{i^2}$  are directly related as appears in Figs. 13b and c. If we determine  $n$ , we simultaneously determine  $e$ . I further question Professor Newell's statement, "where  $k$  is established for various types of members by tests or experience. It cannot be obtained rationally." Mr. Pratley evidently concurs in Professor Newell's position where, in his item 17, he says, "The writer fails to see that anything is accomplished by classing it as futile (the secant formula) merely because some empirical value must be introduced for the item  $e$ ." These statements go to the heart of the position I have taken. Neither Professor Newell nor Mr. Pratley indicates how we are to determine this empirical constant. Mr. Johnston evidently concurs in my statement: "Column tests frequently . . . fail effectively to simulate end conditions of restraints—such as are met with in practice." To determine either my coefficient  $n$  or Professor Newell's coefficient  $k$  experimentally we would have to test actual structures, or models which correctly simulate actual structures. I am fairly familiar with tests on full size transmission towers and aeroplanes. Alas, to my knowledge such tests in the past have only been conducted with a view to satisfying either a customer or a government agency as to the overall strength of the structure. I take the position diametrically opposite to the one taken by Professor Newell. Instead of saying, "It cannot be obtained rationally," I believe that

coefficients  $n$  or  $k$  can be obtained rationally better than they can be obtained experimentally. My chapter, "Determination of constant  $n=L/l$ " was written with the intent of proving this point. In this regard it is interesting to note the concluding remarks from the discussions by Dr. Friedrich Bleich and Mr. Oxley.

I will attempt here to point out a few specific conclusions which seem obvious consequences of the generalizations of the paper. Incidentally, I shall point to an instance in which my generalization "for many types of construction our column design formulae are too safe, too conservative" does not apply.

In Mr. Oxley's own field, which I understand to be that of architectural engineering, is it not true that the frames shown in either Fig. 12 or Fig. 14 represent about the most unfavourable column loading possible? Our analysis, then, seems to point to the conclusion that for slender columns the coefficient  $n$  is definitely less than unity, while for short columns we need not regard the column as a stability problem at all, and that we may proceed without appreciable error to conventional methods based on the assumption that the principle of superposition is applicable, the distinction between "slender" and "short" being the same as that of greater or less than  $(l/i)_c$ . I acknowledge that I have not determined a value for  $n$  to govern in all cases. However, it seems to me, to be able to point out that we either treat the member as a post or give to  $n$  a value less than unity is something of specific value.

Transmission towers are unique in the field of structural engineering, and are of special interest as an illustration of the column problem. My comments are confined to the legs and cross bracing below the cross-arms. The principal loadings are the cross-wind and the torque which may result from the breaking of one or more of the cables. Since we don't know from which direction the wind may blow, or which cable may break, almost all members must be designed to take either tension or compression. Furthermore, some members are very slender. In one transmission line the same tower may be repeated hundreds of times, thus introducing the element of quantity production. Finally, the transmission tower is the only unit in the field of structural engineering which, to my knowledge, is sold on the basis of a guarantee of the finished structure under test.

Almost all the structural elements in towers are angle irons. From the cross-arms down, the legs, under the most unfavourable combination of loading, carry a substantially constant load. They are braced by diagonal bracing and cross-struts in two planes at right angles to each other. The panel points may be said to be "position fixed" not "direction fixed." If the leg buckles, it does so in a continuous sine curve. Any end fixity that may result from being connected to diagonals and cross-struts, most of which have themselves a tendency to buckle, seems too uncertain and too intangible to evaluate. I suggest that the leg of a transmission tower should be designed as an Euler column with an end fixity equal to zero, or with a coefficient  $n$  equal to unity. I believe the formula used, at least by one firm, is of the type similar to Mr. Oxley's formula III. I am of the opinion that this formula, in transmission tower design, is not safe enough for slender columns, while too safe for short columns. It would be interesting to know whether the committee of the C.E.S.A. when it recommended its formula for general use, anticipated its being applied to transmission tower design.

The case of the compression diagonal in a transmission tower treated as a column presents another interesting example of column design. I am aware that in cross-bracing the compression member is frequently held as being inactive. Occasionally both compression and tension members in the cross-bracing are held as transmitting equal forces. The one procedure I regard as wasteful, the other as illogical.

The civil engineer has a strongly expressed preference for simple formulae. In this preference I concur, provided

the formula is not obtained at the sacrifice of sound logic. I believe that my suggestion to confine ourselves to Euler's formula modified by a coefficient  $n$  is both logical and very simple.

The civil engineer also shows a tendency to accept errors provided they can be proved to be "on the side of safety." This is often wasteful and generally stultifying. We have now an aeronautical structural engineering profession and if the aero engineer accepts too many errors on the side of safety he will not be able to lift his aeroplane off the ground. If the transmission tower engineer does not count on the functioning of all the tower's members, he is likely to lose out in this highly competitive international field. In diagonal cross-bracing the compression member is position fixed through the one bolt connection, fixing it to the tension member. If the tower legs are slanting, then the bolt connection divides the compression diagonal of the cross-bracing in two unequal parts. The strength of this compression diagonal, if computed at all, is conventionally computed on the assumption that its length is equal to the longer of the two parts into which it is divided by the bolt connecting it to the tension member, and that the coefficient  $n$  is unity. I definitely feel that  $n$  is less than unity. It is a function of the ratio of the two parts in which the compression member is divided. Its value is between 0.699 and 1.0. If  $a$  and  $b$  represent the two parts in which the compression diagonal is divided, then  $n$  approaches unity when  $a/b$  approaches unity. It approaches 0.699 when  $a/b$  approaches zero.

Professor Newell and Dr. Hans Bleich express regret for the fact that I did not test columns with an  $l/i$  ratio, less than critical. As an explanation, may I say that the paper was conceived and the test started in July, with a deadline, against which I was working, for the manuscript to be in the editor's hands by the first of November. Under too high loads I was afraid that my partial spheres would dent my bearing blocks, and time was lacking to make the necessary changes, either smaller specimens, larger loading spheres, or harder bearing blocks.

I should like to express my appreciation to Professor Newell and Mr. Goodrich for being two discussers who have noticed my test results. However, Professor Newell apparently did not glean all the information from them which nonetheless was there. He says:

"They certainly would have failed under loads less than Euler's if the angle had had wide, thin legs, say a ratio of width to thickness between 20 and 25 instead of 12, as the failures would then have resulted from a combination of torsional and bending instability and would have occurred at loads less than those indicated by Euler's formula even for the long slender members."

In the first column on the last page I said, "All of those which failed with the outstanding flanges in compression manifested twisting, as may be observed in the photograph, Fig. 26. It is of interest to note that this twisting, this secondary failure of the flanges, did not occur until after the specimen had failed as an Euler column." Whereas the ratio of width to thickness of angle leg for the smaller angles was 12 as Professor Newell states, the angle illustrated in Fig. 26 was nominally a 3 by 3 by 9/64 angle, thus having a width to thickness ratio of about 22. The average load which it carried is shown by the little cross furthest to the left in Fig. 21, to equal  $P/A = 26,000$  lb. per sq. in. I plead guilty for not directing attention with sufficient emphasis to this test in the text, in view of the fact that Timoshenko in his *Elastic Stability*, p. 408, states: "In such cases (meaning equal leg angles) to eliminate the possibility of buckling at a stress below the yield point, we take for structural steel  $b/h = 12$  (meaning the width to thickness ratio)." He further adds a significant point which makes my test not strictly comparable: "In all these cases it has been assumed that structural steel has a yield-point stress equal to 34,000 lb. per sq. in." Is there no one sufficiently interested to duplicate my tests?

Before Professor Newell's closing paragraph of his discussion I stand with bowed head as it constitutes the greatest compliment ever paid me by anyone.

Mr. Goodrich's remarks of approval and encouragement, as always, serve as an inspiration.

Mr. Oxley and I, it would seem, are not nearly as far apart as may appear to be the case at first glance. For my using different symbols in successive papers on the same subject I humbly apologize. May I offer as an excuse that during the composition of my last manuscript on columns I was engaged in the revision of my text on Elastic Energy Theory. In this new text appears a very extensive list of symbols. The symbols used in the paper under discussion are already in agreement with the above-mentioned list. Mr. Oxley's discussion presents a valued contribution to the problem of column analysis.

The contribution to the discussion by such an authority as Dr. Friedrich Bleich is highly appreciated.

A misunderstanding of anyone's writing is certainly a reflection on the author. I consider myself fortunate that of all the discussers, only Mr. Holt definitely and completely failed to get the meaning of one of the most important thoughts I have tried to convey. Mr. Holt says,

"Can anyone say this effect (the wow effect) is insignificant for slender columns when for an  $l/i$  ratio equal to 200 the average stress at failure . . . is about 12 per cent (below Euler's value)."

To arrive at this conclusion Mr. Holt picked from my Fig. 4 the curve for  $e' = \frac{l}{600}$ . If he had computed the discrepancy

between the Euler strength and the strength of a column with a wow of  $l/100$ , the percentage difference would have been still greater. The most significant feature of Fig. 4 consists in the four little crosses, marking experimental values, and which all lie between the curves for  $e' = 0$  and  $e' = l/5000$ . Please note the cross for  $l/i = 100$ . To me, these experiments give the first authentic and direct data on wow for run of the mill specimens which I have ever seen. The data are not absolute and most likely constitute an upper limit, as there was no way of determining what the accidental eccentricity of the applied load was.

I must confess that my science is sprinkled with just a little faith. Witness that no two rational philosophers ever completely agree. My faith in science is that the laws of nature are inherently simple. They only appear complicated so long as we have not succeeded in getting to the bottom of them. I do not agree that haggling over a few ounces more or less in connection with loads that run into the thousands of pounds is good engineering. I repeat that, basically, end moments, eccentricity and  $L/l$  ratios, in connection with column analysis, are identities. I further insist, since they are identities, that the  $L/l$  ratio makes the strongest physical appeal. Finally, I maintain, it is in the nature of simplification to reason in terms of one variable rather than three, if the three mean the same thing. The only fly in the ointment which prevents all my formulae from reducing to Euler's formula is the wow factor  $e'$ . Since  $e'$ , on the basis of Fig. 4, appears to be definitely less than  $l/5000$  in light angle irons, it is likely to be still less in heavier sections. Since the wow effect is so small and since its inclusion would spoil an otherwise excellent recommendation, I advised to ignore it, or consider it covered by our inevitable factor of safety. Dr. Hans Bleich lends support to this recommendation when he shows that the reduction in strength of a column, as the result of wow, is less for a column elastically restrained at its ends than for a pin-ended column. Furthermore, he shows that an accurate quantitative determination of this reduction in limit strength of a column, elastically restrained at its ends, is extremely involved.

I believe there is one thing on which we, as engineers, are all agreed, namely, to design for an overload factor of the order of magnitude of 100 per cent, or a factor of safety, say of two. Yet, in connection with the column problem,

some seem to love writing interminably about quantities avowedly of secondary order of magnitude.

I understand that the aero engineer, in column analysis, already directs his major attention to end fixity coefficients. I may, conceivably, contribute by lending encouragement to the aero engineer to continue in the trend he is already following.

Mr. Pratley would like to see residual stresses considered in connection with wow. I am as prepared as anyone to discuss residual stresses, but here again my sense of value restrains me. If a refinement such as the consideration of residual stresses, say in connection with hot-rolled or extruded sections, is necessary, I would like to begin with consideration of the beam phenomena, where we are well agreed and on certain footing. In connection with columns, where we still talk at cross purposes, I think we had better wait until there is more general agreement as to fundamentals.

In item 1 Mr. Pratley states "but the convenient assumption is now made that  $l/R$  at any point may be equated without appreciable error to the second differential." I nowhere make such an assumption. To be sure, toward the bottom of page 1, column 2, I state that  $l/R = d^2x/dy^2$  is correct, since for the critical point  $c$ , when  $y = L/2$  then  $dx/dy = 0$ . If Mr. Pratley means here to criticize me again for assuming the elastic curve of the column to be a sine curve, I would reply that this assumption is not only convenient but also justifiable. It simplifies matters materially by ignoring a quantity of secondary order of magnitude.

Mr. Pratley states in his item 17 "the author's conclusion that theory is usually worthless" is like a straw man set up for the purpose of knocking it over. I have devoted my life to engineering theory. I insist on my right to express my thoughts in terms of graphs, diagrams, words or symbols, whichever appear to fit the occasion best. Mr. Pratley, who talks of philosophy, must surely agree that a test of a theory lies not in the medium of its expression. I deny with all the emphasis at my command any allegation that I fail in appreciation and admiration for the science of mathematics. However, when mathematics produces men who are devoid of engineering judgment, who indulge in a wild-goose chase after refinements of detail while ignoring the large aspects of the problem, and who formulate theory without any physical background for the establishment of the theory with the result that some real engineers are crowded off the stage for no reason other than that they may possibly be lacking in mathematical dexterity, then I think it is high time to call a halt.

In any theory, the method of analysis may be of greater significance than any resulting formula which may be obtained. My main reason for presenting the well-known secant formula was stated in my paper, page 6, column 2, where I said, "Therefore, if we base our proof of a recognized and accepted formula on this identity, we add further evidence toward the establishment of this identity." The significance of my proof of the secant formula lies in the fact that it is predicated on the fact that the eccentrically loaded column is but a special case of the pin-ended column. On page 1, column 2, the explicit assumption is introduced; "The portion BD of this curve is then an arc of a full arch of a sine curve." This assumption Mr. Pratley contests all through his discussion. Yet he champions the formula which is directly predicated upon this assumption.

Mr. Oxley's contribution, and particularly Fig. 31 which he submits, is very pertinent to this discussion. On the one hand, Mr. Pratley and Mr. Holt insist on what I would like to call, overemphasizing quantities of the second order, and on the other hand Mr. Oxley points to four design formulae from which his specifications permit him to choose without any authoritative guidance as to the relative merits of these four formulae.

In closing, I would like to make one plea to the profession. In America the unfortunate idea has developed, carefully nursed by some mathematicians, that mathematics

and theory are synonyms. I confess that I have forgotten, through disuse, a great deal of mathematics I once knew. I still know enough of it, however, to recognize that a vast proportion of the mathematics which is passed off on us as theory is spurious. Mr. Durant refers to the "great university" with which I am connected. That connection, however, has brought to me the realization that some men are attracted to engineering science, not for the love for the science, but as an alibi for the exercise of their mathematical proclivities. When Mr. Durant so easily says, "The formulae in the paper are derivable from a single differential equation and all that is necessary to obtain a particular formula is to put zero for all unwanted quantities in a particular integral," what is he shooting at? Is he writing for the entertainment of his confreres or is he trying to save a few pounds of material in the design of an aeroplane? It does seem to me that, with mathematics glorified as an objective rather than a means, our beloved science of engineering is in a state comparable to that of the dog being

wagged by the tail. Won't some engineers, engaged in designing, building and erecting, join in a little tail wagging by the dog himself?

I offer as an excuse for my lengthy closure the fact that the issue, as I see it, far transcends a mere few column formulae. There appears to exist a long-smouldering divergence of opinion on what I have referred to as sense of value, objective and assumptions. This divergence appears to be excellently illustrated by the contrast of opinions expressed by Mr. Pratley and by me. I know that Mr. Pratley's views have a large and impressive following. My views may be minority views, but they nevertheless also have a following. I realize that custom has it that the author, with his closure, has the last word. I am not asking that an exception be made in this instance. I would like the privilege of saying, however, that since Mr. Pratley was to some extent singled out by me in my closure, I would welcome a rebuttal by him to be regarded by me as well as by everyone else as absolutely final.

## Abstracts of Current Literature

### AIRCRAFT FACTORIES UNDERGROUND

FROM *Trade and Engineering*, APRIL, 1942

Long before the war started both France and Germany were known to possess underground aircraft factories. Now it may be disclosed that similar factories have been constructed in this country. Some of them are already in full production, others are getting into their stride, and the latest—which is also the largest—began to produce aircraft components a week or so ago.

It should not be assumed, however, that the general policy of the Ministry of Aircraft Production is to put all aircraft factories underground. It would obviously be undesirable, and indeed impossible, to transfer production from the increasing number of overground factories, with the consequent hold-ups in output, merely in order to put them below ground. The policy is to take advantage of disused quarries and mines, thus avoiding the necessity for the tremendous task of scooping out many million tons of soil. The use of quarries and mines has another obvious advantage for the "roof" of the factory can be of rock, which has greater resistance than soil to a bomb. The underground aircraft factories so far equipped are spread over different parts of the country, as are the bomb-dumps and ammunition stores which have been placed below ground.

The building of the latest factory is a very remarkable achievement. The whole scheme covers an area of something like six square miles, while the factory itself is approximately three-quarters of a mile square. Total cost is in the neighbourhood of £5,500,000, and more than 8,000 workmen were engaged in its preparation. The vast building is not yet complete, but full production is expected by August, when it will employ 14,000 men and women.

The factory lies at a depth of 90 ft. from the surface, and above it are thick layers of clay and brash (loose stone). The factory itself lies in solid rock. The building is ventilated by means of five air intakes and five exhaust shafts, each of 20 ft. diameter. Some of the shafts have been constructed so as to emerge on the surface at a steep angle, thus preventing any possibility of a bomb falling down the shaft and exploding at the bottom. The method of ventilation is by means of forced draught and forced exhaust. There are eight passenger lifts, arranged in pairs, and each can accommodate 50 persons. The entrances to the lifts are protected by 15 ft. of reinforced concrete and are claimed to be proof against a direct hit.

### Abstracts of articles appearing in the current technical periodicals

The factory has its own artesian well and its own reservoir. Lighting is of the fluorescent type, the normal source of supply being the Grid, but there are two alternative methods of supply. The machinery is lowered into the building through a special shaft, at the top of which is a machine hoist capable of dealing with 20 tons at a time.

The passenger lifts are so sited as to be within a quarter of a mile of the farthest point in the factory, while two escalators will also take employees to and from the surface. Operatives living farthest from the factory will be taken to work and back to their homes by motor-coach. When in full production the factory will work day and night shifts, each of 10 hours. This is regarded as a maximum in view of the length of time required to get operatives from their homes and to their benches underground.

Six hostels, each capable of accommodating 1,000 persons, have been erected on the surface, and there are communal restaurants which can supply 500 meals at one time and will be open day and night. Living quarters are being provided for 6,000 single men and women and married quarters for 2,000 couples. So that married women will be able to leave their children with perfect safety, crèches are being provided, with competent persons in charge. The employees' quarters are neat and comfortable and the accommodation is being provided at a most reasonable charge—27s, inclusive of meals, for men, and 22s, inclusive for women. Half of the married quarters have two bedrooms and the other half three. There is a covered way between the canteens and the recreation centres, one of the latter being provided for each of the six hostels. The entertainment centres contain a cinema, which can be used also for concerts and dances, a bar, and sports and reading rooms.

By the time one has been in the factory for half an hour it is difficult to realize that one is 90 ft. underground. The atmosphere is agreeable—it is claimed that the temperature can be kept almost constant throughout the year—and the lighting is excellent. Main "roadways" lead from the lifts, and off each side of them are lofty galleries. While the floors have been concreted, in many cases the walls have been left in their original state. So far, in spite of the existence of great ready-made galleries, a million tons of gob have been removed, though there has been little new excavation.

To safeguard against falls of roof or walls occurring through vibration or change of temperature when the factory is constantly occupied, brick pillars have been erected at intervals, while solid blocks of the original stone have been allowed to remain. The effect is to divide up the underground space into large galleries, which are being converted into the usual shops. Various other safe-guards have been, and will be, taken. To prevent the possibility of flooding, each wet area was drained and sealed off by stout walls and the water level is kept below that of the factory. Sewage is pumped to the surface through pressure pumps.

As the factory was prepared every square foot of ceiling was tested, all excavations being carried out by skilled quarrymen. The attuned ears of these men can detect, from the answering ring of the rock to a blow, whether it is safe or not, and any suspected "bladder" or unsafe area, was immediately pulled down. Safety patrols will also be maintained, a careful check being kept on the effects of vibration on the rock.

In the parts of the factory where construction is still going on the scene is very like that in a coalmine. The one noticeable difference is that smoking is permitted, there being no risk of fire or explosion. The quarried stone is taken by light-gauge railways—some trains pulled by pit ponies and some by engines—to the foot of conveyors which are not unlike the moving staircases on London's tube railways. As the stone reaches the surface it is tipped out and crushed returning underground in powdered form to be used in the mixing of concrete. The factory is equipped with three ambulance and first-aid departments, and the general arrangements for the work-people are excellent.

### A QUIET REVOLUTION

FROM *The Beama Journal* (LONDON), DECEMBER, 1941

In normal times the expenditure of the average citizen, apart from a proportion of his income that goes in rates and taxes, is at his own discretion and disposal. He can buy a car, travel freely, extend his wardrobe, give presents, and broadly speaking live as he wishes to live. In much the same way a manufacturing or selling organization may carry on independently, guided by the decisions of its directors and management.

The whole procedure of life for the private citizen and for the business concern is completely altered under the strenuous conditions of such a conflict as that in which this country is now engaged. First comes the duty of all to serve in some way that directly helps the war effort, either in the armed forces or by part-time work. Secondly, control of raw materials and rationing in its various forms limits expenditure on clothes and cars, on travelling, on foodstuffs; additional limitation being due to the stimulation of voluntary savings, the increase in taxation direct and indirect, and the stopping of supplies of unessential goods. With these restrictions and the swing-over of industry to war production, the nation's entire standard of living has been quietly but very effectively changed—not so much lowered, as rendered rational in connection with the demands of war.

The co-operation and response of industry in general to the needs of control has been remarkable, and the vast extent of the swing-over is probably not realized except by those who are in a position to view it from the top. Torpedoes are coming from a former boot and shoe factory; anti-gas and medicated ointments from a beauty-cream factory; aero-engine parts from a hairpin factory; aeroplane frames from a toy factory; and such examples could be multiplied a hundred times. Each change-over brings, of course, its own problems of structural alteration, movement of machinery, and often the housing of workers. Six months' operation of this re-planning of industry by the Controller-General of Factory and Storage Premises has meant the allocation of nearly 50 million square feet of space, one-third being for production and two-thirds for storage. One example of foresight is the securing of suitable empty buildings distributed over the country, ready for re-housing a damaged production unit at the shortest notice.

Thus the Government has turned the nation's economic resources to war purposes; and one of the characteristics upon which this nation may pride itself and take good heart is the acceptance by industry and the people generally of the new, inevitable burdens and inconveniences. Britain grumbles—it always does; it criticizes its rulers—often constructively and helpfully; and it gets on with the job, in unshakable faith that the Government will not let it down, in equally unshakable determination that "come the world against her, England yet shall stand."

### BRITAIN'S FACTORIES DODGE BOMBS

FROM ROBERT WILLIAMSON\*

A new method of factory layout which has reduced output delays from bomb damage by as much as 50 per cent has been evolved by British scientists and engineers.

Called the "production lattice," factories engaged on similar work are not dispersed all over the country but are grouped close enough together to provide swift inter-communication. If there are, say, four processes in each factory, the bombing of No. 1 process in one works means that Nos. 2, 3 and 4 processes there can still be supplied from another factory; while if a No. 2 process is put out of action the No. 1 output can go through No. 2 process elsewhere and return to its own No. 3 and 4.

To stop output completely, the enemy must put out of action the same process in each factory, and the mathematical odds against this are immense. In fact, because of these odds, the more accurate the bombing the greater the relative advantage of the "lattice," or criss-cross of production lines.

Under the dispersal system, factories are badly placed to assist each other and whenever one process is put out of action the whole output of the factory stops until this has been remedied. With the "lattice" principle, however, practical examples have shown that in severe attacks up to one-half the output rate for a given section of industry may be saved.

\*London correspondent of *The Engineering Journal*.

## SAVE FOR VICTORY

If you do not keep your *Journals* do not burn or destroy them. Give them to a salvage organization. They are needed for victory.

## WHAT IS BEING DONE ABOUT POST-WAR RECONSTRUCTION

There are many indications that Institute members realize the necessity for adequate planning for post-war reconstruction, so that when victory comes the peace will be won as well as the war. Correspondence received at Headquarters, resolutions passed by the branches, and references to the matter at our meetings all make this attitude clear. At the annual general meeting General McNaughton and Mr. Little both spoke of the urgency of action on this matter. Council has discussed the question on several occasions and items regarding it will be found in recent numbers of the *Journal*.\*

At this time our readers will be interested to have a brief account of the steps which have been taken, the situation as it now stands, and the extent to which the membership of the Institute is being asked to help in solving some of the problems which have arisen or will arise.

The matter, of course, is one in which the Dominion Government is primarily concerned. Preliminary steps were in fact taken two years ago, resulting in the formation of an advisory Committee on Reconstruction, to examine the general aspects of the question, and to make recommendations to the Cabinet as to what government facilities should be established. In speaking on this point the Minister of Pensions and National Health pointed out that the study of the many and diverse problems of reconstruction "should be begun now—and obviously cannot be confined to any one group of men or department; but must be the concern of every branch of the public service and of every provincial and municipal authority in Canada."

It is evident that before any schemes can even be drafted for discussion, a mass of pertinent information must be obtained, so that the many economic, social, industrial and technical problems involved may be clearly presented for consideration.

Actually a "small group of able and distinguished citizens" has been charged with this task—persons "not already under pressure of departmental war work in the public service." They form the Committee on Reconstruction and are to report to the Committee of the Cabinet which was set up in December, 1940, to act in matters relating to rehabilitation and to reconstruction. A separate Committee on Demobilization and Rehabilitation has also been formed and will report to the Cabinet Committee on those subjects.

The calibre of the Committee on Reconstruction may be judged by the fact that its eleven members include Dr. F. Cyril James, Principal of McGill University, who is chairman; Mr. Tom Moore, President of the Trades and Labour Congress of Canada; Dr. R. C. Wallace, Principal of Queen's University; and others who are authorities on social questions, agriculture, commerce and industry; representatives of government departments and international committees concerned; and the chairman of the sister Committee on Demobilization and Rehabilitation. The two committees have a joint executive secretary.

The problems of reconstruction are of wider scope, and perhaps of a more controversial nature, than those of rehabilitation. They are concerned, among other things, with labour and re-employment, agricultural and industrial developments, changes in international trade and investment, changes in legislative economic control, and works programmes for emergency employment or physical and economic restoration. To deal with such matters a number

\*In this connection, see also Post-war Reconstruction, *Engineering Journal*, Feb., 1942, pp. 105-6. National Service—A Challenge to the Engineer, *Engineering Journal*, March, 1942, pp. 151-153. Discussion at Annual General Meeting, *Engineering Journal*, March, 1942, pp. 155.

## News of the Institute and other Societies, Comments and Correspondence, Elections and Transfers

of groups or subcommittees have been formed by the Committee on Reconstruction and are now in operation.

Of these, the most interesting to engineers is probably the Sub-committee on Construction Projects, whose chairman is K. M. Cameron, a vice-president of the Institute, and chief engineer of the Department of Public Works, Ottawa. Its duty is the consideration of the matter of a post-war construction reserve to form a back-log of construction projects which will be available to take up the slack in employment subsequent to the cessation of hostilities. It is now making a study of the information which will be needed in order to judge of the relative advantage of such projects.

At the last meeting of Council, Vice-President Cameron presented a draft questionnaire prepared by his subcommittee and entitled "Considerations for Evaluating Projects," regarding which his subcommittee is consulting technical bodies, regional groups, and individuals whose advice is likely to be helpful. The draft suggests some twenty-five questions concerning possible projects, each designed to elicit some pertinent item of information. These questions are grouped under such headings as the probable general effect of the project on economic efficiency and the welfare of community; its effect on unemployment and labour supply; probable cost, the desirable plan for financing it, and how it should be maintained; what engineering studies have been made and what time would be needed to make necessary plans; what legal questions are likely to arise as to the acquisition of property; and if a grant in-aid is indicated, what controls should be set up.

The subcommittee is asking for the views of interested bodies as to the suitability of this proposed draft, and will endeavour to form a composite picture from the opinions thus obtained.

Members of Council present greatly appreciated the action of Mr. Cameron's subcommittee, in consulting the Institute, and discussed at some length the best way of obtaining and co-ordinating the views of Institute members. It was then decided, first, that a copy of the questionnaire submitted by Mr. Cameron be sent to each branch of the Institute with a request for an expression of opinion as to its form and content; and, second, that a committee to be named by the president be set up to study the replies and present to Council a consolidated report for submission to Mr. Cameron's subcommittee. Further it was provided that this new committee should be continued, so that later it will be available to perform such other duties in connection with post-war reconstruction as may be assigned to it by Council.

It will be noted that Council's decisions thus provide the Institute with a standing committee, which can deal promptly with such reconstruction questions as concern the Engineering Institute, or may be referred to the Institute for helpful action. Every care will be taken to avoid overlapping or possible duplication of the work of other bodies. In this way the Institute committee's work will be done within the framework of any general organization which the Government may set up. Obviously the establishment of innumerable local committees by interested but disconnected organizations could result in nothing but chaos.

It is perhaps unfortunate that up to the present the public has been told very little about the work of the Advisory Committee on Reconstruction of which Dr. James is the head. This does not mean that no progress is being made, as is evident from the activities of Mr. Cameron's subcommittee, and of other similar bodies. This apparent

reticence on the subject, however, is unavoidable, and is due to the fact that the Advisory Committee has to report to the Cabinet. Accordingly none of its proceedings or findings can be made public until they have been considered and approved by the Dominion Government. In the meantime Institute members will receive, through the *Journal* any news or reports of progress which may be released by the authorities concerned.

## AN INSTITUTE COMMITTEE ON INDUSTRIAL RELATIONS

The engineer has been taken to task sometimes for having introduced technological changes in our industrial life without at the same time indicating the reforms necessary to avoid serious disturbances in our social order. This charge, which seems somewhat exaggerated, is perhaps meant to infer that the engineer, who is responsible for making possible the early enjoyment of the benefits of technological advance, should at the same time make sure, through judicious control of the rate of change, that the corresponding human adjustments are made without economic loss or human suffering.

The repercussions caused by the changes in tools and processes have been particularly sensible in the relations between the various groups that constitute our industrialized society. It would seem that the engineer, because of his position between management and labour is well situated to study problems of industrial relationship and develop plans and methods for their solution. In fact, engineers have often been chosen to head personnel departments of industrial firms or governmental bodies dealing with labour problems. It is proper, therefore, that the Institute should become interested in the question of industrial relations.

At the April meeting of Council in Toronto, the proposal was brought forward that a committee of the Institute be established to study such problems. The suggestion was approved unanimously and a Committee on Industrial Relations was formed. Mr. Wills Maclachlan, who made the suggestion, was appointed chairman of the new committee. The scope of the work which lies ahead of the committee is indicated by the following terms of reference prepared by the president, Dean Young, at the request of Council:

"That the Committee continuously study, and from time to time report to Council on important developments affecting industrial relations within Canada, thus providing Council with information and specialized advice on which it can decide

- (a) What attitude or action the Institute as a professional engineering body should take in relation to such developments.
- (b) What direction or advice the Institute should provide to its Branches or individual members as to the part they might play in relation to such developments.
- (c) In what manner the Institute might serve the public interest by exerting its influence in the improvement of industrial relations.

"That, without restricting the field of activity that might properly and judicially be undertaken by a Committee of a professional engineering body, the Committee give consideration to such matters as

- (a) The labour policy of governments, as expressed in statutes and Orders-in-Council.
- (b) Means of promoting earlier and more general utilization of the benefits of technological advance without undesirable disturbance of the economic and social life of the people of Canada.
- (c) Physical conditions of employees' work, environment, and housing conditions, both during and after the war.
- (d) Selection, placement, and training of employees.
- (e) Wage and reward systems and associated economic conditions and terms of employment, as related to

the productivity of industry, especially as affected by labour-saving devices.

- (f) Co-operative plans for mutual benefit.
- (g) Accident and Sickness prevention, Workmen's Compensation and health insurance, hospitalization and rehabilitation.

"That the Committee seek to promote the study and consideration of subjects coming within its purview by the provision of suitable speakers at meetings of the Institute or its Branches and by articles in *The Engineering Journal* or other suitable publications."

The importance of such a committee is evident in time of war when the production of materials is largely dependent on the relationship between management and labour. Its work should be equally useful in the post-war period of readjustment and afterwards for the maintenance of industrial peace.

## THE INSTITUTE AND CIVIL DEFENCE

Recent events have directed marked attention to questions of civil defence in Canada. The admirable lectures of Professor Webster, sponsored by the Institute, have made available to many people who can use it, a mass of the latest technical information on the subject. Following these notes will be found a timely memorandum by Professor R. F. Legget, outlining some of the engineering problems which air attack on Canada would involve, and suggesting suitable steps to make good the damage which may be done.

To deal effectively with matters like these, concerted action is required. Accordingly, Council at its last meeting, recognizing the responsibilities of the Institute as regards the assistance which our members can give, decided to set up a committee which will take charge of all defence interests of the Institute, gather information, study the situation and report to Council from time to time. The members of this committee are to be named by the president, its chairman will draw up its terms of reference, and one of its first duties will be to co-ordinate the efforts of the branch committees already established to utilize as fully as possible the material given in the Webster lectures.

The formation of this committee may well have far-reaching effects. Much may depend on the results of its studies. Its task is not an easy one, for as Mr. Legget points out, objectives of major importance may be attacked; their prompt reparation will be essential to the life of the community.

Under the new committee's guidance, qualified Institute members all over Canada will have an opportunity to take their proper part in civil defence, local and Dominion-wide.

Professor Legget's memorandum follows:

"The possibility of Canada being invaded, by air, must now be envisaged. Attack may come on the East Coast, or on the West, or both, and may extend far inland.

"In view of all that is involved, the inevitable loss of the invading planes, and the state of Canada's air defence, it would appear probable that bombing will not be indiscriminate but will be directed towards specific objectives.

"Such objectives will certainly be of major importance, directly or indirectly, in relation to the war effort. Reparation of damage, without delay, will therefore be essential.

"Possible damage can be classed generally as follows:

- (a) Destruction of small buildings, particularly residences;
- (b) Destruction of larger buildings and interference with municipal services; and
- (c) Destruction of, or damage to, major civil engineering works, such as railway and road bridges, canal locks and walls, power plants and dams, etc.

"Restoration of buildings, large and small, and of municipal services is work that can be carried out effectively by local operators, guided and directed by industrial maintenance and municipal engineering staffs. No special construction equipment will normally be necessary for such work.

"Restoration of major civil engineering projects that may be damaged is, however, work of a very different nature.

Design for temporary structures and repairs will often be necessary before any repair work can be started. Special construction equipment will frequently be required, together with the special skills of men with experience in heavy construction. And special materials, such as long construction timbers, steel sheet piling and quick setting cement, will be essential for the carrying out of much work of this character.

"This memorandum is related to this third category of repair work only.

"The men, the plant and the special materials required for such work are, to a large extent, already associated with construction projects of an essential character. Practically all of these projects are being carried out to unusually rigid and exacting time schedules (e.g. the Shipshaw scheme, near Arvida). Any major interference with the progress of such works (as by diverting plant and men to repair projects) would have a serious effect upon their completion and upon the planned operation of associated projects (e.g., the Aluminum plant extensions at Arvida.)

"If, therefore, adequate plans are to be made for dealing with possible damage to civil engineering structures, they must be made so as to interfere as little as possible with construction work already in progress.

"It follows that plans must therefore be drawn up on a widespread regional basis so that the constructional resources of the region may be drawn upon when emergencies arise rather than that any one construction project should be temporarily halted.

"Many other factors lead inevitably to the idea of regional organization. These include—the limited availability of special construction equipment (especially of a mobile character); the relatively small number of vital works repair to which has to be contemplated; the undesirability of having to rely on one or two contracting organizations only, in case of emergency.

"Regions which naturally suggest themselves are: the Maritime provinces, Quebec and the eastern tip of Ontario, Ontario excluding the centre part and the section from the Lakehead westwards, the Prairie provinces plus the last-named area, and British Columbia.

"Regional committees could be set up for each of these regions, the work of all being correlated by a small national executive committee or staff.

"The question of available men—with construction and engineering experience who could be spared from their regular jobs for emergency work without difficulty—could be handled by each committee in conjunction with the Wartime Bureau of Technical Personnel.

"Essential construction materials, especially those already mentioned, can be watched in each region by the maintenance of a running inventory, maintained in conjunction with the appropriate material controllers.

"An immediate inventory of construction equipment would be necessary to give the essential data on plant; once obtained it would have to be maintained on a day-to-day basis.

"Co-operation of the principal railways would be essential to the success of the proposed scheme not only in relation to transportation but also in view of the availability of such material as the C.N.R. Central Region stock of old steel bridges.

"Although not previously stated, it is naturally expected that all the organization so far suggested will work in conjunction with, and be guided by local maintenance engineering staffs. It is only in view of the probability of serious damage, beyond the scope of local repair facilities, that this memorandum has been prepared.

"Government authorization will be necessary for the use of essential materials, and for the commandeering of construction equipment. Fortunately, British Orders-in-Council Nos. 1277 (1941) and 57 (1942) are available to serve as a guide.

"The scheme herein proposed should most properly be

launched under Government auspices. Pending such action, initial steps might usefully be taken—in conjunction with the Canadian Construction Association—by The Engineering Institute of Canada, to the Council of which this memorandum is, in the first instance, respectfully submitted."

## THE END OF THE PRIZE YEAR

At this time, when the sessions of our branches are ending and the time for sending in papers is nearing its close, it might be appropriate to draw attention to the opportunities provided by the Institute prizes and medals and to urge members to contribute papers. The list follows:

The Gzowski Prize—a gold medal—for the best paper contributing to the literature of the profession of civil engineering.

The Duggan Prize—a gold medal and cash to a value of \$100—for the best paper on constructional engineering involving the use of metals for structural or mechanical purposes.

The Plummer Prize—a gold medal—for the best paper on chemical and metallurgical subjects.

The Leonard Prize—a gold medal—for the best paper on a mining subject.

In addition, five prizes of twenty-five dollars each are offered in each of the four vice-presidential zones—plus one for a French speaking member in the province of Quebec—for the best paper on any subject presented by a Student or a Junior member.

Papers submitted in competition for any of the above prizes should be in the hands of the branch secretary or sent to Headquarters **not later than June 30th.**

## MEMBERSHIP CERTIFICATES

Members are reminded that they can obtain a certificate, suitable for framing, attesting their membership in the Institute. These certificates are engraved on parchment vellum and bear the full name of the member, his classification, and the dates of his election and transfer. They measure approximately nine by twelve inches.

Some time ago, a substantial reduction in the price of membership certificates was authorized by Council. This decision aimed at making new certificates available at the minimum cost to all those Members who were automatically transferred from Associate Members, two years ago, by the by-law amendment abolishing the latter classification. The new certificate contains a complete history of the individual's Institute membership from Student to Member.

The price of the certificate is \$1.25.

## MEETINGS OF COUNCIL

A regional meeting of the Council of the Institute was held at the Royal York Hotel, Toronto, Ont., on Saturday, April 25th, 1942, at ten thirty a.m.

Present: President C. R. Young (Toronto) in the chair; Vice-Presidents deGaspé Beaubien (Montreal), and J. L. Lang (Sault Ste. Marie); Councillors J. E. Armstrong (Montreal), A. E. Berry (Toronto), D. S. Ellis (Kingston), J. G. Hall (Montreal), N. MacNicol (Toronto), A. W. F. McQueen (Niagara Peninsula), W. J. W. Reid (Hamilton), H. R. Sills (Peterborough), and J. A. Vance (London); General Secretary L. Austin Wright, and Assistant General Secretary Louis Trudel. There were also present by invitation—Past-President J. B. Challies (Montreal); Past Vice-President J. Clark Keith (Border Cities); Past-Councillors W. E. Bonn, E. G. Hewson, A. U. Sanderson and C. E. Sisson of Toronto, H. F. Bennett (London), also chairman of the Committee on the Young Engineer, T. H. Jenkins (Border Cities), I. P. Macnab (Halifax), W. R. Manock (Niagara Peninsula), D. A. R. McCannel (Regina), also president of the Dominion Council of Professional Engineers; Branch Chairmen F. T. Julian (London), H. L. Johnston (Border Cities), J. A. Lalonde (Montreal), N. B. MacRostie (Ot-

tawa), and A. L. McPhail (Niagara Peninsula); D. R. Smith, vice-chairman, Saint John Branch; W. S. Wilson, chairman, H. E. Brandon, immediate past-chairman; S. H. deJong, secretary-treasurer, F. J. Blair, S. R. Frost and C. F. Morrison, members of executive, and J. J. Spence, immediate past-secretary-treasurer of the Toronto Branch; W. C. Miller, president, Association of Professional Engineers of Ontario, and Major Barry Watson, registrar of the Ontario Association and secretary of the Dominion Council of Professional Engineers; C. C. Cariss, of Brantford, and Wills Maclachlan, of Toronto.

In welcoming the councillors and guests, the president pointed out that this was the second regional meeting of Council to be held within a week. He was very pleased to see such a large attendance. He extended a special welcome to Mr. McCannel and Major Barry Watson, president and secretary of the Dominion Council of Professional Engineers. Although only members of Council could vote, the president hoped that the guests would take part in all discussions, as Council would be very glad to have the benefit of their views. He asked each person to rise, give his name, place of residence, and Institute affiliation.

At the March meeting of Council in Montreal a suggestion made by Councillor G. M. Pitts regarding the distribution in Canada of the publications of the Founder Societies had been referred to the Publication Committee for consideration and report. For the information of members present the general secretary read Mr. Pitts' original communication, together with an interim report from the Publication Committee. The proposal had been discussed at the Vancouver meeting, but no action had been recommended.

The general secretary presented to the meeting a copy of the A.S.M.E. catalogue which lists all the publications issued by that society. This was a very comprehensive booklet, and confirmed the remarks of the chairman of the Publication Committee as to the large number of publications issued by the Founder Societies. Mr. Wright outlined the arrangement already in force between the Institute and the Founder Societies whereby Institute members may obtain the publications of the American societies at the same price as that paid by their own members. This information is published in the *Journal* at least once a year.

An arrangement such as that suggested by Mr. Pitts had already been discussed with Mr. Davies, the secretary of the American Society of Mechanical Engineers. Mr. Davies was now in the army in an executive capacity at Washington, and therefore there had been no opportunity to give further consideration to this matter. The general secretary thought that if this could be left until after the war it might be possible to work out some arrangement, although it would probably involve the Institute in some expense, and would require a good deal of organization work.

The president reported that the matter had been discussed at some length at the Vancouver meeting and while no formal motion had been passed, the general view appeared to be that the existing facilities should be drawn more forcibly to the attention of members of the Institute, either by inserting a notice in the *Journal* or by communicating with the different branches, but that no new machinery should be set up at the present time.

Mr. Sills thought it might be possible for some of the Institute branches to act as branches of the Founder Societies and as such receive a supply of their literature for distribution. Obviously, the Engineering Institute cannot cover the whole engineering field. Mr. Sills suggested that the *Engineering Journal* be devoted entirely to Canadian conditions. For world wide conditions our members might be supplied with the publications of the

Founder Societies. He understood that at the present time this would be rather difficult but brought it up as a possible objective for the future.

Major Watson inquired whether it would be possible for the Institute to publish lists of all available publications. If a list similar to that shown to the meeting by Mr. Wright could be published in the *Journal*, members of the Institute would know just what publications were available.

Mr. Vance asked if it would be possible to secure copies of the lists of publications and place them in the hands of the branch secretaries and distribute them among the membership.

Mr. Wright thought these suggestions to be very practical. He knew that reprints of the A.S.M.E. catalogue could be secured, and asked whether we should try to cover the whole membership or just get enough copies for councillors, chairmen and secretaries of branches, etc. He could say almost definitely that the A.S.M.E. would be glad to supply the catalogues, and felt sure that the other societies would do the same thing if they had the lists available. He would be glad to go into the matter.

Some of the American societies published abstracts of some of their papers, and Mr. Sills suggested that it might be possible to secure these and publish them in the *Journal*. Mr. Wright did not know whether this would be possible, but pointed out that through the courtesy of the Engineering Societies Library the Institute receives and publishes in the *Engineering Journal* copies of reviews of all the books received by the American societies. After further discussion, it was decided to leave this matter in the hands of the general secretary for further investigation.

The president stated that this discussion and that at the Vancouver meeting would be reported to the Publication Committee for its consideration and assistance in preparing its final report, which would be presented to a later meeting of Council.

The general secretary explained that this question had been brought up by a resolution from the Montreal Branch in which they had asked Council to consider the possibility of abolishing the classification of Branch Affiliate. Branch Affiliates were not members of the Institute itself, but only of the branch. The branches may admit them at any fee they decide upon. Members had complained that affiliates received all the privileges at less than half the fee. When Institute membership lists were published, complaints had been received from Branch Affiliates that their names did not appear in the list. At the March meeting of Council the matter had been referred to the Institute's membership committee for consideration and report. A report had been received from the committee which the chairman, Mr. Hall, read to the meeting and which recommended:

- (1) That the classification be not eliminated.
- (2) That the name be changed from "Branch Affiliate" to "Branch Associate," or some similar name so as to eliminate the confusion in the use of the term "affiliate."
- (3) That Council recommended to each Branch that a fee of, say, \$5.00 be the minimum for "Branch Associate," also, that each Branch be reminded of its power to increase the fee to any desired figure, or, to eliminate the classification entirely, if there is still a tendency to choose it rather than that of Affiliate, as reported by Montreal Branch."

In elaborating on the report, Mr. Hall pointed out that the Montreal Branch had brought up, first, the difficulty in collecting the fee, and, secondly, the fact that, because of the lower annual fee, people tended to apply for admission as Branch Affiliate rather than Institute Affiliate. As far as the first point is concerned, that is entirely up to

# AT THE WEBSTER LECTURES, TORONTO



*Above: J. L. Lang, R. L. Dobbin*



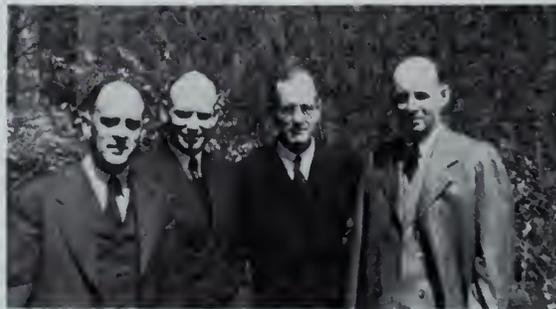
*Below: W. S. Hall and Prof. F. Webster*



*Above: W. S. Wilson and W. H. M. Laughlin, chairman and vice-chairman respectively of the Toronto Branch*



*Below: Prof. C. F. Morrison and Prof. I. F. Morrison*



*Left: T. S. M. Kingston, V. H. McIntyre, W. B. Dunbar, C. D. Carruthers*



*Above: Members of the Toronto Branch Executive. Left to right, back row: J. J. Spence, S. H. de Jong, E. C. Hewson, C. F. Morrison, Front row: H. E. Brandon, W. S. Wilson, President C. R. Young, W. H. M. Laughlin*



*Left: General picture of the "class"*



the branch. Each branch must decide for itself whether or not it wishes to have Branch Affiliates. With regard to the second point, the committee felt strongly that there should be some clarification of the qualifications for these two classifications. Based on his experience as a member of Council, Mr. Hall felt that there was definitely some uncertainty as to what an Affiliate really is. Section 11 of the by-laws, describing Institute Affiliates, indicates a very high type of professional man—not just a salesman who wishes to be connected with the Engineering Institute. There is possibly some confusion between the term "Branch Affiliate" and "Affiliate."

Mr. Hall reported that he had just received from Councillor Macpherson, of Vancouver, a long letter giving his views, particularly on the recently established practice of admitting as Affiliates persons who did not quite fulfill the educational or professional requirements for Junior or Member. Mr. Macpherson was not in favour of this, and did not think it was in accordance with the intent of the by-laws.

The president thanked Mr. Hall for his valuable report. He reported that letters had also been received from the Calgary and Edmonton branches opposing the abolition of the class of Branch Affiliate. The Lethbridge Branch also finds it very desirable to have Branch Affiliates, and are most anxious to retain that particular classification. They would probably have no objection to having the name changed.

Applications were received from many persons who, in the opinion of Council, had not the necessary educational qualifications for membership. Frequently they were given the option of election as Affiliate until such time as they were prepared to sit for the Institute's examinations for Junior or Member.

In response to an inquiry from Mr. Berry, the president read figures from the last annual report giving the number of Branch Affiliates in each branch. Mr. Bennett could see the possibility of abuse of this classification. Persons not eligible for Institute Affiliateship might become Branch Affiliates and pay the smaller fee. In the London Branch their meetings were advertised in the press, and frequently engineers attended who were not members of the Institute and not even Branch Affiliates.

Following further discussion, on the motion of Mr. Hall, seconded by Mr. Vance, it was unanimously resolved that the classification of Branch Affiliate be not eliminated; that consideration be given to the changing of the name, and that some decision be made as to the fees for that classification.

The question of the qualifications for Institute Affiliate had been discussed, and on the motion of Mr. Vance, seconded by Mr. Berry, it was unanimously resolved that the Membership Committee be asked to continue its studies and investigate the qualifications for Institute Affiliate and report to Council at a later meeting.

The general secretary quoted from a memorandum by Mr. P. B. Motley a suggestion that Council consider and report on the desirability of amending the by-laws so that Life Membership would be removed from the section dealing with exemptions, and placed in the same category as Honorary Membership.

At the request of the Finance Committee the matter had been discussed at the Vancouver meeting of Council, and the opinions expressed were summed up in the following minute of that meeting:

"It was agreed that the opinion of this Council meeting is that some steps should be taken to place Life Membership in the category of an honour rather than a concession. It was hoped that this expression of opinion would be of some assistance to the Finance Committee in dealing with the matter."

Mr. Armstrong stated that Mr. Motley is very anxious

to know what action Council has taken on this memorandum.

Mr. McQueen felt that Life Membership should be granted as an honour. Members should not feel that their names were placed on this list simply because they were unable to pay their fees.

Mr. Bennett, Mr. Vance and Mr. Hall spoke on the question, indicating that no change in procedure seemed to be necessary. Finally it was moved and seconded that the proposal be tabled.

The president pointed out that this would not preclude consideration of Mr. Motley's suggestion regarding the by-law covering specifications.

The general secretary outlined the circumstances that had led up to the Institute sponsoring a series of lectures by Professor F. Webster, Deputy Chief Engineer of the Ministry of Home Security, London, England. He described the events leading up to the final arrangements for the lectures, which had been held under the able direction of the officers of the Toronto Branch. He had been extremely pleased to hear of the presentation which had been made to Professor Webster who had deeply appreciated this action. He asked Mr. Wilson, the chairman of the Toronto Branch, to present a report on the lectures.

Mr. Wilson thought it rather superfluous to go into details, as nearly everyone at the Council meeting had attended the lectures. There had been a registration of about one hundred and eighty-five. The lectures had been quite technical and extremely interesting. There had been many favourable comments on the excellent lead the Institute had taken in arranging such lectures. Professor Webster had had a hard assignment. He spoke for two and a half hours at a time. The members attending had indicated their desire to show their appreciation in some tangible way and presented Professor Webster with a very fine wrist watch and a wallet of money. He had stated that he could not possibly accept the money, but finally sent it to the Milk Fund for the children in England. The Toronto Branch had been very glad to have some part in arranging for these lectures.

Mr. Bennett emphasized the necessity of getting the report of these lectures into the hands of those who could make good use of the information. Many engineers who could have been and who should have been at the meetings were disappointed, and he felt that these people should get a copy of the proceedings. The Engineering Institute had a wonderful opportunity to take the lead in getting this information circulated to the right people. Engineers are leading the army and engineers should lead the civilians.

At twelve forty-five the meeting adjourned for lunch and reconvened at two o'clock, with the president in the chair.

Before continuing the discussion on the Webster lectures, Mr. Macnab asked permission to present on behalf of Past Vice-President Wilson, of Sydney, and Past Vice-President Dunsmore, of Halifax, their regret at being unable to be present, and their best wishes for the success of the meeting.

It had given him, personally, a great deal of pleasure to attend the lectures. He had heard Professor Webster in Halifax and, having heard his first talk, was very anxious and very pleased to be able to attend this series of lectures. Both the Cape Breton and the Halifax branches had asked him to represent them and to go back and pass on the information which he would receive. He was very proud of what the Institute had done in sponsoring these lectures. In his opinion it was one of the biggest contributions to the welfare of the country that the Institute had ever made. The way in which the matter was dealt with from now on was very important. While realizing that much of the information received was of a

more or less confidential nature, he felt that those who had attended the meetings should have the privilege of passing much of it on to interested bodies for their guidance. It was most important that the Maritimes should have this information, also the people on the west coast, and he was definitely of the opinion that the information should be disseminated under the leadership of The Engineering Institute of Canada. He felt that a strong committee of the Institute should be appointed with branch committees or provincial committees to work out the details as applied to the different localities.

The president explained that the meetings had been called with that thought in mind—that those who attended would go back to their own localities and act as consultants or advisers, using discretion as to what should or should not be made public.

In reply to an enquiry from Mr. Vance, Mr. Wright stated that when the notes are completed, it might be that Professor Webster would indicate those parts which were to be treated as strictly confidential, or he might delete them altogether from the report. It was impossible to say just how soon the report would be ready, but a considerable amount of work was involved, and Professor Webster has several other appointments in the near future which might delay the editing of the material. From the discussion which followed it seemed desirable that some indication should be given to those who had attended the lectures as to which portions of the material should be treated as confidential. Accordingly, on the motion of Mr. Hall, seconded by Mr. Armstrong, it was unanimously resolved that the general secretary contact Professor Webster at the earliest opportunity and secure from him a list of items which were not to be disclosed, and that it be sent out to all who were registered at the lectures.

It had been suggested that in disseminating this valuable information and in continuing the good work which had been started, some official recognition and support might be secured from the Dominion Government. Accordingly, on the motion of Mr. Vance, seconded by Mr. Armstrong, it was unanimously resolved “that the President of The Engineering Institute of Canada approach the proper authorities of the Dominion Government to urge the formation of a central authority for the implementing of the information obtained by the group assembled at the University of Toronto by The Engineering Institute of Canada, under the leadership of Professor F. Webster, Deputy Chief Engineer of the Ministry of Home Security of Great Britain, in order that the valuable engineering information on protection to personnel, property and vital machinery, should be made available at once to all who are responsible for such protection.”

Mr. Bennett reported that through the establishment of counselling committees, the Committee on The Young Engineer has become personal to each branch of the Institute and, rather than present a report on the work of the committee as a whole, he would have preferred to receive comments from the members of the various branches attending the meeting. Many of the branches have already organized their counselling committees, in many cases the chairman of the branch being on the committee. Good progress had been made in the distribution of the booklet “The Profession of Engineering in Canada.” Copies of the E.C.P.D. booklet, “Engineering as a Career,” and their Guidance Manual had also been distributed in Canada by Mr. Bennett’s committee. The response had been most encouraging.

A suggestion had been made that there should be a French translation of the Canadian booklet for distribution in the province of Quebec. Mr. Bennett also felt that the committee would need three or four thousand additional copies of the English edition to carry on for the next year or so. He would like authority to purchase these

additional copies. The president referred the matter to Vice-President Beaubien, chairman of the Finance Committee, who thought that such an expenditure could be provided for. Accordingly, on the motion of Mr. Hall, seconded by Mr. Sills, it was unanimously resolved that the matter of additional copies of the booklet be referred to the Finance Committee with power to act.

Mr. Bennett also reported that the question of Students’ and Juniors’ Prizes was receiving consideration by his committee. In his opinion these prizes should be continued and Students and Juniors of the Institute should be encouraged to submit papers. Opinions are being obtained from the various branches and a report will be submitted as soon as possible.

The president thanked Mr. Bennett for his very informative report and expressed the hope that this very gratifying activity of the Institute would be carried on in the future as it had in the past with a great deal of vigour and foresight.

A number of applications were considered and the following elections and transfers were effected:

ADMISSIONS	
Members .....	6
Juniors .....	2
Students .....	4
Affiliates .....	3
TRANSFERS	
Student to Junior .....	1

As president of the Dominion Council of Professional Engineers, Mr. McCannel extended the sincere thanks of that Council for the gracious way in which he had been received at the Council meeting—a further evidence of the courtesy which has always been extended. Mr. McCannel also expressed his pleasure at being able to attend the lectures given by Professor Webster and, on behalf of the Dominion Council, extended congratulations to the Institute for their efforts in sponsoring this very valuable series of lectures.

In response to Mr. Vance’s enquiry, the president stated that he hoped to visit the Quebec and Maritime branches during the latter part of July and the first part of August. He would be glad to visit any of the Ontario branches that he had not already visited, at the convenience of the branches themselves. Replying to Mr. Hall, the president stated that he would be greatly pleased if any members of Council could accompany him on any of these visits. He had not made the suggestion as he did not wish to impose on the councillors. He knew they were all extremely busy people.

There being no further business, the Council rose at five o’clock p.m.

A meeting of the Council of the Institute was held at Headquarters on Saturday, May 16th, 1942, at ten thirty a.m.

*Present:* President C. R. Young in the chair; Vice-Presidents deGaspé Beaubien and K. M. Cameron; Councillors E. D. Gray-Donald, J. G. Hall, W. G. Hunt, M. G. Saunders and H. R. Sills; Treasurer E. G. M. Cape; Past-Councillor R. A. Spencer, of Saskatoon; Secretary Emeritus R. J. Durley, General Secretary L. Austin Wright and Assistant General Secretary Louis Trudel.

The general secretary presented a letter from Mr. Thos. E. Storey, secretary of the Joint Committee on Co-operation in Manitoba, together with a copy of a proposed co-operative agreement between the Association of Professional Engineers of the Province of Manitoba and The Engineering Institute of Canada, which had been approved for submission to the Institute by the Council of

the Association and the Executive of the Winnipeg Branch of the Institute.

The proposal had been studied by the Institute's Committee on Professional Interests, and the general secretary read a letter from Mr. Challies, the chairman of that committee, advising that general approval had been given to the proposal by his committee. The committee was of the opinion that with some clarification and some minor changes, the proposal should be acceptable to the Institute. Mr. Challies suggested that if the Council would approve of the general principle of the agreement, his committee would discuss the matter with the joint committee and later submit a final draft for the acceptance of Council.

Council recorded its pleasure at receiving this proposed agreement, and on the motion of Mr. Beaubien, seconded by Mr. Gray-Donald, it was unanimously resolved that Council, on the recommendation of the Committee on Professional Interests, approves of the general principle of the proposed agreement, and leaves the matter of further negotiations in the hands of that committee.

The general secretary read a letter from the executive of the Saint John Branch which expressed appreciation of the progress which has already been made towards co-operation with Provincial Professional Associations, and urging that negotiations be continued with other provinces so that greater benefits would accrue to the engineers in all parts of Canada. This was noted.

The general secretary read a letter which the president had written to the High Commissioner for the United Kingdom in Canada expressing the Institute's appreciation of the courtesy extended in permitting Professor F. Webster, Deputy Chief Engineer of the British Ministry of Home Security, to give the series of lectures at Toronto. He also read an acknowledgment from the Acting High Commissioner, Sir Patrick Duff.

The general secretary reported that after consultation with the president and Professor Webster it had been decided to copyright the material covering the Webster lectures. This was being done in order to prevent unauthorized persons from reprinting all or any portion of it. Professor Webster has requested that the notes be circulated only to those persons who attended the lectures and to appropriate organizations selected by the Institute. This action was unanimously approved.

The general secretary reported that after discussions with the president as to the procedure to be followed with a view to implementing the application of the information received from Professor Webster, as had been suggested at the Toronto meeting of Council, a letter had been sent to the Institute branches suggesting that in each branch a committee be set up consisting of the chairman and councillors of the branch and those persons who had attended the lectures, such committees to discuss local conditions, methods of adapting the material, and to decide how and to whom the material should be distributed.

It was noted that the financial statement to the end of April had been examined and found satisfactory.

Following the practice established last year, it was unanimously resolved, on the recommendation of the Finance Committee, that the annual fees of members resident in the United Kingdom be remitted for the year 1942.

The general secretary read a resolution from the executive of the Saint John Branch suggesting that an opportunity now existed for improving the status of the engineer in the Royal Canadian Engineers and other engineering services in the Canadian Army by obtaining rank and pay equivalent to that accorded to the medical and dental services, and asking that immediate action be taken by the Council of the Institute to bring this mat-

ter to the attention of the Minister of National Defence.

The general secretary stated that this matter had been before Council on several occasions, and that there had been considerable correspondence with the Minister of National Defence. At one time it had seemed that some progress was being made, with particular reference to the engineers in the Ordnance Department, but at that time the whole set-up had been changed and engineers were taken out of that Department entirely, except for maintenance work. Engineers, unlike the doctors and dentists, did not have one single organization representing them, or a common basis of education and accrediting. This, coupled with the fact that professional engineering work in the army is now being done largely by civilians, was the main difficulty. In acknowledging receipt of the resolution, the general secretary had explained the situation to the branch. The resolution and correspondence were noted, and the general secretary stated that he would keep in touch with the situation at Ottawa, to see if anything could be done.

A number of applications were considered and the following elections and transfers were effected:

#### ADMISSIONS

Members .....	11
Students .....	14
Affiliates .....	4

#### TRANSFERS

Junior to Member ... ..	1
Student to Member .....	1
Students to Juniors .....	3

The president welcomed Professor R. A. Spencer of Saskatoon, who was visiting in the city, and asked if he had anything he would like to bring up at the meeting.

Professor Spencer stated that he had come to Ottawa as part of a delegation to attend a conference called by the Wartime Bureau of Technical Personnel, under the chairmanship of General LaFleche, to consider the question of engineering requirements for the active services and industry for the coming year, and a proposal to funnel those requirements through one common channel. The requirements greatly exceeded the supply, but the Bureau pointed out that by withdrawing men from non-essential industry it would be possible to bridge the gap to a great extent. The Bureau recommended that the engineering schools handle as many students as they could accommodate. All applications for technical personnel (students and graduates) would now come through the Bureau, which was a great step forward. A Board would be set up in each university to consider individual cases, and after consultation with the students themselves recommendations would be made as to where they should go. In Professor Spencer's opinion the conference had been a great success.

Professor Spencer commented on the success of the recent visit of the president to Saskatoon. Such visits were an important part in the unification of engineers across Canada, and should be established as a permanent feature.

#### COMING MEETINGS

**Eastern Photoelasticity Conference** — Fifteenth Semi-Annual Meeting at the University Club, 40 Trinity Place, Boston, Mass., on Saturday, June 20, 1942.

**American Water Works Association** — Sixty-second Annual Convention at Stevens Hotel, Chicago, Ill., June 21-25. Executive Secretary, Harry E. Jordan, 22 East 40th Street, New York, N.Y.

## ELECTIONS AND TRANSFERS

At the meeting of Council held on May 16th, 1942, the following elections and transfers were effected:

### Members

- Bell**, Clarence William, B.Sc. (Civil) (Univ. of Sask.), asst. branch mgr., Currie Products Ltd. Toronto, Ont.  
**Burdett**, George Henry, B.A.Sc., C.E. (Ecole Polytechnique), regional representative, Wartime Bureau of Technical Personnel, Montreal, Que.  
**Collard**, Richard Reeve, Air Commodore, director of works and bldgs., R.C.A.F., Ottawa, Ont.  
**Morrison**, Charles Austin, B.A.Sc. (Elec.) (Univ. of Toronto), mgr., lamp sales divn., Canadian General Electric Co. Ltd., Montreal, Que.  
**Thorne**, Edward Charles, Major, R.C.E., Department of National Defence, Ottawa, Ont.  
**Vinet**, Jacques, B.A.Sc., C.E. (Ecole Polytechnique), cost engr., A. Janin & Co. Ltd., Gaspé, Que.

### Affiliates

- Johnson**, Stanley, (School of Technology, Manchester), gen. supt. of mfg., Johnson Wire Works Ltd., Montreal, Que.  
**Loranger**, Aime, Canadian Propellers Ltd., Montreal, Que.  
**Seed**, Charles Edward, asst. engr., Angus Robertson Construction Co., Ottawa, Ont.  
**White**, Gerald Langdale, B.A.Sc. (Chem.) (Univ. of Toronto), editor and asst. business mgr., Westman Publications Ltd., Toronto, Ont.

### Transferred from the class of Junior to that of Member

- Hyman**, Howard Davison, B.Sc. (Civil) (McGill Univ.), gen. mgr., J. R. Booth Ltd., Ottawa, Ont.  
**Ruggles**, Edgar Lenfest, B.Sc. (Civil) (Univ. of Sask.), field engr., The Bird-Archer Co. Ltd., Regina, Sask.

### Transferred from the class of Student to that of Member

- Rogers**, Howard W., B.Sc. (Elec.) (McGill Univ.), sales engr., asst. to branch mgr., Canadian Blower & Forge Co. Ltd. and Canada Pumps Ltd., Montreal, Que.

### Transferred from the class of Student to that of Junior

- Read**, Frederick Cyril, B.A.Sc. (Chem.) (Univ. of Toronto), research asst., Dominion Tar & Chemical Co., Montreal, Que.  
**Watters**, Edgar Steen, B.Sc. (Elec.) (Univ. of N.B.), radio operator, Station C.B.A., Sackville, N.B.  
**Wiebe**, Leslie, B.Sc. (Mech.) (Univ. of Sask.), chief draftsman, MacDonald Bros. Aircraft Ltd., Robinson St. Divn., Winnipeg, Man.

### Students Admitted

- Baird**, Robert Gordon, (Univ. of N.B.), 287 King St. W., Saint John, N.B.  
**Cox**, Kenneth Victor, (Univ. of N.B.), 572 Needham St., Fredericton, N.B.  
**Hibbard**, David Ernest, (Univ. of Toronto), 186 St. George St., Toronto, Ont.  
**Jewett**, Arthur Earle, (Univ. of N.B.), 101 Aberdeen St., Fredericton, N.B.  
**Kennedy**, Robert William, (McGill Univ.), 6922 De Montmagny Ave., Montreal, Que.  
**Marr**, Ralph Burton, (Univ. of N.B.), P.O. Box 285, Fairville, N.B.  
**Peabody**, Gerald Stead, (Univ. of N.B.), North Devon, N.B.  
**Quist**, Jack Ernest, (Univ. of Toronto), 310 Monaghan Road, Peterborough, Ont.  
**Shaw**, Douglas Thomas, (McGill Univ.), 2204 Prud'homme Ave., Montreal, Que.  
**Smith**, Walter Marshall, (Univ. of N.B.), 554 Brunswick St., Fredericton, N.B.  
**Thibault**, Bernard, (Ecole Polytechnique), 4080 St. Hubert St., Montreal, Que.  
**Wirtanen**, Ernest W., B.Sc. (Elec.) (Milwaukee School of Engineering) 313 Maitland Ave., Peterborough, Ont.

## Personals

**The Hon. C. D. Howe**, HON. M.E.I.C., received an honorary degree of LL.D., at the convocation held at Queen's University last month.

**J. E. Porter**, M.E.I.C., has recently been elected vice-president and director of Ford Motor Company of Canada, Limited. A graduate from the University of Toronto in the class of 1915, he joined the staff of the Department of



J. E. Porter, M.E.I.C.

Public Works of Canada as assistant engineer in the district of western Ontario. In 1918 he went with the Canadian Steel Corporation Limited at Ojibway, Ont., as field engineer and inspector. In 1922 he joined the staff of the Ford Motor Company and was in charge of the civil engineering branch. Later he became in charge of all engineering activities of the company and last July he was appointed general superintendent of the company.

## News of the Personal Activities of members of the Institute, and visitors to Headquarters

In 1926 Mr. Porter was a councillor of the Institute representing the Border Cities Branch.

**Dr. Arthur Surveyer**, M.E.I.C., consulting engineer of Montreal and past-president of the Institute has recently been appointed a member of the National Research Council.

**D. R. Smith**, M.E.I.C., is the newly elected chairman of the Saint John Branch of the Institute. Born at St. Martin's, N.B., he was educated at the University of New Brunswick and graduated in 1910 as a civil engineer. For a few years after graduation he was employed as assistant to G. G. Murdoch, consulting engineer at Saint John. From 1913 to 1915 he was in private practice as a civil engineer on surveys, water and sewer construction and suburban development.

During the last war he served overseas from 1916 to 1919.

Mr. Smith is now director of works of the City of Saint John.

**Dr. C. A. Robb**, M.E.I.C., who had been on the staff of the University of Alberta for twenty-five years, has recently accepted a position with the Aluminum Company of Canada Limited in Montreal. At the outbreak of the present war Dr. Robb was put in charge of the Gauge Division of the War Supply Board. Later he was power consultant in the munitions branch of the Department of Munitions and Supply.

**Colonel H. J. Lamb**, M.E.I.C., is now with the Department of Munitions and Supply as resident technical officer, at the strip mill of Anaconda American Brass Limited, New Toronto. Colonel Lamb is a past president of the Association of Professional Engineers of Ontario.

**W. A. Duff**, M.E.I.C., has recently retired from the position of engineer of bridges and roadway, Canadian National Railways. A native of Wentworth County, Ont., Mr. Duff has had a professional career of 41 years, 35 of which have been in railway services and four years with bridge construction companies in the United States and Canada.

Graduating in applied science from the University of Toronto, in 1901 his first position was as draughtsman and engineer with the Vancouver, Victoria and Eastern Railway in the Kettle Valley, B.C., but he came East a year later to join the Grand Trunk at Hamilton. Then followed a four-year period with bridge companies and in 1907 Mr. Duff became assistant bridge engineer for the National Transcontinental Railway at Ottawa, later becoming engineer of bridges for the Canadian Government Railways at Moncton, and then assistant chief engineer. In 1920 he was transferred to the Canadian National Railways as engineer of standards and in 1932 his responsibilities were

**Professor R. W. Angus**, HON.M.E.I.C., head of the department of mechanical engineering at the University of Toronto, has received the George Warren Fuller Award of the American Water Works Association "for his noteworthy contributions to research in water hammer and other hydraulic subjects." The award was presented to him at the annual convention of the Canadian Section of the American Water Works Association held at Niagara Falls last April.

**J. A. Ouimet**, M.E.I.C., joint chief engineer of the Canadian Broadcasting Corporation, has been elected chairman of the Montreal Branch of the Institute of Radio Engineers.

**J. V. Rogers**, M.E.I.C., was transferred at the beginning of this year from the position of chief draughtsman to that of plant engineer with the Alberta Nitrogen Products Limited, and is in charge of all construction and maintenance work.



**W. A. Duff, M.E.I.C.**



**R. O. Stewart, M.E.I.C.**



**J. A. Ellis, M.E.I.C.**

enlarged by appointments as engineer of bridges and roadway.

**R. O. Stewart**, M.E.I.C., has been appointed engineer of bridges with Canadian National Railways at Montreal. Born at Lindsay, Ont., he graduated with honours in applied science from the University of Toronto in 1911. His first position was with the Dominion Bridge Company in 1910 and in 1913 he became assistant bridge engineer for the Canadian Government Railways at Moncton. After the organization of the Canadian National Railways Mr. Stewart became assistant engineer of standards, first at Toronto, then at Montreal remaining in the latter city through subsequent promotions.

**René Dupuis**, M.E.I.C., has recently been appointed director of the new department of electrical engineering of Laval University, Quebec.

He began his engineering education at McGill University, Montreal, and completed his course at Nancy, France, where he obtained his diplomas in Mechanics and Physics. He also studied Political Economy. Returning to Canada, Mr. Dupuis was employed for two years by the Canadian Westinghouse Company, Hamilton, Ont. From 1928 to 1930, he was employed in the repair shop of the Shawinigan Water and Power Company at Three Rivers, where his work brought him into relation with Quebec Power Company engineers. In 1930 he was invited to go to Quebec as assistant superintendent of the power division. In 1937 he was appointed superintendent of that division and in 1939 he became assistant general superintendent of the company.

Mr. Dupuis has also been appointed lately a member of the Superior Board of Technical Education of the province. He has been lecturing at Laval University for the last two years in the Mining and Metallurgical Department.

**J. A. Ellis**, M.E.I.C., has been appointed engineer of track for Canadian National Railways at Montreal. He was born at Arbroath, Scotland, and his engineering qualifications were gained at the City and Guilds Technical College, London. Following service on underground railway construction in London and with the former Great Northern Railway, now part of the London and North Eastern, Mr. Ellis spent five years on construction and maintenance with the Oudh and Rohilkhand State Railway in India. He came to Canada in 1911 and joined the Canadian Northern Railway, later entering the service of the Canadian Government Railways at Moncton where he afterwards became office engineer. In 1921 Mr. Ellis was appointed assistant engineer of roadway standards for the Canadian National Railways at Toronto, later being transferred to Montreal in a similar capacity and continuing these duties until his present appointment.

**George E. Kent**, M.E.I.C., has recently returned from Talara, Peru, where he was assistant refinery superintendent with the International Petroleum Company. He has now gone to Regina, Alta., to take the position of assistant refinery superintendent with Imperial Oil Limited.

**George H. Midgley**, M.E.I.C., who was loaned to Wartime Merchant Shipping Limited, Montreal, has now returned to Dominion Bridge Company Limited, Lachine, Que. During the past year he has been acting as chief engineer, manager of purchasing division, etc., for Wartime Merchant Shipping Limited. Owing to ill health it was necessary for him to take a considerable rest. Mr. Midgley has now recovered and is in charge of certain phases of Dominion Bridge Company's war work.

**R. L. Morrison**, M.E.I.C., who is employed with Messrs. Airspeed (1934) Limited at Portsmouth, England, has

recently been transferred from the grade of Associate to that of Associate Fellow in the Royal Aeronautical Society.

**R. M. Hardy**, M.E.I.C., of the Department of Civil Engineering at the University of Alberta is in Montreal for the summer months and is employed in the general engineering department of the Aluminum Company of Canada Limited.

**W. E. Weatherbie**, M.E.I.C., has accepted a position with the Aluminum Company of Canada at Shawinigan Falls, Que. He has spent the past two years at Trinidad, B.W.I., employed by the Trinidad Leaseholds Limited and later with Walsh and Driscoll, contractors.

**Bernard Collitt**, M.E.I.C., was elected a director of Jenkins Brothers Limited at the recent annual meeting of the shareholders held in Montreal. He has been metallurgist with the company for the past twelve years.



**Bernard Collitt, M.E.I.C.**



**Viggo Jepsen, M.E.I.C.**



**G. W. Griffin, M.E.I.C.**

Born in Lincoln, England, Mr. Collitt was educated at Queen Elizabeth's Grammar School, Gainsborough. After a thorough training in chemistry in London, he studied metallurgy in Sheffield and in Germany and came to Canada in 1909. During the Great War of 1914-1918 he was chief chemist and metallurgist with Ruston and Hornsby Limited, of Lincoln, England, a company which at that time employed over 10,000 workpeople in the manufacture of aeroplanes, aero-engines, submarine engines, tank engines, tractors, paravanes and numerous other munitions of war. Holding high qualifications both as an engineer and a chemist, he has had a wide experience in the application of metallurgy and chemistry to engineering and is well known to the leading metallurgists of the Dominion and to many of those in the United States.

In 1937 he was chairman of the Montreal Chapter of the American Society for Metals.

**Viggo Jepsen**, M.E.I.C., is the newly elected chairman of the St. Maurice Valley Branch of the Institute. He was born and educated in Denmark and came to Canada in 1928. He joined the staff of the Shawinigan Water and Power Company, Limited where he was engaged in power development. In 1932 he went with James A. Ogilvy's Limited, Montreal, as sales engineer for oil burning equipment. For a few months in 1936 he worked on the installation of caustic treatment plant at the Canadian Copper Refineries Limited, Montreal. Later in the same year he joined the staff of Consolidated Paper Corporation, Limited, in the Laurentide Division, at Grand'Mère, Que., and soon became chief draughtsman, a position which he still occupies.

**Guillaume Piette**, Jr.E.I.C., has received his degree of Master of Science in Engineering after two years of post-graduate work at the University of Michigan, Ann Arbor. He graduated as a B.A.Sc. from Ecole Polytechnique of Montreal in 1939 and he is at present employed with the Department of Highways at Quebec.

**G. B. Batanoff**, S.E.I.C., has joined the staff of the Canadian General Electric Company and is working in their plant at Peterborough, Ont. He graduated from the University of Saskatchewan in mechanical engineering this spring.

**G. A. Mussen**, S.E.I.C., is now employed by Amalgamated Electric Corporation Limited in Toronto. He graduated in electrical engineering from McGill University in the class of 1935, and had been employed by the Dominion Bridge Company, Montreal, since 1937.

**G. W. Griffin**, M.E.I.C., has recently been appointed secretary-treasurer of the Saint John Branch of the Institute. Mr. Griffin is assistant engineer of the Canadian Pacific Railway at Saint John, N.B.

**Major Frank S. Milligan**, M.E.I.C., is attached to Military

District No. 2 as district engineer officer. During the last war Major Milligan served overseas with the Royal Engineers, 206th Field Company in France. As a civilian he was in private practice in Toronto.

**Robert A. Cunningham**, S.E.I.C., has joined the staff of E. G. M. Cape and Company at St. John's, Newfoundland. He was formerly with Price Brothers and Company, Limited, at Kenogami, Que. He graduated from Queen's University with the degree of B.Sc., in civil engineering in the class of 1941.

**Flying-Officer Raymond P. Woodfield**, S.E.I.C., is now attached to Air Force Headquarters at Ottawa after taking a course in aeronautical engineering at Montreal. Previous to his enlistment, he was on the staff of Canadian Westinghouse Company, Hamilton, Ont. Flying-Officer Woodfield graduated from the University of Manitoba in electrical engineering with the degree of B.Sc., in the class of 1939.

**W. R. Topham**, S.E.I.C., has been commissioned as a pilot officer in the R.C.A.F. and is at present stationed in the school of aeronautical engineering at Montreal. Before his enlistment he was on the staff of the Canadian Industries Limited at Beloeil, Que.

**Frederick Dixon**, S.E.I.C., has joined the staff of the Westinghouse Electric and Manufacturing Company, Limited, Atlanta, Georgia, U.S.A., and he expects to take the co-operative course in electrical engineering at the Georgia School of Technology. He was previously employed as a junior in the engineering department of Bepco Canada Limited, Montreal.

**Gilbert Proulx**, S.E.I.C., has recently joined the staff of the Saguenay Electric Company at Chicoutimi, Que., as assistant to the superintendent. He had been employed by

the Dominion Bridge Company, Limited in Montreal since his graduation from Ecole Polytechnique in 1941.

**John C. Hamilton**, S.E.I.C., has taken a position with the Canadian International Paper Company, Limited, at Three Rivers, Que. He graduated this spring from Queen's University.

**Allan C. Findlay**, S.E.I.C., who has received his degree from McGill University this spring is now employed by the Steel Company of Canada, Montreal.

**J. A. Martin**, S.E.I.C., has taken a position in the aircraft department of Canadian Vickers Limited, at Montreal. He received his degree from Ecole Polytechnique last month.

**P. W. Bishop**, S.E.I.C., who graduated from the University of New Brunswick this spring has joined the staff of Demerara Bauxite Company at Mackenzie, British Guiana.

### VISITORS TO HEADQUARTERS

**J. J. Hurley**, S.E.I.C., of Toronto, Ont., on April 27th, 1942.

**John E. Cade**, M.E.I.C., assistant chief engineer, Fraser Companies Limited, Edmundston, N.B., on April 27th, 1942.

**Major Alexandre Dugas**, Officers' Training Centre, Brockville, Ont., on April 29th, 1942.

**J. N. Galli**, S.E.I.C., Winnipeg, Man., on April 30th, 1942.

**W. V. Morris**, S.E.I.C., Winnipeg, Man., on April 30th, 1942.

**Camille Lessard**, M.E.I.C., consulting engineer, Quebec, Que., on May 5th, 1942.

**M. F. Dean**, S.E.I.C., Halifax, N.S., on May 6th, 1942.

**George E. Kent**, M.E.I.C., Imperial Oil Limited, Regina, Sask., on May 8th, 1942.

**Harold A. Fuller**, M.E.I.C., engineer, Tropical Oil Company, Colombia, South America, on May 11th, 1942.

**R. L. Smith**, S.E.I.C., Portreeve, Sask., on May 12th, 1942.

**Morris Fast**, S.E.I.C., Aluminum Company, Shawinigan Falls, Que., on May 15th, 1942.

**Professor R. A. Spencer**, M.E.I.C., Department of Mechanical Engineering, University of Saskatchewan, Saskatoon, Sask., on May 16th, 1942.

**M. G. Saunders**, M.E.I.C., Arvida, Que., on May 16th, 1942.

**K. M. Cameron**, M.E.I.C., chief engineer, Department of Public Works, Ottawa, Ont., on May 16th, 1942.

**Pilot Officer E. S. Braddell**, M.E.I.C., R.C.A.F., Winnipeg, Man., on May 16th, 1942.

**Arnold Haltrecht**, Affiliate E.I.C., National Research Council, Ottawa, Ont., on May 18th, 1942.

**John E. Pringle**, M.E.I.C., Port-of-Spain, Trinidad, B.W.I., on May 19th, 1942.

**P. G. Wolstenholme**, Affiliate E.I.C., Port-of-Spain, Trinidad, B.W.I., on May 19th, 1942.

**Charles A. Robb**, M.E.I.C., Edmonton, Alta., on May 20th, 1942.

**M. B. Watson**, M.E.I.C., secretary-treasurer, Dominion Council of Professional Engineers, Toronto, Ont., on May 21st, 1942.

**Roy W. Emery**, M.E.I.C., Demerara Bauxite Company, Mackenzie, British Guiana, S.A., on May 21st, 1942.

**P. J. MacDonald**, M.E.I.C., Aluminum Company of Canada, Kenogami, Que., on May 23rd, 1942.

**Guillaume Piette**, Jr., E.I.C., Department of Highways, Quebec, Que., on May 23rd, 1942.

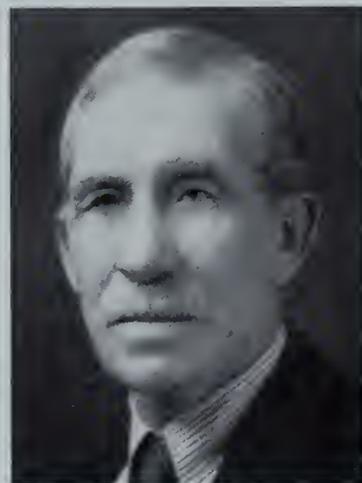
## Obituaries

*The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.*

**Thomas Stiryaker Armstrong**, M.E.I.C., died at the hospital in Port Arthur on March 25th, 1942. He was born at Liverpool, England, on January 22nd, 1868. He came to Canada in 1878 and began his engineering career as a Dominion land surveyor in the North-West Territories. Two years later he was with the location and construction department of the Canadian Pacific Railway working between British Columbia and Quebec.

From 1890 to 1893 he was employed by the Toronto Belt Line street railway system, but he relinquished this job late in 1893 to take a position with the Grand Trunk Railway and the Canadian Pacific Railway as locator and construction man.

He was assistant engineer in charge of location and construction for the Canadian Pacific Railway between Port Arthur and British Columbia for nine years starting in



T. S. Armstrong, M.E.I.C.

1896, and in 1905 he became district engineer, District F, in charge of reconnaissance and location for the Transcontinental Railway. From 1906 to 1915 he was district engineer, District E, located at Cochrane, Ont.

He was associated for four months in 1916 with Professor Swain in a valuation of Canadian National and Canadian Pacific Railways properties, and in 1918 he worked on arbitration of Canadian National Railways property. From 1920 to 1930 he was with the Toronto Transportation Commission and from 1930 until his retirement in 1937 with the Northern Development Branch, of the Department of Highways of Ontario.

In recent years he had been living with his son, T. C. Armstrong, Affiliate E.I.C., at Port Arthur.

Mr. Armstrong joined the Institute as a Member in 1907 and in 1926 he was made a Life Member.

**G. Rupert Duncan**, M.E.I.C., died suddenly at his home at Port Arthur on April 19th, 1942. He was born at Ottawa, Ont., on February 7th, 1878, and was educated at McGill University, Montreal, where he graduated in electrical engineering in 1900. He spent the following year as a demonstrator in physics at McGill and received the degree of M.Sc. for post-graduate research work in 1901. He then joined the staff of the Montreal Pipe Foundry Company at Three Rivers as electrical and mechanical engineer and he went to Fort William with this company in 1906 to supervise the construction of the Canada Iron Foundries Limited. The plant was completed in 1908 and Mr. Duncan stayed as superintendent and engineer until February, 1909, when he founded the firm of G. R. Duncan and Company, real estate, of which he was still president at the time of his death.

He was also managing director of the Superior Brick and Tile Company, Limited, director of the Fort William Commercial Chambers, Limited, manager and secretary of the Schreiber Gold Mines Limited and the Atikokan Iron and Lands Limited.



G. R. Duncan, M.E.I.C.

In civic affairs, Mr. Duncan represented Fort William's Ward 3 as an alderman on the City Council in 1916 and 1917. At the Atlantic City convention in June, 1919, he was elected vice-president of the National Association of Real Estate Boards. The same year and the following year he was president of the Fort William Board of Trade, and president of the Fort William Chamber of Commerce in 1932, 1933 and 1934.

In 1934 and 1935 he was president of the North West Ontario Associated Chambers of Commerce. He was a member of the St. John's Ambulance Association, and an

officer brother of the Order of the Hospital of St. John of Jerusalem.

Mr. Duncan was the father of Gaylen R. Duncan, S.E.I.C., of McKean Sheet Piling Company, Montreal, and Frederick Duncan, S.E.I.C., of Canadian General Electric Company, now studying law at Osgoode Hall, Toronto.

Mr. Duncan joined the Institute as a Student in 1899 and was transferred to Associate Member in 1902. He became a Member in 1940. He was particularly active in Institute affairs, having been chairman of the Lakehead Branch.

**Leonard Ernest Schlemm**, M.E.I.C., died suddenly at his home in Montreal on April 29th, 1942. He was born at Brooklyn, N. Y., on September 16th, 1878, and was educated at the Massachusetts Institute of Technology. From 1903 until 1908 he was engaged on railway reconnaissance, location and construction work in the United States. He then spent two years with Brett and Hall, landscape architects, Boston, and was in charge of their construction work.

In 1910 he came to Montreal and engaged in private practice as a consultant in landscape architecture and town planning. During his successful practice he carried out developments, such as Redpath Crescent, West Crescent Heights, Monklands, Trafalgar Circle, Belvedere Terrace, Mount Alison University Grounds, Town of Leaside, Toronto. He was consulting engineer for the Towns of Hampstead, Mount Royal and Beaconsfield, Que. He was also town planning consultant for the Town of Iriquois Falls, Ont.

In 1930 he was appointed by the City Executive Committee of Montreal as a member of the board of town planning. He also served for a time as chairman of the town planning section of the Metropolitan Planning Board, Montreal.

Mr. Schlemm joined the Institute as an Associate Member in 1913 and he was transferred to Member in 1923.

## News of the Branches

### CALGARY BRANCH

K. W. MITCHELL, M.E.I.C. - *Secretary-Treasurer*  
J. N. FORD, J.F.E. I.C. - *Branch News Editor*

President C. R. Young visited the Calgary Branch on Friday, April 10th, 1942. After a busy day, Dean Young had dinner with the Executive Committee of the branch at the Ranchmen's Club, and immediately following the dinner and ensuing discussions, he addressed a general meeting of the branch at the Glencoe Club.

The president, addressing the large gathering, presented a comprehensive and interesting picture of Institute affairs. He pointed out that it was the tradition of each newly elected president to visit all the twenty-five branches of the Institute. He regretted that Mr. L. Austin Wright was not able to make the western trip with him, due to his appointment as assistant to Mr. Little, director of National Selective Service. Mr. Young gave figures showing that the Institute had now the highest membership in its history, and that its financial position was very sound. The property loss at Headquarters was dealt with in detail.

Dean Young paid tribute to the work being done by the Bennett Committee on the training and advising of the young engineer, and pointed out that the welfare of the young engineer was one of the most important jobs of the Institute.

The president digressed from purely Institute affairs at this point and offered his views on technological post war activities and how Canada is equipped to cope with this problem.

### Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

"We have," he said, "numerous highly trained technical personnel. We have an impressive backlog of ideas and inventions that never have been developed. We are not by any means at the end of our inventive tether." Canadians are now being deprived of vast quantities of consumer goods, the president pointed out, and we will want all these things after the war. Many new developments would be forthcoming. Television would be a commercial enterprise. There would be new materials and alloys. Probably, there would be a great extension of air conditioning. He thought we would find combinations of agricultural holdings in eastern Canada as a result of mechanical development.

Dean Young spoke of reconstruction and rehabilitation after the war. "Reconstruction," he said, "involves the whole question of rehabilitation of democracy." There was a strong feeling within a cabinet committee to which he belonged, one of a number set up to consider the question of rehabilitation, that government expenditure should be invoked only as a supplement to, and aid to, private enterprise.

In conclusion, the president left this thought with the meeting—the most important function of the Institute is the guarding of the "trusteeship," which is entrusted to all members. "The Institute is not concerned in restriction or licensure to practise. This is left to the Professional

Associations," he stated. The layman, when placing his case in an engineer's hands, trusts him as he would his doctor or lawyer. "Every young engineer should be aware of this trusteeship and practise it," the president concluded.

### HALIFAX BRANCH

S. W. GRAY, M.E.I.C. - *Secretary-Treasurer*  
G. V. ROSS, M.E.I.C. - *Branch News Editor*

The last scheduled dinner meeting of the Halifax Branch for this season, was held in the Halifax Hotel, on April 23. Dr. Allen E. Cameron, Deputy Minister of Mines for the Province of Nova Scotia, was the speaker.

Several years ago the government of Nova Scotia set up an Economic Council, of which the Economic Survey Committee is headed by Dr. Cameron. This committee has undertaken the task of co-ordinating the studies of the different government bodies such as the Federal Departments of Agriculture, Mines, Fisheries, National Research Council, etc., and the Provincial Departments of Agriculture, Mines, Lands and Forests, etc. No province of Canada has been more completely covered by topographical and geological survey parties and a large portion of it has been photographed from the air. The committee is at work on soil surveys and forest surveys and for some sections of the province three dimension maps and forest cover maps have already been prepared. Dr. Cameron stated that full co-operation had been obtained from Federal authorities in all this work, and that many survey parties had been put in the field through agreements to share expenses that could not have operated otherwise.

The recent development of barite deposits and, within the past few days, the bringing into production of a tungsten mine, are a direct outcome of committee investigations which will help Canada's war effort. It is hoped that in the near future results will be obtained from the studies now being made on the recovery of magnesium from the dolomite deposits of Cape Breton. But the soil, forests and minerals are not the only resources studied by the committee. The eagle eye has been turned on the oyster and the clam to see how they can be made to produce more and better stews and chowders.

P. A. Lovett was chairman of the meeting which was attended by about forty members and guests.

### MONTREAL BRANCH

L. A. DUCHASTEL, M.E.I.C. - *Secretary-Treasurer*

The last regular Thursday night meeting in the 1941-1942 session of the branch, was held on April 9th, at which time a paper was presented by Dr. D. A. Keys. The speaker is Macdonald professor of physics at McGill University, director of the R.C.A.F. Radio Mechanics Course at McGill, and on behalf of the Wartime Bureau of Technical Personnel in Ottawa, is in charge of a survey and registration of all persons in Canada qualified for research.

The subject of the talk was the **Electron Microscope**, a tool which has opened up a new and broader field in microscopic work. An instrument of this type was under construction at McGill University at the outbreak of war, but work was of necessity discontinued due to war duties taken on by the research personnel.

In order to provide a suitable background for the subject, Dr. Keys reviewed the fundamental principles and formulæ necessary to an understanding of the optical microscope, touching briefly on the difficulties encountered due to spherical and chromatic aberration and showing that the resolving power of an optical microscope is limited by the wave-length of light. He then proceeded to draw the analogy between the optical and electron microscope, the

latter having the same type of limitations but at much higher magnifications. The electrons from a filament are accelerated by a high potential and travel at a constant velocity past the object under study. They are then controlled by either a magnetic or an electrostatic field analogous to the way in which the light rays in an optical microscope are brought to a focus by means of a lens. In the case of an electron microscope, the electrons impinge on a photographic plate or fluorescent screen.

Due to the use of electrons with a much shorter wave length than that of light, the resolving power of an electron microscope is such that its maximum practical magnification is a great many times that of the optical type.

Dr. Keys then showed a number of very interesting slides made from photographs taken with the electron microscope. These included pictures of the smoke from different burning metals, pus cells, cocci and bacilli.

An interesting point emphasized in the question period was the fact that the electron microscope cannot be used for the study of fractures in metals, since its operation depends upon the ability of the electrons to pass by the object to the photographic plate.

On April 20th, a special meeting of the branch was held at which Professor F. Webster, Deputy Chief Engineer of the Ministry of Home Security, London, England, gave an interesting talk on the effects of bombing on structures and the methods whereby the damage can be minimized.

### NIAGARA PENINSULA BRANCH

J. H. INGS, M.E.I.C. - *Secretary-Treasurer*

The Niagara Peninsula Branch held a joint dinner meeting with the Canadian Section of the American Water Works Association on April 15th at the General Brock Hotel, Niagara Falls, with an attendance of 100. Mr. A. L. McPhail acted as chairman and introduced the two speakers: Mr. William Storrie, M.E.I.C., consulting engineer and chairman of the Canadian Section, A.W.W.A.; and Dr. A. E. Berry, M.E.I.C., director Sanitary Engineering Division, Ontario Department of Health and secretary of the Canadian Section, A.W.W.A.

Mr. Storrie introduced the general subject for the evening: **Public Health Engineering in Canada**. The control of our environment, as regards water and food supplies and the disposal of waste, was definitely a public problem, one that we could not handle as individuals. The matter of supplying pure and wholesome water was mainly the responsibility of the public health engineers, whose duty it is to control the forces of nature for the protection and improvement of the public health. The first water works system in Canada was built at Saint John, N.B., in 1837, the Toronto system was started in 1841, by 1900 there were 235 municipal systems, but now there are 1,400 public systems in Canada, serving 60 per cent of the population. Three different sets of law-making bodies control the field of water supply legislation in Canada. The Federal Government controls only water problems that are interprovincial or international in scope. A greater degree of control is exercised by the provincial governments because they pass the legislation that controls the activities of the municipalities who actually own and operate the individual systems. Of the 95 municipal systems in Ontario, 33 are managed directly by the council, 17 by a committee of council and 45 by separate commissions. In the past, we have depended mainly on our lakes and rivers for water but as the population has grown, the danger of pollution from sewage has increased. Mr. Storrie expects that after the war, it will be necessary to spend more money in Canada on sewage disposal than on water supply.

Dr. Berry spoke on **Water Treatment**. There are two general objectives in treating water. The quality of the water, as regards its taste and appearance, is improved by mechanical filtration and by aeration. Water softening is an added refinement that is necessary sometimes in the case of water obtained from wells. Water is made safe by chlorination, which destroys any disease organisms that may be in the water and so protects the public health. In Canada, the chlorination of water was introduced first in Toronto in 1910, but now 80 per cent of the water supplied by public systems is chlorinated. Two important health improvements have been the chlorination of water and the pasteurization of milk, in the introduction of which engineers and doctors have worked together. As these two improvements have come into more general use, the death rate from typhoid fever has declined.

Both speakers used lantern slides to illustrate their subjects and additional slides on water treatment apparatus were shown. Mr. A. W. F. McQueen moved the vote of thanks to the speakers

### OTTAWA BRANCH

A. A. SWINNERTON, M.E.I.C. - *Secretary-Treasurer*  
R. C. PURSER, M.E.I.C. - *Branch News Editor*

In co-operation with the local branches, respectively, of the Canadian Institute of Mining and Metallurgy, and of the Society of Chemical Industry, an evening meeting was held on April 17 at the auditorium of the National Research Council. A. E. Byrne, of the staff of the Canadian General Electric Company, Limited, gave an address on the subject of **Plastics** illustrated by lantern slides and by actual specimens. The subject was one, stated the speaker, that was difficult to cover completely in a single popular lecture so the greater part of the time was taken up in describing the commercially-important synthetic plastics of the phenol-formaldehyde type.

Plastics, which are entering more and more into our daily life, may exhibit a variety of characteristics. They may, for instance, be tough, brittle, elastic, translucent or transparent. Grouping them according to chemical origin they may be of natural origin such as those made from soy beans, casein, or even coffee beans, or they may be of synthetic origin such as those of the phenol-formaldehyde type referred to.

From a physical point of view they may be thermo-plastic or thermosetting. Those belonging to the thermo-plastic class when subjected to an elevated temperature will liquefy and then when allowed to cool to ordinary temperatures will reharden with no change in their structure. Thermosetting plastics on the other hand will change by the application of heat and pressure into chemically different materials which cannot be remelted. In the electrical industry, plastics of the thermosetting class are mostly used.

Plastics themselves are very complex in chemical composition, though all modern examples are usually composed of five or six elements such as carbon, hydrogen, oxygen, nitrogen, chlorine and sometimes sulphur, as in the case of synthetic substances exhibiting the characteristics of rubber. Synthetic resins, a general generic term applied to an initial product in the manufacture of modern plastics, are usually non-crystalline and form the basis of the plastics themselves. Phenol, derived from soft coal, and formaldehyde, a compound of carbon, hydrogen and oxygen, will react to form a synthetic resin which itself is ground up, blended with a filler, placed in a mould and turned into a plastic form through the simultaneous application of heat and pressure.

The filler is very important. It may consist of wood flour, a finely ground up cloth fabric, mica in the case of electric insulators, or asbestos in the case of high heat-

resisting devices. It helps to give the desired physical characteristics and may also serve to impart the required colour to the end product. The making of the mould is also most important and requires considerable skill on the part of the operator.

Plastics as replacement materials in engineering industries often eliminate many machine operations that would otherwise be required if a metal were used. At the present time with the war effort rendering certain metals difficult to obtain in quantity a tremendous impetus has been given to the plastics industry. Basic ingredients in the manufacture of plastics, according to the speaker, are coal, air, water, limestone, salt, petroleum, oil and sunshine. Wherever these are available together with the necessary machinery and labour the making of plastics is readily possible.

---

At a special evening meeting April 20 at the auditorium of the National Research Laboratories an address on **Bombs and Structures** was given by Professor F. Webster, dean of engineering, University of Rangoon, and deputy chief engineer of the Ministry of Home Security, London, England. Professor Webster had been sent to Canada and the United States by the British Government to advise engineers in the re-inforcing of buildings to withstand heavy bombs. His talk was illustrated by slow-motion film studies of the effects of bomb explosives upon experimental structures. The meeting, which was not open to the general public, was presided over by N. B. MacRostie, chairman.

---

At an evening meeting at the auditorium of the National Research Laboratories on May 7, an address was given by C. E. MacDonald of the International Nickel Company of Canada, Limited, on the **Mining, Smelting and Refining of Nickel-Copper Ores**.

Mr. MacDonald, who described himself as a "salesman in reverse" stated that his efforts are now directed toward retarding the use of nickel wherever possible so that it may be made more completely available as an essential contribution to the war effort.

He described the uses of nickel as an engineering material and by means of sound pictures taken at International Nickel Company plants illustrated various steps in its production. He forecast a tremendous increase in the use of nickel after the war for hitherto unsuspected purposes.

### PETERBOROUGH BRANCH

D. J. EMERY, M.E.I.C. - *Secretary-Treasurer*  
E. WHITELEY, JR., E.I.C. - *Branch News Editor*

The Peterborough Branch met on Thursday, April 23rd, for the last technical meeting of the season. Mr. G. E. Bourne, Canadian General Electric Company, Toronto, presented a fine paper on **Electricity in Warfare**.

Obviously, the uses of electricity in modern warfare are too many and varied to describe in detail in a paper such as this one. Mr. Bourne, with the aid of a large number of lantern slides briefly touched on typical uses to give an overall view of the subject.

Every civilian and military function now depends more or less on electricity. Direct military applications, are electrical machinery, control, lighting, communication equipment and degaussing equipment used by the navy; modern mechanized armies are guided, controlled and protected by telephone and radio; aircraft instruments and motorized controls are essential to modern Air Force equipment.

Production of war material is now many times as great and much faster, due to the wide-spread use of electricity in industry and improvement in machines made possible by electric drives. Typical examples are the electrolytic

refining of aluminum and copper, and the high-speed metal rolling mills now in service.

The Peterborough Branch held their annual Student and Junior Night on May 7. At this meeting it is the custom that the chairman of the student and junior section takes charge and the programme is provided by student and junior members. With Mr. J. M. Mercier in the chair and two fine papers by Richard Scott, S.E.I.C. and A. M. McQuarrie, JR.E.I.C. the meeting was well up to the high standard set in previous years.

Mr. Scott discussed the **Pickwick Landing Project** of the Tennessee Valley Authority, with the idea that this is one of the United States Government's large-scale efforts in social reconstruction. An objective study of such projects can show much experience which we will do well to consider in our plans for post-war reconstruction.

Technical details of the dam and power house were mentioned only briefly as these are well known by now, and they are only a part of the project. As a link in the chain of dams and power plants being built by the Tennessee Valley Authority the project will help to provide flood control, navigation facilities, and, as a by-product, electrical power for the people along the Tennessee river. Throughout, however, emphasis has been placed on improving the living conditions of these people.

Since the days of the American Civil War, settlers along the Tennessee river have existed at a very low level. By providing part time employment for these settlers and by educational programmes, a general raising of their standard of living has been achieved. The flood areas created by the dam were carefully cleaned to control malaria. The relocation of farmers from these flooded areas was used as a means of improvement. The new lakes and the river are being stocked with edible fish, and game is being encouraged in wooded areas. By locating local leadership, and by giving it responsibility it is hoped that the improvements will continue and will be permanent.

Mr. McQuarrie spoke on **Sound Reproduction in Motion Picture Theatres**. The equipment used and the technique of recording sound on photographic film, and later reproducing it, were described. Since this is the most commonly used system now, the paper did not describe any other except to mention briefly one or two that had been tried and abandoned.

Both papers provoked a lively question and discussion period following their presentation.

### ST. MAURICE VALLEY BRANCH

J. B. SWEENEY, S.E.I.C. - *Secretary-Treasurer*

On April 22nd, the St. Maurice Valley Branch held its annual dinner meeting at the Cascade Inn, Shawinigan Falls. The retiring chairman, Dr. A. H. Heatley, presided. Also present at the head table were, Viggo Jepsen, the newly appointed chairman, H. G. Timmis, J. A. Hambly, president, Shawinigan Chemical Association, C. G. de Tonnancour, retiring secretary-treasurer and the guest speaker of the evening, Dr. R. S. Jane, assistant to the vice-president in charge of research, Shawinigan Chemicals Limited.

Following the presentation of annual reports by the secretary-treasurer and Mr. M. Mitchell, chairman of the Branch Nominating Committee, the chairman reviewed the year's activities and asked Mr. Jepsen to introduce the new members of the Executive Committee.

The meeting adjourned and joined the Shawinigan Chemical Association to hear Dr. Jane, who was introduced by Mr. J. A. Hambly.

Dr. Jane had chosen as a subject **Synthetic Rubber, its Possibilities and Development**—a subject of vital concern indeed, due to recent developments in the Pacific ocean. Speaking to engineers as well as to chemists, the

speaker first defined some terms used freely by chemists, such as "monomer," "polymer" and made a brief summary of the early work on the constitution of natural rubber, and the discovery of polymerization by the French chemist Bouchardat. He then explained why so little was achieved in the field of synthetic rubber until 1916, due to a false orientation of efforts and talents in the next to impossible search for the synthesis of natural rubber, from isoprene.

### SAGUENAY BRANCH

D. S. ESTABROOKS, M.E.I.C. - *Secretary-Treasurer*

A meeting of the Saguenay Branch was held in the Arvida Protestant School on Wednesday, April 22nd.

Previous to introducing the speaker of the evening a film entitled **London Night** was shown. This was the story of London on any night of a blitz. The film was actually filmed during bombing attacks and showed clearly the wonderful work being done by the women's branch of the army.

The speaker, Dr. Philip L. Pratley, M.E.I.C., was introduced by the chairman, N. F. McCaghey.

Dr. Pratley gave a most interesting and enlightening lecture on the **Lions' Gate Bridge**. This bridge which spans the Narrows at Vancouver is the most filmed bridge in the world and the longest suspension span in the British Empire. It gets its name from two mountain peaks which resemble lions when viewed from certain angles.

A detailed account of the construction of the bridge was given from the time it was first designed until it was completed. The river at the point where the bridge was constructed was 1600 ft. wide and the two piers were spaced at 1550 ft. centre to centre.

The towers were built to accommodate elevators which were to be used to provide access to marine signals placed on top of the towers. However the authorities decided on another position for the signals and the elevators have never been installed.

The cables were built by the Anglo-Canadian Wire Rope Company and when assembled were 13¼ in. in diameter and contained 61 strands which in turn were made up of many wires. The building up of the cable was a very interesting feature. The various tests used on the wire were explained and it was pointed out that every wire in the cable had been tested. Every wire was required to run the whole length of the bridge without a splice. The completed cables weighed just over 1000 tons and contained 4715 miles of wire.

The method of anchoring the cables at each end was explained and it was interesting to note the pleasing appearance of the finished pylons.

During the construction of the cat-walks, the Narrows were closed to boat traffic for a little over 35 minutes.

The completed structure cost \$3,634,000 and required 5000 gallons of paint.

Toward the close of his lecture Dr. Pratley showed four interesting films on the construction of the bridge which he had already explained so thoroughly.

A vote of thanks was extended to Dr. Pratley by M. G. Saunders.

### SASKATCHEWAN BRANCH

STEWART YOUNG, M.E.I.C. - *Acting Secretary-Treasurer*

The Saskatchewan Branch, jointly with the Association of Professional Engineers, held a special meeting in the Hotel Saskatchewan, Regina, on April 20th to honour Dean C. R. Young, president of the Institute. The attendance was 45.

Upon concluding the dinner hour and after a short period of entertainment, Dean Young delivered an unusually inspiring address on matters of professional interest. Dealing with the affairs of The Engineering Institute of Canada, he outlined briefly the work of the com-

mittee on student guidance, and contacts with the Engineers' Council for Professional Development, the War-time Bureau of Technical Personnel and Polish engineers in Canada. Mention was also made of the recent arrangements made by the Institute for a series of lectures to selected Canadian engineers on protection against bombing.

Speaking of the several co-operative agreements between Professional Associations and the Institute, President Young expressed the view that there was something more fundamental behind these than a mere effort to simplify procedure or obtain reduced fees, namely a sincere desire to advance the interests of the engineering profession. Forty years ago engineers were not considered to be members of a profession but, over a period of years, this attitude had changed. He stated also that the profession of engineering is much more than the mastering of a technique based on mathematics; it is a trusteeship to be carefully guarded and advanced through cultural attainment.

### SAULT STE. MARIE BRANCH

O. A. EVANS, Jr., E.I.C. - *Secretary-Treasurer*  
N. C. COWIE, Jr., E.I.C. - *Branch News Editor*

The fourth general meeting for the year was held in the Grill Room of the Windsor Hotel on Friday, April 24th, when twenty members and guests were present.

Chairman R. L. Brown announced that three members of the branch were attending Professor Webster's lectures in Toronto on Air Raid Precautions, and their services would be available in a consulting capacity on their return to the city.

The chairman then called upon William Seymour, M.E.I.C. to address the meeting. Mr. Seymour had for his address a review of Dr. Rueckel's paper on **New Principles in Heating Becker Coke Ovens.**

Mr. Seymour showed in detail the various heating curves for coal and gasses in the coke ovens, stressing that to make uniform coke the coal must be heated at a uniform rate and uniformly about the charge. The average rate of heating the coal to make coke in the ovens was one inch per hour. The address was well illustrated with slides.

At the conclusion of his address, Mr. Seymour showed a film by the Kopps Coke Oven Company of the flames inside the flues of the old and new coke ovens. There was a striking difference in the flames of the old and new coke ovens. In the old the flames were highly luminous while in the new the flames were barely visible showing that almost complete combustion was taking place.

Mr. Seymour then showed two films of his own, one a trip down the St. Lawrence and up the Saguenay rivers and one depicting the coloured foliage of Algoma countryside in the fall of the year.

C. Stenbol thanked the speaker, remarking that few people would have taken the trouble to review such a highly technical paper and present it in such a way that the layman would understand it.

### VANCOUVER BRANCH

P. B. STROYAN, M.E.I.C. - *Secretary-Treasurer*  
A. PEEBLES, M.E.I.C. - *Branch News Editor*

The Vancouver Branch held a dinner meeting in the Georgia Hotel on April 17, in honour of the president of the Institute, Dean Young. Branch Chairman W. O. Scott presided, and forty members and guests were present. Following dinner and some vocal entertainment, Dean Young spoke on the affairs of the Institute. He described the progress which has been made by the War-time Bureau of Technical Personnel in making an inventory of technically trained persons, and in using that information to supply the needs of war industries. The Institute has played a major part in the preparation and use of the catalogue of the Bureau. A committee on the Training and Welfare of the Young Engineer has prepared a pamphlet for distribution to high schools and colleges throughout Canada, designed to acquaint students with the nature of engineering as a profession, as well as the requirements and responsibilities attached to it. This knowledge should be of great value to students who face the very real problem of choosing a life work.

Dean Young also informed the branch that cordial relations were being maintained with other engineering societies in Canada and the United States, resulting in mutual advantages to the members. He spoke of a group of Polish engineers who have found refuge in this country, whose training and experience are proving extremely valuable to Canadian industry. The Institute has extended to them certain privileges which are very much appreciated.

A vote of thanks to the president for his excellent address was proposed by Dr. E. A. Cleveland, and met with unanimous approval. Other members who spoke briefly were Professor I. M. Fraser, councillor from Saskatoon, Councillor S. G. Coultis of Calgary, Councillor J. Haines of Lethbridge, Councillor H. N. Macpherson of Vancouver, and Mr. F. Newell of Montreal.

Dean Young also visited the University of British Columbia where he addressed the engineering students and presented the Institute's prize to Eric Smith, fifth-year student in chemical engineering. He was present at a meeting of the branch executive, and was entertained by the council of the Association of Professional Engineers of British Columbia. A Regional Meeting of the Council of the Institute and other activities concluded a very busy three-day visit to Vancouver.

The Vancouver Branch has been exceedingly fortunate to have three lectures delivered by Professor F. Webster of London, England, on the subject of air raid shelters and the making of structures bomb-resistant. Professor Webster's experience in this work in Great Britain plus his experience in structural engineering instruction, produced a wealth of authoritative information, presented in understandable form. A large attendance of members and specially invited guests at each lecture indicated the degree of interest in the subject.

## SAVE FOR VICTORY

If you do not keep your *Journals* do not burn or destroy them. Give them to a salvage organization. They are needed for victory.

## ADDITIONS TO THE LIBRARY

### TECHNICAL BOOKS

**Steam Boiler Yearbook and Manual:**  
*London, Paul Elek, (1942). 5½ x 8½ in. 20s. 7d.*

**Public Works Engineers' Yearbook, 1942:**  
*Chicago, American Public Works Association, 1942. 5¾ x 8¾ in. \$3.50.*

### PROCEEDINGS, TRANSACTIONS

**Institution of Water Engineers:**  
*Transactions, vol. xlvi, 1941.*

**Canadian Institute of Mining and Metallurgy:**  
*Including the Mining Society of Nova Scotia Transactions, vol. 44, 1941.*

**Electric Supply Authority Engineers' Association of New Zealand:**  
*Transactions, vol. 13, 1941.*

**Society of Naval Architects and Marine Engineers:**  
*Transactions, vol. 49, 1941.*

### REPORTS

**Nova Scotia, Board of Commissioners of Public Utilities:**  
*Report for the year, ended December 31, 1941.*

**Southern California, The Metropolitan Water District:**  
*Report for the fiscal year July 1, 1940, to June 30, 1941.*

**Royal Society of Edinburgh:**  
*Yearbook 1940-41.*

**Winnipeg Hydro Electric System:**  
*Thirtieth annual report, December 31, 1941.*

**American Institute of Electrical Engineers:**  
*Year Book 1942.*

**Electrochemical Society:**  
*Theory of oxidation and tarnishing of metals; thin oxide films on iron; corrosion on binary alloys; electrolytic behaviour of ferrous and non-ferrous metals in soil corrosion circuits; anodic and surface conversion coatings on metals; cathodic protection; single metal, binary and ternary alloy deposition from thiosulfate solutions; "Null" methods applied to corrosion measurements; ferro-alloys in Australia and notes on other metallurgical developments there; some mechanisms of alloy corrosion; the parabolic and logarithmic oxidation of copper; the effect of hydrochloric acid plus inhibitor on the corrosion resistance of 18/8 stainless steel. Preprint 81-14 to 81-25.*

**Ohio State University Studies—Engineering Series:**  
*Steam flow through safety valves; engineering experiment station bulletin No. 110.*

**University of Illinois—Engineering Experiment Station:**  
*The effect of range of stress on the fatigue strength of metals; bulletin series No. 334. Eighth progress report of the joint investigation of fissures in railroad rails. Reprint series No. 22.*

**University of California—Department of Geological Sciences—Bulletin:**  
*The molluscan genus siphonalia of the Pacific Coast Tertiary; Vol. 26, No. 3.*

## Book notes, Additions to the Library of the Engineering Institute, Reviews of New Books and Publications

**University of Minnesota—Engineering Experiment Station:**  
*Developments in high speed cathode ray oscillography. Technical paper No. 27.*

**American Institute of Steel Construction:**  
*Specification for the design, fabrication and erection of structural steel for buildings by arc and gas welding (tentative), January, 1942.*

**Edison Electric Institute and Bell Telephone System:**  
*Positive disconnection of distribution circuits during faults to ground; engineering report No. 47.*

**U.S. Bureau of Standards—Building Materials and Structures:**  
*Performance test of floor coverings for use in low-cost housing; pt. 4. Report No. 80.*

**U.S. Bureau of Mines:**  
*Sponge chromium; investigations of permissible electric mine lamps 1930-40; seismic effects of quarry blasting; inter-crystalline cracking of boiler steel and its prevention; coal mine accidents in the U.S., 1939. Bulletins Nos. 436, 441-444.*

**Federal Security Agency—Vocational Division:**  
*Engineers are needed; a plan for secondary schools and engineering institutions to supply engineers urgently needed for war production.*

**Canada—Department of Mines and Resources—Forest Service:**  
*Decay in Red Stained Jack Pine ties under service conditions; Circular No. 58. Results of the examination of six ground line treatments on Eastern White Cedar Poles after two years' service.*

**Asphalt Institute:**  
*Specification for stock-pile asphalt paving mixture for making quick repairs of bombed surfaces.*

**Institution of Mechanical Engineers:**  
*Proneness to damage of plant through enemy action by Hal Gutteridge.*

### AIR RAID PRECAUTION BULLETINS

**Ministry of Home Security—Research and Experiments Department:**  
*Bulletin No. C14—Refuge room dormitories (2nd ed.). No. C24—Protective walls in single-storey factories. Methods of heightening and strengthening existing walls. No. C25—Protected accommodation in large buildings of load-bearing wall construction. No. C26—Timber shelters for countries where timber is plentiful and steel difficult to obtain.*

**Department of Scientific and Industrial Research—Building Research:**  
*Standard designs for single storey factories for war industries with notes on siting and layout; Wartime building bulletin No. 15.*

The following books have been presented to the Institute Library by Mrs. T. C. Keefer in memory of her husband who was the son of the first president of the Institute and they are gratefully acknowledged here:

**Scientific American:**  
*N.Y., Sept.-Dec., 1848.*

**Hicks, W. M.**  
*Elementary dynamics of particles and solids. Lond., Macmillan, 1897.*

**Hunt, Charles Warren:**  
*Historical sketch of the American Society of Civil Engineers, 1852-1897.*

**Lyndon, Lamar:**  
*Storage battery engineering, 3rd ed. McGraw Hill Book Co., 1911.*

**Morgan, Henry J.:**  
*Sketches of celebrated Canadians and persons connected with Canada from the earliest period down to the present time. Quebec, 1862.*

### BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet the books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

#### AIRCRAFT ASSEMBLY

By C. F. Marschner. Pitman Publishing Corp., New York and Chicago, 1942. 104 pp., illus., diagrs., tables, 8½ x 5½ in., cloth, \$1.00.

Aircraft assembly procedure, design and equipment are briefly covered in the first three chapters. Succeeding chapters deal with the specific operations necessary for attaching and grouping together the many parts which make up the various basic structural units. The last chapter covers the final assembly of the complete airplane.

#### AIRCRAFT SHEET METALWORK

**Pt. 1: The Textbook**  
123 pp., 10 x 7 in., cloth, \$2.50.

**Pt. 2: Workbook in Blueprint Form**  
58 pp., 8½ x 13½ in., paper, \$1.50.  
By J. W. Ciachino. Manual Arts Press, Peoria, Ill., 1942. Illus., diagrs., charts, blueprints, tables.

Part I of this two-volume set describes the layout, cutting, bending, forming, riveting and development operations performed in aircraft sheet metalwork. Part II, the workbook, presents in blueprint form actual jobs for the practical application of the information given in volume one. The text also contains a brief chapter dealing with aluminum and its alloys.

**BENCH WORK UNIT (Dunwoody Series, Machine Shop Training Jobs)**  
155 pp., \$1.35; (work sheets, 30c.).

**GRINDER JOB TRAINING UNITS (Dunwoody Series, Machine Shop Training Jobs)**  
111 pp., \$1.25; (work sheets, 30c.).  
American Technical Society, Chicago, Ill., 1942. Illus., diagrs., charts, tables, 11 x 8½ in., paper.

These publications belong to a series of six manuals for training on various machine tools. General and special procedures in working with the respective machines are briefly described with the care and use of necessary tools. Detailed instructions are given for a series of practical jobs, including check sheets for determining the learner's grasp of each problem, and a final section relates the knowledge gained to actual shop work. Helpful hints are also given on blueprint reading.

#### COTTON LOOMFIXERS' MANUAL

By I. Moberg. McGraw-Hill Book Co., New York and London, 1942. 197 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$2.50.

Practical, step-by-step instructions are given on all phases of cotton loomfixing. The book covers the setting, adjusting and timing of modern looms and the latest loom motions as applied on older looms. The material is so presented that the book can serve as a textbook for courses or as a self-study manual.

#### **ELECTRICAL CIRCUITS AND MACHINERY, Vol. 2: Alternating Currents**

By F. W. Hehre and G. T. Harness. John Wiley & Sons, New York; Chapman & Hall, London, 1942. 635 pp., illus., diags., charts, tables, 9 x 6 in., cloth, \$6.00.

As in volume one of this two-volume treatment of Electrical Circuits and Machinery, the authors have followed the general plan and method of textbook with that title written in 1933 by Morecroft and Hehre. The book is intended as a general text for non-electrical engineering students and as an introductory text for electrical engineering students. It is comprehensive in scope and includes two chapters on electronic devices. There are many problems chosen with special reference to present commercial practice.

#### **(The) ELECTRON MICROSCOPE**

By E. F. Burton and W. H. Kohl. Reinhold Publishing Corp., New York, 1942. 233 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$3.85.

Beginning with a simple exposition of the properties of light and electrons, this book proceeds to a comparison of light and electronic activity and of the methods for their control for use in microscopes. The history of the electron microscope is briefly related, the construction and use of both the electrostatic and electromagnetic types are described, and present and future applications are noted.

#### **HIGHWAY RESEARCH BOARD, Proceedings of the Twentieth Annual Meeting, held at Washington, D.C., Dec. 3-6, 1940**

Edited by R. W. Crum. National Research Council, Division of Engineering and Industrial Research, Washington, D.C. 883 pp., illus., diags., tables, 10 x 6½ in., cloth, \$3.25.

Some sixty technical papers and reports presented at the 1940 annual meeting of the Highway Research Board are published in this volume. The comprehensive scope of the Board is reflected in the separate titles which are grouped under the headings—economics, design, materials and construction, maintenance, soils, traffic and safety. Brief information about the Board is included.

#### **(The) HISTORY OF COMBAT AIRPLANES. (The James Jackson Cabot Professorship of Air Traffic Regulation and Air Transportation at Norwich University, Publication No. 7)**

By C. G. Grey. Norwich University, Northfield, Vermont, Dec., 1941. 158 pp., 9 x 6 in., paper, \$1.00.

The author describes in considerable detail examples of the many types and variations of airplanes which were developed specifically for combat from 1914 to the present day. All countries are covered, comparisons are indicated, and the men who played the leading parts in this development are given due credit.

#### **INSTRUCTOR'S GUIDE. (Dunwoody Series, Machine Shop Training Jobs)**

American Technical Society, Chicago, Ill., 1942. 39 pp., diags., charts, tables, 11 x 8½ in., paper, 75c.

This instructor's guide furnishes helpful information and suggestions regarding the use of any or all of the units of the Dunwoody series of manuals on lathe, drill press, milling machine, grinder, shaper and planer, and

bench work. It covers the use of the manuals themselves, the organization and control of the training experience, and methods of instruction.

#### **LOCOMOTIVE CYCLOPEDIA of American Practice, 11th ed., 1941**

Compiled and edited for the Association of American Railroads—Mechanical Division; edited by R. V. Wright and R. C. Augur. Simmons-Boardman Publishing Corp., New York, 1941. 1,312 pp., illus., diags., charts, maps, tables, 12 x 8 in., cloth, \$5.00.

In the eleventh edition of this well-known reference work, as in previous ones, considerable revision has occurred both in the text and in the arrangement and indexing. By the addition of new material, such as the chapter on welding and cutting in locomotive shops, the book remains representative of the latest practice in locomotive design, construction and maintenance. In order to keep the book to a reasonable size little except current practice is included, and previous editions should be consulted for information on older locomotives.

#### **MACHINE SHOP WORK**

By J. T. Shuman and others. American Technical Society, Chicago, Ill., 1942. 499 pp., illus., diags., charts, tables, 8½ x 5½ in., cloth, \$3.50.

The fundamentals and principles of modern machine-shop practice are described, including all major machines and operations rather than merely typical ones. A trouble-shooting page accompanies each chapter, listing common operating difficulties, probable causes and suggested remedies. Review questions are also provided for each chapter.

#### **METALLURGICAL AND INDUSTRIAL RADIOLOGY**

By K. S. Low. Sir Isaac Pitman & Sons, Ltd., London; Pitman Publishing Corp., New York, 1940. 88 pp., illus., diags., charts, tables, 7½ x 5 in., cloth, \$2.50.

The obvious advantages of non-destructive testing and examination of objects indicate the increasing importance of radiological methods. The general principles, apparatus and equipment, and methods of radiographic technique in metallurgical work are described, and the interpretation of radiographs is explained. Certain specialized practices are also briefly discussed.

#### **MODERN ASSEMBLY PROCESSES, Their Development and Control**

By J. L. Miller, with a foreword by E. A. Watson. Chapman & Hall, London, 1941. 166 pp., illus., diags., charts, tables, 9 x 5½ in., cloth, 13s. 6d.

This book deals with the processes used to assemble small parts in large-scale production. In surveying these processes the book describes recent developments, shows how the processes may be controlled and discusses the factors which influence the designer and the production engineer in the choice of the process to be used.

#### **OPTIMUM HOURS OF WORK IN WAR PRODUCTION. (Research Report Series No. 65)**

By J. D. Brown and H. Baker. Princeton University, Industrial Relations Section, Princeton, New Jersey, March, 1942. 25 pp., tables, 10 x 7 in., paper, 75c.

Based on information obtained from 140 companies in war production, this pamphlet presents experiences with various work schedules of from 40 to 60 hours per week and from 5 to 7 days per week. The several important factors in the determination of optimum hours (physical effort, rest periods,

labor supply, etc.) are discussed and conclusions drawn.

#### **(The) PHYSICAL EXAMINATION OF METALS, Vol. 2: Electrical Methods**

By B. Chalmers and A. G. Quarrell. Longmans, Green & Co., New York; Edward Arnold & Co., London, 1941. 280 pp., illus., diags., charts, tables, 8½ x 5½ in., cloth, \$6.00.

This second of two volumes on the application of the various branches of physics to the examination of metals deals with magnetic, electric, electronic and X-ray methods. Underlying physical theories are explained, the apparatus and more important applications are described, and some discussion of operational techniques is included.

#### **S A E HANDBOOK, 1942 Edition**

Society of Automotive Engineers, 29 West 39th St., New York, 1942. 828 pp., illus., diags., charts, tables, 8½ x 5½ in., cloth, \$5.00; \$2.50 to members.

All the current standards and recommended practices of the Society of Automotive Engineers concerning automobile and aircraft materials and parts, tests and codes, production equipment, nomenclature and definitions are contained in this annually revised handbook. The numerous changes include new and revised standards, corrections and cancellations. There is also a partial list of American standards of interest to the automotive industry.

#### **TABLES OF THE MOMENT OF INERTIA AND SECTION MODULUS OF ORDINARY ANGLES, CHANNELS AND BULB ANGLES WITH CERTAIN PLATE COMBINATIONS**

Prepared by the Federal Works Agency, Work Projects Administration for the City of New York, as a report of Official Project No. 165-2-97-22, Mathematical Tables Project; conducted under the sponsorship and for sale by the National Bureau of Standards, Washington, D.C., 1941. 197 pp., tables, 10½ x 8 in., cloth, \$1.25 (payable in advance).

This new volume in the series of mathematical tables sponsored by the U.S. Bureau of Standards presents tables of the moment of inertia and section modulus of ordinary angles, channels and bulb angles with certain plate combinations. Tables of various dimensional properties of these structural shapes are appended.

#### **TECHNIDATA HAND BOOK, Engineering, Chemistry, Physics, Mechanics, Mathematics, etc.**

By E. L. Page. Norman W. Henley Pub. Co., New York, 1942. 64 pp., diags., charts, tables, 8½ x 5½ in., looseleaf, paper, \$1.00; cloth, \$1.50.

Essential data taken from the fields of mathematics, physics, chemistry, and engineering mechanics, are presented in condensed form. Facts, figures, theory, definitions, laws, formulas, simple calculations, diagrams and numerical tables are all utilized. The use of the slide rule is also briefly exemplified.

#### **UNIFORMITY IN HIGHWAY TRAFFIC CONTROL**

By W. P. Eno. The Eno Foundation for Highway Traffic Control, Saugatuck, Conn., 1941. 83 pp., diags., illus., 7 x 5 in., paper, \$1.00.

The basic principles of traffic control as developed by the author during the last forty years are summarized for general use. Topics covered include police enforcement, licensing, traffic aids, pedestrian rules, parking, one-way traffic and noise reduction. The necessity for uniformity is stressed.

## of Applications for Admission and for Transfer

May 27th, 1942.

The By-laws provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.\*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

**Communications relating to applicants are considered by the Council as strictly confidential.**

The Council will consider the applications herein described at the July meeting.

L. AUSTIN WRIGHT, General Secretary.

\*The professional requirements are as follows:—

**A Member** shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science or engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

**A Junior** shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

**A Student** shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

**An Affiliate** shall be one who is not an engineer by profession but whose pursuits, scientific attainment or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

**FINLAYSON—HAROLD MUSGRAVE**, of Montreal, Que. Born at Toronto, Ont., Aug. 8th, 1897; Educ.: B.Sc. (Civil), McGill Univ., 1923; 1922 (summer), instr'man., City of Montreal; 1923-28, junior engr., Dept. Rlys. and Canals; 1928 (summer), res. engr., John S. Metcalf Co.; 1928-30, field engr., Shawinigan Engineering Co.; 1930 to date, hydraulic engr., Shawinigan Water & Power Company, Montreal, Que.

References—J. B. Challies, J. Morse, H. Massue, D. W. McLachlan, C. R. Lindsey, O. O. Lefebvre, E. Brown, J. A. McCrory.

**GASOI—WILLIAM**, of Montreal, Que. Born at Montreal, July 3rd, 1918; Educ.: Completed 2nd year junior engr. and applied science; 1936-38, Standard Electric Co.; 1939-40, Fairchild Aircraft Ltd.; 1940, Noorduyn Aviation Co. Ltd.; 1941, Dominion Engr. Co. Ltd.; 1941 to date, designer, Harrington Tool & Die Co. Ltd., Montreal. (Applying for admission as Affiliate.)

References—W. A. Wood, B. R. Perry, C. E. Herd, H. M. Black.

**HINTON—RALPH**, of 5 Birch Ave., Kingston, Ont. Born at West Hartlepool, England, July 6th, 1901; Educ.: Armstrong College, Newcastle-on-Tyne; 1915-16, 1918-22, ap'tice, Wm. Gray & Co., West Hartlepool; 1922-28, millwright, hydro operator, steam plant engr., Spruce Falls Power & Paper Co., Kapuskasing, Ont.; 1928-29, erecting, Dominion Bridge Co., Toronto; 1929-31, steam plant engr., 1931-33, plant engr., Dominion Motors of Canada, Leaside, Ont.; 1933 to date, mtce. engr., supt. of bldgs. and grounds, Queen's University and Kingston General Hospital. (Applying for admission as Affiliate.)

References: J. B. Baty, D. S. Ellis, L. M. Arkley, T. A. McGinnis, J. M. Campbell, C. Folger, A. Jackson.

**LOOMIS—DAN MCKAY**, of 927 Graham Blvd., Town of Mount Royal, Que. Born at Sherbrooke, Que., Jan. 8th, 1901; Educ.: Grad., R.M.C., 1922. B.Sc. (Mech.), McGill Univ., 1924; 1916-17 (summers), C.N.R., New Brunswick and Nova Scotia; 1918 (summer), level and transitman, W. I. Bishop; 1925-27, design, erection and operation of contractors' plant in constrn. of bldgs. (industrial) in Montreal area; 1927-28, design, constrn. and operation of mfg. plant for emulsifying bitumen in water; 1928-33, research work in developing road pavements (asphaltic), mining machy. and machy. for emulsifying bituminous materials in water; 1933-39, managing director, Bitumen Products Corporation; 1941, technical asst., Dept. of Munitions and Supply, and at present, sources officer, tank production branch, Dept. of Munition and Supply, Ottawa, Ont.

References: H. B. Bowen, W. F. Drysdale, J. M. R. Fairbairn, R. DeL. French, R. E. Jamieson, C. M. McKergow, G. L. Wiggs.

**MAGNANT—DANIEL ARMAND**, of Boucherville, Que. Born at New York, N.Y., March 28th, 1907; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1931; R.P.E. of Que.; 1931, surveying, 1931-33, res. engr., 1933-36, divn. engr., Quebec Roads Dept.; 1937-40, dist. engr., Colonization Dept., Prov. of Quebec; 1941 to date, tool engr. and tool designer, Fairchild Aircraft Ltd., Boucherville, Que.

References: J. A. Lalonde, A. Gratton, S. A. Baulne, A. Circe.

**MATTE—RAYMOND E.**, of 4369 Coolbrook Ave., Montreal, Que. Born at Montreal, Aug. 13th, 1903; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1927; R.P.E. of Que.; 1923-27 (summers and part time during lectures), surveying; 1927-28, office engr., Balia Corporation, New York; 1929, inspr. on constrn., Moran & Proctor, New York; 1929-34, engr., estimator and constrn. supt., Alphonse Gratton Ltd., contractors; 1934 to date, engr. and salesman, Canadian Tube & Steel Products Ltd., Montreal.

References: J. A. Lalonde, L. A. Duchastel, L. Trudel, O. O. Lefebvre, A. Frigon.

**MILLMAN—JOSEPH MALCOLM**, of 33 Claxton Blvd., Toronto, Ont. Born at Arima, Japan, July 29th, 1912; Educ.: B.Eng. (Mech.), 1934, B.Eng. (Civil), Univ. of Sask., 1935; R.P.E. of Ont.; 1929-31, misc. summer work, Univ. of Sask. mtce. engrs.; 1935-36, struct'l. design and plant mtce., 1936-41, test engr., Canadian Kodak Co. Ltd.; 1941-42, struct'l. design for C. F. Morrison, M.E.I.C., consltg. engr., and 1941 to date, mech. engr., Canadian & General Finance Co. Ltd., Toronto, Ont.

References: C. F. Morrison, V. H. McIntyre, W. H. Laughlin, C. J. Mackenzie, E. K. Phillips.

**MCQUARRIE—ALEXANDER MACRAE**, of 422 Park Street, Peterborough, Ont. Born at Edson, Alta., Aug. 16th, 1914; Educ.: B.Sc. (Elec.), Univ. of Alta., 1941; 1940-41, test dept., and 1941 to date, aircraft instrument engrg., Can. Gen. Elec. Co. Ltd., Peterborough, Ont.

References: G. R. Langley, H. R. Sills, J. Cameron, B. I. Burgess, W. T. Fanjoy, D. J. Emery.

**RICHARDSON—JOHN MAXWELL**, of 299 Ile Bigras, Laval Islands, Que. Born at Toronto, Ont., Nov. 7th, 1906; Educ.: B.Sc., McGill Univ., 1928; 1925 (summer), asst. on sampling and assay work; with the Southern Canada Power Co. Ltd., Montreal, as follows: 1926-27 (summers) and 1928-29, ap'ticeship, 1929-35, junior engr., 1935-36, acting operating supt., 1936-41, asst. to asst. plant mgr., and at present, elec. engr.

References: J. S. H. Wurtele, T. C. Connell, J. H. Trimmingham, H. L. Mahaffy, C. V. Christie.

**SMITH—JAMES MORRISON**, of Toronto, Ont. Born at Dornoch, Ont., Dec. 29th, 1894; Educ.: B.A.Sc., Univ. of Toronto, 1923; R.P.E. of Ont.; 1916-19, overseas, Pilot, R.F.C., Lieut., Special Reserve; 1925, paving and sewers, Town of Riverside; 1926-30, ditches, sewers and tunnels, Macomb County Drain Comm.; Summer 1922, 1923-24, and 1930 to date, with Dept. of Highways of Ontario, rodman, instr'man., inspr., surveys and location, and at present, dftsmen.

References: W. S. Wilson, J. M. Gibson, T. F. Francis, H. E. Wingfield, V. H. McIntyre.

**SWANSTON—MURRAY MAXWELL**, of 1142 Spadina Crescent East, Saskatoon, Sask. Born at Holstein, Ont., Oct. 23rd, 1904; Educ.: private study in highway engrg.; 1925-26 and 1928-29, electrician's helper; 1929-30, electrical contracting, Shaunavon, Sask.; with Dept. of Highways of Sask., as follows: 1930-31, rodman, 1931-32, instr'man., 1932-38, operation of equipment and mtce. of a section of highway at Swift Current; 1938-40, misc. mtce. work; 1940, instr'man. and inspr., Dept. of Transport; 1940-41, asst. engr., No. 4 Training Command, R.C.A.F.; Nov., 1941, to date, Commissioned as Flying Officer, Works and Bldg. Engineer Branch, R.C.A.F., and posted to Newfoundland i/c snow removal and aerodrome mtce., also Works Officer i/c aerodrome lighting, certain power houses, etc.

References: W. W. Perrie, H. R. MacKenzie, F. H. Smail, H. A. Gray, R. A. McLellan, C. A. Davidson.

**UNDERWOOD—WILLIAM MARK**, of Halifax, N.S. Born at Winnipeg, Man., April 29th, 1913; 1933-38, chainman, rodman, instr'man., highway constrn., Dept. of Mines and Resources (Federal); 1938-39, instr'man., 1939-40, res. engr., Dept. of Public Works, at Cranbrook & Rossland, B.C.; 1940-41, junior asst. engr., on constrn. of No. 34 S.F.T.S., Dept. of National Defence for Air; at present, Lieut., R.C.E. Works Officer i/c of all mtce. and constrn. of military bldgs. in the City of Halifax.

References: J. M. Wardle, E. S. Jones, W. S. Lawrence, J. F. C. Wightman.

(Continued on page 398)

# Employment Service Bureau

## SITUATIONS VACANT

- MECHANICAL DESIGNING DRAUGHTSMAN, Graduate preferred, required for work in Arvida on specification drawings for plate work, elevators, conveyors, etc., equipment layouts, pipe layouts and details. Apply to Box No. 2375-V.
- MECHANICAL ENGINEER, with machine shop experience required for position in South America on important war work. Apply to Box No. 2441-V.
- MECHANICAL ENGINEER, Mechanical construction and maintenance, some experience on diesels and tractors preferred, for work in Mackenzie, B.G. Apply to Box No. 2482-V.
- MECHANICAL ENGINEER with experience in pulp and paper industry for supervision and maintenance work in large paper mill. Must be experienced in machine shop work and the handling of men. Apply to Box No. 2522-V.
- ELECTRICAL ENGINEER, construction and maintenance of diesel electric locomotives for work at Mackenzie, B.G. Apply to Box No. 2536-V.

## AN APPEAL!

One of our members who has just returned from overseas reports that there is an urgent need of surveying instruments in the Canadian Corps in England. Some organizations have already supplied a few instruments on loan but many more are needed.

Any members who would be willing to loan such instruments to our fighting forces should address them to:

**THE CHIEF ENGINEER**  
Headquarters 1st Canadian Corps  
Canadian Army Overseas

The need is mostly for transits and measuring tapes.

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.

- MECHANICAL DESIGNING DRAUGHTSMAN, on permanent moulds and die casting dies. Apply to Box No. 2537-V.
- CIVIL ENGINEER, with actual pile driving and heavy construction experience required for work in British Guiana. Apply to Box No. 2538-V.
- YOUNG GRADUATE ENGINEER required by machinery supply firm located in Montreal. Some selling experience preferred. State military status. Apply to Box No. 2539-V.
- CIVIL ENGINEER, supervising construction operations in Mackenzie, B.G. Apply to Box No. 2549-V.
- MECHANICAL DRAUGHTSMAN, for important war work in Montreal. Apply to Box No. 2550-V.

## SITUATIONS WANTED

- GRADUATE ENGINEER in Electrical and Mechanical Engineering, M.E.I.C., and R.P.E., electric utility experience. Age 30. Married. Transmission line, and distribution, estimating, design, survey and construction three years, (one year acting superintendent), interior light and power wiring design, estimating and supervision one year. Electric meters (AC) six months, electric utility drafting six months, foundation layouts and concrete inspection six months. Steam power plant operation two years. Presently employed but desire advancement. Apply to Box No. 2430-W.
- DESIGNING DRAUGHTSMAN, M.E.I.C. Age 47. Married. Location immaterial. Experienced in

estimates, design, layouts and details of industrial buildings. Presently employed but desirous of change with prospects of advancement. Apply to Box No. 2439-W.

GRADUATE CIVIL, STRUCTURAL ENGINEER, M.E.I.C., middle age. Twenty years' experience estimator, designer, and sales engineer. Excellent references. Open for engagement. Apply to Box No. 2440-W.

## WANTED

Someone to back up my chemical engineering education. Have saved eight hundred dollars to start on, need someone to help from there on. Age 21, army (reserve) discharge. Good references for repayment plus interest, plus promise to loan to another student as you have to me. S.E.I.C. Apply to Box No. 40.

## FOR SALE

Transit, Buff and Buff Mfg. Five-inch circle, brass telescope and sliding leg tripod. One nick in the vertical half-circle, but no other damage. Thirty-year old instrument, but not much used. Would sell for \$225.00. Apply Box No. 45-S.

## PRELIMINARY NOTICE

(Continued)

WALTERS—PAUL W., of 39 Hickory St., Ottawa, Ont. Born at Toronto, Feb. 7th, 1912; Educ.: B.A.Sc. (Civil), Univ. of Toronto, 1934; R.P.E. of Ont.; 1930-31 (summers), Turnbull Elevator Co.; 1934, Raynor Constrn. Co.; 1935, asst. engr. and checker, Dufferin Constrn. Co.; 1935, engr. i/c of constrn. of landing field, Trans Canada Airlines; 1936-41, with the Dept. of Highways of Ontario, 1936, draftsman, 1937, on survey and constrn., Queen Elizabeth Highway, 1938, res. engr., Grimsby, 1938-41, res. engr., Niagara Falls and district; at present, investigator, organization branch, Civil Service Commission, handling organization and personnel work for Dept. of Munitions and Supply.

References: R. M. Smith, C. R. Young, H. L. Bucke, M. F. Ker, E. Viens.

WILSON—JOHN SHAW, of Vancouver, B.C. Born at Glasgow, Scotland, Aug. 15th, 1882; Educ.: Royal Technical College, 1898-1904; R.P.E. of B.C.; 1902-04, ap'ticed to John Dalglish & Sons, engr. and ironfounders, Glasgow; 1904-06, plant engr., Heenan & Froude, Worcester; 1907-16, varied experience in U.S.A.; 1916-19, chief engr., Willamette Iron & Steel Works, Portland, Oregon; 1921 to date, president and general manager, Tyee Machinery Company, Limited, Vancouver, B.C.

References: W. N. Kelly, J. Robertson, J. N. Finlayson, H. N. Macpherson, W. O. Scott.

## FOR TRANSFER FROM THE CLASS OF JUNIOR

EAGLES—NORMAN B., of Moncton, N.B. Born at Moncton, Oct. 4th, 1912; Educ.: B.Sc. (Elec.), Univ. of N.B., 1935; 1935 (summer), R.C.A.F. Flying Training Course; 1936-41, asst. city electrical engr., City of Moncton; Sept., 1941, to date, Engineering Instructor, No. 21, Elementary Flying Training School, Chatham, N.B. (St. 1935, Jr. 1940.)

References: V. C. Blackett, T. H. Dickson, G. L. Dickson, J. Stephens, A. F. Baird, E. B. Martin, W. E. Seeley.

GAUDEFROY—HENRI, of 3269 Van Horne Ave., Montreal, Que. Born at Montreal, June 18th, 1909; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1933, B.S. (Elec.), Mass. Inst. Tech., 1934; R.P.E. of Que.; 1934-35, technical operator, Radio Station CHLP; 1935-39, with the Bell Telephone Company of Canada—1935, training experience, engrg. plant, traffic and commercial depts., constrn. and mtce.,

installn work, etc., 1936, appointed to staff of central office equipment engr. (enrg. dept.), design and hook-up of dual central office equipment, etc.; 1939 to date, asst. professor of mathematics, administration work under the supervn. of the director of studies, Ecole Polytechnique (Faculty of Engrg., Univ. of Montreal), Montreal, Que. (Jr. 1934).

References: J. A. Lalonde, A. Circe, O. O. Lefebvre, J. A. Beauchemin, H. Massue.

ROY—JOSEPH EUGENE LEO, of Quebec, Que. Born at Montreal, Dec. 23rd, 1907; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1930; B.Eng. (Elec.), McGill Univ., 1932; 1928-29 (summers), surveying, Bureau of Mines; 1930-32, ap'ticeship course, 1932-34, elec. testing, 1934-37, power sales, Shawinigan Water & Power Co.; 1937 to date, power sales, Quebec Power Company, Quebec, Que. (St. 1931, Jr. 1936.)

References—C. V. Christie, A. Frigon, A. B. Normandin, A. Lariviere, R. B. McDunnough, P. S. Gregory, E. D. Gray-Donald.

## FOR TRANSFER FROM THE CLASS OF STUDENT

CHAPMAN—STUART M., of Montreal, Que. Born at Montreal, March 6th, 1911; Educ.: B. Eng. (Chem.), McGill Univ., 1936; 1934-35 (summers), research asst., Forests Products Labs. of Canada, Montreal; 1937-41, research worker, Canadian Pulp & Paper Ass., Montreal; at present, research associate i/c of investigations on the printing properties of paper, Dept. of Mines & Resources, Pulp & Paper Research Institute of Canada, Montreal (St. 1936).

References: C. M. McKergow, R. DeL. French, E. Brown, G. J. Dodd, L. R. McCurdy, J. B. Phillips.

PETERSON—ROBERT, of 610 4th Ave., Saskatoon, Sask. Born at Eston, Sask., April 12th, 1918; Educ.: B.Sc. (Civil), Univ. of Sask., 1939. S.M., Harvard Univ., 1941; 1939-40, instr'man., 1941 to date, asst. engr., P.F.R.A., also instructor at Univ. of Sask., Saskatoon, Sask. (St. 1939).

References: C. J. Mackenzie, R. A. Spencer, J. I. Mutchler, W. L. Foss, E. K. Phillips, H. I. Nicholl.

WATSON—JOHN CRITTENDEN, of Montreal West, Que. Born at Yarmouth, N.S., July 28th, 1918; Educ.: B.Eng. (Mech.), McGill Univ., 1940; 1939 (summer), student engr., Canada Cement Co., Belleville, Ont.; 1940 to date, service engr., Combustion Engineering Corp. Ltd., Montreal, Que. (St. 1939).

References: L. H. Birkett, C. M. McKergow, M. G. Saunders, I. P. Macnab, J. G. Hall.

# THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 25

MONTREAL, JULY 1942

NUMBER 7



"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

★ ★ ★

PUBLISHED MONTHLY BY  
THE ENGINEERING INSTITUTE  
OF CANADA

2050 MANSFIELD STREET - MONTREAL

L. AUSTIN WRIGHT, M.E.I.C.  
*Editor*

LOUIS TRUDEL, M.E.I.C.  
*Assistant Editor*

N. E. D. SHEPPARD, M.E.I.C.  
*Advertising Manager*

#### PUBLICATION COMMITTEE

C. K. McLEOD, M.E.I.C., *Chairman*  
R. DeL. FRENCH, M.E.I.C., *Vice-Chairman*  
A. C. D. BLANCHARD, M.E.I.C.  
H. F. FINNEMORE, M.E.I.C.  
T. J. LAFRENIÈRE, M.E.I.C.

## CONTENTS

HYDRO ELECTRIC POWER COMMISSION OF ONTARIO— ADMINISTRATION BUILDING, TORONTO, ONT. . . . .	Cover
(Photo J. H. Mackay)	
BARRETT CHUTE DEVELOPMENT . . . . .	402
A. L. Malcolm, M.E.I.C.	
WAGES STABILIZATION . . . . .	406
Dr. W. J. Couper	
SIZE AND THE AEROPLANE . . . . .	412
Major Oliver Stewart	
THE LIONS' GATE BRIDGE—IV . . . . .	414
S. R. Banks, M.E.I.C.	
ABSTRACTS OF CURRENT LITERATURE . . . . .	428
FROM MONTH TO MONTH . . . . .	432
PERSONALS . . . . .	437
Visitors to Headquarters . . . . .	439
Obituaries . . . . .	440
NEWS OF THE BRANCHES . . . . .	440
LIBRARY NOTES . . . . .	444
PRELIMINARY NOTICE . . . . .	448
EMPLOYMENT SERVICE . . . . .	449
INDUSTRIAL NEWS . . . . .	450

Price 50 cents a copy, \$3.00 a year: in Canada, British Possessions, United States and Mexico, \$4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, \$2.00 a year.—Entered at the Post Office, Montreal, as Second Class Matter.

THE INSTITUTE as a body is not responsible either for the statements made or for the opinions expressed in the following pages.

# THE ENGINEERING INSTITUTE OF CANADA

## MEMBERS OF COUNCIL - 1942

### PRESIDENT

C. R. YOUNG, Toronto, Ont.

### VICE-PRESIDENTS

\*A. L. CARRUTHERS, Victoria, B.C.  
†H. CIMON, Quebec, Que.

### PAST-PRESIDENTS

†T. H. HOGG, Toronto, Ont.

### COUNCILLORS

†E. D. GRAY-DONALD, Quebec, Que.  
†J. HAIMES, Lethbridge, Alta.  
\*J. G. HALL, Montreal, Que.  
†R. E. HEARTZ, Montreal, Que.  
†W. G. HUNT, Montreal, Que.  
†E. W. IZARD, Victoria, B.C.  
†J. R. KAYE, Halifax, N.S.  
\*E. M. KREBSER, Walkerville, Ont.  
†N. MacNICOL, Toronto, Ont.  
\*H. N. MACPHERSON, Vancouver, B.C.  
\*H. F. MORRISEY, Saint John, N.B.

### TREASURER

E. G. M. CAPE, Montreal, Que.

### GENERAL SECRETARY

L. AUSTIN WRIGHT, Montreal, Que.

†J. L. LANG, Sault Ste. Marie, Ont.  
†G. G. MURDOCH, Saint John, N.B.

†C. J. MACKENZIE, Ottawa, Ont.

\*W. H. MUNRO, Ottawa, Ont.  
†T. A. McELHANNEY, Ottawa, Ont.  
\*C. K. McLEOD, Montreal, Que.  
†A. W. F. McQUEEN, Niagara Falls, Ont.  
†A. E. PICKERING, Sault Ste. Marie, Ont.  
†G. McL. PITTS, Montreal, Que.  
†W. J. W. REID, Hamilton, Ont.  
†J. W. SANGER, Winnipeg, Man.  
\*M. G. SAUNDERS, Arvida, Que.  
†H. R. SILLS, Peterborough, Ont.  
\*J. A. VANCE, Woodstock, Ont.  
\*For 1942 †For 1942-43 ‡For 1942-43-44

### SECRETARY-EMERITUS

R. J. DURLEY, Montreal, Que.

### ASSISTANT GENERAL SECRETARY

LOUIS TRUDEL, Montreal, Que.

## STANDING COMMITTEES

### FINANCE

DEG. BEAUBIEN, *Chairman*  
J. E. ARMSTRONG  
E. G. M. CAPE  
G. A. GAHERTY  
J. A. McCRORY  
F. NEWELL

### LEGISLATION

J. L. LANG, *Chairman*  
R. L. DOBBIN  
R. J. DURLEY

### PAPERS

J. A. VANCE, *Chairman*  
DEG. BEAUBIEN  
K. M. CAMERON  
A. L. CARRUTHERS  
H. CIMON  
J. L. LANG  
G. G. MURDOCH

### LIBRARY AND HOUSE

W. G. HUNT, *Chairman*  
A. T. BONE  
J. S. HEWSON  
M. S. NELSON  
G. V. RONEY

### PUBLICATION

C. K. McLEOD, *Chairman*  
R. DEL. FRENCH, *Vice-Chairman*  
A. C. D. BLANCHARD  
H. F. FINNEMORE  
T. J. LAFRENIERE

## SPECIAL COMMITTEES

### BOARD OF EXAMINERS AND EDUCATION

R. A. SPENCER, *Chairman*  
I. M. FRASER  
W. E. LOVELL  
A. P. LINTON  
H. R. MacKENZIE  
E. K. PHILLIPS

### GZOWSKI MEDAL

H. V. ANDERSON, *Chairman*  
A. C. D. BLANCHARD  
T. H. JENKINS  
V. A. McKILLOP  
W. H. POWELL

### DUGGAN MEDAL AND PRIZE

J. T. FARMER, *Chairman*  
J. M. FLEMING  
R. C. FLITTON

### PLUMMER MEDAL

C. R. WHITTEMORE, *Chairman*  
J. CAMERON  
R. L. DOBBIN  
O. W. ELLIS  
R. E. GILMORE

### LEONARD MEDAL

JOHN McLEISH, *Chairman*  
A. E. CAMERON  
A. O. DUFRESNE  
J. B. DEHART  
A. E. MACRAE

### JULIAN C. SMITH MEDAL

C. R. YOUNG, *Chairman*  
T. H. HOGG  
C. J. MACKENZIE

### PROFESSIONAL INTERESTS

J. B. CHALLIES, *Chairman*  
J. E. ARMSTRONG  
G. A. GAHERTY  
O. O. LEFEBVRE  
H. W. McKIEL  
J. A. VANCE

### STUDENTS' AND JUNIORS' PRIZES

#### Zone A (Western Provinces)

##### H. N. Ruttan Prize

A. L. CARRUTHERS, *Chairman*  
E. W. IZARD  
H. N. MACPHERSON

#### Zone B (Province of Ontario)

##### John Galbraith Prize

J. L. LANG, *Chairman*  
A. E. PICKERING  
J. A. VANCE

#### Zone C (Province of Quebec)

##### Phelps Johnson Prize (English)

DEGASPE BEAUBIEN, *Chairman*  
J. E. ARMSTRONG  
R. E. HEARTZ

##### Ernest Marceau Prize (French)

H. CIMON, *Chairman*  
J. H. FREGEAU  
E. D. GRAY-DONALD

#### Zone D (Maritime Provinces)

##### Martin Murphy Prize

G. G. MURDOCH, *Chairman*  
G. L. DICKSON  
S. W. GRAY

### THE YOUNG ENGINEER

H. F. BENNETT, *Chairman*  
J. BENOIT  
D. S. ELLIS  
J. N. FINLAYSON  
R. DEL. FRENCH  
R. F. LEGGET  
A. E. MACDONALD  
H. W. McKIEL

### MEMBERSHIP

J. G. HALL, *Chairman*  
S. R. FROST

### INTERNATIONAL RELATIONS

R. W. ANGUS, *Chairman*  
J. B. CHALLIES, *Vice-Chairman*  
E. A. ALLCUT  
C. CAMSELL  
J. M. R. FAIRBAIRN  
O. O. LEFEBVRE  
M. J. McHENRY  
H. H. VAUGHAN  
C. R. YOUNG

### DETERIORATION OF CONCRETE STRUCTURES

R. B. YOUNG, *Chairman*  
E. VIENS, *Vice-Chairman*  
G. P. F. BOESE  
A. G. FLEMING  
W. G. GLIDDON  
O. O. LEFEBVRE  
J. A. McCRORY  
C. J. MACKENZIE  
J. H. McKINNEY  
R. M. SMITH

### WESTERN WATER PROBLEMS

G. A. GAHERTY, *Chairman*  
C. H. ATTWOOD  
L. C. CHARLESWORTH  
A. GRIFFIN  
D. W. HAYS  
G. N. HOUSTON  
T. H. HOGG  
O. O. LEFEBVRE  
C. J. MACKENZIE  
H. J. McLEAN  
F. H. PETERS  
S. G. PORTER  
P. M. SAUDER  
J. M. WARDLE

# THE ENGINEERING INSTITUTE OF CANADA

## OFFICERS OF BRANCHES

### BORDER CITIES

*Chairman*, H. L. JOHNSTON  
*Vice-Chair.*, G. G. HENDERSON  
*Executive*, W. P. AUGUSTINE  
 J. F. G. BLOWEY  
 W. R. STICKNEY  
 (Ex-Officio), E. M. KREBSER  
 G. E. MEDLAR  
*Sec.-Treas.*, J. B. DOWLER,  
 754 Chilver Road,  
 Walkerville, Ont.

### CALGARY

*Chairman*, H. J. McEWEN  
*Vice-Chair.*, J. G. MacGREGOR  
*Executive*, J. N. FORD  
 A. GRIFFIN  
 H. B. SHERMAN  
 (Ex-Officio), G. P. F. BOESE  
 S. G. COULTIS  
 J. B. DEHART  
 P. F. PEELE  
*Sec.-Treas.*, K. W. MITCHELL,  
 803—17th Ave. N.W.,  
 Calgary, Alta.

### CAPE BRETON

*Chairman*, J. A. MacLEOD  
*Executive*, J. A. RUSSELL M. F. COSSITT  
 (Ex-Officio), F. W. GRAY  
*Sec.-Treas.*, S. C. MIFFLEN,  
 60 Whitney Ave., Sydney, N.S.

### EDMONTON

*Chairman*, D. A. HANSEN  
*Vice-Chair.*, D. HUTCHISON  
*Executive*, C. W. CARRY  
 B. W. PITFIELD  
 E. R. T. SKARIN  
 J. A. ALLAN  
 E. ROBERTSON  
 (Ex-Officio), J. W. JUDGE  
 J. GARRETT  
 R. M. HARDY  
*Sec.-Treas.*, F. R. BURFIELD,  
 Water Resources Office,  
 Provincial Government,  
 Edmonton, Alta.

### HALIFAX

*Chairman*, P. A. LOVETT  
*Executive*, A. E. CAMERON  
 G. T. CLARKE G. J. CURRIE  
 A. E. FLYNN J. D. FRASER  
 D. G. DUNBAR J. A. MacKAY  
 J. F. F. MacKENZIE  
 J. W. MacDONALD  
 G. T. MEDFORTH  
 (Ex-Officio), S. L. FULTZ J. R. KAYE  
*Sec.-Treas.*, S. W. GRAY,  
 The Nova Scotia Power  
 Commission,  
 Halifax, N.S.

### HAMILTON

*Chairman*, STANLEY SHUPE  
*Vice-Chair.*, T. S. GLOVER  
*Executive*, H. A. COOCH  
 NORMAN EAGER  
 A. C. MACNAB  
 A. H. WINGFIELD  
 (Ex-Officio), W. J. W. REID  
 W. A. T. GILMOUR  
*Sec.-Treas.*, A. R. HANNAFORD,  
 354 Herkimer Street,  
 Hamilton, Ont.

### KINGSTON

*Chairman*, T. A. McGINNIS  
*Vice-Chair.*, P. ROY  
*Executive*, V. R. DAVIES  
 K. H. McKIBBIN  
 K. M. WINSLOW  
 (Ex-Officio), A. H. MUNRO  
 G. G. M. CARR-HARRIS  
 D. S. ELLIS  
*Sec.-Treas.*, J. B. BATY,  
 Queen's University,  
 Kingston, Ont.

### LAKEHEAD

*Chairman*, B. A. CULPEPER  
*Vice-Chair.*, MISS E. M. G. MacGILL  
*Executive*, E. J. DAVIES  
 J. I. CARMICHAEL  
 S. E. FLOOK  
 S. T. McCAVOUR  
 R. B. CHANDLER  
 W. H. SMALL  
 C. D. MACKINTOSH  
 (Ex-Officio), H. G. O'LEARY  
 J. M. FLEMING  
*Sec.-Treas.*, W. C. BYERS,  
 c/o C. D. Howe Co. Ltd.,  
 Port Arthur, Ont.

### LETHBRIDGE

*Chairman*, C. S. DONALDSON  
*Vice-Chair.*, W. MELDRUM  
*Executive*, R. F. P. BOWMAN G. S. BROWN  
 N. H. BRADLEY  
 C. S. CLENDENING  
 (Ex-Officio), J. HAIMES  
 A. J. BRANCH J. T. WATSON  
*Sec.-Treas.*, R. B. McKENZIE,  
 McKenzie Electric Ltd.,  
 706, 3rd Ave. S., Lethbridge, Alta.

### LONDON

*Chairman*, F. T. JULIAN  
*Vice-Chair.*, T. L. McMANAMNA  
*Executive*, F. C. BALL  
 V. A. McKILLOP  
 H. F. BENNETT  
 A. L. FURANNA  
 R. S. CHARLES  
 (Ex-Officio), R. W. GARRETT  
 J. A. VANCE  
*Sec.-Treas.*, H. G. STEAD,  
 60 Alexandra Street,  
 London, Ont.

### MONCTON

*Chairman*, F. O. CONDON  
*Vice-Chair.*, H. J. CRUDGE  
*Executive*, B. E. BAYNE E. R. EVANS  
 G. L. DICKSON E. B. MARTIN  
 T. H. DICKSON G. E. SMITH  
 (Ex-Officio), H. W. McKIEL  
*Sec.-Treas.*, V. C. BLACKETT,  
 Engr. Dept., C.N.R.,  
 Moncton, N.B.

### MONTREAL

*Chairman*, J. A. LALONDE  
*Vice-Chair.*, R. S. EADIE  
*Executive*, R. E. HEARTZ  
 J. B. STIRLING  
 J. M. CRAWFORD  
 J. COMEAU  
 H. F. FINNEMORE  
 R. C. FLITTON  
 G. D. HULME  
 (Ex-Officio), DE G. BEAUBIEN  
 J. E. ARMSTRONG  
 J. G. HALL  
 W. G. HUNT  
 C. K. McLEOD  
 G. McL. PITTS  
*Sec.-Treas.*, L. A. DUCHASTEL,  
 40 Kelvin Avenue,  
 Outremont, Que.

### NIAGARA PENINSULA

*Chairman*, C. G. CLINE  
*Vice-Chair.*, G. E. GRIFFITHS  
*Executive*, A. G. HERR  
 R. T. SAWLE  
 G. F. VOLLMER  
 W. D. BRACKEN  
 J. W. BROOKS  
 J. H. TUCK  
 D. S. SCRYMGEOUR  
 (Ex-Officio), A. L. McPHAIL  
 A. W. F. McQUEEN  
*Sec.-Treas.*, J. H. INGS  
 1870 Ferry Street,  
 Niagara Falls, Ont.

### OTTAWA

*Chairman*, N. B. MacROSTIE  
*Executive*, W. G. C. GLIDDON  
 R. M. PRENDERGAST  
 W. H. G. FLAY  
 G. A. LINDSAY  
 R. YUILL  
 (Ex-Officio), K. M. CAMERON  
 C. J. MACKENZIE  
 W. H. MUNRO  
 T. A. McELHANNEY  
 R. K. ODELL  
*Sec.-Treas.*, A. A. SWINNERTON,  
 Dept. of Mines and Resources,  
 Ottawa, Ont.

### PETERBOROUGH

*Chairman*, D. J. EMERY  
*Executive*, C. R. WHITTEMORE F. R. POPE  
 I. F. McRAE R. L. DOBBIN  
 A. J. GIRDWOOD  
 (Ex-Officio), J. CAMERON  
 H. R. SILLS  
*Sec.-Treas.*, A. R. JONES,  
 5, Anne Street,  
 Peterborough, Ont.

### QUEBEC

*Life Hon.-*  
*Chair.*, A. R. DECARY  
*Chairman*, L. C. DUPUIS  
*Vice-Chair.*, RENE DUPUIS  
*Executive*, O. DESJARDINS  
 R. SAUVAGE G. ST-JACQUES  
 S. PICARD L. GAGNON  
 G. W. WADDINGTON  
 (Ex-Officio), E. D. GRAY-DONALD  
 R. B. McDUNNOUGH P. METHÉ  
 H. CIMON  
*Sec.-Treas.*, PAUL VINCENT,  
 Colonization Department,  
 Room 333-A, Parliament Bldgs.,  
 Quebec, Que.

### SAGUENAY

*Chairman*, N. F. McCAGHEY  
*Vice-Chair.*, R. H. RIMMER  
*Executive*, B. BAUMAN  
 G. B. MOXON  
 A. I. CUNNINGHAM  
 W. J. THOMSON  
 (Ex-Officio), M. G. SAUNDERS  
 J. W. WARD  
*Sec.-Treas.*, D. S. ESTABROOKS,  
 Price Bros. & Co. Ltd.,  
 Riverbend, Que.

### SAINT JOHN

*Chairman*, D. R. SMITH  
*Vice-Chair.*, A. O. WOLFF  
*Executive*, H. P. LINGLEY  
 C. D. McALLISTER  
 C. C. KIRBY  
 (Ex-Officio), F. A. PATRIQUEN  
 V. S. CHESNUT  
 G. G. MURDOCH  
 H. F. MORRISEY  
*Sec.-Treas.*, G. W. GRIFFIN,  
 P.O. Box 220,  
 Saint John, N.B.

### ST. MAURICE VALLEY

*Chairman*, VIGGO JEPSEN  
*Vice-Chair.*, J. H. FREGEAU  
*Executive*, E. BUTLER R. D. PACKARD  
 A. C. ABBOTT  
 R. DORION  
 H. J. WARD  
 E. T. BUCHANAN  
 J. JOYAL  
 H. G. TIMMIS  
 (Ex-Officio), A. H. HEATLEY  
*Sec.-Treas.*, J. B. SWEENEY  
 Consolidated Paper Corporation,  
 Grand Mère, Que.

### SASKATCHEWAN

*Chairman*, A. P. LINTON  
*Vice-Chair.*, A. M. MacGILLIVRAY  
*Executive*, F. C. DEMPSEY  
 N. B. HUTCHEON  
 J. G. SCHAEFFER  
 R. W. JICKLING  
 H. R. MacKENZIE  
 B. RUSSELL  
 (Ex-Officio), I. M. FRASER  
*Sec.-Treas.*, STEWART YOUNG  
 P. O. Box 101,  
 Regina, Sask.

### SAULT STE. MARIE

*Chairman*, L. R. BROWN  
*Vice-Chair.*, R. A. CAMPBELL  
*Executive*, N. C. COWIE  
 C. O. MADDOCK  
 C. R. MURDOCK K. G. ROSS  
 (Ex-Officio), J. L. LANG  
 E. M. MacQUARRIE  
 A. E. PICKERING  
*Sec.-Treas.*, O. A. EVANS,  
 159 Upton Road,  
 Sault Ste. Marie, Ont.

### TORONTO

*Chairman*, W. S. WILSON  
*Vice-Chair.*, W. H. M. LAUGHLIN  
*Executive*, D. FORGAN  
 R. F. LEGGET  
 S. R. FROST  
 F. J. BLAIR  
 E. G. HEWSON  
 C. F. MORRISON  
 (Ex-Officio), C. R. YOUNG T. H. HOGG  
 A. E. BERRY N. MacNICOL  
 H. E. BRANDON J. J. SPENCE  
*Sec.-Treas.*, S. H. deJONG  
 Dept. of Civil Engineering,  
 University of Toronto,  
 Toronto, Ont.

### VANCOUVER

*Chairman*, W. O. SCOTT  
*Vice-Chair.*, W. N. KELLY  
*Executive*, H. P. ARCHIBALD  
 I. C. BARLTROP  
 H. C. FITZ-JAMES  
 H. J. MacLEOD  
 R. E. POTTER  
 (Ex-Officio), J. N. FINLAYSON  
 T. V. BERRY  
 H. N. MacPHERSON  
*Sec.-Treas.*, P. B. STROYAN  
 2099 Beach Avenue,  
 Vancouver, B.C.

### VICTORIA

*Chairman*, A. S. G. MUSGRAVE  
*Vice-Chair.*, KENNETH REID  
*Executive*, A. L. FORD  
 B. T. O'GRADY  
 J. B. PARHAM  
 R. BOWERING  
 (Ex-Officio), A. L. CARRUTHERS  
 G. M. IRWIN  
 E. W. IZARD  
*Sec.-Treas.*, J. H. BLAKE,  
 605 Victoria Avenue,  
 Victoria, B.C.

### WINNIPEG

*Chairman*, D. M. STEPHENS  
*Vice-Chair.*, J. T. DYMENT  
*Executive*, C. V. ANTENBRING  
 N. M. HALL  
 T. H. KIRBY  
 E. W. R. BUTLER  
 H. B. BREHAUT  
 (Ex-Officio), J. W. SANGER  
 V. MICHIE  
 C. P. HALTALIN  
*Sec.-Treas.*, THOMAS E. STOREY,  
 55 Princess Street,  
 Winnipeg, Man.

# BARRETT CHUTE DEVELOPMENT

A. L. MALCOLM, M.E.I.C.

Resident Engineer, The Hydro-Electric Power Commission of Ontario, Calabogie, Ont.

Paper presented before the Ottawa Branch of The Engineering Institute on December 18th, 1941.

**NOTE**—No attempt is made herein to give in detail a description of the construction of headworks, penstocks and power house. Procedure in this part of the work followed, in general, the methods pursued on many similar projects.

At the present time (June 23rd, 1942), the penstock for the first unit is completed and the concrete envelope is being poured. Erection of the first unit in the power house is practically completed. It is anticipated that the remaining diversion sluice in the main dam will be closed shortly after the first of July and the headpond raised sufficiently to operate No. 1 unit for the generator dry-out run. Following this and the conducting of necessary tests, the unit will be placed in commercial service early in August. It is expected the second unit will be ready for operation about one month later.

The Hydro-Electric Power Commission of Ontario has under construction at the present time a 54,000 hp. hydro-electric development at Barrett Chute on the Madawaska river, twenty-five miles south-east of the town of Renfrew. This is one of a series of eight projected developments which, along with appropriate storage works and the existing plant at Calabogie, will eventually effect a complete and carefully correlated development of the major part of the main stream for the production of power.

The Madawaska river, one of the main tributaries of the Ottawa, rises in Algonquin Park and flows south-easterly for a distance of about 190 mi. to its confluence with the Ottawa at Arnprior (Fig. 1). It drains an area of 3,300 sq. mi., falling over 1,000 ft. from its headwaters to the mouth. Of this total fall, 665 ft. occurs in the last eighty miles of its course, and it is in this part of the river that the eight development sites referred to above are located. There are many lakes in the upper half of the drainage basin, some of which are susceptible of economical development as storage basins. Barrett Chute Development is located about thirty miles from the mouth of the river.

At the site of the development the river, following a wide semi-circular course, drops through a series of rapids immediately before it enters the south end of Lake Calabogie, at elevation 505 G.S. datum. Proceeding downstream, the series comprises Chain Rapids, Ragged Rapids, High Falls and, lastly, Barrett Chute. The highest and most beautiful of these is High Falls, where the river pitches through narrow gorges between pine-covered rock islands

(Fig. 2). The locality for many years has been a centre of tourist attraction both for fishing and hunting. The entire watershed of the river is rugged and beautiful and, being less frequented, has the advantage of being in a more natural state than many better known resorts. There are no settlements of any size from the village of Calabogie up to Bark lake, a distance of ninety miles by the river.

From the seventies on, when lumbering operations were at their height, extensive cribbing and flume construction were necessary to drive logs over the rapids close to the site of the present development. Through one of the islands at High Falls, solid rock cut, well over 250 ft. long, had to be excavated by hand labour, to carry the log-slide in a direct line to the pool above Barrett Chute. Facilities of this nature were carried out by the Upper Ottawa River Improvement Company. With the depletion of the original pine in the lower part of the watershed, cutting of cedar proceeded and, thereafter, log-driving gradually dwindled. No log-drive of any size has been taken down the Madawaska for over twenty-five years, so that now only broken and decayed remnants of the original flumes and mooring cribs remain as evidence of the activity of that day. The bulk of the original pine went down in the eighties and nineties. Clearings along the shores of the river above the development and private cemetery plots alone bear mute evidence of occupation by early settlers, who for a time attempted to farm on the timber clearings but have long since abandoned their holdings. The development now under construction perpetuates the name of one of those early settlers.

## DESCRIPTION OF THE DEVELOPMENT

The Barrett Chute generating station, when completed, will operate with two vertical units of 28,000 turbine hp. each, under a gross head of 155 ft. The main dam will raise the waters of the Madawaska to elevation 660 for a distance of eight miles upstream to the foot of Mountain Chute. In the forebay so formed, including Mud lake, which is tributary to it, a pondage 3,700 acres in area will be available. The low water flow of the Madawaska river has for some years been augmented from storage on Bark

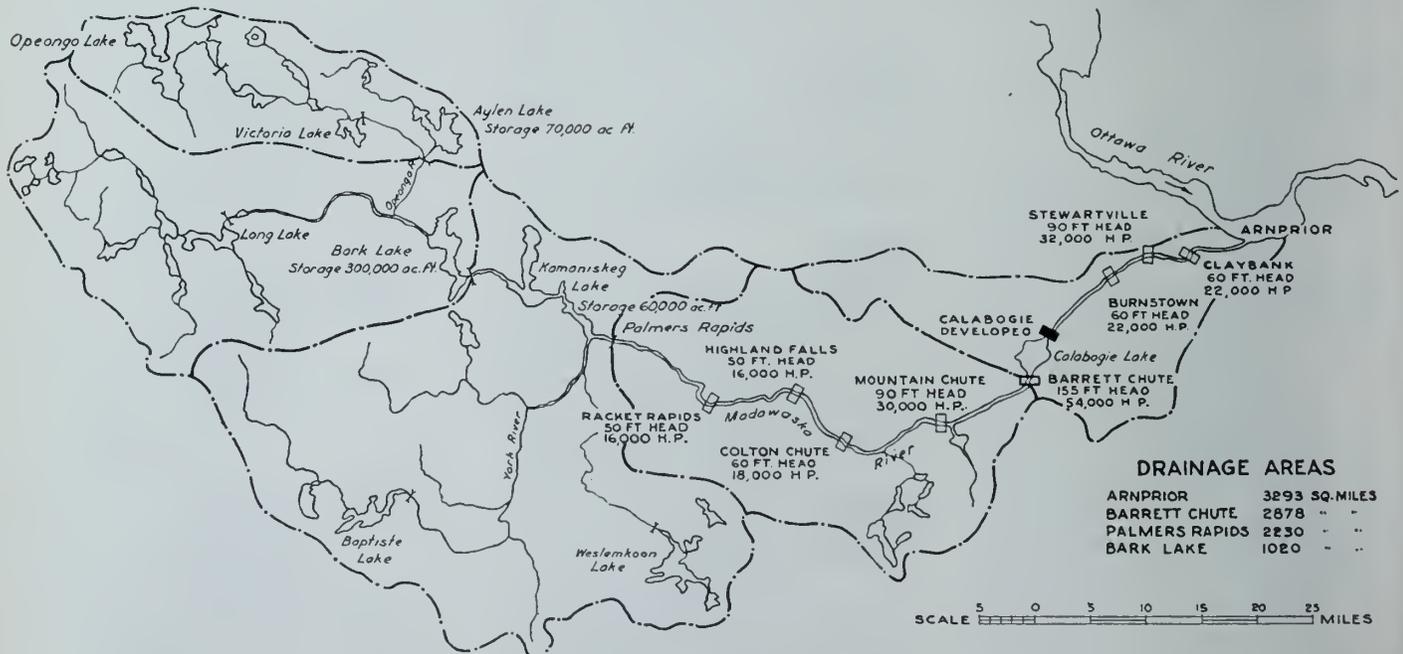


Fig. 1—Barrett Chute Development on the Madawaska River.

lake. An old rock-filled timber dam, originally built by Booth, has been improved from time to time and impounded approximately 30,000 acre-ft. on that lake.

Coincident with the development at Barrett Chute the Commission has under construction, by contract with the Dominion Construction Corporation, a new storage dam at Bark lake. The Bark lake dam is, in the main, an earth-fill structure with concrete control section comprising five sluiceways of the conventional type and, at a lower level,



Fig. 2—Foot of the High Falls.



Fig. 3—Power Canal excavation looking upstream.

four conduits  $5\frac{1}{2}$  ft. in diameter controlled by butterfly valves. This dam will enable water to be stored to a maximum depth of 30 ft. on a greatly increased lake area, the total storage amounting to 300,000 acre-ft. This project is to be completed in time to impound the spring run-off of 1942.

Like many similar water power projects, the scheme of the Barrett Chute Development is quite simple. A short distance downstream from the foot of Ragged Rapids a power canal, 2,400 ft. in length and 38 ft. in width, is now being excavated through solid rock to the headworks structure (Fig. 3). This will involve the excavation of approximately 140,000 cu. yd. of rock and 32,000 cu. yd. of earth. Two shovels, one Diesel and one steam-engine operated, a battery of trucks, and two Athey steel waggons of 14 cu. yd. capacity and tractor drawn, comprise the excavating and disposal equipment. If the haul is not too great, the Athey waggons are far superior to the ordinary dump truck on which the upkeep is very heavy on this class of work. With this set-up, from 12,000 to 15,000 cu. yd. of solid rock can readily be handled per month. For the regular channel excavation, waggon drills are used with  $1\frac{1}{8}$  in. hollow round steel, and for trimming the sides of the cut, plugger drills are used.

At the lower end of the canal, a reinforced concrete headworks structure, 80 ft. in length by 40 ft. in height, will control the flow into the two penstocks by means of electrically operated steel gates (Figs 4 and 5). From the headworks, two 14-ft. diameter steel penstocks will conduct the water to the units in the power house. They will be spaced at 40-ft. centres and, instead of the usual concrete saddles, each pipe will be half embedded in concrete

throughout its entire length. Additional angles riveted on the underside will supply anchorage and render the building of cumbersome and unsightly anchor blocks unnecessary. The narrow rock cuts in which the pipes will be built will limit the sides of the concrete envelope. The penstocks will be approximately 535 ft. in length, and will be laid on a uniform grade to the power station.

For its capacity of 56,000 hp. the power house is of very moderate size, being only 104 ft. long by 80 ft. wide. Two vertical Allis-Chalmers turbines at 40-ft. centres are now being installed in the substructure, which is approximately 40 per cent completed at this date. The station is well located in a deep bay near the foot of Barrett Chute, the rough water of which is deflected from the tailrace by a natural rock ridge extending more than 200 ft. downstream from the foot of the rapids.

#### TRANSPORTATION FACILITIES AND CAMPS

In the early stages of construction, access to the site was obtained by water transportation from the Canadian Pacific Railway siding in Calabogie to the head of the lake, a distance of four miles by water. The work began in September 1940, and the original camp was in tents. Before heavy equipment could be brought in, a new road,  $2\frac{1}{2}$  mi. long, was built around the head of the lake from the Calabogie-Black Donald Mines highway, which is maintained by the Department of Highways. The road was largely a sidehill cut, with a small yardage of solid rock excavation. With the use of two one-yard steam shovels, three bulldozers, two portable compressors and about ten dump trucks, the road to the power site was completed in a little over two months.

Following the completion of the road, the permanent camps and staff houses were built quickly for occupancy by the end of January 1941, after which the tent camp was dismantled. All the camps are of frame construction with Donnacona board for exterior sheathing. Each camp has its own hot and cold water service from the colony water mains. Water service for both camp and construction requirements is supplied from an electrically operated pump house located upstream from the dam. The water main is laid in a trench 3 ft. deep with a steam line wrapped in tar paper beside it. Although installed in mid-winter no appreciable trouble was experienced. A complete sewerage system, with three septic tanks, was built to serve the camp of 600 men. A recreation hall, equipped with radio and a camp commissary handling soft drinks, candy and tobacco, affords the workmen facilities for social gatherings in the evenings.

#### DIVERSION SLUICES

Following closely on the completion of the permanent camps, preparations for construction of the main dam and mixing plant were made in the early spring. By the middle of April 1941, excavation for the foundation of the dam on the north bank of the river, next to the mixing plant,

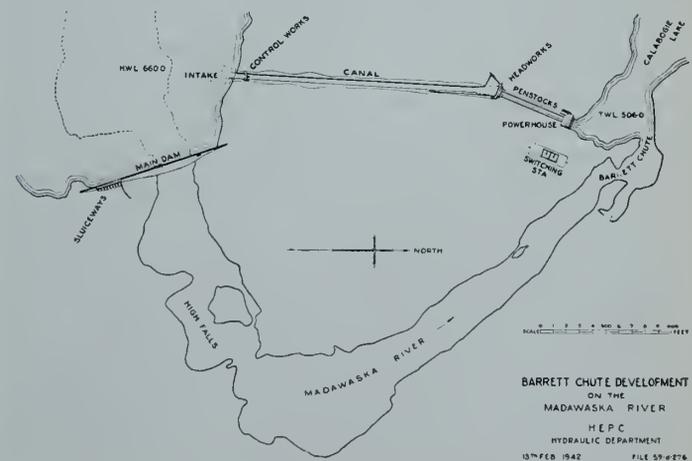


Fig. 4—Madawaska river drainage area.

was very nearly completed and the steam shovel was moved over the construction bridge to the south bank. Coincident with this work a cofferdam was built to unwater the south shore and about one-third of the river channel. By May 24th the piers and floors of the diversion sluices were completed. These temporary sluices were designed to pass the flow of the river during the construction of the major part of the dam and are to be filled with concrete when the headwater is raised to operating level. (Fig. 8).

#### CONCRETE PLACING BY PUMPCRETE MACHINE

Two systems of concrete placing were used, the first of which was by means of the Rex pumperete machine. For several years the Commission has placed most of the concrete on its projects using the pumperete system of dis-



Fig. 5—Headworks gatehouse substructure and penstocks.

tribution, except where the volume exceeded 50,000 cu. yd. This system has many advantages, chief of which is that it eliminates towers and high chutes entirely and discharges the concrete through a 7-in. steel pipe at the exact spot desired. The machine is located in the mixing plant directly below the mixers and its hopper is of the same capacity as the mixer itself. The action of pumping is a pulsating flow, the entire mass of concrete in the pipe coming to rest at the end of each pulsation, during which approximately 0.4 cu. ft. of concrete has been spouted from the discharge pipe into the forms. One disadvantage of the system is that the momentum of the moving mass causes the pipe to surge about one-half an inch with each pulsation, and great care must be taken to see that the supports for distributing pipe are free of the forms. Generally, 6-in. by 6-in. posts are used for this purpose.

The system works well on the level for a distance of six or seven hundred feet, and quite satisfactorily uphill for a shorter distance. When used for pumping downhill our experience with it was not as satisfactory. When so used, segregation of the aggregate sometimes takes place, the stone lagging behind the mortar, causing the pipe to plug. The pipe, which comes in lengths of 10 ft. approximately with an internal diameter of 7 in. has then to be dismantled. Each length of pipe has a smooth end and an enlarged hub end, in the face of which is mounted a fixed round rubber gasket. By means of two clamps, 180 deg. apart, operating on a cam rotation, the ends of adjacent pipes are quickly drawn together. The arm of the clamps is about 10 in. long, and a special T pipe handle is used for additional leverage. The pipes can be disconnected in less than ten seconds and reconnected in a slightly longer time. In service, when running along the horizontal, they should be blocked up about a foot from the ground. Although they are self-aligning, the speed of connecting depends largely on a reasonably even blocking. Standard bends of 90 deg. and less are also used; such bends are indispensable when altering the discharge end of the pipe above a form, so that all concrete will not drop in one place. One desirable feature of the system is that it does not place the concrete too fast for proper puddling, as so often occurs with the use of

chutes and towers. A one-yard pumperete machine will handle the batch from a one-yard mixer and place it in the forms at the rate of 20 cu. yd. per hour, which is quite fast enough for the size of the forms and the heavy reinforcing in ordinary power house construction.

On the Barrett Chute dam, which is a large mass concrete gravity type structure, the pumperete machines owned by the Commission were too small to distribute the concrete for the major part of the dam. For this reason, the pumperete was used to pour the diversion sluices only, a total of 4,800 cu. yd. As the sluices were located on the opposite side of the river from the mixing plant, a four-cable suspension bridge was built from shore to shore. Plank slats 4 ft. long, spaced about 4 in. apart, were cleated to the cables, and the pumperete pipe connected on this catenary platform for a distance of 650 ft. A crib near the south shore carried the cables high enough above the ground to clear the tops of the diversion sluice piers.

A word regarding the filling of these temporary sluices may be of interest at this point. In front of each of the two sluices, short piers were built to hold sectional steel gates. When the time comes to raise the headwater, these gates will be dropped in place and the river will rise to the level of the lowest of the sills in the regulating sluices at the southern end of the dam. After chinking the diversion sluice gates and providing for seepage, concrete will be poured down a series of 10-in. filling pipes extending from the ceiling of the diversion sluice openings to the top of the dam. This will be done in four sections. The procedure for each section will be to pour the concrete to within 2 or 3 in. of the ceiling. When this has set for sufficient time to assure no further shrinkage, the gap will be plugged with dry-pack concrete rammed into place. This procedure will be repeated for each of the four sections in each sluice, working from the front of the dam to the downstream side.

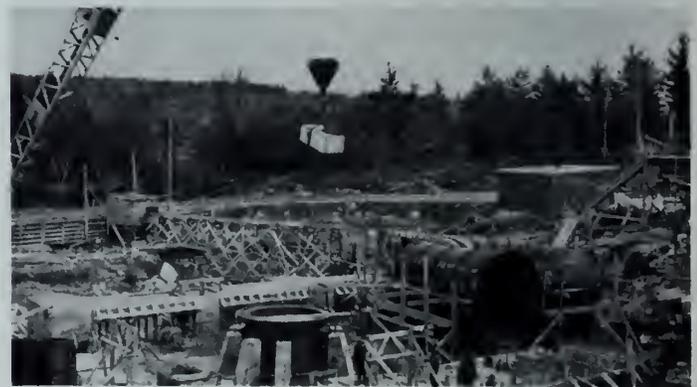


Fig. 6—Scroll case erection at power house site

#### CONCRETE PLACING BY CONVEYOR

Upon completion of the diversion sluice piers the cofferdam was reversed to unwater the north shore and the remaining two-thirds of the river channel. The reversal of the upstream wing of the cofferdam diverted the river through the diversion sluices. A timber trestle, 1,260 ft. in length by 110 ft. high in the centre of the river, was built across the site about 5 ft. upstream from the front line of the dam (Fig. 9). On an 18-ft. plank deck, with planks spaced 1½ in. apart, a 36-in. track on raised sills was installed to carry the tripper and the carriers for a 24-in. concrete belt conveyor. In the mixing plant at the north end of the dam, a pair of two-cubic-yard mixers was set up over a 4-yd. air-operated steel hopper. These mixers discharged alternately into the hopper, and an operator at this point fed the concrete to the belt. With this set-up, 1,200 cu. yards of concrete could be placed per day. For much of the time only one mixer could be used, especially near the top of the dam, as at this rate the concrete rose too rapidly for the safety of the forms. With a system of signal lights on the trestle and at the mixer, and a telephone on the tripper, pouring could be stopped at a moment's notice.

An interesting phase of the work on the dam is now in progress. A contract has been awarded the Dur-ite Company of Chicago to pressure-grout all the cracks and faults in the rock immediately below, and for a short distance in front of, the dam. The grouting will be carried to a depth of 30 ft. if found necessary. The Dur-ite grout is made up of equal parts of Portland cement and Dur-ite powder, to which is added a lubricating agent to facilitate flow in the fine cracks. The grout mixture is made up in a mechanical mixer and water is added until it has the consistency of thin gruel. This is at once pumped into the grout holes, drilled in a row at 5-ft. centres, about two feet in front of the dam. The grout pump has special valves, and extra strong rubber hose is used to carry the grout to the holes.

The procedure used in carrying out this work is as follows:

By the use of special drill steel, holes of 2½ in. in diameter are first put down at 5-ft. centres to an even depth of 5 ft. When fifty or more such holes are completed, inserts are introduced into the first four or five holes, to the first of which the hose is attached. To prevent breaking out, the insert, which is a patented device, is then adjusted so that it closes the hole about one foot from the top, compressing a special gasket to do so. The insert is hollow and, when the operator opens a valve at the top of the insert, grout

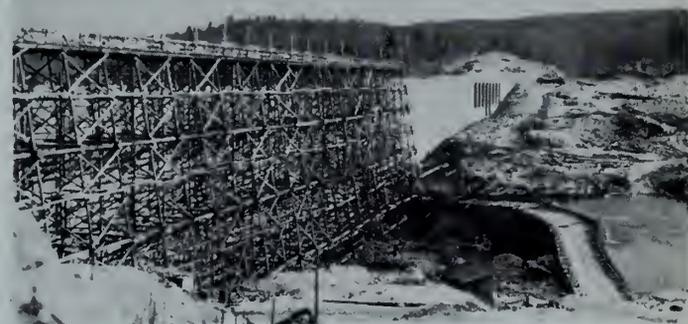


Fig. 9—Upstream face of dam showing conveyor trestle (partly dismantled) and coffer dam.

from the pump flows into the hole. As the pressure rises the grout is forced into the cracks in the rock. A rapid rise in pressure observed by the operator at the pump shows that the hole is nearing the "saturated" stage. The pump is then stopped and the gauge is watched to note any pressure drop. To effect saturation, the pressure in the first 5-ft. lift is raised to 250 lb. per sq. in. If the pressure drops within a minute, the pump is started up slowly until the gauge reading is static at the 250-lb. reading; the hose is then detached and moved to the next insert where the process is repeated.

When the pressure grouting is completed in the series, the inserts are removed and an air jet is applied into each hole to blow out the grout remaining in the hole itself. Next day, drilling is resumed to a depth of 10 ft. and the process of pressure-grouting repeated. If not much grout is taken up in the 5-ft. grout zone, it is then considered fairly well saturated. The drilling to 10-ft. depth is then carried out in every other hole, that is, at 10-ft. spacing. The applied pressure in the second zone is raised to 350 lb. per sq. in. and, if only 0.5 cu. ft. of grout is taken in each hole on the average, the rock is considered tight enough to stop leakage and grouting is discontinued. In this way, so long as the holes take grout, they are deepened 5 ft. at a time until at 25-ft. depth most of them take very little. If there are faults or micaceous areas within the limits of the drilling, the grout most certainly detects their presence and fills them. On the north bank of the river, where excavation for the dam foundation uncovered crystalline limestone and pegmatite intrusions, some decomposition was found along the lines of contact with the com-

Fig. 7—Tail race and lower end of pipeline excavation.

In building the forms for the gravity section of the dam, the front and back forms were continuous with transverse bulkheads every 30 ft. The order of pouring consisted in filling every other section. When a number of such sections were poured, the bulkhead forms were stripped and the exposed end faces of each section covered with a ⅜-in. layer of emulsified asphalt to provide for expansion and contraction. The intermediate sections were then poured. In the deep part of the dam the yardage per section varied from 2,800 to 3,500. A few of the sections were poured continuously from bottom to top, slightly more than two days being required for this. Later, this practice was changed to two lifts per section to avoid the possibility of excessive shrinkage stresses when cooling. Throughout the construction of the dam, pouring was continuous, day and night shifts being used.

#### DRAINAGE SYSTEM

In the design of the Barrett Chute dam, provision was made for the collection of all leakage through the construction joints from the front of the structure. At the end of each 30-ft. section a 6 by 6-in. vertical box was formed on the bulkhead from top to bottom at a distance of 7 ft. from the upstream face. A similar box drain was formed along the rock foundation at the same distance from the face. The vertical drains led into the top of this horizontal box, thus interconnecting the whole drainage system. At a distance of 8 ft. from the upstream face and adjacent to the vertical drains, an arched tunnel, 4 ft. wide by 8 ft. high, was formed through the deep sections of the dam, approximately 10 ft. above the rock. The presence of this tunnel makes possible the inspection for leakage at the construction joints and observation of shrinkage cracks and temperature changes. During midsummer, temperatures of 135 deg. F. were recorded as the structure cooled. Connecting with the vertical drains, a 9 by 9-in. gutter was formed along the upstream side of the tunnel floor. Thus all leakage will have to flow along the gutter before draining out through two 10-in. wrought iron pipes which have their outlets well below tailwater level at the rear of the dam.



Fig. 8—Dam, looking south from mixing plant, showing conveyor trestle and diversion sluices.

petent grey gneiss. Some micaceous layers were also found along the lines of contact, and the occasional vug was opened up. Whenever a hole cut one of these lines of contact there was generally an increase in the volume of grout taken; as much as 40 cu. ft. and more was pumped into a few of the grout holes. If the line of contract was not cut



Fig. 10—Power house steel superstructure, looking north, on April 9th, 1942.

by the drill hole until the third zone, at 15-ft. depth, the upper zone grouting might not give any evidence of the underlying fault. It should be emphasized here that the presence of such faults in the rock at this depth below the base of the dam did not cause it to be considered unsuitable in terms of its competency as a foundation for the dam. The grouting was done solely to stop flow through some of the uncovered contacts which might, in the course of time, become water-bearing. The entire foundation of the dam was core drilled before construction was started. The cores were boxed, suitably labelled and sent to head office for examination. Most of the core drill holes were put down to

50 ft., and in the river channel some of them to 100 ft. A full knowledge of the foundation rock was thus obtained before the site was accepted.

The pressure-grouting contract is still in progress and at the end of November was about 60 per cent completed. Grouting operations may yet be considered from the tunnel floor, which will give a new line of holes 8 ft. from the face of the dam. They would be at greater spacing than out in front where undoubtedly some of the grout, and possibly most of it, works its way upstream from the dam, where sealing of the cracks is equally effective and just as necessary.

#### TIME OF COMPLETION

The early completion of the Barrett Chute Development is desired as a war measure to ensure adequate power for the Eastern System of the Commission. It is estimated to cost \$5,250,000, and the Bark Lake storage dam \$1,750,000.

Conditions favourable for construction have prevailed since the beginning of the project. Except for possible delays in the manufacture and delivery of structural steel and equipment, which are subject to priority regulations, it is expected that the development will be completed on time, that is to say, by early midsummer, 1942, and the Bark Lake storage dam in time to impound the spring run-off of 1942.

#### ACKNOWLEDGMENT

Mr. Otto Holden, M.E.I.C., chief hydraulic engineer of the Hydro-Electric Power Commission, is responsible for the design and supervision of construction of the development. The electrical features are being designed and supervised by the Electrical Engineering Department, of which Mr. A. H. Hull, M.E.I.C., electrical engineer, is the head. Construction is being carried on by the Commission's Construction Department, of which Mr. D. Forgan, M.E.I.C., is construction engineer and is represented in the field by Mr. Angus Richardson, superintendent. The writer is resident engineer.

## WAGES STABILIZATION

DR. W. J. COUPER

*Executive Assistant to the Deputy Minister, Interdepartmental Committee on Labour Co-ordination, Department of Labour, Ottawa.*

**NOTE**—This address deals with price fixing and wage ceiling in relation to inflation. It is an unusually clear explanation of a subject which vitally affects every citizen, but which is not fully understood by all. It was given at Ottawa at the annual meeting of the Canadian Association of Administrators of Labour Legislation, as part of a symposium on wage stabilization policy.—*Editor.*

It is my purpose to start to-day's discussion by indicating in a very few minutes the underlying theory of the wages stabilization policy. I think it can be stated very simply, and it is in essence very simple.

In time of war we have to stop producing automobiles for civilian use and produce military equipment; we have to stop producing washing machines and produce shells; we have to make far-reaching adjustments in our whole productive system. That is to say, we have to divert productive resources from the production of things which civilians consume into the things which the military forces will destroy. We have to reduce consumption. It is on that principle that the wages stabilization policy is based.

The importance of that is obscured, because we entered the war at a time when we were not using our productive resources fully, and it was therefore possible during a considerable period of time, both to expand the production of civilian goods and to expand the production of military equipment; but as we came nearer and nearer the point of relatively full employment we had to face the fact, as I stated at the outset, that we have to reduce consumption.

Now, there are only two main ways to reduce consumption of civilian goods. The first is by a combination of definite government policies such as rationing, taxation and saving. The other is by a process of inflation. Let us pause

there for a just a moment to examine the choice before us, because it is a choice which we cannot escape. Inflation is nothing very mysterious. Inflation is any sustained rise in prices, and the function of inflation is to cut consumption. I am putting it very simply and in a very elementary fashion, because I think it is in those terms that we should always think.

We started out, as I said, without full utilization of our resources. By the government's policy of spending money to buy munitions and other military supplies more and more money got into the hands of the public in the form of spendable money income. While large numbers of men were unemployed, the spending of that money income on civilian goods could produce opportunities for their employment, could stimulate the production of goods to balance the increased money income; but that process can continue only for a relatively limited period of time, and we finally reach the situation where through the government's spending policy more and more money is pumped into the pockets of the consumer without at the same time more goods being produced on which he can spend that money. Then, as I say, one of two major things must happen: either the government must take that money from him in taxation so that he cannot spend it, or the consumer deliberately must fail to spend it and save it; or by spending an increasing amount of money on a not increasing, or at a later stage, an actually decreasing supply of goods, he will force up the prices of those civilian goods.

Putting it in very crude, arithmetical terms, you start off, let us say, with net spendable income after taxation and saving, of two billion dollars, and you spend it on

goods, which for simplicity's sake we will say average a dollar apiece. If you increase your spending income to three billion dollars, that is by 50 per cent, and at the same time increase the supply of civilian goods by 50 per cent, there is no necessary change in prices. If, however, you increase your spendable income from two billion dollars to three billion dollars or by 50 per cent and do not increase your supply of civilian goods by the same proportion, prices must begin to rise: they begin to rise because there must be some arrangement to decide which of those consumers with the three billion dollars, together shall share the relatively limited supply of consumption goods. And that process becomes tremendously accelerated when we reach the stage of increasing money income because of increasing employment, overtime rates and higher money wages; and at the same time face an absolutely decreasing supply of civilian goods.

I want to emphasize that despite all the discussions and fear of inflation, in time of war it is a necessary development unless something can be substituted for it, and it has many advantages: it operates without any Order in Council; it operates without any conscious decision by any governmental authority; it operates without any army of bureaucrats to enforce it. It is a simple process by which, as prices rise, you and I and everybody else in the community because of that price rise are forced to cut our consumption.

It has, however, some appallingly serious defects: it is a process which, once really started, can continue on indefinitely to levels that for those of us who have never seen it, are utterly inconceivable. The prices do not rise at the rate of 1 per cent per month, but at the rate of 10, 30, 50 or 100 per cent per day; it "snow-balls" up, and it has the defect of being exceedingly unjust since different groups in the community are in various positions with respect to their power to adjust their incomes more or less to the rising price level. Because of that injustice it creates unrest, and because of that unrest after a certain point is reached it seriously interferes with the efficiency of production. So that although it works quietly and smoothly in its earlier stages it disrupts all social relations in its later stages, and if allowed to continue in Canada, even to the point that it reached during the last war when our wholesale price level increased by about 150 per cent and our cost of living index rose approximately 100 per cent, would leave in its train a very serious problem of post war readjustment. It allocates sacrifice in an arbitrary fashion.

Because of the fact that this war is so much more highly mechanised, it is going to take a very much larger proportion of the total national income in all belligerent countries than did the last war, and the degree of inflation necessary to restrain consumption during this war would be very much greater than the extent necessary during the last war. So for those general reasons, and because of the particular reason that the extent of inflation this time would need to be very much more severe, the government set its face in the very beginning of the war in the direction of any kind of policy that would check inflation. So that, broadly speaking, the whole wage policy can be summed up in one very simple sentence: Generally speaking, the government has undertaken to say that, apart from some minor adjustments, there shall be no increase in basic wage rates because of the fundamental fact that there cannot be any general increase in real wages; it is physically impossible in time of total war to increase real wage rates, namely, the things that consumers can in fact buy with their wages. That is the story.

Any criticism of the wage policy in its broad meaning is a criticism which must contend that it is physically possible to give all consumers in Canada more and more civilian consumption goods at a time when we are withdrawing men and women from the production of civilian consumption goods.

Let me jump very quickly to the other half of the picture, namely, the price control policy: If money incomes are increasing more rapidly than the supply of the goods on

which those incomes may be spent, unless something is done about it prices will inevitably rise, and I repeat again for emphasis that the only things that can be done about it are taking the money away by taxation, encouraging the people to put their money away by saving, or prohibiting them from spending it through rationing, (and that of itself has a tendency to raise prices of unrationed goods). The government then in its price policy has done as it has in connection with the wage policy, and has said that as of a given date there may be no more rise in prices; but a government declaration of that sort cannot be made effective as long as money incomes increase more rapidly than the goods on which they are spent, and I want to emphasize the fact that the War Time Prices and Trade Board is acutely conscious of that fact. You cannot just by fiat stop prices from rising when the forces of increased income and the short supply of goods are pushing prices up.

So the wage ceiling and price ceiling policies which are the most obvious features of our present Canadian policy are not in themselves the basic instruments. The basic instruments are the taking of money away by taxation, and the saving of money by the population, and the maintenance of supply of goods. The major effort of the War Time Prices and Trade Board is not the prosecution of offenders against the price ceiling. Its major effort is continually to review the supply of goods to make sure that they are maintained in sufficient quantity to permit their distribution without a rise in prices. And I think that we should link up the wage policy under which we have lived for several months with the new policy which is implied in what I have just said. Just as the War Time Prices and Trade Board cannot possibly, and knows it cannot possibly maintain the price ceiling without maintaining the supply of goods, so I think the authorities concerned in all phases of labour relations and related problems are aware of the fact that we cannot maintain the wage ceiling without at the same time maintaining and directing the supply of labour. It is for that reason that we are just beginning a policy of National Selective Service. And just as through the War Time Prices and Trade Board the price control policy is defended by a series of rationing arrangements which thus far chiefly take the form of saying that the rations shall be zero, and you are not allowed to buy this and that, so I think the wage ceiling policy will necessarily have to be supported by a similar arrangement in the rationing of labour. One could continue on at very considerable length to analyze details of the wage policy, but I think in very broad terms I have stated the basic problem.

Let me just repeat it again: The problem is to divert resources and reduce consumption; and in the reduction of that consumption to allocate the sacrifice with a reasonable degree of equity over the different classes in the community. The wage ceiling policy is only one small phase of that problem which says in effect: In this general situation where money incomes are necessarily rising because of increased employment, because of increased spending by the government, we will take one of the factors that would increase money incomes, we will take the rise in wage rates. That is only a small part of the problem, but we do it on the ground that if we do not do it in this way impersonal forces of inflation will do it in another way which will impose sacrifices in a very much more arbitrary and capricious fashion. But we do not exaggerate the importance of it. It is only one small phase of the problem. The basic problem is to increase taxation, to encourage people not to spend their money, and by every device to maintain the supply of goods to the maximum possible extent compatible with the war effort and, when necessary, when they are definitely short, to allocate them under a rationing system. And to do that we have to do the same thing with labour; and I think in the Wartime Bureau of Technical Personnel Regulations (P.C. 638) you get a little indication of the probable trend of development with respect to every other class of labour.

# A PEACE WORTH FIGHTING FOR

WILLIAM E. WICKENDEN

*President of the Case School of Applied Science, Cleveland, Ohio, U.S.A.*

Substance of an address delivered at the Edison Medal presentation, January 28th, 1942, during the American Institute of Electrical Engineers 1942 Convention, New York, N.Y.\*

The name of Edison reminds us that imagination is no less a tool of the engineering profession than fact-bound analysis. The medal which honors the revered memory of Benjamin Lamme bears these words from his pen, "The engineer views hopefully the hitherto unattainable." Kettering is quoted as saying that the difference between a research man and an inventor is that the latter does not know all the reasons why a thing cannot be done, therefore he goes ahead and does it. We engineers who have not only a war to win but also a peace to make secure should pray for a double portion of their spirit.

The 30th of September in 1938 may be marked in future histories as the most tragic date in a thousand years. The Munich pact which sealed the fate of Czechoslovakia not only shattered the tottering structure of world peace, but blasted the last vestige of international good faith on which a new and better peace could be built. Where law had once reigned, only a shadow of law remained, and gangsters were free to take over with impunity. We in the United States, a nation without border complexes to breed an instinct of distrust, were slow to perceive the truth. For three years we moved in a fog of indecision, allowing the shifting pressure of events to shape our course. We had neither enlightened policy nor consistent leadership as our guide. With our political left hand we sought to extend a social revolution, while our industrial right hand was called upon to prepare for a total war. Neither hand trusted or understood the other. Authority was confused and co-ordination lacking. The normal processes of democracy worked badly and the defense results were disappointingly meager and unduly costly. Then came Pearl Harbor.

As if by a flash of lightning, the fog dissipated. The character and the caliber of the foes to be faced stood revealed in starkest outlines. Our own weaknesses were pitilessly laid bare. The path ahead grew clear, brutally clear. Grim resolution seized the nation. Yet there was an unmistakable wave of relief, for even brutal certainty is often easier to bear than confusion of mind and conflict of will. Thus like Britain and France before us we were plunged into a war which none but fanatics desired, sadly, reluctantly, without hate, in a spirit of fatalism. Never in modern times had a whole generation of mankind so completely lost its way.

When future historians come to fix a label upon our times it should surprise no one to find this called "the age of Hollywood"—an era that preferred diverting illusions to solid realities; a generation of jazz and jitterbugs, that thought it more important to be smart than to be wise, that preferred glamor out of a make-up kit to charm acquired through painstaking cultivation; an age of Utopias, that fought a war to end wars, that created a League of Nations without police powers, that built peace on political disintegration in a Europe desperately in need of economic integration, that signed the Kellogg-Briand Pact and trusted its security to the deep caverns of a Maginot line; an age—in America, at least—of economic fantasies, that spent the 1920's abolishing poverty by the magic of stock-market inflation and the '30's restoring social security by spending more than was produced, that dreamed of an America made immune from the ills of mankind by broad seas and a tariff wall, an island of peace and of plenty in the midst of a world of want and of woe.

In all soberness, I do not believe that thoughtful men are willing to go through an inferno of blood and sweat and

tears merely to get our old world back. With all our souls we do not want Hitler's new order of international gangsterism, nor Tokyo's co-prosperity sphere, nor Lenin's proletarian Utopia. To lick Hitler and avenge ourselves of Japanese treachery is necessary, but it is not enough. Remembering Pearl Harbor will put a useful shot of adrenalin into our blood stream to spur our immediate efforts, but it will not give us the staying power for a long and exhausting conflict. Faith, not anger or fear, is the greatest source of staying power that human experience has revealed. Faith in what? We are therefore justified in looking beyond the actual conflict to a peace worth fighting for. Experience has shown too often and too clearly that if you do not prepare for defense until your country is invaded, it is then too late; but it is equally true that if you do not prepare for peace until an armistice is declared, it is then too late. A peace conceived in an atmosphere of economic prostration and emotional exhaustion carries within it the germs of its own destruction.

This is a good time to examine the fruits of our experience. Wise men, it is said, make mistakes but fools repeat them. The United States helped once to win a world war as a minor military partner and found itself outvoted at the peace table. As a compromise, its chief negotiator imposed on Europe a new scheme of collective security designed to replace the long-familiar system of a balance of power. The only chance of the novel scheme's success lay in United States participation as a balancing and moderating influence, but our Senate had not been consulted in the planning stages—a fatal error politically—and repudiated it. Unfortunately, the architect of the plan was better versed in political ideals than in economic realities. The ideal of self-determination was allowed to overshadow completely the economic integration which Europe desperately needed. In place of the collective security of Wilson's dreams, a flood of destructive nationalism was let loose on the world.

Having insured the political collapse of the peace structure, we proceeded to its economic sabotage, not by deliberate calculation but by refusing to assume the role into which the war had thrust us. We were innocents abroad, in a world beyond our experience. We had entered the war a debtor nation. For three centuries we had drawn on European capital to develop our land and mineral resources, build our railroads, and equip our industries. We were accustomed to settle the interest account by sending abroad an export surplus each year of 600 millions of dollars. Our market for manufactures was elastic; as costs fell its volume rose behind a tariff dyke. Our market for food, cotton, and other agricultural staples was relatively inelastic, and we found it convenient to let the surplus flow out over the spillway at the ruling prices of the world. In short, the protectionist policy of our prewar years was one well fitted to our economy.

We came out of the war in the unfamiliar role of a creditor nation. On paper, Europe owed us 25 billions of dollars. To collect our interest and spread the amortization over 50 years would mean our taking in an import surplus of a billion a year. The whole idea seemed repugnant to our instincts. Here we were, geared to an immense surplus of production, with Europe hungry, its stocks depleted, its equipment deteriorated, needing everything we could supply. They wanted our goods. We wanted the business. We wanted to sell without buying and expected a settlement in cash. Very well, we would lend them the means to keep the game going, and did so until it blew up in our faces. As

\*Reproduced through the courtesy of the American Institute of Electrical Engineers.

to terms, was it not Calvin Coolidge who expressed in his sparse Vermont idiom the verdict of the nation, "They hired the money, didn't they?" In the cold light of experience, we can whistle for the money, forever.

If it is hard to forgive the Harding-Coolidge regime on the League of Nations and the World Court, or Hoover—who of all men ought to have known the rudiments of international economy—on the tariff and the debts, it is also hard to forgive the Roosevelt regime for scuttling the London Economic Conference after sending delegates pledged to co-operation in world rehabilitation, and for embarking on a policy of dollars wild in the poker game of currency devaluation. Alas for our peace of mind, too many of Europe's tragedies have been in no small measure of our making.

But we were not alone in our bungling. Our former allies were not to be outdone. In repeated visits to Germany over a six-year period, beginning shortly after the restabilization of the money and ending only a year before Hitler came to power, I was able to see at first hand the tide turn from hope to despair and from faith in free institutions to the fanatical introversions of blood and race. We had a good chance to save the peace down to the days of Briand and Stresemann. The Germans, I believe, sincerely meant to accept the reparations settlement under the Dawes and the Young plans.

Germany could bear this burden only as a surplus of production over her own elemental needs; lacking raw materials, this surplus could come only from their own intelligence and labor. It meant extra hours of hard work, for the seeming benefit of their recent enemies, but the Germans said they liked to work—they would work 50 hours a week, 50 weeks a year, and 50 years a lifetime. To avoid deranging the economic life of Western Europe, the Germans felt they must be given a free hand to exploit the raw materials and the hungry markets of Russia. In 1926 negotiations to this end were actively under way and Germany was engaged in a most intensive effort to perfect her working tools and operations and to master thoroughly the arts of mass production on American lines. Then the secret began to leak out—the very scale of industrial development and operation necessary to settle the reparation account would inevitably give German industry an overwhelming dominance in all Europe. When the British and the French fully perceived this fact, they refused to go along, setting in motion the policy of progressive frustration which finally drove a not-too-willing Germany into Hitler's arms. It is reported that when one highly respected German consular official in America learned that the Nazis had come to power, he remarked to a friend with a gesture of despair, "The hoodlums have taken over!"

Paradoxical as it may seem, it is not war but its aftermath that destroys nations and threatens civilization. Doctor Harry Emerson Fosdick, New York's famous preacher, illustrates that point with the story of a man who fell from the roof of his house; when a friend asked if the fall hurt him, he answered "No, the fall did not hurt me, it was the stopping that nearly killed me." Human nature, it seems, can withstand the disciplined rigors of war better than the disintegration of peace, as the Hapsburgs, the Romanoffs, and the Hohenzollerns would quite agree. To make a successful peace, it is not enough to have blueprints ready in an official file, it is also important to condition the people for their acceptance. Woodrow Wilson learned this to his sorrow. Returning soldiers, sick of fighting and fed up with their recent allies, and emotionally exhausted civilians homesick for normalcy, cannot be counted upon to build a brave new world.

As a prelude to the problems of peace, we shall have to take some of the risks of prophecy. Some outcomes seem inevitable, no matter who wins the war. There will be world-wide depletion of men, materials, equipment, and liquid wealth. Whole continents will be enfeebled by inadequate nutrition. World-trade, shipping, and banking

structures which it has taken two centuries to build will be largely destroyed. Staples like silk and rubber on which trade empires have been built may yield place to synthetic substitutes. The bonds of world empires will be loosened. Primitive peoples who in the past have asked little of life except that their rice bowls be filled will have felt the impact of technological war and technological economy, awakening their craving to share in the means of defense and in the abundance of goods which only an industrial civilization can supply.

Whatever the military outcome, it seems that the world is being welded by blood and sweat into a group of larger economic units in which the economy of mass production and mass distribution can operate effectively. Men everywhere will want to share the American secret of high wages and of more, better, and cheaper goods. Little nations lacking assured access to a great variety of raw materials and to vast and diversified markets are excluded effectually from this system. How to assure to Finns, Danes, Belgians, Swiss, and other small peoples whose contributions to civilization have been unique and precious, freedom of language and culture, together with autonomy of regional and local government, in the larger economic aggregations which seem sure to come, is a problem to give us pause.

In to-morrow's world it may no longer be possible to fence off privileged areas and to possess them in security by virtue of technological pre-eminence or monopoly of basic materials. It may be no longer possible to preserve a \$14-a-day standard of living for the American workman in the presence of a 14-cent-a-day standard for the equally intelligent and incomparably more industrious Chinese coolie. It may not be in our interest to try do to so. No one expects, and few desire, an immediate equalization of income standards over the world, even though the present conflict should turn out to be a prelude to Utopia, but there are inherent leveling forces in an economy of science and technology which soon must be reckoned with on a world-wide basis. A nation far advanced may hold its favored position for a time by exporting its products while retaining a semi-monopoly of technological equipment and skill. This was the classic economic strategy of Great Britain, against which we rebelled in 1776, but which continued to operate in a diminishing degree down to World War I. Sooner or later the advanced nation reaches the point where it begins to export not only goods but tools for producing them, to equip steel mills in Brazil or machine shops in Russia or arsenals in China, and the slow but inevitable leveling process picks up acceleration as one nation after another industrializes.

No matter who wins the war, unless all civilization is converted into a permanent arsenal, much of the world must grapple with the problem of converting an armament economy back into an economy of social welfare. With it we must tackle the problem of restoring a dictated economy to a free economy. The dislocation of a return to peace is beyond our imagining. At the lowest possible estimate, the war's end will find 250 millions of people in Europe, America, and the British dominions entirely dependent for their living on the production of the material of war. The incidence of war on the world of production is usually gradual. Hitler spread the transition over seven years in Germany and spent over 90 billions of reichsmarks on war production before the first blow was struck. But the incidence of peace is almost instantaneous; production stops overnight. The Nazis have an answer: war is the normal state of human existence, while peace is a mere interlude in which to replenish population and restock the arsenals. We need a better answer, and finding it is likely to take the full measure of our wisdom and of our planning capacity.

Let us not delude ourselves into thinking of a mere return to the soil as the way back to a peace economy. That door was closed for most of mankind over a century ago. The world's population has considerably more than doubled since 1800; some areas have grown acutely overcrowded.

"Lebensraum" is a real enough problem when we recall that some 12 Germans or 18 Italians or perhaps 30 Japanese have to contrive to get a living with the aid of natural resources roughly equivalent to those available to the average American. Only mechanized industry and open channels of trade can give *lebensraum* to crowded peoples without pillage. Hjalmar Schacht, the German economic genius, knew that when he said "If goods do not cross frontiers, armies will."

The people of the United States will have problems at home from which no victory can shield us. Debt, for one thing. Last year our public debt—Federal, state, and local—reached a total of 85 billion dollars, exceeding for the first time in our history the corporate debts of our business system and equaling approximately our annual national income. The program of war effort already announced is fairly certain to raise the Federal debt to 150 billion, and no one knows where the ceiling will be. A debt of 200 billions is bearable, and need not invite repudiation, as it represents less than half our national wealth and is roughly twice our annual income. A Federal debt of this magnitude would be roughly equivalent to a public mortgage of 75 cents on every dollar of the nation's productive assets, including farm land and urban real estate. Some measure of inflation is inevitable and the wisest controls will be needed, but debt alone is not likely to cause a runaway. Most of us will recognize inflation when it comes simply as our old acquaintance, Mr. High Cost O'Living. The mere carrying of this debt will impose a severe strain on government finance; it will eat up three or four billions a year in taxes, and the first \$25 or \$30 of income for each member of the average family will be earmarked in advance for interest charges. Government will find it necessary for its own relief to use every known expedient to hold interest rates and the return on invested funds in general down to the lowest possible level. This will bring no joy either to colleges dependent on endowment earnings or to holders of insurance policies. Competition for tax money among the various units of government—national, state, city, and local—and among publicly supported institutions and social services will grow severe. There will be no will-o'-the-wisp of reparations to buoy up false hopes and no money return from lend-lease operations.

In dealing with the debt, we shall have three possibilities to choose among. Either we shall repudiate the debt by inflation, or grin and bear it, or ease its burden by creating new wealth and a greater national income. Freedom is better than slavery at any price, but only the third of these courses of action can stir our hope of a better age to come.

We shall have not only increased debt, but increased assets as well. On paper, the national balance sheet may not look quite so bad. Not all our war outlay is going to be used up in action. A rough calculation indicates that our capital investment in defense plant may run up to 40 or 50 billion dollars. It will be represented by our enormously increased capacity for producing metals, chemicals, power, aircraft, machine tools, and machine products. If we succeed in making this greatly augmented plant investment earn its way, we shall be well on the road to a solution of the problem of finding employment for our greatly increased working population. If the plans recently announced by the President for 1942 and 1943 are carried out—and they must be—war production and the armed forces together will require the services of about 24 million people, in comparison with the 16 million ordinarily employed in production industries. Past experience indicates that relatively few of the millions thus added to our employment rolls will voluntarily accept demobilization at the end of hostilities.

Another problem to be faced is the gold hoard now in our possession, five sixths of the entire world supply, valued at some 23 billion dollars. We do well to consider that what gives our gold this value is not its utility in industry and in art, but rather its potential usefulness as a monetary

base and especially its unique value as a convenient medium for the settlement of international trade balances. Apart from a free economy such values have little meaning. In Nazi internal economy, currency is merely a government-backed claim against whatever goods are available for civilian consumption; in Nazi external economy, money is merely a reckoning unit in hard-driven barter deals or forced requisitions. Unless we can restore a gold-backed monetary system in the postwar world of international trade, our gold hoard is merely so much lustrous metal, good for filling teeth and making jewelry, with a value fixed by the law of supply and demand.

With these premises, let us confront the issue: is there a peace beyond mere military security worth fighting for? To struggle for self-preservation alone is after all little more than an instinctive fatalism. We crave a higher faith to transform sacrifice into privilege, to face tragedy with fortitude, and to nerve our spirits when the flesh wearies and the will grows faint. Win or lose, the outlook for much of the world is dark. The vanquished must face the peace hungry and exhausted, their goods gone, their productive equipment worn out, the scant remnant of their capital frozen in armament industries, and their social structure together with the ideology that sustained it in utter ruin. Their intellectual and spiritual bankruptcy may threaten a return to the dark ages. Where in all the Nazi world may one look for even a remnant of uncorrupted youth to be the nucleus of a reborn culture? Is there not a Biblical parable of a man who had been cleansed of a devil only to have seven devils move into the empty place? Our allies in victory will at least be the captains of their souls, however stricken in material resources.

It is not too much to say that if civilization is not to pass into a lasting decline we in America shall have to underwrite its rehabilitation. Whatever the cost and wastage of the war may be, I have faith to believe that we shall finish the job with our man power and vigor but little impaired with our productive capacity vastly increased, and with our trust in human worth and in a free and just society unshattered. True, we shall be burdened with debt and vexed with dislocations, but I believe we can rise above them. Indeed, the surest way to rise above our troubles may be to forget them and dedicate ourselves without reserve to the salvage and spread of civilization which we alone can undertake.

When we come actually to face this issue, no doubt the isolationists will still be with us, counseling us not to waste our shrunken wealth on the down-and-outs, but to wash our hands of the sick world and retire into an economic quarantine. Perhaps they might consent to some sort of swap for coffee and bananas, or for tin and manganese, or for tea and rubber, but as for the rest—let the world go hang. Leaving all humanitarian sentiment aside for the moment, there are certain costs to be counted before committing ourselves to any such self-serving program. We shall have to pay for the war, no matter who fights it. Win or lose the peace, we shall have to pay for it anyway. We can pay for it by withdrawing into a closed economy, which may mean the writing off of a hundred billion dollars of capital more or less, without chance of recovery; or we may pay for it by underwriting the world's recovery and the extension of civilization, in which case we may not only do some good, but have at least a sporting chance of getting our money back with some profit.

Suppose the United States does withdraw into a closed economy, what are the chances of gain or loss? As a start, we should have to write off forever all we are putting into the lend-lease program. Next, we might have to write off some fifteen billion dollars or more of the supposed value of our gold hoard. If gold is just metal, priced by supply and demand, our overstock might be little more than a monument to our folly. Then we might experience difficulty in finding much use for the greater part of the new war-goods plant we are now building. Who will be buying air-

craft, or machine tools, or armor plate—or using power, for that matter—in the amounts we will be geared to produce? Not the home market surely. That might mean writing off another 30 or 40 or perhaps 50 billions of capital. And who would buy the extra acreage we are putting into production, beyond our normal requirements, to make good on the food end of the lend-lease program? Who would provide employment in a closed economy for the greatly swollen ranks of our working population? If there are no outlets abroad for what these men and women can produce, may we not expect a new generation of false prophets, to arise, preaching salvation by division instead of multiplication, while relief rolls and made-work projects and pump-priming expenditures suck us down even faster into the vortex of national insolvency?

If we do accept the great adventure and decide to risk our wealth on world recovery rather than to hoard it, we might logically begin by digging our gold out of the vaults of Kentucky for use in re-establishing the world's money system and as a base for international credit. That would mean lending it to recent friend and recent foe alike. If we lend it, we ought to expect some reasonable guarantees. It might do more good and we might have better prospects of a return on it if we placed it in the hands of strong borrowers, with diversified resources that might be organized into a well-balanced economy, than into too many small and weak hands paralyzed by mutual hates. Choosing the borrowers would give us a powerful voice in any economic and political regrouping of the world.

The tragic failure of World War I and its aftermath testifies to the futility of building a new order on political disintegration rather than economic integration. Sovereignty without a decent economic sufficiency is an empty shell. Under the guise of self-determination, the concept of extreme nationalism reached its all-time peak in the last postwar interlude. Sovereignty was understood to secure to each nation its right to manage its fiscal affairs, to devalue its money, to protect its industries by tariffs and preferences, to force its goods on others by intimidation at no matter what cost to its neighbors. And of course, sacred honor gave it the right to make war on anybody at any time. The obsessions of ultranationalism rise but little above the economics of the robber barons. It is only a meager and transient wealth that a man gains by pillaging his neighbors, keeping them poor, and refusing to do business with them. The modern key to wealth is more, better, and cheaper goods, produced in volume through advanced technology by high-paid workmen where supplies of materials are favorable, and sold in the widest markets at the lowest costs. This principle is no respecter of political sovereignty. It cannot operate in close confinement.

If the United States is to be the world's banker and use its gold to reanimate the world's atrophied economy, it will be well to remind ourselves that the surest way to guarantee our own prosperity is to create prosperity elsewhere, that the surest way to protect our standard of living is not to quarantine it against the plague of world poverty but to encourage a healthy standard in other lands. We cannot sustain the banker's role by lending our money and immediately taking it back in cash payment for the food, cotton, oil, metal, and industrial equipment the world will be needing so desperately when peace comes. We must insist on the borrower's keeping our money in his business as working capital and using our gold to re-establish his credit. Give or sell we must, or millions will starve and our own economy will languish; but we must sell on long-term credits and be prepared to take other peoples' specialized goods and raw materials in excess of our exports. Our role will be to lead in destroying trade barriers rather than in erecting them.

Any peace worth fighting for must not only keep our own industrial plant working, but insure its gradual renewal and expansion as well. Economists assure us that we cannot prosper by merely producing goods to consume; we must

gain added buying power by adding to our capacity to produce. We do this partly by saving, but mostly by borrowing from the future through the mechanism of credit. We then sluice this borrowed capital into added consuming power by spending it for labor, materials, and equipment to build new tools and larger plants. Without this expansive force, it is doubtful if a free economy can survive, much less prosper.

War expansion is now discounting this normal expansive force many years in advance. When peace comes there will be the United States' own war deficits in consumption and the world's tragic depletion to be made up. After a transient postwar boom, then what? Can the expansive force be preserved? The development of new products and new industries, which D. C. Prince has advocated so effectively, will go far, but will that be far enough? Depressions are like epidemics with a world-wide sweep. The forces of economic health must have as wide a scope. Frankly, I see but one chance to preserve the expansive forces of economic freedom and vigor. There are still immense areas of the world which sustain overcrowded populations of hundreds of millions at a bare subsistence level. Primitive agriculture and handcraft hold out no promise of betterment. Human experience offers only one hope, and that is industrialization. The United States alone will have the capital and the productive capacity to tackle the huge job of industrializing such areas as India and China. In doing so we might find our one chance to keep our own wealth working and our own plant going at a real prosperity level.

The postwar role I have suggested for the United States is one that would make unprecedented demands on our faith, our foresight, our restraint, and our organizing capacity. It is a role which no other nation could assume. It calls for the faith to try the key to our own prosperity on the closed doors of the world. It calls for faith to free science and technology from the barriers of an outmoded nationalism. It calls for faith to abandon the idea that America is to be kept as a free and prosperous island in an economically submerged world. It calls for the restraint of refusing to impose either the political or economic overlordship of America and the white race on the retarded areas of the world.

It would also demand an organizing capacity in world affairs which far outruns our experience. In many respects our present partnership with Great Britain may turn out to be almost providential. The circumstances of our entry into the war left us with the greatest freedom of action. We have no obligation to become mere financial underwriters and copolicemen for the historic type of British imperialism. The British, however, have a world experience which we lack, and British experience and talent may well serve in an expert capacity in the execution of a reconstruction plan of our own conceiving.

The titanic conflict in which we are now engulfed has come upon us as a revolt against the misdirected consequences of human freedom, particularly in the handling of new and vast economic forces generated by the advance of science and technology, in these past 150 years. However much we and our fathers have blundered in the handling of these forces, I have faith that they hold the germs of a new and better world order. Unthinking men who have observed engineers working with equal zeal in both free and totalitarian systems, under capitalism and communism alike—or even embracing the New Deal with enthusiasm—have assumed that we are but abject tools of whatever powers may be in control. That is not the truth. Beneath the surface of our conformity, often silent and inarticulate, a social creed is taking form that transcends the prevailing order. We have faith that science and technology, which know no frontiers of geography or political system, hold potentialities of human betterment as yet dimly recognized. We have a faith—and at times, it can burn with religious conviction—that the well-being of mankind comes through

the multiplication of wealth, not through fencing it off, or looting it from the other fellow, or unloading a lot of debt claims on Wall Street, or by distributing a lot of purchasing power through political channels.

We insist that the problems of national security, of social welfare, and of international order must be solved by multiplication and not by division. We insist that our greatest source of multiplied wealth is in new knowledge of nature won through research, in new tools of production, in improved instruments of human living, in more efficient ways of doing work, in more harmonious co-ordination of human effort. We can accept for the moment any political or economic system so far as it works toward those ends,

but we cannot accept as final any theory of society or organization of civilization that does not aim at the spread of enlightenment, abundance, and freedom among all men. We are peculiarly the executors of these potentialities in the realm of material well-being. Ours is a profession of imagination, visualization, experimentation, and constructive boldness. Why suggest revolutionary ideas to such hard-headed men as engineers? To whom can we better suggest them, pray tell? We who "view hopefully the hitherto unattainable" have the call to visualize for mankind an economic order that will restore its now shaken faith in human decency and progress, and to sketch the blueprint of a peace worth fighting for.

## SIZE AND THE AEROPLANE

MAJOR OLIVER STEWART, M.C., A.F.C.,  
*Editor of Aeronautics, London, England*

**SUMMARY**—In this article, written specially for the *Journal*, the author expresses his views, influenced by operational events, on the optimum size of aircraft. Two outstanding planes, the Short *Stirling* bomber and the *Spitfire* are taken as examples and discussed.

Optimum aircraft size has for many years been a subject to which senior Royal Air Force officers, technical advisers to the Air Staff and aircraft manufacturers have devoted special attention. Obviously optimum size is related directly to the duties which an aircraft has to perform and the size best suited to the bomber will be totally different from that best suited to the fighter. There is perhaps no subject on which there is greater diversity of opinion than this of aircraft size and we see in the aeroplanes of the belligerent nations to-day a reflection of the numerous different opinions which are held upon the subject. Let us see whether any more precise definition can be obtained by scrutinizing the machines that are actually in use in the Royal Air Force.

If we start with the fighter we find that the position is comparatively simple. For a given power the smaller the fighter the better. The reason is plain; it is concerned with the tactical advantage of speed. In aerial combat speed is the trump card and the fighter must be given all the speed that can be built into it. Aerodynamically speaking, the smaller the aircraft for a given power and a given design merit, the faster it will fly. There are, of course, many complications, among them that of wing loading. If one may speak again in the wildest generalization one may say that as the smaller the faster, so the higher the wing loading the faster. In brief, the very small aircraft with very small wings and a very powerful engine is the fastest aircraft. Speed being the pre-eminent requisite for the fighter, this very small aircraft with very small wings and very high power automatically becomes the ideal type of fighter.

The limitations, however, are severe. If the wing loading goes up beyond a certain point the aircraft is unable to remain in the air below a certain speed. In other words, the higher the wing loading not only the higher the maximum speed but also the higher the minimum speed at which the aircraft can remain in the air. In consequence the aircraft with a high wing loading must necessarily land and take off at high speed. This means larger aerodromes and already aerodromes have been extended up to something approaching practical limits, at any rate in a small island, like Great Britain.

### THE TWO OUTSTANDING PLANES OF THE WAR

Now let us, before coming to actual examples which illustrate optimum aircraft size, look at the other end of the picture, the load carrying machine or heavy bomber. The

heavy bomber must be contrived to take the biggest weight for a given horse-power if its hitting power is to be as great as possible. But the complications in the bomber are far more difficult to resolve than in the fighter. For the bomber must still have a sufficient speed to enable it to pierce enemy defences without undue loss. Consequently there is



British Short "Stirling" heavy bomber.

in a bomber a balance which has to be held between weight and bombs carried and the speed of flight. The greater the weight of bombs for a given power the lower will be the speed of flight. In aviation there is always a balance of this kind to be struck. It is always impossible to get something for nothing, and those people who speak of high speed bombers which carry a heavy load or of high speed fighters that have great range are speaking in paradoxes, for the bigger the load the lower the speed. I am deliberately simplifying a great many matters in this discussion but by this means it is possible to see clearly into the thoughts of the great engineers who have been responsible for the production of the two outstanding types of aircraft of the present war. I name these two types as the Short *Stirling* and the Vickers-Armstrongs *Spitfire*. The Short *Stirling* carries a greater bomb load than any other aircraft in regular use in the operational units of any air force in the world. The *Spitfire* flies faster than any fighter in regular operational use in any other air force in the world.

My own views on bomber design have been influenced by operational events, as is natural, and I am of the opinion that improvements in anti-aircraft fire and other defence methods, especially night fighters, demand that bomber speeds be increased. The Short *Stirling*, however, is not a slow aircraft for its size. The speed has not been officially disclosed but German reports give it as 267 miles an hour. This is a high speed for a four-engined machine with a wing span of 99 ft. and a length of 87 ft.

There can be no doubt whatever that, provided a target is selected where the defences are not prohibitively strong,

the Short *Stirling* is able to deliver a more useful attack than any other machine. In fact Royal Air Force pilots who have been flying the *Stirling* expressed the view that after using these aircraft against the enemy the use of smaller types with their greatly restricted hitting power appears to be comparatively useless. The technical features of the Short *Stirling* are many for this machine is not only of large size but it embodies a great many advanced design characteristics. The range with full bomb load is over 2,000 miles and the bomb load can be increased in special circumstances. The aircraft has a number of power-operated turrets which are equipped with Browning machine guns, and there is a very complete armoured protection for the crew. The equipment is also elaborate and includes every conceivable device for aiding the operational efficiency of the aircraft and for increasing the safety of the crew in emergencies.

The engines are four Bristol Hercules sleeve-valve units each with a take off power of about 1,600 hp. Wright Cyclone engines are alternative power units. The bomb bay is over 42 ft. long.

This aircraft is the direct outcome of a long period of careful research and development work undertaken by Short Brothers of Rochester, Kent. This work may be said to have included that done on the famous Short flying boats which were used by Imperial Airways Limited before war broke out and which are to-day still in use with British Overseas Airways Corporation.

Before the war Short Brothers had prepared a design for long range passenger carrying and this design has in some respects been of assistance in the evolution of the *Stirling*.

#### MALTA'S SPITFIRES

I turn now to the other extremity of air force equipment, the fast fighter. The *Spitfire* still retains the position it has held throughout of being supreme in this class and consequently it may be claimed for the Royal Air Force with justice that, at the two extremes of the scale, weight carrying and speed, it has aircraft of greater technical merit than any other country. It is necessary to qualify this statement by remarking that the more specialized an aircraft becomes the fewer the operations on which it can be used with full effect. Thus the very big bomber of the *Stirling* type cannot be employed where the defences are extremely strong in the daylight. Similarly, the *Spitfire* pays for its very great speed by reduced power of operating from improvised aerodromes. Nevertheless, dispatches coming from Malta in the middle of March related that for the first time the *Spitfire* was operating from the island. This is the first occasion on which this machine has been used in battle outside Britain.

The *Spitfire* has been successively improved in performance since the early days of the war and one of the latest

changes has been in relation to the engine, the type of engine now employed being the Rolls-Royce Merlin XX, an engine with two speed superchargers capable of maintaining power at great heights. There is also the Rolls-Royce Merlin XLV, which is not a specially high altitude engine but which gives extremely good performance at the lower levels. Precise figures of *Spitfire* performance have not been



Cannon-armed Spitfire.

given recently but it may safely be assumed that the maximum speed is now in the region of 400 miles an hour. The armament of the *Spitfire* has also been progressively improved and now includes cannon.

Between these two extremes, the fastest aircraft and the greatest weight carrier, there are innumerable different types, and the merits of these intermediate Royal Air Force aircraft vary. In some cases they are fully as high relative to the aircraft of other countries as in the two extremes. In other cases there is room for considerable improvement and work is proceeding to try and build up the technical quality of these intermediate classes of aircraft so that there is a uniformly high grade in this respect throughout service.

# THE LIONS' GATE BRIDGE—IV\*

S. R. BANKS, M.E.I.C.

General Engineering Department, Aluminum Company of Canada, Limited, Montreal, Que. Formerly with Messrs. Monsarrat and Pratley, Consulting Engineers, Montreal, Que.

This paper was awarded the Gzowski Medal of the Institute for 1941

## SUPERSTRUCTURE: ERECTION

### ERECTION-PROGRESS

The erection of the superstructure was carried out, on behalf of the contracting partnership, by the Dominion Bridge Company's Vancouver organization, under direction from the main office at Lachine. Operations at the site were begun on November 8th, 1937, and, in spite of certain delays in substructure-work (on account of which the contract-date for completion was moved forward 105 days, from Nov. 1st, 1938, to February 15th, 1939) the bridge was adjudged to be sufficiently complete to enable commercial traffic to use it on September 30th, 1938. On that date the greater part of the cable-wrapping was yet to be done, the catwalks were still in position, and the tower-tops were necessarily not completely erected; and it was anticipated that those parts of the work would be carried on while the bridge was open to traffic. The contractor, however, took full advantage of the few weeks remaining before the completion of the toll-collection plaza, and succeeded in finishing the steel-work erection a few days prior to the opening of the bridge on Monday, November 14th, 1938. Part of the painting was left over until the following year, and was finished in readiness for the Royal visit to Vancouver on May 29th, 1939.

The remarkable speed with which the erection was performed, while primarily due to the high quality of the shop-work and to the meticulous care with which the erection-programme had been worked out by the contractor, was attributable in part to the excellence of the weather throughout the summer and in part to the convenient proximity of the contractor's offices and plants. A tribute to the organization is implied in the fact that no fatalities, and only one serious injury, occurred throughout the erection of some 10,000 tons of steel, most of it at elevations of more than 200 ft.

The actual dates of erection-progress are given in the accompanying tabulation (Table I), in which is included also an analysis of the weight of the bridge.

### CABLE-ANCHORAGES

The first steel to be erected was that of the cable-anchorages. In each case the heavy forgings and "buttons" were pre-aligned by assembly onto a light structural framework, and accurate final positioning inside the pier-cavity was readily performed by means of the adjustable holding-down bolts provided (Fig. 47).

### CABLE-BENT AND APPROACH-VIADUCT

For construction of the viaduct, a standard-gauge service-track was established on piles alongside the site, extending from a wharf near the north main pier. The steel was shipped on scows from Western Bridge Company's wharf at False Creek, and was then transferred onto flatcars. Erection of the entire viaduct (excepting the tower-girders immediately above the anchor-pier) was accomplished by a steel derrick-tower 40 ft. by 30 ft. in plan, carried on four 4-wheel bogies, two running on the service track and two on a second track laid in short sections as required. The traveller supported a stiffleg-derrick (75-ft. boom and 30-ft. mast) on a working-platform 120 ft. above rail-level. The weight of the traveller was about 190 tons, and it was capable of lifting the heaviest viaduct-piece, \*\* and a secondary 5-ton hook could be used at a radius of as much as 80 ft.

\*This is the final part of the paper. Parts I, II and III respectively appeared in the April, May and June issues of the *Journal*.

\*\*The 123-foot girders weighed 27 tons each, and the heaviest section of the cable-bent weighed 22 tons.

The cable-bent was erected first, the base-slabs being set on canvas soaked with red lead on the dressed central areas of the pedestals, and fully grouted as soon as the columns had been made plumb. The cable-saddles, offset 15-in. northward, were assembled, together with jacking-brackets and catwalk-supports; and the completed bent was tied back to the anchor-pier by two 1½-in. pre-stressed bridge-wire strands which resisted the southward push of the main cables pending their final clamping to the cable-bent saddle. Erection of the next two bents followed, and then the four longest girders were placed. A 5-ton stiffleg-derrick was



Fig. 55—Erection of north viaduct.

mounted on the floorbeams at the south end in readiness for placing the cable-strands in the saddles. This much of the viaduct (Fig. 55) was fully riveted, and then erection ceased owing to delay in delivery of steel from British mills. Work was resumed a month later and proceeded continuously until the viaduct was complete except for tower 3-4 and for the fences. An 8-ton stiffleg-derrick was assembled on the deck near bent 4 for lifting the strand reels onto the anchor-pier for unreeling. The traveller was dismantled, and the missing parts of the viaduct were erected later by the above-mentioned derrick. The completed steelwork of tower 3-4 is seen in Fig. 56.

Throughout the viaduct, the bents were plumbed by guys and then secured by the adjustable anchor-bolts, after which the pedestals were grouted up to the base-plates. Some 25 cu. yd. of grout (a 7-sack mix with aggregate graded up to ½-in., and an admixture of 175 lb. of "Embeco" per cu. yd.) was used in this connection.

### VIADUCT-PAVING

The concrete deck of the viaduct (Fig. 49) was poured in eleven sections, each of which, with an average length of about 200 ft., was bounded at either end by the transverse steel of a break in the pavement. Timber forming was used, and the reinforcement was bent at the site.

To make the process as continuous as possible, the contractor built a stout timber framework across the width of the viaduct. Mounted on skids, this could be moved along on greased timbers that were laid just within the fences. It carried a stiffleg-derrick and a narrow-gauge track, the

TABLE I  
PROGRESS OF ERECTION OF SUPERSTRUCTURE (WITH SUMMARY OF QUANTITIES)

ITEM	Erection-dates		Steelwork: weight in pounds (other items as noted)	
	Start	Finish		
Anchorage steel—north end.....	Nov. 8 (1937)	Nov. 29	133,614	
—south end.....	Nov. 17	Nov. 30	132,691	
Cable-bent (Bent 0).....	Nov. 25	Nov. 30	416,120	
Viaduct—Bent 0 to Bent 2.....	Nov. 30	Dec. 16	VIADUCT—	
—Bent 2 to Bent 15 (omitting span 3-4).....	Jan. 17 (1938)	Mar. 4	Bents: 1,872,424	
—Bent 15 to end.....	Mar. 15	Apr. 7	Girders and floor: 3,336,934	
—Span 3-4 (over anchorage).....	June 2	June 3	Fences: 312,549	
—Concrete paving.....	June 1	Oct. 5	1,733 cu. yds. concrete 366,800 lbs. reinforcing steel	
South Tower—creeper-assembly.....	Jan. 18	Feb. 1	} 2,058,814 15,773 2,055,667	
—steelwork.....	Feb. 2	Mar. 10		
South cable-posts.....	Mar. 8	Mar. 8		
North Tower—steelwork (by derrick).....	Mar. 7	Mar. 18		
—creeper-assembly.....	Mar. 23	Mar. 29		
—steelwork (by creeper).....	Mar. 30	Apr. 29		
Catwalks.....	May 2	May 13		
*Cable-strands.....	May 12	June 1		
Cable-bands and splay-castings.....	June 1	June 2		
Suspender-ropes.....	June 2	June 23		
Stiffening-trusses.....	June 9	June 29	2,839,463	
Floorbeams.....	June 9	July 4	1,244,857	
Lateral-bracing	} (Erected together)		225,457	
Stringers		June 29	July 12	870,213
Teegrid-sections				1,641,722
Rivetting lower chords and floor-system.....	July 12	Aug. 12		
*Welding grid-sections and fence-posts.....	July 18	Aug. 15		
Sidewalk-supports, kerbs, fence-posts, and Inspection-traveller rails (erected together).....	July 25	Aug. 9	218,197	
Anglgrid-sections (sidewalks).....	Aug. 4	Aug. 10	99,716	
Inspection-travellers.....	Aug. 5	Aug. 11	274,944	
Observation-platforms.....	Aug. 10	Aug. 11	27,235	
Concrete filling for Teegrid-slab.....	Aug. 16	Sept. 23	41,220	
Ladder-rungs (on suspenders).....	Aug. 18	Aug. 31	706 cu. yds. concrete	
Rivetting upper chords.....	Sept. 12	Sept. 22	23,808	
*Cable-wrapping—wire.....	} (Erected together)		101,454	
—wood-fillers and caulking-lead.....		Sept. 12	Oct. 27	27,046
Roadway expansion-joint sections.....	Sept. 10	Sept. 22	84,455	
Signal-bridge (at mid-span).....	Sept. 22	Sept. 27	24,001	
Fences (including fence-posts and welding).....	Sept. 22	Sept. 29	94,951	
Fence on south anchorage—cable-flashings.....			6,370	
Finals, and completion of tower-tops.....	Nov. 1	Nov. 7		
Painting (two field-coats).....	May 16	Nov. 30 (1938)		
	Apr. 12 (1939)	May 26 (1939)		
<b>SUMMARY:</b>				
Steelwork in suspension-bridge.....			14,747,897	
Steelwork in north viaduct.....			5,521,907	
Total steelwork.....			20,269,804	

\*Most of this work was done by 3 shifts of men, working continuously day and night except on Sundays.

latter extending from side to side of the road. Concrete was supplied from the mixing-plant at the main pier and was delivered alongside the viaduct in trucks.

The batches were lifted over the viaduct-fence by the derrick, and placed in a small dumping-buggy running on the narrow-gauge track. The concrete was thus deposited with precision, the amount of spading being reduced to a minimum, and was flowed into place by electrically-driven spud-vibrators. Rough surfacing was done with a heavy screed pulled by the structure as the latter was moved up the grade. Further screeding was performed by heavy canvas belting, and the final wood-float finish was roughened with corn-brooms drawn athwart the roadway. The surface was sprinkled with a metallic hardener (20 lb. of "Metaliron" per 100 sq. ft.) and was sprayed with the Hunt process of liquid waterproofing to retard evaporation during curing. It was found that, owing to the vibration of the viaduct caused by operation of the derrick, the deck-concrete of each span tended to slump downgrade, causing a slight depression at the upper end of the slab, and a corresponding hump at the lower end. The retention of such

waves in the surface was prevented by careful workmanship during the finishing process.

The roadway-slab, poured in the manner described, was finished to a width of some 31 ft., including the lower parts of the kerbs. Dowels for the latter were placed near the edges of the slab before the concrete was set.

The sidewalk-slabs (together with kerbs and stringers) for each section were poured on the day following completion of the roadway-slab, the concrete being distributed in wheelbarrows running on the roadway. It was vibrated and the top surfaces were treated with the Hunt process. No metallic hardener was used.

Work on the viaduct-deck went forward smoothly and without haste, the substructure-contractor arranging his programme so as to be ready to place the concrete of the suspended-span decks as soon as the grid-sections were ready to receive it. The work went forward smoothly, the only trouble encountered being that of leakage of wet concrete through the joints of the wooden formwork onto the steel work below. Some of this deposit (during the first few pours) had time to harden, and the contractor

had considerable difficulty in cleaning the steelwork to the satisfaction of the painters and the engineers. On later occasions, however, a gang of men with hosepipes and brooms were set to cleaning the steel both during the pour and afterwards until leakage had stopped.

With a specified strength of 3,000 lb. per sq. in. at 28 days, a water-cement ratio of approximately  $4\frac{1}{2}$  gallons per sack was selected for the viaduct-slab. A typical batch consisted of  $6\frac{1}{2}$  sacks of cement, 1,365 lb. of sand (containing four per cent of surface-water), 2,080 lb. of stone ( $\frac{1}{2}$  to  $1\frac{1}{2}$ -in. in size: water-content one per cent) and  $21\frac{1}{2}$  gallons of added water. This proportioning produced a



Fig. 56—Viaduct-tower.

workable mixture with a slump ranging from 1 to  $1\frac{3}{4}$  in. As a general rule, three test-cylinders were made for each day's work. The 28-day strengths varied from 3,500 to 4,800, with an average of 4,430 lb. per sq. in.

#### SOUTH TOWER

The first erection-operation was the assembly of a platform on the tops of the pier-shafts: this was supported on steel posts that had been set in the concrete of the pier and which were later burned off below the surface, the recesses then being grouted flush. On this platform was built the creeper-traveller by means of which the tower was erected. The creeper (Fig. 57) consisted of a structural framework built to embrace the two tower-columns, and on which was mounted a steel stiffleg-derrick. The derrick (with 30-ft. mast and 69-ft. boom) had a capacity of 21 tons at a radius of 50 ft., enabling loads to be picked up from scows moored alongside the pier. An auxiliary 5-ton hook at the head of the boom, operative at a slightly greater radius, was also provided. The entire creeper-assembly was capable of being jumped up the tower by lifting-tackle attached to the tops of the columns at each stage of their erection, and was guided by sliding-devices attached to those columns. All the operating machinery (with the exception of the boom-swinging engine, set on the working platform) was located either on the pier or on shore, and communication with the engine-men was made by telephone.

The creeper-derrick was arranged with its mast on the shoreward side of the tower in order to minimize eccentricity of loading when handling steelwork, and the mast-offset (variable on account of the diminishing section of the columns) was kept as small as possible. The smallest offset, with the creeper at the top of the tower, was 8 ft. The framework of the creeper, fitted with ladders and hand-

railings, served to support working-platforms for operation, assembly, and riveting. The total weight of the creeper, when unloaded and ready for jumping, was approximately 82 tons. The lifting-effort required to overcome friction amounted to some 90 tons.

The tower-splices (nine in each column) were so arranged that the sections to be lifted ranged in length around 40 ft., with the single exception of the sixth section. This member, extending through the portal, was 52 ft. long, and, in order to avoid undue weight, its core-section was divided into two parts (see Fig. 32). The heaviest piece, which determined the derrick-capacity, was the 21-ton main cross-strut at roadway level, other pieces being generally about 19 tons in weight.

The main shoes (18 tons each: see Fig. 35) and the three lower sections of each column, together with the bottom cross-strut and the lowest diagonal members, were placed while the creeper was resting on its assembly-platform. The shoes were scribed with centre-lines which were accurately aligned with corresponding scribings on the dressed areas of the pier-tops, and each shoe was laid on sheets of oiled canvas.

The creeper was subsequently jumped to six successive new locations, being suspended each time by hanger-bars from the top of the previously-erected columns; and its width was adjusted at each move in accordance with the decreasing size of the tower. In its highest position, hung from the splice-point at elevation 435, the creeper erected the top sections of the columns and bracing, and the top strut: the cable-saddles were also placed, in the offset-positions noted on p. 421. Final operations in the tower-erection consisted in the assembly of temporary saddles for the catwalk-strands, jacking-brackets for the later adjustment of the main saddles, a commodious timber working-platform over the top cross-strut, and a 5-ton guy-derrick (with 20-ft. mast and 40-ft. boom, capable of lifting 5 tons plus impact at a radius of 27 ft.) for handling catwalk-material and cable-strands.

Meticulous care was taken to achieve perfect contact at the column-splices. Because of the method of erection, with eccentric loadings of constantly-varying amounts, it was useless to take interim observations on the plumbness of the columns, and full reliance for the verticality of the structure was perforce placed upon the accuracy of the shop-work and of the field-connections. Before riveting was commenced at any joint, a careful survey of the abutting surfaces was made, and the match-marked splice-material was securely pinned and bolted into place, the acceptable tolerance in the splices being established at .004 in. In drawing-down the splices, advantage was taken of the effects of sunshine in its expanding and distorting effects upon the steelwork. As a further safeguard, the engineers insisted upon the full riveting of the principal parts of each splice before the creeper was moved into its next position. The number of field-rivets in each tower was approximately 48,000. Up to seven rivet-gangs were employed simultaneously, each driving 300 to 400 rivets a day. As a protection to the steelworkers (who were also supplied with metal helmets), trapdoors of  $\frac{1}{4}$ -in. plate were set in the towers at various levels: they were eventually retained as a permanent part of the structure.

On completion of the tower, and after the creeper had been removed, a series of transit-observations was made on several mornings before sunrise, by different observers, and it was found that both the columns stood within  $\frac{1}{2}$ -in. of verticality. It was also recorded that the daily northward movement of the free-standing tower amounted at least to six inches.

#### NORTH TOWER

Erection of the two towers was prerequisite for work on the cables, and every effort was therefore made to expedite their construction. For this reason the north tower-shoes and the bottom sections of the columns were erected by the substructure-contractors stiffleg-derrick, the creeper mean-

while being dismantled and re-assembled at the north pier. From then on, erection followed the same lines as for the south tower. Observations on the verticality of the north tower indicated that the east and west columns leaned shorewards  $3\frac{3}{4}$  and  $2\frac{1}{8}$  in. respectively. These deviations from plumb, although very small in comparison with the 360-ft. height of the tower, were large in view of the excellent results obtained for the other tower, and were attributed to the combined effects of sun on the offshore faces of the columns and of the shoreward eccentricity of the erection-loads.

#### SOUTH CABLE-POSTS

The two rocker-posts at the south end of the bridge, together with cable-saddles and temporary catwalk-supports, were erected by the derrick on the anchor-pier. Temporary lateral support was provided by cross-timbers, and the posts were shored up so that the saddles were approximately 2 in. shoreward of their final positions, thus allowing for the lengthening of the backstays due to the effect of dead load.



Fig. 57—Creeper-traveller erecting north tower.

#### CATWALKS

The decision of the contractor to use catwalks for erection was made without hesitation, particularly in view of his satisfactory experience with similar equipment in building the Island of Orleans Bridge. The advantages that they possess over other methods of erection (which can only give access to one or two places at a time) are, for the engineers, those of providing continuous access to all points of the cable and ancillary parts, and of permitting detailed inspection of construction, (including cable-wrapping and painting), with the result that more careful workmanship is assured. From the contractor's point of view, the work is considerably expedited by the aforesaid freedom of access, while the greater safety afforded is reflected in the increased quality and quantity of the work done. It is worthy of note, incidentally, that, although the Workmen's Compensation Board of British Columbia were at first inclined to require the use of safety-nets, the contractor was able to persuade that body that the hazards of assembly and dismantling of nets would outweigh their advantages. The contractor's subsequent enviable safety-record, to which attention has already been drawn, provided vindication of his argument.

The two catwalks extended for the full 3,400-ft. length of the cables, being slung at elevations some three feet

below those of the first cable-strands to be erected. Each was supported by four pre-stressed strands (fabricated, specially for the purpose, from unspliced wire of the same quality as that for the cable-strands), two under each side of the deck, the strands being hung from temporary brackets riveted to the steelwork at a convenient distance below the cable-saddles proper.

The four strands for each catwalk were mounted on individual reels on a scow that was towed northwards across the Narrows, the strands (the outer ends of which had been secured to the south anchorage) meanwhile being unreeled and laid on the bottom. Upon arrival of the scow at the north shore, the strands were connected with shorter lengths that had previously been connected at the north anchorage and laid out on the shore. Then each strand in turn was hoisted into place onto the temporary saddles, being raised at the two towers simultaneously by the 5-ton derricks on the tower-tops. These operations, which were carried out for the two catwalks respectively at slack water of high tide on two successive early mornings, were completed each in approximately  $1\frac{1}{4}$  hours, the work going forward smoothly and with precision. The aggregate period of  $2\frac{1}{2}$  hours during which the signal "Fairway Obstructed" was exhibited at Prospect Point was the only time that First Narrows was closed to navigation during the whole of the construction.

The catwalks were formed of 2 by 10 planks long enough to lie athwart the supporting-strands and to provide a walk-way 6 ft. wide. The material selected was clear Sitka spruce, a tough and resilient wood weighing about 27 lb. per cu. ft. The planks were laid with 2-in. spaces and were kept in place by longitudinal toe-boards and by hook-bolts around the strands at frequent intervals. Handrail-posts braced in two directions were used, and the railing consisted of  $\frac{5}{8}$ -in. wire-ropes, bolted to every post. The catwalk-decks were prepared at the site in 10-ft. lengths. These sections were lifted to the tops of the towers and the cable-bent, laid on the strands (to which they were loosely bolted), and allowed to slide down to the low points. When the deck was in position, the hook-bolts were tightened, the posts and hand-lines assembled, and a light trussed cross-bridge was erected at mid-span to give access from one catwalk to the other (Fig. 58).

The catwalks were braced together with 12 by 12 cross-struts at about 200-ft. intervals to prevent undue lateral movement, while vertical rigidity was ensured by guy-ropes in a vertical plane. These guys formed an inverted suspension-system, fastened at intervals by wire-rope bridles to the catwalk-strands, and, incidentally, caused the greatest constriction of underclearance that occurred during construction.

The catwalk-anchorage consisted of two long  $3\frac{1}{2}$ -in. rods set into the anchor-pier and connecting to two pairs of long 3-in. bolts. The sockets of the strands in turn connected with those bolts and were at first placed as close to the anchorages as the assembly permitted. The amount of adjustment then available at each end of the catwalks was about 4 ft. As the cables sagged under the suspended loads, the catwalks were correspondingly lowered by paying out the sockets along the 3 in. bolts.

#### MAIN CABLES: ERECTION

The 122 cable-strands, each on an individual wooden reel (total weight eight tons) were shipped by truck, via the Second Narrows Bridge, from Dominion Bridge Company's Burnaby plant to the north shore. They were unloaded (by

the eight-ton derrick on the approach-deck near Bent No. 4) directly into temporary storage on the top of the incomplete anchorage-pier. For cable-erection, each reel in turn was fitted with a shaft and mounted (by the same derrick) on bearings behind and above the appropriate cable-anchor cavity. Its outer socket (resting in a small steel box designed to skid easily over the catwalk-planking and to hold the socket against twisting) was then hauled over the catwalk with a  $\frac{5}{8}$ -in. line by means of a hoisting-engine established on the south anchorage-pier. At the tops of the towers hardwood blocks were placed to receive the heavy pressure of the moving strands and to preserve the galvanizing, and wooden rubbing-strips were provided wherever there was any possibility of the strands coming into contact with bolt-heads or other steelwork.



Fig. 58—Catwalks and cross-bridge.

The hauling-operations were controlled throughout by telephone, watchmen being stationed at the tops of the towers and the cable-bent and also on the cross-bridge at the centre of the span. Each skid was accompanied by a man whose duty it was to prevent its overturning and to give due warning in case of any obstacle to its progress. It was found that there was practically no tendency to overturning, and that the tell-tale paint-marks on the strand never indicated more than one or two twists in the full length. Operations on the two sides of the bridge were entirely independent of each other, although it was found convenient and expedient to conduct them more or less simultaneously.

Upon the arrival of the leading socket at the south end of the catwalk it was disconnected from the skid, which itself was retracted by a  $\frac{1}{2}$ -in. overhauling-line operated from the north anchor-pier. At the same time, the north-end socket was disconnected from the reel, the latter being then removed and the next full one substituted. The two sockets were attached to the appropriate anchorage-buttons by the adjustable anchor-bolts (Fig. 46). Each end of the strand was also laid into a temporary splay-jig (lined with hardwood: Fig. 59) located a few feet nearer to the anchorage than the designed position of the permanent splay-casting. The main part of the strand meanwhile rested on the deck of the catwalk.

The next operation consisted in picking up the strand from the catwalk and laying it into the four saddles. Lifting into the saddle was done with a double sling of wire rope, the two points of contact with the strand being protected with burlap: hardwood levers were used while the burlap was removed and the strand eased into position. Great care was exercised to avoid damage to the strand by scraping the galvanizing or by abrupt bending.

At the time of erection, each strand was positioned by setting the appropriate painted mark in coincidence with the scribed centreline of the north-tower saddle, and this point was chosen as the starting-point for adjustment. At the other points of support the strand was arbitrarily placed so that its sag in the middle of each bight was a few inches less than the ideal. In this manner the subsequent

adjustment involved slackening of the socket-bolts rather than tightening, the former operation being the more readily performed. Both before and after adjustment, the strand was held from slipping in the saddles by means of hardwood blocks bolted down upon the partially-assembled cable.

As may be seen in Fig. 40, the strands of each cable are arranged in nine horizontal layers, the lowest of which (consisting of four strands) takes its bearing directly onto the fluted invert of the saddle (Fig. 36). The lower half of the cable, including the bottom and the adjacent four layers, is confined laterally by the sides of the saddle. The remaining four upper layers are rendered stable by the strands of each layer bedding into the hollows between the strands of the layer below, and they are further prevented from lateral movement by the six keepers shown in place in Fig. 61.

#### GUIDE-STRAND ADJUSTMENT AND SURVEY

Notwithstanding the care that had been exercised in measuring the guide-strands and in checking the positions of the towers, it was deemed prudent to make, as a further check, a comprehensive guide-strand survey. To this end charts were prepared to show the required elevations of the free-strand catenary at the mid-point of each span. The curves were plotted for a temperature-range of 30 to 90 deg. F., and also for such range of horizontal distances between points of support as might occur from saddle-movements due to erection-loads or other causes. The survey, which was made independently on two guide-strands, involved the determination of the position of each saddle, the elevation of the strands in the centre of each catenary, and the position of each socket in relation to the anchorage.

Since it was essential to make the survey in calm unless weather with a steady temperature, it began at 3 a.m. and was finished before sunrise. To ensure that the interrelated observations might be made as nearly simultaneously as possible, four parties were employed: each comprised two observers and a rodman, so that every measurement could be made several times and checked independently. Six instruments were used, all having been previously arranged for speedy setting-up; and lines of sight were easily established by means of targets painted on the steelwork and illuminated where necessary. The towers and the cable-bent were plumbed by means of transits set up (on shore) on lines perpendicular to the bridge centre-line and offset a few feet from the member in question so as to read onto each saddle independently.

The strand-elevation in the centre span was read with a level set up on the portal-strut of one tower, and reading onto a vertical rod held on the strand at the mid-point of span. The strand-elevation in each side-span and in the north backstay was measured with a transit set up with its line of collimation parallel with the catenary-tangent at mid-span and reading onto a rod held on the mid-point of the strand and normally to the tangent, thus avoiding errors that might derive from reading onto a vertical rod.

The guide-strand survey was made on May 14th, 1938. During the previous day, two strands of each cable (being the four strands that had been measured with special care) had been hauled across the catwalks, placed in the saddles, and adjusted so that the strand-markings agreed with the scribed centre-lines of the saddles and so that the sockets were at their theoretical distances from the anchorage-buttons. The weather-conditions on the morning of the survey were perfect, with a steady temperature of  $42\frac{1}{2}$  deg. F. The two guide-strands were then moved at the saddles and anchorages the small amounts indicated by a comparison of the observed elevations with the corresponding calculated ones. On the following morning, under equally good weather-conditions, the survey was repeated, and the results were so close to those of the first survey (the greatest variation being represented by a strand-movement of  $\frac{1}{8}$ -in. at one of the main saddles) that no

further observations were adjudged necessary. It is of interest in this connection to recall that, in the case of the Island of Orleans Bridge in the winter of 1934, no less than three weeks elapsed between the erection of the guide-strands and the completion of the final survey, that long delay being due to lack of suitable weather conditions.

In order to avoid any encroachment upon the clearance under the central span such as might eventuate from any kind of settlement or bedding-down of any part of the structure, it was considered advisable to set the guide-strands (in the central span) 3 in. higher than was indicated by the calculations.

#### MAIN CABLES: ADJUSTMENT

The adjustment of the cable-strands (the criterion for which was that each strand should hang freely in conformity with the guide-strands) demanded a uniform temperature throughout the assembly, and was necessarily done at night. It was found that temperature-inequalities due to the day's sunshine frequently persisted until after midnight, so that the adjustment-crew were not able to commence work until that hour. The procedure followed was to haul and place the strands of one layer of the cable during the day-time and to perform the adjustment of that layer during the ensuing night. This plan was very satisfactory, since the growing skill of the steelworkers in this operation enabled them to assemble the increasing number of strands each day without rushing the work.

The adjustment of each strand took place simultaneously northwards and southwards from the established setting at the north main tower. The north side-span and north backstay were treated as a unit, as also were the central span and south side-span. The short south backstay needed no special treatment, because the cable-profile there approximated very closely to a straight line.

The first adjustment-operation for each strand was the measurement of the distances by which its sag in each of the four spans required to be increased so that it would lie in contact with the already-adjusted strands. The ratio  $\frac{\text{change in sag}}{\text{change in length}}$  for each span had been previously evaluated and amounted to 2.3, 6.3, and 11.0 for the central span, the side-spans, and the north backstay respectively.

From these figures the approximate amount by which any particular anchor-bolt had to be slackened was quickly determined. The strand was then moved through the cable-bent and south-tower saddles by means of turnbuckles pulling on clamps bolted onto the strand near the saddle. Observers remained on the catwalks at the centre of the spans, and controlled the movements by megaphone. The final precise settings of the anchor-bolts were controlled in the same way. When the strands had all been adjusted, the nuts were spot-welded to the bolts to preserve the setting, and the four permanent splay-castings (Fig. 61) were bolted onto the cables at the designed locations. The temporary jigs were then dismantled and the strands



Fig. 59—Temporary splay-jig.



Fig. 60—Completed main saddle.

allowed to spring out into bearing against the splay-castings.

During the adjustments no attention was paid to the painted reference-marks (p. 352) except that care was taken that the original setting at the north tower did not alter. A later examination of the other marks, however, showed excellent agreement between the different strands at each saddle, those marks rarely being as much as an inch distant from one another in spite of the fact that the cables had been pre-stressed at temperatures ranging from  $-20$  to  $50$  deg. F. and were adjusted at temperatures between  $50$  and  $80$  deg. F.

At all times during the erection of the cables, the adjusted strands were held solidly together by hardwood frames (adjustable to suit the variations of the cable-section as it increased layer by layer: Fig. 62) at frequent intervals.

The usual daytime-phenomenon of twisting or rolling of the cable owing to the thermal lengthening of the upper strands was observed. Thus in the side-spans when the sun was shining the cables would roll over (towards the sun) until the list at the middle of the bight amounted to  $45$  deg. or more, as seen in Fig. 62. After sundown, when a uniform temperature obtained among all the strands, the list would disappear.

In the central span, however, it was noted that the maximum list of both cables occurred at approximately the quarter-points of the bight. This list, which sometimes amounted to  $90$  deg., was opposite in direction for the two halves of the bight respectively, while at the lowest points (span-centre) the cables always remained nearly upright. Furthermore, the cables in the central span did not entirely right themselves even during the uniform-temperature periods of early morning. This persistent reverse-roll was undoubtedly the effect of over-adjustment of the upper layers of strands, whereby the length of these strands was, in the central span, slightly more than ideal. It was a difficult matter to decide at the time of adjustment when a strand was precisely in contact with the lower strands, and the excess length referred to above was due to the cumulative effect of successive heavy contacts. The reversal at span-centre of the cable-roll may be set down to the same natural phenomena due to which oscillations (from wind or other causes) of the free strands in the long central span generally occurred as double vibrations with a node at span-centre.

The excess length (probably amounting to less than an inch) of the upper strands is not sufficient to cause any significant variation of stress through the cable cross-section; and the list was readily corrected by holding the cable in an upright position while the truss-sections were connected to the suspenders, the weight of the trusses thereafter being more than adequate to maintain its verticality.

#### CABLE-BANDS

The cable-bands were brought to the site in scows and delivered alongside the main piers, the two parts of each band having been previously bolted together. The bands

were lifted to the tops of the towers and were distributed along the catwalks on wooden sleighs, the latter being pulled along by the hauling-lines that had been reeved for strand-erection. The bands were positioned by reference to the painted marks on the two outer strands of each cable (Fig. 40), and were assembled onto the cable by hand. The two halves of the saddle-groove were carefully aligned to prevent damage to the suspender-ropes, and the bolts were then tightened to the specified tension (in the manner described on p. 355).

During the subsequent erection of the suspended structure, the increasing load on the cables caused them to decrease in diameter, owing to compaction of the 61-strand assembly. On this account, and to prevent slipping, the bolts were retightened to their original tension on two occasions during the progress of the work. When all the dead loads, including that of the deck-concrete, were in place, a third and final tightening was carried out, under careful inspection.

After the cable-wrapping had been applied, the space at the upper junction of the two halves of each band was filled with oakum and then caulked with lead wool, as also were the counterborings at the ends of the band. Small openings were, however, left in the underside-caulking of bands near the low points of the cables, to permit the free drainage of any moisture that might accumulate inside the cables.

#### SUSPENDER-ROPES

The suspender-ropes were delivered alongside the main piers, hoisted to the tower-tops, and then assembled by hand. Care was taken to place the marked centre-point of each rope exactly over the joint of the cable-band, and that positioning was maintained by the small keeper-castings (Fig. 43). The sockets were left hanging freely in readiness for assembly to the trusses.

One of the few erection mishaps occurred when a long suspender slipped out of control while being lowered into place, and fell to the ground near the south tower. The rope was condemned, and a new suspender, fabricated from a reserve of tested wire, was duly pre-stressed and installed prior to the opening of the bridge.

Immediately before connection to the stiffening-truss, the suspender-sockets were rotated as required in order to bring the tell-tale paint-marks (see p. 354) into alignment, and thus to ensure the correctness of the suspender-length. The galvanized ladder-rungs were assembled after the suspenders had received the greater part of their dead load. They were clinched onto the ropes by hand, with copper-headed hammers. The annular depression at the top of each socket (see Fig. 43) was filled with a non-hardening putty (Tremco) to prevent the accumulation of moisture.

#### STIFFENING-TRUSSES

The contractor, being satisfied after study of the site that no undue hazard would attend, decided to erect the suspended steelwork as far as possible from the water. This procedure was eminently successful, and the erection-forces were able to work under practically any conditions of the tidal stream. There was no interference with navigation through the Narrows.

For the central span, all steel was delivered on standard scows\*, loaded at False Creek, towed to the site around Prospect Point, and manoeuvred into position underneath the span: two tugs were necessary to hold the scow when the tide was running swiftly. The steel was lifted directly into place by falls attached to the cables, the latter being protected by hardwood waistcoats at the points of attachment. Hoisting-engines were located at the main piers, the hauling-lines running to the tower-tops and thence along the catwalks. Signals were transmitted by field-telephone.

\*A 300-ton standard scow is 30 by 90 ft. in plan and 8 ft. deep, drawing about 2 ft. of water when unloaded.

The first lift consisted of the two central sections of each truss, shop-assembled with floorbeams and lateral bracing. This unit was lifted by four tackles and was connected to four suspender-ropes. Subsequent lifts consisted each of a single truss-section which was secured by hanging from one suspender and bolting to the adjacent section that was already in place; and a modicum of lateral stiffness was provided by assembling a floorbeam at approximately every sixth panel-point. Erection of the two trusses took place simultaneously (in order to avoid differences between the cable-loads, with consequent racking of the towers) and proceeded both northward and southward from span-centre (see Fig. 63). The order of erection was governed principally by the deflections of the towers and is discussed later in connection with saddle-adjustments.

In the early stages of truss-assembly, the concentration of dead load was in the middle of the span, and the cable-curve was consequently accentuated in that vicinity. It was thus feasible to bolt only the upper-chord splices, the lower ones remaining open. Later, when the trusses were fully erected, the suspended load then being uniform but considerably less than the eventual total, the trusses were constrained to an exaggerated camber that made it necessary to release the upper splices to avoid kinking the cables, and to connect the lower ones only.



Fig. 61—Splay-casting: hand-wrapping of cable.

For the north side-span, trusses were delivered by scow to a dredged basin near the main pier, whence the steel was unloaded onto flat-cars on a service-track running approximately on the centre-line of the bridge. The cars were positioned by a gasoline-locomotive, and were hoisted as for the central span. (Fig. 64). Occasional floorbeams were assembled with the trusses. Connection of only the lower splices was feasible at the time of erection.

Truss-erection in the south side-span was, owing to the rugged nature of the terrain, less speedy than for the other spans. The sections were delivered by truck (passing through the city at special hours permitted by the authorities) to a flat piece of ground underneath the side-span, at the head of the clay-bluff. From here they were transferred to a narrow-gauge funicular railway whence they were erected in the manner described for the other spans. The most northerly sections were brought alongside the main pier on scows.

To provide safe passage across the bridge during the period between erection of the trusses and that of the floor, and to give protection to riveters on the upper chords, a full-length wooden walkway was assembled along the outside of each truss, at lower-chord level. The walkways were secured by hook-bolts passing through stitch-rivet holes left for the purpose. Each truss-section was fitted with its appropriate portion of walkway at the site, prior to erection. The walkways remained in use for about 2½ months, and were dismantled upon the completion of riveting.

## ADJUSTMENT OF CABLE-SADDLES

During assembly of the suspended loading, daily observations were made on the verticality of the towers and the cable-bent, and the sequence of erection was ordered in such a way as to prevent undue deflections of those structures. In general, as suspended weight was applied the towers deflected riverwards in accordance with the elastic lengthening of the cables, and, finally, all dead load being in place, the movements of the saddles were equal and opposite to the amounts by which they had originally been offset shorewards. These total movements for the north and south main saddles were respectively 35 and 20 ins., and, during the course of erection, the saddles were from time to time moved riverward in relation to the tower-tops by amounts sufficient to restore the towers approximately to the plumb position. In the final condition the towers were vertical, and the saddles were then permanently fixed on the centre-lines.

Those saddle movements on the towers were accomplished by means of 50-ton jacks operating horizontally against temporary steel brackets riveted to the tops of the tower-columns and afterwards burned off. In order to maintain positive control of the jacking, a pair of turnbuckle-stays was used as a tie-back for each saddle, the turnbuckles being slackened as the jacks pushed forward. The saddles moved quite readily on all occasions. The jacking was performed at the earliest practicable date, since that operation became progressively more difficult as the saddle-reactions increased with added load. It was arbitrarily established that the tower-deflections should not be allowed to exceed about one foot, even though, under the partial loadings obtaining, considerably greater deflections could take place without damage to the structures.

Approximately the middle one-third of the central-span trusses were placed before erection in the side-spans began. At this juncture, when the tower-tops were each deflected about one foot riverwards (owing principally to the straightening of the cables in the sidespans), the four main saddles were jacked 10 in. riverwards. Further adjustment, of 15 in. in the case of the north saddles, and 10 in. in the case of the south saddles, followed a few days later, while the preponderance of trusses erected was in the central span. The final main-saddle jacking, of 10 in. for the north saddles, took place after another short interval. Subsequent observations on the deflections of the towers did not suggest any modification of a straightforward programme of truss-assembly simultaneously in the two side-spans and in the two outer thirds of the central span. The progress of erection in each of these four cases was towards the towers, and the panel-by-panel erection of the floor-steel followed the same sequence.

In the case of the north cable-bent, the riverward movement of the saddles (due entirely to the lengthening and straightening of the backstay) took place slowly and regularly, being dependent on the amount of the suspended load rather than on its disposition. The saddle-offsets (originally 15 in.) were reduced to zero each in four movements. The initial adjustment, amounting to 6 in., was made early in the course of truss-assembly, when the bent had moved forward owing chiefly to the straightening of the backstay. A second jacking, of 3 in. was performed towards the end of the truss-assembly, and the saddles were moved a further 3 in. during the erection of floor-steel.

After that third jacking it was noted (in the course of routine-observations by transit) that the three inches of saddle-movement was not fully reflected as a complementary shoreward displacement of the top of the bent. An examination of the saddle-assemblies revealed that the saddles had slipped forward on the cables by approximately half-an-inch, and it was evident that insufficient friction was being developed by the pressure of the saddle-covers. The sixteen cap-bolts were therefore screwed down as much as possible, and reference-marks were painted on the cables as tell-tales in case of possible further movement in the

saddles. In the course of the next week or two (during which period a considerable weight of floor-steel was added to the suspension-system) it became apparent that a definite, although almost imperceptible, slipping was taking place. As a temporary preventative measure, the  $1\frac{1}{4}$ -in. tie-back strands (which were still in place, though they had been slackened after the placing of the saddle-caps) were re-tightened; and the final 3-in. jacking was postponed. At this time the total riverward movement of the top of the cable-bent relative to the cables amounted to  $\frac{7}{8}$  in. No further movement occurred.

A revision of the computations relating to the cable-bent



Fig. 62—Partially-assembled cable.

saddle was at once made, and this indicated that sufficient friction\* was not available to obviate entirely the risk of cable-slip. To develop the necessary additional grip, recourse was made to the expedient of clamping onto each cable (in contact with the saddle) a "keeper" consisting of a pair of steel castings bolted together similarly to the two halves of a cable-band. The keeper-castings were fabricated as quickly as possible, and were erected soon after commencement of the deck-concreting. The saddles were then jacked the final three inches and fastened permanently to the bent, and the heavy guys were dismantled. In Fig. 65, the keeper-casting, secured by ten  $1\frac{3}{4}$ -in. high-tensile bolts, is seen in place against the cable-bent saddle: the photograph shows the wrapped cable.

No saddle-adjustment was required at the rocker-posts at the south end of the bridge. The assembly at these saddles, complete except for cable-wrapping, is shown in Fig. 66.

### FLOOR-STEEL

Erection of the remaining floorbeams followed that of the trusses. In order to load the cables and thus to bring the trusses into alignment for riveting as soon as possible, the roadway-grids were delivered at the same time as the stringers and lateral bracing, the several items for each panel being loaded onto the same scow. The stringers and bracing were bolted into place, but the grids were merely piled across the stringers so as to leave room for riveting the floor members (Fig. 67).

The stringers of the four bays contiguous to the main towers were not assembled with the others. The members in question were fabricated a few inches longer than their theoretical dimensions in order to provide for any contingencies, and were not precisely cut until the trusses had taken their final positions under full dead load. When all the grid-concrete (except, of course, that of the bays in question) had been poured, the end-stringers were cut and fitted so that the expansion-fingers could be assembled to the proper setting for the temperature obtaining at the time. The stringers and expansion-joints were then riveted, the grid-sections welded, and the grids concreted. During the two months that elapsed between the erection of the bridge-

\*NOTE: The difference in the cable-tension across the saddle is 440 kips.

deck and the final assembly of the end-stringers, the end bays of the trusses were bridged by stout timberwork, to permit the free passage of the contractors' equipment along the spans.

Beginning at the south end of the bridge, distribution of the teegrid-sections followed closely upon the riveting of the floor-steel, and the tedious (some 2,300 man-hours) process of welding the grids to the stringers then began. The grid-sections were handled by a 5-ton gasoline crane, which, running on pneumatic tires, was able to operate over the unfilled grids without damage to them.

After the roadway-grids were laid, the sidewalk-supports, kerbs, anglgrids, traveller-rails, fence-posts, and fences were erected. Heavier members were placed by the crane, and small pieces by hand. The observation-platforms were assembled in the same manner, and riveting of all these small parts followed.



Fig. 63—Trusses partly erected, central span.

The signal bridge at the centre of the span was not erected until cable-wrapping had taken place over the middle bays; and, since the latter operation was not permitted to go forward until the great majority of dead load had been placed, this structure was not built until the deck of the bridge had been concreted. It was fabricated and delivered in pieces as large as was convenient, each of the two cabins being shipped as a unit. The inspection-travellers were hoisted into position (from below the bridge) as soon as the traveller-rails had been riveted, and were of great value during the painting of the underside of the deck.

#### RIVETING OF STIFFENING-TRUSSES AND DECK

At the time of lower-chord riveting, the smaller members comprising the steelwork of the sidewalks, kerbs, fences, and traveller-rails were not erected. The weight of those parts, however, was approximately represented by that of the two wooden walkways, and the suspended loading therefore amounted to about 75 per cent of the final dead load, the remaining 25 per cent representing mainly the weight of the concrete filling of the grids. The camber of the central span at this time was some 5 ft. greater than its final amount of 25 ft. Under these conditions it was found practicable to bolt-up all the lower-chord splices, although those of the upper chords remained slightly open in general, and could only be loosely connected with one or two bolts. The stringers, floorbeams, and lateral bracing were riveted at the same time as the lower-chord splices, and the work was carried out from the two wooden walkways, supplemented by underslung stagings. As many as 12 gangs of riveters were simultaneously at work during the lower chord riveting, and the maximum number of rivets driven in one 8-hour day was 5,092. The riveting was carefully inspected, the number of rejects amounting usually to

about 0.5 per cent. At the chord-splices, the engineers insisted upon full bearing of the faced material, the stipulation being that at no part of any splice should the opening exceed 0.005 in. Drawbars were used where necessary, and the splices were heavily bolted before riveting was permitted. That these requirements were met without difficulty except in rare cases bore testimony to the precision of the fabrication.

The upper-chord splices were not made until the whole of the dead load, excepting only the cable-wrapping and the concrete of the end panels was in position. At this juncture the splices could be drawn together without difficulty, and drawbars were not ordinarily required. The riveting was done from stagings slung from the trusses, the lower-chord walkways remaining in place for safety. Ten gangs of riveters were employed. The same strict ruling regarding tightness of bearing obtained as for the lower splices, and every rivet was inspected. The number of rivets in the field-connections of the deck and trusses was about 120,000.

#### MAIN EXPANSION-DETAILS

The heavy expansion-details at the main towers were placed as soon as the deck-concrete had been poured except in the end-panels involved. As originally installed in accordance with the drawings, the difference in level between the fingers and the normal slab amounted to one-inch. This apparently insignificant variation in level, occurring over a distance of some 12 ft., was found to cause a slight but definite shock to a vehicle passing at speed, while simultaneously a noticeable vibration occurred at the more sensitive parts of the suspension-structure. Certain alterations, after a few months' operation, were therefore made to the expansion-joints. These changes, whereby the maximum deviation of the riding-surface from the regular grade was reduced to  $\frac{1}{2}$  in.,

proved to be entirely satisfactory as a remedial measure. Figure 31 shows the final profile at the joints.

The twelve traction-rods (see p. 290) were erected soon after the expansion-joints, their turnbuckles being tightened just sufficiently to ensure a slight initial tension. Figure 68 shows one of the traction-rod assemblies.

Before the bridge was opened to traffic, it was found that the sliding shoes of the trusses moved jerkily and noisily under the influence of temperature-changes. This phenomenon, occurring at both ends of the central span, was particularly noticeable as the temperature increased on sunny mornings. The vibratory effects of traffic, however, together with a maintenance-programme involving regular greasing of the slides, eliminated this trouble.

#### CONCRETE FILLING FOR GRIDS

The concrete filling of the Tee-grid slab constitutes one of the heaviest items of the suspended structure, and the sequence of pouring was therefore arranged to avoid undue deflections. A length of approximately 250 ft. was chosen as the most practicable unit for concreting, and the order in which the panels of concrete were placed is shown in Fig. 70. It will be noted that each group of pours was so spread as to load the three spans more or less evenly. Owing to the north-shore location of the mixing-plant, the southernmost section of each of the four groups was the first to be concreted; and, in order not to disturb the green concrete, a period of at least seven days elapsed between the final pour of a group and the first pour of the next group. Observations on the towers were taken at the end of each day's work, and the worst deflection was less than three inches.

The concrete was trucked over the unfilled grids and after dumping was spaded out to a uniform depth of about 6 in. in order to render effective the use of surface-vibrators.

The wood-floated finish was kept fractionally above the tops of the grids so as to avoid depressions between the stems of the tees. The surface received 20 lb. of "Metalicon" per 100 sq. ft., and was protected during curing by the Hunt spraying-process.

In spite of the tightness of the grids and the dryness of the mix, a certain amount of leakage of concrete onto the floor-steel occurred owing to the vibration, and this was cleaned off the steel by men stationed on the lower-chord walkways with hoses.

The specified 28-day strength of the concrete was 3,000 lb. per sq. in. In view, however, of the special exigencies of this work, (requiring the driving of concrete-trucks over the surface as soon as possible after pouring), the mix was designed to give a high strength at seven days. A total of 15 test-cylinders was included in the routine-testing. Five were broken at seven days, and yielded an average strength of 3,430 lb. per sq. in. The remaining ten, broken at 28 days, gave results varying from 4,920 to 5,660. The mix was based on as low a water-cement ratio (approximately  $4\frac{1}{4}$  imperial gallons of water per  $87\frac{1}{2}$ -lb. sack of cement) as practicable in view of the small size of the pockets of the grids. The average proportions of material per batch were: seven sacks of cement, 1,200 lb. of sand (containing about four per cent of surface-moisture), 2,225 lb. of gravel (maximum stone-size  $\frac{3}{4}$  in.: surface-moisture  $\frac{3}{4}$  per cent), and 23 gallons of added water\*. The slump varied between 1 and 2 in. The resulting concrete was unusually dense and hard, with an average weight of 152 lb. per cu. ft.

#### CABLE-WRAPPING

The cable-wrapping consists of a continuous serving of No. 9 S.W.G. soft annealed galvanized wire, the purpose of which is to seal the cable against weather. Immediately prior to its application, the cable (cleaned and dry) received a generous brush-coat of red-lead paste,\*\* and the oil-impregnated cedar fillers (Fig. 40) supplied in 10-ft lengths, were assembled. As far as possible, the wrapping-wire was applied mechanically, this method, besides being more expeditious, giving a very tight and close wrapping of even and regular appearance. The wrapping-machine (Fig. 70) was of the usual planetary type, three turns of wire being laid simultaneously from three revolving spools. The machine was operated by a compressed-air motor, and was guided by a beam clamped to and parallel with the cable. It was propelled upwards along the cable by means of the pressure exerted by the wire as it was laid against that already in place. On the steeper slopes, the machine was assisted by a hand-tackle. Its best operating speed, at approximately 70 r.p.m., was such as to wrap about 2 ft. per minute, but the general rate was much slower, since frequent stops were necessary for changing spools and

\*Expressed in terms of dry materials, the average batch would contain seven sacks cement, 1,150 lb. sand, 2,200 lb. stone, 29 gallons water.

\*\*The paste used was a red-lead-and-linseed-oil paint containing 62 per cent of red lead and weighing about 28.5 lb. per gallon.



Fig. 64—Erection of truss-section, north side-span.



Fig. 65—Cable-saddle and keeper at cable-bend.

splicing the wire (by brazing) and for moving the machine past the cable-bands. The wrapping-wire was delivered in coils at the bases of the main piers, and spooling-machinery was set up, under cover, on the tops of the towers.

The first few inches of wrapping on the upper side of each cable-band was done by hand, commencing inside the counter-boring. Machine-wrapping then proceeded towards the next cable-band as far as possible, after which the wrapping was soldered down to keep it tight, and the end few inches was again applied by hand. As each panel of wrapping was completed, it was closely inspected, and, wherever adjacent turns did not appear to be in tight contact, the open spaces were sealed by soldering. Every precaution was thus taken to ensure watertightness prior to painting; and the three subsequent coats of paint effectually sealed such minor imperfections as otherwise escaped notice.

Hand-wrapping was also resorted to over short distances inside the anchor cavities of the piers, when there was no room for the machine to operate (Fig. 61).

Wrapping was permitted in wet weather (provided that the wood-fill assembly ahead of the machine was kept under cover) because it was impossible to prevent the ingress of water into the higher reaches of the cable. Drain-holes were left in the caulking of the bands to permit the escape of such water.

#### COMPLETION OF THE TOWERS

The towers remained in their unfinished state, with a guy-derrick and working-platform at the top of each, until completion of the wrapping and painting of the cables terminated the useful life of the catwalks. The catwalk-decks were then dismantled, the strands were lowered to the deck by the tower-derricks, and the saddle-brackets and other temporary structures were removed. The final operations performed by each tower-top derrick were the removal of the platform from the top of the tower, and the assembly of the previously-omitted parts of the crown-strut, the final-covers for the saddles, and the aerial-beacon support. After these structures had been riveted, the derricks were dismantled.

#### PAINTING

In accordance with common practice, all of the structural steelwork (as distinct from steelwork under the cable-classification) received one sprayed coat of priming-paint before leaving the shops, and two finish-coats in the field, the shop-coat being first repaired where it was in any way damaged.

The shop-paint approved was an expensive proprietary brand of red-lead primer with a modern synthetic-resin vehicle. The contractor's experience with this paint, however, was unfortunate. In the first place, probably owing to the readily-flowing nature of the vehicle, the protective film appeared to be abnormally thin, and, after two or three weeks' outdoor exposure, it was noticed that rusting was taking place. The paint-manufacturer was apprised of the state of affairs, and made changes in the composition of the paint. Nevertheless, the primer continued to be



Fig. 66—Saddle at south cable-post.

generally unsatisfactory, and many fabricated pieces had to be repainted during the three or four months of storage in the yards. Similar deterioration, with rusting, occurred in the field. When the time came for spot-painting of rivets and abrasions prior to application of the field-paint, it was found that very large areas, notably in the towers and trusses, had to be completely reprimed. Those areas were cleaned very thoroughly, and at considerable expense, by means of rotary wire-brushes, and some 600 gallons of primer were used in brush-painting them.

The failures of the shop-paint were attributed by the manufacturer to improper cleaning of the steel, incomplete removal of mill-scale, and to painting under other than ideal conditions. The contractor on the other hand maintained (and was supported in his contention by the engineers' inspectors) that the steel had been cleaned in the shops with mechanical wire brushes and had, in damp weather, been warmed by blow-torches immediately before painting: all the painting had been done under cover. There was no doubt, in fact, that more than ordinary care had been employed in the preparation of the steel.

The author inclines to the view that the synthetic primer used, while possibly an excellent base-coat in the case of perfectly-cleaned metal, was not suited to such limited preparatory treatment of the steel as is generally considered economical for structural purposes. The whole subject of protection of steelwork is frequently under review in the technical press, and it is becoming clear that the only really satisfactory solution lies in the absolute cleaning of the steel down to solid metal by sandblasting (possibly after a preliminary period of weathering), or by the recently-introduced flame-cleaning process. Failing such procedure the safest method is probably to use the old-fashioned red-lead-and-linseed-oil primer, which, when applied to reasonably-cleaned steel, is known to give a long-lived protection even under extremely adverse conditions.

It may here be noted that, in accordance with modern Canadian practice, no paint was applied to surfaces shop-riveted together. In view of the almost inevitable and most unsightly staining of the field-paint due to subsequent infiltration of moisture between such surfaces, the author is of the opinion that the older practice of applying shop-paint (or at least linseed-oil) to those surfaces before riveting, should be revived, at any rate in the case of structures exposed to the weather.

In the field, after the shop-coat had been spot-painted and repaired under careful inspection, two further coats of paint were applied to all structural steelwork as distinct from the cables and suspenders. The engineers, rather reluctantly, approved the application of the field-coats by spraying except in the cases of those portions of the main towers above roadway level as far as, and inclusive of, the portal-strut; and the bottom 20 ft. of each tower-leg. The engineers stipulated that the painting should be done to their satisfaction and by experienced spray-painters with modern equipment, and failing such satisfaction, they reserved the right to order brush-painting throughout, the

additional cost of which would be borne by the owners. That right was not exercised, however, since the subcontractor's men were fully experienced in spray-painting and the coverage of the steel was generally excellent. The several advantages of spray-painting, particularly its efficacy in reaching into small crevices and to other places that are rarely properly painted by brushwork, were in evidence, and the greater speed of the work enabled full advantage to be taken of the fine weather that prevailed during the summer of 1938.

The first coat throughout was of a light grey colour, chosen to provide a practicable contrast with the dark-brown primer and also with the various finishing-colours. The second or finishing-coat was a rich olive-green for the majority of the structure, including the viaduct. In contrast, the underside of the suspended spans was finished in a dark brown. The insides of the towers, to assist the lighting, were done in light grey. A light grey finish was also chosen for the aerial-beacon supports and for the hand-railing at the tops of the towers. Neither of those two erections has structural importance, and the lighter finish was designed to render them inconspicuous and thus to preserve the functional appearance of the towers. The success of the expedient may be judged from the photograph of the south tower shown in Fig. 71.

The field-paints for the structural steelwork were compounded, along established lines, under the direction of the engineers. The main pigmenting-materials for the first coat were white lead, zinc oxide, and aluminum, and, for the finishing-coats (except in the case of the dark-brown paint, where ferric oxide and graphite were the main ingredients), white lead and zinc oxide. The vehicle in every case was based upon linseed-oil.

In the case of the wrapped cable, suspender-ropes, and ladder-rungs, the galvanized metal was first cleaned of dirt and grease, after which it was treated with a weak solution of cupric salts and hydrochloric acid, in order to destroy the smooth finish and to present a surface better suited for the reception of paint. Three coats were then brush-painted onto these members. The first, brownish in colour, was a fast-drying varnish-paint with a dull finish adapted to receive the final coats, the pigment consisting principally of ferric oxide, zinc chromate, and zinc oxide. The two subsequent coats, comparatively slow in drying, were "International Aviation Red" in colour (a requirement of the Department of Transport) and differed from each other only in that the final coat offered a glossy weather-resistant finish while the intermediate coat was dull in appearance. With a vehicle the permanent part of which was spar-varnish, the pigment for these two paints was composed principally of lead chromate. In order to preserve uniformity of appearance, the cable-saddles and covers, the cable-bands, and the suspender-sockets, were finished with the same three coats. The following table shows the amount of paint used.



Fig. 67—Erection of deck-steelwork.

TABLE II  
QUANTITIES OF PAINT USED

Description	Amount used (imp. gals.)	Approx. average weight per imp. gal. (lb.)
Structural steelwork:—		
Shop-coat (brown).....	2045*	13
First field-coat grey.....	1710	13½
Finish-coat green.....	1678	17
Finish-coat light grey.....	262	16½
Finish-coat brown.....	814	12
Cables and suspenders:—		
Red-lead paste.....	241	28½
Galvanized-iron fixative.....	60	10.2
Red metal primer.....	120	13
First coat red.....	120	13½
Finish-coat red.....	135	13½

SURVEY OF THE SUSPENSION-BRIDGE

On the day before the bridge was opened, the contractor co-operated with the engineers in making a survey of the suspension-structure, partly as a check on the accuracy of the construction, and partly in order to establish reference-data to which measurements made during future inspections might be referred. Weather-conditions were good. It was a cloudy morning, without wind, and the steelwork was dry: a uniform temperature of 36 deg. F., prevailed. Transit-observations were made on the verticality of the towers and the cable-bent, and a line of levels was run from end to end of the roadway.

The towers were found to be very nearly plumb, the south tower leaning ¼ in. to northward and the north tower ½ in. in the same direction. The elevation of the crown-of-road was found to be 276.23, 314.61, and 276.23 at the centres of the south, central, and north spans respectively; and the difference in level between the two sidewalks at each of those points amounted, respectively, to ½ in., ⅝ in., and ⅞ in.

For comparison with the ideal geometry, however, these results must be corrected for the normal temperature of 60 deg. F. The calculated movements of the main saddles for a 24 deg. rise in temperature are 1½ in. and 2 in. for south and north respectively. The indication therefore is that, at normal temperature, the towers will both lean off-shore, the south tower by 1¾ in., and the north by 1½ in. With reference to road-elevations, it was computed that a temperature-rise of 24 deg. F. will cause a sag of .90 ft. at the centre of the central span and of .10 ft. at the centre of each side-span. The corrected elevations for central and side-spans respectively are thus 313.71 and 276.13, and, the theoretical elevations being 315.00 and 276.19, it will be seen that the centre of the bridge is about 15 in. lower than the design-figure.

The explanation of this discrepancy lies mainly in that the dead loads are about one per cent in excess of those estimated (p. 288), the preponderance of that excess being comprised in the 17-ton weight of the central signal-station. Re-calculation (on the basis of the actual suspender-loads) of the cable-polygon gave the elevation of crown-of-road at span-centre of 313.69, a figure in close accord with that actually obtained. The same computation, incidentally, shows that the dead-load stress in the cables exceeds the estimated amount by 1.68 per cent, and that the maximum stress is increased by 1.3 per cent. These increments, however, are offset by the excess of cable cross-section referred to on p. 349. In regard to clearance over the ship-channel, attention is drawn to the liberal allowance that was made for contingencies in this respect (p. 282). In view of this, the underclearance under the most unfavourable conditions exceeds the 200-ft. requirement by at least 1½ ft.

\*This figure does not include the additional paint used in the field for repairing the shop-coat.

In addition to the survey described, reference hubs were established for future use in checking any settlement of the main piers or forward-movement of the anchorages.

ELECTRICAL INSTALLATION

Further to the obvious requirement of roadway-illumination throughout the length of the structure, the electrical equipment of the Lions' Gate Bridge includes the provision of lighting for the interiors of the main towers, the anchorage-piers, the administration-building and toll-booths, the pylons of the south bridge-head, and the beacons on those pylons (Fig. 11.) Navigation-lights and aerial warnings are also provided in accordance with Federal Government requirements, and there is a power-line on the bridge to supply electricity to the signal-station at mid-span and to



Fig. 68—Traction-rods at north end.

the south end of the bridge. In addition, the signal-station is equipped to control the navigation-signals at First Narrows Inner and Outer Beacons (Fig. 1) and at Prospect Point.

Telephones for policing and administrative purposes are installed at strategic points along the bridge, and communicate with the south plaza, the signal-station, and the administration-building. The latter three stations are also connected with the city system, and there is a direct line between the signal-station and the signalman's residence.

The electric power for the bridge\* is obtained from a 4,000-volt transmission-line (B. C. Electric Railway Company) that passes, under the viaduct-deck, along the side of the Pacific Great Eastern Railway's right-of-way (Fig. 2). A sub-station is located on the top of the north anchor-pier (Fig. 15), and here, by means of three 25 kva. single-phase 2300v/550v transformers in star-delta arrangement, the supply is stepped down to 550 volts, at which voltage it is distributed to the various outlets on the bridge. A further transformer (3 kva.: 2300v/230-115v) is furnished for an independent supply for the sub-station itself.

Two 6.6-amp. series-circuits, fed from two constant-current transformers (15 kw. and 10 kw. respectively) equipped with "Novalux" controllers, are employed for the roadway-lighting, which comprises 4 units on the south plaza, 22 on the suspension-bridge, 16 on the viaduct, 7 on the embankment and plaza, and 11 on the grade-separation roads. Of these, 34 are on an all-night circuit, controlled entirely by a photo-electric cell. The other circuit, carrying 26 lamps, is closed in the evening by the same photo-electric cell, but the lights are extinguished at midnight (or other suitable time) by a clockwork mechanism. The wiring of each circuit consists of two single No. 8 conductors (R.I.L.C.) carried in a 2-in. conduit.

The 60 roadway-lighting units are supported on British Mannesman fluted weldless-steel standards, with orna-

\*Power for the administration-building and toll-booths is supplied separately, from a pole-line running along Marine Drive, through a 25 kw. transformer.

mental brackets, the light-centres being situated 24 ft. above the roadway and 6 ft. inside the fence-line. The lamp-standards are shown structurally in Figs. 25 and 52 and their general appearance is seen in Fig. 11. The lights, spaced at approximately 130-ft. intervals, are alternately on opposite sides of the road, those on the west side being the all-night lights. The 247 va. isolating current transformer for each lamp is housed in the base of the standard in the case of units resting on concrete pedestals, and in an inconspicuous box attached to the stiffening-truss in the case of those mounted on the steelwork.

The lighting-unit adopted was the Canadian Westinghouse "Reflectolux Senior" luminaire, equipped for a 10,000-lumen sodium-vapour lamp. The assembly, which was developed especially for this bridge, is of the pendant type, totally enclosed, and with a single vertical flask: the reflectors throughout are of "Alzak" aluminum. This form of unit was adjudged by the engineers to be superior to the open butterfly-type both aesthetically and because of its higher resistance to corrosive influences. With a "coefficient of utilization" of 20.5 per cent (2050 lumens from each unit actually reach the 29-ft. carriageway) the luminaire is believed to be the most efficient of its kind yet developed.

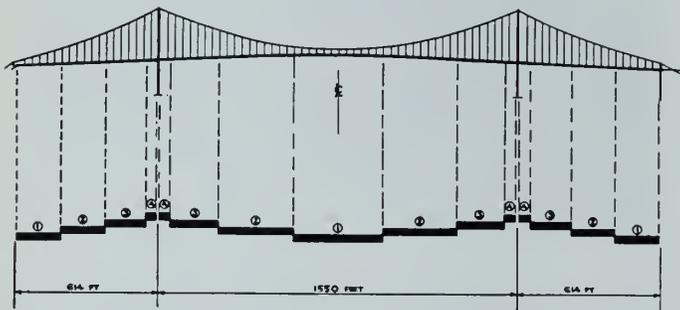


Fig. 69—Programme of pouring deck-concrete.

The gentle glow of the sodium-vapour lamps, and the appearance of the lighting as a whole, have been the subject of many favourable comments, particularly owing to the remarkable absence of glare. From a distance, the general appearance of the yellow lights, reproducing the profile of the roadway over the Narrows, is most pleasing.

In addition to the lighting-circuits, a 550-volt three-phase power-line extends from the substation as far as the south bridge-head. The line commences as three No. 1 conductors (R.I.L.C.) running in 2-in. conduit, and the conductor-size is progressively reduced in accordance with the diminishing capacity needed. This power-supply is used as follows. A 7 kva. transformer (550v/230-115v) is located at each main tower, supplying power for the inspection-lighting of the tower, for the two 500-w lamps of the aerial beacon (300-mm. code obstruction-beacon), and for the six 500-w floodlights which, illuminating the masonry of the pier-ends, serve as an aid to navigation. Near the signal-station, and mounted on the outside of the eastern stiffening-truss, are two transformers (550v/230-115v) of 10 kva. and 5 kva. capacity respectively. The former delivers to the 7½-hp. motor-generator by which direct current is supplied to the two signal-station search-lights, while the latter provides for heating and lighting in the signal-station cabins, for signalling, and for the navigation-lights that, hung below the deck of the central span, mark the limits of the five-fathom L.W.O.S.T. ship-channel. At the south entrance to the bridge, a 7½ kva. transformer, set on the upper floor of the west pylon, is provided for lighting in the two pylons and for the two ornamental beacons. The three-phase line also supplies power for the signalman's residence, for the fog-bell and light below Prospect Point, and for the restaurant on the headland.

Two control-cables, originating at the signal-station, are

required for the operation of the harbour-signals to which reference has already been made. The multiple cable running northward along the bridge contains 27 separate 19-wire conductors, the whole being rubber-insulated, lead-sheathed and running in 2½-in. conduit, while that serving equipment on the south-shore contains 19 similar conductors. Control-cabinets are housed inside the main-tower columns at sidewalk-level; and a comprehensive switch-board in the signal-station controls the lights, fog-horns and bells at Prospect Point and at the two Beacons, as well as the beacons and navigation-lights that pertain to the bridge itself. A 32-volt nickel-iron battery provides for emergency-operation of the last-mentioned lights by means of automatic stand-by lamps.

The telephone-wiring is carried in a one-inch conduit which extends, beneath the deck, over the full length of the bridge.

The conduits, pull-boxes, junction-boxes, and fastenings throughout the work were electro-plated by the "Oxoseal" patent process, and are further protected by the two field-coats of paint. For the most part the conduits are laid out of sight below the deck. On the suspended spans, however, the conduits for the series lighting-circuits are secured, for convenience of connection to the lighting-units, along the inner webs of the top chords of the trusses (Fig. 68), while the control-cable conduit is located on the top of the chord. The conduits in general are clamped onto the steelwork, as the engineers did not permit the drilling of any primary structural members. Provision for expansion at the joints of the viaduct is made by sliding-sleeves where the conduits enter the pull-boxes. On the suspension-bridge, the cables are conveyed past the expansion-joints in lengths of flexible conduit.

The electrical contractor began the installation of conduits as soon as the viaduct-steelwork was sufficiently far advanced. The roadway-lighting was put into regular operation on December 3rd, 1938, and the signal-station was formally handed over to the National Harbours Board on January 14th, 1939. A maintenance-period of six months elapsed before the electrical installation was finally accepted by the engineers.

## PARTICULARS REGARDING CONTRACTS AND PERSONNEL

The main part of the works, comprising the suspension-bridge and the approach-viaduct in their entirety, together with the filling and paving of the north embankment, was executed under two major contracts.

The general contractor for the substructure (including the four main piers together with their architectural features, the pedestals and abutment-wall of the viaduct, the concrete of the bridge-deck throughout, and the construction, paving and fencing of the north embankment) was Stuart Cameron & Company Limited, Vancouver. The contract was privately awarded by the owners in July, 1936 on a cost-plus basis (with profits limited to \$100,000), and the total cost of the work was \$1,116,585. The names of the principal sub-contractors, with an indication of the work done by each, follow:

- Boyle Bros. Drilling Co. Ltd., Vancouver, exploratory diamond drilling.\*
- North-Western Dredging Co. Ltd., Vancouver, dredging of pier-sites.
- Dominion Bridge Co. Ltd., Vancouver, cutting-edges for south caissons.
- Ross & Howard Iron Works Co. Ltd., Vancouver, cutting-edges for north caissons.
- Vancouver Granite Co. Ltd., quarrying of granite for pier-facings.
- A. S. Allan & Co. Ltd., Vancouver, granite-cutting.
- J. A. & C. H. McDonald, Vancouver, granite-cutting.
- W. C. Arnett & Co. Ltd., Vancouver, construction of north-approach embankment.
- San-O-Heat, Vancouver, plumbing installations.

The contract for supply and erection of the metallic

\*This work did not form part of the main contract, but was carried out at an earlier date under a separate arrangement with the owners.

superstructure was awarded privately by the owners to a partnership of Dominion Bridge Company Ltd., and Hamilton Bridge Company Limited, at the lump-sum price of \$2,365,000. That price was later adjusted by certain exemptions from Government Sales Tax and by the extra cost of certain small additions to the structure ordered by the owners, the final total, apart from a \$50,000 bonus awarded under a contract-clause relating to early completion of the work, amounting to \$2,372,220. The



Fig. 70—Cable-wrapping machine.

principal parts of the work that were sub-let, together with the names of the approved subcontractors, are given hereunder:

- Anglo-Canadian Wire Rope Co. Ltd., cable-strands and suspender-ropes.
- John A. Roebling's Sons Co. Ltd., wire for strands and suspenders.
- B. C. Anchor Fence Co. Ltd., wire mesh fences for suspended spans.
- Steel Company of Canada Ltd., wire for fences and for cable-wrapping.
- Vancouver Engineering Works Ltd., steel castings for cable-bands, etc.
- Canada Foundries & Forgings, Ltd., suspender-rope sockets.
- C. H. Brawn, Vancouver, field-painting.
- E. Chrystal & Co. Ltd., Vancouver, shaped and treated wood-fills for cable.
- San-O-Heat, Vancouver, plumbing and water-line for signal-station.

The supply and installation of the equipment involved in the electrical services for the bridge was the subject of a third primary contract. This contract was awarded to the C. H. E. Williams Company Limited, Vancouver, at the price of \$58,014, that figure being the lowest of the six tenders received. Subsequent additions to the contract, including those required for the Marine Drive overpass, brought the final cost to \$63,427. The cost of extensions to the control-system, made at the instance of the Department of Transport, amounted to an additional \$4,150, this latter item being borne by the Department.

Construction of the toll-booths and administration-building on the north plaza was the subject of a separate contract. This work was designed and supervised by Messrs. Palmer & Bow, architects, of Vancouver, under the direction of the engineers. Tenders were called, and the contract was awarded, in August 1938, to Andrew Davidson of Vancouver (the lowest bidder), at a price of \$18,980, this figure being subsequently increased, by extra requirements, to \$19,830. The electrical work and plumbing were done by the same contractors who handled the corresponding items under the major contracts.

The architectural treatment of the four main piers of the suspension-bridge was developed by the engineers in collaboration with Mr. John W. Wood, architect, of Montreal; and the late Mr. Charles Marega, sculptor, of Vancouver, was responsible for the modelling of the monumental lions that form a striking feature of the bridge-head in Stanley Park.

The decision to provide a grade-separation at the junction of the bridge-road with Marine Drive was not made until the main works had progressed to an advanced stage. Plans for this "modified clover-leaf" were subject to the approval of the Provincial Department of Public Works and were prepared by Major W. G. Swan, M.E.I.C., who also supervised the field-work. Competitive bids were received, and a contract was awarded, in July 1938, to Dawson Wade & Co. Ltd., of Vancouver, the lowest bidder. The construction of the 40-ft. concrete overpass was sublet to Hodgson King & Marble Ltd., of Vancouver, while the principal contractor himself undertook the considerable amount of earth-filling involved in the grade-separation and in the necessary extension to the existing main embankment. The cost of the complete grade-separation was \$47,197.

Inspection of materials and workmanship (apart from that done directly by the engineers) throughout was handled, under the direction of the engineers, by Macdonald & Macdonald, testing and inspecting engineers, of Vancouver.

Messrs. Monsarrat & Pratley, consulting engineers, of Montreal, were retained by The First Narrows Bridge Company Limited, for the design and supervision of the construction of the Lions' Gate Bridge, with Major W. G. Swan, consulting engineer, of Vancouver, as associate. Mr. James Muirhead, electrical consultant, of Vancouver, was employed by the engineers for the design of the electrical installations. Messrs. Robinson & Steinman, consulting engineers of New York City, were retained by the owners in an advisory capacity with regard to certain features, such as the relative merits of sodium-vapour and incandescent lighting, the use of electrical equipment for toll-recording, and the reviewing of Messrs. Cockfield, Brown and Company's Report on Traffic and Earnings.

In the field, the substructure-work was directed by Mr. W. F. Way, superintendent for Stuart Cameron & Co. Ltd. For the superstructure-contractors, operations were directed by Mr. E. E. Davis and Mr. James Robertson, M.E.I.C., while Mr. D. B. Armstrong, M.E.I.C. (Dominion Bridge Company, head office, Lachine) was engineer-in-charge for the contract. The engineers were represented at the site by Mr. J. W. Roland, M.E.I.C. and the author, as resident engineers respectively for the substructure and the superstructure, and Mr. G. W. F. Ridout-Evans, M.E.I.C., was the principal field-inspector.

The 30-ft. concrete approach-road (some 6,500 ft. long) through Stanley Park, together with the necessary accommodation for crossing and connecting with existing thoroughfares, was constructed by Anglo-Construction Co. Ltd., of Vancouver, at a cost of roughly \$400,000. This part



Fig. 71—Completed south tower.

of the project, however, did not come under the jurisdiction of the engineers and therefore does not enter the scope of this paper.

The total cost of the bridge and all its approach-works, together with franchises and rights-of-way, and including a provision for working-capital, is stated by the owners to have been \$5,700,000. The First Narrows Bridge Company is capitalized by shares to the extent of \$500,000, and by 30-year and 40-year bond issues amounting to \$5,700,000, the authorized loan-capital amounting to \$6,000,000. Reference to that company would be incomplete without

mention of its president, Mr. A. J. T. Taylor, to whose unremitting efforts the successful promotion of the whole project was largely due.

#### ACKNOWLEDGEMENT

For permission to present this paper, and for valued criticism during its preparation, the author in concluding wishes to acknowledge his indebtedness to P. L. Pratley, D.Eng., M. INST. C.E., M.E.I.C., M. Am. Soc. C.E., M.I. Struct. E., the surviving member of the firm of Monsarrat and Pratley.

## Abstracts of Current Literature

### MARINE OIL ENGINES

FROM *Supplement to the Overseas Daily Mail*, APRIL 25, 1942

The developments of marine oil engines concern both the largest and smallest types, ranging from engines suitable for the standardized or semi-standardized cargo vessels to the needs of the smaller coastal vessels.

Details are available of two engines which are typical of these applications. The first concerns two engines of 6,000 S.hp., of the Kincaid-Harland-B. and W. type for a twin-screw vessel.

These are the highest powered six-cylinder units so far built by the particular engine builder concerned, although there are also under construction eight-cylinder units of the same cylinder size which will develop 8,000 S.hp. The particulars of the six-cylinder units are as follows:

Designed output 6,000 S.hp.

Cyl. diameter 620 mm.

Piston stroke 1,400 mm.

Piston speed, 1,000 ft. per min.

Mean effective pressure 85 lb. per sq. in.

It will be noted that the mean effective pressure has been kept to a moderate figure, although some engines of this type have been constructed for a mean effective pressure of 96 lb. per sq. in., giving a shaft horse power of 1,120 from the same size of cylinder. In the present case the shipowners have taken the view that economy, low maintenance and avoidance of replacements make the lower rating advisable. As the rating is low, they intend, however, to operate continuously at speeds and output approximating to the normal rating.

In this type of engine the main piston uncovers scavenging air ports situated at the centre belt of the double-acting cylinder—that is, at the top and bottom respectively of the lower and upper combustion spaces. The cylinder therefore exhausts at its extremities; the exhaust ports are uncovered by separate exhaust pistons, which are given a seven deg. lead of the main piston, to cause the exhaust pressure to fall quickly to the level of the scavenge air pressure.

The separate exhaust pistons are roughly two-thirds of the diameter of the main piston, and their employment is stated to augment the power output by about 10 per cent of that which would otherwise be developed.

The scavenging air is supplied to the scavenging ports by two-positive displacement rotor-type blowers placed at the back of the engine. The blowers are chain-driven from the crankshaft through spring shock-absorbing couplings at 2.6 times the engine speed. The scavenging pressure is just below two lb.

One of the most remarkable phenomena of pre-war shipping was the growing popularity of the coaster type of vessel carrying upwards of a thousand tons of cargo. Although the type was pioneered before 1914 by British shipbuilders, with triple-expansion reciprocating steam

### Abstracts of articles appearing in the current technical periodicals

engines taking steam from unsuperheated Scotch boilers, this method of propulsion proved rather extravagant of fore and aft space, a length equal to 50 per cent of the length devoted to cargo being occupied by machinery abaft the cargo space.

From about 1925 the use of oil engines became popular with Dutch and German shipbuilders and shipowners for this type of vessel, and as power for power the oil engine occupied less than half the space, with other economies, many such ships were built. British owners and builders, however, took up the type a few years before the war, and as described in a recent issue of their "Crossley Chronicle" by Crossley Brothers, Ltd., Manchester, the present day British built engine does all that the Continental engines did in the Dutch-built coasters, and more so.

Many vessels have been equipped with the Crossley direct-reversing scavenging engine in various sizes, of which the six-cylinder type may be regarded as typical, although many other sizes from four-cylinder 100 hp. upwards have been installed in coaster vessels for use in home waters and abroad.

In the six-cylinder engine, developing 330 b.hp., the scavenge-pump is at the forward end of the engine, together with the fuel pumps and the controls. This type of engine is easy to handle, and is adaptable to remote control from the wheel-house by a simple and neat arrangement.

### CONSERVATION OF WELDING ELECTRODE

CLAYTON B. HERRICK

*Welding Engineer, The Lincoln Electric Company, Cleveland, Ohio.*

It is important at this time to recall the factors contributing to the best use of the welding electrode and resulting in a faster rate of production and conservation of metal.

1. SELECT THE RIGHT TYPE OF JOINT AND BE CAREFUL OF FIT-UP—Since the type of joint greatly affects the amount of metal required, it is suggested that a study be made to make sure the joint is proper for the particular application. Obviously, the joint to select is the one which meets requirements at the greatest speed and the lowest cost.

Joints and their fit-up should be given most careful consideration, as fit-up affects not only the cost of the welded joint as such, but also the performance of the finished product. As an illustration of the effect upon cost in a very simple fit-up, take the case of T-weld with  $\frac{1}{4}$ -in. plates. Assume that the cost of deposited metal is \$1.00 per lb. Then if the joint is properly fitted up, the cost per ft. of joint (two beads), would be \$0.40. If, however, there is a gap between the vertical plate and the horizontal plate of

$\frac{1}{16}$ -in., the cost is increased to \$0.58 per ft. If this discrepancy is  $\frac{1}{8}$ -in., the cost is increased to \$0.80 per ft., resulting in a difference of \$0.18 to \$0.40 for  $\frac{1}{16}$ -in. and  $\frac{1}{8}$ -in. respectively. Obviously money spent in obtaining good fit-up is readily saved in welding.

2. CHOOSE THE CORRECT TYPE OF ELECTRODE—While the general purpose electrode will produce satisfactory welds under virtually every condition, special electrodes as for example heavily coated fast flowing types would prove more efficient. The electrode should be chosen with respect to: (a), physical properties required; (b), type of joint; (c), position of welding, that is, flat, vertical, overhead or horizontal; and (d), condition of fit-up of the work. Recommendations of the equipment manufacturer should be considered.

3. USE AN ELECTRODE WHICH HAS AND MAINTAINS A UNIFORM COATING—The electrode coating, if not correct, will cause rejects not only of the electrodes themselves but possibly of the welds produced by their use. It should be remembered that the coating not only produces the protecting shield but it also controls: (1), fluidity of the metal; (2), penetration; (3), shape of the beads; (4), physical properties of the deposit; and (5), composition of the deposit.

4. USE ELECTRODES WHICH PROVIDE PROPER PHYSICAL PROPERTIES—Electrodes manufactured to-day are clearly described by the manufacturer in respect to the quality of weld they will produce. Required physical properties of the work at hand should be known and the electrode should be selected to meet these requirements.

5. USE FAST FLOWING ELECTRODES WHEREVER POSSIBLE—Certain electrodes are manufactured to-day to permit the fastest possible welding under specified conditions. It is obvious, therefore, that electrode and, hence, time will be saved if these fast flowing types are used wherever practical.

6. SELECT AN ELECTRODE WHICH KEEPS SPLATTER AND SLAG LOSS AT A MINIMUM—Since all splatter is a waste of weld metal, the importance of this is obvious. It should be realized that the splatter loss of the electrodes vary and care should be taken to avoid use of those which have excessive losses.

7. WHEREVER POSSIBLE USE ELECTRODES WHICH PRODUCE FLAT BEADS—It is a waste of welding electrode to deposit any more metal than is required. Not only is the welding electrode itself wasted but useless time is required to remove the excess metal from the welded joint.

8. SELECT THE RIGHT SIZE ELECTRODE—The largest diameter electrode which can be used effectively is the best from the standpoint of electrode conservation. The saving runs up to 40 per cent per pound deposited, for example, when  $\frac{1}{4}$ -in. is used instead of  $\frac{3}{16}$ -in.

9. USE LONG ELECTRODES IN THE LARGER SIZE—The obvious result is the reduction in the number of stub ends and in the time saved by eliminating interruptions to change rods. The 18-in. length should be used in  $\frac{1}{4}$ -in. and larger sizes.

10. DO NOT BEND ELECTRODES—This generally unnecessary habit will waste from  $\frac{1}{4}$  to  $\frac{1}{3}$  of the electrode. Use electrodes straight and get the maximum of deposited weld metal from each rod.

11. USE PROPER VOLTAGE AND CURRENT SETTINGS—Every electrode manufactured is designed to operate at a certain voltage and within a specified current range. If current is too high or too low, it will manifest itself either in excessive splatter loss or inferior welds, having improper fusion and penetration.

12. FOLLOW THE PROCEDURE SPECIFIED FOR THE ELECTRODE—Accompanying each different electrode manufactured are detailed specifications regarding procedures to be followed. These specifications have been prepared carefully by the electrode manufacturer and, if followed consistently, will prevent waste of electrode and assure high quality welding.

13. AVOID USING AN EXCESSIVE NUMBER OF BEADS—If one bead of weld metal will meet design requirements, it is obviously a waste of electrode to add additional beads. This same applies to applications where two beads suffice. Additional beads are simply a useless waste of electrode.

14. USE ELECTRODE DOWN TO MINIMUM STUB END—Remember that the electrode can be used the entire length of its coated surface. By using care in gripping the electrode at its extreme end in the holder and burning it down to the maximum extent, the operator is rendering a patriotic service in saving electrode. Just  $\frac{1}{2}$ -in. difference in stub end saves  $3\frac{1}{2}$  per cent on an 18-in. length rod. The great variation in stub ends in one welding shop caused waste amounting to  $17\frac{1}{2}$  per cent. In cost, for the time covered, it amounted to \$268.36.

15. COLLECT AND SAVE STUB ENDS OF ELECTRODE—At the rate at which welding is being used to-day in war production, the amount of metal which would be wasted by failure to save stub ends would be tremendous. The average stub end is 2 in. long and this length multiplied by the millions of electrodes used, would constitute the great loss.

16. USE MODERN HIGH CAPACITY WELDING GENERATOR—Welding generators manufactured to-day have much higher capacity and much greater efficiency. For example, a modern 40-volt generator was shown to produce 7.7 in. of joint per electrode as against 6.6 in. for an older machine.

## AEROPLANE versus TANK

FROM *The Engineer*, (LONDON) MAY 1, 1942

That the aeroplane and the tank have proved themselves to be two of the most potent weapons of the war will be readily admitted, but their relative strength when in combat with each other has still to be disclosed. We are told of aeroplanes and tanks weighing 60 tons apiece, and although the former possess the advantage of vastly higher speed, the tank is immensely more stoutly armoured. The flying attack on the tank will not, however, be made by an aeroplane of comparable mass, but by some smaller and faster aircraft just large enough to carry the right size of bomb or gun for the task. Any such gun could well be the "tank-buster" desired of the popular Press, though whether an aircraft or some other vehicle is the best form of mounting for it has, we may suppose, yet to be settled.

The power of the bomb is already well known, but when one has to consider the problem whether an aircraft can carry a gun of sufficient power to destroy even the most powerful tank, one will naturally first ascertain what kind of gun is carried for this purpose by rival tanks. It has been disclosed that an "M3" tank of combined British and American design, with an all-up weight of 28 tons, carries a 3 in. gun; this is in addition to a  $1\frac{1}{2}$  in. A.A. gun and the usual battery of machine guns. The big gun is carried in a fixed position pointing forward, but in a larger tank, of twice the weight, it is reported to be mounted in a revolving turret, which, of course, makes it much more effective. This tank also carries heavy armour, but how thick remains undisclosed. It is hard to discuss intelligently the relative strengths of gun and armour when the facts have, as at present, to remain hidden, but if we turn to the standard text-books on such subjects we find that the thickness of armour penetrated by a given projectile is stated to rise in direct proportion to the projectile diameter and much more rapidly than the impact velocity; in fact, as fast as  $V^{1.5}$ . If, as is likely, these general rules apply even to the projectiles and armour of to-day—much improved no doubt, though one can picture the degree of improvement as much the same in both—one may make suggestive calculations. Given that modern tanks are fitted with 3 in. guns in order to dispose of their rivals, we can assume that if an aeroplane could carry

such a weapon it would be at least equally able to deal with them; but it should not be necessary to go nearly so far as this, for the gun carried in the aeroplane has the enormous advantage that its projectile shares the high forward speed of possibly as much as 500 ft. per second, even before the gun is fired. If the gun normally has a muzzle velocity sufficient at close range to give a striking velocity of 2,200 ft. per second, it may, if fired from an aeroplane, have its velocity raised to 2,700 ft. per second. The consequent penetrative power will, owing to the law already cited, rise much more quickly than in the ratio of 2,700 to 2,200; in fact, it may be expected to rise more nearly as 3,000 is to 2,200. This is a considerable jump, and if the former figure sufficed to ensure penetration with a 3 in. gun, it would follow, on these classical rules, that a 2¼ in. gun should suffice if fired from an aeroplane. Similarly, a 3 in. gun in the air should compare in penetrative power with a 4 in. gun on the ground. Indeed, one may go further and have the reasonable hope that, with the greater freedom possessed by aircraft in choosing the precise point to be attacked, an even smaller gun rightly aimed would be able to do all that is necessary. We know that the American "Airacobra" carried a 1½ in. gun, so that the advance suggested here cannot be said to be extravagant. One must not forget, however, that there is still the recoil force of the gun to be taken into consideration. If this considerable force is not arranged to pass through the centre of gravity of the aircraft, it will produce a pitching couple which may prove troublesome to both pilot and gunner. This point certainly needs to be watched. There is also the effect of the recoil force in tending to retard the motion of the aeroplane as a whole, which, in the limit, might lead to stalling. As it happens, this risk need not trouble us much since the aircraft is certain to be attacking its target during a dive, and this additional amount of braking effect would be welcome rather than otherwise; indeed, machines designed as dive bombers need to be fitted with air brakes under their wings for this very purpose. Hence a gun which acts as an appreciable air brake is certainly no hindrance.

We realize that there need to be taken into account many other considerations than these, but such matters cannot well be pursued in the public Press. We have based this discussion on what is already text-book matter and on such information as has been published elsewhere, but so far as it goes it suggests that the tank may yet find the large gun aeroplane to be the most powerful foe it has to encounter. And it is obvious that other targets than tanks might well find themselves in the future to be the objectives of such enhanced forms of air striking force. The gun has the advantage over the bomb in its greater penetrative power and its surer aim, but for some targets the bomb would, no doubt, retain its old priority.

### ABSENTEEISM

From *Trade & Engineering*, MAY, 1942.

In the factories much has been done to improve liaison and understanding between managements and employees by setting up joint committees, composed of representatives of both sides, to discuss factory problems. Their one weakness was that they did nothing to deal with what were perhaps the two most serious problems—absenteeism and bad time-keeping. Between them these two things must have robbed the war effort of a great number of man-hours and machine-hours. It was pleasing therefore to note that the Minister of Labour recently made a new order to deal with both evils at the same time, amending the Essential Work (General Provisions) Order, 1942.

Hitherto, absence or persistent lateness on the part of workers in scheduled undertakings had not been a direct offence under the Defence (General) Regulations. The Essential Work Order provided that such cases could be

reported by the employer to the National Service Officer, who, after investigation, could give the worker concerned directions as to the method or manner of his work and the times at which and during which he should present himself for work and remain at work. The worker had the right of appeal to a local Appeal Board against any direction. When a direction had been given and was not withdrawn as the result of an appeal the worker committed an offence if he did not comply with the direction and attend for work at the specified times.

This procedure was found to be too cumbrous and to result in difficulties in dealing promptly with serious cases of absenteeism or persistent bad time-keeping. The amending order makes it an offence for a person to whom the Essential Work Order applies either to absent himself from work or to be persistently late without reasonable excuse. Proceedings can be taken against an offender without the National Service Officer having to give a specific direction to the person concerned and without him having an opportunity to appeal. Where, however, there is in the undertaking a works committee or other joint council which, in the opinion of the National Service Officer, can appropriately deal with the matter, the case must be referred to that body.

A similar amendment to the order relating to the building and civil engineering industries came into force just before Easter and the question of amendments to other orders relating to special industries is being further discussed with the industries concerned. It would appear that if full use is made of these extended powers absenteeism and persistent lateness will cease to be a nightmare to those responsible for war production.

### THE "F.W. 190" FIGHTER

FROM *The Engineer* (LONDON) APRIL, 17, 1942

More and more frequently, in accounts of the air fighting across the Channel, mention is made of encounters with Germany's new fighter, the "F.W. 190." So far, in their sweeps and on bomber escorting raids over enemy occupied territory, British "Spitfires" have had much the best of these brushes with the "F.W.s" despite the advantage which the enemy had in operating near his own bases, and with the support of ground defences. In January R.A.F. pilots reported that they did not find the new German fighter capable of any exceptional performance, and that the latest type "Spitfires" and "Hurricanes" were more than a match for it.

The R.A.F. first encountered the "F.W. 190" last September, when two radial-engined fighters of an unidentified type were reported shot down. Since then the "F.W." has appeared in increasing numbers in the west. From twos and threes they have been met with in batches of at least thirty. The type has also been reported in action against the Russians in the East. Comparing the "F.W. 190" with the enemy's standard single-seat fighter—the "Me. 109"—the most obvious point about it is that it has an air-cooled radial motor, instead of the liquid-cooled, in-line type generally chosen for fighter aircraft where speed is a foremost consideration. Apart from any purely mechanical advantages or disadvantages, the shape of an in-line engine—with cylinders arranged one behind the other—lends itself to better streamlining than the radial form, where the cylinders are arranged in a circle. For this reason most of the world's fastest short-range fighters—British "Spitfires" and "Hurricanes," American "Airacobras," Russian "M.I.G. 3s," German "Me. 109s," and Italian "Macchi 202s," all have liquid-cooled, in-line motors. Only in America has the air-cooled radial engine continued to find favour for single-seat fighters in recent years. In the States a great deal of development went on after other countries more or less dropped the type. One result of American research was the Curtiss "Hawk"

fighter supplied to the French Armée de l'Air which although comparatively slow, did good work against the "Me. 109s" before France fell.

In reverting to the radial engine for a new fighter to which the Germans at one time seemed to pin a good deal of faith, it would appear that the *Luftwaffe* has some special object in mind. It has been suggested that its need was for an interceptor with a very rapid rate of climb to contend with the increasing power of British sweeps over occupied territory. But as these sweeps are of comparatively recent date and as it takes a considerable time to design and build a new aircraft, it is certain that the development of the "F.W. 190" was started much earlier, and with a different object. More probably the outstanding successes which the highly manoeuvrable "Hawk 75s" gained during the Battle of France impressed the Germans with the possibilities of the type. Also the relatively greater ease of maintenance and freedom from coolant troubles may have persuaded the *Luftwaffe* that what was lost in absolute speed might be made up in other directions.

So far the "F.W. 190" has not ventured into combat with British fighters on this side of the Channel, and although a number have already been destroyed by British fighters they have mostly fallen on enemy territory. Nevertheless, a certain amount is now known about it. The engine appears to be an improved version of the "B.M.W." fourteen-cylinder engine, similar to that fitted in the enemy's new two-motor bomber, the "Do. 217E." It probably develops around 1,600 hp.—which is about 25 per cent more power than the latest "Me. 109" is credited with. In general appearance the "F.W. 190" is not unlike the "Messerschmitt." Its armament is not very great—less than the latest British "Spitfires" and "Hurricanes." The general performance of the "F.W. 190" does not appear to be greatly different from its predecessor, and on the evidence of its showing so far it is no great menace to the R.A.F.'s existing fighters, and definitely below the standard of the new British and American fighters known to be on the way.

### ATLANTIC FERRYING RECORD

From *Trade & Engineering*, MAY, 1942.

Though it has been operating for nine months and has brought across the Atlantic aircraft worth millions of pounds, not a single machine of R.A.F. Ferry Command has yet been intercepted by the enemy. At the head of Ferry Command is Air Chief Marshall Sir Frederick Bowhill, formerly Commander-in-Chief, Coastal Command. His headquarters are at Montreal, and it is from there that delivery flights are controlled. The terminal base for incoming aircraft is somewhere on the west coast of Britain. Associated with this is the control centre, which is in constant touch with the American-made aircraft as they make their way across the Atlantic. The new bombers are first delivered to Montreal from the American factories, and are then flown by Ferry Command pilots and crews to Newfoundland for the long hop of 1,900 miles across the Atlantic. The flying-boats make an even longer flight of

about 3,500 miles. Passengers and crew carry only a few sandwiches and some fruit juice to sustain them on the journey—which, in itself, is proof of the faith they have in the reliability of the service. This is well justified, for aircraft brought to this country are rarely more than five minutes over their estimated time of arrival.

It is a military offence for pilots to hazard an aircraft by attempting to set up a new time record. Nevertheless, favourable conditions have enabled some extremely fast times to be set up, the best performance to date being that of a civilian pilot, who crossed with a bomber in six hours 50 minutes. The first recorded case of an aerial stowaway occurred in connection with the Atlantic Ferry. He was a member of the civilian ground staff who had tried to join the R.A.F. but had been graded as indispensable. He reported to the captain half-way across the Atlantic—and eventually achieved his object. Recently a British Airways captain completed his twenty-fifth Atlantic crossing in 10 months—a very fine record.

### PRODUCER GAS FOR ROAD VEHICLES

From *The Engineer*, MAY, 8TH, 1942.

At a meeting of the Mobile Producer Gas Association, which was held in London last week, a scheme was put forward for the conversion of 50,000 road vehicles to run on producer gas. It was stated that the proposed conversion would save 3,000 gallons of petrol yearly for each vehicle, or an aggregate of 150,000,000 gallons. Mr. J. W. Noel Gordon, the Chairman of the Association, pointed out that 50,000 vehicles represented but a fraction of our motor transport fleet. The extent of the fuel saving would, he said, be dependent on the amount of fuel released for the making of producer gas and the quantity of producer gas plant which could be manufactured. On the Continent, he added, some 300,000 vehicles were operating on producer gas, of which about two-thirds were in Axis countries. Compared with that position, only a handful of vehicles were using producer gas in this country, which possessed the finest coals in the world from which gas could be made. The British Coal Research Association, with the assistance of the Department of Scientific and Industrial Research and industrial concerns, had evolved a producer gas plant which could be manufactured and used in large numbers, while Imperial Chemical Industries Ltd., had shown how fuel gas could be made from certain kinds of British coke and anthracite. Intensive research had enabled a scheme to be laid before the Government which provided for a standardised form of producer that could be made in quantity with comparatively little labour. The larger transport operators would, Mr. Jordan said, be able to get producer plants direct from the manufacturers and their own mechanics could install them in existing lorries. The supply of steel and labour which would be necessary to carry out the scheme would be infinitely less than that needed to build tankers to transport the equivalent quantity of petrol saved. It was further stated that fuel of the necessary quality could be manufactured at a number of centres in England, Scotland and Wales, and that this special fuel, together with anthracite fuel, could be distributed by service stations.

## PRESIDENT YOUNG TO VISIT QUEBEC AND MARITIME BRANCHES

Institute members in all the Branches east of Montreal will welcome the news that the president is planning a two weeks' journey to visit all the Branches in that territory. He will be present at meetings to be held in Three Rivers, Quebec City, Moncton, Sydney, Halifax, Saint John and Arvida, at which he will speak on Institute affairs, more particularly as regards the aid members can give in the war effort. Detail arrangements are now being made for these gatherings.

The president's tentative itinerary is as follows:—

Lv. Toronto.....	P.M.	Wednesday,	June 29th
Ar. Three Rivers.....	A.M.	Thursday,	July 30th
Meeting with St. Maurice Valley Branch			
Lv. Three Rivers.....	A.M.	Friday,	July 31st
Ar. Quebec.....	P.M.	Friday,	July 31st
Meeting with Quebec Branch			
Lv. Quebec.....	P.M.	Sunday,	August 2nd
Ar. Moncton.....	P.M.	Monday,	August 3rd
Meeting with Moncton Branch			
Lv. Moncton.....	P.M.	Tuesday,	August 4th
Ar. Sydney.....	A.M.	Wednesday,	August 5th
Meeting with Cape Breton Branch			
Lv. Sydney.....	A.M.	Thursday,	August 6th
Ar. Halifax.....	P.M.	Thursday,	August 6th
Meeting with Halifax Branch			
Lv. Halifax.....	A.M.	Saturday,	August 8th
Ar. Saint John.....	P.M.	Saturday,	August 8th
Meeting with Saint John Branch			
Lv. Saint John.....	A.M.	Tuesday,	August 11th
Ar. Rivière-du-Loup.....	P.M.	Tuesday,	August 11th
Lv. Rivière-du-Loup.....	A.M.	Wednesday,	August 12th
Ar. Bagotville.....	P.M.	Wednesday,	August 12th
Meeting with Saguenay Branch			
Lv. Bagotville.....	A.M.	Friday,	August 14th
Ar. Murray Bay.....	P.M.	Friday,	August 14th

Visitations of this kind make considerable demands on the president's time, but are willingly undertaken, for they do so much to promote and maintain that fellow feeling which unites Institute members wherever they reside. Further, they enable him to meet old friends and make new ones and they give Branch officers and members an enjoyable opportunity of paying their respects to the official head of the Institute to which they are proud to belong.

## THE JAMES WATT INTERNATIONAL MEDAL

Word has been received that the Council of the Institution of Mechanical Engineers has awarded this medal for 1942 to A. G. M. Michell, of Melbourne, Australia. Awards are made with the co-operation of engineering societies throughout the world; Mr. Michell's name was put forward by The Engineering Institute of Canada, and also by the Institution of Engineers, Australia, and the South African Institution of Engineers. It may be noted that the recipient of the medal in 1941, Dr. Aurel Stodola, was nominated by the Institute, as well as by the Swiss Society of Engineers and Architects, and the Czechoslovakian Society of Engineers.

The terms of reference for the James Watt Awards call for a scientist, an inventor and a producer who has achieved international recognition by his work as a mechanical engineer and in the application of science to the progress of mechanical engineering. A. G. M. Michell amply fulfills these conditions.

His name is best known as the discoverer of improvement in journal and thrust bearings, based on investigations which continued and greatly extended the classical study

## News of the Institute and other Societies, Comments and Correspondence, Elections and Transfers

of lubrication commenced by Beauchamp Tower and Osborne Reynolds. After publishing an important paper on the "Lubrication of Plane Surfaces," Michell patented his thrust bearing in 1905. The marine thrust bearing of to-day employs the principles he developed, which made possible the successful operation of marine propelling machinery of much greater size and power than previously, and differs little if at all from his original design. The work of Kingsbury in the United States along similar lines is well known.

In addition to this achievement Michell made other valuable contributions to the science of engineering, notably in his regenerative centrifugal pump and an opposed-piston crankless steam engine which is being manufactured in the United States. He is a Fellow of the Royal Society and an author of many technical papers. Personally he is of a retiring disposition, and is not a seeker for honours, so that the distinction now to be conferred upon him seems to call for special mention.

## AN ENGINEERING SOCIETY IN WARTIME

As yet restrictions due to war conditions have not seriously limited the activities of engineering societies on this side of the Atlantic, although many new kinds of effort have been necessary, and some lines of work have been made more difficult. There has been marked development in advisory and committee work, in which the societies are rendering important service to their governments, particularly as regards the technical and personnel questions for which their organization specially fits them. But conditions are by no means so favourable for the publication and discussion of professional papers. Even in Canada, censorship regulations—whose necessity everyone admits—make it difficult, if not impossible, to publish or discuss matter dealing with the very subjects in which engineers are now most interested. This applies even more forcibly in Britain, where the work of such institutions has to be carried on under conditions of which as yet we have had no experience in this country.

Aeronautical engineering, a branch to which the war has given immense impetus, is a case in point. The last number of the *Journal of the Royal Aeronautical Society*, for example, reports an increase in membership, some bomb damage to its headquarters in London, a surplus of income over expenditure, and the maintenance of a skeleton organization by most of the sixteen branches of the Society. But since the majority of its members are engaged on work for the Ministry of Aircraft Production, the Royal Air Force, or the aircraft industry, and therefore come under the Secrecy Act, and also since the only subject not barred by censorship seems to be civil aviation, it has only been possible to carry out a very meagre programme of society and branch meetings, although some informal technical discussions have been held. The Society is of course represented on or by a number of important committees which are actively concerned in the war effort and are giving results of great value. Its publications, and notably its *Journal*, have maintained their high standard in spite of paper shortage and other difficulties due to war conditions. An admirable series of abstracts from the scientific and technical press, and references to current scientific papers (occupying more than sixty pages in the May issue) is provided by the Air Ministry each month. This is an important feature of the *Journal* and is notable because it pays special attention to the work carried out in foreign countries.

The Engineering Institute of Canada has long maintained cordial relations with the Royal Aeronautical

Society. Institute members will recall\* that some years ago an agreement was entered into by the Councils of the two bodies, providing for the formation of an Aeronautical Section by any branch of the Institute. These sections have joint membership and consist of such corporate members and juniors of the Institute and technical members of the R.Ae.S. as applied for membership therein. Several of these sections were formed. The papers presented before them were published in a special section of *The Engineering Journal*, copies of which were forwarded to London for distribution to R.Ae.S. members. In return Institute members of our Aeronautical Sections received copies of the R.Ae.S. *Journal*. The Society recognized such Aeronautical Sections as local sections of its own, an arrangement which worked well and made for co-operation and joint interest in aeronautical work in Canada.

The agreement is still in force and functioned until quite recently. In fact the latest Aeronautical Section Reprint was issued in November, 1941. War conditions, however, caused a complete upheaval of our aircraft industry, an immense development in aircraft production, the building up of an air force to which some 150,000 men have been added since 1940, and the employment of a host of engineers and technically trained men in the industry, the Department of Munitions and Supply, and the Royal Canadian Air Force. These stirring events have left our members and those of the Royal Aeronautical Society who are now in Canada but little time or opportunity for meetings or discussions other than those connected with their special duties. This, and the frequent transfer of people from place to place, have, for the present, made it impossible to carry on the activities of the Aeronautical Sections. We look forward, however, to the time when this state of things will be remedied and the joint sections will again be able to make their contributions to aeronautical progress in Canada.

### FEES OF MEMBERS OVERSEAS

It might be appropriate to remind members that following the practice established in the last war, Council has authorized the remission of fees, upon request, for all members serving in the overseas forces. The official minute reads as follows:

"The remission of annual fees of members normally resident in Canada, appointed to or enlisting in His Majesty's Armed Forces, will be considered by Council upon written request, and on the following basis:

"The fee which is applicable at the first of the year is the amount for which the member shall be liable, and for which he shall be billed. If, subsequently in that year, conditions change, allowance will be made on the following basis:

"When service requires the member to leave Canada his fee will be remitted for the balance of the year, and his account credited accordingly.

"Members in the Naval or Air Services, who are intermittently absent from Canada because of the war, will be considered as eligible for this privilege.

"In computing the 'balance of the year' only half year periods will be considered, and the remission will date from January 1st or July 1st, whichever is nearest to the date at which notice of change is received at Institute Headquarters.

"Under such conditions all Institute services cease, except that it is the desire of Council to assist overseas members in any way that may be possible, and opportunities to render special services to such members will be welcomed. Members on active service are requested to keep Headquarters informed of their movements, as this is the only means by which a proper accounting can be rendered. This detailed information is also desirable as it is proposed to keep at Headquarters a record of all members who are on active service."

\*See *The Engineering Journal*, December, 1930.

It should be noted that members whose fees are thus remitted and who are on active service overseas may have *The Engineering Journal* sent to them on payment of one dollar per year.

If it is not found convenient to have some one here make the remittance, the amount will be left in members' accounts until such time as they return to Canada.

The Institute is honoured by the national services of its members, and this remission of fees is but a modest expression of appreciation which Council feels it is making on behalf of all members who remain in Canada.

### LETTER FROM WASHINGTON

The following article was contributed by E. R. Jacobsen, M.E.I.C., Engineering and Technical Assistant to the Director General, Commonwealth of Australia War Supplies Procurement, Washington, D.C. Mr. Jacobsen is on loan from the Dominion Bridge, Company, Limited of Montreal. It is hoped that his contributions will become a monthly feature of the *Journal*—EDITOR.

#### THE ALL ENGINEERS DINNER

It was recently my privilege to attend the largest all-engineering dinner ever held in Washington, D.C. The affair was arranged under the auspices of no less than sixteen national engineering societies—both civil and military. The subject was "The Engineer's Job in War Production." Over twelve hundred people sat down to dinner in the main ball room of the Mayflower Hotel—that rendezvous of politicians, statesmen, Hollywood celebrities and, now, a meeting place for interesting people from all over the world. Uniforms of all descriptions were very much in evidence. The three speakers were Lt. Gen. Brehon Somervell, Commanding General of the Services of Supply, Donald M. Nelson, Chairman of the War Production Board, and William L. Batt, Joint Chairman of the Raw Materials Board. The chairman of the evening was James W. Parker, President of the American Society of Civil Engineers.

It strikes me as particularly significant that the three men who head the three most important bodies in the field of supply and production should all be engineers. A few words about their background should be of interest.

General Somervell served in France in the last war as second in command of the 15th U.S. Engineers and was decorated three times. He has remained in the U.S. Corps of Engineers ever since. He made extensive surveys of the Rhine and the Danube under special commission from the League of Nations. At the request of the Turkish Government he carried out an economic survey of Turkey. Later, he was WPA Administrator for the City of New York. Recently, he was in charge of the construction of Army cantonments and completed in just over a year the construction of housing facilities for over one million men.<sup>1</sup> As Commanding General of the Services and Supply, he now holds one of the really important jobs in the U.S. Army.

At the last moment, Donald Nelson was prevented from attending in person. It is not always remembered that Donald Nelson is an engineer. He graduated in 1911 as a chemical engineer from the University of Missouri and worked for ten years as a chemist in the testing laboratories of Sears-Roebuck before he transferred to the merchandising side of the business. He eventually became executive vice-president of Sears Roebuck. He first came to Washington to work for the Treasury Department and was then made head of the purchasing division of the Office of Production Management. His present job as chairman of the War Production Board makes him the second most powerful man in the United States—second only to the president.

William L. Batt graduated as a mechanical engineer in 1907. He eventually became president of the SKF Company

<sup>1</sup>See "Citadels of Democracy" published by the U.S. War Department.

and is a past president of the American Society of Mechanical Engineers. He has been decorated by the King of Sweden for his contributions to international trade. He is now chairman of the Requirements Committee of the War Production Board and joint chairman, with Sir Clive Baillieu, of the Raw Materials Board which was set up as one of the direct results of the Churchill-Roosevelt Conference.

The following notes are the result of jottings made during this interesting evening.

The American productive machine should shortly be running full out. Never before has this machine been allowed to run without periodic stoppages and without the handicaps caused by financial considerations, political exigencies, and labour intrigue. We are about to discover the real measure of the productive capacity of the American people. Once this capacity is known, the long term implications cannot be ignored. If we take the national income as a measure of the productive capacity of the United States, we begin to see the trend. The national income for the best pre-war year was 85 billion dollars. This year the national income will be between 110 and 120 billion, with a further considerable increase expected in 1943.

Much of the present difficulty in the United States is the result of overlooking the fact that, though they were the largest consuming nation, they were also the largest importing nation in the world. Mr. Batt suggested that in future days the United States should guard against any repetition of the errors of this war by the constant maintenance of stock piles. He also stated that American industry had been ill equipped to meet certain specific military demands and argued that specialized war plants should not be dismantled after the war but maintained as part of the national defence.

It was argued that the supply of materials would be the deciding factor in the war and, while confidence in our position was expressed, the meeting was gravely warned that our supply problems could only be met by stern and drastic measures. The limit of available natural resources in many categories has already been reached and from now on we must rely upon what Mr. Batt called "mines above the ground." These fall into two classes. The first is in the elimination of waste. He said that it is impossible to overestimate the importance of scrap of all kinds—scrap will probably win the war. This is going to involve hard lessons for an extravagant people. The second "mine above ground," is in the field of specification and standardization and here can be found full scope for engineering ingenuity, skill, originality, and even audacity. Twenty-five per cent of our nickel consumption has been saved largely by a revision of specifications. The savings of both critical materials and productive capacities which have been effected by the railway standardization programme is an exciting story in itself.

*Fortune* recently listed the causes of production lags without mentioning bad management. Mr. Batt said that, while management had done a wonderful job, it has a bigger job still to do and much to learn. As examples, he pointed out, that if the thirty manufacturers of aeroplane engines were all as good as the top three, total production would be up 25 per cent; if the hundred and fifty machine tool manufacturers were all as good as the first three, production of machine tools would be up 45 per cent.

We were urged to pay even more attention to engineering and scientific laboratories. Considerable stress was laid on the importance of engineering education in war time. In the United States industry will require about 80,000 new engineers this year and the army about 12,000.

Mr. Batt did not feel that the engineering profession as a unit was fully in harness—engineers still had to learn to think and act and plan as a body. General Somervell asserted that America is now building tanks and planes in numbers that would astound and dismay the dictators but warned that transport afloat and ashore is still our greatest

bottleneck. The engineer who devises a scheme for increasing our transportation efficiency will be "as great a hero as the general who wins a battle in the field."

Speaking to the point that this is an engineers' war, General Somervell said that while the "road ahead may be dim with the dust of battles yet to fight" the ultimate result was not in doubt. "When Hitler put this war on wheels he ran it straight down our alley. When he hitched his chariot to an internal combustion engine he opened up a new battle front, a front that we know well. It's called Detroit. When Hitler took this war into the skies he rose into our own element. We'll meet him there on even terms. We're meeting him there already. From Brest to Berlin he feels our strength, and as the days of summer lengthen he'll feel it again and yet again without respite."

## CORRESPONDENCE

To the Editor:

Sir: Please allow me a few lines in your correspondence column to offer as a gift 21 bound volumes of the *Engineering News Record* from January 1920 to June 1930. They cover admirably a period of great technical progress and are being released only because a gain of space compensates for the trouble of consulting the company set on the same floor.

Delivery would be made at my office. The preferred recipient would be the library of a small university.

J. B. MACPHAIL,

P.O. Box 6072,  
Montreal.

16th June, 1942.

The following letters have been received from the students who have been awarded the Institute prizes in the various faculties of engineering:

—Editor.

Duparquet, Que.,  
June 6th, 1942.

The Editor,

The *Engineering Journal*, Montreal, Que.

Dear Sir:

I wish to thank very sincerely the Engineering Institute of Canada for the honour it has conferred upon me.

This award means really more to a student than a simple prize. It is an indication that he might be an asset to the engineering profession and be able to follow in the footsteps of all those engineers who have contributed to make our country what it is today, by bringing in his own efforts to its future development. I hope to be able, with your assistance, to keep up to it.

I always have had an interest in the Institute activities and desire to co-operate with it in every possible way. Would you be kind enough to inform me of which way I could actually participate and keep in touch with the Institute.

Yours very sincerely,

(Signed) CYRILLE DUFRESNE.

Saskatoon, Sask., June 7th, 1942.

The Editor,

The *Engineering Journal*, Montreal, Que.

Dear Sir:

Thank you very much for your letter and the honour you have bestowed upon me by your award of "The Engineering Institute of Canada Prize."

I would also like to thank you for your good wishes and hope that in the future I can continue to live up to the high standards of the engineering profession in Canada.

Yours truly,

(Signed) WILFRED GRAHAM.

R.C.O.T.C. "A 21"  
Barrie, Ont., June 9th, 1942.

The Editor,  
The Engineering Journal, Montreal, Que.

Dear Sir:

Your letter of May 29th has been forwarded to me and I was pleased to receive it.

I was quite surprised to be awarded "The Engineering Institute of Canada Prize" and may I take this opportunity to say that I greatly appreciate the prize.

Although I am not a registered member of the Institute now, I should like to become a Student member next year. I have attended a number of the Institute meetings in Winnipeg and hope that I shall be in a position to continue in the future.

My present address is hardly permanent as I am a student officer at the Ordnance Army Camp here in Barrie. I shall return to the University of Manitoba next year and after graduation will be a member of the Armed Forces.

I hope that this letter will prove satisfactory and again I will express my appreciation of the prize.

Yours truly,  
(Signed) J. R. WALDRON.

Galt, Ont., June 15th, 1942.

The Editor,  
The Engineering Journal, Montreal, Que.

Dear Sir:

On behalf of the junior students of Nova Scotia Technical College I thank you for the prize which you generously donate each year to a member of our class. As I was awarded the prize this year, I also wish to express my personal thanks.

Yours sincerely,  
(Signed) WM. H. BOWES.

Toronto, Ont., June 16th, 1942.

The Editor,  
The Engineering Journal,  
Montreal, Que.

I wish to thank you for your recent letter regarding the award of "The Engineering Institute of Canada Prize" for 1942 at the University of Toronto.

As you must realize, this, my first direct contact with the Institute, is indeed a pleasant one. During my course I have often found the publications of the Institute of great assistance, and this present award will certainly serve as a lasting encouragement in the work that lies ahead.

I am aware of the invaluable contribution that the Institute is making in the engineering profession, and I look forward to the time when, through further associations with the Institute, I may direct a personal effort towards its success.

Yours sincerely,  
(Signed) J. M. HAM.

### THE ENGINEERING INSTITUTE OF CANADA PRIZE AWARDS 1942

Twelve prizes known as "The Engineering Institute of Canada Prizes" are offered annually for competition among the registered students in the year prior to the graduating year in the engineering schools and applied science faculties of universities giving a degree course throughout Canada.

Each prize consists of twenty-five dollars in cash, and having in view that one of the objects of the Institute is to facilitate the acquirement and interchange of professional knowledge among its members, it has been the desire of the Institute that the method of award should be determined by the appropriate authority in each school or university so that the prize may be given to the student who, in the year prior to his graduating year, in any department

of engineering has proved himself most deserving as disclosed by the examination results of the year in combination with his activities in the students' engineering organization, or in the local branch of a recognized engineering society.

The following are the prize awards for 1942:

Nova Scotia Technical College.....	William Henry Bowes
University of New Brunswick.....	G. Herbert Loane, S.E.I.C.
McGill University.....	Saul Bernstein
Ecole Polytechnique.....	Henri Audet, S.E.I.C.
Queen's University.....	Kenneth Morgan Clarke
University of Toronto.....	James Milton Ham
University of Manitoba.....	John Ross Waldron
University of Saskatchewan.....	Wilfred Graham
University of Alberta.....	Henry T. Steverson
University of British Columbia.....	C. Gordon Rogers
Laval University.....	Cyrille Dufresne
Royal Military College of Canada.....	No award—regular course discontinued during the war.

### RECENT GRADUATES IN ENGINEERING

Congratulations are in order to the following Juniors and Students of the Institute who have completed their courses at the various Universities:

#### McGILL UNIVERSITY

##### HONOURS, MEDALS AND PRIZE AWARDS

Cholette, Albert, Quebec, Que., B.Eng. (Chem.); British Association Medal; Honours in Chemical Engineering.  
Davis, John Frederick, Montreal, Que., B.Eng. (Elec.); British Association Medal; Honours in Electrical Engineering; Montreal Light, Heat and Power Consolidated First Prize; The Institute of Radio Engineers' Prize; The Engineering Institute of Canada Prize (1941); The Engineering Undergraduates' Society Second Prize for Summer Essay.  
Findlay, Allan Cameron, Westmount, Que., B.Eng. (Mech.); Honours in Mechanical Engineering.  
Mason, Vere Karsdale, Bridgetown, N.S., B.Eng. (Ci.); British Association Medal; Honours in Civil Engineering.  
Ouellette, Robert Pascal, Montreal, Que., B.Eng. (Ci.); The Robert Forsyth Prize in Theory of Structures and Strength of Materials.  
Simpson, Francis William, Montreal, Que., B.Eng. (EL.); Honours in Electrical Engineering; Montreal Light, Heat and Power Consolidated Second Prize.

##### DEGREE OF BACHELOR OF ENGINEERING

Anderson, John MacDonald, Ottawa, Ont., B.Eng. (Mech.).  
Anglin, Thomas Gill, Westmount, Que., B.Eng. (Mech.).  
Bain, Frederick Archibald, Montreal, Que., B.Eng. (Chem.).  
Baxter, John Frederick, Saint John, N.B., B.Eng. (Chem.).  
Bennett, John Robert Gordon, Montreal West, Que., B.Eng. (Elec.).  
Bogert, Frank Godard, Pointe Claire, Que., B.Eng. (Mech.).  
Bowie, Ralph Allen, Lachine, Que., B.Eng. (Elec.).  
Brett, John Edward, Montreal, Que., B.Eng. (Ci.).  
Cantwell, Edward Marcel, Outremont, Que., B.Eng. (Mi.).  
Chapman, Harris James Wesley, Sackville, N.B., B.Eng. (Mech.).  
Dunbar, George Gray, Stellarton, N.S., B.Eng. (Chem.).  
Garton, John McConnell, Boissevain, Man., B.Eng. (Chem.).  
Grant, Frank Alexander, Lachine, Que., B.Eng. (Elec.).  
Griesbach, Robert Johnston, Hampstead, Que., B.Eng. (Ci.).  
Griffin, Vincent Oswald, Brighton, Ont., B.Eng. (Mech.).  
Harkness, Andrew Dunbar, Lancaster, Ont., B.Eng. (Mech.).  
Holland, Henry Alfred Nelson, Montreal West, Que., B.Eng. (Ci.).  
Hudson, George Waugh, Montreal, Que., B.Eng. (Elec.).  
Hunter, Douglas David, Lachine, Que., B.Eng. (Mech.).  
Iliffe, Francis Henry, Montreal West, Que., B.Eng. (Elec.).  
Kennedy, Robert William, Montreal, Que., B.Eng. (Elec.).  
Lindsay, Gerald Alec Edwin, Westmount, Que., B.Eng. (Elec.).  
McCulloch, Urban Francis, Montreal West, Que., B.Eng. (Ci.).  
Martin, William Stormont, Montreal, Que., B.Eng. (Elec.).  
Norton, Howard William, Montreal, Que., B.Eng. (Mech.).  
Richardson, George William, Montreal, Que., B.Eng. (Mech.).  
Rogers, Frank Knox, Winnipeg, Man., B.Eng. (Chem.).  
Routly, William James, Montreal West, Que., B.Eng. (Mech.).  
Shaw, Douglas Thomas, Montreal, Que., B.Eng. (Elec.).  
Simpson, William Tyrie, Montreal, Que., B.Eng. (Elec.).  
Stapells, Robert Frederic, Montreal, Que., B.Eng. (Mech.).  
Stoppes, Reginald Edward, Cochrane, Ont., B.Eng. (Elec.).  
Ward, Walter George, Peterborough, Ont., B.Eng. (Elec.).  
Webster, John Alexander, Town of Mount Royal, Montreal, Que., B.Eng. (Elec.).  
Wells, James Edwin, Montreal, Que., B.Eng. (Chem.).  
Wilson, John Howard, Hudson Heights, Que., B.Eng. (Elec.).  
Wilson, William Henry, Farnham, Que., B.Eng. (Mech.).

#### UNIVERSITY OF MANITOBA

##### HONOURS AND MEDALS

Laird, David William, Winnipeg, Man., B.Sc. (Ci.); University Gold Medal; Honours in Civil Engineering.  
Pink, John Frederick, St. James, Man., B.Sc. (Elec.); University Gold Medal; Honours in Electrical Engineering.

## DEGREE OF BACHELOR OF SCIENCE

Anderson, Clarence Arthur, Winnipeg, Man., B.Sc. (Elec.).  
Bateman, Leonard Arthur, Winnipeg, Man., B.Sc. (Elec.).  
Beresford, Morris Maskew, Winnipeg, Man., B.Sc. (Elec.).  
Bowman, William Arthur, Hudson, Ont., B.Sc. (Ci.).  
Bradshaw, Thomas Earl, Winnipeg, Man., B.Sc. (Elec.).  
Buhr, Richard Kenneth, Winnipeg, Man., B.Sc. (Elec.).  
Dudych, Daniel, Winnipeg, Man., B.Sc. (Ci.).  
Galli, Joseph Nicholas, Winnipeg, Man., B.Sc. (Ci.).  
Gregory, Arthur Herbert, Winnipeg, Man., B.Sc. (Elec.).  
Hand, Dennis Herbert, Winnipeg, Man., B.Sc. (Elec.).  
Harvie, John Duncan, Winnipeg, Man., B.Sc. (Ci.).  
Lawson, Glenn William, Brandon, Man., B.Sc. (Ci.).  
Marantz, Oscar, Winnipeg, Man., B.Sc. (Ci.).  
Macfadyen, Allan Burt, Flin Flon, Man., B.Sc. (Elec.).  
Pratt, James Crawford, Winnipeg, Man., B.Sc. (Elec.).  
Schofield, Stewart Macleod, Winnipeg, Man., B.Sc. (Ci.).  
Smith, Robert Lovelace, Winnipeg, Man., B.Sc. (Elec.).

## UNIVERSITY OF ALBERTA

### HONOURS AND PRIZE AWARDS

D'Appolonia, Elio, Edmonton, Alta., B.Sc. (Ci.); High distinction in Civil Engineering.  
Ford, George, Edmonton, Alta., B.Sc. (Ci.); High Distinction in civil engineering; First Class General Standing in Applied Science; Association of Professional Engineers of Alberta Prize in Civil Engineering.  
Hall, Albert Henry, Edmonton, Alta., B.Sc., in Engineering Physics with High Distinction; First Class General Standing in Applied Science.

### DEGREE OF BACHELOR OF SCIENCE

Blackstock, William John, Edmonton, Alta., B.Sc. (Ci.).  
Charyk, Joseph Vincent, Lethbridge, Alta., B.Sc. in Engrg. Physics with High Distinction.  
Davies, Richard Llewelyn, Lusco, Alta., B.Sc. (Ci.).  
Grimble, Louis George, Edmonton, Alta., B.Sc. (Ci.).  
McManus, Ralph Norman, Edmonton, Alta., B.Sc. (Ci.).  
Martin, John Henry, Edmonton, Alta., B.Sc. (Elec.).  
Mitchell, Maurice Stephen, Foothills, Alta., B.Sc. (Ci.).  
Moseson, Stanley Gustav, Wetaskiwin, Alta., B.Sc. (Ci.).  
Phillips, Ronald Edward, Edmonton, Alta., B.Sc. (Elec.).  
Preboy, Joseph William, Fox Valley, Sask., B.Sc. (Mi.).  
Smith, Allen Cedric, Edmonton, Alta., B.Sc. (Ci.).  
Swallow, Murray Gordon, Edmonton, Alta., B.Sc. (Ci.).  
Willis, Lloyd Everett, Edmonton, Alta., B.Sc. (Ci.).

## UNIVERSITY OF TORONTO

### HONOURS

Extence, Alan Barr, Toronto, Ont., B.A.Sc. (Mech.); Honours in Mechanical Engineering.  
Livingston, Charles Burton, Toronto, B.A.Sc. (Engrg. Physics); Honours in Engineering Physics.  
Prideaux, Norman Llewellyn, Toronto, Ont., B.A.Sc. (Ci.); Honours in Civil Engineering.

### DEGREE OF BACHELOR OF APPLIED SCIENCE

Glynn, Walter Sylvester, Toronto, Ont., B.A.Sc. (Ci.).  
Quist, Jack Ernest, Peterborough, Ont., B.A.Sc. (Elec.).  
Shearer, Charles William, Windsor, Ont., B.A.Sc. (Elec.).

## QUEEN'S UNIVERSITY

### HONOURS AND MEDALS

Pasquet, Pierre Auguste, Kingston, Ont., B.Sc. (Ci.); Honours in Civil Engineering; Governor-General's Medal; Departmental Medal.

### DEGREE OF BACHELOR OF SCIENCE

Armstrong, Howard Elgin, Rodney, Ont., B.Sc. (Ci.).  
Carmichael, Douglas Alfred, Fort William, Ont., B.Sc. (Mech.).  
Chilman, William Richard, Hamilton, Ont., B.Sc. (Ci.).  
Haacke, Ewart Mortimer, Deloro, Ont., B.Sc. (Elec.).  
Hamilton, John Charles, Westport, Ont., B.Sc. (Chem.).  
McCallum, John Francis, Port Arthur, Ont., B.Sc. (Ci.).  
Seymour, David Llewellyn, Ottawa, Ont., B.Sc. (Ci.).  
Thomas, Jack Arthur, Belleville, Ont., B.Sc. (Mech.).

## NOVA SCOTIA TECHNICAL COLLEGE

### DEGREE OF BACHELOR OF ENGINEERING

Lewis, George Donald, Louisburg, N.S., B.Eng. (Mech.).  
MacAulay, Roy Daniel, Sydney, N.S., B.Eng. (Mech.).  
Macdonald, Ian Malcolm, Hopewell, N.S., B.Eng. (Mech.).  
Rossetti, Anthony Bruce, Sydney, N.S., B.Eng. (Mech.).  
Thompson, Alvin Henry, Pictou, N.S., B.Eng. (Mech.).

## THE UNIVERSITY OF BRITISH COLUMBIA

### DEGREE OF MASTER OF APPLIED SCIENCE

Breeze, John Ellis, Ottawa, Ont., M.A.Sc. (Elec. Engrg. and Physics).

## UNIVERSITY OF SASKATCHEWAN

### HONOURS AND SCHOLARSHIP

Buchanan, James Charles, Saskatoon, Sask., B.Sc. (Mech.); Distinction in Mechanical Engineering.  
Fast, Morris, Blaine Lake, Sask., B.Sc. (Mech.); Distinction in Mechanical Engineering.  
Garrett, Cyril, Wilkie, Sask., B.Sc. (Engrg. Physics); Great Distinction in Engineering Physics.  
MacCoy, Gerald Bates, Regina, Sask., B.Sc. (Mech.); Distinction in Mechanical Engineering.  
Mitchell, Jasmin Lewis, Orkney, Sask., B.Sc. (Ci.); Great Distinction in Civil Engineering.  
Seowcroft, Gordon Caverly, Bowsman, Man., B.Sc. (Ci.); Distinction in Civil Engineering.  
Staples, William Robert, Oxbow, Sask., B.Sc. (Mech.); Great Distinction in Mechanical Engineering; Association of Professional Engineers of Saskatchewan Scholarship.  
Thomson, Walter Barron, Regina, Sask., B.Sc. (Ci.); Great Distinction in Civil Engineering.

### DEGREE OF BACHELOR OF SCIENCE

Auld, Frank Mantle, Regina, Sask., B.Sc. (Mech.).  
Batanoff, George Boris, Blaine Lake, Sask., B.Sc. (Mech.).  
Bryce, Ronald Campbell, Drinkwater, Sask., B.Sc. (Mech.).  
Cox, Wilbur John, Landis, Sask., B.Sc. (Mech.).  
Giauque, Louis Frederick, High Point, Sask., B.Sc. (Mech.).  
Hall, William Francis, Regina, Sask., B.Sc. (Ci.).  
Hargrave, Herbert Thomas, Walsh, Alta., B.Sc. (Agric.).  
Hughes, Gordon Lyall, Broderick, Sask., B.Sc. (Mech.).  
McElroy, George Robson, Ormiston, Sask., B.Sc. (Mech.).  
Olafson, Ellaf Arni, Eston, Sask., B.Sc. (Mech.).  
Reynolds, Donald Doane, Biggar, Sask., B.Sc. (Mech.).  
Traynor, John Clair, Regina, Sask., B.Sc. (Ci.).  
Turner, Leslie Charles, Hudson Bay Jct., Sask., B.Sc. (Mech.).  
Tyerman, John Alexander, Prince Albert, Sask., B.Sc. (Mech.).  
Webster, Gordon Frederick, Elbow, Sask., B.Sc. (Ceramic).  
Wellington, John Richard, North Battleford, Sask., B.Sc. (Chem.).

## ECOLE POLYTECHNIQUE

### DISTINCTIONS ET PRIX

de Villers, R. Albert, Montréal, Qué., B.Sc.A., I.C., avec distinction. Médaille de Son Exc. le Lieutenant-Gouverneur de la Province, décernée au premier de sa promotion pour toute la durée des études. Médaille d'Argent de l'Association des Anciens Elèves de l'Ecole Polytechnique, décernée à l'élève classé premier de cinquième année. Médaille offerte par le Docteur Eugène Saint-Jacques pour succès dans les travaux d'application offerte à l'élève classé premier aux cours de Physique et d'Electrotechnique.  
Marsolais, Irénée, Montréal, Qué., B.Sc.A., I.C., avec distinction.  
Dansereau, René, Montréal, Qué., B.Sc.A., I.C., Médaille d'Or de l'Association des Anciens Elèves de l'Ecole Polytechnique, offerte à l'étudiant ayant présenté la meilleure thèse.  
Letendre, Lucien, Montréal, Qué., B.Sc.A., I.C., Médaille de Bronze de l'Association des Anciens Elèves de l'Ecole Polytechnique.  
Valiquette, Maurice, Montréal, Qué., B.Sc.A., I.C. Prix Paul D'Arçon pour succès en Mines.  
Rousseau, Jean-Melville, Montréal, Qué., B.Sc.A., I.C. Médaille de Bronze de l'Association des Anciens Elèves de l'Ecole Polytechnique.  
Saint-Jacques, Maurice, Outremont, Qué., B.Sc.A., I.C. Prix Ernest Cormier pour succès au cours d'Architecture.  
D'Amours, Albert, Montréal, Qué., B.Sc.A., I.C. Prix de la Cinquantième Promotion de l'Ecole Polytechnique, offert à l'élève finissant qui a présenté la meilleure thèse industrielle.

### DEGRES

Brazcau, Lucien, Montréal, Qué., B.Sc.A., I.C.  
Boisclair, Robert, Montréal, Qué., B.Sc.A., I.C.  
Tétreault, Jacques, Montréal, Qué., B.Sc.A., I.C.  
Martin, Adolphe, Montréal, Qué., B.Sc.A., I.C.  
Lefebvre, Gérard, Montréal, Qué., B.Sc.A., I.C.  
Dancose, Léon, Lévis, Qué., B.Sc.A., I.C.  
Boileau, Charles-Antoine, Montréal, Qué., B.Sc.A., I.C.  
Drouin, Jacques, Montréal, Qué., B.Sc.A., I.C.  
Rousseau, Antoine, Montréal, Qué., B.Sc.A., I.C.  
Mercier, Charles-Edouard, Montréal, Qué., B.Sc.A., I.C.  
Lalberge, Paul, Montréal, Qué., B.Sc.A., I.C.  
Valiquette, Zéphirin, Abord-à-Plouffe, Qué., B.Sc.A., I.C.  
Tremblay, G. René, Montréal, Qué., B.Sc.A., I.C.  
Rolland, Lucien, Montréal, Qué., B.Sc.A., I.C.  
desRivières, Edouard, Montréal, Qué., B.Sc.A., I.C.  
Latreille, André, Montréal, Qué., B.Sc.A., I.C.  
Gagné, Germain, Montréal, Qué., B.Sc.A., I.C.  
Gauthier, Gaston C., Montréal, Qué., B.Sc.A., I.C.  
Bélanger, Lucien, Outremont, Qué., B.Sc.A., I.C.  
Hébert, Guy, Outremont, Qué., B.Sc.A., I.C.  
Lapierre, Maurille, Montréal, Qué., B.Sc.A., I.C.  
Laquerre, Maurice, Montréal, Qué., B.Sc.A., I.C.  
Rochon, André, Montréal, Qué., B.Sc.A., I.C.  
Girouard, Laurent, St. Lambert, Qué., B.Sc.A., I.C.

Normandeau, Laurent, Montréal, Qué., B.Sc.A., I.C.  
Simard, J. Edmond, Montréal, Qué., B.Sc.A., I.C.  
Hurtubise, Marc, Montréal, Qué., B.Sc.A., I.C.  
Smith, Paul, Marcel, Montréal, Qué., B.Sc.A., I.C.  
Dury, Jean, Montréal, Qué., B.Sc.A., I.C.

## THE UNIVERSITY OF NEW BRUNSWICK

### PRIZE AWARDS

Bishop, Percival William, Three Hills, Alta., B.Sc. (Ci.); Ketchum Silver Medal for the highest standing in fourth year Civil Engineering.  
Peabody, Gerald Stead, North Devon, N.B., B.Sc. (Elec.); Brydone-Jack Memorial Prize for the highest standing in fourth year Electrical Engineering.

### DEGREE OF BACHELOR OF SCIENCE

Baird, Robert Gordon, Saint John, N.B., B.Sc. (Elec.).  
Cox, Kenneth Victor, Fredericton, N.B., B.Sc. (Elec.).  
Jewett, Arthur Earle, Fredericton, N.B., B.Sc. (Elec.).  
Skelton, Eric Tudor, Fredericton, N.B., B.Sc. (Ci.).  
Smith, Walter Marshall, Fredericton, N.B., B.Sc. (Elec.).

### ELECTIONS AND TRANSFERS

At the meeting of Council held on June 20th, 1942, the following elections and transfers were effected:

#### Members

**Hale**, Frederick John, asst. colonial engr., Public Works Dept., Roseau, Dominica, B.W.I.  
**Hunt**, Edwin Harold, chief geologist i/c exploration dept., McColl-Frontenac Oil Co. Ltd., Calgary, Alta.  
**Lambert**, Noel Dudley, B.Sc. (Univ. of B.C.), Director of Engineer Services (Army), Dept. of National Defence, Ottawa, Ont.  
**Schmelzer**, Hans, Mech. Engr. (Staatl. Technische Hochschule, Karlsruhe, Germany), mech. engr., Robert A. Rankin & Co., Montreal, Que.

#### Junior

**Hailey**, Arthur Roberts Trail, B.A.Sc. (Univ. of B.C.), testman, Can. Gen. Elec. Co. Ltd., Peterborough, Ont.

### Affiliates

**Allen**, Charles Harry, sales engr., Montreal Office, Canadian Westinghouse Co. Ltd., Montreal, Que.  
**Both**, John, resident engr., No. 5 Manning Depot, Lachine, Que.  
**Hargreaves**, Welsford Thomas, asst. engr. and senior instr'man, aerodrome constrn., Scoudouc, N.B.

#### Transferred from the class of Junior to that of Member

**Benjafield**, Philip Grant, B.Sc. (Civil) (Queen's Univ.), instr'man, International Nickel Co. Ltd., Copper Cliff, Ont.  
**Malby**, Arthur Leslie Ernest, B.Sc. (Elec.) (Univ. of Man.), asst. industrial control engr., Can. Gen. Elec. Co. Ltd., Peterborough, Ont.

#### Transferred from the class of Student to that of Junior

**Giauque**, Louis Frederick, B.Sc. (Mech.) (Univ. of Sask.), design engr., B. Greening Wire Co. Ltd., Hamilton, Ont.  
**McCrary**, Donald Carman, B.Eng. (McGill Univ.), asst. gen'l. engr., Can. Gen. Elec. Co. Ltd., Peterborough, Ont.  
**McGregor**, Douglas Robert, B.Eng. (McGill Univ.), industrial control engrg. dept., Can. Gen. Elec. Co. Ltd., Peterborough, Ont.  
**Taylor**, Charles Gray, B.Sc. (Civil) (Queen's Univ.), instr'man, H.E.P.C. of Ont., Toronto, Ont.  
**Vatcher**, Chesley Holmes, B.A.Sc. (Elec.) (Univ. of Toronto), sales engr., carbon sales division, Canadian National Carbon Co. Ltd., Toronto, Ont.

#### Students Admitted

**Barchyn**, Donald Edward, B.Sc. (Elec.) (Univ. of Alta.), 313 Maitland Ave., Peterborough, Ont.  
**Brown**, George Henry, 1692 Leclair Ave., Montreal, Que.  
**Cunningham**, Carl Norman, B.Eng. (Nova Scotia Tech. Coll.), 46 Harding St., Fairville, N.B.  
**Keays**, Bryce Fraser, B.Sc. (Civil) (Univ. of N.B.), Newcastle, N.B.  
**Ross**, Gordon William (Univ. of N.B.), 513 King Street, Peterborough, Ont.  
**Watt**, John Simmons (Univ. of N.B.), 261 First Avenue, Ottawa, Ont.

## Personals

**W. F. Drysdale**, M.E.I.C., has recently been appointed executive assistant to the Hon. C. D. Howe, Minister of Munitions and Supply at Ottawa. Mr. Drysdale has also been named president of Machinery Service Limited, a Government-owned company employing skilled civilian refugees from enemy countries.

Mr. Drysdale joined the department in May, 1940, as director of munitions. Upon the expansion of the Munitions Production Branch, he became joint director-general of munitions production. Subsequently, he was named director-general of the industrial planning branch. From August, 1940 to February, 1942, Mr. Drysdale was chairman of the central committee of Sorel Industries Limited.

A highly trained mechanical engineer, Mr. Drysdale is a graduate of McGill University. He received his practical mechanical engineering training at the Pointe St. Charles shops of the Grand Trunk Railway, and seven years' experience in manufacturing and engineering with the American Locomotive Company were followed by three years of railroading with the United Fruit Company in Central America.

Mr. Drysdale was with the Steel Company of Canada, Limited, when the Great War broke out and he was responsible for designing and superintending much of the munitions production of that company. In 1916, he went to France in charge of the locomotive work undertaken there by the American Locomotive Company and the Montreal Locomotive Works. Following the war, he became managing director of the Worthington Pump & Machinery Company interests in Europe. In 1923 he founded the Brazilian Portland Cement Company in San Paulo. He has been vice-president and director of the Montreal Locomotive Works since 1932.

## News of the Personal Activities of members of the Institute, and visitors to Headquarters

**Arthur Duperron**, M.E.I.C., was elected president of the Canadian Transit Association at the annual convention held in Toronto last month. Mr. Duperron is the recently appointed assistant general manager of the Montreal Tramways Company.

**D. E. Blair**, M.E.I.C., vice-president and general manager of the Montreal Tramways Company, has been elected a member of the executive of the Canadian Transit Association.

**E. L. Cousins**, M.E.I.C., general manager of the Toronto Harbour Commission, has been appointed wartime administrator of the port of Halifax. He will report to the war committee of the Cabinet through the Minister of Munitions and Supply.

It will be his responsibility to direct the institution of any measures he deems necessary to assure the security of port facilities and of ships from time to time in or about the port, to assure the proper movement of traffic through the port, and to co-ordinate shipbuilding, ship repair, and salvage operations in or about the port with other port activities.

**Ira P. Macnab**, M.E.I.C., of Halifax, has recently been re-elected for ten years to the Board of Commissioners of Public Utilities for Nova Scotia.

**W. P. Dobson**, M.E.I.C., of Toronto, chief testing engineer of the Hydro-Electric Power Commission of Ontario, and former president of the Association of Professional Engineers of Ontario, was elected president of the Dominion Council



**W. P. Dobson, M.E.I.C., President, Dominion Council of Professional Engineers.**



**Dr. C. A. Robb, M.E.I.C., who recently joined the Aluminum Co. of Canada, Montreal, Que.**



**C. G. Cline, M.E.I.C., newly elected chairman, Niagara Peninsula Branch.**

of Professional Engineers, at the annual meeting held in Saint John, N.B. at the end of May. Born at Ballinafad, Ont., he received his education at the University of Toronto where he was graduated in 1911, at which time he joined the staff of the Toronto Hydro Electric System. From 1912 to 1914 he was an alumni research Fellow at the University of Toronto where he obtained his degree of Master of Applied Science. He then joined the staff of the Hydro Electric Power Commission of Ontario as a laboratory engineer. Mr. Dobson is a past vice-president of the American Institute of Electrical Engineers.

**de Gaspé Beaubien, M.E.I.C.,** vice-president of the Institute, is chairman of the Montreal Citizens' Recruiting Committee for Home Defence.

**Lieut.-Colonel G. E. Cole, M.E.I.C.,** who has been in Ottawa for the past year, on loan from the Department of Mines and Natural Resources, Manitoba, to the Wartime Bureau of Technical Personnel, returned to Winnipeg on June 1st to resume his duties as Director of Mines.

**Group Captain D. C. M. Hume, M.E.I.C.,** has been loaned by the Department of National Defence for Air to act as national director of the Air Cadet League of Canada. He was director of technical training at R.C.A.F. headquarters, Ottawa.

**F. C. Meehin, M.E.I.C.,** has been appointed director for the protection of oil reserves. Mr. Meehin, who is manager of the Montreal refineries of the Imperial Oil Company, has been technical adviser to the Departments of Munitions and Supply and National Defence since the outbreak of war.

**Frank L. Mitchell, M.E.I.C.,** operating manager of the Alliance Paper Mills Ltd., at Merriton, Ont., has been appointed technical adviser to the pulp and paper administration of the Wartime Prices and Trade Board. Born in Jamaica, West Indies, Mr. Mitchell came to Canada in 1912 and studied engineering at the University of Toronto. He was graduated in chemical engineering from McGill University in 1921. Since then he has had extensive experience in the technical and managerial field of the pulp and paper industry.

**W. G. McBride, M.E.I.C.,** head of the department of mining engineering and metallurgy at McGill University, has been appointed a member of the advisory committee to co-operate with G. C. Bateman, metals controller of the Department of Munitions and Supply.

**R. A. Strong, M.E.I.C.,** has been appointed director of the Munitions Contract Branch of the Department of Munitions and Supply. He had been consultant to the contracts branch since early in 1940 when he was loaned to the Department of Munitions and Supply by the Bureau of Mines of the Department of Mines and Resources.

**C. M. Gibson, M.E.I.C.,** has recently joined the staff of the R. F. Walsh Co. Ltd., Montreal, as chief engineer of the Lithcote Division. Born in Farnham, Que., Mr. Gibson started his engineering career with MacKinnon-Holmes Steel Co., Ltd., Sherbrooke, Que., as a structural steel detailer. From 1915 to 1932 he was with the Canada Cement Company Ltd., Montreal, and was engaged on general plant engineering. In 1933 he joined the staff of Jeffrey Manufacturing Co. Ltd., Montreal, as sales engineer. Since 1938 he had been with Link-Belt Ltd., at Toronto and Montreal.

**D. G. Geiger, M.E.I.C.,** transmission engineer, western area, Bell Telephone Company of Canada, has been re-elected a member of the Council of Queen's University for a six-year period. The chief function of the Council is to act in an advisory capacity to the administrative organizations of the University.

**O. W. Ellis, M.E.I.C.,** director of the department of engineering and metallurgy, Ontario Research Foundation, Toronto, was elected president of the Affiliated Engineering and Allied Societies of Ontario at the annual meeting of the Council held in Hart House, University of Toronto, on April 28th. Mr. Ellis had served previously as vice-president.

**Professor E. A. Allent, M.E.I.C.,** department of mechanical engineering, University of Toronto, has been elected vice-president of Affiliated Engineering and Allied Societies of Ontario.

**P. E. Doncaster, M.E.I.C.,** has been representing the Government interests since March 1st on the Dominion Magnesium Ltd. project near Renfrew, Ont. Mr. Doncaster is district engineer for the Department of Public Works of Canada at Fort William, Ont., and is a past councillor of the Institute.

**H. B. Stuart, M.E.I.C.,** who had been located in Toronto, lately has moved to Montreal with the intention of continuing a consulting practice in this city. Mr. Stuart is retired from the Canadian National Railways.

**A. R. Moffat, M.E.I.C.,** is now employed as reconnaissance engineer in the Naval service of the Department of National Defence at Halifax, N.S. Lately he had been employed with H. G. Acres Company at Kenogami, Que. Previously he was chief surveyor with Lamaque Gold Mines Ltd., Bourlamaque, Que.

**J. G. D'Aoust, M.E.I.C.,** has left his position with Consolidated Paper Corporation at Port Alfred, Que., to join the staff of Price Bros. & Co. Ltd., at Riverbend, Que. He had been employed for several years with Powell River Company Limited, at Powell River, B.C.

**B. G. Flaherty**, M.E.I.C., formerly chief engineer of Consolidated Marine Companies Ltd., and later of Marine Industries Ltd., Montreal, has been with Aluminum Company of Canada Ltd., since last February and has been travelling on the Carribean Sea.

**G. J. T. Gunn**, M.E.I.C., is employed with the James Stewart Associates Company, Inc., at Trinidad, B.W.I.

**John A. Ferrier**, Jr.E.I.C., formerly of the engineering department of the Ford Motor Company at Windsor, Ont., has been commissioned as a lieutenant in the special branch of the R.C.N.V.R. and has taken up duties at Halifax.

**John Kazakoff**, Jr.E.I.C., has now returned to Canada after four years spent in La Paz, Bolivia, with the Bolivian Power Company a subsidiary of Montreal Engineering Company Limited.

**Paul MacNeil**, Jr.E.I.C., is now residing in Arvida, Que., where he is employed by the Aluminum Company of Canada, Limited. He graduated from the Nova Scotia Technical College in the class of 1936. He was employed at Sydney and Glace Bay, N.S., with the Dominion Steel and Coal Corporation until early in 1940 when he came to Montreal to work in the mechanical department of the Steel Company of Canada.

**Jean Asselin**, M.E.I.C., has been appointed city manager at Three Rivers, Que. Upon his graduation from Ecole



**Jean Asselin, M.E.I.C.**

Polytechnique in 1929, he joined the staff of Frederick B. Brown, consulting engineer, Montreal, and was engaged in field and office work until 1932 when he went with the Quebec Streams Commission, Montreal. In 1934 he was appointed city engineer and manager at La Tuque, Que., a position which he occupied until his recent appointment.

**John F. Davis**, S.E.I.C., who was graduated in electrical engineering from McGill University this spring is now employed in the radio branch of the National Research Council at Ottawa. Mr. Davis was the recipient of the Engineering Institute of Canada Prize at McGill last year.

**L. F. Giaque**, S.E.I.C., has joined the staff of B. Greening Wire Company Ltd., at Hamilton, Ont. He was graduated in mechanical engineering this spring from the University of Saskatchewan.

**J. G. Pierce**, S.E.I.C., has been commissioned as a second lieutenant in the Royal Canadian Engineers and is at present stationed at Petawawa, Ont. He had been employed with Falconbridge Nickel Mines at Falconbridge, Ont., since his graduation from Queen's University in 1941.

**W. R. Staples**, S.E.I.C., has joined the staff of Dominion Engineering Works at Lachine, Que., and is employed in the hydraulic department. He was graduated this year from the University of Saskatchewan with the degree of B.Sc.



This photograph is of particular interest to members of the Institute. It shows Brigadier J. E. Genet, M.E.I.C., Chief Special Officer, Canadian Army, addressing employees of the Northern Electric plant in Montreal. On his left are P. F. Sise, M.E.I.C., president of the company, C. A. Peachey, M.E.I.C., works manager and A. B. Hunt, M.E.I.C., manager, special products division of the company.

**L. C. Turner**, S.E.I.C., has been commissioned as a sub-lieutenant in the R.C.N.V.R., and is stationed at Esquimalt, B.C. He was graduated in mechanical engineering from the University of Saskatchewan this spring.

**Paul A. Verdier**, S.E.I.C., who has lately been employed in the engineering department of Aluminum Company of Canada, has received his commission as sub-lieutenant in the R.C.N.V.R.

#### VISITORS TO HEADQUARTERS

**Roland Saint-Pierre**, M.E.I.C., division engineer, Roads Department, Beauceville, Que., on May 28th.

**John Kazakoff**, Jr.E.I.C., superintendent, Bolivian Power Company, Limited, La Paz, Bolivia, S.A., on May 28th.

**Y. R. Anderson**, M.E.I.C., ceramic engineer, The Cooksville Company, Limited, Toronto, Ont., on May 28th.

**Marcel Lamoureux**, M.E.I.C., district engineer, Department of Transport, Parry Sound, Ont., on May 29th.

**R. Donald McKay**, M.E.I.C., engineer, Department of Public Health, Halifax, N.S., on May 29th.

**Donald Ross**, M.E.I.C., Foundation Company, Mont Laurier, Que., on May 30th.

**C. C. Kirby**, M.E.I.C., secretary, Association of Professional Engineers of New Brunswick, Saint John, N.B., on June 1st.

**Fred R. Duncan**, S.E.I.C., Toronto, Ont., on June 2nd.

**A. D. Creer**, M.E.I.C., registrar, Association of Professional Engineers of British Columbia, Vancouver, B.C., on June 4th.

**W. B. Haselton**, S.E.I.C., Beebe, Que., on June 4th.

**G. L. Dickson**, M.E.I.C., engineer, Canadian National Railways, Moncton, N.B., on June 12th.

**A. Peebles**, M.E.I.C., Department of Civil Engineering, University of British Columbia, Vancouver, B.C., on June 19th.

**A. B. Rossetti**, S.E.I.C., Sydney, N.S., on June 19th.

**K. M. Cameron**, M.E.I.C., chief engineer, Department of Public Works, Ottawa, Ont., on June 20th.

# Obituaries

*The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.*

**Lieut.-Colonel William Edward Andrewes, M.E.I.C.**, was killed last month in a traffic accident in England, while on active service. He had recently been promoted to Lieut.-Colonel and had assumed command of the 4th Regiment, Royal Canadian Engineers.

Born at Beamsville, Ont., on October 28th, 1902, he was educated at the local public school and at the Lake Lodge School at Grimsby, Ont.; then he went to the Royal Military College at Kingston where he received his diploma in 1924. He attended McGill University during the 1926-27 session and received his degree of B.Sc. in civil engineering in 1927. From 1927 to 1929 he attended courses at the School of Military Training, Chatham, England. Returning to Canada in 1929, he became an instructor at the Royal

Canadian School of Military Training at Halifax, N.S., and later was employed on engineer services and works in the district.

For some time in 1933 he was acting district engineer officer of M.D. No. 3 at Kingston, Ont. From 1934 to 1935 he occupied the same position in M.D. No. 2 at Toronto. He was appointed district engineer officer of M.D. No. 1 at London, Ont., in 1935.

At the outbreak of war he was stationed for some time at Petawawa, and Camp Borden and he went overseas in December, 1940. He attended Khaki College in England and was later attached to Canadian Military Headquarters in London. Early this year he was assigned as a major to the 2nd Field Company, R.C.E., and a few weeks ago he was promoted to the post which he occupied at the time of his tragic death.

Colonel Andrewes joined the Institute as a Junior in 1930. He was transferred to Associate Member in 1937 and became a Member in 1940.

## News of the Branches

### BORDER CITIES BRANCH

J. B. DOWLER, M.E.I.C. - *Secretary-Treasurer*  
W. R. STICKNEY, M.E.I.C. - *Branch News Editor*

Mr. A. E. Davison, transmission engineer with the Hydro Electric Power Commission, was the guest speaker at the monthly dinner meeting of the branch held in the Prince Edward Hotel on April 10th. He was introduced by Mr. A. H. McQuarrie, and spoke on **220,000-Volt Lines in Ontario—1941**, illustrating his paper with slides and films.

The principal problem of the transmission engineer is to keep electricity from escaping from the wires. Lightning troubles are the most prolific source of outages on transmission lines, but mechanical characteristics of the line are extremely important. Because they are continuously exposed to the elements, the fatigue problem becomes of prime consideration, and if the aluminum, copper and steel portions of a transmission line are not kept within recognized endurance limits, it is only a matter of time till incipient failures are evident.

Fatiguing comes from two sources, a small, continuous aeolian vibration and a dancing or galloping vibration which is less frequent but more strenuous. The latter is due to the effect of wind on ice coatings on the conductors.

Steel grillages are generally used for anchoring steel transmission towers to earth. These were formerly set by templates while backfilling was being done, but recently an alternative method of setting each leg and grillage independently by using a surveyor's instrument and reference stakes has been found more accurate and economical.

Films were then shown of methods of setting grillages and bases, also of erection of towers using horses and gin poles. Details of the stringing and splicing of conductors and installation of so called shock absorbers were shown on slides, as well as the effect of frost on footings. A moving picture film was then given showing the erection of a wood pole line in northern Ontario during winter, and the various problems encountered in setting footings and stringing conductors.

After an interesting discussion period, a vote of thanks was moved by Mr. S. E. McGorman and the meeting adjourned.

The May meeting was held on Friday, May 22nd in the Prince Edward Hotel. Mr. W. H. Furlong, K.C., chairman of the Sandwich, Windsor and Amherstburg Railway Com-

### Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

pany, and transportation controller of the Windsor Civilian Defence Committee, spoke on Canada's war effort as shared by the S.W. & A. Railway Company.

He gave first a brief history of the company since his appointment as chairman in 1938. The existing equipment was out of date, wires and tracks were badly worn and it was found, on investigation, that the operating and maintenance costs were more than the returns. To remedy this the fares were raised and new vehicles purchased which would operate at a lower cost. Before purchasing these a careful study of other transportation systems was made, and after consultation with the American Transit Association and Mr. W. R. Campbell of the Ford Motor Company, four buses were purchased and put on the Amherstburg line. These were carefully checked for two weeks and found to be satisfactory. More buses were purchased, and daily records of all passengers carried on every line at all times of the day were kept. This led to the establishment of a time table giving economical operation and efficient service.

The maintenance and repair of buses was difficult at first as there was no proper building for this nor men to do the work. Qualified motor mechanics were hired, tracks ripped up, buildings rearranged, lights, heating systems and modern machinery installed. A service department was set up which allows straight line service from terminal to garage, to gas and air pumps, to wash racks to street. Buses are checked over every night and washed inside and out. The walls of tires are whitewashed to prevent drivers from scraping curbs. Last but not least the drivers are urged to be courteous and helpful, as it is really they who sell the transportation for the company.

As regards the war effort, the S.W. & A. Railway Company have now assumed the obligation of carrying thousands of passengers to their daily work in essential war industries. Recently, to save gas and rubber, alternate stops on several main routes have been eliminated which on one route alone has resulted in about fifteen percent saving in gasoline.

Due to the increase in passengers being carried to essential war industries, at the instigation of the Transit Controller, an attempt was made to stagger working hours and avoid capital expenditure of buying more buses. The large automobile companies in the city have co-operated splendidly in this matter, and as a result, the S.W. & A. Railway Company have been able to save seven buses which other-

wise would have been required at on- and off-shift hours, and the plan is still uncompleted.

In cases of blitz when evacuation of the city would be necessary, the company now has over one hundred buses which could completely move the population of Windsor out of the city in thirty-six hours. With the street railway system this would have been impossible. There are also many cars, trucks and smaller buses strategically located in the city to aid as ambulances, etc., in cases of air raids.

In conclusion, Mr. Furlong proudly stated that many cities in both Canada and the United States have sent representatives enquiring about the success of our transportation system, and are considering the installation of a system patterned on exactly the same lines as the S.W. & A. Railway Company.

Mr. Furlong was introduced by Mr. G. Medlar and was heartily thanked for his interesting address by Mr. C. G. R. Armstrong.

### HAMILTON BRANCH

A. R. HANNAFORD, M.E.I.C. - *Secretary-Treasurer*  
W. E. BROWN, J.E.I.C. - *Branch News Editor*

On Tuesday evening, May 5th, members of the Hamilton Branch and visitors had the privilege of hearing Dr. L. M. Pidgeon speak on **Magnesium, Lightest Commercial Metal**. The meeting was held in the Lecture Theatre, McMaster University, and the attendance was 75.

Dr. Pidgeon is metallurgist for the new Dominion Magnesium Company, located at Haleys. The speaker, who is outstanding in the world of magnesium, prefaced his talk with a brief history of metals, dividing it into three parts. First; when only "native metals" were available, i.e., those found in nature as a metal, not ore. Platinum and gold come under such a heading and are soft and heavy.

The second phase came when the art of smelting was discovered. This resulted in the industrial world, as we know it to-day, enabling us to build steel structures, locomotives, etc. Such metals are heavy and strong. The third, and present epoch, surrounds the subject matter of the paper, i.e., metals that are strong and light.

The speaker pointed out that aluminium is relatively heavy when compared to magnesium; the densities being 2.7 and 1.7, respectively, and that because of this, members of a structure may be massively designed and thus have a high rigidity, in fact magnesium structures weight for weight are the most rigid of any metal. Generally speaking, magnesium is not pure, but in the form of an alloy with aluminium. The alloys run from 90 per cent to 98 per cent magnesium, the balance being aluminium with up to 3 per cent zinc and about 1.5 manganese. The alloying is carried out in crucibles, using a flux on top to prevent burning of the metal. In considering some of the metal's properties, burning was mentioned because as a powder it is very dangerous but in pieces such as form part of a machine it is perfectly safe. In a thermite bomb it burns readily after the thermite melts it. The metal is produced in several ways, depending upon what magnesium deposits are found in the district.

In the state of Nevada, U.S.A., the oxide is used which is treated with chlorine to form magnesium chloride which in turn is electrolysed to produce the metal. Sea water is also utilized, the magnesium chloride present being the source. In Canada large deposits of dolomite which is a type of limestone containing about 50 per cent magnesium carbonate, are utilized. The stone is first calcined to produce oxide which is then treated with a reducing agent to produce the metallic vapour, which is colled and collected. Research in various reducing agents has been one of the main phases of the work carried on by Dr. Pidgeon and his efforts have been rewarded with considerable success.

A very lively discussion followed the lecture.

The speaker, who had been introduced by Norman Eager,

was accorded a very hearty vote of thanks by Harold Cooch. In closing the meeting the chairman, Stanley Shupe, paid special tribute to the speaker for his informative address.

### KINGSTON BRANCH

J. B. BATY, M.E.I.C. - - *Secretary-Treasurer*

A very interesting address on **Aircraft-in-War** was given by Wing-Commander Morgan Keddie of the Norman Rogers Air-Training School at a branch meeting held at the Badminton Club, on March 20th.

Commander Keddie began his address with a discussion of the forces acting on an aircraft. He emphasized that the resultant from the total lift and the total drag are, to a certain extent, concepts in the mind of the aeronautical engineer and cannot be said to exist at any one place. The actual forces are the innumerable pressures and suction forces distributed over the whole area of the wing and fuselage. The resultant force and consequently, the lift and drag components are to be regarded chiefly as convenient ways of representing the aggregation of very small individual forces. The speaker differentiated between the induced drag which always accompanies the lift and the parasite drags on the airplane.

The lift which must equal the weight of the machine for static equilibrium is the product of the air density, the wing area, the velocity relative to the air squared and the coefficient of lift. The relationship among these quantities was very clearly explained and deductions made therefrom. Wing loading and engine horse power for the necessary thrust to maintain the lift required with heavy bombers was considered by the speaker. Commander Keddie predicted that the aircraft of the future, particularly fighter aircraft, would have engines approaching 2000 hp. each.

The speaker explained the outstanding details of propeller design and the characteristics of certain types. An airplane air-screw, using the name the speaker preferred (whereas the military authorities insist on its being called a propeller), at a given altitude, forward speed and pitch setting, absorbs power very nearly in proportion to the cube of its r.p.m. The intersection of the rated-power curve and the propeller-power curve gives the speed at which the combination will run at rated engine power to good advantage. The propeller is selected so that it will absorb the rated engine power at normal r.p.m. in level flight. Changing the speed by climbing or diving will move the propeller curve to the left or right and will alter the maximum engine speed at rated horse power accordingly.

The speaker gave descriptions of personal experience with propellers that failed to bite the air as an air-screw until certain speeds were attained. He explained that this was due to the blade angle and pitch being incorrect for the speed and power. This difficulty is eliminated by using controllable-pitch propellers. The propeller usually runs with this type at constant speed and the varying pitch takes care of the many variable factors involved. However, for purposes of design and aeronautical calculations pertaining to flight it is usual to use the curve of power required by a fixed-pitch propeller, and when this is plotted against engine speed the propeller-load curve is obtained. Though there is a slightly different propeller-load curve for each forward speed, the difference between the curves is slight, and since level flight is more usual, the propeller-load curve for normal level flight is the one generally used in airplane-engine power and fuel-consumption calculations.

After the formal address was completed, the meeting was given over to discussions and the answering of specific questions. These were many and varied. One question that was of interest was about the matter of using airplanes to spread poisonous gases over areas of country. The speaker explained that the airplane, according to his view, would not be used for this purpose to any extent, as it would be very inefficient and the results obtained would be insignificant.

## LONDON BRANCH

H. G. STEAD, J.E.I.C. - *Secretary-Treasurer*  
A. L. FURANNA, J.E.I.C. - *Branch News Editor*

On Thursday, May 21, the chairman of the Branch, Mr. F. T. Julian, presided over a complimentary dinner meeting to Mr. W. C. Miller, M.E.I.C. at the London Hunt and Country Club.

Mr. Miller is the city engineer of the city of St. Thomas, and was recently elected president of the Association of Professional Engineers of Ontario.

Following the dinner several speakers preceded Mr. Miller's address. Representing St. Thomas, Mr. Rowe, the city treasurer, and Alderman Curran, chairman of the Board of Works, both told of Mr. Miller's work in St. Thomas. Colonel I. Leonard, one of the first presidents of the Association of Professional Engineers of Ontario, gave an outline of the history of the Institute and the origin of the Association. Mr. J. A. Vance, a councillor of the Institute spoke of the ever increasing part engineers are playing in the war effort. Mr. H. F. Bennett summed up his tribute to Mr. Miller by saying that the London Branch honours itself in honouring Mr. Miller. The speaker was introduced by Mr. E. V. Buchanan.

Mr. Miller's chosen subject was **A Philosophy of Engineering.**

Opening his address the speaker showed how, in spite of the fact that men are daily reaping the harvest of the engineers' efforts, they fail to recognize in engineering, the personal man to man relationships which they readily see in the other professions. Even great engineers of our own time such as Harry Acres, designer of the Queenston Power Development, Professor Price who made it possible for us to have our electric clocks, and Col. Wm. J. Wilgus, designer of the New York Grand Central Station, receive little or no thought from those who enjoy the results of their labours.

What then has the engineer in common with other professions, or what right has his work to be raised to the dignity of a profession? The common bond is the great principle of trusteeship. Each is entrusted with the great values of our lives, even life itself, and the only security that he demands of his trusteeship is his professional integrity.

The desired recompense from any job is the fundamentals of life. But we may be thankful that there are other great satisfactions from the practice of engineering, far surpassing the pay cheque, which makes the difference between a laborious effort and a happy accomplishment.

The first of these is experienced at the conclusion of any job we do. We see traffic moving smoothly and rapidly over a newly channelized highway intersection we have designed. Or we watch a street lighting system come on for the first time. The joy of creative effort is one the engineer shares with the artist.

Another of the great rewards of the engineer is the abiding mental satisfaction in solving a complex problem.

The engineer is very keen for the rendering of that kind of service to mankind which expresses itself not so much in words, as in deeds. The definite consciousness that his work is making a positive contribution to mankind in helping to create a new order, is the third great satisfaction of the engineer.

The employer or client entrusts his wealth, his very life to the engineer. The appreciation of this responsibility of exalted trust, is characteristic of the profession, and is the fourth great satisfaction of engineering.

Mr. Miller's philosophy of engineering is best summarized in his own verses "The Road Builder".

I've never wished to sit aloof  
In a cottage by the roadside bare  
And watch the race of men go by  
Toiling and stumbling with their care.

I wish to be a friend to man  
But not in a quiescent mood  
To rest myself while others toil  
Along the dry and dusty road.

A helpful and kindly word  
Is good, and man, since time began  
Has been encouraged on his way  
By kindly word from brother man.

But words cannot compare with deeds  
When man is chafing at his goad.  
A helping hand is better far,  
Than ready tongue when dragging load.

So, I will build a highway broad  
And straight and level, where men ride  
From town and hamlet carrying  
The commerce of the countryside.

Man's load will thereby be made light  
And I will help each toiler grim  
Along his way by building roads  
That ease the path of life for him.

## NIAGARA PENINSULA BRANCH

J. H. INGS, M.E.I.C. - *Secretary-Treasurer*  
C. G. CLINE, M.E.I.C. - *Branch News Editor*

The annual meeting of the Niagara Peninsula Branch was held at the Leonard Hotel, St. Catharines, on May 21st. Mr. A. L. McPhail, branch chairman, presided and there was an attendance of 75. The members of the Branch Executive Committee, elected by the recent ballot, were introduced by the secretary. Appointments by the committee for the coming year were: Chairman, C. G. Cline; Vice-Chairman, G. E. Griffiths; Secretary, J. H. Ings. The guest speaker, Dean C. R. Young, president of the Institute, was then introduced by the chairman. After a few preliminary remarks about his recent trip to the Western Branches and about the affairs of the Institute in general, the President proceeded to speak generally on **The Engineer and the War.**

This is a war of the engineer and the scientist. For every fighting man at the front, it takes 18 persons to furnish him with the necessary supplies. The demand for technically-trained men is very great; by the end of 1943 several thousand additional engineers and technologists will be required. To meet this demand, it will be necessary to take engineers from non-essential industries and to draw back into the profession engineers who have drifted into other lines of work. Students will be graduating each year from our engineering faculties, but undergraduates in engineering should not be drafted into industry until they have completed their courses. In addition, it may be necessary to train men in short, special courses for particular lines of work.

The engineer is in demand during this war because of his special technical qualifications and also because he has been trained to clear thinking and exact measurement. In this war, industry must be as fluid as the battlefield. It requires engineers who can adapt themselves to frequent changes in design and who have sufficient imagination to think out new methods of increasing production and of improving the finished product. Engineers are filling important positions both in the armed forces and in industry. Of 3,500 graduates of the University of Toronto in the armed forces, 19 per cent are from the Faculty of Applied Science and Engineering, whereas engineers form only about 10 per cent of the total adult male population of comparable educational qualifications. A large number of Institute members are serving in the armed forces, including the Commander of the Canadian Army overseas and some of his most distinguished officers; many are in ordnance, the engineers, signals, the airplane detection service

and in the navy. At home, the engineer is found in war industry and in normal industry, in the public service and in vital research work. Thus the engineering profession is playing an important part in Canada's war effort, both at home and abroad. Truly, as Pythagoras said, "In the theatre of man's life, it is given only to God and the angels to be lookers-on."

The Institute, as a body, is also contributing to the war effort. The secretary, Mr. L. Austin Wright, has been loaned to the Wartime Bureau of Technical Personnel and later to National Selective Service to act as executive assistant to the director, Mr. E. M. Little. The Institute has interested itself in the engineering features of civilian defence and has sponsored courses of lectures on this subject by Professor Webster. Members of the Institute are taking an active part in the work of the sub-committee on Post-war Re-construction Projects, of which Vice-President K. M. Cameron is chairman. Mr. Wills Maclachlan is the chairman of an Institute committee recently set up by Council to study Industrial Relations, a matter of particular import in time of war and in the years following it.

The Engineering Institute of Canada is a comprehensive organization of engineers, respected and highly regarded by professional men throughout Canada. It fathered the provincial Associations of Professional Engineers and continues to back them up. However, there is still plenty of work to be done by the parent organization. As Col. Willard Chevalier has said, "There is more in the professional relationship than anything you can write into a statute." The professional man should have a broad education, catholic sympathies, should be devoted to the public welfare and should be able to appear in any society and to represent any cause with credit. The greatest contribution the Institute could make would be to foster this ideal among the members of the engineering profession in Canada.

A vote of thanks to the speaker was proposed by past-president A. J. Grant. The concluding feature of the programme was a showing of the moving pictures of the collapse of the Tacoma bridge.

### PETERBOROUGH BRANCH

A. R. JONES, J.E.I.C. - - Secretary-Treasurer  
J. F. OSBORN, S.E.I.C. - - Branch News Editor

The Peterborough Branch held its annual meeting at the Kawartha Golf and Country Club on May 20th, at which 34 members were present. Preceding the business meeting in the evening, the members participated in golf matches, and after the business meeting three motion and sound films were shown, followed by refreshments.

The following Executive was elected for the coming year:

C. R. Whittemore	D. J. Emery
F. R. Pope	A. J. Girdwood
I. F. McRae	J. Cameron (Ex-Officio)
R. L. Dobbin	H. R. Sills (Ex-Officio)

At an Executive meeting held on June 4th, the following members were elected for the coming season:

Chairman: D. J. Emery.  
Secretary-Treasurer: A. R. Jones.  
Meetings and Papers Committee: A. J. Girdwood.  
Social and Entertainment Committee: J. Cameron.  
Membership and Attendance Committee: A. L. Malby.  
Branch News Editor: J. F. Osborn.  
Branch Auditor: E. R. Shirley.  
Representative on Nominating Committee: W. T. Fanjoy.  
Students' Guidance and Counselling Committee: G. R. Langley.  
Committee on Post-War Problems: G. R. Langley.

### SAGUENAY BRANCH

D. S. ESTABROOKS, M.E.I.C. - Secretary-Treasurer  
J. B. D'AOUST, M.E.I.C. - Branch News Editor

A meeting of the Saguenay Branch of the Institute was held in the Protestant school at Arvida on the evening of May 18th.

It was the privilege of the members, on this occasion, to hear an address by Professor F. Webster, deputy chief engineer, of the Ministry of Home Security, London, England, on the subject of **Air Raid Shelters**. Professor Webster is considered one of the foremost authorities on the subject of air raid shelters for protection against high explosive bombs.

The various types of bombs used by the Germans in their raids on England were described and their characteristics discussed. This was followed by a detailed account of the experiments with various types of shelters and the evolution of the most satisfactory designs—work which was seriously hampered by the shortage, at that time, of the most commonly used structural materials.

The effects of bombs on structures, as discussed by Professor Webster, was very well illustrated by a film, after which the speaker answered a number of questions raised by the members. It was reassuring to Canadians to learn that the frame house common in this country could be expected to stand up comparatively well under a bombing raid and that the injuries and loss of life due to falling debris would in all probability be small as compared to that experienced in England.

Mr. N. F. McCaghey, branch chairman, called upon Mr. S. J. Fisher to express the thanks and appreciation of the members present to Professor Webster for his most interesting address.

### SAINT JOHN BRANCH

G. W. GRIFFIN, M.E.I.C. - Secretary-Treasurer

The Saint John Branch tendered a luncheon on the 22nd May at the Admiral Beatty Hotel, Saint John, to the Dominion Council of the Association of Professional Engineers of Canada on the initial day of their recent visit to New Brunswick. Thirty-three members of the branch attended.

The visit was the result of an invitation extended by the New Brunswick Association in October, 1940, to the Dominion Council that they hold their 1942 annual meeting in this province.

D. R. Smith, chairman of the branch, presided at the luncheon and other speakers were D. A. R. McCannel, M.E.I.C., of Regina, and W. H. Golding, president and councillor of the Association of Professional Engineers.

A report of the year's activities was delivered by President McCannel. He noted that the work of the Association was most important, particularly in war-time. He felt that the war presented a challenge to the Council in that "we must take our place in aiding with post-war problems."

Among those present at the luncheon were F. W. MacNiell, A. D. Creer, Vancouver; J. B. deHart, Calgary; P. Burke-Gaffney, Winnipeg; W. P. Dobson, Major M. Barry Watson, Toronto; C. L. Dufort, Montreal; F. W. W. Doane, Halifax; Professor E. O. Turner, W. J. Lawson, Fredericton; G. L. Dickson, A. R. Bennett, T. H. Dickson, Moncton; and J. M. M. Lamb and C. C. Kirby, Saint John.

### VANCOUVER BRANCH

P. B. STROYAN, M.E.I.C. - Secretary-Treasurer  
A. PEEBLES, M.E.I.C. - Branch News Editor

The Vancouver Branch concluded a particularly successful programme at a meeting on May 27th, in the Medical-Dental Building, when Professor Frank Forward, professor of metallurgy at the University of British Columbia, spoke on **Metallurgical Progress in the War**.

The measure of our future success depends upon those working on advances in technical knowledge. "The spirit of an age must not be judged on the finality of its achievement, but on the seriousness of its effort."

Metallurgy was an art up to the end of the last century, before which it had advanced but slowly, depending upon the wisdom of plant operators rather than upon any serious attempts to discover new methods or to improve processes. Such men as did carry on research work received little co-operation from those in the operation field and each tended to deprecate the efforts of the other. After 1870, there was a gradual change in which scientific research began to play a more important part in the direction of metallurgical processes, and a number of notable improvements came into use. One of the first great scientists in this field was Charles Benjamin Dudley, who set up chemical analysis specifications for metal products purchased by the Pennsylvania Railroad. These were soon copied by other railroads and later adopted by the steel manufacturers themselves. Andrew Carnegie enlisted scientific research in his steel mills, as did other operators, but progress was slow, and in 1890 the United States Steel Company employed only one research metallurgist.

More rapid progress was made in non-ferrous metals than in the iron and steel industry. In the early part of this century, chloride processes, flotation, and chemical composition were introduced. During the last war, very rapid developments took place in all branches of the field of metallurgy. Dural was discovered, and the electrolytic process for zinc and nickel were put into practice. Alloy steels were required for war purposes and by the end of the war, their production was on a thoroughly scientific basis. Efficiency and output increased very rapidly, and the quality of carbon steels improved tremendously. Alloyed and stainless steels were made available, and controlled grain size was made standard production practice. Soon after 1930 the continuous strip mill was developed, which

greatly increased the output of sheet steel for automobiles and many other products. The average life of steel products was increased by more than 100 per cent. The Bessemer process, which had remained rather stationary after the introduction of the open hearth furnace, was developed and brought under scientific control.

In the non-ferrous field the purity of metals was greatly increased, an important factor since extremely small amounts of impurities have pronounced effects upon the physical properties of metals.

In the present war the necessity has arisen to produce some metals no longer available, as a result of loss of imports and the increased demands. A limited amount of tin is being produced in British Columbia and low grade tungsten is being refined by new processes. Magnesium is now being made in several different ways to meet the tremendous demand for this metal. The expansion in the aluminum industry is well known. Electric furnace steel is being made in larger quantities for work requiring high quality control. Silver is being used as a tin substitute in many cases. Boron steels are being used, and carbide tools are playing a large part in the machining of parts. Induction heating, or a means of localized heat treatment is now quite common. Powdered iron is now used, eliminating much machine work, and resulting in a product of pure iron. The present trend in steel metallurgy is the improvement of hardenability, and good results are being achieved in steel and alloy metals.

There is still plenty of room for further knowledge in the field of metallurgy, and in several new phases which have recently been opened up. The chief gain in recent decades is that complete co-operation between the scientist and the operating engineer has been achieved.

The meeting was under the chairmanship of W. O. Scott, branch chairman, and closed with a vote of thanks proposed by P. Buchan.

## Library Notes

### NEW C.E.S.A. SPECIFICATIONS

The Canadian Engineering Standards Association has recently issued the following new standards:

#### A23 Concrete and Reinforced Concrete. 2nd ed.

*The first edition of this specification was published in 1929 and the second edition has been revised extensively to take cognizance of the many developments that have taken place in concrete and reinforced concrete construction since the first edition was published. This specification is intended to cover the use of concrete and reinforced concrete in general. In such structures as arches, tanks, reservoirs, chimneys, etc., where specialization relates principally to the mechanics of design and details of construction, the general provisions of the specification may be applied with the modifications necessary to suit the special conditions. An extensive cross-reference index has been added for the convenience of the users of this specification. \$1.00 per copy.*

#### A72T Alkali Sulphate Resisting Cement

*This specification covers alkali sulphate resisting cement which is a modified Portland cement that resists to a considerable degree, the deteriorating action of alkali sulphate on concrete. This specification is published in tentative (mimeographed) form to provide for trial in the field prior to future publication as a formally adopted CESA standard. \$0.50 per copy.*

### Book notes, Additions to the Library of the Engineering Institute, Reviews of New Books and Publications

#### C22.2 CESA Electrical Standards. Part 11 of the Canadian Electrical Code No. 14 Industrial Control Equipment for Use in Ordinary (non-hazardous) Locations. 2nd edition.

*This specification applies to control and protective devices for electric motors and for industrial-heating apparatus, for potentials up to and including 2500 volts between conductors on ungrounded systems and 4500 volts between conductors on grounded-neutral systems, and intended to be employed in accordance with the Rules of Part 1 of the Canadian Electrical Code. Equipment for higher voltages shall be made the subject of special investigation. Fuses, circuit-breakers, snap switches, and transformers will only be judged under this specification in relation to their assembly as part of a control appliance. Individually they shall conform to the particular specification covering the type of device to which they belong. It should be noted that electrical instruments, such as meters, which may be mounted along with control apparatus as part of control equipment, are not covered by this specification. \$0.50 per copy.*

#### No. 42 Receptacles, Plugs and Similar Wiring Devices. 2nd edition.

*This specification is intended to apply to: 1. Attachment-plugs (caps and adapters) cord connectors, motor attachment-plugs*

*and current taps, rated at 20 amperes and less, at 250 volts and less, designed to be employed in accordance with the rules of Part 1 of the Canadian Electrical Code. 2. Receptacles and plugs rated at 200 amperes and less at 750 volts and less designed to be employed in accordance with the rules of Part 1 of the Canadian Electrical Code.*

*It should be noted that lampholders and pull-off plugs for electrothermal appliances are not included in this specification. \$0.50 per copy.*

Copies of these standards may be obtained from the Canadian Engineering Standards Association, National Research Building, Ottawa.

### ADDITIONS TO THE LIBRARY TECHNICAL BOOKS

#### Industrial Statistics:

*H. A. Freeman. N.Y., John Wiley and Sons, Inc., 1942. 6 x 9 in., \$2.50.*

#### Electric Motors in Industry:

*D. R. Shoults and C. J. Rife. Edited by T. C. Johnson. N.Y., John Wiley and Sons, Inc., 1942. General Electric Series. 6 x 9 1/4 in., \$4.00.*

**Engineering Drawing and Mechanism:**

Harold J. Brodie. N.Y., Harper and Brothers Publishers (c. 1942). Rochester Technical Series. 8½ x 11 in., \$2.25.

**Bibliography on Circuit-Interrupting Devices 1928-1940:**

American Institute of Electrical Engineers, Committee on Protective Devices, N.Y., 1942. 26 p., \$0.80.

**Canadian Engineering Standards Association:**

Canadian Electrical Code pt. 2, Essential requirements and minimum standards covering electrical equipment. C22.2 No. 3, Construction and test of electrical equipment for oil-burning apparatus 2nd ed.—No. 64, Construction and test of cooking and liquid-heating appliances (domestic and commercial types)—No. 72, Construction and test of heating and heater elements replacement types.

**PROCEEDINGS, TRANSACTIONS****American Institute of Consulting Engineers:**

Proceedings of the annual meeting held January 19, 1942.

**The Institution of Mechanical Engineers:**

Proceedings July-December 1941. Vol. 146.

**University of Toronto—Engineering Society:**

Transactions and year book 1942.

**REPORTS****Association of Professional Engineers of Nova Scotia:**

Year Book 1941.

**Canada. Department of Labour:**

Report for the fiscal year ending March 31, 1941.

**Canada. National Harbours Board:**

Report for the calendar year 1941.

**Australia. Council for Scientific and Industrial Research. Bulletin No. 145:**

Friction and lubrication, report No. 1.—Part 1: The theory of metallic friction and the role of shearing and ploughing.—Part 2: The friction of thin metallic films.

**Alberta. Department of Lands and Mines:**

Report for the fiscal year ended March 31, 1940 and for the year ended March 31, 1941.

**U.S. Bureau of Standards. Building Materials and Structures Report No. 81:**

Field inspectors' check list for building construction.

**U.S. Bureau of Mines: Technical Papers:**

Collecting and examining subsurface samples of petroleum: No. 629—Technical and economic study of drying lignite and sub-bituminous coal by the fleissner process: No. 633—Design of air-blast meter and calibrating equipment: No. 635—Production of explosives in the United States during the calendar year 1940: No. 636—Index of coals tested in the Bureau of Mines survey of carbonizing properties of American coals: No. 637—Coke-oven accidents in the United States during the calendar year 1940: No. 640.

**Cornell University—Engineering Experiment Station: Bulletin:**

The buckling of compressed bars by torsion and flexure: No. 27—Flexural-torsional buckling of bars of open section: No. 28.

**University of Minnesota—Engineering Experiment Station—Bulletin:**

Pulp paper and insulation mill waste analysis. No. 19.

**University of Minnesota. Engineering Experiment Station. Technical Papers:**

Lightning discharge investigation: No. 38—The effect of fine aggregate on the durability of mortars: No. 39—Effect of surface resistance on thermal conductivity by the hot plate method: No. 40.

**Bell Telephone System—Technical Publications:**

Improved ceramic dielectric materials.—Programme-operated level-governing amplifier.—Stereophonic sound-film system.—Trajectories of electrons in an arbitrary field.—Monographs No. 1325-1328.

**Bell Telephone Laboratories:**

Your voice and the telephone by Franklin L. Hunt: Feb. 1942.

**Electrochemical Society:**

The use of statistical control in corrosion and contact resistance studies:—Principles of microelectrophoresis cells: Conversion of magnesite to periclase: Preprints no. 81-26 to 81-28.

**Edison Electric Institute:**

Specification for strand-eye anchor rods approved by Transmission and distribution committee. TD—2, 1942.

**Low-Frequency Shielding in Telephone Cables:**

Joint subcommittee on development and research, Edison Electric Institute and Bell Telephone System. Engineering report No. 48.

**Bonneval, Henri A. de:**

Review of the direct-current compound generator as used aboard ship. Reprinted from Marine Engineering and Shipping Review, March 1942.

**The Use of Air-Locks:**

George Oswald Boulton. Reprinted from the Journal of the Institution of Engineers, Australia, Vol. 14, No. 1, January 1942.

**Aluminium Research Laboratories:****Technical Paper:**

Typical tensile and compressive stress-strain curves for aluminium alloy 24S-T, Alclad 24S-T, 24S-RT and alclad 24S-RT products. No. 6.

**AIR RAID PRECAUTION****What the Citizen Should Know about Civilian Defense:**

Walter D. Binger and Hilton H. Railey. N.Y., W. W. Norton and Co., Inc. (c. 1942). 5½ x 8 in. \$2.50.

**Ministry of Home Security—Research and Experiments Department. Bulletin:**

Shelter design by Professor J. F. Baker. No. 27.

**BOOK NOTES**

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet the books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

**ACID-BASE CATALYSIS**

By R. P. Bell. Oxford University Press, New York; Clarendon Press, Oxford, England, 1941. 211 pp., diags., charts, tables, 9 x 5½ in., cloth, \$3.50.

A general account of the phenomena of catalysis by acids and bases is presented in

this book. The earlier chapters contain a systematic description of the laws governing catalysis in aqueous solution, with special reference to the work of Brønsted on salt effects and general acid-base catalysis. After a section on non-aqueous solutions, the last part of the book deals with recent attempts to obtain a molecular picture of the mechanism of catalysed reactions and their bearing on modern theories of reaction kinetics.

**ALLOY CONSTRUCTIONAL STEELS**

By H. J. French and F. L. Laque. American Society for Metals, Cleveland, Ohio, 1942. 294 pp., illus., charts, tables, 9½ x 6 in., cloth, \$4.00.

Based on a series of lectures, this discussion of the utilization of alloys in constructional steels illustrates the importance of the alloy steels and is also intended to provide help in the selection of steels for different classes of service. Following a general survey of the subject of alloy steels, both unhardened and heat-treated, the author covers service at sub-atmospheric and elevated temperatures, wear, corrosion and special treatments. The methods of identification of S.A.E. and A.I.S.I. steels are explained.

**DRILL PRESS, Job Training Units SHAPER and PLANER, Job Training Units**

(Dunwoody Series Machine Shop Training Jobs). 103 pp.

(Dunwoody Series Machine Shop Training Jobs). 115 pp.

American Technical Society, Chicago, Ill., 1942. Illus., diags., charts, tables, 11 x 8½ in., paper, \$1.25 each.

As in previous volumes of this set of manuals for machine tool training, the material consists of instruction sheets for jobs covering the setting up and operation of various types of machines as in actual practice. The jobs are progressively more difficult, and each is accompanied by a check sheet containing questions to be answered by the learner. Each manual contains hints on blueprint reading.

**EMPLOYMENT TESTS in INDUSTRY and BUSINESS, a Selected, Annotated Bibliography. (Bibliographical Series No. 67)**

Prepared by H. C. Benjamin. Princeton University, Industrial Relations Section, Princeton, New Jersey, 1942. 32 pp., 9 x 6 in., paper, \$0.25.

To aid war industries and agencies in canvassing the possibilities of employment tests this selected, annotated bibliography of the best available literature in the field has been compiled. The two largest sections cover material concerning specific types of tests, and reports of company experience and of research in the use of tests.

**ENGINEERING DRAWING AND MECHANISM**

(Rochester Technical Series)

By H. J. Brodie. Harper & Brothers, New York and London, 1942. 241 pp., diags., charts, tables, 11 x 9 in., cloth, \$2.25.

This textbook is one of a series developed as part of a programme for developing practical teaching materials which will be closely related to the actual requirements of various jobs in industry. The two sections of this book provide a sound foundation in the general phases of mechanical drawing and in the drafting of cams, gears and mechanisms.

**Fairhurst Manual of HIGH EXPLOSIVES, INCENDIARIES and POISON GASES, for Home Defense Workers and Wardens**

By J. Fairhurst. Fairhurst Book Co., Greenfield, Mass., 1942. 110 pp., tables, 7½ x 5 in., paper, \$1.00.

This pamphlet is intended for wardens and laymen interested in civilian defence, for

whom it provides a simple, understandable description of various explosives, incendiaries and poison gases, with instructions as to methods of protection.

### FIRE PROTECTION IN REFINERIES 3 ed. 1941

*American Petroleum Institute, Division of Refining, 50 West 50th St., New York. 116 pp., illus., diagrs., charts, tables, 10½ x 8 in., paper, \$1.00.*

A comprehensive review is presented of the principles underlying adequate measures for fire prevention, control and extinguishment, with the emphasis on prevention. An appendix contains detailed information and tabular data illustrative of the manner in which these principles have been applied in some typical refineries.

### (The) FIRST CENTURY and a QUARTER of AMERICAN COAL INDUSTRY

*By H. N. Eavensen. (Privately printed, Koppers Bldg., Pittsburgh, Pa., composed and printed at the Waverly Press, Baltimore, Md.), 1942. 701 pp., tables, charts, maps, 10½ x 7 in., cloth, \$8.00.*

Compiled mainly from original documents, this comprehensive history of the American coal industry presents an authentic picture of its development. The bulk of the material is arranged by states, with a brief section on the very early history and a general summary. Direct quotations from many sources and reproductions of original maps preserve the feeling of the early periods. 160 pages are devoted to an extensive compilation of production statistics, and there is a large bibliography.

### FLUORESCENT LIGHTING MANUAL

*By C. L. Amick. McGraw-Hill Book Co., New York and London, 1942. 312 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$3.00.*

This practical manual gives authoritative information on the construction and performance of all types of fluorescent lamps, covers principles and methods of calculating illuminating requirements and designing luminaires, and furnishes methods and special pointers for installation and maintenance. Working data are given, and a comparison of the economic factors of fluorescent and incandescent lighting is included.

### FOUNDRY SAND CONTROL

*By H. W. Dietert. Great Lakes Foundry Sand Co., United Artists Bldg., Detroit, Mich., 1941. 54 pp., illus., charts, tables, 11 x 9 in., cardboard, \$4.00.*

This book is designed to provide the detailed information on core and molding sands which every foundry needs, and to act as a reliable guide to the precautions needed to prevent defects in castings, and to the methods of discovering their causes and applying corrections when defects occur. Complex relationships have been simplified by charts, graphs and formulae to facilitate finding and applying the information given.

### FOUR TREATISES OF THEOPHRASTUS VON HOHENHEIM CALLED PARACELSUS, translated from the original German, with introductory essays

*By C. L. Temkin, G. Rosen, G. Zilboorg and H. E. Sigerist. Johns Hopkins Press, Baltimore, 1941. 256 pp., illus., 9½ x 6 in., cloth, \$3.00.*

In commemoration of the four hundredth anniversary of the death of Paracelsus, these four works by the great Renaissance physician are presented in English translation. Of these treatises the second, "On the Miners' Sickness and Other Miners' Diseases" is an interesting contribution to mining literature. This is the first monograph ever written on the diseases of an occupational group. The diseases of miners, smelter workers and metallurgists are discussed and treatments recommended.

### FUNDAMENTALS OF INDUSTRIAL PSYCHOLOGY (Industrial Series)

*By A. Walton. McGraw-Hill Book Co., New York and London, 1941. 231 pp., diagrs., charts, tables, 7½ x 5 in., cloth, \$2.00.*

This book has been prepared primarily for use as a text for foreman training in industrial plants. It states the essential concepts and principles of psychology and explains their application in industrial management. Topics discussed include aptitude and ability tests, psychological factors in production, fatigue problems and morale.

### GENERAL TRADE MATHEMATICS

*By E. P. Van Lewen. McGraw-Hill Book Co., Whittlesey House Dept., New York, 1942. 575 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$3.50.*

The mathematics needed to solve actual shop problems in manufacturing and mechanical operations is presented in a step-by-step manner for quick grasp and practical use. Beginning with various straight arithmetical operations, the book works through simple algebra and geometry to specific industrial calculations. A wealth of practical problems furnishes useful practice material.

### HANDBOOK OF CIVILIAN PROTECTION

*Edited by L. L. Snyder, R. B. Morris and others. McGraw-Hill Book Co. (Whittlesey House), New York, 1942. 184 pp., illus., diagrs., tables, 7½ x 5 in., fabricoid, \$1.25.*

This little book provides the basic information concerning protection in air attacks which the general public should have. In simple language it gives definite advice on air-raid conduct and services, fire fighting, incendiary bombs, poison gas, first aid, civilian conservation and salvage, and war-time nutrition. There is a bibliography.

### HOW TO READ ELECTRICAL BLUEPRINTS

*By G. M. Heine and C. H. Dunlap. American Technical Society, Chicago, 1942. Paged in sections, illus., diagrs., charts, tables, 8½ x 5½ in., cloth, \$3.00.*

The major part of this book is devoted to an explanation of the symbols used to represent the various pieces of electrical equipment which must be indicated on a blueprint. Owing to the diversified character of the electrical industry, separate sections are used for such major branches as house wiring, automobile wiring, motor and generator diagrams, etc. The book is copiously illustrated, including nine large sample blueprints as a practical aid.

### ILLUMINATION ENGINEERING

*By W. B. Boast. McGraw-Hill Book Co., New York and London, 1942. 274 pp., diagrs., charts, tables, 9½ x 6 in., cloth, \$3.00.*

The purpose of this text is to give electrical engineering students a detailed treatment of the fundamental concepts of illumination, their historical background and the inter-relationships among them. Following a consideration of the present electrical sources of light, the book takes up the design and testing of illumination systems. A long list of recommended standards for commercial, industrial and public interior illumination is included.

### INTRODUCTION TO CHEMICAL THERMODYNAMICS

*By L. E. Steiner. McGraw-Hill Book Co., New York and London, 1941. 516 pp., diagrs., charts, tables, 9½ x 6 in., cloth, \$4.00.*

The author of this new text aims to acquaint the student with the fundamental theory of thermodynamics and of the relations between the thermodynamic functions; to prepare him

to utilize the various tables of thermodynamic data and the data found in chemical literature; and to give him a sound background for more extended work in thermodynamics. To this end the book deals with the basic laws and concepts of thermodynamics and with their application both to relatively simple chemical systems and to nonideal systems where the concepts of partial molal quantities and activities are useful.

### INTRODUCTION TO HEAT TRANSFER

*By A. I. Brown and S. M. Marco. McGraw-Hill Book Co., New York and London, 1942. 232 pp., diagrs., charts, tables, 9½ x 6 in., cloth, \$2.50.*

In this book the authors' purpose is to present the essential fundamentals of heat transmission in a treatment that is readily comprehensible and at the same time fairly comprehensive. Emphasis is placed upon acquiring a clear conception of the manner in which heat is transmitted and upon development of the fundamental mathematical expressions which apply to calculations of heat transfer through clean surfaces.

### MECHANICS OF FLUIDS

*By G. Murphy. International Textbook Co., Scranton, Pa., 1942. 329 pp., illus., diagrs., charts, tables, 8½ x 5 in., fabricoid, \$3.25.*

In this introductory textbook on the behaviour of fluids, the approach and techniques are those which have proved successful in the mechanics of solids. The basic method of analysis is that of the free-body, used in conjunction with the fundamental principles of mechanics, expressed in Newton's laws of motion. Numerous practical applications of the theory are cited, and numerical and laboratory problems are provided.

### METALLURGY

*By C. G. Johnson. American Technical Society, Chicago, 1942. 262 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, \$2.50.*

The purpose of this textbook is to present information on the subject of metals in such a way that the average untrained person will be able to obtain some working knowledge of the manufacture and behaviour of metals and their alloys. The questions at the end of each chapter help the student to check his understanding of the material covered, and a list of books and magazines useful for further reference is provided.

### MILLING MACHINE Job Training Units (Dunwoody Series, Machine Shop Training Jobs)

*American Technical Society, Chicago, Ill., 1942. 110 pp., illus., diagrs., tables, 11 x 8½ in., paper, \$1.25.*

This book covers jobs in connection with setting up and operating various types of milling machines, and forms part of a series of six manuals for training on different machine tools. A job check-sheet accompanies every job in order to test the learner's understanding before he starts on the job itself. Hints on blueprint reading and a list of useful shop knowledge items are included.

### MODERN SMALL ARMS

*Compiled by "Steel," Panton Publishing Co., Cleveland, Ohio, 1942. 66 pp., illus., diagrs., charts, tables, 11½ x 9 in., paper, \$1.00.*

This third of a series of handbooks on armament production compiled by the magazine "Steel" contains reprints of articles describing the construction and operation of various types of semi-automatic, machine and sub-machine guns. The types of small arms ammunition and representative manufacturing processes for cartridge cases are also described.

## (The) MUNICIPAL YEAR BOOK, 1942

Edited by C. E. Ridley and O. F. Nolting.  
[International City Managers' Association,  
1313 East 60th St., Chicago. 685 pp.,  
maps, charts, tables, 10 x 6½ in., cloth,  
\$8.50.

The Year Book provides an accurate picture of municipal conditions each year, discussing new developments, trends and the various activities, and providing much statistical information, directories of officials, etc., Maps showing all cities of over 5,000 population are included in the present issue, as is information upon metropolitan districts. Other new sections deal with city planning, city-owned parking lots and wartime organization.

## OPTICAL MINERALOGY (published formerly under the title "Thin-Section Mineralogy")

By A. F. Rogers and P. F. Kerr. 2nd ed. McGraw-Hill Book Co., New York and London, 1942. 390 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$3.75.

Part I of this volume deals with the preparation of thin sections of minerals and rocks, the use of the polarizing microscope, the optical principles which apply and the procedure for the identification of minerals in thin sections. Part II contains descriptions of the optically important properties of practically all the common minerals found in igneous, sedimentary and metamorphic rocks, and of the most important vein minerals. Microscopic identification of minerals in other than thin sections is also covered in this revised edition.

## OUTLINES OF FOOD TECHNOLOGY

By H. W. von Loesecke. Reinhold Publishing Corp., New York, 1942. 505 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$7.00.

The purpose of this book is to outline the more important processes used in preparing, preserving and storing all kinds of foodstuffs. Detailed descriptions have not been attempted, owing to the breadth of the field, but suggestions for further reading are appended to each chapter. Analyses and many other technical data are included, but no attempt has been made to discuss nutritive values.

## PRACTICAL CONSTRUCTION OF WARSHIPS

By R. N. Newton. Longmans, Green & Co., London, New York and Toronto, 1941. 318 pp., illus., diagrs., charts, tables, 10 x 6½ in., cloth, \$6.00.

This textbook is based on courses at the Royal Naval Engineering College and the Royal Naval Dockyard, and replaces an older text by N. J. McDermid, "Shipyard Practice as applied to Warship Construction." It deals with the principles of construction and erection of the structure and the more important

ships' services of modern warships. Chapters on launching, docking and undocking, and on the prevention of corrosion are included.

## PREVENTING FATAL EXPLOSIONS IN COAL MINES

By E. A. Wieck. Russell Sage Foundation, New York, 1942. 156 pp., 9½ x 6 in., paper, \$0.75.

This book presents a study of recent major disasters in coal mines in the United States as accompaniments of technological change. Six major disasters from explosions in 1940 are described and analyzed, explosion hazards and principles of safety with particular reference to mechanized mines are discussed, and the various agencies currently involved in or responsible for the promotion of safety in coal mines are designated.

## (The) RECOVERY OF VAPORS with Special Reference to Volatile Solvents

By C. S. Robinson. Reinhold Publishing Corp., New York, 1942. 273 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$4.75.

This work is an enlarged, revised edition of an earlier book, "The Recovery of Volatile Solvents." It aims to present, as simply and completely as possible, the fundamental principles involved in the recovery of vapors, with numerous illustrative examples, to discuss briefly the various factors entering into the design of recovery equipment, and to describe the standard forms of apparatus in more common use. It is intended for engineers and others in search of a course of study in the basic theory of the recovery of vapors, not as a reference book for experts.

## Short Course in TENSOR ANALYSIS for ELECTRICAL ENGINEERS

By G. Kron. John Wiley & Sons, New York; Chapman & Hall, London, 1942. 250 pp., diagrs., charts, tables, 9½ x 6 in., cloth, \$4.50.

This volume contains a series of lectures delivered to students in the Advanced Course in Engineering of the General Electric Company. It provides a short outline of the tensorial method of attack of certain problems in electrical engineering and shows its application to those confronting the power engineer.

## SURFACE FINISH

### Report of the Research Department

By G. Schlesinger. Institution of Production Engineers, London, W.1, 1942. 231 pp., illus., diagrs., charts, tables, 9 x 5½ in., cloth, 15s. 6d.

In 1939 the Institution of Production Engineers began an investigation of the problem of surface finish. The present report covers the initial stage of the work. It gives the results of a study of limits of surface roughness already in use and as inspected by the

existing surface measuring appliances, undertaken as a first step toward the establishment of standards for measuring surface finish. These results are presented in detail. There is a bibliography.

## SURVEYORS' FIELD-NOTE FORMS

By C. E. Bardsley and E. W. Carlton. 2 ed. International Textbook Co., Scranton, Pa., 1942. 127 pp., diagrs., charts, tables, 7½ x 4½ in., fabrikoid, \$1.00.

This book offers a sample set of field notes for use with classroom lectures and a text on plane surveying, and is intended especially for students beginning that subject.

## TABLE OF NATURAL LOGARITHMS, Vol. 4, Logarithms of the Decimal Numbers from 5.0000 to 10.0000.

Prepared by the Federal Works Agency, Work Projects Administration for the City of New York. Published by the National Bureau of Standards, 1941, Washington, D.C. 506 pp., tables, 11 x 8 in., cloth, \$2.00 (payment in advance).

This last volume of a series of four contains the sixteen decimal place values of the natural logarithms of the decimal numbers from 5 to 10 at intervals of 0.0001. The previous three volumes contained the sixteen decimal place values of the natural logarithms of the decimal numbers from 0 to 5 at intervals of 0.0001 and of the integers from 1 to 100,000.

## (The) TECHNIQUE OF EXECUTIVE CONTROL

By E. H. Schell. 5th ed. McGraw-Hill Book Co., New York and London, 1942. 252 pp., 7½ x 5 in., cloth, \$2.00.

This book defines the tools of executive control, outlines the factors involved in the successful handling of others and gives practical methods for getting a maximum output of work with a minimum amount of friction. The equally important factors of maintaining cordial and mutually helpful relations with associates and superiors also receive detailed consideration. A new chapter, "Executive conduct and the national effort," shows the influence of the war on executive technique.

## (The) TECHNOLOGY OF NATURAL RESINS

By C. L. Mantell and others. John Wiley & Sons, New York; Chapman & Hall, London, 1942. 506 pp., illus., diagrs., charts, maps, tables, 9½ x 6 in., cloth, \$7.00.

While the literature on synthetic resins is extensive, material on natural resins is not so readily accessible. This volume is designed to provide a summary of information on the latter group. The properties of the various resins and the methods of collecting and purifying them are described, and their uses in varnishes, paints, printing inks, etc., are presented in detail. A chapter is devoted to methods of testing.

# PRELIMINARY NOTICE

of Applications for Admission and for Transfer

June 27th, 1942.

The By-laws provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.\*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

**Communications relating to applicants are considered by the Council as strictly confidential.**

The Council will consider the applications herein described at the August meeting.

L. AUSTIN WRIGHT, General Secretary.

\*The professional requirements are as follows:—

A Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupillage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science or engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainment or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

## FOR ADMISSION

BAINBRIDGE—ARTHUR STANLEY, of Hamilton, Ont. Born at Sunderland, England, June 2nd, 1899; Educ.: Two years mech. engrg., Sunderland Technical School; 1915-21, ap'ticeship in marine engrg., Wm. Duxford & Sons Ltd., Sunderland; 1922-28, mtce. (mech.), and shift engr., I.C. engines for power plant supply, James A. Jobling & Co. Ltd., Sunderland; 1930 to date, plant engr., respons. for mech., elec. & steam equipment, mtce. alterations & additions, development of special equipment, Porritts and Spencer (Canada) Co. Ltd., Hamilton, Ont.

References: J. T. Thwaites, C. H. Hutton, A. C. Macnab, A. R. Hannaford, P. Ford-Smith.

## FOR ADMISSION—Continued

BROOKS—KENNETH MAHR, of Welland, Ont. Born at Ottawa, Ont., April 22nd, 1906; Educ.: B.Sc. (Mech.), N.S.Tech. Coll., 1929; 1927-28 (Summers), Topographic Survey of Canada, Ottawa Suburban Roads Commission; 1929, Foundation Co. of Canada (Maritime); 1929-30, sales engr., Riley Engineering & Supply Co.; 1931-39, asst. engr. & master mechanic, Canadian National Carbon Co., Toronto; 1939-42, with National Carbon Co., 6 mos. in Edgewater plant checking equipment for new plant to be built in India, and from 1940 chief engr./i/c of organization of this plant in Calcutta; at present, gen. engrg. dept., Electro-Metallurgical Company, Welland, Ont.

References: A. Hay, T. C. Agnew, M. B. Watson.

DILLON—ELDRIDGE ARTHUR, of 467 Downie St., Peterborough, Ont. Born at Round Island, C.B., N.S., Jan. 17th, 1915; Educ.: B.Eng., N.S. Tech. Coll., 1941; 1941 (June-Aug.), junior instructor in radio, Dalhousie Univ.; Sept. 1941 to date, student, test dept., Can. Gen. Elec. Co. Ltd., Peterborough, Ont.

References: F. Cameron, G. R. Langley, D. V. Canning, B. I. Burgess, W. M. Cruthers, W. T. Fanjoy, H. R. Sills.

HARVEY—ERIC WILLIAM, of Montreal, Que. Born at North Sydney, N.S., July 16th, 1906; Educ.: 5 years ap'ticeship, marine & mech., Newfoundland Dockyards Ltd., St. John's, Nfld. Two additional years ap'ticeship drfsmen., same company; Three years as engr. at sea, passed exams, and obtained Board of Trade Engrs. Cert.; Seven years, shop supt., Jeffrey Mfg. Co. Ltd., Montreal; With paper company in Cornerbrook, Nfld., in engrg. dept., on design & layout of new boiler plant; With Canadian International Paper Co. Ltd., Three Rivers, on gen. engrg. design, etc.; March 1941, loaned by C.I.L. as co-ordinator, Wartime Machine Shop Board, Canadian Pulp & Paper Assn., i/c all war work in paper mill shops.

References: A. Cunningham, G. F. Layne, E. Cowan, L. Sterns, W. T. Bennett, J. Frisch, C. H. Champion.

LETTERICK—CAMERON JOHN, of 345 Robinson St., Moncton, N.B. Born at Keavan's, Scotland, June 7th, 1888; 1909-11, i/c steam plant, cheese factory, Dalreage, Scotland; 1912-18, asst. city electrician, and 1918 to date, city electrician and wiring insp., City of Moncton, N.B.

References: V. C. Blackett, G. L. Dickson, T. H. Dickson, H. J. Crudge, C. S. G. Rogers, B. E. Bayne, C. H. Wright.

MELANSON—JOSEPH ERIC, of Mont Joli, Que. Born at Bathurst, N.B. Oct. 30th, 1914; Educ.: 1935-36, Univ. of N.B.; I.C.S.; 1936, rodman, 1937-39, instr'man., 1939-40, dftsman., Dept. Public Works N.B.; Aug. 1940 to date, res. engr., No. 9 Bombing & Gunnery School, Mont Joli, Que.

References: E. L. Miles, J. N. Flood, A. Collett, J. H. T. Morrison, W. L. Rice.

SWINTON—KURT RUDOLF, Lieut., R.C.C.S., Ottawa, Ont. Born at Vienna, Austria, March 3rd, 1915; Educ.: B.Sc., 1936, M.Sc., 1938 Technical University, Vienna; 1933, Fiat Works, Vienna; 1934, Henry Limited, Vienna; 1935, O.S.T.A.R. Ganz and Co., Vienna; 1936-38, Henry Ltd., Korting Radio, consultant on circuit patents, type tests, etc.; 1939-40, research and development engr., Sangama Weston Ltd., Enfield, Middlesex, England; 1940 (Feb.-July), technical asst. to chief of design & development lab., Decca Radio & Television Co. Ltd., London, England; At present on staff of Director of Signals (Army Engrg. Design Branch), Dept. of Munitions & Supply, Ottawa.

References: L. A. Wright, R. D. Harkness, R. H. Hall, H. J. MacLeod, A. B. Hunt, C. A. Peachey.

TOURIGNY—CHARLES E., of 2670 Pie IX Blvd., Montreal, Que. Born at Magog, Que., Sept. 12th, 1900; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1924. R.P.E. of Que.; 1922-23 (summers), gen. work in constg. engr's office; 1924-25, i/c survey work on trans. line for Lower St. Lawrence Power Co.; 1925-26, ap'ticeship course, Shaw. Water & Power Co.; 1926-30, i/c constn. work for Electric Service Corporation and other Shawinigan subsidiaries; 1930-34, i/c bldg. constn., Commercial & Distr. Dept., 1934-35, gen. power sales work, and 1935 to date, Director of Customer's Service Bureau and Employee Education, Shawinigan Water & Power Co. Ltd., Montreal, Que.

References: R. H. Mather, L. Trudel, L. A. Duchastel, A. Duperron, J. A. Beauchemin, A. B. Normandin, J. A. Lalonde, A. Lariviere.

VAN DEN BROEK, Jan. A., of 785 Arlington Blvd., Ann Arbor, Mich. Born at Middelharnis, Holland, March 6th, 1885; Educ.: B.Sc., Univ. of Kansas, 1911; Ph.D., Univ. of Mich., 1918; R.P.E. State of Mich.; 1911, surveyor on rly. location; 1911-12, bridge engr., dftsman., Kansas City; 1911-12, detailer, Boston Bridge Works; 1912-14, designer, bridge dept., C.P.R.; 1914 to date, professor of engrg. mechanics, University of Michigan. Also consultant for various firms, and research for U.S.A. Govt.

References: C. M. Goodrich, P. B. Motley, P. E. Adams, A. Duperron, L. Trudel, L. A. Wright.

WATTS—THOMAS ORD, of Lampton Mills, Ont. Born at London, England, Sept. 18th, 1907; Educ.: B.Sc., Queen's Univ., 1933; 1928-31, Otis-Fensom Elevator Co. Ltd.; 1934-39, plant supt., E. L. Ruddy Co.; 1939-40, mgr., Claude Neon Company; 1940 to date, works mgr., Sutton-Horsley Co. Ltd., Toronto, Ont.

References: D. M. Jemmett, L. M. Arkley, E. G. Wyckoff, O. W. Ellis, W. J. W. Reid.

## FOR TRANSFER FROM JUNIOR

CHARLEWOOD—CHARLES BENJAMIN, of London, England. Born at Toronto, Ont., Aug. 10th, 1908; Educ.: B.Sc. (Mech.), McGill Univ., 1931; Assoc. Member, Inst. Mech. Engrs.; 1929, instr'man., C.P.R.; 1930, student engr., Canada Power & Paper Corp.; 1931, production foreman i/c coil winding, R.C.A. Victor Corp., Montreal; 1931-32, service engr., Canadian Diesel Engine Corp., Montreal; 1932-36, underground pumpman, mechanic, dftsman., lubrication foreman, boiler & turbine operator, Noranda Mines Ltd.; 1936-37, contract, proposition and service work on steam boiler plant, Babcock-Wilcox & Goldie-McCulloch Ltd., Galt, Ont.; 1937-40, design of steam boilers and related equipment, operation & service, also charge of erection, Foster Wheeler Limited, London, England; At present, Lieut., R.C.A. (St. 1931, Jr. 1937).

References: C. M. McKergow, C. W. Crossland, F. B. Rolph, A. R. Roberts, E. A. Allcut.

PETURSSON—HANNES JON, of Longlac, Ont. Born at Foam Lake, Sask., Oct. 24th, 1908; Educ.: B.Sc., Univ. of Man., 1930; R.P.E. Ont.; 1928-29, (summers) chairman, rodman, res. engr., highway constn., Dept. Public Works, Man.; 1931-36, instr'man. & res. engr. on location & constn. of highways, Ont. Dept. of Northern Development; 1937, gen. concrete design & dftng. for J. C. Krumt, constg. engr.; 1937-40, instr'man. i/c constn. & location, Dept. of Highways of Ont.; 1940-41, res. engr. i/c constn., Gananogue Airport, Dept. of Transport; March 1941 to date, instr'man. i/c constn., Dept. of Highways of Ontario, Longlac, Ont. (Jr. 1932).

References: G. H. Herriot, R. O. Paulsen, C. K. S. Macdonell, T. F. Francis, J. A. McCoubrey.

## FOR TRANSFER FROM AFFILIATE

HALTRECHT—ARNOLD, of Ottawa, Ont. Born at Berlin, Germany, Aug. 11th, 1902; (Naturalized British subject July 1935); Educ.: M.E., Technical University, Darmstadt, Germany; R.P.E. Ont.; 1928, testing high voltage apparatus, Voigt & Haefner, Frankfurt; 1928-29, designing radio equipment, Kramolin & Co., Berlin; 1930-31, estimating, designing, etc., chief elec. engr's office, C.N.R.; 1932-41, own business—Electroradio Engineering Co., Montreal. Designing & bldg. testing equipment and public address systems; April 1941 to date, elect. engrg. lab., National Research Council, Ottawa, Ont. (Affiliate 1940).

References: R. W. Boyle, B. G. Ballard, R. G. Gage, H. J. Roast, W. H. Cook, N. B. MacRostie.

# Employment Service Bureau

## SITUATIONS VACANT

**MECHANICAL DRAUGHTSMAN** experienced in piping and equipment layout, or heating and ventilating work for war work in Montreal. Apply to Box No. 2375-V.

**MECHANICAL ENGINEER** for Mackenzie, British Guiana. Man with machine shop experience preferred. Apply to Box No. 2441-V.

**MECHANICAL ENGINEER** for British Guiana. Some experience on diesels and tractors preferred. Apply to Box 2432-V.

**ELECTRICAL ENGINEER**, construction and maintenance of diesel electric locomotives for work at Mackenzie, B.G. Apply to Box No. 2536-V.

**MECHANICAL DESIGNING DRAUGHTSMAN**, on permanent moulds and die casting dies. Apply to Box No. 2537-V.

**CIVIL ENGINEER**, with actual pile driving and heavy construction experience required for work in British Guiana. Apply to Box No. 2538-V.

**YOUNG GRADUATE ENGINEER** required by machinery supply firm located in Montreal. Some selling experience preferred. State military status. Apply to Box No. 2539-V.

**CIVIL ENGINEER**, supervising construction operations in Mackenzie, B.G. Apply to Box No. 2549-V.

**MECHANICAL DRAUGHTSMAN**, for important war work in Montreal. Apply to Box No. 2550-V.

**ELECTRICAL ENGINEER** with ten to fifteen years experience. Theoretical electrical engineering. To undertake the various electrical engineering studies requiring ability to handle theoretical problems combined with knowledge of actual system requirements. Apply to Box No. 2557-V.

**MINING ENGINEER** with operating experience for work in Newfoundland. Single man preferred. Apply to Box No. 2558-V.

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to **THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.**

**ELECTRICAL ENGINEER** for Arvida. Testing and maintenance of system relays. Short circuit studies. Preparation of wiring diagrams, etc. Apply to Box No. 2559-V.

**ASSISTANT WORKS MANAGER** with machine or boiler shop experience, or both, by engineering firm in western Ontario. Permanent job for progressive man not afraid of work. Apply to Box No. 2560-V.

## SITUATIONS WANTED

**GRADUATE MECHANICAL ENGINEER**, military exempt. Age 33, married. Detail experience in mechanical departments of paper-making, construction and foundry work. Available immediately. Location immaterial. Desirous of executive or production position with prospects of advancement. Apply to Box No. 1650-W.

**DESIGNING DRAUGHTSMAN**, M.E.I.C. Age 47. Married. Location immaterial. Experienced in estimates, design, layouts and details of industrial buildings. Presently employed but desirous of change with prospects of advancement. Apply to Box No. 2439-W.

**GRADUATE CIVIL, STRUCTURAL ENGINEER**, M.E.I.C., middle age. Twenty years' experience estimator, designer, and sales engineer. Excellent references. Open for engagement. Apply to Box No. 2440-W.

**CIVIL ENGINEER**, Jr.E.I.C., age 28, Canadian, married. McGill graduate '37. Employed since graduation with large industrial concern. Enthusiastic, energetic, seasoned with five years shop experience. Understands labour. Study made of management from the shop floor. In responsible position but desirous of following natural bent for organizing. Opportunities available with present employers unsuitable. Work leading to development as planning engineer, administrator, manager or personnel representative desired. Good background, strong, clean character, excellent health, best of references. Home city, Montreal. Work near a city preferred. Location and salary considered but type of work to be determining factor. Apply to Box No. 2441-W.

**ELECTRICAL ENGINEER**, age 34, twelve years experience in design, manufacture and application of fire protection systems. Good general knowledge of mechanical engineering, experience with tool design machine tools and shop practice. Trained in business administration and accustomed to responsible charge of large staff. Available immediately. Apply to Box No. 2442-W.

## FOR SALE

Transit, Buff and Buff Mfg. Five-inch circle, brass telescope and sliding leg tripod. One nick in the vertical half-circle, but no other damage. Thirty-year old instrument, but not much used. Would sell for \$225.00. Apply Box No. 45-S.

## RADIO BROADCASTS

on "THE ENGINEER AT WAR"

Dr. R. L. Sackett, of The American Society of Mechanical Engineers, announces that beginning Thursday, July 16, the National Broadcasting Company will broadcast from 6.30 to 6.45 p.m., over its nationwide network and possibly also by short wave a series of eleven radio programmes dealing with the contributions of engineers to the prosecution of the war.

The idea of telling the world by radio about engineers and their war activities came from a series of radio programmes put on the air in 1941 by the American Institute of Electrical Engineers. The success of this series led the American Society of Civil Engineers, The American Institute of Mining Engineers, The American Society of Mechanical Engineers, The American Institute of Electrical Engineers and The American Institute of Chemical Engineers to appoint three representatives of each society to form a committee to consider a possible programme and report to each society. Dr. Sackett is a member of this committee.

The programme selected is one which is intended to reflect the

varied contributions of engineers to the prosecution of the war. The committee began its deliberations before Pearl Harbour was attacked and had scripts under way on blackouts, bombs, and damage to structures.

The National Broadcasting Company and the Office of Civilian Defense enthusiastically endorsed the committee's proposal and have been generous in their help and approval of scripts so far submitted. Controversial matters are included in the broadcasts and changes will be made when requested by OCD up to the minute that a programme goes on the air. In this way the latest authoritative information will be given.

The material has been prepared by eminent men or by those selected from their staffs because of special knowledge. The scripts have then been woven into a story which presents a few of the striking features of the part played by engineers in some of the more important fields.

### PUMPING CONTROL

"Rotax" electric-operated control as employed in pumping applications is described in an 8-page bulletin, No. B-294, just issued by Foxboro Company, Montreal, Que. This bulletin shows "Rotax" controllers of the recording and indicating type, together with specimen chart records and installation photographs. The text is largely devoted to water-works and sewage engineering but also covers pumping applications which are common in various industrial fields. Schematic diagrams of typical pumping installations are also given.

### PACKING RING

Joseph Robb & Company, Limited, Montreal, Que., have just issued a 4-page folder which gives sectional views showing component parts of "Hunt-Spiller" duplex sectional lip type packing ring for locomotive service and also describes its construction. This folder also tells how to determine when renewals should be made, and gives directions for renewal, and methods of application of this type of packing ring.

### SCIENTIFIC INSTRUMENTS

A 20-page catalogue has been issued by Frederick C. Baker & Company, Toronto, Ont., featuring tachometers, thermo switches, hydrometers, thermometer dials, recording and indicating thermometers, laboratory instruments, pressure gauges, vacuum and compound gauges, thickness and speed indicators, stack thermometers and magnifiers. The catalogue also gives descriptions, specifications, performance applications and price of each.

### REFERENCE LIST

Mussens Limited, Montreal, Que., have made available bulletin No. 10, 16 pages, which is a ready reference list of all types of new, used and rebuilt machinery and supplies for coal yards, contractors, factories, lumbering, paper mills, mines, railroads and municipalities, handled by this company.

### SOLDERING IRONS

Canadian General Electric Co. Ltd., Toronto, Ont., have issued a 2-page leaflet, CGEA-2619A, giving tables of specifications and renewal parts for types I and CI General Electric soldering irons of various sizes. Construction details and reasons for their popularity are also included.

### NICKEL IN OIL REFINING

The International Nickel Company, Inc., New York, N.Y., have published a 30-page bulletin, C-2, which describes how nickel, Monel metal and Inconel are specially useful in resisting refinery corrosives such as sulphuric and hydrochloric acid, solvents, caustic soda and brine. Illustrations are given of many types of refinery equipment, along with tables and graphs showing corrosion rates in different metals; details of small parts are also illustrated. Properties of Monel, "S" Monel, nickel, Inconel castings and nickel-clad steel are given, together with notes on fabrication and technical service by the company.

### INDUSTRIAL INSULATION

A 14-page bulletin issued by Fiberglas Canada Limited, Oshawa, Ont., illustrates Fiberglas products including insulating blocks, "PF" insulation in bats and panels, metal mesh blankets, insulating and finishing cements, mastic and wool. Performance and applications of each are given and their advantages for ventilating, heating, air conditioning, plumbing and weatherproofing are shown. Also included are photographs illustrating how the product is handled and cut to fit.

## The Geologists' Paradise

The province of Nova Scotia is the geologists' paradise because all ages of rocks from Mesozoic down to Precambrian are predominately displayed within a relatively small area.

Fossil ferns and stems found in the coal measures are the palaeo-botanists' delight.

Pitching anticlines, synclines and anticlinal domes are prominently displayed in the Precambrian sediments.

The rock exposures around Minas Basin are the museum curators' favourite hunting ground for zeolites.

Shortage of gasoline and tires may curtail your proposed motor trip—but come just the same—the province is well served by the two largest railway systems on the North American continent, and inter-connecting bus lines.

### THE DEPARTMENT OF MINES

HALIFAX, NOVA SCOTIA

L. D. CURRIE  
Minister

A. E. CAMERON  
Deputy Minister

### ABRASIVE CUT-OFF WHEELS

Norton Company of Canada Limited, Hamilton, Ont., have issued a 28-page booklet illustrating and describing uses of abrasive cut-off wheels in industry, telling of their advantages over metal saws and comparing various bonds. The booklet also explains the selection of the right type of wheel and how to use it and what speeds are suitable, and tables of recommendations of wheels for dry and wet cutting are added for a hundred materials.

### AIR RAID SYRENS

A 6-page folder is being distributed by Burlec Limited, Toronto, Ont., illustrating the Burlec-Carter twin-note air raid syrens and controls, and gives sizes, capacities and performance, with descriptions of controls and directions for setting them up. Also included are interconnection diagrams, wiring diagrams, control dimensions, wire size tables and dimension tables.

### ASBESTOS SUIT

Mine Safety Appliances Company of Canada, Limited, Toronto, Ont., have issued Bulletin No. CF-7, illustrating and describing the "M.S.A." one-piece asbestos protective suit. Details are given of its construction and also lists industries or services where fire hazards call for its use.

### CARBON TOOL STEEL

Jessop Steel Company, Limited, Toronto, Ont., have published an 8-page booklet outlining the history of the Company, and describing each step in the manufacture of its products, from ingot to finished tool. Analysis, tempers and applications for each tool are given and critical range diagrams are also added. A tempering diagram listing step by step directions for hardening is also included.

### CONNECTION DIAGRAMS

Canadian Westinghouse Company, Limited, Hamilton, Ont., have issued, in bulletin form, a reprint from Factory Management and Maintenance, October, 1941, by E. B. Ankerman, Westinghouse Electric & Manufacturing Company. This reprint, H-210, shows connection diagrams for pushbutton circuits, with explanations. Definitions of terms used with pushbutton applications are given, together with fundamental rules for obtaining control sequence for low-voltage protection.

### PRESSURE INSTRUMENTS

Taylor Instrument Companies of Canada Limited, Toronto, Ont., have available for distribution Catalogue 76 JF, 28 pages, which fully describes the bourdon spring, bellows and manometer type instruments for indicating, recording and controlling pressures. All the latest information on gauge, differential and absolute pressure and vacuums can be found in this catalogue. The Taylor indicating mercury gauges for absolute pressures and vacuums are listed, as well as complete information on Taylor charts for pressure recorders and controllers.

### SCREWS AND BOLTS

A folder recently issued by The Steel Company of Canada Limited, Montreal, Que., and Hamilton, Ont., entitled "A New Head Takes Half the Work Out of Screw Driving," accompanies the announcement that this Company have been appointed sole licensees for manufacturing "Phillips" recessed head screws in Canada. The folder describes and illustrates these products, at the same time features the advantage of this type of recessed head for screws and bolts. Four types of Stelco Phillips head screw drivers and power bits are also described.

### CORRUGATED PIPE

The Pedlar People Limited, Oshawa, Ont., have published a folder illustrating and describing the various uses for Pedlar's "Metal Built" products. Views are shown of processes in manufacture of culvert pipe and of the methods of shipment and installation.

### WHEEL DRESSING MANUAL

"For Grinder Men Only" is the title of a 24-page booklet issued by Canadian Koebel Diamond Tools Limited, Windsor, Ont. This is a wheel dressing manual for grinder operators and combines concise statements of informative facts with attention-directing headings and humorous drawings which help to emphasize each point. It is virtually a treatise on the dressing of grinding wheels and contains much information of special importance to operators in shops where there is such a variety of work that it is not practical to have a special tool for each kind of work.

### RESUSCITATION AFTER ELECTRIC SHOCK

Canadian Line Materials Limited, Toronto, Ont., have published a 6-page bulletin, No. 4245, which is a reprint of an article by Mr. Charles F. Dalziel appearing in Volume 20, No. 2, of the company's house-organ, "The Line." It reviews the mechanisms of death due to severe electric shock and deals with methods of resuscitation including the "prone pressure method" and the "pole top method."

### DIAL-INDICATING THERMOMETERS

Catalogue 1170, 18 pages, just issued by C. J. Tagliabue Manufacturing Company, Brooklyn, N.Y., features "Tag" standard dial-indicating thermometers. The catalogue is illustrated and gives performance, dial ranges and specifications and lists and describes the thermometers' various uses; also gives illustrated descriptions, with dimensions, specifications and capacities, of electric contact alarms, connecting tubes, standard all-stainless steel bulbs, plain capillary bulbs, adjustable connection bulbs, fixed-stem indicating thermometers and bakelite cases. Other catalogues of "Tag" instruments are listed.

# THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 25

MONTREAL, AUGUST 1942

NUMBER 8



"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

★ ★ ★

## CONTENTS

PUBLISHED MONTHLY BY  
THE ENGINEERING INSTITUTE  
OF CANADA

2050 MANSFIELD STREET - MONTREAL

L. AUSTIN WRIGHT, M.E.I.C.  
*Editor*

LOUIS TRUDEL, M.E.I.C.  
*Assistant Editor*

N. E. D. SHEPPARD, M.E.I.C.  
*Advertising Manager*

### PUBLICATION COMMITTEE

C. K. McLEOD, M.E.I.C., *Chairman*  
R. DeL. FRENCH, M.E.I.C., *Vice-Chairman*  
A. C. D. BLANCHARD, M.E.I.C.  
H. F. FINNEMORE, M.E.I.C.  
T. J. LAFRENIÈRE, M.E.I.C.

THREE DESTROYERS OF THE ROYAL CANADIAN NAVY . . . . .	Cover
<i>(Photo Public Information, Ottawa)</i>	
CONSTRUCTION FEATURES ON THE EXTENSION OF THE SAN- TURCE STEAM PLANT, PUERTO RICO . . . . .	454
<i>J. T. Farmer, M.E.I.C. and E. A. Goodwin, M.E.I.C.</i>	
WATER WHEEL DRIVEN GENERATORS IN THE U.S.A. . . . .	457
<i>C. M. Laffoon</i>	
DISCUSSION ON ACCIDENT PREVENTION METHODS AND RESULTS	459
RECONSTRUCTION AND RE-ESTABLISHMENT . . . . .	465
PROFESSIONAL DEVELOPMENT AND RESPONSIBILITY . . . . .	469
<i>Robert E. Doherty</i>	
ABSTRACTS OF CURRENT LITERATURE . . . . .	471
FROM MONTH TO MONTH . . . . .	478
PERSONALS . . . . .	483
Visitors to Headquarters . . . . .	484
Obituaries . . . . .	485
NEWS OF THE BRANCHES . . . . .	486
LIBRARY NOTES . . . . .	487
PRELIMINARY NOTICE . . . . .	489
EMPLOYMENT SERVICE . . . . .	490
INDUSTRIAL NEWS . . . . .	491

Price 50 cents a copy, \$3.00 a year: in Canada, British Possessions, United States and Mexico. \$4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, \$2.00 a year.—Entered at the Post Office, Montreal, as Second Class Matter.

THE INSTITUTE as a body is not responsible either for the statements made or for the opinions expressed in the following pages.

# THE ENGINEERING INSTITUTE OF CANADA

## MEMBERS OF COUNCIL - 1942

### PRESIDENT

C. R. YOUNG, Toronto, Ont.

### VICE-PRESIDENTS

\*A. L. CARRUTHERS, Victoria, B.C.  
†H. CIMON, Quebec, Que.

### PAST-PRESIDENTS

†T. H. HOGG, Toronto, Ont.

### COUNCILLORS

†E. D. GRAY-DONALD, Quebec, Que.  
†J. HAIMES, Lethbridge, Alta.  
\*J. G. HALL, Montreal, Que.  
†R. E. HEARTZ, Montreal, Que.  
†W. G. HUNT, Montreal, Que.  
†E. W. IZARD, Victoria, B.C.  
†J. R. KAYE, Halifax, N.S.  
\*E. M. KREBSER, Walkerville, Ont.  
†N. MACNICOL, Toronto, Ont.  
\*H. N. MACPHERSON, Vancouver, B.C.  
\*W. H. MUNRO, Ottawa, Ont.

### TREASURER

E. G. M. CAPE, Montreal, Que.

### GENERAL SECRETARY

L. AUSTIN WRIGHT, Montreal, Que.

†J. L. LANG, Sault Ste. Marie, Ont.  
†G. G. MURDOCH, Saint John, N.B.

†C. J. MACKENZIE, Ottawa, Ont.

†T. A. McELHANNEY, Ottawa, Ont.  
\*C. K. McLEOD, Montreal, Que.  
†A. W. F. McQUEEN, Niagara Falls, Ont.  
†A. E. PICKERING, Sault Ste. Marie, Ont.  
†G. McL. PITTS, Montreal, Que.  
†W. J. W. REID, Hamilton, Ont.  
†J. W. SANGER, Winnipeg, Man.  
\*M. G. SAUNDERS, Arvida, Que.  
†H. R. SILLS, Peterborough, Ont.  
\*J. A. VANCE, Woodstock, Ont.  
\*A. O. WOLFF, Saint John, N.B.

\*For 1942 †For 1942-43 ††For 1942-43-44

### SECRETARY-EMERITUS

R. J. DURLEY, Montreal, Que.

### ASSISTANT GENERAL SECRETARY

LOUIS TRUDEL, Montreal, Que.

## STANDING COMMITTEES

### FINANCE

DEG. BEAUBIEN, *Chairman*  
J. E. ARMSTRONG  
E. G. M. CAPE  
G. A. GAHERTY  
J. A. McCRORY  
F. NEWELL

### LEGISLATION

J. L. LANG, *Chairman*  
R. L. DOBBIN  
R. J. DURLEY

### PAPERS

J. A. VANCE, *Chairman*  
DEG. BEAUBIEN  
K. M. CAMERON  
A. L. CARRUTHERS  
H. CIMON  
J. L. LANG  
G. G. MURDOCH

### LIBRARY AND HOUSE

W. G. HUNT, *Chairman*  
A. T. BONE  
J. S. HEWSON  
M. S. NELSON  
G. V. RONEY

### PUBLICATION

C. K. McLEOD, *Chairman*  
R. DEL. FRENCH, *Vice-Chairman*  
A. C. D. BLANCHARD  
H. F. FINNEMORE  
T. J. LAFRENIERE

## SPECIAL COMMITTEES

### BOARD OF EXAMINERS AND

#### EDUCATION

R. A. SPENCER, *Chairman*  
I. M. FRASER  
W. E. LOVELL  
A. P. LINTON  
H. R. MacKENZIE  
E. K. PHILLIPS

#### GZOWSKI MEDAL

H. V. ANDERSON, *Chairman*  
A. C. D. BLANCHARD  
T. H. JENKINS  
V. A. McKILLOP  
W. H. POWELL

#### DUGGAN MEDAL AND PRIZE

J. T. FARMER, *Chairman*  
J. M. FLEMING  
R. C. FLITTON

#### PLUMMER MEDAL

C. R. WHITTEMORE, *Chairman*  
J. CAMERON  
R. L. DOBBIN  
O. W. ELLIS  
R. E. GILMORE

#### LEONARD MEDAL

JOHN McLEISH, *Chairman*  
A. E. CAMERON  
A. O. DUFRESNE  
J. B. DEHART  
A. E. MacRAE

#### JULIAN C. SMITH MEDAL

C. R. YOUNG, *Chairman*  
T. H. HOGG  
C. J. MACKENZIE

#### PROFESSIONAL INTERESTS

J. B. CHALLIES, *Chairman*  
J. E. ARMSTRONG  
G. A. GAHERTY  
O. O. LEFEBVRE  
H. W. McKIEL  
J. A. VANCE

#### THE YOUNG ENGINEER

H. F. BENNETT, *Chairman*  
J. BENOIT  
D. S. ELLIS  
J. N. FINLAYSON  
R. DEL. FRENCH  
R. F. LEGGET  
A. E. MACDONALD  
H. W. McKIEL

### MEMBERSHIP

J. G. HALL, *Chairman*  
S. R. FROST

### STUDENTS' AND JUNIORS' PRIZES

**Zone A (Western Provinces)**  
**II. N. Ruttan Prize**

A. L. CARRUTHERS, *Chairman*  
E. W. IZARD  
H. N. MACPHERSON

**Zone B (Province of Ontario)**

**John Galbraith Prize**

J. L. LANG, *Chairman*  
A. E. PICKERING  
J. A. VANCE

**Zone C (Province of Quebec)**

**Phelps Johnson Prize (English)**

DEGASPE BEAUBIEN, *Chairman*  
J. E. ARMSTRONG  
R. E. HEARTZ

**Ernest Marceau Prize (French)**

H. CIMON, *Chairman*  
J. H. FREGEAU  
E. D. GRAY-DONALD

**Zone D (Maritime Provinces)**

**Martin Murphy Prize**

G. G. MURDOCH, *Chairman*  
G. L. DICKSON  
S. W. GRAY

### INTERNATIONAL RELATIONS

R. W. ANGUS, *Chairman*  
J. B. CHALLIES, *Vice-Chairman*  
E. A. ALLCUT  
C. CAMSELL  
J. M. R. FAIRBAIRN  
O. O. LEFEBVRE  
M. J. McHENRY  
H. H. VAUGHAN  
C. R. YOUNG

### DETERIORATION OF CONCRETE

#### STRUCTURES

R. B. YOUNG, *Chairman*  
E. VIENS, *Vice-Chairman*  
G. P. F. BOESE  
A. G. FLEMING  
W. G. GLIDDON  
O. O. LEFEBVRE  
J. A. McCRORY  
C. J. MACKENZIE  
J. H. McKINNEY  
R. M. SMITH

### WESTERN WATER PROBLEMS

G. A. GAHERTY, *Chairman*  
C. H. ATTWOOD  
L. C. CHARLESWORTH  
A. GRIFFIN  
D. W. HAYS  
G. N. HOUSTON  
T. H. HOGG  
O. O. LEFEBVRE  
C. J. MACKENZIE  
H. J. McLEAN  
F. H. PETERS  
S. G. PORTER  
P. M. SAUDER  
J. M. WARDLE

### ENGINEERING FEATURES OF

#### CIVIL DEFENCE

J. E. ARMSTRONG, *Chairman*  
P. E. ADAMS  
J. N. ANDERSON  
S. R. BANKS  
H. F. BENNETT  
R. S. EADIE  
E. V. GAGE  
G. A. GAHERTY  
R. J. GIBB  
A. GRAY  
J. GRIEVE  
J. L. LANG  
R. F. LEGGET  
I. P. MACNAB  
J. A. McCRORY  
H. J. McEWEN  
C. B. MUIR  
W. H. MUNRO  
G. McL. PITTS  
M. G. SAUNDERS  
T. G. TYRER  
H. K. WYMAN

### INDUSTRIAL RELATIONS

WILLS MACLACHLAN, *Chairman*  
E. A. ALLCUT  
J. C. CAMERON  
E. R. COMPLIN  
J. A. COOTE  
W. O. CUDWORTH  
F. W. GRAY  
E. G. HEWSON

FRASER S. KEITH  
A. M. REID  
A. ROSS ROBERTSON

### POST-WAR PROBLEMS

W. C. MILLER, *Chairman*  
F. ALPORT  
DEGASPE BEAUBIEN  
A. L. CARRUTHERS  
J. M. FLEMING  
E. R. JACOBSEN

G. R. LANGLEY  
G. L. MacKENZIE  
D. A. R. McCANNELL  
A. W. F. McQUEEN  
G. McL. PITTS  
D. C. TENNANT

# THE ENGINEERING INSTITUTE OF CANADA

## OFFICERS OF BRANCHES

### BORDER CITIES

*Chairman*, H. L. JOHNSTON  
*Vice-Chair.*, G. G. HENDERSON  
*Executive*, W. P. AUGUSTINE  
 J. F. G. BLOWEY  
 W. R. STICKNEY  
 (Ex-Officio), E. M. KREBSER  
 G. E. MEDLAR  
*Sec.-Treas.*, J. B. DOWLER,  
 754 Chilver Road,  
 Walkerville, Ont.

### CALGARY

*Chairman*, H. J. McEWEN  
*Vice-Chair.*, J. G. MacGREGOR  
*Executive*, J. N. FORD  
 A. GRIFFIN  
 H. B. SHERMAN  
 (Ex-Officio), G. P. F. BOESE  
 S. G. COULTIS  
 J. B. DEHART  
 P. F. PEELE  
*Sec.-Treas.*, K. W. MITCHELL,  
 803—17th Ave. N.W.,  
 Calgary, Alta.

### CAPE BRETON

*Chairman*, J. A. MacLEOD  
*Executive*, J. A. RUSSELL M. F. COSSITT  
 (Ex-Officio), F. W. GRAY  
*Sec.-Treas.*, S. C. MIFFLEN,  
 60 Whitney Ave., Sydney, N.S.

### EDMONTON

*Chairman*, D. A. HANSEN  
*Vice-Chair.*, D. HUTCHISON  
*Executive*, C. W. CARRY  
 B. W. PITFIELD  
 E. R. T. SKARIN  
 J. A. ALLAN  
 E. ROBERTSON  
 J. W. JUDGE  
 (Ex-Officio), J. GARRETT  
 R. M. HARDY  
*Sec.-Treas.*, F. R. BURFIELD,  
 Water Resources Office,  
 Provincial Government,  
 Edmonton, Alta.

### HALIFAX

*Chairman*, P. A. LOVETT  
*Executive*, A. E. CAMERON  
 G. T. CLARKE G. J. CURRIE  
 A. E. FLYNN J. D. FRASER  
 D. G. DUNBAR J. A. MacKAY  
 J. F. F. MacKENZIE  
 J. W. MacDONALD  
 G. T. MEDFORTH  
 (Ex-Officio), S. L. FULTZ J. R. KAYE  
*Sec.-Treas.*, S. W. GRAY,  
 The Nova Scotia Power  
 Commission,  
 Halifax, N.S.

### HAMILTON

*Chairman*, STANLEY SHUPE  
*Vice-Chair.*, T. S. GLOVER  
*Executive*, H. A. COOCH  
 NORMAN EAGER  
 A. C. MACNAB  
 A. H. WINGFIELD  
 (Ex-Officio), W. J. W. REID  
 W. A. T. GILMOUR  
*Sec.-Treas.*, A. R. HANNAFORD,  
 354 Herkimer Street,  
 Hamilton, Ont.

### KINGSTON

*Chairman*, T. A. McGINNIS  
*Vice-Chair.*, P. ROY  
*Executive*, V. R. DAVIES  
 K. H. McKIBBIN  
 K. M. WINSLOW  
 A. H. MUNRO  
 (Ex-Officio), G. G. M. CARR-HARRIS  
 D. S. ELLIS  
*Sec.-Treas.*, J. B. BATY,  
 Queen's University,  
 Kingston, Ont.

### LAKEHEAD

*Chairman*, MISS E. M. G. MacGILL  
*Vice-Chair.*, E. J. DAVIES  
*Executive*, J. I. CARMICHAEL  
 R. B. CHANDLER  
 S. E. FLOOK  
 O. J. KOREEN  
 S. T. McCAVOUR  
 W. H. SMALL  
 E. A. KELLY  
 J. S. WILSON  
 (Ex-Officio), B. A. CULPEPER  
 J. M. FLEMING  
*Sec. Treas.*, W. C. BYERS,  
 c/o C. D. Howe Co. Ltd.,  
 Port Arthur, Ont.

### LETHBRIDGE

*Chairman*, J. M. DAVIDSON  
*Vice-Chair.*, W. MELDRUM  
*Executive*, R. F. P. BOWMAN G. S. BROWN  
 N. H. BRADLEY  
 C. S. OLENDENING  
 (Ex-Officio), J. HAIMES  
 A. J. BRANCH J. T. WATSON  
*Sec.-Treas.*, R. B. McKENZIE,  
 McKenzie Electric Ltd.,  
 706, 3rd Ave. S., Lethbridge, Alta.

### LONDON

*Chairman*, F. T. JULIAN  
*Vice-Chair.*, T. L. McMANAMNA  
*Executive*, F. C. BALL  
 V. A. McKILLOP  
 H. F. BENNETT  
 A. L. FURANNA  
 R. S. CHARLES  
 (Ex-Officio), R. W. GARRETT  
 J. A. VANCE  
*Sec.-Treas.*, H. G. STEAD,  
 60 Alexandra Street,  
 London, Ont.

### MONCTON

*Chairman*, H. J. CRUDGE  
*Vice-Chair.*, J. A. GODFREY  
*Executive*, A. S. DONALD  
 E. R. EVANS E. B. MARTIN  
 H. W. HOLE G. C. TORRENS  
 (Ex-Officio), F. O. CONDON  
 G. L. DICKSON H. W. McKIEL  
*Sec. Treas.*, V. C. BLACKETT  
 Engrg. Dept., C.N.R.,  
 Moncton, N.B.

### MONTREAL

*Chairman*, J. A. LALONDE  
*Vice-Chair.*, R. S. EADIE  
*Executive*, R. E. HEARTZ  
 J. B. STIRLING  
 J. M. CRAWFORD  
 J. COMEAU  
 H. F. FINNEMORE  
 R. C. FLITTON  
 G. D. HULME  
 (Ex-Officio), DE G. BEAUBIEN  
 J. E. ARMSTRONG  
 J. G. HALL  
 W. G. HUNT  
 C. K. McLEOD  
 G. McL. PITTS  
*Sec.-Treas.*, L. A. DUCHASTEL,  
 40 Kelvin Avenue,  
 Outremont, Que.

### NIAGARA PENINSULA

*Chairman*, C. G. CLINE  
*Vice-Chair.*, G. E. GRIFFITHS  
*Executive*, A. G. HERR  
 R. T. SAWLE  
 G. F. VOLLMER  
 W. D. BRACKEN  
 J. W. BROOKS  
 J. H. TUCK  
 D. S. SCRYMGEOUR  
 (Ex-Officio), A. L. McPHAIL  
 A. W. F. McQUEEN  
*Sec.-Treas.*, J. H. INGS  
 1870 Ferry Street,  
 Niagara Falls, Ont.

### OTTAWA

*Chairman*, N. B. MacROSTIE  
*Executive*, W. G. C. GLIDDON  
 R. M. PRENDERGAST  
 W. H. G. FLAY  
 G. A. LINDSAY R. YUILL  
 (Ex-Officio), K. M. CAMERON  
 C. J. MACKENZIE  
 W. H. MUNRO  
 T. A. McELHANNEY  
 R. K. ODELL  
*Sec.-Treas.*, A. A. SWINNERTON,  
 Dept. of Mines and Resources,  
 Ottawa, Ont.

### PETERBOROUGH

*Chairman*, D. J. EMERY  
*Executive*, C. R. WHITTEMORE F. R. POPE  
 I. F. McRAE R. L. DOBBIN  
 (Ex-Officio), A. J. GIRDWOOD  
 J. CAMERON  
 H. R. SILLS  
*Sec.-Treas.*, A. R. JONES,  
 5, Anne Street,  
 Peterborough, Ont.

### QUEBEC

*Life Hon.-*  
*Chair.*, A. R. DECARY  
*Chairman*, L. C. DUPUIS  
*Vice-Chair.*, RENE DUPUIS  
*Executive*, O. DESJARDINS  
 R. SAUVAGE G. ST-JACQUES  
 S. PICARD L. GAGNON  
 (Ex-Officio), G. W. WADDINGTON  
 E. D. GRAY-DONALD  
 R. B. McDUNNOUGH P. METHÉ  
 H. CIMON  
*Sec.-Treas.*, PAUL VINCENT,  
 Colonization Department,  
 Room 333-A, Parliament Bldgs.,  
 Quebec, Que.

### SAGUENAY

*Chairman*, N. F. McCAGHEY  
*Vice-Chair.*, R. H. RIMMER  
*Executive*, B. BAUMAN  
 G. B. MOXON  
 A. I. CUNNINGHAM  
 W. J. THOMSON  
 (Ex-Officio), M. G. SAUNDERS  
 J. W. WARD  
*Sec.-Treas.*, D. S. ESTABROOKS,  
 Price Bros. & Co. Ltd.,  
 Riverbend, Que.

### SAINT JOHN

*Chairman*, D. R. SMITH  
*Vice-Chair.*, A. O. WOLFF  
*Executive*, H. P. LINGLEY  
 C. D. McALLISTER  
 C. C. KIRBY  
 (Ex-Officio), F. A. PATRIQUEN  
 V. S. CHESNUT  
 G. G. MURDOCH  
*Sec.-Treas.*, G. W. GRIFFIN  
 P. O. Box 220,  
 Saint John, N.B.

### ST. MAURICE VALLEY

*Chairman*, VIGGO JEPSEN  
*Vice-Chair.*, J. H. FREGEAU  
*Executive*, E. BUTLER R. D. PACKARD  
 A. C. ABBOTT  
 R. DORION  
 H. J. WARD  
 E. T. BUCHANAN  
 J. JOYAL  
 H. G. TIMMIS  
 (Ex-Officio), A. H. HEATLEY  
*Sec.-Treas.*, J. B. SWEENEY  
 Consolidated Paper Corporation,  
 Grand'Mère, Que.

### SASKATCHEWAN

*Chairman*, A. P. LINTON  
*Vice-Chair.*, A. M. MACGILLIVRAY  
*Executive*, F. C. DEMPSEY  
 N. B. HUTCHEON  
 J. G. SCHAEFFER  
 R. W. JICKLING  
 H. R. MacKENZIE  
 B. RUSSELL  
 (Ex-Officio), I. M. FRASER  
*Sec.-Treas.*, STEWART YOUNG  
 P. O. Box 101,  
 Regina, Sask.

### SAULT STE. MARIE

*Chairman*, L. R. BROWN  
*Vice-Chair.*, R. A. CAMPBELL  
*Executive*, N. C. COWIE  
 C. O. MADDOCK K. G. ROSS  
 C. R. MURDOCK  
 (Ex-Officio), J. L. LANG  
 E. M. MacQUARRIE  
 A. E. PICKERING  
*Sec.-Treas.*, O. A. EVANS,  
 159 Upton Road,  
 Sault Ste. Marie, Ont.

### TORONTO

*Chairman*, W. S. WILSON  
*Vice-Chair.*, W. H. M. LAUGHLIN  
*Executive*, D. FORGAN  
 R. F. LEGGET  
 S. R. FROST  
 F. J. BLAIR  
 E. G. HEWSON  
 (Ex-Officio), C. F. MORRISON  
 C. R. YOUNG T. H. HOGG  
 A. E. BERRY N. MacNICOL  
 H. E. BRANDON J. J. SPENCE  
*Sec.-Treas.*, S. H. deJONG  
 Dept. of Civil Engineering,  
 University of Toronto,  
 Toronto, Ont.

### VANCOUVER

*Chairman*, W. O. SCOTT  
*Vice-Chair.*, W. N. KELLY  
*Executive*, H. P. ARCHIBALD  
 I. C. BARLTROP  
 H. C. FITZ-JAMES  
 H. J. McLEOD  
 R. E. POTTER  
 (Ex-Officio), J. N. FINLAYSON  
 T. V. BERRY  
 H. N. MacPHERSON  
*Sec.-Treas.*, P. B. STROYAN  
 2099 Beach Avenue,  
 Vancouver, B.C.

### VICTORIA

*Chairman*, A. S. G. MUSGRAVE  
*Vice-Chair.*, KENNETH REID  
*Executive*, A. L. FORD  
 B. T. O'GRADY  
 J. B. PARHAM  
 R. BOWERING  
 (Ex-Officio), A. L. CARRUTHERS  
 G. M. IRWIN  
 E. W. IZARD  
*Sec.-Treas.*, J. H. BLAKE,  
 605 Victoria Avenue,  
 Victoria, B.C.

### WINNIPEG

*Chairman*, D. M. STEPHENS  
*Vice-Chair.*, J. T. DYMENT  
*Executive*, C. V. ANTENBRING  
 N. M. HALL  
 T. H. KIRBY  
 E. W. R. BUTLER  
 H. B. BREHAUT  
 (Ex-Officio), J. W. SANGER  
 V. MICHIE  
 C. P. HALTALIN  
*Sec.-Treas.*, THOMAS E. STOREY,  
 55 Princess Street,  
 Winnipeg, Man.

# CONSTRUCTION FEATURES ON THE EXTENSION OF THE SANTURCE STEAM PLANT, PUERTO RICO

J. T. FARMER, M.E.I.C., and E. A. GOODWIN, M.E.I.C.  
*Montreal Engineering Company, Limited, Montreal, Que.*

Paper presented before the Montreal Branch of The Engineering Institute of Canada on March 19th, 1942.

**NOTE**—The information contained herewith supplements the paper on "The Modernization of a Puerto Rico Steam Plant," by the same authors, published in the June issue of the *Journal*.

In carrying out the latest extension of the power plant of the Puerto Rico Railway, Light & Power Company, in San Juan, Puerto Rico, a number of problems of construction arose which are of some interest.

A construction schedule was drawn up in Montreal, but as is often the case, could not be followed exactly as planned. The matter was of some urgency as the power company needed the new unit as soon as possible.

It was known that a number of changeover jobs and dismantling operations had to be done in sequence, before the real work of new construction could begin. The old steel chimney had to be removed to allow for the extra bay necessary on the north end of the building, and before this could be done it was necessary to construct a new breeching from the old low pressure boiler system into the new concrete stack. The low pressure steam main had to be re-routed to make way for the new high pressure boiler. Also, the station switchboard which was located at the extreme north end of the building had to be removed and re-located. Each one of these operations had to be done in such a way as to reduce the period of shut-down to a minimum.

But on December 29th, 1940, the 5,000 kw. unit No. 5, the largest and latest addition to the station stripped its blading and disarranged the whole carefully arranged schedule. It became impossible to shut down any of the low pressure units or boilers until No. 5 was on the line again. The two old boilers and the 500 kw. turbo-generator that were about to be dismantled were therefore put back in service and the steel stack had to remain until stoppage for changeover was possible.

Due to the conditions at the hydro plants at this time, the steam plant was being called on to carry a base load of about 8,000 kw., and this with a nominal capacity of 12,000 kw. all told. With the largest unit out of commission this nominal capacity was reduced to 7,000 kw. For the time being the maintenance of the supply became a hand-to-mouth performance. It is to the credit of the operating staff that they managed to carry the load through this critical period, without any dislocation of the service.

It was therefore necessary to change the order of procedure, early in February, 1941, and while the completion of the contract took somewhat longer than originally estimated, it would seem that after allowing for the breakdown, the load conditions, the weather, the war and its effect on labour conditions and delivery of materials, a very expeditious job was carried out and the final results were not too unsatisfactory.

It was found that in general, the unskilled labour available was willing and hard working, but of a low order of education. Racially the labourers ranged from jet black to sunburned white, being composed of Negroes, Indians, Spanish and mixtures of all these races. Most of them were illiterate and lived under the poorest conditions in squatters' huts, build at the edge of the bays and inlets around San Juan. They were, however, a happy crowd and responded very quickly to decent treatment. Tempers, however, were quick and quarrels between them not infrequent. Many a morning showed the results of "a few words" in the form of cuts and bruises. The skilled workers, such as carpenters, fitters, etc., were intelligent and, when relieved from the fear of unemployment, were willing to work hard.

The Puerto Rican engineers and technical men are of quite a high order and take a keen interest in the work. At Rio Piedras they have a University consisting of modern buildings set in a spacious campus, and staffed with American professors. It is quite evident that the engineer graduates have been very thoroughly grounded and are very keen to use the knowledge gained there. The only criticism which might be levelled at them would be a slight lack of initiative and a tendency to look for leadership to any one in authority who might be working with them.

The Puerto Ricans really excel in the making of concrete structures, and if properly watched, make a very good job of it indeed. They seem to have a natural instinct for formwork and make and install it in double quick time. They have to be carefully watched, however, when it comes to mixing concrete, as they appear to be great believers in using plenty of water in the mixing, without any regard to the cement water ratio. The consequence is that unless some engineer is placed over them at the mixer, great variation in the batches occurs, some being wet and others much wetter. One of the contractors' foremen told me, at the beginning of the job "that concrete always cracks," and this became one of the problems of the job—to see that the mix was such that the risk of cracking was at least reduced to a minimum.

Labour of any kind, skilled and unskilled, on this particular contract was very difficult to obtain, owing to the tremendous activity on the Island due to war work. The construction of many naval and military projects together with civilian extensions and alterations to docks, etc., caused a scarcity of available men, and the best of them were all snapped up long before we began our project.

The contractor, who incidentally carried out the extensions in 1936 and 1938 became inundated with new work. After the signing of the contract in November 1940, he obtained a contract from the Waterman Lines to build a new wharf and buildings, and another one from the Navy of some million and a quarter dollars, both of which contracts had very binding clauses regarding progress. As this man, although very capable, was at best only equipped for work under ordinary conditions it will be realized that his lack of equipment and his limited ability to give full personal attention to our work tended to hamper progress.

An interesting difference between this project and the ordinary run of construction lay in the erection of the new extension over the top of the old building and then, after all sheeting had been put in place, removing the old structure from the inside. (Fig. 1). This, of course, had to be done whilst retaining continuous electrical service. Some very careful planning was necessary when removing the old roof trusses, but we were fortunate enough to completely dismantle everything without any mishap and without stopping a machine.

The foundations for the new building, lying well outside the boundaries of the old structure, presented no particular difficulties. The turbine room pit floor, located 13 ft. below turbine room floor level made it necessary to sheet and shore, but as the ground there consists of, in the main, good sharp sand, the driving of the sheet piling was easy and quickly done. One trouble, however, was experienced at the north end of the building where there is a concrete tank 16 ft. 6 in. deep. This tank is very important as the cooling water for all the low pressure units is drawn from here. On excavating for the north wall it was discovered that the tank was leaking from an old crack about 9 or 10 ft. down. Excavation had to be stopped, sandbags placed and pumps

operated to keep the water out of the excavation for the east wall. A form was made and placed inside the tank. No. 1, 2 and 3 units were then shut down, the tank emptied and a concrete liner 8 in. thick extending from the bottom of the tank to the top was cast. This work was carried out very expeditiously, as the whole job was completed inside of 48 working hours and the shut-down was less than 24. It was fortunate, however, that No. 5 unit had just been brought into operation again and made a shut-down possible.

In the centre of the building some difficulty was experienced in underpinning the centre columns. The old foundations were only about 6 ft. below turbine room floor level and it was necessary to excavate down to below the 13 ft. level, propping up the steel columns B<sub>1</sub>, B<sub>2</sub> and B<sub>3</sub>, forming a concrete foundation column under them, and a continuous wall between them.



Fig. 1—East wall of turbine room looking towards northwest.

The piping and equipment both on the east and west side of the columns were very close indeed and the sheet piling had to be driven almost touching the formwork. Water trouble was experienced as two streams came in, in such quantities that a three inch centrifugal pump had to be kept going all the time.

The subsoil was not too good here and as it was not possible to get in with a pile driver, it was decided instead of piling under the columns to make a spread footing for the pit wall and put in enough reinforcement that some support would be given to the column foundations.

One of the greatest difficulties met with during the building of the turbine room pit was water. Being so close to the bay and so much below sea level this had to be coped with as well as some small streams that were flowing from south to north.

As mentioned before, the contractor was very short of reliable equipment and his pumping equipment was the most unreliable of all. Two three-inch antiquated gasoline driven clack pumps were installed but never at any time were both operating due to breakdowns and finally we had to lend him a three inch motor driven centrifugal.

After the floor of the pit was cast the pump had still to work continuously to keep the water anything like under control.

It was finally discovered that most of this leakage was coming up through the bottom of the sump which up to this time had been unsuspected.

In making this sump, a steel box without a bottom had been forced down into the sand and the inside excavated. The concrete sump was then formed, but it was finally discovered that water was coming in from two places close to the bottom. In order to cure this a form was finally put in about 6 in. from the bottom, with 2½ in. pipes coming out above floor level. Over the form the sump was filled with rock and sand and a 6 in. concrete slab laid over the top at floor level. Four holes were then punched in the floor outside the box. When the concrete was set a cement gun was attached to one of the pipes and a thick grout was forced down under air pressure until the

grout appeared at the top of the other pipe, which was then capped and pressure re-applied. After some time the grout appeared at two of the holes made in the floor. We then changed the gun over to the second pipe, capping the first one. When grout appeared at the other two holes in the floor, the form was removed and the grout allowed to set; after which the top slab was broken out. This appears to have cured the trouble and the whole floor was afterwards surfaced.

The pumphouse was an interesting structure to build and as it was an extension of the one built in 1936, care had to be taken to keep the building looking symmetrical.

The work consisted in sinking six concrete piles 10 x 10 in. x 35 ft. long, cutting off the tops after they had been driven to refusal and capping them with reinforced concrete beams. On top of and integral with the beams was cast a 6 in. floor with a rectangular hole 14 ft. 10 in. x 7 ft. in it to receive the precast pump suction box.

The piles were located by falsework attached to the existing building, the pile driving barge approaching the falsework and when in position allowing the pile to sink as far as it would by its own weight. This appeared to be an average of about 12 ft., after which it was driven by means of a three-ton steam driven pile driver. When all were driven the supports for the formwork consisting of 3 x 12 in. planks were bolted in exact position on the piles and using the planks as a platform support, the tops of the piles were cut off and their reinforcing rods laid over. The floor—or rather, under-floor, was then formed and cast and after setting, a temporary plank floor was laid down. On this the form for the suction box was made, care being taken to make the form as nearly as possible over the hole that the box had to go through. As the box, when finished weighed approximately 19 tons, it will be seen that too much lateral movement was not advisable.

At the bottom of the box stirrups were cast in each corner for lowering purposes. These stirrups were an afterthought put in on the job, but they saved quite a lot of work and avoided the use of a diver to release the tackle after the box was lowered into place.

#### TURBINE FOUNDATION

Due to the delay in completing the turbine room pit, it was decided to construct the formwork for the turbine foundation outside in the open and so save some time. Accordingly, a flat piece of land was chosen and the work laid out and constructed there in such a manner that it could easily be taken down and re-erected in place.

The foundation was 15 ft. high by 10 ft. 4 in. wide, by 30 ft. long. The generator end was a complete structure as was the turbine support, the two portions being joined at the top by two main steel beams 25¾ in. deep cross-tied by channels, all the steel being set in concrete. The form was made by one carpenter and two helpers and took three weeks to complete. It took one day to dismantle and four days to re-assemble in place. The concrete, about 90 cu. yd., was placed in one day up to the underside of the steel beams. The beams were placed the following morning and the balance of the concrete work completed the same day.

Although perhaps a little unusual, this method of construction worked out very well, because after the formwork was removed and the position of the foundation re-checked it was found to be less than ¼ of an inch out in any direction.

The formwork also, because of its method of construction was found after removal to be in such good condition that it was decided to save it for use in the next extension job (which is at present proceeding).

Before placing the formwork in the pit however, it was necessary to place the condenser roughly in position and assemble the formwork around it. This was something of a problem as the condenser weighed 35 tons and the capacity of the crane was only 20 tons. It was therefore decided to

construct a moveable skidway and this was done in the following manner: Two 15 in. "I" beams, 32 ft. long (which fortunately we had on the site, having salvaged them from the old building structure) were tied together with cross channels to form a frame of a width equal to the supporting feet of the condenser. A crib formed of rail ties was made at one side of the building to the full height of the pit and at the other side to a height about half that of the pit. The frame was set on this and the condenser was skidded down, being controlled by four sets of chain blocks, two in front and two behind.

When the condenser had been thus lowered about half-way down, the framework was attached to the crane at the high end and the cribwork removed the crane slowly lowering the framework to the pit floor, the condenser meanwhile being held from sliding by two sets of chain blocks. The operation of skidding was then repeated in the



Fig. 2—Boiler foundation. Note the temporary supports for the centre building columns in the background.

opposite direction until the condenser was practically at pit floor level, when the crane was attached to the other end of the skids and the other crib removed. The crane was then used on each end of the condenser in order to turn it 90 deg. into its position and block it up to the proper height. It was found possible to set the condenser within half an inch of its final setting.

The whole operation took two days and worked very smoothly. The main difficulty was that the condenser was very cumbersome and top-heavy, but before any work was done at all, three men were chosen to act as leaders, one in charge at either end and one located centrally to control all movements. A rough sketch was laid out and the three men rehearsed in every move to be made, and fortunately everything worked out exactly as planned.

#### BOILER FOUNDATIONS

A change in the construction under the boiler had to be made after excavation started.

A design for a two ft. thick reinforced concrete mat had been made in Montreal, but it was found that after dismantling the old boilers and taking out the mat constructed under them, there was another old foundation below, which in turn had to be removed. The excavation, when this was done was about four ft. six. in. deep and the condition of the ground such that 30 piles, 25 ft. long had to be driven. (Fig. 2).

On top of this it was decided to build a kind of wall construction, the outside walls forming a box, with cross walls joining wherever there was any heavy loading. These walls extended to the underside of the designed mat, and after being made, the spaces between the walls were filled with good firm sand tamped down, the whole forming a good bottom for the mat. The whole excavation could, of course, have been filled with solid concrete, but as the contract was based on a price per cubic yard about \$500.00 was saved by the method carried out.

The erection of the boiler was carried out by the boiler manufacturers and calls for no special comment, except for a curious accident which, while serious enough and the cause of a second accident, had no fatal results and occasioned no very serious delays.

After the mat was finished, the mud drum was placed in position on its saddles and the steam drum was placed on the mat ready for lifting.

Two 30 ft. power poles were selected as single sticks, either of which should have had ample strength to carry the whole drum load of nine tons. When the drum was about 12 ft. up in the air, the pole taking the front end of the drum began to slowly give at the centre. There was no noise of breaking at first and the front end seemed to come down quite slowly. Two men who were handling the hoisting chains on the top of the drum almost had time to slip down the chains to the floor before the pole cracked off short, letting the load go. The front end of the drum hit the mud drum and slid over, trapping one of the men by the foot and the other was just pinned at the soft part of the leg. This man released himself, but the drum had to be jacked up to release the other who was found to have a very badly lacerated foot indeed.

A light truck was brought into service as an ambulance, and it was here that the second accident occurred. The men were placed lying down on the bottom of the truck whilst another man sat on the side of the truck holding the injured foot high in the air.

The truck driver, a coloured man, appeared to think that he was driving a real ambulance and dashed off towards the gates at top speed. The gates were only about half open when he reached them and the latch of the gate caught the man sitting on the side of the truck in his side, breaking two ribs and lacerating him badly. He, also, was left in the hospital and was indeed there when the man with the lacerated foot was discharged.

The only other accident was a shock received by a man who tried to saw through a conduit on the lighting circuit without first making the line dead.

#### DIVERSION WALL

During the 1941 extension it was decided to go ahead with the construction of a diversion wall in the Condado bay. This had been under consideration for some time, and city drainage which had recently been led into the bay close to the pumphouse depositing silt and offal, made it necessary to do something soon or have trouble with the pumps. It was decided to construct a diversion wall extending about two ft. above high tide and for a distance of 300 ft. into the bay. This would have the effect of carrying all drainage well past the pumphouse before spreading. It also had the advantage of conducting the warm water from the circulating water discharge canal to a point where it would not be re-circulated.

Concrete piles about 30 ft. long x 12 x 10 in. were precast on the shore. They had a groove 4 x 4 in. cast in on two sides for the reception of 12 x 3 in. precast slabs which were laid horizontally. The piles were driven to refusal, and measurements were then taken for the horizontal slabs. After the slabs had been laid in to the necessary height, formwork was set up on the top and a 10 x 12 in. concrete beam was cast continuous along the top. Soffits set in the beam allowed a handrail to be easily erected. No attempt was made to make a tight joint between the slabs as it was felt that shellfish would soon do all that was necessary in the way of jointing. As a matter of fact, there was very little opening observed after the slabs were originally laid.

The results of this installation have been highly satisfactory in every way. Not only was the debris kept clear of the pumps, but the temperature of the cooling water, at certain directions of the wind became noticeably cooler with a beneficial effect on the vacuum at the condensers.

The machinery, such as the turbo-generator and boiler,

was erected by contract under the supervision of manufacturers' erectors, such skilled and unskilled help as they needed being supplied by the light company.

The erection of the steam piping and auxiliary equipment was carried out by the light company staff and it was very pleasing to note that, thanks to the care taken in setting out the various foundations and main equipment, every flange on the whole job came to its companion, straight and square and not one pipe had to be changed.

The whole job was completed about ten weeks later than

originally estimated, but in view of the breakdown mentioned, this was fairly satisfactory. In order to do this, it was necessary to work long hours and very often Sunday was forgotten. This, in war time is not a great hardship, but to work the hours necessary to complete the job in the time taken, in the hot and humid climate of Puerto Rico was something of a trial. Great credit is due to the regular staff of the Puerto Rico Railway, Light and Power Company, for the unceasing efforts they made to do this work in addition to their regular maintenance duties.

## WATER WHEEL DRIVEN GENERATORS IN THE U.S.A.

C. M. LAFFOON

*Manager, A.C. Generator Engineering Department, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., U.S.A.*

**Paper presented before the Hamilton Branch of The Engineering Institute of Canada on April 9th, 1942.**

During the past decade the U.S.A. government has undertaken a broad scale development of the water power resources of the nation. The development programme is long range in scope, and embraces navigation, flood control, irrigation, and power production. At the present time power production is of major importance, whereas in the future the other aspects may be of equal or greater importance. Water power projects that fall under these classifications come under the jurisdiction of the United States Army, Bureau of Reclamation, Special Authorities set up by Congress, states and municipalities.

The United States Army Engineers Corps has been engaged for many years in developing navigation and flood control projects for our principal rivers. Two of the most important recent projects are Fort Peck on the upper Missouri river and Bonneville on the lower Columbia river. When completed, the Bonneville Power Plant will have approximately 500,000 kw. generating capacity.

Two of the largest and most important power, flood control, and irrigation projects under the jurisdiction of the Bureau of Reclamation, are Boulder and Grand Coulee Dams. The Boulder Dam power house has space for 15-82,500 kw. units and two 40,000 kw. units with a total capacity of 1,277,500 kw. Nine 82,500 kw. and one 40,000 kw. units with a total capacity of 782,500 kw. are now in operation. Three 82,500 kw. units are now under construction. The unapplied space will accommodate three 82,500 kw. and one 40,000 units for future installation.

Grand Coulee will have an ultimate capacity of approximately 2¼ million kw. involving 18-108,000 kw. and two 12,500 kva. generating units. Three 108,000 kw. and the two 12,500 kva. units are now in commercial operation, and six additional units are on order. These 108,000 kv., 120 r.p.m. generators are the largest capacity water-wheel generators built to date.

The Tennessee Valley Authority (T.V.A.) has under development and near completion, a most comprehensive and complete flood control, power generation and distribution programme for the Tennessee river and its tributaries. This programme includes 27 dams which will have an aggregate capacity of 2½ million kw. when completed.

Other recent hydro-electric developments of this type are Shasta in upper California, Parker Dam on the Colorado river below Boulder Dam, Grand river in Oklahoma, Santee-Cooper in South Carolina, Dennison Dam in Texas, and numerous others.

The major items in connection with waterwheel generators at present are associated with manufacturing and production problems. The following units are either under construction or are being installed by the Westinghouse Company at the present time. Additional projects and additional generating capacity for existing projects are being actively negotiated.

TABLE I

WATER WHEEL GENERATING UNITS ON ORDER OR BEING INSTALLED BY THE WESTINGHOUSE ELECTRIC & MFG. CO.

Units	R.P.M.	Kva- Unit	Total Kva.	Customer
6	120	108,000	648,000	U.S. Bu. of Reclam.—Grand Coulee
3	81.8	40,000	120,000	TVA.—Pickwick Station
3	150	75,000	225,000	TVA.—Fontana Station
2	150	33,333	66,666	TVA.—Wautauga Station
2	138.5	27,778	55,556	TVA.—South Holston
1	200	26,667	26,667	TVA.—Ocoee
2	225	40,000	80,000	TVA.—Appalachia
2	94.7	33,333	66,666	TVA.—Watts Bar
1	150	16,000	16,000	Grand River
2	90	36,842	73,684	U.S. Eng., Dennison Dam
2	180	82,500	165,000	Bu. of Reclam.—Boulder Dam
1	94.7	30,000	30,000	Bu. of Reclam.—Parker Dam
1	300	11,000	11,000	Pacific Gas & Elec. Co.
2	300	40,000	80,000	Pacific Gas & Elec. Co.
1	600	31,000	31,000	Mexican Fed. Commission
3	300	32,000	96,000	Cachapool Elec.—Chili
1	600	35,000	35,000	Rio de Janeiro
1	138.5	16,500	16,500	Sao Paulo
Total			2,082,739	Kva.

Since hydro-electric plants are usually remote from the utilization centres and transmission problems are involved in the disposal of the power, the stability characteristics of the generating units for each plant must be determined from the conditions existing on the systems involved or contemplated for the future. The desired characteristics are usually determined by analytical studies and calculating board investigations. The characteristics normally associated with rating can, and do conform to accepted standards. Most units are designed for operation at 13,800 volts, a few at 16,500 volts, and very few at higher voltages.

Usually waterpower projects of major scope are designed and built for long time service. It has thus become standard practice for the generating equipment to be designed on the same premise. Class B insulation (mica, glass and asbestos), are therefore used for both the conductor and ground insulation for both the stator and rotor windings. The temperature rises are limited to 60 deg. C. in order to obtain generators of long life and which will have low maintenance. The performance record of this type of unit has been further improved by using the closed circuit ventilating system with surface type of air coolers. This insures a continuous supply of clean air free of excessive moisture. In many cases the housing enclosure is made sufficiently tight that the CO<sub>2</sub> can be economically injected into the system and an inert gas mixture obtained for extinguishing internal fires. When CO<sub>2</sub> fire extinguishing is required, protection against excessive internal pressure is provided for by using spring or pressure loaded relief doors, which open automatically when the pressure reaches

a pre-determined value. The customary procedure is for the generator manufacturer to provide and install suitable nozzles for the introduction of the CO<sub>2</sub> and the fire-extinguishing companies to supply the piping and equipment external to the generator.

In order to utilize most effectively the entire available water head, vertical type units are used almost universally. The weight of turbine and generator rotating parts and the water thrust are supported on a single thrust bearing which is normally furnished by the generator builder and mounted on generator parts. The most widely used thrust bearing is the Kingsbury adjustable shoe type with pivoted supports for the individual shoes. In the case of low speed, large diameter, short core-length units, it is rapidly becoming accepted practice to use only one guide bearing and to locate it and the thrust bearing below the rotor spider. The design, construction, and lubrication of the bearings has been greatly simplified by using the adjustable shoe type for both guide and thrust bearings, and mainly there is a common oil pot which forms an integral and standard part of the supporting bracket. Water-cooling coils are usually located in the oil pot and no pump or piping are required for circulating the oil. Waterwheel generators with this type of construction are slightly less costly and easier to maintain than the conventional unit with two guide bearings, one located above and the other below the rotor spider. Over 2 million kva. of single guide bearing (umbrella type) units are in service giving satisfactory performance.

The overall performance of the Kingsbury type thrust bearing has been remarkably good. Two recent unexplained cases of trouble occurred during the initial starting-up period after completion of erection. Two other cases of bearing trouble developed in which the trouble first manifested itself as vertical vibration of the thrust bearing support, at a frequency equal to the product of the speed and the number of thrust shoes. An investigation disclosed that the trouble was caused by distortion of the thrust bearing runner. It is believed that the distortion was caused by a gradual release of residual stresses in the runner material.

The development in the welding art has resulted in the use of fabricated construction instead of castings for the major mechanical parts. The shipping dimension limitations are such that the stator frame and rotor spider must be shipped in parts or sections. The rotor core is usually built from laminations and since it must withstand stresses due to rotation, it is imperative that it be assembled at destination as a complete circle. In the case of the stator core, only static forces are involved and its laminations can be assembled complete in the individual frame sections, shipped as individual unit parts, and bolted together to form a complete frame. This type of construction is less costly than building the core in a complete circle at destination and is being used almost universally for modern units. It is recognized that the separate core section must be solidly clamped together to avoid movement between adjacent sections. Provision is made in modern design to increase the bolting force between the frame section at definite time intervals as a part of normal maintenance.

#### ELIMINATION OF CORONA ON STATOR END WINDINGS

The elimination of corona from the entire stator winding and wiring connectors of high voltage rotating machines at operating voltages has been desired by both manufacturer and user for many years. Since 1929, successful elimination of corona on the straight or buried part of the coil has been accomplished by applying a semi-conducting material known commercially as Aquadag to the outer surface of the coil. This high resistance conducting material in contact with the stator iron, brings the potential of the coil surface to ground potential and thus completely eliminates corona.

With the conventional two-coil-side-per-slot type of

windings, two adjacent coils, or two coils within the same slot, may differ in potential by full line voltage. The amount of corona existing in the end winding zone depends on the distance between coil surfaces, condition of the surface with respect to smoothness, and the type of bracing used. The corona situation can be appreciably improved by obtaining smooth surfaces free of projections or sharp corners, and avoid small spacing between coil sides which have high potential differences. Generally speaking, such coils should be sufficiently insulated so that the surfaces can be brought firmly together, or the spacing made great enough to prevent appreciable corona. Further reduction of corona can only be accomplished by applying a semi-conducting material to the surfaces of the parts in question. The end winding problem is essentially different from that of the part in the slots due to the fact that the electrical charges on the end turns must be conducted over the surface of the coil to ground (stator iron). The surface coating of each section of the coil must permit the total charge on the coil beyond this section to flow across the surface without overheating. With the present state of the art it is not deemed advisable to use relatively low resistance material such as Aquadag over the entire end winding due to the fact that it would fix the entire surface of the coil at ground potential and thus puts full line to neutral voltage on the insulation. This is undesirable because the end turns due to bends and joints cannot be insulated as effectively as the slot portion.

An ideal solution to the end-turn problem would be to grade the resistivity of the semi-conducting treatment applied. That is, start with a low resistance value (Aquadag) in the slots and gradually increase to high values at the loops of the winding. This would uniformly decrease the voltage stress on the end turn insulation. This uniform grading of the resistance is not easy to accomplish commercially. It has been found that a single compromise resistance value can reduce the voltage stress sufficiently to eliminate the corona. Such a semi-conducting material, called Coronox, has been applied to windings during the past year. Actual experience indicates that complete visual elimination of corona at operating voltages can be obtained by using a single value of surface resistance.

During the past year, Coronox has been applied to 11, 13.8, and 16.5 kv. windings for the following ratings:

2 Units	9,000 kva.	Turbine Generators
2 Units	18,750 kva.	Turbine Generators
1 Unit	20,000 kva.	Synchronous Condenser
1 Unit	30,000 kva.	Synchronous Condenser
1 Unit	31,250 kva.	Turbine Generator
1 Unit	40,000 kva.	Waterwheel Generator
1 Unit	43,750 kva.	Turbine Generator
1 Unit	50,000 kva.	Turbine Generator
1 Unit	62,500 kva.	Turbine Generator
1 Unit	75,000 kva.	Turbine Generator
1 Unit	81,250 kva.	Turbine Generator
2 Units	82,500 kva.	Waterwheel Generator
1 Unit	100,000 kva.	Turbine Generator
3 Units	108,000 kva.	Waterwheel Generator

Of these ratings, one unit has been in continuous service for the past ten months, and other units have been in service over six months. Three of the largest waterwheel generators received their Coronox treatment on customer's property.

Application of Coronox has been made to existing machines in the field, but such consideration should be given only where actual damage from corona has been observed. Not only must the winding surface be clean and dry before application can be made, but the rotor usually needs to be removed. These steps cause delay and great expense, and are generally not necessary as the entire winding of machines built in recent years are protected against corona attack by mica shielding. Corona damage of these machines has been limited to oxidation or pitting of the surface varnishes.

# DISCUSSION ON ACCIDENT PREVENTION METHODS AND RESULTS

Paper by Wills Maclachlan,<sup>1</sup> M.E.I.C., published in *The Engineering Journal*, January, 1942, and presented before the General Professional Meeting of The Engineering Institute of Canada, at Montreal, Que., on February 6th, 1942.

J. A. BEAUCHEMIN,<sup>2</sup> M.E.I.C.

Further explanations by the author on the following points would be much appreciated:—

1. Who investigates the causes of the accidents included in the statistics, as affecting the interests of:

- (a) The Utilities
- (b) The Compensation Board
- (c) The Electrical Employers' Association of Ontario.

Are the results of these investigations made known to the employees with the view of further accident prevention?

2. What importance is given to near-accidents, their warning and educational values?

3. Has any relation been established between the size of companies (as indicated by their annual output) and the frequencies of accidents?

4. What are the comparative frequencies of accidents affecting unskilled, semi-skilled and skilled labour classified under the headings temporary, permanent and fatal.

5. What have been the most general causes of accidents under the same headings?

J. H. BRACE<sup>3</sup>

I fully endorse the author's views and suggestions on the subject of Accident Prevention Methods and Results.

The experience we have had in telephone work is similar to his own, and confirms his view that accident prevention is initiated, and must be continued, by higher management. The man on the job and especially the first line supervisor must also be sold on accident prevention, or the effort will not reach maximum effectiveness.

At one time in our experience we used to give awards in the form of pocketbooks, silver trophies, etc., to those foremen whose vigilance had prevented accidents. It was soon found that this did not produce the desired results. The next step was to make accident prevention and the safe conduct of the job the direct responsibility of the foreman or supervisor in charge of the work. As the theory of this principle commended itself to supervision the ratio of accidents was reduced. After this had been made generally effective the next step was to educate the line employee and the new employee in these ideas. This has been done in various ways and, of course, includes supervision. Motion pictures and sound slides are used to demonstrate safe methods of performing the work. The design of tools and equipment is looked at from the safety angle as well as the utility or economic one. Methods of operation and construction are designed to perform the job the safe way and are under review continuously to reduce any possible accident hazard.

Some years ago a Safety Code was developed and has since undergone two or three revisions. In each instance employees were selected from different lines of occupation to suggest, consider and approve the information to go into this safety code. In this way the employee feels that it is his safety code.

Posters, bulletins, etc., are issued periodically drawing attention to safe methods of doing work. Demonstration boards illustrating the various phases of the safe way of work have been used to good advantage. Safety inspectors

are also used in this way. These men spend enough time with the foreman and his gang to be looked upon as part of the gang, and they continue their regular working habits. In this way they are in a position to point out any undesirable habits or to commend the men on safe practices.

Throughout all of this effort the safe conduct of the work is considered just as much as quality or production.

Some years ago an extensive First Aid programme was started with a view to improving the accident situation. This is a continuous programme and employees are encouraged to take refresher courses at short intervals. The results obtained have been quite satisfactory. At the present time we have about 90 per cent of our outside forces trained in first aid. In numbers we have between 2,000 and 2,500 people who take first aid during the year.

In all of our accident prevention work we discuss and show the safe and correct way of doing the work rather than to emphasize what should not be done. We feel that this is the more effective method.

ANGUS D. CAMPBELL,<sup>4</sup> M.E.I.C.

This paper is particularly important at this time when a casualty in Canadian industry is as much a gain to Hitler as a casualty in the armed forces. The paper demonstrates conclusively that accident prevention methods, based on engineering, do get results. Figure 2 with its steadily downward curve of frequency of accidents shows an achievement in safety of which the Electrical Employers' Association and its engineer, Mr. Maclachlan, may well be proud. It is an achievement that has favourably affected each of us as private or industrial users of electricity, and we are grateful for it.

The paper gives a clear exposition of how this increasing safety in public electrical utilities is being obtained. Accident prevention methods for all industries are here charted. But there is a real danger that we members of The Engineering Institute of Canada may not take this paper as personally as we should. The conclusion says "the sincere leadership of management is vital to the whole matter." That puts it right up to each of us. Canadian engineers have done and are doing much for safety, but can achieve a much greater measure of industrial and highway safety than Canada now has. A plan for accident prevention is presented by Mr. Maclachlan. Let's get on with the job.

R. N. COKE,<sup>5</sup> M.E.I.C.

I should like to add the following notes to Mr. Maclachlan's able paper.

In sub-stations and power houses safe operating conditions are obtained by:

1. Design which allows safe clearance between live parts and to ground.

2. The use of gang-operated disconnecting switches and the locking of same.

3. Clear marking of the disconnecting switches and other equipment so that the operator can definitely see which switch he is going to operate.

4. The use of barriers between disconnecting switches when installed indoors.

5. For smaller stations where switching may be done by other than experienced operators, proper interlocking of

<sup>1</sup>Secretary-Treasurer and engineer, Electrical Employers' Assoc. of Ont.

<sup>2</sup>Chief engineer, Public Service Board of the Province of Quebec.

<sup>3</sup>Vice-president, Bell Telephone Co. of Canada.

<sup>4</sup>Manager, Omega Gold Mines Ltd., Larder Lake, Ont.

<sup>5</sup>Vice chief engineer and general superintendent, Montreal Light, Heat & Power Co.

the oil circuit breakers and the sectionalizing disconnecting switches is advocated to compel the following of a definite sequence of operation.

6. Operators are carefully trained with the idea implanted in their minds that operations must be carefully performed and that the operations must be definitely and deliberately done without undue hurry. Many of the mistakes made by experienced operators are due to either misunderstanding the instructions or attempting to unduly hurry the operations.

7. When shifts are changed the operating set-up of the station is discussed by the off-going and incoming operators. Any change in operation which has taken place from the usual routine is clearly pointed out.

8. The entire operation of the system is under the control of one man, in our case the system supervisor, and no operation is allowed without his knowledge and sanction.

#### DISTRIBUTION

Lines with voltages up to and including 4,000 volts between phases are worked on alive, weather permitting. Lines with voltages above 4,000 volts are always killed before work is performed on them.

By proper engineering, adequate clearance is allowed between different lines and phases, also between lines and cables. Sufficient working clearance is also arranged so that the workman may safely perform his duties.

All senior men are taught first aid and resuscitation work, with the result that many lives have been saved and accidents quickly treated until a doctor's care could be obtained.

Linemen are instructed that before attempting to climb a pole they must be properly equipped with rubber gloves, rope, etc., and that they are to stay at the foot of the pole until they have figured out the best and safest way to climb the pole and actually do the work on the pole.

Where men work in close proximity to live wires, rubber protectors are placed on 550 volt, 2,300 and 4,000 volt wires to protect the man.

Belts and rubber protecting equipment, etc., are supplied and maintained by the company.

The question of grounding transformers is one that has occasioned a great many discussions with regard to the policy of the different companies. One school of thought is that if the transformer case is grounded and the man is accidentally in contact with a live wire, and at the same time his foot touches the case of the transformer, then a short circuit will occur. The other school of thought is that if the case of the transformer is not grounded and there is an insulation breakdown in the transformer, the case of the transformer will probably be energized with the result that if the man comes in contact with the transformer case and contacts either live wires or grounded wires he will cause a short circuit.

#### DISTRIBUTION—OVERHEAD

Tree trimming—Particular care must be taken in tree trimming to not only protect the man who is doing the tree trimming, but also the lines which will probably be below the trees, and the pedestrian who will probably attempt to walk under the trees which are being trimmed.

No trees are trimmed in the vicinity of 12,000 volts and higher voltage lines unless those lines are made dead if there is any possibility of the limb coming in contact with the wires.

#### METHOD OF GIVING CLEARANCE

Where lines and equipment have to be made dead to allow work to be performed on them, it is essential that the apparatus or lines be kept dead while men are working. One man is responsible for "taking the clearance" and to see that the equipment or lines are dead before men attempt to work. The same man is responsible to see that the clearance in the form of a pass, signed by him after he has personally made himself responsible to see that the

line or apparatus is clear of grounds and men, is returned to the operator of the station. Wherever possible, apparatus and lines are grounded before men work on them.

#### HANDLING OF EXPLOSIVES

All work performed with explosives is handled carefully in accordance with instructions issued by the Dominion Government, Explosives Division of the Department of Mines.

The operation of ice-breaking tugs is carried out under the jurisdiction of the Department of Transport, Marine Service, and all the necessary precautions with regard to safety are taken.

All emergency patrols are equipped with special light emergency trucks whose crews are thoroughly trained in first aid and resuscitation methods.

Particular care should be taken in allotting different types and mentalities of staff to the various duties which they have to perform. Naturally, certain men are better adapted to perform certain types of work than others.

The question of safety to the worker and equipment is at all times a very important one. It is especially so to-day during war time when so much depends on the public utilities maintaining uninterrupted service to war plants. Without electric power to-day our system of civilization practically stops.

We are particularly interested in the author's handling of the problem of the re-establishment of the electrical worker who has been hurt and cannot continue the work he has been doing. Further study is needed as to the re-establishment of the injured, handicapped worker. We hope Mr. Maclachlan will continue his work on this matter.

#### T. NORMAN DEAN<sup>6</sup>

This splendid paper is perhaps the finest presentation the writer has seen in an experience of thirty years. The portion dealing with cost of accidents is especially striking. Too often comparisons are made without any examination of underlying conditions and much so-called statistical evidence is based upon figures rather than facts. The conclusion which Mr. Maclachlan has drawn from his carefully discovered facts,<sup>6</sup> namely, that there has been a reduction of costs which can, in part at least, be attributed to accident prevention efforts, is sound from the statistical point of view. His ingenious method of applying the facts is likewise sound. Emphasis could be placed upon the substitution of payroll for man-hours in expressing frequency rates: the use of man-hours connotes equal distribution of hazard over each hour worked and to my mind this is *reductio ad absurdum*. The obvious shift from serious to less serious accidents over the period is important: the bettering of medical service and technique may be a factor as well as accident prevention methods, but the important thing is, that the decrease is real. The continuous decrease in frequency and cost perhaps indicates hope for the future—that the ultimate in reduction has not yet been reached and that continuous and co-ordinated effort will result in lessening further the burden of industrial accidents.

#### R. L. DOBBIN,<sup>7</sup> M.E.I.C.

The accomplishments of the Ontario Electrical Employers' Association and particularly of Mr. Maclachlan, are well known to those connected with the transmission and distribution of electrical power. But the public generally is not so conversant, and this paper is valuable because it brings out the facts in connection with the work of accident protection for the past twenty-five years.

Mr. Maclachlan's efforts have not been wholly confined to methods of work on electrical lines and apparatus. He has gone further, and has been able to beneficially influence

<sup>6</sup>Statistician, The Association of Workmen's Compensation Boards of Canada, Toronto, Ont.

<sup>7</sup>General manager, Utilities Commission, Peterborough, Ont.

the design of electrical materials and apparatus, thus making them safer to work with.

His figures show that not only has the number of fatal accidents been reduced by two-thirds, but accidents of all kinds have been reduced. This shows what can be done by patience and assiduity in promulgating safe procedures and methods.

The financial saving has been large, as is pointed out in the paper, but there has also been the great decrease in suffering and anguish attendant on serious and fatal accidents.

If one can judge by the rates imposed by the Ontario Workmen's Compensation Board, working for an electrical utility is only one-half as hazardous as for a waterworks utility. The rates are \$1.00 and \$2.00 per \$100 of payroll, respectively.

The author is to be congratulated on the results of this quarter of a century campaign for safety in the electrical business.

G. H. FERGUSON,<sup>8</sup> M.E.I.C.

The paper presented by Mr. Maclachlan, (with whom I was in much closer contact during the construction of the transmission lines of the Hydro-Electric Power Commission between Niagara Falls and Toronto than in recent years) is a splendid record of accomplishment in a very important field of work. The value of his work seemed so striking to the writer, that it was brought to the attention of Dr. C. F. Blackler, the acting chief medical officer of the Division of Industrial Hygiene of the Department of Pensions and National Health at Ottawa. Dr. Blackler regards Mr. Maclachlan's resumé as an "excellent report on the common accidents in the electric public utility industry and the methods adopted in their prevention."

The paper indicates a significant and commendable reduction in fatal accidents. Thus in the last five years fatal accidents were less than one third of what they amounted to in the period included between 1915 and 1919. So also permanent partial disabilities were so reduced that in the last five years their total was only 15 per cent of the total for the 1915-1919 period.

A preventive policy like that adopted in regard to linemen's belts, is an excellent example of a simple though effective safety measure. In this particular instance the replacement of malleable belt snaps with snaps of forged steel has had the desired result.

Workers in occupations where hazards are great should be carefully selected; they should be well-balanced individuals with definite aptitude for the work in which they are engaged. Indeed, it would be to everybody's great advantage if some form of aptitude test could be given to men who are to be exposed to great hazards. In this connection the halt which a lineman makes four feet below the lowest cross-arm is an excellent "pause and think" measure. But no amount of aptitude can meet the risk to which a worker is exposed when a supposedly dead transmission line accidentally comes back into service operating at 44,000 volts.

It is most desirable that Mr. Maclachlan and his colleagues should continue to "carry on."

E. D. GRAY-DONALD,<sup>9</sup> M.E.I.C.

I would like to compliment Mr. Maclachlan on his paper, and on the work that he and all others engaged in the promotion of safety are doing. We all realize that it is uphill work, but it is worthwhile.

There is one point in the paper that I think would stand amplification. It is said that discipline develops fear, and frequently results in more accidents. What is the alternative to discipline? Education may be, but only up to a point, because most accidents are due to flagrant disregard of

safety rules. I would be interested to hear more about this matter of discipline. Another point I wish to stress, and it has been mentioned by Mr. Maclachlan, is the necessity for simplicity in safety rules. Keep them simple and based on plain common sense. If there are too many rules they cannot all be known, and if such a situation develops the workmen, and very often the supervisor will lose interest. It is possible to get so many rules that they defeat their own purpose.

Mr. Maclachlan's remarks on habit training deserve more attention. There is no doubt that a man of careful habits is much less likely to get into trouble, and such training is worth a lot of educational effort.

R. B. MORLEY<sup>10</sup>

My thanks, first of all, are extended to Mr. Maclachlan and to the Institute for the opportunity to follow him in the comprehensive story of the work in which he is engaged. I wish that the concluding paragraph of his paper might be read by every employer, every superintendent and every foreman in Canada.

Mr. Maclachlan has dealt with engineering revision, with the provision of suitable tools and equipment, with work methods and with the human factor, all of these things looking to straight accident prevention. Those of us who have been in the work for any length of time, realize with him, that accident prevention work to be fully effective, must include a certain amount of follow-up after an accident has happened, in order to see, first, that the injured employee has received proper treatment, and, second, that the conditions which caused the accident are corrected.

The prime requisite for any machine is that it should turn out work quicker, more easily and more cheaply than could be done by hand. The designer of the machine probably had this always in mind and the safety of the operator was a subsequent development brought about, in my opinion, in industry at least, by two things, Workmen's Compensation and ordinary humanity. Workmen's Compensation served to bring into sharp focus the cost of accidents and it became evident that it was cheaper and better to prevent accidents than to pay compensation for them. Engineers have a responsibility to design tools with a wide factor of safety for the protection of the operator, as properly guarded equipment will make production easier and cheaper and quicker. The story of safeguarding is the old story of "trial and error." Some found out by cruel experience that unguarded gears spelt sorrow, suffering and expense. Someone found out that the law of gravity was a good reason for foot protection; someone found that, not only did goggles protect eyes and save costs, but the man wearing those goggles stood up better to his job, I remember a man telling me, some years ago, that a hammer-man had said to him that he had never really seen a forging made until he began wearing goggles.

When management and supervisors have accepted responsibility for accident prevention work, when working conditions have been made reasonably good and safeguarding has been carried out, industry is then faced with the problem of getting the interest of the worker, and that is not a problem to be solved in an afternoon.

Responsibility is something no one of us can shirk. The worker in a plant has a responsibility for doing good work in a safe manner, a responsibility for using the safeguards provided and for keeping them in place. He has the responsibility for applying for First Aid for any cut or scratch and a responsibility to follow plant safety rules as part of his regular work. There is, too, a responsibility to be clean and orderly and to work well with others.

Fixing the responsibility from the viewpoint of accident prevention must be quite independent of any investigation connected with the liability for compensation. If safety

<sup>8</sup>Chief, Public Health Engineering Department, Department of Pensions and National Health, Ottawa, Ont.

<sup>9</sup>General superintendent, Quebec Power Company, Quebec, Que.

<sup>10</sup>General manager Industrial Accident Prevention Association of Ontario, Toronto, Ont.

rules have been broken and guards have not been used, if orders have been disobeyed, the responsibility for the accident must rest, in part, on the supervisory force. Consciences may possibly be eased by blaming the injured workman, but, from the viewpoint of accident prevention that is futile.

Last year, in Canada, there were 314,514 accidents reported to The Workmen's Compensation Boards in eight provinces (Prince Edward Island has no Workmen's Compensation Act). Those figures included 1,217 fatalities. With the standard charge of 6,000 days for a fatality, you will see that the time lost, in fatal cases, would run to more than seven million man days in 1941, or, the equivalent of more than twenty thousand men working 300 days in the year. The actual days lost in temporary disability cases alone, would probably run to 1,500,000 days and when you are thinking in terms of production and working against time, these figures represent colossal losses; losses that in many instances, could be controlled to an even greater degree than is now being done, but which would have been many times greater had there not been organized accident prevention throughout the country.

The author's story of control of accident experience in the public utilities of Ontario is a practical demonstration of the sound common sense of intelligent accident prevention work and I quote from statements made in 1941 by Mr. T. N. Dean, statistician of The Workmen's Compensation Board of Ontario, to indicate that industry, generally, has done good work, but work that can be further extended.

"From 1915 to 1940 the benefits paid to or on behalf of injured workmen steadily increased as revision upward was made by legislative enactment. The general rate of compensation was increased from 55 per cent of earnings to 66 $\frac{2}{3}$  per cent. Pensions to widows and children were doubled. A minimum compensation for low wage earners was introduced. Rehabilitation was added; burial expenses were increased, and above all, the Act, which provided for no payment of medical aid at its inception, now provides for full and complete medical aid without stint or limitation of quality or kind except the needs of the workman. In a general summing up, benefits under the Workmen's Compensation Act have at least doubled in the twenty-six years of existence . . . These, and other amendments and interpretations, have increased the coverage of the Act probably thirty per cent and are in addition to the increase in benefits provided by the Act itself. In other words, the Act is probably 130 per cent more liberal as far as benefits are concerned than it was at the time of its introduction. The cost of these increased benefits is best measured by the rates of assessments charged the employers on the payrolls under the Act. In 1915, when of course rates were experimental and very conservative as benefited the situation when there was no considerable body of experience for rate-making, the average general level of rates was \$1.24. In 1939 (the last complete year for which figures are obtainable as a large number of accidents occurring in 1940 are not yet finally disposed of and hence costs, therefore, are not yet obtainable), the average general rate-level was \$1.06 for each \$100.00 of payroll. This represents a straight decrease of nearly 15 per cent. . . . The fact, then, stands boldly forth. During the twenty-five years Workmen's Compensation has been in force in Ontario, benefits have been doubled, coverage has been increased one-third and rates have decreased by one quarter. It is, of course, entirely obvious that this situation might have been brought about if the individual claim cost had decreased but this is not so."

Mr. Dean also released some figures showing the average cost of medical aid only cases in 1921 at \$5.19, as an average, compared with 1939, at \$6.03. Temporary Disability cases in 1921 averaged \$80.77, and in 1939, \$141.69; Permanent Disability cases in 1921 averaged, \$1,163.90, while in 1939, the average was \$2,033.51, and death cases in 1921 averaged \$4,352.43, against \$4,558.87 in 1939.

JOHN MORSE,<sup>11</sup> M.E.I.C.

The subject discussed by Mr. MacLachlan is very timely and one in which we have been greatly interested for some years.

As one of the large public utility systems in Canada, we would like to submit our views on certain phases of some of the points brought out from the viewpoint of a public utility operating high voltage lines up to 220 kv., hydro-electric generating stations having a gross capacity in excess of 1,000,000 hp., and a number of substations with transformer units as large as 50,000 kv.a.

#### DESIGN

Modern design, particularly of substations, tends to dictate outdoor stations with gang-operated disconnecting switches usually operated by means of a crank, so that the operator is in little danger from an arc, and with ample clearance so that he has many ways of getting clear in case of trouble, which is not possible in the case of many indoor stations.

Three-phase grounding switches are provided in all cases on transmission lines, which switches must be closed and locked closed before clearance for work may be given to any employee. This is in addition, of course, to the portable grounds which will be placed on the conductors by the linemen.

In many cases to guard against incorrect switch operation, signal lights are placed near important disconnecting switches to indicate the position of the oil circuit breaker controlled by such disconnecting switches which should never be opened unless the signal light shows a green indication.

In some of the older indoor stations where a large number of single-pole-operated, high current capacity, disconnecting switches are installed side by side, not only are insulating barriers placed between phases, but distinguishing insulating barriers of a different shape and colour are installed to isolate each three phase circuit from its neighbour. Together with proper designation, this serves, when doing switching, to restrict the operator to a particular group of disconnecting switches on the same circuit. In addition, portable barriers are often used which are set in place by the foreman in front of apparatus which is to be worked on, and this again serves to prevent the workman from carelessly or otherwise becoming involved with neighbouring equipment which looks identical but which may not be dead.

#### TOOLS AND EQUIPMENT

All tools and equipment used must be of standard design and approved by the company. Furthermore, our procedure is that such equipment must be inspected at definitely determined intervals of time, and reports made out so that all such equipment is kept in good working condition at all times. This is the responsibility of the electrical or mechanical foreman, as the case may be, and applies to such matters as ropes, slings, hand-lines, grounding sticks, switch sticks and testing devices.

We do not make use of any equipment for working on high voltage lines alive. As a matter of fact, we are trying to design our system so that any line may be taken out for work and service maintained over a duplicate channel.

Special attention is also given to the condition of rubber gloves and fire-hose. Chains and insulated wire must not be used as grounding mediums, but rather an ample capacity braided and bare copper conductor is used for temporary grounding.

#### METHODS OF WORK

A Standard Operating Code and Safety Rules have been prepared and have been in use for many years. This was originally intended as a collection and standardization of a

<sup>11</sup>General superintendent, Shawinigan Water & Power Company, Montreal, Que.

number of operating practices and safety rules which had existed in many of the component parts of the company. This standardization has worked out very well and has been of definite value in reducing accidents to a minimum and improving service. In order that employees may know these operating rules and safety practices thoroughly, an operating instructor is employed for this purpose. Such operating instructor must be a well-qualified man, well sold on the matter of safety and reporting to the Head Office.

Without going into the details of the clearance system, our general rule is that before a Clearance Card is given to a foreman or workman, the apparatus on which he is to work must be made dead, securely grounded (or blocked in the case of mechanical work) and every reasonable safeguard taken before the clearance card is delivered to the foreman. This, of course, is in addition to any safety measures which the foreman must or wishes to take for the protection of himself and the men working under his direction.

The foreman is made directly responsible for the safety of men under his supervision. In case of new apparatus going into service or extensive testing being undertaken, a competent man is always detailed to supervise the whole job from the point of view of safety only. We find that this is a very necessary and valuable precaution to take.

Another point of interest is a rule which makes it obligatory that where mechanics, painters, cleaners, or other laymen are to begin work near electrical apparatus where an element of danger may exist, a watchman must be appointed to do nothing else but supervise the men on that job. The watchman's job is concerned with safety only. He is not there to dictate how the job is to be done but to dictate between what limits the men are to work and to see that men who leave the job for any reason, return to the proper area. In case the watchman has to leave for any reason, work must stop while he is absent, unless another watchman relieves him.

To insure that every effort is being made to perform switching operations properly and in the proper sequence, a Switching Order Form has been prepared which must be filled out by the shift operator and checked by the control operator before any switching is started. The shift operator does the switching with the control operator staying on the control board.

From experience it has been found out that most switching errors occur during normal operation when time is not a deciding factor. Every effort is made to direct the operator's attention to following the sequence as outlined on the Switching Order, doing switching deliberately and taking sufficient time so that the operations will be properly done. It is most essential that an operator make a final short pause immediately before operating switch controllers, to read the designation of the switch he is about to operate, see that it corresponds with the Switching Order and that the switch is in normal position, and to realize what to expect when he operates the controller.

Mental reminders are often used in the way of signs near the controller where some abnormal condition exists.

#### THE HUMAN FACTOR

Statistics indicate that it is not the highest grade men or the poorest men who get involved in accidents, particularly electrical accidents. In many cases, the man cannot give a plausible explanation as to why he performed an incorrect operation. This is the most difficult problem to cope with, and we are always interested to know what other companies have done or are doing to try to prevent accidents due to this cause. We have succeeded in reducing the number of controllable electrical accidents to negligible quantities, and in several cases which have been investigated, we are at a loss to know what we as a company could have done to avoid the accident.

As far as possible, we believe in the theory of *preventing* the accident if at all possible, but we realize that accidents may happen, and, therefore, it is essential that every employee knows how to conduct himself as far as first aid and resuscitation are concerned. All employees in the field are given frequent examinations in their knowledge of these principles of first aid and resuscitation.

In case of accidents, a careful investigation is made by the safety engineer with a view to finding a method of avoiding a repetition and working out a solution which might result in changes to our safety regulations which would be beneficial to the company's staff in general.

In cases of operating mistakes, disciplinary measures are not taken except where the operator deliberately withholds information or does not tell a truthful story, or in case the accident involves an infraction of the Clearance or Hold-off System.

J. E. PATTERSON<sup>12</sup>

We would like to congratulate Mr. MacLachlan on the excellent manner in which his subject is presented. The examples and graphs make it particularly interesting.

As a matter of interest we would like to list a few practices which Gatineau Power Company follows in its accident prevention work.

It is our policy to investigate all accidents requiring medical attention and also some accidents which have not required medical attention, but which might have been more serious under less fortunate circumstances.

The primary object of the investigation is to determine the cause or causes of the accident being investigated. When the cause or causes have been determined the blame is usually embodied therein.

Employees have been disciplined in a few rare cases and the results have been encouraging. The discipline apparently has reduced repetition by fellow employees.

All accidents and causes are later discussed with all employees engaged in similar classes of work and construction methods are altered when it is in the interests of safety.

For the past few years an annual questionnaire has been prepared and linemen are questioned individually on safe practices in carrying out their work.

We believe that this has resulted in a decline in the frequency and severity of certain types of accidents.

L. H. URMSON<sup>13</sup>

The author, gives graphs showing the frequency and cost of accidents in the public utilities in Ontario over a twenty-five year period. These show very substantial, steady improvement, particularly in the past ten years since the construction companies' accident records have not been included in the electrical industry class.

The Quebec Public Utilities Safety Association has been in existence since 1931 only. During this entire time the construction companies have been included in Class 22, and for this reason, frequency and costs are not comparable with the electrical industry in Ontario. The cost of accidents for installation and operation of electric power plants only (apart from construction works, telephone and telegraph systems) averaged \$1.35 per \$100.00 of payroll.

In an effort to reduce the accident toll amongst member companies, the Quebec Public Utilities Safety Association sends out educational literature such as bilingual safety posters, safety instruction cards, material for superintendents' safety talks, accident history bulletins, etc. The Association has eight motion picture films, with bilingual titles, which are available to members.

Histories of fatal and serious accidents to employees of member companies are sent out in the form of accident

<sup>12</sup>Safety engineer, Gatineau Power Company, Ottawa, Ont.

<sup>13</sup>Shawinigan Water & Power Company, Montreal, Que.

history bulletins, and contain a warning and how to overcome hazard. These are bilingual, and sufficient copies are sent to give each workman a copy.

In addition to the above, posters are sent to non-members of the Association.

Since 1933 a Safe Driving Competition, for men driving company automobiles, trucks, buses and street cars, and private automobiles used on company business, has been carried on. Medals and certificates are awarded each year to men driving motor vehicles a minimum of 5,000 miles without accident, and 10,000 miles per year for drivers of street cars.

Speaking for the companies I am directly connected with, The Shawinigan Water & Power Company and subsidiaries, for many years have had safety rule books for the different industries, which are distributed to all the men. These are brought up to date and revised from time to time.

All Shawinigan workmen are trained in first aid to the injured, particular stress being laid on resuscitation from asphyxiation by electric shock, gas or drowning. A first aid man is employed, whose entire time is given to first aid and safety instruction in the field. On large construction works, where it would be impossible to train casual labour, there is a hospital and resident plant doctor, and special crews of men are trained in first aid and resuscitation.

Our experience has shown that, with proper direction, the foreman can do most to prevent accidents to the workmen. On two of the large Shawinigan construction jobs, where accident frequency and severity were high, the foremen were told they would be held responsible for all accidents to their men. They were given to understand that upon the keeping down of accidents to their men depended their usefulness to the company. As a result of this the accidents were cut down by forty per cent almost immediately, and the improvement was maintained throughout the jobs.

The method used to keep the figures before the foremen was, first, by the posting of a large board in a prominent spot on the jobs, which had the names of all the foremen. Each month a record was posted which showed the accumulated number of accidents chargeable to each foreman. Each month a record was sent to superintendent, general foreman and sub-foremen showing accidents, and to whom chargeable.

At the generating and sub-stations the superintendents give the men weekly safety talks, using the General Operating Code and Safety Practices and aforementioned bulletins as material for the talks.

Frequent plant inspections are made in search of physical hazards, which are removed or guarded against when discovered.

By the means outlined above our accidents, in which are included accidents in non-electrical industries, were substantially reduced in frequency and cost, and this reduction has been maintained.

#### THE AUTHOR

The discussion of the paper, by members of the Institute and others is very gratifying to the author and to the officers of the Electrical Employers' Association of Ontario. The interest evidenced and the details given in amplification by various senior officers of large organizations, add very considerably to the general outline given in the paper.

There are certain specific points raised which should be answered.

Mr. Beauchemin, asks specific questions and the following are the answers:

1. The statistics used as a basis of the graphs were developed from data prepared by the Workmen's Compen-

sation Board of Ontario. The injury to the man usually defines whether the accident is temporary, permanent or fatal. Other statistics are prepared by the Electrical Employers' Association of Ontario and by some of the utilities.

2. Near-accidents at times are used in drawing lessons, which of course are not as effective as accidents that cause an injury. Where a similar accident results in one case in no injury and in another case a serious or fatal injury, the lesson is presented to the men.

3. There is no doubt that the increased exposure of a large company may result in more accidents but there are so many other factors present, such as interest of senior management, concentrated or scattered employment, type of work, etc., that no definite relation can be developed.

4. No definite ratio can be given. Generally men have accidents in the first six months of their employment and after five years employment. This general statement has many variations and exceptions. Recently, serious accidents have been occurring to trained and experienced men.

5. In the electrical public utility industry, electrical shock and burns have been responsible for more serious and fatal injuries than from any other agency.

In the discussion by Mr. Morse it is very interesting to note that the Shawinigan Water & Power Company is not carrying out hot-line maintenance of high tension lines but is providing a duplicate service so that lines can be taken out of service for maintenance. Further in his discussion Mr. Morse develops a method for watchmen while mechanics, painters, cleaners and other laymen are working near live apparatus. This method is receiving more and more consideration in large utilities and the results obtained are well warranted.

In the discussion of Mr. Brace, he points out that the Bell Telephone Company in developing its rules or safety code, used the suggestions and criticisms of experienced employees. "In this way, the employee feels that it is his safety code." This is a most important point, for people are only interested in things in which they take part.

Both Mr. Gray-Donald and Mr. Patterson raise the question of discipline, the point being that "accidents are due to flagrant disregard of safety rules."

A number of years ago, four senior supervisors examined into the details of one hundred serious accidents. Of these accidents very complete information was available, as careful investigation was made in each instance. At that time, it was thought that placing the responsibility of the accident was important. These supervisors placed 54 per cent of the accidents to the responsibility of the supervisor; 36% per cent to the responsibility of the workman and 10 per cent to the responsibility of design or material. Similar investigations have been carried out by other organizations with very comparable results. It would therefore appear that many accidents are not primarily due to flagrant disregard of rules but to lack of adequate supervision.

As is pointed out in the paper, there is no doubt that quick results can be obtained by the use of discipline, but these results are not lasting. The whole effect of discipline has as its motive, fear; fear of being fined, fear of being reduced in the job; fear of losing the job. Fear is always sickening and leads to a sub-normal man, who is more likely to have accidents. Education and leadership take longer but the results are well worth-while. Dictation and domination for a time get quick results but only postpone the solution of the problem.

It is sincerely hoped that the paper and discussions may be taken to heart by some of our war industries and save unnecessary waste of men and material.

# RECONSTRUCTION AND RE-ESTABLISHMENT

**NOTE:** The following is a summary of the evidence presented by Dr. F. Cyril James, Principal of McGill University and Chairman of the Cabinet Committee on Reconstruction before the Select Committee of the House on Reconstruction and Re-Establishment. It has been prepared, at the request of Council, by Warren C. Miller, M.E.I.C., Chairman of the recently established Institute Committee on Post-War Problems and is published in order to keep members informed of the work that is being done in that field.

On March 24th, 1942, the Dominion Parliament appointed a Select Committee of the House to report upon the general problems of Reconstruction and Re-establishment which may arise at the termination of the present war. On May 14th and 19th Principal James of McGill University who is the Chairman of the Cabinet Committee on Reconstruction gave evidence before the House Select Committee.

Principal James described the general approach which his committee has been making to the problem of reconstruction since its appointment and the sequence of ideas upon which its work has been based. This he did under three general headings: first, the basic assumptions or ideas on which the committee has worked; second, a description of the broad outline of the probable sequence of events at the end of the war; and third, the breaking down of the problem into nine sections so as to be sure that nothing would be overlooked.

## BASIC ASSUMPTIONS

Dealing first with basic assumptions the committee believes that the essential requirement for Canadian prosperity and Canadian progress at the end of this war is, that the individual who is able to work and wishes work should have a decent opportunity to work. All our financial, fiscal, political, economic, agricultural and other policies should be designed to produce that ultimate result. A solution of the problem of demobilization should be included. Workers in munition factories who will presumably be released from that employment must also be considered along with all other members of the community. Many people feel as well, that in addition to full employment, a definite increase in the standard of living should be contemplated.

Reconstruction is not something that begins one second after the last gun is fired. It is intimately related to the present and the past. We should not assume that the end of the war will automatically bring us closer to Paradise. We will not be in a position to start afresh with a full new plan. Circumstances at the end of the war will be those that result from all of the long traditions of this Dominion. All the things that have happened in the past and which are happening during this war will leave an impress on that moment of time. Reconstruction is something which must be thought of in advance, partly for the purpose of recognizing exactly the influence of wartime activities, controls and regulations on the post-war Canadian scene. Many people are acutely interested in this great problem. It is not that they are not interested in the war itself, or consider the post-war period as more important than the epochal events that are taking place from day to day. They have a vision of that future which they hope will be Canada's, and this vision inspires them to even greater efforts at the present time. They begin to see the possibility of realizing many of the things that they have dreamed of in the past. The psychological importance of our approach to the problem of reconstruction may contribute just as directly to the war effort as clearcut and carefully planned development of reconstruction policies will contribute to the solution of immediate war problems.

We should attempt to preserve as far as we may, compatibly with the attainment of full employment, the basic Canadian tradition of free enterprise and personal initiative

in both political and economic life. Principal James' committee is not envisaging the creation of a completely new society nor is it writing a Utopian programme of what society might be if there were no traditions. They are attempting to envisage a situation in which there will be carried on all of the basic traditions embodied in the phrases "personal liberty" and "democratic institutions."

The underlying philosophy on which the committee has been working, therefore, includes the assumptions of full employment, reconstruction as a continuing aspect of present policy and the maintenance as far as possible, of basic Canadian political and economic traditions.

## THE SEQUENCE OF POST WAR EVENTS

In addition to a philosophy it is necessary to have some sort of idea continually in mind as to what is likely to happen at the end of the war. While we have no precise idea of what is going to happen, each of us has some picture in his mind which, while it is clear at any given moment, is always subject to revision. Without such a picture we are likely to flounder around in an uncomfortable morass.

Examining the situation which followed the armistice of 1918, three sets of factors may be seen. First there was a great accumulation of consumer purchasing power. Substantial profits were earned by certain industries and high wages were being paid to many groups of workers in those industries. During the war there was a shortage of goods so that this large accumulation of consumer purchasing power was itching to be spent. Second, returning soldiers were paid substantial cash bonuses which provided an immediate fund which was often spent rather extravagantly. Third, there was a very general desire to get back to business as usual, a restlessness against restraint arising from the feeling that the war had ended and that the world was now going to be able to get back to the good old days of 1914.

No one of these factors will be equally important at the end of the war. Taxes are already higher than they were at any time during the last war. We have imposed price and wage controls and other regulations to preclude the possibility of excess profits in war industries or sharp increases in the wages paid to workers at the present time. We have controlled consumer prices. The only substantial sums available for immediate post-war expenditures will consist of the funds now invested in war savings certificates, together with forced savings accumulated under the new budget. Both of these amounts, however, will be smaller and more easily controlled than the amounts that were involved in 1918 and 1919. With respect to returning soldiers, the plan contemplated by the government will involve some small cash bonuses distributed by means of periodic payments during re-education, re-training, unemployment, or interrupted education. Thus there will be little possibility of any sudden splurge in consumer expenditures from this source. With regard to the third point, the average man on the street today has less desire to get back to business as usual than the average man on the street had in 1918. The war has changed fundamentally the pattern of our economic structure. Certain developments, changes and plans will have to be carried out and the experience of the 1921 and 1929 depressions have made them rather cautious about suddenly wanting to get rid of all restrictions and to return to the idea of operating business in the old way. At the end of this war the business boom will be less intense than it was after the last war, but it is likely that there will be a boom. Such a boom will provide a slight breathing spell. We ought, during that period, to be ready to accelerate the rehabilitation of industry, agriculture and commerce to the greatest possible extent. We should be able to accelerate the changeover of factories from wartime

to peacetime production both for the purpose of absorbing unemployed workers whether soldiers or others, and also for the purpose of providing a maximum supply of those consumer goods which the people of this and other countries will need.

Such a period of prosperity will come to an end. We must admit the possibility that there may not be a period of prosperity at all. We are compelled, therefore, to look to the fact that there will inevitably be a post-war depression, either immediately after the war, or at the end of this period of prosperity. That depression will show itself first by local unemployment in certain areas where private enterprise has not been able to meet the needs of the situation satisfactorily. We must have in reserve some supplementary programme of government activity. That presumably will take the form of publicly financed construction projects. It is too early to say whether they will be financed by the Dominion, the provinces or the municipalities. It will, however, be financing and organization by some governmental authority, in the interests of solving the whole problem of re-employment and rehabilitation throughout the community.

#### THE FRAMEWORK OF THE PROBLEM

In order that progress can be made at more or less the same rate on all fronts, the committee has attempted to develop a broad picture of what reconstruction actually means in several different fields. The problems were divided between: first, those purely domestic to the Dominion of Canada, problems in regard to which Canada can go ahead and do practically what she wants without consulting anyone else; second, those that are domestic to Canada in the sense that they have to be decided by the Dominion Government but in which the freedom of action of the government is conditioned by events and activities in other parts of the world; and third, those of vital importance to Canada, but in regard to which Canada can do nothing at all because their solution depends on international action.

Dealing with the first subdivision we can further subdivide it into three parts:

- (a) employment opportunities within the Dominion;
- (b) the conservation and utilization of natural resources; and
- (c) the development of plans for publicly financed construction projects.

#### EMPLOYMENT OPPORTUNITIES

The first thing to be done was to see whether there existed or could be developed in the Dominion, machinery by which unemployed individuals in any part of the Dominion could be brought into touch with jobs requiring their particular skills in some other part of the country.

There is also the question of the size of the labour force retiring from and entering the labour market. At the end where labour leaves gainful employment, there is the whole question of old age pensions, retiring allowances, unemployment relief, sickness compensation and other associated factors. We need to know how nearly uniform is the treatment of these matters across the Dominion. Are any variations appropriate to the differences in economic conditions and living standards within several provinces where improvements can be made? How well can we take care of those who through no fault of their own have to withdraw from active competition for available employment? At the other end of the scale the inflow of labour depends on the ordinary school leaving age which varies according to our ideas of minimum educational requirements for all and on the question of specialized education where access to particular professions and trades is conditional on adequate training, either in colleges, technical schools, or by apprenticeship. The place of education in this picture is a difficult one, since it is clearly under provincial control. The Dominion Government has no direct responsibility. The committee is, however, exploring the question and is bring-

ing together a small group of outstanding educators from several of the provinces to discuss the general aspects of the problem in regard to primary, technical and higher education. It is hoped that as a result of the work of this committee, another will be formed on which the provinces will have direct representation, and which will have the confidence of the provinces as well as the various educational groups, and which will be able to make constructive recommendations.

#### CONSERVATION AND UTILIZATION OF NATURAL RESOURCES

The conservation and utilization of natural resources is another purely domestic problem. Forests, fisheries and mines not only contribute a substantial proportion of the needs of our industries, but have been one of the great amenities of the continent. They contribute to the aesthetics of our standard of living and have attracted tourists from all parts of the world. Their conservation and constructive utilization is apt to provide substantial employment opportunities in the immediate post-war period. Principal Wallace of Queen's University is chairman of a subcommittee on conservation and natural resources with members representative of Dominion and provincial governments and private enterprise in the various important fields of natural resources.

#### CONSTRUCTION PROJECTS

A programme of publicly financed construction projects is the third field of purely domestic activity. At some stage of the post-war period it is going to be necessary for government to step into the picture in order to provide employment in an area where business has become slack. Well laid plans should therefore be available long before that moment comes. It has been the experience of many countries that have used publicly financed construction projects to cure unemployment during the last ten years, that the difficulties arise, not at the stage where labour is employed and materials purchased, but rather at that earlier stage when it is necessary to prepare plans, to determine quantities of materials, and types of men to be employed, estimates of cost and above all to determine the exact type of project and its location. This must, in its very nature, be local. Unemployment in British Columbia requires projects in British Columbia, not Ontario. Otherwise, we are confronted with the task of trying to move substantial numbers of workers from one section of the country to another, something that in Britain was found to be very unsatisfactory when an attempt was made to move people from the distressed parts of Wales to certain other parts of the country where new industries were developing. It is necessary therefore, that there must be close co-operation between any Dominion organization and the provincial and municipal organizations that are responsible for the most of such projects. Long before the war ends we must have available carefully developed plans for a variety of possible projects. A sub-committee to study this phase of the problem is working under the chairmanship of Mr. K. M. Cameron, M.E.I.C., Chief Engineer of the Department of Public Works, Ottawa.

Mr. Cameron's sub-committee is trying to do two things. First, there is the problem of plans that will enable it to recommend the creation of a public works reserve in Canada. In the United States this is a Federal organization, with an elaborate technical staff which is at present engaged in discussions with the several states, encouraging them to prepare specific plans for post-war projects of this kind. At the present stage there is no suggestion of financial commitments of any kind. The big problem is the determination of what ought to be done. What are desirable projects that contribute to the social good? What will they cost in terms of labour and materials? How long will they take to construct? If a complete list of projects can be compiled for each area, it can be the subject of subsequent financial discussions between the municipalities and the

provincial governments or between the provincial and Dominion Governments. We shall then have progressed a long way toward the solving of our problem. Even if Canada should never have to use publicly financed projects for the purpose of meeting unemployment, it still would have been time well spent to develop such an insurance against a conceivable unemployment situation.

Secondly, Mr. Cameron's sub-committee is trying to develop certain criteria or standards by which such projects can be appraised. It is necessary that there should be certain clear-cut methods of accounting and documentation, certain standards of the drawing of plans and the preparation of specifications. This is absolutely essential to the building up of any large group of construction projects and to the putting of those projects into effect at the moment it becomes necessary.

#### RELAXATION OF WARTIME CONTROLS

The second broad group of subjects are those within the control of the Canadian Government in the sense that Canada can develop and carry out a specific policy, but in which the effectiveness of that policy is going to be affected by developments in other parts of the world. The relaxation of war time controls is one of these problems. Canada has, since the commencement of the war, instituted a very elaborate series of controls of practically every aspect of economic life. At the end of the war, if we are going to get back to a less controlled economy, it is obvious that those controls will have to be relaxed gradually and wisely. There would be chaos if they were suddenly abandoned on the day after the armistice. That chaos would extend to many other countries because the controls are to-day geared to the economic activities of other countries. For instance, in the field of foreign exchange control, our regulations and operations are tightly meshed together between this country, the United States and Great Britain.

We have to face a serious psychological problem. At the end of this war, in terms of the Atlantic Charter, we are trying to create a world in which there will be reasonable prosperity, individual freedom, and full employment. There will, however, be a completely different set of circumstances on this continent from that in Great Britain. Canada will have a surplus over and above everything we could eat, and also over and above what we can send to Europe in available shipping bottoms. England will receive for consumption only those materials for which there are ships. Consideration must be given as well to the re-vice of Europe. It will be easier in this country to relax controls than it will be in Britain. The question will arise whether there should be some joint policy in timing the relaxation of controls.

This whole problem is one of the most complicated that the community will confront at the end of the war. Everyone will want to get rid of the controls that worry him personally, although many people believe that Canada should keep all of the controls that do not seriously inconvenience them. However, each group of controls will be under attack from some sections of the community. The desirable procedure to be followed should be that of attempting to find out now the way in which particular controls can be modified, step by step, in a sensible and coordinated fashion. We ought first to make a study of the exact facts of the relaxation of comparable controls, in the case of particular industries during and after the last war. On the basis of those two sets of data, we should try to develop a programme for progressive relaxation of controls, as far as may be practicable after the war.

#### THE REHABILITATION OF AGRICULTURE

It is probable, although we cannot be sure, that we might expect a slump in Canadian agriculture at the end of the present war. Other nations will come into competition for British and United States markets. To complicate the picture, there is the whole question of land settlement, since

it is to be expected that a good many returned soldiers, under the option given them in proposed legislation will want to settle on the land.

Agriculture depends also on another very interesting recent development, nutrition. It has been said that in the western world, including Great Britain, Canada and the United States, if we were able, either by education or public assistance, to develop a satisfactory standard of nutrition for all people below age 20, we would require all the agricultural output of this continent and that of Argentina. The problem of Canadian agriculture is not only one of foreign trade, but it is also governed by our approach to good nutritional standards and adequate feeding. Both of these are intimately related to full employment and a decent standard of living for the people of Canada.

Agriculture, during the past fifty years, has been greatly mechanized. A farmer with a tractor and appropriate equipment, is able to look after many more acres of land than his predecessor with two horses and a plough. It is necessary, therefore, to obtain some clear idea of the number of people that are necessary to meet our agricultural demands and the number that can attain a decent standard of living with reasonable prosperity and comfort through farming.

#### INDUSTRIAL REHABILITATION

A third aspect of these domestic problems that depends partly on world affairs, is the rehabilitation of Canadian industry. There are probably more workers in factories, in proportion to the total population, than ever before. The total output of manufactured goods is greater, the number of factories is greater, and the number of machines in those factories is probably greater. That industrial equipment is now necessarily devoted to the production of a large number of things that are not very useful in times of peace. It is easy to switch over from the manufacture of aeroplane radios for the combat service, to the making of civilian radios. It is not so easy to rehabilitate a shell making factory which has, mainly, single purpose tools, or a factory designed for making cartridges. It is probable that we have more shipbuilding capacity of the simple freighter kind than we will need, and not enough capacity for passenger liners.

Canada will face two serious problems at the end of the war. In the first place we must decide early what factories ought to be scrapped. At the end of the last war we gave ourselves lots of grief by trying to keep in operation factories that were neither necessary or useful for peacetime operation, and so contributed to the general depression. Secondly, since no factory ought to be scrapped if it is of any conceivable use to the community, we should also develop clear plans for rehabilitating the rest of the factories in such a way that they can promptly and effectively begin to manufacture appropriate civilian goods of a kind that are needed.

By and large, the problem of rehabilitation, of switching factories over, putting in new machines where necessary, and reorganizing assembly lines is something that must be done promptly. If not, there will be a great deal of unemployment as well as a great scarcity of many kinds of goods which people want and which they might reasonably expect to be able to get.

#### THE WORLD ECONOMY

The international aspect of the problem may be divided into three sections, first, the study of the probable world economy; second, the study of monetary and fiscal policies; and third, a study of Canada's foreign trade.

The general structure of the world economy is not a Canadian problem in the narrow sense, but what happens outside the frontiers is of vital importance to any policy that may be adopted in this Dominion. The general monetary system of the world and its effect on foreign trade and capital movement, the attitude of this country and other countries toward international migration, the policies that are adopted for the maintenance of world peace; all of these things are of tremendous significance to what we do, and

no matter how ideal Canadian policy may be in the purely domestic field, that policy could be completely wrecked by unsatisfactory developments outside our borders.

There seems to be only two conceivable types of organization for the post-war world; either the world must attempt to build up some integrated economic organization, or it must divide into a series of regions each of which is integrated within itself and protected by barriers of tariffs against other parts of the world.

If we accept the possibility of economic regionalism, there are many possibilities. There have been those who have suggested that Canada might become part of an integrated economic region based on Great Britain and the other British Dominions, a sort of Empire Federation economically integrated much more closely than at present along the lines foreshadowed in the Ottawa Agreements. On the other hand there is a group who suggest that the economic position of Canada should be integrated with a Pan-American region focussing on the United States. Economic regionalism along these lines would necessarily extend to the rest of the world. There would be a far eastern region under the hegemony of China; there would certainly be a central Asiatic and eastern European region under the control of Russia. If Canada should move into the orbit of the United States as part of a western hemisphere region, the position of Great Britain would be such that it would be compelled to link itself up with western European countries, Scandinavia, Holland, Belgium, etc.

All of these suggestions are random hypotheses. Unfortunately, any such division of the world into regions suggests the possibility of war, since nobody has yet suggested any regional grouping which is completely free from friction. The Committee on Reconstruction has come to the tentative conclusion that the ideal for the future structure of the world is an organization that is world embracing in its scope. The centre or nucleus of such an organization would necessarily be some broad economic affiliation between the British Commonwealth of Nations and the United States around which other countries might be induced to co-ordinate their economies, and not develop into isolated competitive regions.

#### MONETARY AND FISCAL POLICIES

Certain broad conclusions have been reached in connection with monetary and fiscal policies. It appears essential to the committee that if there is to be a world economy, there should be throughout the area of that world economy a co-ordination of monetary policies. This does not imply a restoration of the pre-'39 or still less the pre-'14 gold standard. It is recognized by a very large number of monetary theorists that monetary policy is the handmaid of commerce, industry and agriculture, and not itself the governing factor by which basic economic activities should be regulated. There is a widespread recognition of the idea that the post-war aim of monetary policy must be the attainment of full employment, so that the standard of living of the nation may be as high as it can conceivably be.

In practice there are difficulties especially in connection with the differences that may exist in the rate at which production expands in each of the several countries. This would offer opportunity for those who are not socially minded and encourage them to move their capital funds from one country to the other, to the detriment of both the losing and the gaining country. The committee has agreed that foreign exchange controls in something like their present form will have to continue during the post-war period. They will have to be administered in such a way as

to interfere as little as possible with normal commercial and industrial operations in the international field. It is also felt that there will need to be close and continuous consultation between the monetary authorities and the leading economic powers.

It is apparent that the fiscal policy in regard to taxation and borrowing will be much more closely and intimately related to the monetary policy than it has been at any time in the past. Full employment implies, at certain periods, an unbalanced budget. It implies a programme of publicly financed construction projects. When this is put into operation the government will be spending more than it will be collecting in the form of taxes. Taxation will continue to be heavy for some years. Government expenditure will probably be higher than it was before the war, since the ideals that we expect to attain and the several problems that will confront us for solution, are going to demand a very high level of governmental expenditure.

It is necessary to study very carefully the standards or criteria by which monetary policy will be judged. Monetary policies directed toward the attainment of full employment are comparatively new things, and the only historical examples that have not ended in chaotic inflation are those which have been tried out in a few countries in the past ten years. The ultimate danger of excess of monetary expansion is obvious, but it is difficult in a democratic community, to explain the reasons why expansion cannot continue beyond a certain point. We must endeavour therefore to maintain the position of the monetary authority on the highest line of prestige and assist it in its task by a willing recognition of the standards by which its policy must be determined.

#### CANADA'S FOREIGN TRADE

Foreign trade is intimately linked up with many of the things that have been already discussed. There has never been a period at which Canadians were uniformly prosperous and happy unless the export market was sound and reasonable profits were being earned. This generalization may not, however, be as true after this war as it was before the war. There will be a larger domestic demand for our agricultural foodstuffs and raw materials, together with a smaller comparative demand for foreign industrial products. However, despite these changes, Canada will depend on international trade for many of the things that she needs for that higher standard of living which we wish to attain, as well as for the raw materials of some of our essential industries.

We can export goods only to the extent that we are willing to import goods and services from abroad for the payment of our exports, or to the extent that we are willing to send capital abroad. Canada either must take payment for exports in goods, or services produced in other countries, or it must frankly express its willingness to supply such goods as a long term capital investment to be paid either by principal and interest in traditional fashion or to be repaid intangibly by better relations and a better ordered world. We must study carefully the extent to which we are willing to export goods on either of these hypotheses; either in the case of a comprehensive world economy, or within the frontiers of any economic region of which Canada may be a part. Such a study, which is basic to any further discussion of Canada's foreign trade, cannot be made until we have decided upon the probable nature of the world economy, but it cannot be too much emphasized that the basis should be that we need things from other parts of the world, rather than that the other nations ought to buy Canadian goods.

# PROFESSIONAL DEVELOPMENT AND RESPONSIBILITY

ROBERT E. DOHERTY

*Chairman, Engineers' Council for Professional Development*

An address presented before the 1941 Annual Meeting of the American Society of Mechanical Engineers\*

At the annual meeting of the American Society of Mechanical Engineers in 1966, someone will present a paper on what has happened during the twenty-five years since the United States entered World War II. It may recite how engineers, along with professional men from other fields, broke away from their traditional attitude of professional self-sufficiency, stepped into the rapidly widening breach on the social and economic front, and helped to save America. Or, it may recite how engineers, along with other professional men, kept their eyes so steadily focused on *status quo*, clung so tenaciously to their traditional and interesting business of giving the country a technological joy ride, that they completely lost sight of facts that were vital. They forgot that they were, after all, living in a democracy; they overlooked the fact that if the people do not determine policy affecting their welfare, democracy must vanish; they did not recognize that the activities and interdependence of groups in the national community had become so complex that the nation could no longer entrust its destiny as completely as in the past to emotional oratory and ignoble politics; they forgot that society had given them the privilege of higher education, and thus presumably greater competence to struggle with problems, and that therefore they had a commensurate responsibility for active interest and leadership. They lost sight of these vital facts. In other words, that paper—if indeed one can be given at all in such a case—may accuse our generation bitterly and with justice. It may say, "These men took things for granted. They forgot that they were trustees. They let us down. They forfeited freedom."

I do not know which of these papers will be read twenty-five years from now. It will depend upon what professional men do in practice and in education during the years immediately ahead. The engineer's part is a very important one, and it is my purpose here to outline my view of the situation and indicate what seems to be the clear responsibility of his profession.

After the war we shall live in a new world. It will be a world requiring fundamental readjustments in our thinking and in our way of national life. Indeed we are already well into that world and are advancing further into it day by day. To understand that all of this is so, we need not depend wholly upon the almost unanimous conclusions of serious students; we need only to look about us. Intense social stresses, widespread confusion of purpose, and gross abuse of privilege are all too evident. National action has leaped far beyond national thinking. The simple fact is that this country is set up under a theory—the theory of individual rights and democratic procedures—and there is, after all, a limit to the extent to which that theory may be contravened. To go too far is to crack up. Flexible as history has shown the theory to be, there is yet a limit, as was demonstrated, for instance, in 1861. And since we have been rushed from our simple beginnings into the new, complex world, impelled first by technological development and now thrust headlong by the demands of war, we have got to accelerate our thinking to keep pace with our actions or we shall again stretch our theory beyond the breaking point. We must readjust our thinking and our attitudes regarding national and community life to bring these again into workable accord with our theory of democratic government; else there can be no lingering remnant of justification for the assumption that, as a nation of once-free people, we are still capable of intelligent action, or worthy of freedom.

\*Reproduced through the courtesy of the American Society of Mechanical Engineers.

How can these readjustments be initiated? Whose responsibility is it to plan them? From what I have already said my answer is clear. Professional men must undertake the task. One need not labour the point that, as a matter of right, they *should* do so because they have had privileges of education denied to others. The fact is that nobody else *can* do it. The problems are too complex. They involve the establishment of new interconnections—lines of communication and understanding—between fields of human activity that in the past have been held separate. The problems of sociology, economics, and technology are no longer merely technical in nature. The technical aspects of the problems in each of these fields are indeed difficult enough, but there are new elements to be recognized, new complications beyond those considered in the past. One is the imperative necessity now of recognizing more fully the interdependence of situations in these different fields. For instance, the technical problems of economics and the technical problems of engineering involved in the design of a piece of apparatus have of course usually been coordinated in the past, but the sociological problem created by the introduction of the apparatus into social use has not been adequately taken into account. Or, the other way round, a sociological problem—say, the employment of idle people who want to work—may not be solved because the technological or economic problems concerned are not solved. In other words, we have reached a stage, as I understand it, where the interdependence of situations in these different fields must be recognized. Human life is not divided into subject matter compartments; we can't continue solving one part of the problem and thinking we have solved the whole; we must actually *solve* the whole. Then another complication is the necessity of readjusting our philosophical base. Merely recognizing the interdependence of situations is not enough. The solution of these problems, if there is to be one, must be geared into a principle. That principle is not new; it is just forgotten—the principle of individual rights and democratic procedures. If our national problems are to be solved the parts must be related to the whole and this relationship must be made to accord with this fundamental principle of our existence as a political unit. And the intellectual task involved in the initiation and consummation of such a complex national readjustment is one in which professional men in all fields—including the social and physical sciences, the learned professions, business, engineering, industry, labour—are obliged to assume leadership, and obliged also to recognize, even in this process of assuming leadership, the principle of democratic procedures.

Among the professional men who should undertake such a task, the engineer has a heavy responsibility. I have said elsewhere: "A technological war is raging in a technological civilization. It is based on the engineer's work. He is conversant with the mechanical, chemical, electrical, and structural bases of both civil life and war. He plans mills and machines; he executes their construction; he employs and manages the men who do the work. He is responsible, in other words, for seeing that plans on paper become actual material things that work, and also that the job is done on time within estimated cost. On the other hand, he has not had in the past either responsibility or great interest as to what the social effects of his work would be. It is idle to censure him, as some do; and it is equally idle, I might add, to censure social scientists and business and political leaders, who did have the responsibility and presumably also the interest. That water is over the dam. But in the future the engineer must enlarge the scope of his view and take an

active interest, both as an educated citizen and as a professional man, in the problems of national and community life where his creations have so completely changed the environment and way of life."

"There are two things he can help to do, both of them immediately urgent. One is to create employment for the post-war period. After ten years of increasing population and increasing invention and discovery, yet of curtailment in most areas except government activity, the possibilities of constructive enterprise appear boundless: new materials, new products, new homes, new structures, new machine tools and methods, new services, and so on. Every engineer in the country, whether he be at the design table, in the field, in the laboratory, or in the plant; whether he be superintending construction, managing a factory, or running a business—wherever he is, every engineer should be figuring out what he can do on his job to provide constructive employment. His position may or may not carry decision, but he can at least think and suggest, and in many cases he can decide upon action. Seventy-five thousand trained minds turned upon the problem can bring results; and those minds can be reached and oriented through the professional engineering societies."

The other thing engineers can do is an educational job. It is to develop in their younger brothers and themselves a new understanding of their professional obligations to society, and the capacity and knowledge to discharge those obligations. This is a long-run undertaking, but time is nevertheless an element. One hopes that in the next generation of engineers there will be more who through education and interest are in a position to sit in policy-making bodies and thus help to guide the use of the engineers' creations, more who as teachers can help young engineers acquire the broader view of their professional responsibility, more who as educated men can recognize and support constructive political measures and oppose destructive ones, and help other citizens to understand complicated situations and issues. We cannot wait two or three generations; we must begin now, because the educational undertaking to which I have referred properly should begin in college. The foundation of knowledge and of incentive must be laid there. But the educational process we are considering, like the student's other professional studies, cannot end with college; it must continue afterward. Hence, in our emergency the process of education to prepare the young engineer for his new obligations should be begun at once both in the colleges and among practicing engineers, especially those recently graduated.

It is here that the responsibility of the organized engineering profession is absolute. Engineers individually cannot be expected to assume, on their own, these new responsibilities. I think I am right in saying that to bring about readjustments in interests and attitudes requires, even in younger people, unremitting guidance and attention, and in mature minds I have not yet fully learned what it requires. But if we are going to help the younger generation of engineers to prepare themselves for the job that is ahead of them, we must provide an organized educational movement. This movement will necessarily sweep across the entire range of functional organizations of the engineering profession, including the educational, legal, and practicing. In other words, to accomplish the purpose, it would appear that nothing less than a co-operative movement on a grand scale is required.

What, then, are the necessary steps in such a movement? The first is to bring about a full understanding of the problem, its vital importance and urgency, among the boards and executive officers of those national organizations concerned with engineering, and the acceptance by them of a plan of action. The second is to put the plan into execution. May I outline to you how I think these steps might be carried out?

Fortunately, the machinery already exists for doing the job; no new organization is necessary. The national engi-

neering societies, The Engineering Institute of Canada, and the Society for the Promotion of Engineering Education have local organizations through which the individual engineer and the individual student are reached. The National Council of State Boards of Engineering Examiners represents the local State Boards that deal with the legal side of engineering. Then there is the central conference body of all these groups, the Engineers' Council for Professional Development, which can provide such co-ordination among the groups as may be necessary. As I see it, the role of this central Council of twenty-four members in the whole undertaking would be thinking, planning, and conference. The undertaking is distinctly one of professional development. The members of the Council would bring to the conference table the best of what each group has to offer and what the Council's own Committees can contribute, and then by debate and deliberation and by consultation of Council members with their own organizations, work out for the purpose we are considering a co-ordinated plan that will fit into the existing programmes and machinery of the Council and that will have the support of the constituent groups.

The support of the several groups is absolutely essential, not only because they must approve any important project before it is put into effect, but also because the constituent bodies are the ones that will have to do the job. Although there are a few undertakings which the Council itself has been authorized to administer—the accrediting programme, for instance—it seems perfectly clear that an educational programme such as the one here contemplated must be carried out by the constituent organizations. The function of E.C.P.D. would be merely co-ordination of the effort through the Council's standing committees.

In short, then, the role of the Council would be co-ordination of planning and effort, and the role of the constituent bodies, the execution of plans. May I now say a more specific word regarding these roles?

I visualize in some detail a picture that has been taking form during the past few years of the machinery of national professional development. Some parts of the machinery are already in place and in motion, and others are being constantly added and put in motion. The problem is to complete the picture—to provide the links that are still missing, get all the parts in motion, and then gear them together in one effectively co-ordinated movement. Need I add, incidentally, that not an insignificant part of the problem is to accomplish all of this without stripping any of the gears? I have come to visualize this picture in increasing detail because several hard-working members of E.C.P.D. and its standing committees have been sketching in those details. And among these people, there is one who has been especially active and helpful in sketching the whole. I refer to that Socratic catalyzer, Dr. Charles F. Scott. From his unique vantage point—having served as head of American Institute of Electrical Engineers, Society for the Promotion of Engineering Education, National Council of State Boards of Engineering Examiners, Engineers' Council for Professional Development, and of the Connecticut State Board—he has dreamed professional development, pondered its problems, hammered unremittingly with searching questions his associates in all of these widespread interests, and made them—if by no other means, then by exhaustion—give him an answer. One phase of his genius is the bringing of miscellaneous ideas into constructive combination and seeing that people know them. And partly out of this catalytic process has emerged a picture of how the existing machinery of engineering organizations can be utilized to accomplish professional development in general, and therefore also the specific purpose we are here considering.

One visualizes lines of flow for ideas and plans from the several headquarters of the engineering societies to engineering students through the respective student branches, and to practicing engineers through the local sections; and from the S.P.E.E. headquarters to the engineering teachers

through its local sections. Also one sees crossflow on campuses between the several student branches and the local S.P.E.E. sections or groups, and in industrial centres between local sections of the engineering societies. Then there is the possible line to engineers entering practice through the licensing bodies. And the headquarters of all these agencies are tied together for co-ordination in the E.C.P.D. Thus the machinery exists all the way through. It needs only to be put to greater use for the purpose of professional development, including our present problem of cultivating a new understanding of professional obligation.

Can we not begin at once to utilize these available means to bring about this new understanding among engineers of the problems that face the country and of their responsi-

bility to take a hand? Can we not bring them to realize that all of them can help individually by thinking and planning how to create employment after the war and then doing what they can to get their thoughts adopted? And can we not—must we not—look ahead at least a generation and take responsibility for helping the younger generation to understand and prepare for the professional life and service that are ahead of them? Cannot the responsible heads and boards of engineering organizations take the necessary initiative to get this thing going? Then perhaps the paper at the annual meeting in 1966, reviewing the twenty-five years since we entered World War II, will say, "Engineers recognized their responsibility and did a magnificent part in saving America."

## Abstracts of Current Literature

### INDIA MEETING THE DEMANDS OF WAR

From *Trade & Engineering*, JUNE, 1942

The success achieved in the past twelve months in expanding India's industrial output has been substantial but does not justify complacency. Dr. Henry Grady, the head of the United States Technical Mission which arrived in India in April, declares indeed that India's industry is not yet in its war stride.

It must be remembered that India's engineering industry in peace-time was comparatively limited and was not designed for production in the accepted sense, though it had a capacity for structural, mechanical, electrical, and civil job work. Before the war there was practically no production of machine tools in India, though a few firms made a small number of special machines for their own requirements. There are now a substantial number of firms making, under licence, lathes (including small capstans), drilling, shaping, planing, slotting and hack-sawing machines presses, furnaces, power blowers, and sand-blasting plant. It has been estimated that the approximate output of machine tools and ancillary plant in India amounts to over 400 units a month, and this figure is rapidly increasing. The production of precision gauges, previously imported, has reached 1,000 units weekly in railway workshops alone. On the output of the machine-tool industry must in great part depend the pace of factory expansion.

The Government of India is doing its utmost to train labour, and by March last plans were made to provide for some 15,000 technicians (with expectations of 48,000 by March, 1943), quite apart from the training of personnel for the Government ordnance factories.

Another determining factor in the pace of industrial effort has been the capacity of the steel industry. Before the war India had an important steel industry, but it produced only plates, sheets, rails, tinplates, and bars. In the past twelve months there has been further progress in the production of high-grade steels. Among new types of special steels now being produced are bullet-proof armour plate for vehicle bodies, bullet-proof plate for howitzer shields and gun turrets; various kinds of alloy steels; a chrome-molybdenum alloy steel needed for aircraft, spring steels high carbon sheets, and a stainless steel. By the middle of this year steel production in India should attain a rate of  $1\frac{1}{4}$  million tons a year, by no means a final figure, for a further substantial increase in total production may be expected.

So far the manufacture of motor engines or chassis has been regarded as involving an unwarranted diversion of highly specialized factors of production urgently wanted elsewhere, and there has consequently been concentration on the manufacture of bodies, armour, and armament for imported chassis. By the end of last year many thousands of armoured vehicles of various types had been completed and delivered.

All shipbuilding yards in India are now working to full

### Abstracts of articles appearing in the current technical periodicals

capacity on the construction of naval vessels of various types. Over 300 such vessels are under construction, including trawlers, corvettes, minesweepers, motor-launches, lifeboats, cutters, and other seagoing and coastal craft, and floating docks. Altogether well over 30,000 men are engaged in the various new shipbuilding and repairing yards in the country. In addition to new naval construction, shipbuilders are engaged on extensive repairs to merchant ships, and in fitting degaussing equipment, gun mountings, and bridge protection. Approximately 4,000 sea-going ships have been repaired at Indian yards since the outbreak of war.

Engineering works in India are manufacturing components for main propelling and auxiliary machinery, and it is hoped that complete marine engines of indigenous manufacture will soon be produced. Many other ship fittings which had to be imported before the war are now being manufactured locally. Among these are anchors, windlasses, mine-sweeping winches, ventilating fans, prismatic glasses for portholes, and a large number of electric fittings. India, however, has not yet been able to undertake the manufacture of boilers, while other equipment such as electric generators and apparatus, submarine-detecting gear, navigating instruments, solid drawn steel, brass and copper tubes and pipes, and non-magnetic plating and armament have also still to be imported.

So far as aircraft manufacture is concerned India, owing to the same considerations as those applying to motor manufacture has not yet got beyond the stage of assembly plant. Several heavy chemical factories have made progress in the past twelve months, and the manufacture of T.N.T. has been started at an ordnance explosive factory. Another notable new product recently reported is ammonia—also at an ordnance factory.

Last year there was something like a four-fold increase over the greater part of the war supply field, and this year the demands on India may well prove gigantic.

### NEW A.A. GUN PLATFORM

From ROBERT WILLIAMSON\*

In twelve days a workshop in the English Midlands has produced an anti-aircraft gun platform of simplified design which has now been accepted as standard.

The original design was a riveted construction of rolled steel sections, demanding many man-hours to make. A simple design of sheet metal construction, arc-welded instead of riveted, was suggested. The Government asked how long it would take to turn out a test platform.

It was promised within 14 days. Four draughtsmen, working under the chief designer, produced the drawings

\*London correspondent *The Engineering Journal*.

overnight. Construction began in the morning and went on continuously day and night.

In ten days the components were ready for assembly, and in two days more the completed platform was towed off for test—48 hours before the stipulated date.

After official tests the simplified platform was accepted, within a month, as the standard design, with much saving to Britain in man-power, materials, machine hours and money.

### DRYING WITH INFRA-RED LAMPS

*From Trade and Engineering, APRIL, 1942.*

The infra-red radiant-heat lamp is a new industrial tool which promises to have a wide field of usefulness. It has been used in America chiefly for baking finishes on metal, but is being applied in other ways because of its advantages over more conventional methods of heating and for the solution of problems which cannot be tackled by other means.

Radiant heating is not new in principle, but when applied by suitably designed and disposed electric lamps it offers a convenient, easily-controlled, and, above all, fast method of heating. Two types of lamps are made, having tungsten and carbon filaments, in 250, 500 and 1,000 watt sizes. In order to provide the maximum proportion of heat radiation the lamps operate at a somewhat lower temperature than ordinary incandescent lamps, and have a life of up to 10,000 working hours. The carbon filament lamp is said to emit a higher proportion of useful heat radiation, but has the disadvantage that the glass blackens sooner.

The use of the flame-proof radiant-heat lamp enables heating to be used for drying finishes where before only air-drying was possible. Some remarkable reductions of drying schedules have thereby been effected. A New York firm producing advertising signs found that whereas with air-drying the paint took 12 hours to dry, the work could be done in  $7\frac{1}{2}$  minutes by using infra-red lamps. The finish was much better because there was little time for dust to settle on the surface.

Even where convective heating was previously used, the change to infra-red lamps can often cut down drying times considerably, partly because the maximum temperature differential can be brought to bear on the work and also because special new finishes have been introduced to take advantage of this method of heating. Cases have been quoted where times have been reduced from 1-4 hours by oven drying to 2-15 minutes by radiant-heat lamps. For finishing local repairs, where several coats of paint may be required, the saving in time may run into days.

Radiant heating lends itself admirably to continuous operation. In the usual method the articles to be dried, providing they are not too irregular in shape, are hung from a conveyor and passed through a circular tunnel of lamps which completely surround the work. Motor-car bodies and other massive parts are pushed into the oven and left for the necessary time. If desired the lamps can be arranged to be switched on automatically as the work passes beneath them. Where flat sheets have to be heated from one side only they are carried in a horizontal position below a long bank of lamps. Some very long ovens have been constructed on this principle. The Ford Motor Company, which pioneered the use of radiant heat lamps in America, recently installed a tunnel 300 ft. long and 10 ft. wide, containing 8,500 260-watt lamps.

### MODERN TIMBER CONNECTOR CONSTRUCTION

L. P. KEITH

*Structural Engineer, Timber Engineering Company,  
Washington, D.C., U.S.A.*

The shortage of materials and the scarcity of labour in Europe after World War I led to a critical analysis of construction methods and building materials.

Wood was a structural material more available than many, so it is no wonder that it and its use were carefully

scrutinized. Why were timber structures less economical than they should be? The material itself, pound for pound, is one of the strongest; it is easily worked by local labour; it adapts itself to varying conditions more readily than other materials; impact up to 100 per cent can be ignored, which is not so in other material; allowable working stresses may be increased a greater percentage for wind loads than for any other structural material; and structures made of it are easily altered to meet new use-conditions.

The chief indictment against the timber truss was the joint. Expensive metal fittings were required. Bolts transmitting loads from one piece to another were used with low design stresses, because of the concentration of load on a relatively small portion of the wood—that surrounding a bolt and only a short distance in from a contacting surface. The result was so much face area required at a joint in order to place all the needed bolts, that between joints there was much more wood than necessary to carry the load. Over-design is never economical.

The first step, then, was to strengthen the offending joint. This was accomplished by magnifying the area available around a bolt with a ring, concentric with the bolt and extending half the depth of the ring into each of the mutually contacting surfaces. Splitting the ring at some point in the circumference produced even greater load capacity because of bearing against both the inside and outside walls of the groove.

Thus, from the simple expedient of placing the metal where it counts the most, a new system of construction—modern timber connector construction—came into practice. Europe readily adopted it, and there were many fine examples of its use. Among these was the Stuttgart railway station. Outstanding and perhaps astounding was a 600-ft. radio tower erected in Germany. A Russian engineer passing through the Lumber Industry House at the Century of Progress Exhibition told me in his broken English of his use of connectors in Russia in 1927 in a building 800 ft. long with a clear span of 200 ft. Incidentally, the glued laminated timber arch was another development. Both were advances in the use of wood and both helped to solve the rehabilitation programme by carrying it on in spite of scarcity of material and labour.

Meanwhile on this continent, we were enjoying the extravagant twenties. Timber construction was practically ignored by the engineering profession and was left to carpenters; engineering schools devoted a minimum of attention to timber design.

In the depression of the early thirties the lumber industry realized that the best way to increase the sale of wood was to make its use more economical. The Department of Commerce of the U.S. suggested connected construction, so successful in Europe during the previous decade, as the best means of accomplishment. Accordingly, the National Lumber Manufacturers Association organized the subsidiary, Timber Engineering Company, a wholly owned industry company, to make connectors available in this country. Never, however, was it felt that merely so much hardware was being offered; rather, with vision and imagination, it was realized from the start that it was a system of construction which was being presented to the building public.

Progress was slow. There was none too much building. Engineers were still skeptical about the modernity of any wood construction. Vast educational work had to be done. There were many, many discouragements.

Time went on, and results, meagre at first, appeared. In 1934, a radio tower for Edgeworth Tobacco Company was built outside of Richmond, Virginia. This was a self-supporting, three-legged tower, 323 ft. high with all members, both tension and compression, of wood. Last year five organizations and thirty universities and laboratories tested timber connectors or conducted special studies, and requests from heads of engineering departments were for

some six thousand complimentary copies of the National Lumber Manufacturers Association publication *Wood Structural Design Data* to be placed personally in the hands of senior engineering students.

Timber design was revolutionized by this new system of construction. Characteristics of it are:

Tension members of wood. The material was always strong in tension, but pieces could not be connected to develop this strength.

The spaced column principle: two or more members separated by blocks at each end held in place by connectors and a centre length spacer block, bolted, form a spaced column. The end blocks so connected give restraint to the column ends, thereby increasing the load capacity as a column over what it would have as simple column of equal length, least dimension and cross sectional area.

The elimination of expensive hardware, such as shoes, heel plates, etc., and the labour to place these items.

The system lends itself either to prefabrication at a distant plant or to fabrication at the site. Unskilled and untrained labour can easily fabricate or erect it, so it was regarded favourably by relief agencies.

When fabricated at the building site, trusses are generally laid out in a horizontal position with the members held in place either by tacking or clamping. Holes are bored, with care being taken to keep the drill plumb. The truss is then either taken apart to cut the grooves for types requiring this treatment or toothed types inserted between the members before applying pressure to bring them into place. Where grooves are to be made for split-rings or shear plates, a pilot is inserted in the hole, and a cutter head then cuts the groove to the necessary depth and size. The diameter of the split-ring groove is slightly more than that of the ring when closed so that when in place there is bearing against both the inside and outside walls irrespective of whether the timbers shrink or swell.

This operation is suitable for a relatively small job. Obviously when many trusses are to be made the going would be somewhat slow. One defence plant is at present inquiring for 2,000 trusses involving the use of 5,000,000 ft. of lumber.

A large job can be prefabricated more economically, either by the contractor in his own plant on the premises or by sawmill or roof truss company even at a distant point. In either case the truss is shop detailed just as a steel fabricator might do, with grooves indicated far-side, near-side, or both sides as may be required. Multiple drills and other arrangements then permit rapid manufacture.

Leading up to our present contribution to the war programme, in which one pound of steel in the form of connectors, bolts, etc., used with wood, releases about twelve pounds of structural steel for tanks, guns, ships, etc., were two large governmental programmes in which modern timber construction established itself favourably with Federal agencies destined to become responsible for our war construction programme.

The first of these was the C.C.C. programme. Major Andre Violante, C.Q.M., reviewed this work in articles appearing in the *Quartermaster Review* in May-June, 1940. The portable camp buildings were designed with the roof panels a combination of the functions of a roof surface and the upper chord of a truss. The rafters were thus both integral parts of roof panels and the upper chords of trusses ten feet on centres. The truss connections required more strength than could be developed by bolts, so timber connectors were indicated. The system lent itself to prefabrication, and this meant speed in completion. In 1934, these buildings were on trial and their performance was being compared to that of conventionally-built buildings of the same size but without connectors. Major Violante recites instances of where portable structures with men inside have been lifted by wind off foundation posts with

no resultant damage except for the labour incidental to re-erecting them on the foundations. Five C.C.C. camps were in the path of a Florida hurricane; two were of rigid construction and three were connected prefabricated camps. The two of rigid construction were seriously damaged, many of the buildings collapsing, whereas the three connected camps escaped practically unharmed, although many trees several feet through the bole within these portable camps were blown down. Because of performance the connected type was adopted as standard in 1935, and Major Violante states the Quartermaster Corps of the Army accomplished the biggest prefabricated job of the country, if not in the world.

The other programme which provided evidence of the merit of the connector system of timber construction was the construction of hangars by the Canadian Department of National Defence, accounts of which were duly recorded in both the *Military Engineer* (July-August, 1941) and the *Quartermaster Review* (July-August, 1940). Prefabricated connected hangar units (112 by 160 ft.) were erected, and the governmental department announced that the savings were estimated at \$2,500,000. Incidentally, connectors were shipped to New Zealand for a similar purpose.

## CADMIUM IMPORTANT IN INDUSTRY

FROM *Trade & Engineering*, JUNE, 1942

A scarcity in the last war focused attention on the use of cadmium in solders and took the price of American supplies of the metal to 6s. 8d. a lb. Today there is a similar increase in its importance, with a trebling of its price. It has proved invaluable as a substitute for tin in bearing metals for taking heavy loads, for resisting wear and distortion, and for use at temperatures at which tin-base bearing alloys would be useless. Yet though cadmium is rather like tin in mechanical properties, other commercial uses are reminders that it is the brother of zinc both in chemistry and in the electromotive series of metals, which explains the superiority of zinc and cadmium in plating iron and steel.

America, Upper Silesia, Canada, and Australia are producers of cadmium, the New World being predominant with an annual output of 4,500,000 lb. The metal is chiefly a by-product of zinc extraction, the more volatile cadmium coming over first and appearing in the "blue powder" collected before the zinc distills. Apart from the well-known methods of production, like those used in the electrolytic refining of zinc and in separating cadmium from subsidiary dusts from the lead blast-furnace, interest now centres chiefly on the modern distillation and refining processes used at New Jersey and on the continuous vertical retorts used at Avonmouth, where the cadmium sponge extracted is cast into anodes of 99.95 per cent purity.

Before cadmium plating assumed such importance and when the new bearing and brazing alloys were unheard of, cadmium was somewhat of a "pretty" metal, providing pigments for pottery and paints. Cadmium found other commercial outlets in alkaline batteries, in fusible plugs for automatic fire sprinklers, and in alloys with copper for giving resistance to abrasion in electrical overhead conductors, such as trolley wires. A recent addition to the list of alloys having high electrical and tensile properties is a bronze containing 0.9 per cent, of cadmium and 0.35 per cent of zirconium.

Tin-lead-cadmium and cadmium-zinc alloys constitute solders useful for many purposes. In the first of these cadmium reduces the amount of tin, while in the second it completely replaces it in a solder containing 40 per cent of cadmium and 60 per cent of zinc, which gives joints of satisfactory strength and the highest shear strength of any alloy of the two metals.

Cadmium has won a prominent place in electroplating. While both cadmium and zinc are superior to copper, nickel, and chromium in protecting iron, cadmium surpasses zinc

in non-accumulation of corrosion products to hinder the smooth working of exposed mechanisms; in the ease with which cadmium plate can be soldered (hence its use in the electrical industry); and in resistance to alkalis, which makes it invaluable in textile machinery and domestic washing appliances.

## LONDON'S TRAM LINES

### Wrenched Up to Build Tanks and Battleships

ROBERT WILLIAMSON\*

Britain's old tram rails, tons of which are going into the melting-pot every day, will soon roll out of war factories all over the country in the shape of tanks, guns and other arms.

The eighty miles of tram rails abandoned in London since trolley-buses have taken the place of trams are made of high grade steel. All over London they are being wrenched up from the roads and more than half the work has been completed. Since it began last year, some 16,000 tons of metal have been recovered, and one London borough alone has taken up more than  $2\frac{1}{2}$  miles of track and sent it off to the scrap metal depots. Other materials taken up are being used to restore the roads. Old granite paving, for example, is broken up to make asphalt.

Apart from tram lines, railings and iron gates all over Britain are yielding a steady flow of metal for arms production. More than 200,000 tons of metal have been recovered, the equivalent in weight of about 12,500 Valentine tanks; or enough for the steel of thirteen 35,000-ton battleships.

Just under one-half of the total is from London.

## MOLYBDENUM INDUSTRIAL APPLICATION

FROM *Trade & Engineering*, APRIL, 1942

Though molybdenum has been known as a metallic powder for 150 years, it remained a curiosity until, on the one hand, it proved important in guns, armour plate, aircraft steels and special constructional steels, and, on the other, the pure metal plate and wire found wide use in radio valves and X-ray equipment. Regarded at one time as an unknown factor in metallurgy, its true role in high-class constructional steels, saw steels, die steels, propeller shafts, permanent magnets, and steel rolls has now been fully established.

Molybdenum is not a deoxidizer but an enhancer of the mechanical properties of steel, reducing the softening effect of tempering so as to widen the range of mechanical properties. In the general view it is classed with vanadium and tungsten, although a study of its properties will show considerable divergence from the characteristics of these two metals. In high-speed steels, however, it has been used as a substitute for tungsten, like which it commands uses in the pure form, as ferro-alloy, and in chemical compounds.

While the demands of warfare will increase the use of the metal for radio work, this increase will not be comparable to the upward curve of consumption in alloy steel for aircraft and motor-vehicles, in nitriding steels, in improving grey iron castings, and, especially in the United States, in rolls for both iron and steel. Indeed, in that country its use in iron rolls seems as common as in steel rolls, while it is also included in rolls for brass, copper, bronze and other non-ferrous metals. It is claimed that it produces a stronger roll, reduces breakages, and ensures a smoother and better finish in the rolled product. To these wide applications must be added its use in alloys for pressing bakelite; as a substitute for diamonds in wire-drawing; in alloys with copper for contact terminals; in alloys with platinum to replace iridium alloys for thermo-elements; and in Hastelloys in which from 17 to 20 per cent of molybdenum is included along with nickel, iron, chromium, tung-

sten or manganese for plant requiring strong resistance to corrosive chemicals.

The unalloyed metal was commonly regarded as rare. It was first prepared by Moissan and is now produced by reducing in hydrogen an oxide which has been previously volatilized from the the roasted ore and condensed in special receivers in a crystalline form. The crude grey molybdenum from an electric furnace containing 6 per cent carbon and some iron is useless for high-grade electrical work, as was the early German commercial form prepared from calcium molybdate by reduction with carbon. The reduced metal powder is pressed into bars, sintered, swaged, and drawn into wire in a manner similar to that used in treating tungsten. The metal is softer and more easily worked than tungsten, and the sheet can be bent cold and stamped into shape by ordinary steel tools even when manufacturing the hemispherical cups used in X-ray reflectors. The average tensile strength determined by the Fansteel Products Company is 260,000 lb. per sq. in., though when measured parallel to the direction of rolling it is appreciably higher.

## ELECTRICAL USES

Molybdenum wire is largely used in radio valves, the metal proving pliable enough for weaving the small screens and maintaining its properties at the high temperatures at which the valves operate. Thoriated molybdenum with a high electron emissivity may be produced by including thorium nitrate before the reduction process; uranium oxide has been specified as an alternative activating agent. Molybdenum wire is of value as a heating element in electric furnaces for temperatures up to 2,000 deg. C. provided that a suitable refractory of a porous nature is used to permit diffusion of hydrogen into the tube (a hydrogen atmosphere must be maintained in the furnace). The Fansteel Company has found zirkite a suitable packing material and alundum trustworthy for making the tubes of the wire-wound furnaces used in many operations. Molybdenum has appeared also in spot-welding, having greater strength than copper and showing little tendency to wear and to stick to the work under treatment.

While calcium molybdate has long been known as intermediate between the ore and the steel bath, other salts of molybdic acid have proved valuable. The ammonium salt, the well-known reagent for phosphorus determination, is a germicide for cloth, a fire-proofing agent, and an intermediate in dyeing wool and silk, as also is the sodium salt. Molybdates impart a blue colour to pottery and to glazes; molybdenum tannate is applied in colouring rubber and leather; and other molybdenum products have appeared in lakes and pigments. As a catalyst for converting toluene into benzaldehyde, anthracene into anthraquinone, and naphthalene into phthalic acid, the anhydride of molybdic acid seems to have gained an established position.

## BOMB DAMAGE TO A TUNNEL

FROM *Aeronautics* (LONDON), JUNE, 1942

Railways have from the first attracted all those who plan bombing offensives. And a great deal of pertinent information has been amassed upon the vulnerability of metals and marshalling yards, of junctions, and of other nodal points in modern railway systems. The general inference to be drawn from experience to date is that railways are less vulnerable than had originally been supposed. It has been found that permanent-ways can be repaired with great swiftness by specialized gangs of workpeople who move to the spot in transport vehicles equipped with appropriate tools. Some astonishing feats of repair have been successfully completed by the British railway companies. More recently the railway companies have been studying the repair of tunnels damaged by bombs, for here the impression was fairly general that a direct hit would put a railway line out of action for an extended period. Once again experience tends to show that the powers of repair and recuperation

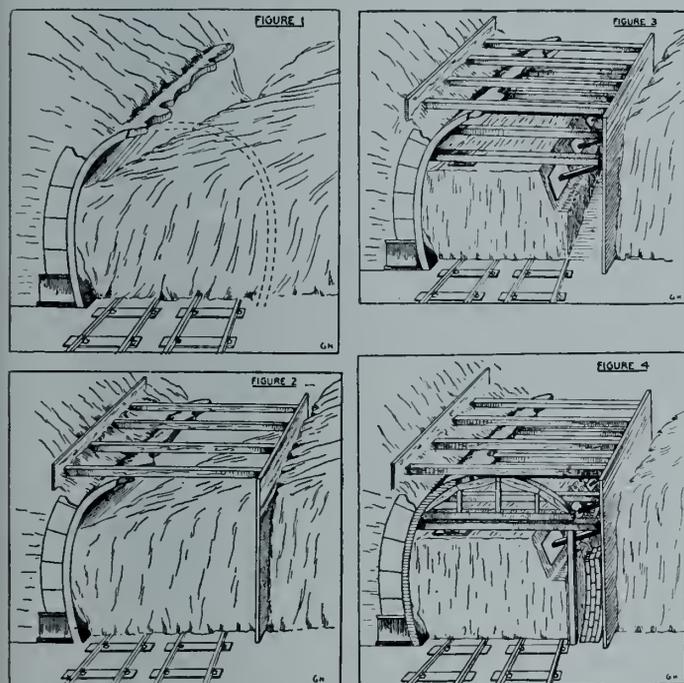
\*London correspondent of *The Engineering Journal*

are equal to the powers of such bombs as have been used up to the present. The cautionary remark is here necessary that this does not necessarily mean that the damage done by the larger bombs which may be used in the future will not be more extensive and more difficult to put right.

No better means of indicating to the Royal Air Force and all who are interested in the vulnerability of targets to aerial bombardment, and particularly the case of the railway tunnel, can be devised than by giving an actual case, and for this special diagrams have been prepared, based on published work and especially that which appeared in *The Engineer* of April 3, 1942 (page 281). In the diagrams there set out the factual basis for the illustrations which accompany this article was given. A case which provides a good foundation of reasoning on the subject is that of Knight's Hill tunnel on the electrified double-line that runs from Peckham Rye to Tulse Hill and Streatham, which is a tunnel of brickwork through London clay. A high explosive bomb penetrated this tunnel and exploded behind the up-side wall, forming a crater and breaking in the tunnel ground inside wall.

About 40 feet of the tunnel were completely filled in with clay.

The sequence of events can then be followed from the diagrams. The first step of the repair was the driving of sheet steel piling behind the damaged wall, this piling being then strutted to the opposite slope, the struts being arranged above the level of the tunnel roof. Excavation was the next step, with further strutting of the piling and trenching along the damaged side. The side wall was



These figures illustrate the damage done to a railway tunnel by air bombardment and the successive stages of repair.

Fig. 1—Above is shown the result of a direct hit which penetrated several feet of earth and exploded behind the up-side tunnel wall, blocking both lines for a distance of over 40 feet. The debris in this instance was clay.

Fig. 2.—Having enlarged the crater and stabilized the sides, steel sheet piling is driven into the earth just behind the site of the shattered wall and strutted across to the opposite wall with 12 in. by 12 in. timber joists.

Fig. 3.—The clay is then excavated to the level and shape shown above, and a trench taken out against the damaged side wall. Additional support is given to the dumping of clay and 12 in. by 12 in. timber strutted across to give maximum strength to the opposite undamaged wall.

Fig. 4.—The new wall is then rebuilt just clear of the steel piling and timber centres erected to the lower main struts to receive the wooden templates on which the tunnel crown will be built.

rebuilt and all the brickwork repaired. The clay was cleared from the inside of the tunnel and the line reopened to traffic. The last move was the filling of the crater to the original ground level.

This case is of particular interest, inasmuch as there is a popular idea that a railway tunnel constitutes the most vulnerable of all transport targets for the air bomber. It has already been said that it may happen that newer and bigger bombs may come into service which do increase the vulnerability of these tunnels, but it is also clear that during the sustained and heavy raiding of England by Germany a railway tunnel, even after a direct hit, could be repaired with remarkable and unexpected rapidity.

The general and bigger lesson to be learned is that appropriate equipment, competent staffs, sound planning, and energetic and loyal workers enable miracles of repair work to be achieved under the stress of war. The case of the Knight's Hill tunnel is one of many, and in all of them proof was given of this power of recuperation.

## PLASTICS USE IN "LITTLE SHIPS"

FROM *Trade & Engineering*, MAY, 1942

Details have been recently published in America of the part played by plastics in the construction of small fast surface craft. A writer in the current issue of *Modern Plastics* states: "To-day a New Orleans boat-builder is using resin-bonded plywood where solid timbers were used yesterday, and providing the United States Navy with motor torpedo patrol boats, landing boats, and vehicle carriers which will write a new chapter in the history of the little boat."

In the construction of the new craft the technique developed for the use of plastics in aeroplane construction has been very closely followed. Side panels, deck planks, bulkheads, partitions, etc., are in plastic-bonded plywood while for wind shields and port lights transparent acrylic sheet replaces the heavier glass. The entire sides of these boats from the sheer to the chine are single panels of plywood, Honduras mahogany is the basic material, and a special phenolic resinoid is the bonding agent. The laminated panels produced are 84 ft. by 8 ft. and are stated to be the largest known to the industry. These sheets are cut by the template and applied directly to the sides of the boats. The transom, which has rounded corners, is moulded in one piece, as are also the machine-gun turrets, in which it is claimed it is almost impossible to detect a joint. The high-speed triple-screw motor torpedo-boats thus constructed are 70-80 ft. in length, capable of carrying four 21 in. torpedo tubes, two twin 50-calibre anti-aircraft machine-guns, and eight depth charges. They are manned by a crew of 10 men and can do up to 50 knots.

## POSITION FINDING BY WAVES

FROM *The Engineer*, MAY 1, 1942

The perception of the presence of an object by its effect on waves sent to it by an observer has been practised in many aspects and for many purposes. Leaving out the most universal of applications, namely, the manner in which we use light for seeing objects, there are two branches of physics, namely, acoustics and wireless, in which reflected waves have entered practical affairs. But long before human beings studied physics, the echoes of sound waves were employed by animals. For instance, a bat, it is thought, may sense obstacles confronting it in its flight by means of the echo from them. Similarly, a blind man or a man in a black-out senses the presence of a wall as he approaches it by subtle echoes of his footfalls. Everyone must have noticed how, when walking past a row of shop windows in the dark, it is easy to distinguish window fronts from doorways by aid of these muffled echoes. A more refined instance of the same phenomenon is afforded by those blind persons who can come into a room and after speaking a few sentences give a fairly accurate estimate of its length, height, and breadth.

This feat clearly involves "position finding," for the direction and distance of each wall—that is, its position relative to the observer—have been determined.

The same skilled blind person who can size up a room may be unable to detect a lamp-post which he is approaching. Evidently the size of the reflecting surface has something to do with success. This raises an extremely important point in both range finding and direction finding by waves. The mathematical laws of the matter were worked out more than a century ago, and applied to optical phenomena, by Fresnel, and about sixty years ago they were applied to acoustical problems by Rayleigh. An abbreviated summary of these laws will be useful for the purposes of this article.

#### THE GENERAL PRINCIPLE

Fresnel's main principle may be described by supposing that we set up a flat circular board or target in a vertical plane several yards away from an observer situated on its axis. If the observer blows a short blast on a whistle he will hear an echo. The intensity of the echo depends on the target's distance and size. According to Fresnel, the best size of target, the size that gives the strongest echo, is such that a line drawn from the observer to the periphery of the target is longer than the line drawn from the observer to its centre by a quarter wave length of the sound being employed. This may be called the optimum relationship between distance, size of target and wave length. To illustrate, let us send sound of wave length 4 ft., about 275 vibrations per second, against a target placed 800 ft. away. Then the rule indicates that the diameter of target which gives the best echo is 80 ft.

What happens if the optimum target is varied in size, other things being kept the same? First, if the target is reduced the intensity of the echo gradually falls, until when the diameter becomes of the same order as the wave length the wave is scattered rather than reflected, and the rule breaks down. Secondly, if the target is enlarged, say by having a relatively small ring placed in its plane round its edge, the intensity of the echo will again fall. This paradox is explained by noticing that the path of the rays to and from the added ring is longer than the path of rays to the corresponding central area of the target by half a wave length, and the waves to the ring and to the centre therefore annul each other. As the target is enlarged steadily, the intensity of the echo goes through maxima and minima, but never again reaches the optimum value, however big the target becomes.

The above rule may be put in algebraic form as follows, when the distance to the target is much greater than a wave length:—(Diameter of target)<sup>2</sup> = 2 × wave length × distance. In addition, good reflection demands that the wave length should be smaller than the diameter of the target.

Although the theory has been worked out only for a target of circular shape, the general conclusion may be used as a guide to the behaviour of a reflector of any shape. So used, it explains why the pedestrian in a black-out walks so easily into the lamp-post. Sound waves made by footfalls are not short enough to deal with lamp-posts. For suppose the target is, say, ½ ft. diameter and we require a good echo at, say, 3 ft. Then the formula shows that the optimum wave length is ½ in., which corresponds to a pitch of 26,000 vibrations per second—a very high frequency, inaudible except to the very young and certain small animals. It is said that bats when flying, emit shrill supersonic waves and so steer clear of quite small obstacles. Perhaps the pedestrian could help himself by jingling a bunch of keys as he walks along.

#### APPLICATION AT SEA

One of the earliest engineering applications of echo principles was to the detection of obstacles submerged in the sea and dangerous to shipping. The idea seems to have been suggested after the disaster to the "Titanic" in 1912.

Thereafter, numerous inventors attacked the problem of producing sound waves under water and detecting them by submerged microphones. By applying Fresnel's principle to the case of detecting an object 50 ft. in diameter at a distance of 10,000 ft., we find that the optimum wave length is ⅓ ft., corresponding to a note of frequency 40,000 vibrations per second. Thus for underwater reflections at distances of more than a mile a supersonic frequency is desirable when the object is of the above order of magnitude. On the other hand, when the reflecting surface is large—for instance, when it is the sea bottom—waves of any frequency will serve. Therefore, in depth sounding by sound a musical note is often used; indeed, very often the "note" is merely the thud of a hammer on a steel plate bolted on the bottom of the hull. The echo from a normal sea bottom is excellent whatever the length of the sound waves used. In operating the method, the note is emitted as a short pulse, and the times of emission of the pulse and of the return of the echo are recorded by means of the same microphone on a chonographic drum. Knowing the velocity of sound in water, the depth is easily calculated from the observed time of go and return.

The distance to the reflecting surface is the only quantity sought in depth sounding, but when the obstacle is small, like a submerged wreck, its bearing is also desired. Two alternatives are in common use. In one the sender is directive, in the other the receiver. When using a directive sender a beam of sound radiation is swept round a horizontal circle like a searchlight, and an omni-directional receiver is used for listening for the echo. The echo only comes when the sender points to the obstacle. In the other method a sender that emits sound waves in all directions is used and a directional receiver is rotated until an echo is picked up. The receiver must then be pointing to the obstacle. It should be noted that for accurate directional work, either sending or receiving, the shortest possible waves should be used. This fits in with the requirement taught by Fresnel's principle. A very successful apparatus was developed by Langevin in 1918-19. In this, one and the same quartz plate is electrically vibrated at supersonic frequency, and is also used for reception, a switch being employed to connect the quartz plate to the transmitting and receiving circuits in rapid succession. In this apparatus the sender and the receiver, being identical, are both directional, and the echo is obviously picked up only when the plate faces towards the obstacle.

#### ECHOES OF ELECTRIC WAVES

The principles set forth above apply to waves of all kinds, including electric waves. They were applied by early investigators of Hertzian waves to the design of mirrors for projecting the short waves then used in laboratories—for a mirror is, of course, a reflecting obstacle which is placed rather near the source. But as short waves were gradually discarded by communication engineers in favour of long, the phenomena of reflection were studied less and less. Still, the Zeppelin raids of 1917-18 provoked proposals to detect airships by reflection of wireless waves—with what success was never published. Investigators returned to the study of reflection, however, after Barkhausen and Kurz opened up a new method of generating waves less than a metre in length by means of thermionic valves. Later, the magnetron was invented in America and developed to great efficiency in Japan. Everything was ready by the year 1930 for the application of short electric waves to the detection and placing of small objects by echo methods.

An interesting description of a prolonged research on short wave propagation appears in the "Proceedings" of the Institute of Radio Engineers for March, 1933, at page 464 *et seq.* The paper is by Carl Englund and others, of the Bell Telephone Laboratories, New York, and gives the results of experimental studies extending over several years. The main feature is the investigation of the effects of the reflections from the ground, from hills, trees, buildings, and

other obstacles, and with disturbances of the field due to moving objects. The wave lengths used varied from 3 m. to 12 m. The transmitter was stationary and the receiver movable, being usually accommodated in a car. It was found that when the car moved in the neighbourhood of the transmitter the strength of the received signals varied through maxima and minima. In fact, the waves reflected from surrounding obstacles were strong enough to combine with the outward-going waves and form energetic standing waves—that is to say, stationary loops and nodes of electric force. The whole area for miles round any short-wave transmitter is, it seems, covered with a fixed interference pattern, like the fringes seen in certain optical demonstrations. A car movement of 1 ft. could easily be detected on the meter of the receiving set. As the receiving set was carried slowly past trees and houses, the strength of signal indicated their presence. Moving obstacles produced movements in the loops and nodes and could thus be detected by a stationary receiver. Thus while surveying the nodal pattern in open country on a certain occasion, the observers noticed that an aeroplane flying above them at an altitude of 1,500 ft. produced a flutter in the signals. Going to a neighbouring airport it was found that incoming aeroplanes could easily be detected at a distance, sometimes before they came into sight. The strength of these reflection effects is understandable, say the authors, because at a distance of some five miles an elevated object is exposed to a field intensity about ten times that existing at the ground beneath it.

A method of estimating the distance of an aeroplane in flight can be based upon the phenomena just described. For the number of loops and nodes between the sender and receiver can be counted. This number depends on the wave length in use, and by slowly changing the wave length of the sender and counting the number of maxima and minima experienced at the receiver, an estimate of the total number of loops and nodes can be made. Hence the distance can be measured. An elaboration of this principle is seen in British patent No. 457,737, of date May 18th, 1935, granted to the Telefunken Gesellschaft, of Berlin. In this improved method a modulated short wave is employed and the modulation frequency, not the carrier frequency, is altered.

#### ECHO-SOUNDING IN THE AIR

Observing the movement of loops and nodes is only one way of utilizing the echo from a reflecting obstacle. A simpler way is to pick up the echo direct and estimate the time of travel. It is easy and has become standard for sound waves in water, but is difficult for electric waves because they travel half a million times faster than sound waves in water. Thus while in water a distance of 10,000 ft. involves measuring an echo time of about 4 sec., in the electrical case it involves an echo time measurement of

about 8 micro-seconds. However, by 1930 the technique of "depth sounding" the ionosphere had reached a high state of development, and apparatus for measuring micro-seconds was available. The usual apparatus employs a cathode ray tube and operates as follows: a sending apparatus generates a short train of waves a few metres long, lasting about one ten-thousandth of a second and emits this pulse fifty times per second. This is reflected at the upper layer being "sounded," and the echo is picked up by a receiver near the sender. After amplifying and rectifying, the pulse is applied to one pair of deflecting plates of the cathode ray tube. To the other pair of deflecting plates a rising electro-motive force is applied which carries the spot across the fluorescent screen to form a line, called the time base. The emission of the pulse from the sender is synchronized with the starting of the time base by aid of the commercial A.C. supply. The direct pulse from the sender also affects the receiving apparatus, and therefore this and the echo pulse are both exhibited as perpendicular flicks on the time base. When dealing with high levels of the ionosphere the time interval to be measured is of the order of a milli-second; when applied to an obstacle at only a few miles distance, the time interval is in micro-seconds; but by 1935 this could be measured with fair accuracy.

For fixing the position of an object its bearing as well as its distance must be measured. An interesting example of bearing finding is seen in British patent No. 478,456, of date January 31st, 1936, granted to E. Montu, of Milan. The invention is for obtaining the bearings of aeroplanes and the like. Leaving out details, it consists of two rotating directional aerials, each with receiving apparatus, amplifier, rectifier, and cathode ray tube. In each of these twin sets the time base is synchronised with the rotation of its aerial and therefore when the aerial points to an aeroplane a flick appears at a point on the line across the screen. The position of the flick can be translated into angular position of the aerial, and therefore of the aeroplane. Now one of the aerials rotates on a vertical axle and the other on a horizontal one. Thus the elevation and the azimuth of the aeroplane are determined. Applying Fresnel's rule to an object 100 ft. in diameter at a distance of 50,000 ft., we find the optimum wave length is about one-tenth of a foot.

In the years following 1936 the possibilities of wireless position finding have become of military importance, and an intense study of the matter has been carried forward in many countries. Naturally, the results of this study and the particulars of the apparatus developed have been kept secret. We may look forward to learning the details of the methods and means adopted in different countries when the war is over. Doubtless, great technical advances will then be put on record.

## STRUCTURAL DEFENCE AGAINST BOMBING

The summary of the lectures delivered under the auspices of the Institute last April at Hart House, by Professor F. Webster, was issued last month and copies have been sent to all those who were in attendance at Toronto.

Owing to the technical nature of the subject, it was necessary to have Professor Webster revise the notes which had been taken at the meeting. In fact, the author undertook to completely rewrite the lectures, a task which necessitated a great intellectual and physical effort in view of the short time available before the professor's return to England. The Institute is all the more grateful to him for this additional service which provides those who had the privilege of listening to him with a record of the information conveyed as well as a convenient reference book.

The summary covers 129 pages of 8½ x 11 in. format. In addition there are 136 figures grouped at the end with a few tables. The text is mimeographed and the figures are reproduced by the photo-engraving process.

A limited number of copies have been made and each copy is identified. This was done in accordance with Professor Webster's desire to restrict the distribution to those who attended the lectures, plus a few other persons whom he has specifically mentioned.

Comments which have been received indicate that the Institute has been doing a national service by sponsoring these lectures and providing a printed record. It is expected that the special committee established by Council to implement the information thus obtained will further the usefulness of the undertaking, and that we shall be better prepared should the time come when it will be necessary to make use of the information so generously supplied by the Deputy Chief Engineer of the British Ministry of Home Security.

## COMMITTEES AT WORK

General approval has been expressed of Council's decision to establish three new committees to deal with matters of particular concern to members. The following notes on the progress of the organization work and on the membership of these committees will supplement the information already published in the *Journal*.

### CIVIL DEFENCE

The special committee set up to implement the information obtained through the lectures delivered under the auspices of the Institute by Professor Webster, is to be known as the Committee on the Engineering Features of Civil Defence. Mr. J. E. Armstrong, chief engineer of the Canadian Pacific Railway and councillor for the Montreal Branch, has consented to serve as chairman. The following list of members who have already accepted to serve on the committee is representative of the entire profession and should be a guarantee of the thoroughness of the work which is to be done:

- J. N. Anderson, managing director, Wm. N. O'Neill Co., Ltd., Victoria, B.C.
- S. R. Banks, Aluminum Company of Canada, Limited, Montreal, Que.
- H. F. Bennett, district engineer, Department of Public Works of Canada, London, Ont.
- R. S. Eadie, assistant chief engineer, Dominion Bridge Co., Montreal, Que.
- E. V. Gage, president, A. F. Byers Construction Co., Montreal, Que.
- G. A. Gaherty, president, Montreal Engineering Co., Ltd., Montreal, Que.
- A. Gray, chief engineer and port manager, National Harbours Board, Saint John, N.B.
- J. L. Lang, consulting engineer, Lang & Ross, Sault Ste. Marie, Ont.
- R. F. Legget, assistant professor of civil engineering, University of Toronto, Toronto, Ont.

## News of the Institute and other Societies, Comments and Correspondence, Elections and Transfers

I. P. Macnab, commissioner, Board of Commissioners of Public Utilities, Halifax, N.S.

J. A. McCrory, vice-president and chief engineer, Shawinigan Engineering Co., Ltd., Montreal, Que.

The membership of the committee will also include the chairmen of the Civil Defence committees being set up by the various branches of the Institute.

Terms of reference have been drafted by the chairman of the committee and circulated among members of Council for criticism and suggestions. In accordance with those terms, contact has been established and is being maintained between the chairman of the committee and the Director of Civil Air Raid Precautions at Ottawa.

Special committees have been set up in most of the branches and are generally made up of the chairman and the councillor of the branch and those persons who attended the lectures. The committees are expected to meet from time to time to discuss the local situation and determine methods of adapting the Webster material to the particular needs of the community.

As reported in another column, the printed notes of the Webster lectures have now been sent to those who were in attendance. Sub-committees of Mr. Armstrong's committee have been appointed: one of these is preparing a summary of the lectures which will bring out the essential points for general use; others are studying specific problems like design of shelters and structures as applied to Canada.

### POST-WAR PROBLEMS

The article on Reconstruction and Re-Establishment which appears on page 465 of this issue is a summary of the evidence presented before the Select Committee of the House by Principal James of McGill University, who is chairman of the Cabinet Committee on Reconstruction. It was prepared at the request of Council by the chairman of the Institute's Committee on Post-War Problems, Mr. Warren C. Miller, city engineer of St. Thomas, Ont., and president of the Association of Professional Engineers of Ontario. This article is intended to present, in a form convenient for all members to read, the information available on the subject.

- Mr. Miller's committee includes the following members:
- Frederick Alport, engineer, Works and Buildings Branch, Department of National Defence, Halifax, N.S.
  - deGaspé Beaubien, consulting engineer, Montreal, Que.
  - A. L. Carruthers, engineer, Department of Public Works, Victoria, B.C.
  - J. M. Fleming, president and general manager, C. D. Howe Co., Ltd., Port Arthur, Ont.
  - E. R. Jacobsen, engineering and technical assistant to the director general, Commonwealth of Australia War Supplies Procurement, Washington, D.C.
  - G. R. Langley, Canadian General Electric Company, Peterborough, Ont.
  - G. L. MacKenzie, engineer, Prairie Farm Rehabilitation Administration, Regina, Sask.
  - D. A. R. McCannel, city engineer, Regina, Sask.
  - A. W. F. McQueen, hydraulic engineer, H. G. Acres, Co., Ltd., Niagara Falls, Ont.
  - G. McL. Pitts, Maxwell and Pitts, architects, Montreal, Que.
  - D. C. Tennant, Dominion Bridge Co., Ltd., Toronto, Ont.

It is suggested that members who have suggestions to offer for the consideration of the committee voice them through the nearest committee man.

It will be recalled that a draft questionnaire entitled "Considerations for Evaluating Projects" was submitted to the Institute by the Sub-Committee on Construction

Projects of the Cabinet Committee on Reconstruction for an expression of opinion. This draft form has been circulated in the branches of the Institute and several suggestions have been received from all parts of the country. These have been turned over to Mr. Miller's committee on Post-War Problems and a consolidated report is being prepared which, it is believed will present the opinion of the Institute as a whole.

#### INDUSTRIAL RELATIONS

As reported before, this committee is headed by Mr. Wills Maclachlan, secretary-treasurer and engineer, Electrical Employers Association, Toronto, Ont. Acceptances to serve on this committee have been received from the following persons:

- E. A. Allcut, professor of mechanical engineering, University of Toronto, Toronto, Ont.
- J. C. Cameron, head of the Industrial Relations Section, Queen's University, Kingston, Ont.
- E. R. Complin, executive director, National War Labour Board, Ottawa, Ont.
- J. A. Coote, assistant professor of mechanical engineering, McGill University, Montreal, Que.
- W. O. Cudworth, assistant engineer, Maintenance of Way, Canadian Pacific Railway Company, Toronto, Ont.
- F. W. Gray, assistant general manager, Dominion Steel and Coal Corporation, Sydney, N.S.
- E. G. Hewson, office engineer, Canadian National Railways, Toronto, Ont.
- A. M. Reid, Bell Telephone Co., of Canada, Ltd., Toronto, Ont.
- W. J. W. Reid, works manager, Otis-Fensom Elevator Co., Ltd., Hamilton, Ont.
- A. Ross Robertson, manager, Ontario Division, Dominion Bridge Co., Ltd., Toronto, Ont.

One of the duties of the committee is to see that adequate attention is given in the engineering press to matters associated with the field in which the committee will work. Accordingly, material for publication in the *Journal* is being prepared and will appear in the September issue.

#### PRINCE RUPERT-TERRACE-CEDARVALE HIGHWAY

The construction of this road, which has been designated as necessary for National Defence purposes, is now well under way under the supervision of the Surveys and Engineering Branch of the Department of Mines and Resources. The total distance between Prince Rupert and Cedarvale is 136.3 miles, of which 97 miles are to be completed under the existing contracts. The work has been divided into eight sections, ranging from 11 miles to 18 miles each, and these have all been awarded to contractors, as follows:

- Sections 1 and 8—E. J. Ryan Construction Co. Ltd., Vancouver, B.C.
- Section 2—Rayner Construction Limited, Leaside, Ontario.
- Section 3—Tomlinson Construction Co. Ltd., Toronto, Ontario.
- Section 4—Standard Paving Limited, Toronto, Ontario.
- Section 5—McNamara Construction Co. Ltd., Leaside, Ontario.
- Section 6—Dufferin Paving Co. Ltd., Toronto, Ontario.
- Section 7—General Construction Co. Ltd., Vancouver, B.C.

When it was decided to build this highway late in February last, the road had not been surveyed, and it was necessary to rush location survey parties into the field. By the end of March seven of these parties were at work, and most of the final location through difficult country was completed by the end of May.

Work has begun on all sections and has been under way from three to four weeks. Contractors are bringing in heavy equipment as the construction involved ranks among the most difficult in British Columbia.

Between Hazelton and Cedarvale, particularly at the Cedarvale end, the existing road, while passable, has not been graded to standard and Dominion engineers are

making inspections to see just what work should be done on this section.

After exhaustive surveys it was decided that the Highway would be routed on the north side of the Skeena River between Prince Rupert and Terrace and from Terrace easterly would follow the south side.

The estimated distance between Prince Rupert and Hazelton by highway is 172 miles. Of this distance 97 miles is new work and improvement work will likely be required over another 10 or 15 miles. The cost of grading will range from \$45,000 to \$65,000 per mile.

Approximate estimates of cost for a 20-foot Highway run from \$5,500,000 to \$6,000,000.

#### A.S.C.E. COMES TO CANADA

The American Society of Civil Engineers is holding its annual autumn meeting during the week of October 11th, in Niagara Falls, Ontario. The details of the programme are not yet available, but it is expected that a very complete programme will be arranged.

The Society has invited The Engineering Institute of Canada to participate fully in the meeting, and particular emphasis has been placed in the invitation to supply papers on the technical subjects, and speakers for other occasions.

This will afford another excellent opportunity for Canadian engineers to extend their contacts with members of the profession south of the border. The Institute is very pleased at the decision to come to Canada, and will certainly co-operate to the full extent.

Meetings have been arranged between the officers of both societies, to discuss details, and it is expected that the complete programme can be announced in the September number of the *Journal*. In the meantime, members of the Institute are asked to make a note of the dates, so that plans may be made to attend.

#### ENGINEER STUDENTS TURN LITERARY

The poem reproduced herewith was written by a third year engineering student at the University of New Brunswick, and it appeared in a recent issue of the University paper. This number of *The Brunswickian* deserves special mention as it was prepared entirely by the engineering students and indicates the interest shown by the young engineer of today in subjects outside his own field.

#### FUNDY

*Have you ever been down to Fundy,  
Down to the rolling swell,  
Have you seen the fogs of Fundy,  
Have you heard the warning bell?*

*When deep fog horns are blowing,  
And the spray is flying free,  
As the waves roll in on Fundy—  
Have you ever longed for the sea?*

*There are ships that come to Fundy,  
That will take your heart away,  
When they slip from Saint John Harbour  
And head out down the Bay.*

*There's a smell of oil and oakum,  
Of tar and fish and brine,  
There's a warship in from Britain,  
And a sloop from Tormentine.*

*There are tankers, trawlers, schooners,  
And a swarm of fishing smacks,  
A corvette fresh from a convoy,  
And a freighter from Halifax.*

*If you like big ships and salt spray,  
And a sea that's running high—  
You'll like the Bay of Fundy  
When the storm flags start to fly.*

JOHN SIMMONS WATT, S.E.I.C.

## LETTER FROM WASHINGTON

The decisions arising out of the Oliver Lyttleton-Donald Nelson conversations may well come to be regarded as of major importance—not only in winning the war but in shaping the peace. Lyttleton's visit may hold more promise for the future than even Churchill's or Molotov's recent Washington visits. Many of the decisions were not made public but even the announced results are very significant. The most important was the formation of the Combined Production and Resources Board. Munitions, Shipping, Aircraft and even Raw Materials have already been brought under joint control, but this recent Board carries with it the implication of international control of industrial production and resources. This control has always been considered as a jealously guarded national prerogative. The second body set up was the Combined Food Board. This Board is important, not only because it sets up the machinery necessary to ensure the food supplies of the United Nations at war, but because of the strategic importance, in respect to both the war and the post-war period, of a global control of food resources. The four existing boards are the Combined Munitions Assignment Board, the Combined Shipping Assignment Board, the Joint Aircraft Board, and the Combined Raw Materials Board. With the creation of the Combined Production and Resources Board and the Combined Food Board, the pattern of a new world order begins to emerge. Recent press releases indicate that Mr. Nelson is reorganizing the War Production Board to conform more closely to the emerging pattern. His newly appointed Vice-Chairman, Mr. J. S. Knowlson, besides being responsible for all programme determinations, will act as Mr. Nelson's deputy on the Combined Production and Resources Board. He will also be Chairman of the U.S. Requirements Committee. It is also interesting to note, throughout the reorganization, a tendency to separate policy-determining and administrative functions.

---

One of the most interesting controversies in Washington recently has been raging round synthetic rubber. It is bewildering for a layman to try to keep up with the rapid developments but it is also extremely interesting. Not the least interesting feature of the story has been provided by the Senate Agricultural Committee which is pressing the claims of grain alcohol against those of petroleum as a potential source of synthetic rubber. I have attended several hearings of this committee which is chaired by the colourful and dynamic Senator Gillette of Iowa. When the Senate Committee went to Philadelphia to investigate a new process for producing butadiene from alcohol, Senator Gillette invited me to join the party as an observer. We had our own car on the train and a police escort in Philadelphia! The particular process under investigation is being sponsored by a large Philadelphia industrial alcohol firm. The inventor operated his process in Poland for several years before the German invasion and his escape and subsequent arrival in the United States reads rather like an Oppenheim thriller.

The magnitude of the whole synthetic rubber programme is tremendous. Plans are going forward for the production of 800,000 tons of synthetic rubber a year. In addition to formidable technical difficulties, the programme will cost about eight hundred million dollars and, according to releases by Mr. Nelson, will require 330,000 tons of steel, 7,000 tons of copper, bronze and brass, and 170,000 hp. of compressor capacity. Another interesting sidelight of the synthetic rubber programme is the fact that there will be no more beverage alcohol produced in the United States after the beginning of next year.

---

Sir Earle Page, convalescing from an attack of pneumonia, was recently in America on his way back to Australia from London in order to get two summers in a row to regain

his health. Sir Earle, who has been representing Australia on the British War Cabinet, was once Prime Minister of Australia and was co-head of the Bruce-Page Government. As leader of the Australian Country Party, Sir Earle has been interested in power and irrigation developments in Australia. He was therefore most anxious to inspect the work of the Tennessee Valley Authority. A visit was arranged and it was my privilege to accompany him on the trip. The T.V.A. project is only incidentally the largest single construction programme ever attempted—essentially it is a great social experiment based on agricultural considerations and directly affecting the welfare of four States and the lives of three million people. The project will have the vitally important secondary function of helping to control the hitherto devastating floods on the lower Mississippi. It was flood control on the Mississippi which first made control of the Tennessee Valley necessary. The valley comprises very hilly country and is an ideal water shed. Tennessee had always produced row crops and the top soil was being constantly washed off the sharply tilled ploughed fields. Run-off was rapid and the soil of the whole State was being impoverished. The original conception of the Muscle Shoals development, one of the forerunners of the T.V.A., was to use cheap power to produce nitrogen from the air and then to use the nitrogen to restore the land. It was Dr. Harcourt Morgan who pointed out the fallacy of this. Cheap nitrogen would make possible more row crops; more row crops would increase the run off and soil erosion and hasten a cycle by which Tennessee was being turned into barren land. His conception of flood control rested on the necessity of controlling water *where it falls*. To this end, he said, row crops must give way to alfalfa and blue grass which would both hold the soil and conserve the water and incidentally, take nitrogen from the air and restore it to the soil. For this purpose phosphates, rather than nitrogen, were necessary and here again a new type of electric furnace made possible the conversion by cheap power of mineral phosphorus deposits into fertilizing phosphates. Tennessee is to become a rich grazing country. Dr. Morgan presented his idea personally to the President. Back in 1933, at the age of 61 he resigned as President of the University of Tennessee to undertake the direction of the T.V.A. project. For eight years, as the senior member of a board of three directors, he has acted as the guiding genius of a project which now employs about 45,000 persons. Since power has become important for such industrial developments as the vast Alcoa plant outside of Knoxville, the project is being rushed on a full war-time basis. From an engineering point of view the T.V.A. project includes 28 dams, 16 completed and 12 now being rushed to completion. The total cost will be about one and one-quarter billion dollars or considerably more than the cost of the Panama Canal. The power output will be about three million kilowatts. Controlling the drought-flood cycles, furnishing power and irrigation, the project will also add 650 miles of navigable water with a nine foot draft to the Mississippi system from the conjunction of the Ohio all the way up to Knoxville.

---

A few weeks ago, a party of us were invited to attend a church parade at Annapolis Naval Academy. We were subsequently shown over the whole academy by a very personable lieutenant. To say that we were impressed with the size and "ship shapeness" would be a presumptuous understatement. After visiting the dining hall at which 4,000 "Middies" can be served at one sitting, we asked to see the kitchens—they must be seen to be believed with their tiled walls and long batteries of burnished equipment. My wife found herself standing near a large piece of equipment into which two men were pouring baskets full of peeled apples which were emerging all finely sliced. "For apple pie?" asked she, "No," said the attendant haughtily, "Salad Supreme."

July 21, 1942.

E. R. JACOBSON, M.E.I.C.

H.Q. First Canadian Army,  
20 May, 1942.

L. Austin Wright, Esq., M.E.I.C.,  
General Secretary, The Engineering Institute of Canada,  
2050 Mansfield Street, Montreal, Canada.

Dear Mr. Wright,

I have just received your letter of 13 April, 1942, and I am indeed grateful to you for your kind thoughtfulness in sending me the pictures taken in the course of the E.I.C. banquet in February last and also the copy of the March number of *The Engineering Journal* with the record of that, for me very memorable, occasion, for neither my wife nor I will ever forget the warmth of the reception which you gave us.

Back again with the Canadian forces in England, it hardly seems that we have been away at all. Army Headquarters is developing steadily and the other parts of our organization are progressing—training goes on at a high pitch—the physique and the morale of the men is marvellous, and I have no doubts as to their performance when the time for action comes. Meanwhile, we hold our patience and try to make the best use we can of this period of waiting and of the pause before the storm.

With kindest regards to all, and again very many thanks for your letter.

Very sincerely yours,

A. G. L. MCNAUGHTON.

L. Austin Wright,  
Secretary, Engineering Institute of Canada,  
Mansfield Street, Montreal, P.Q., Canada.

Dear Mr. Wright,

Your letter of June 1st was much appreciated. It was very good of you to write to me. I believe I paid last year's subscription, so am in credit for the time being anyway.

I enjoy reading the monthly *Journals*, and occasionally send them to associated engineers. The personal photographs interest me immensely as I so often get a glimpse of long lost friends, such as Colonel Donald White and Hugh Lumsden. The latter's father gave me my first engineering appointment with the C.P.R. in Winnipeg.

I had the pleasure and honour of meeting General McNaughton at the Vimy Anniversary Service held in Westminster Abbey last April, which was a most impressive affair. He is held in very high esteem in this country.

I am continually meeting Canadians serving in the various branches, particularly those connected with the Naval and Fleet Air Arm branches, some of whom are members or honorary members of the Royal Thames Yacht Club.

Some few years ago, I made a suggestion that the E.I.C. should be represented in the British Isles. It is a pity there is not an English Branch of the Institute.

I have not visited Canada since 1934, and on that occasion was in Montreal from a Friday only until Monday, so it was difficult to fit in a call on the Institute.

I should always be pleased to meet any friends coming this way.

With kind regards,

Yours sincerely,

E. VICTOR COLLIER.

The following letters refer to Council's recent action in granting remission of fees again this year to all members in the combatant areas. *Editor.*

20, Eyre Court, St. Johns Wood, N.W.S.

June 27th, 1942.

Dear Mr. Wright,

Your letter of the 1st instant received today and I reply to it at once as I feel guilty at not having acknowledged a similar letter last year. You will forgive me I hope, when I remind you we lead busy lives in this little island, but rather wonderful ones. It is wonderful to watch the unfolding of good and this omnipotent power is destroying the evil we are fighting.

Please convey to the Council my grateful thanks for their kind thought and action.

I am so proud of Canada, my country (almost) by adoption. In 1937 I set down a plan of world betterment, the motive power of which is giving. "Give and it shall be given unto you", is an immutable law and Canada has set the example amongst the nations, as I knew she would. There is spiritual power in a gift that for all the friendship expressed, lies not in a loan. In the future—*now*, it must be "give, give" not "lend, lease". I have thought much of sending you the plan to present to the Council and membership, much of it has already come into operation and Canada has given it the spiritual impulse I have awaited.

Congratulations on your new job—I have read of it in *The Journal* which I much enjoy reading. May I ask you to remember me to my friends and fellow members.

All best wishes to yourself and many thanks for your services.

Yours sincerely,

R. EWART CLEATON.

L. Austin Wright, Esq., M.E.I.C.,  
General Secretary, The Engineering Institute of Canada,  
2050 Mansfield Street, Montreal, Quebec.

The Editor,

*The Engineering Journal*, Montreal, Que.

I note that Mr. S. R. Banks, M.E.I.C., in the fourth part of his splendid paper on the Lions' Gate Bridge, records the failure of the spray paint shop coat on this structure that gradually developed before the field coats were applied and that much repainting had to be done in the field.

As the author and those in charge of fabrication and erection seem to be in doubt as to the cause of the failure of this shop coat, may I refer to my own experience with similar applications.

I happened to be in engineering supervision of the erection of one of Toronto's early sky-scraper buildings about 1914. Spray painting had just come in, and as one machine did the work of seven men, we jumped at the opportunity of the saving this meant and started our painting by machine. After two or three days work, the architect forbade spray painting absolutely. While I was awaiting the explanation of the prohibition, into my office walked the sales agent of the company supplying the paint, and, as he was an intimate friend of mine, by way of teasing I reproached him with advising the architect against spray painting. He gasped a little and then said "I'm sorry, but I really had to. Have you seen the micro-photographs we have taken of this coat of paint?" No, I hadn't so he showed them to me. They clearly showed that the painted surface was not a complete surface or skin but a series of superimposed discs like small shingles and frequently there were gaps and spaces between the discs so it was not a waterproof skin but a porous shingled surface and rust was bound to develop. He also expressed the opinion that the

oxygen of the air, under high pressure, not only volatilized the oil of the paint, but oxidized and set it almost as it contacted the steel surface and so prevented the blending of the drops into a skin.

On a certain very large Canadian bridge, this action of spray painting machines in creating a porous paint surface has been confirmed. Formerly the maintenance coats were applied at high cost, by hand and blistering usually followed. When spray painting was adopted, the blistering stopped. A little thought will show the reason. Blistering is caused by volatilization of liquids or oils under an air-tight skin, the gas pressure lifting the skin surface. If the skin is porous, the gases escape and no blistering occurs.

Many will point out that autos, etc., are spray painted—no not painted—they are enamelled. A varnish does not seem to oxidize as suddenly as an oil paint, and the drops tend to fuse and form a skin.

However, I am not a paint expert and these remarks are made in the hope that the whole, very vital, subject may be opened for discussion.

It is very interesting to me to see results recorded in connection with the Lions' Gate Bridge that correspond to my experience of 28 years ago.

C. S. G. ROGERS, M.E.I.C.,  
*Bridge Engineer, Canadian National Railways.*

### MEETING OF COUNCIL

A meeting of the Council of the Institute was held at Headquarters on Saturday, June 20th, 1942, at ten-thirty a.m.

*Present:* President C. R. Young in the chair; Vice-President K. M. Cameron; Councillors J. E. Armstrong, J. G. Hall, R. E. Hertz, W. G. Hunt, T. A. McElhanney, C. K. McLeod, A. W. F. McQueen, and G. McL. Pitts; Secretary-Emeritus R. J. Durley, General Secretary L. Austin Wright and Assistant General Secretary Louis Trudel.

The general secretary reported that when in New York recently, he had discussed informally with the secretaries of the American Founder Societies the suggestion that the Institute might act as a distributing agent in Canada for their publications. While the opinions expressed were entirely those of the secretaries, it appeared that the American Society of Mechanical Engineers would be interested in any proposition the Institute might submit. That society has a very extensive list of publications, and publishes a comprehensive catalogue every year, a copy of which could be made available to every member of the Institute. They would also be willing to consider sending a supply of the various publications to Headquarters, the Institute to distribute them and collect the money for transmission to the American society.

The American Society of Civil Engineers has very little to offer in the way of literature other than *Civil Engineering* and their Transactions, but would be very willing to co-operate in any way possible. The situation with regard to the American Society of Electrical Engineers and the American Institute of Mining and Metallurgical Engineers would require some further investigation.

The general secretary's statement was noted and accepted as a progress report with the understanding that the matter would be kept continually in mind. It was also suggested that it might be desirable to commence negotiations with any of the societies that were willing to co-operate.

Mr. Hall, chairman of the Institute's Membership Committee, reported that his committee had under consideration the various matters which had been referred to it previously by Council. Considerable thought had been given to the question of a new name for Branch Affiliate, but the committee was not yet ready to make a recommendation. The qualifications for Institute Affiliate, as prescribed in the By-laws, were also receiving consideration.

The resolutions from the Toronto Branch regarding the

method of considering applications for admission, were receiving further consideration. Mr. Hall pointed out some of the difficulties of the present method, and outlined briefly a line of procedure being considered by his committee. It was felt that the branches were in a better position than the Council to verify the information presented in an application, but the Membership Committee or the Council should interpret this information in terms of qualification for membership. The committee was very anxious that any suggested change in procedure would not involve a change in the By-laws. The question of membership in a provincial professional association as a qualification for membership in the Institute was also receiving attention. A short discussion followed which Mr. Hall would be very helpful to his committee.

The general secretary had received from the Executive of the Montreal Branch a copy of a draft of a suggested agreement between the Institute and the Corporation of Professional Engineers of Quebec which, he understood, Mr. Armstrong had been asked to present to the meeting. Mr. Armstrong stated that at a meeting of the Montreal Branch executive, held the previous evening, he had been asked to speak on behalf of the branch. The branch felt that the present was an appropriate time to make some progress towards co-operation with the Corporation and, accordingly, has prepared a draft of a possible agreement. The other branches in the province or the Corporation had not yet been consulted. The Montreal Branch executive had approved of this preliminary draft and presented it to Council with a request for authorization to discuss the matter informally with the other Institute branches in the province, to develop the draft and then discuss it with representatives of the Corporation, all with a view to preparing it for submission to Council. The present preliminary draft was not presented for formal action by Council but rather as an indication of what the Montreal Branch would like to discuss informally with the other branches and the Corporation. The branch would also like permission to lay the draft before the Institute's Committee on Professional Interests.

Following some discussion, on the motion of Mr. McLeod, seconded by Mr. Armstrong, it was unanimously resolved that the Montreal Branch executive be authorized to discuss informally the draft agreement with the chairman of the Institute's Committee on Professional Interests, the other Institute branches in the province and the Corporation of Professional Engineers of Quebec.

The president outlined briefly the relations between the Institute's committee, Dr. Manion's Committee on Air Raid Precautions, and the Canadian Engineering Standards Association.

Dr. Manion had advised the president that certain printed material which he was receiving from the C.E.S.A. would be distributed to the Provincial A.R.P. committees, and had asked if it would be in order for these committees to consult with the Institute branch committees which were being set up. The president had assured Dr. Manion that this would be entirely in order; had undertaken to supply him with the names and addresses of the chairmen of the branch committees, and had informed him of Mr. Armstrong's appointment as chairman of the co-ordinating committee.

Mr. Armstrong had been in touch with Dr. Manion's office in an endeavour to secure copies of the C.E.S.A. material which was being sent to the Provincial A.R.P. committees, but had been informed that as Dr. Manion would be absent from his office for some weeks, this would have to be held over until his return. It was suggested that if Mr. Armstrong was in Ottawa in the near future, it might be desirable for him to discuss this with the secretary of the C.E.S.A.

It was noted that the financial statement to May 30th, 1942, had been examined and approved by the Finance Committee.

A copy of the minutes of the last meeting of the Advisory Board of the Wartime Bureau of Technical Personnel was presented, from which it was noted that Mr. H. W. Lea, M.E.I.C., had been appointed Director of the Bureau, replacing Mr. Little who is now Director of National Selective Service. Mr. Wright reported that the Bureau is now acting as a division of the National Selective Service, doing excellent work in a greatly expanded field.

A communication was presented from the Engineers' Council for Professional Development announcing that Dr. Surveyer's term as representative of the Institute on E.C.P.D. expired this fall. On the motion of Mr. McLeod, seconded by Mr. Heartz, it was unanimously resolved that Dr. A. Surveyer be re-appointed as the Institute's representative on E.C.P.D. for a further period of three years.

A cablegram had been received from the Institution of Mechanical Engineers, from which it was noted that the 1942 award of the James Watt International Gold Medal had been made to the Institute's nominee, Mr. A. G. M. Michell, of Australia.

Mr. Pitts called Council's attention to the workings of Order-in-Council P.C. 638 (Scientific and Technical Personnel) as it affected architects. He explained that it is now necessary for a client, as well as the architect, to secure a permit before work could be undertaken for a client. He thought this might frequently put the client in an awkward position, particularly when it was someone who is not well versed in business transactions. He thought the legislation was too restrictive.

Mr. Wright, as Assistant to the Director of National Selective Service, explained the purpose of the legislation and expressed the hope that not many cases would arise such as the one which Mr. Pitts described.

The president was of the opinion that little could be done

about it now, but asked Mr. Wright to keep note of it in case any adjustment could be made subsequently.

The president reported that he had attended the annual meeting of the National Construction Council of Canada in Toronto on May 28th. A very excellent meeting had been held. There were good discussions on several important matters including post-war problems. Mr. D. C. Tennant, the Institute's representative on the Council, had also been present and would, no doubt, submit a report on the meeting.

The president stated that he was planning to attend the annual meeting of the Society for the Promotion of Engineering Education to be held in New York on June 27th to 29th.

A number of applications were considered and the following elections and transfers were effected:

ADMISSIONS	
Members.....	15
Juniors.....	2
Students.....	7
Affiliates.....	3
TRANSFERS	
Juniors to Members.....	2
Student to Member.....	1
Students to Juniors.....	5

The president reported that he expected to leave Toronto on July 29th for a two weeks' visit to the Quebec and Maritime branches. It was suggested that if satisfactory arrangements could be made, it would be very desirable to hold a regional meeting of Council in the Maritimes during the president's visit. It was left to the president and the general secretary to decide, after consultation with the branches concerned, whether such a meeting should be held.

The Council rose at one o'clock p.m.

## Personals

**Lieut.-General A. G. L. McNaughton**, C.B., C.M.G., D.S.O., M.E.I.C., commander of the Canadian Army in Britain, received the honorary degree of Doctor of Laws on July 4th, from Birmingham University, England.

**J. L. Morris**, M.E.I.C., has recently retired from the Department of Lands and Forests of the province of Ontario. He was the first graduate of the School of Practical Science in the University of Toronto in 1881 and in 1885 he received the first degree of C.E. from the same university. In 1927 his *Alma Mater* conferred on him the degree of Doctor of Engineering.

Dr. Morris began his engineering career with the Canadian Pacific Railway Company as an assistant on construction work. In 1886 he commenced a private practice at Pembroke, Ont., and carried out many important works throughout Ontario and Quebec. For a number of years he was town engineer of Pembroke, Ont., and up until March, 1928, he was senior partner of the firm of Morris and Moore, surveyors and engineers at Pembroke. He joined the Department of Lands and Forests in 1928 and the following year became inspector of surveys with the same Department.

**Brigadier Noel D. Lambert**, M.E.I.C., formerly director of engineer services has been recently promoted from the rank of colonel and appointed deputy quartermaster-general (engineering), Department of National Defence at Ottawa, as a result of a reorganization in the quartermaster-general's branch.

Brigadier Lambert is a graduate of the University of British Columbia and previous to joining the Department of National Defence he was vice-president and general

## News of the Personal Activities of members of the Institute, and visitors to Headquarters

manager of the Northern Construction Company and J. W. Stewart Limited, Vancouver, B.C.

**Lieut.-Colonel E. C. Thorne**, M.E.I.C., who was assistant director of Chemical Warfare in the Department of National Defence in Ottawa, has been promoted from the rank of major and appointed acting director and engineer of the Department. He returned last year from England where he was officer commanding the 2nd Field Company, R.C.E. Before the war Colonel Thorne was with the operating department of the Southern Canada Power Co., Ltd., Montreal, Que.

**Lieut.-Colonel R. A. Logan**, M.E.I.C., who has been attached lately to Royal Canadian Air Force Headquarters at Ottawa, has been transferred to the Air Staff, Plans Division, at Washington, D.C.

**H. J. Crudge**, M.E.I.C., building engineer of the Canadian National Railways at Moncton, N.B., is the newly elected chairman of the Moncton Branch. Mr. Crudge has been located in Moncton since 1915, but prior to this was connected with the engineering department of the Canadian Pacific Railway in Montreal. He has served as a councillor of the Institute and is past president of the New Brunswick Association of Professional Engineers. In 1938 he was appointed to the advisory committee of the National Research Council of Canada in the preparation of a national building code.

**John McHugh**, M.E.I.C., who retired last March from the Dominion Department of Fisheries after 28 years service, accepted an appointment in May with the Wartime Prices and Trade Board as regional representative for the controller of supplies at Vancouver, B.C.



**Elizabeth M. G. MacGill, M.E.I.C.**

**Elizabeth M. G. MacGill**, M.E.I.C., is the newly elected chairman of the Lakehead Branch. She holds the position of chief aeronautical engineer with the Canadian Car and Foundry Co. Ltd., at Fort William, an appointment which she accepted in 1939.

**Roy W. Emery**, M.E.I.C., has recently returned from British Guiana, S.A., and he is now employed in the design department of H. G. Acres and Company at Niagara Falls, Ont.

**Herbert R. Davis**, M.E.I.C., is at present employed as an engineer with the R.C.A.F., Western Air Command at Victoria, B.C. He was previously located at Saskatoon where he was a partner in the firm of Davis-Fisher Limited, design and construction engineers.

**E. M. Nason**, M.E.I.C., is resident engineer of the R.C.A.F. Station at Boundary Bay, B.C. He was previously located at No. 3 Training Command at Moncton, N.B.

**D. R. McGregor, Jr.**, E.I.C., has left his position with the Canadian General Electric Company, Limited, Peterborough, Ont., to join the R.C.N.V.R. as a sub-lieutenant. He graduated from McGill University in 1935 and has been with the company ever since.

**Robert T. Tamblin**, S.E.I.C., enlisted with the Royal Canadian Engineers shortly after graduating from the University of Toronto this year.

**E. T. Skelton**, S.E.I.C., has accepted a position with the Demarara Bauxite Company, Mackenzie, S.A. He graduated this spring in civil engineering from the University of New Brunswick.

**Carl Norman Cunningham**, S.E.I.C., of Fairville, N.B., graduated this spring from Nova Scotia Technical College with the degree of B.Eng., in mechanical engineering.

**Bryce Fraser Keays**, S.E.I.C., of Newcastle, N.B., graduated this spring from the University of New Brunswick with the degree of B.Sc., in civil engineering.

**Arnold William Dyck**, S.E.I.C., of Vancouver, B.C., graduated this spring from the University of Saskatchewan with the degree of B.Sc., in mechanical engineering.

**Wilbert Hunter Tate**, S.E.I.C., of North Battleford, Sask., graduated this spring from the University of Saskatchewan with the degree of B.Sc., in mechanical engineering.

**John S. Lochhead, Jr.**, E.I.C., has recently joined the staff of Defence Industries Limited, Montreal, Que. Since his graduation from McGill University in 1937, he has been employed with the Dominion Bridge Company, Montreal.

**Irving I. Sweig**, S.E.I.C., obtained his B.Sc. degree from Sir George Williams College, Montreal, in May.

**Walter M. Smith**, S.E.I.C., who graduated in electrical engineering this spring from the University of New Brunswick, has joined the staff of the Bell Telephone Co. of Canada in Montreal.



**Leon A. Duchastel, M.E.I.C.**

**Leon A. Duchastel**, M.E.I.C., has been elected chairman of the Montreal Chapter of the Illuminating Engineering Society. Mr. Duchastel who is power sales engineer with the Shawinigan Water and Power Company, is the secretary-treasurer of the Montreal Branch of the Institute.

#### VISITORS TO HEADQUARTERS

**J. A. Van den Broek**, professor of engineering mechanics, University of Michigan, Ann Arbor, Mich., U.S.A., on July 3rd.

**Flight-Sergeant Eric Grant**, M.E.I.C., R.C.A.F., Eastern Air Command Headquarters, Halifax, N.S., on July 4th.

**E. R. Jacobsen**, M.E.I.C., Commonwealth of Australia, War Supplies Procurement, Washington, D.C., on July 8th.

**Major J. H. McIntosh**, M.E.I.C., R.C.A., Victoria, B.C., on July 11th.

**René Dupuis**, M.E.I.C., director, Department of Electrical Engineering, Faculty of Applied Science, Laval University, Quebec, Que., on July 16th.

**Professor R. F. Legget**, M.E.I.C., assistant professor, Department of Civil Engineering, University of Toronto, Toronto, Ont., on July 20th.

**T. M. Moran**, M.E.I.C., vice-president, Stevenson & Kellogg, Ltd. Toronto, Ont., on July 23rd.

**H. A. Lancefield**, S.E.I.C., Defence Industries Limited, Montreal, Que., on July 23rd.

**Sidney Hogg**, M.E.I.C., designing engineer, St. John Dry Dock & Shipbuilding Co., Ltd., Saint John, N.B., on July 24th.

**Guy Thibaudeau**, S.E.I.C., Quebec, Que., on July 24th.

**Jean L. Lacombe**, S.E.I.C., Quebec North Shore Paper Co., Baie Comeau, Que., on July 27th.

# Obituaries

*The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.*

**Harry Wendell Mahon**, M.E.I.C., passed away at Halifax, N.S., on June 8th, 1942, after a short illness. He is survived by his widow the former Marion Reid Smith, a son and a daughter, and his brother Arthur S. Mahon.

He was born at Great Village, N.S., on April 26th, 1889, the son of Captain James A., and Mrs. Mahon, and he received his education in his native province. He graduated in engineering from Dalhousie University, and from the Nova Scotia Technical College in 1914 in civil engineering. Except for three years overseas during the First World War, his life work has been the investigation of the water power resources, and the development and operation of hydro-electric power in Nova Scotia.

His engineering work commenced in 1915 with the Dominion Water and Power Bureau of the Department of Mines and Resources. He continued with the Nova Scotia Water Power Commission and then with the Nova Scotia Power Commission when organized in 1919. With the latter Commission, he was engineer of investigation, for which Department he continued to be responsible for twenty-three years, and, in addition, administered the Nova Scotia Water Act for the Minister.

His engineering memorial remains in the foundations which he laid for the power industry of Nova Scotia. It was on his engineering surveys and studies that a great number of the hydro-electric plants were built and operated, including most of the plants of the Nova Scotia Power Commission. His reports will continue to be basic for future development of provincial water resources.

Professionally, he was a member of The Engineering Institute of Canada, and of the Association of Professional Engineers of Nova Scotia. His was an active life, and the engineering profession of Nova Scotia has lost a leading figure who is deeply mourned.

Mr. Mahon joined the Institute as a Junior in 1916. He was transferred to Associate Member in 1918 and became a Member in 1940.

**Lieut.-Colonel Henry Fairweather Morrisey**, M.E.I.C., district engineer for the Department of Transport of Canada at Saint John, N.B. and a councillor of the Institute, died in the hospital at Montreal on June 25th, 1942.

He was born at Saint John, N.B. on June 14th, 1890, and received his preliminary education in the local public schools and the Saint John high school. He studied engineering at the University of New Brunswick where he graduated in 1912 as a B.Sc. In 1915 he received the degree of M.Sc. from the University. During the summers of 1909 to 1911 he was engaged in engineering work for the Department of Public Works of Canada on construction of wharves and breakwaters at Saint John. Except for the time which he spent in service overseas in the last war, he served as assistant engineer on the River St. Lawrence ship channel from 1912 to 1920.

In 1920 he was appointed district engineer at Saint John, N.B. for the Marine Department of Canada and occupied the same position with the Department of Transport until his death.

Before the First World War Colonel Morrisey had served in the Corps of Guides and at the outbreak of hostilities he enlisted in the Royal Canadian Engineers but was transferred later to the Royal Navy with the rank of lieutenant. He was stationed at the St. Lawrence ship channel during the first years of the war and was in charge of arrangements to block the channel in the event of enemy craft entering the river. He had oversight of the clearing of the way for transports and was on guard duty for the safety of submarines, drifters and trawlers which had been built at Montreal, Sorel and Three Rivers. For the last two years of the war he served with the Royal Navy in the

Mediterranean aboard H.M.S. Endeavour and H.M.S. Caesar.

On his return to Canada in 1919 he joined the non-permanent militia. He was commissioned in the 3rd New



Lieut.-Colonel H. F. Morrisey, M.E.I.C.

Brunswick Medium Brigade, Canadian Artillery, (The Loyal Company of Artillery), now the Royal Canadian Artillery. He commanded the 15th Medium battery, a crack battery of the brigade for a time and later took command of the brigade and held that responsible position for some years. Since the outbreak of the present war he had assumed command of the 3rd New Brunswick Coast Brigade, Reserve, R.C.A., and played an important role in the organization for local defence.

Colonel Morrisey joined the Institute as a Junior in 1913. He was transferred to Associate Member in 1922 and became a Member in 1940. He was very active in Institute affairs and had been elected a councillor of the Institute for the Saint John Branch last year.

**John Earle Porter**, M.E.I.C., died suddenly at Windsor, Ont., on June 28th, 1942. He was born at Wingham, Ont.,



J. E. Porter, M.E.I.C.

on December 6th, 1891, and received his education at the University of Toronto where he graduated in 1915.

Upon graduation he joined the staff of the Department of Public Works of Canada as assistant engineer in the district of western Ontario, and was connected with harbour and river development and improvement work until 1915 when he joined the staff of the Canadian Steel Corporation, Limited at Ojibway, Ont., as field engineer and inspector. In this capacity he was in charge of surveys, lay-out and construction of harbours and piers.

In 1922 he joined the staff of the Ford Motor Company

of Canada, Limited at Windsor, Ont., and was in charge of the civil engineering branch. Later he became in charge of all engineering activities of the company and in July 1941, he was appointed general superintendent of the company. A few weeks ago he had been elected vice-president and director of the company.

Mr. Porter joined the Institute as a Student in 1914 and was transferred to Junior in 1917. In 1919 he was further transferred to Associate Member and he became a Member in 1940. He was a councillor of the Institute representing the Border Cities Branch in 1926.

**Sir Charles Ross**, M.E.I.C., died at Passagrille, Florida, on June 28th, 1942, after a short illness. Born at Balnagown, Rosshire, Scotland, on April 4th, 1872, he was educated at

Eton and Trinity College, Cambridge. He served as a lieutenant in the 3rd Battery, Seaforth Highlanders, retiring in 1894. In the Boer War he served as a captain.

In 1896 he became connected with the West Kootenay Power & Light Company, B.C., as a construction engineer and contractor. In 1902 he organized the Ross Rifle Company for the production of the weapon which he had designed and which had been adopted for the Canadian Militia. During the First World War he was advisor on small arms to the Canadian Government and also conferred confidentially with the American Government.

Sir Charles joined the Institute as a Member in 1918 and kept an active interest in Institute affairs as revealed by an exchange of correspondence with Headquarters only a few weeks before his death.

## News of the Branches

### LAKEHEAD BRANCH

W. C. BYERS, JR., M.E.I.C. - - *Secretary-Treasurer*

The annual dinner meeting of the Lakehead Branch was held at the Port Arthur Golf and Country Club on June 10th commencing at 7.00 p.m.

Miss E. M. G. MacGill presided at the meeting.

Grace was said by R. B. Chandler.

A resolution regarding the status of the engineer in the armed forces was discussed by several members and unanimously passed.

Reports were received from the finance, membership, entertainment and nominating committees.

At the conclusion of the business meeting the members took part in a golf game and putting contest.

There were thirty members and guests present.

### MONCTON BRANCH

V. C. BLACKETT, M.E.I.C. - - *Secretary-Treasurer*

A dinner meeting of the branch was held in the Brunswick Hotel on Monday, June 1st. The attendance was the largest for some years and included members of the staffs of the Robb Engineering Works and the Canada Car & Foundry Co., who motored from Amherst to attend the meeting. H. J. Crudge, vice-chairman of the branch presided.

A very interesting address on **Plastics** was delivered by H. Franklin Ryan, B.Sc., M.E.I.C., of the Canadian General Electric Co., Halifax. In his opening remarks, the speaker stated that while the tremendous need for war time substitutes had brought plastics into prominence, they are not of recent origin. As far back as the middle of the last century the scarcity of large elephants gave rise to a need for a suitable substitute for ivory made from the tusks of these animals. A solution to the problem was found by an American Chemist, John Wesley Hyatt, who discovered that by mixing cellulose with alcohol, there was produced a substance which later became known as celluloid. That, Mr. Ryan said, was the first plastic. A plastic consists essentially of a resin blended with a filler and molded either with heat alone or by means of heat and pressure combined. In the former case the structure of the materials is not altered, and the plastic can be again liquified and re-molded. Where, however, both heat and pressure are required, chemical changes take place, and the plastic cannot be re-melted. Phenol is the most common resin and wood flour is among the fillers used. Other resins are petroleum, coal, natural gas, urea, vynal, glycerine and milk. The uses that have been found for plastics are many and varied and include radio cabinets, optical glass, aeroplane parts and electrical equipment of all kinds. It must be kept in mind that modern plastics are not substitutes in the sense of inferior replacements but are rather replacements that are of greater value than the original products. Nylon is an

### Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

example. It is a substitute for silk and is superior to silk. A notable achievement has been the development of a plastic with a tensile strength of 100,000 lb. per sq. in.

Mr. Ryan's remarks were illustrated by lantern slides. He also placed on display samples of materials and finished products of the plastic art. One that aroused special interest was the nose cap of an anti-aircraft shell.

Following a period of questions and answers, a vote of thanks to the speaker was moved by G. L. Dickson and seconded by A. S. Donald.

At this meeting nominations were made for branch officers for 1942-43.

### SAGUENAY BRANCH

D. S. ESTABROOKS, M.E.I.C. - - *Secretary-Treasurer*

J. G. D'AOUST, M.E.I.C. - - *Branch News Editor*

A meeting of the Saguenay Branch was held in the Protestant School in Arvida on Thursday, June 11th. Two industrial films were shown, one by Mr. C. A. Booth of Fiber Glass, Canada Ltd., and the other by Mr. Paul LeBel, M.E.I.C., of the Imperial Oil Company.

The use of glass insulation has in many cases solved the problems created by wartime demands on electrical equipment, and Mr. Booth's film explained the principal uses and advantages of this material as class B insulation. After sketching the history and manufacturing of fiber glass products the speaker answered questions raised by the members and demonstrated by means of samples, the many forms in which glass fibres can be used.

Raw material is produced in the United States and at present only electrical insulation is manufactured in Canada. The raw material comes in the form of small glass spheres which are melted down in an electric furnace. The molten glass then flows through tiny holes in a platinum bushing and the very fine glass fibers so produced are twisted into a strand of 204 fibers and are then wound on bobbins ready for the process of weaving into the many forms of cloth used.

Six times as strong as cotton, this product will withstand higher temperatures and more severe acid conditions than other forms of class B insulation. The cost is about the same as other materials in use.

The second film of the evening, a colour film depicting the construction of the Portland-Montreal pipe line, was taken by Mr. LeBel of the Imperial Oil Co. who was closely associated with the work.

The various phases of the project were well illustrated and Mr. LeBel's remarks in answer to the many questions

asked gave an interesting picture of the problems which had to be overcome.

Construction of this pipe line greatly reduced the distance which the tankers had formerly to travel in going to Montreal via the St. Lawrence, the oil now being pumped from Portland by eight pumping stations through the 236 miles of pipe to Montreal. Twelve inch pipe was used throughout excepting under the larger rivers where two ten-inch pipes were laid in a common trench in the riverbed and connected by manifolds on either bank to the main twelve inch line. This arrangement permits of uninterrupted service when cleaning the line at these points, and insures against a stoppage should trouble be experienced on one of the branches.

An interesting feature of the pumping system is the use of diesel driven pumps which take their oil fuel direct from

the pipe line, at the Highwater station, at which point electrical power was not available.

The work was done by two contractors who made extensive use of diesel tractors, not only for handling materials and excavating, grading, etc., but also for the actual bending and placing of the pipe in the trench. The pipe lies two to four feet below grade and in the more favourable terrain was placed at the rate of three miles a day, the total time for the job constituting a record for this kind of work. In the rivers the twin ten inch pipes lie fifty feet below low water in the navigable portions, the trench in the remaining parts being twenty feet deep.

Mr. McCaghey, branch chairman, conveyed the thanks and appreciation of the members to the speakers for their contributions.

## Library Notes

### NEW C.E.S.A. SPECIFICATION

The Canadian Engineering Standards Association has recently issued the following new standard:

#### C83 Pole Line Hardware. 1st. ed.

This specification covers the purchasing requirements for pole line hardware used by utilities engaged in power supply, electric traction or communication transmission. It is divided into three parts: 1. General—2. Material and Manufacture—3. Drawings. This specification is being issued for the purpose of benefiting producers, distributors and consumers of pole line hardware and of helping the war effort: 1. By restricting steel to a few grades. 2. By substituting a large production volume of the standard item in place of relatively small volumes of many types and sizes of equivalent articles. 3. By permitting any of the three above mentioned groups to assist a particular user of such hardware when affected by an acute supply shortage or abnormally large construction and maintenance programme. 4. By permitting a considerable reduction in stocks in warehouses and storage. In order that review of new information and drawings on new or existing standard hardware items can be added from time to time this specification is issued in loose-leaf form under a special binder. Copies of this standard may be obtained from the Canadian Engineering Standards Association, National Research Building, Ottawa. Price 75c. a copy.

### ADDITIONS TO THE LIBRARY

#### TECHNICAL BOOKS

##### Industrial Furnaces:

Vol. 2, 2nd ed., W. Trinks. N.Y., John Wiley and Sons, Inc., 1942. 6 x 9 in. \$5.00.

##### Practical Aerodynamics:

3rd ed., Bradley Jones. N.Y., John Wiley and Sons, Inc., 1942. 6 x 9 in. \$3.75.

##### Structural Theory:

3rd ed., Hale Sutherland and Harry Lake Bowman. N.Y., John Wiley and Sons, Inc., 1942. 6 x 9 in. \$3.75.

##### Definitions of Electrical Terms:

American Standard C42. Sponsor the American Institute of Electrical Engineers. 7 3/4 x 11 in. \$1.00 in the U.S.A. \$1.25 outside the U.S.A. \$1.00 in Canada if ordered through the Canadian Engineering Standards Association.

##### Prize Bridges 1928-1941:

American Institute of Steel Construction, Inc., 1942.

### Book notes, Additions to the Library of the Engineering Institute, Reviews of New Books and Publications

#### Fatigue of Metals:

2nd ed., D. Landau. N.Y., The Nitralloy Corporation, 1942. This booklet will be ready for distribution after August 1st, 1942.

#### REPORTS

##### Hydro:

Ontario's successful experiment in public ownership by Thomas H. Hogg. Address delivered before Princeton University on December 10, 1941. The Guild of Brackett Lecturers, 1941.

##### The Royal Aeronautical Society:

Aims, work, membership and rules. Revised February 10, 1940.

##### Extraction not Conversion:

The answer to the refiners mercaptan problem. Universal Oil Products, Booklet No. 251. Reprinted from World Petroleum Vol. 13, No. 2, February, 1942.

##### Handbook of Scientific and Technical Societies and Institutions of Canada:

National Research Council, Ottawa, 1942. 50c.

##### Trade and Professional Associations of the United States:

U.S. Department of Commerce, Bureau of Foreign and Domestic Commerce, 1942. For sale by the Superintendent of Documents, Washington, D.C., 70c.

##### Science and Mathematics and the War:

A progress report by the Philadelphia Regional Committee on Science and Mathematics Teaching.

##### National Bureau of Standards:—Building Materials and Structures:

Water permeability of walls built of masonry units. Report 82:—Strength of sleeve joints in copper tubing made with various lead-base solders. Report 83:—Survey of roofing materials in the South Central States. Report 84.

##### Canada—Department of Mines and Resources—Mines and Geology Branch:

Industrial waters of Canada. Report on investigations 1934-1940. Ottawa, Bureau of Mines publication No. 807, 1942. 25c. Petroleum fuels in Canada. Publication No. 808, 10c.

##### Canada—Department of Mines and Resources—Surveys and Engineering Branch:

Surface water supply of Canada. St. Lawrence and Southern Hudson Bay drainage Ontario and Quebec. Ottawa, Water Resources Paper No. 79, 1942. \$1.00.

Altitudes in Northern Ontario. Geodetic service of Canada publication No. 45, 25c.

##### Bell Telephone System—Technical Publications:

Performance of ground-relayed distribution circuits:—Viscosity-molecular weight of rubber:—The Thermal expansion of pure metals pt. 2:—Determination of antimony in lead-antimony alloys:—Fractionation and molecular weight of rubber and gutta-percha:—A more symmetrical fourier analysis:—L type impedance transforming circuits:—Monographs 1329-1335.

##### The Electrochemical Society:

The electrodeposition of hard nickel:—A strange phenomenon in plating:—Electrodeposition of nickel-tungsten alloys from an acid plating bath. Preprints 82-1, 2 and 3.

#### BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet the books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

##### A.S.T.M. STANDARDS ON ELECTRICAL INSULATING MATERIALS, prepared by A.S.T.M. Committee D-9 on Electrical Insulating Materials; Specifications, Methods of Testing, December, 1941.

American Society for Testing Materials, Phila., Pa., 448 pp., illus., diagrs., charts, tables, 9 x 6 in., paper, \$2.25.

This volume contains the specifications and test methods covering this field in their latest form as well as the current report of the committee on electrical insulating materials. The report outlines its work and gives proposed revisions of standards. Several appendices discuss the significance of various tests.

##### AIR RAID PRECAUTIONS HANDBOOK No. 14 (1st ed.) THE FIRE GUARDS HANDBOOK.

Great Britain, Ministry of Home Security and Scottish Home Department. Publ. by His Majesty's Stationery Office, London, 1942. 45 pp., diagrs., 6 1/2 x 4 in., paper, (obtainable from British Library of Information, 30 Rockefeller Plaza, New York, \$.05).

The specific duties of a fire guard in connection with air raids are outlined. The approved methods for dealing with incendiary bombs and fires caused by them are described,

and some consideration is given to the organization of fire guards for the most efficient action.

#### AIRCRAFT ENGINE DESIGN

By J. Liston. McGraw-Hill Book Co., New York and London, 1942. 486 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$4.50.

The component parts of an aircraft engine are described and discussed in detail, with emphasis upon fundamentals of mathematics, mechanics and machine design necessary for successful designing. Suggested design procedures, problems and references to further reading accompany each chapter. A large section of useful engineering data, including brief specifications of American marine, vehicle and aircraft engines, is appended.

#### AIRCRAFT INSPECTION

By E. E. Wissman. McGraw-Hill Book Co. (Whittlesey House), New York and London, 1942. 268 pp., illus., diagrs., tables, 9½ x 6 in., cloth, \$3.00.

In this volume an experienced inspector presents practical information on the factory inspection of aircraft. Every step, from fabrication and sub-assembly to preflight and delivery inspection, is covered in detail, with full information.

#### AUDELS MECHANICAL DICTIONARY for Technical Trades, Arts and Sciences

By N. Hawkins and E. P. Anderson. Theodor Audel and Company, 49 West 23rd St., New York, 1942. 948 pp., 8 x 5½ in., fabrikoid, \$4.00.

This dictionary published about thirty years ago, is reissued with a supplement nearly one-half as large as the original work. It contains about seventeen thousand technical words and terms with definitions and explanations.

#### ELECTRIC MOTORS IN INDUSTRY

Dr. D. R. Shoults and C. J. Rife, edited by T. C. Johnson. John Wiley & Sons, New York; Chapman & Hall, London, 1942. 389 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$4.00.

Written for the industrial engineer, this book presents information on the characteristics and control of electric motors which will aid in the efficient selection and installation of the proper equipment for typical jobs. Enough description of the mechanical construction of motors is given to aid in understanding their operation. Two chapters deal with the principles and applications of electronic devices, but no attempt has been made to cover the generation, transmission or distribution of power.

#### ELECTROMECHANICAL TRANSDUCERS AND WAVE FILTERS

By W. P. Mason. D. Van Nostrand Co., New York, 1942. 333 pp., diagrs., charts, tables, 9½ x 6 in., cloth, \$5.00.

It is the purpose of this book to set forth the fundamental analogies and interconnections between electrical theory and mechanical theory. Electrical network theory is first analyzed and then applied to lumped mechanical systems; acoustic equations and the vibration of membranes and plates are discussed; and the final chapters take up the form and design of electromechanical elements and systems of which the piezoelectric effect is an example.

#### ELEMENTS OF HEAT TRANSFER AND INSULATION

By M. Jakob and G. A. Hawkins. John Wiley & Sons, New York, 1942. 169 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, \$2.50.

The basic principles of heat transfer and insulation and their application to simple problems are presented as a course suitable for undergraduates. Conduction, convection and radiation are first treated separately and then

in combinations. Unsteady state equations, dimensional analysis and certain other more advanced phases are dealt with in a very elementary manner but with an equally rigorous adherence to the accuracy of fundamental details as in the rest of the text.

#### FOUNDRY WORK

By R. E. Wendt. 4th ed. McGraw-Hill Book Co., New York and London, 1942. 261 pp., illus., diagrs., charts, tables, 8 x 5 in., cloth, \$2.00.

This book is intended for use as a textbook by college students and apprentices in shops, and aims to present the fundamental principles and give a general working knowledge of foundry practice. The fourth edition contains new exercises in molding and discusses the causes of defective castings.

#### 14,000 GEAR RATIOS

By R. M. Page. Industrial Press, New York; Machinery Publishing Co., Brighton England, 1942. 404 pp., diagrs., tables, 11½ x 8½ in., fabrikoid, \$5.00.

The four sections of this book give: Common fractional ratios and their decimal equivalents; Decimal ratios, their logarithms and equivalent pairs of gears; Total number of teeth with equivalent gear pairs and ratios; Numbers and equivalent gear factors. The tables cover all ratios from 1/120 to 120/2, thus providing over fourteen thousand ratios. The various uses of the tables are illustrated by examples. The book will be of practical value to engineers and designers.

#### INDUSTRIAL STATISTICS

By H. A. Freeman. John Wiley & Sons, New York, 1942. 178 pp., diagrs., charts, tables, 9 x 6 in., cloth, \$2.50.

This book is based upon a one-semester course in the subject given at the Massachusetts Institute of Technology, and is intended for students without any previous training in statistics. It gives examples of the use of elementary statistical methods in the design and analysis of experiments carried out in industrial plants and scientific laboratories, and also deals with the problem of establishing a systematic programme for studying and controlling the quality of industrial output. A final chapter discusses some of the statistical aspects of the relationship of sampling to the risks incurred by producers and buyers.

#### (An) INTRODUCTION TO ELECTRO-CHEMISTRY

By S. Glasstone. D. Van Nostrand Co., New York, 1942. 557 pp., diagrs., charts, tables, 9½ x 6 in., cloth, \$5.00.

The object of this book is to provide an introduction to electrochemistry in its present state of development. In accordance with this idea the author has incorporated in the book the following four important and relatively recent developments: the activity concept; the interionic attraction theory; the proton-transfer theory of acids and bases; and the consideration of electrode reactions as rate processes. A chapter on electrokinetic phenomena is included.

#### MACHINE TOOLS AT WORK

By C. O. Herb. Industrial Press, New York; Machinery Publishing Co., Ltd., 17 Marine Parade, Brighton, England, 1942. 552 pp., illus., diagrs., 9½ x 6 in., fabrikoid, \$4.00.

Applications of modern machine tools of various types are illustrated by selected examples from actual practice. These examples are accompanied by close-up photographs and condensed descriptions, including the outstanding features of each job, with speed, feed, and other practical shop data. The emphasis is on the more unusual operations performed by modern machine tools, and a fair knowledge of shop practice is assumed.

#### (The) MARINE POWER PLANT

By L. B. Chapman. 2 ed. McGraw-Hill Book Co., New York and London, 1942.

401 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$4.00.

Intended for the practical man as well as for the student, this book is restricted to fundamental principles, with a minimum of descriptive matter and details. It presents the thermodynamics of the marine power plant and the types of machinery used for ship propulsion, and gives a comprehensive idea of the layout and function of the various pieces of auxiliary machinery. Complete calculations for boilers and auxiliaries of a typical plant are included.

#### MERCHANT MARINE OFFICERS' HANDBOOK

By E. A. Turpin and W. A. MacEwen. Cornell Maritime Press, New York, 1942. 740 pp., illus., diagrs., charts, tables, 7½ x 5 in., cloth, \$5.00.

This handbook has been prepared to give the essential information required for the new examinations of the Bureau of Marine Inspection and Navigation, and also to serve as a practical reference book for use at sea. Navigational instruments, piloting, tides and currents, cargo, shiphandling, signals and other important subjects are covered. The rules of the road are included. Appendixes contain mathematical formulae and tables.

#### MODERN CORE PRACTICES AND THEORIES

By H. W. Dietert. American Foundrymen's Association, 222 West Adams St., Chicago, Ill., 1942. 532 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$5.00 to members; \$8.00 to non-members.

This volume presents a series of lectures delivered at the 1941 and 1942 conventions of the American Foundrymen's Association. It aims to make available in one place all the existing technical and practical information on coremaking. Core ingredients and the methods of mixing them, core forming and baking, preparing cores for the mould and their setting and holding are described. Casting defects caused by the core are discussed and remedies suggested. There is a bibliography.

#### THE "PARTICLES" OF MODERN PHYSICS

By J. D. Stranathan. Blakiston Co., Phila., 1942. 571 pp., illus., diagrs., charts, tables, 9½ x 6 in., fabrikoid, \$4.00.

This book presents the material essential to an appreciation of modern physics and the newer concepts of atomic structure. The experimental evidence upon which each concept is founded has been stressed throughout. The book is intended both as a fundamental text in its field and as a reference work for advanced students, for which purpose a large number of specific references have been included as footnotes.

#### PETROLEUM AND NATURAL GAS ENGINEERING, Vol. 1, 536 pp., \$3.00

#### PETROLEUM REFINING, Vol. 2, 522 pp., \$3.00

#### PETROLEUM REFINING, Vol. 3, 419 pp., \$3.00.

By M. M. Stephens. Pennsylvania State College, Division of Mineral Industries Extension, School of Mineral Industries, State College, Pa. Vol. 3, 1939; Vols. 1 and 2, 1941. Illus., diagrs., charts, maps, tables, 9 x 6 in., fabrikoid.

These volumes present a three-year course of study for men employed in petroleum refining and allied industries, which is adapted for use by employee groups under teachers or for self instruction. It represents the extension course of Pennsylvania State College. Volume one contains the fundamental mathematical, physical and chemical principles necessary for the later volumes; Volume two discusses the basic refining processes, and Volume three describes their more technical phases.

(Continued on page 490)

# PRELIMINARY NOTICE

of Applications for Admission and for Transfer

FOR ADMISSION

CARTER—HARRY AKERS, of Toronto, Ont. Born at Wilke, Sask., July 31st, 1918; Educ.: B.Sc., Queen's Univ., 1940. S.M. (Aero. Engrg.), Mass. Inst. Tech., 1942; R.P.E. of Ont.; 1937-38-39 (summers), International Nickel Co. Ltd., Copper Cliff, Ont.; 1941 to date, research asst., aeronautical engrg. dept., Massachusetts Institute of Technology, Cambridge, Mass.

References—A. Jackson, L. M. Arkley, D. S. Ellis, L. T. Rutledge.

CAVERLY—JEFFERSON AUSTIN, of Snow Lake, Wekusko, Man., Born at Bowsman, Man., May 20th, 1920; Educ.: B.E. (Geol.), Univ. of Sask., 1941; 1939 (summer), student asst., Geol. Survey of Canada; 1940 (summer), underground mining, Teck Hughes Gold Mines; 1941, underground mining, engrg. staff, asst. geologist, Britannia Mining & Smelting Co.; Dec. 1941 to date, exploration engr., Howe Sound Exploration Co., Snow Lake, Man.

References: I. M. Fraser, R. A. Spencer, N. B. Hutcheon, C. J. Mackenzie, G. M. Williams, E. K. Phillips.

JOINER—WALTER STEWART, of 2334 Chilver Road, Windsor, Ont. Born at Glasgow, Scotland, April 2nd, 1902; Educ.: Detroit Institute of Technology; 1918-22, apprentice, Dominion Iron & Steel Co., Sydney, N.S.; dftsmn. with the following companies: 1922-23, American Blower Co., 1923-24, Dominion Steel & Coal Co., 1924-25, Dominion Bridge Co.; 1925, dftsmn., 1925-32, layout, checking and estimating, Canadian Bridge Company; 1932-34, pump installn. and erection, Wright Hargreaves Mine; 1934 to date, designing and estimating, at present, structl. steel designer, Ford Motor Co. of Canada, Windsor, Ont.

References: H. L. Johnston, B. Candlish, G. W. Lusby, G. E. Medlar.

LAARI—WILLIAM, of 27 Greenlaw Ave., Toronto, Ont. Born at Toronto, Jan. 15th, 1917; Educ.: B.A.Sc., Univ. of Toronto, 1939; 1938 (summer), survey, Toronto Transportation Commn.; 1939 (summer), field engrg. staff, Dufferin Paving Co.; 1939 (Fall), field constrn., Canadian Gypsum Co.; 1939-41, field survey, trans. section, H.E.P.C. of Ontario; 1941-42, demonstrator in hydraulics, Univ. of Toronto; At present, junior field engr., Canadian Allis Chalmers Mfg. Co., Toronto, Ont.

References: C. R. Young, R. W. Angus, C. A. Smith, G. R. Lord, R. F. Leggett, J. A. Aeberli, E. A. Allcut.

LANGEVIN—LOUIS EMILIE, of 2788 Cote St. Catherine Road, Montreal, Que. Born at Montreal, July 1st, 1905; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1929, 1929-30, Mass. Inst. Tech.; 1927-28, power project at Shipshaw, also City of Arvida; 1929, estimator, Collet & Freres; 1929-41, Ministry of Health, since 1931 i/c of milk pasteurization control for the Prov. of Quebec; 1941, gen. mgr., Cooperative de Lait & Creme de Montreal; At present, conslgt. engr., 513 Rachel St. East, Montreal, Que.

References: J. Leblanc, L. A. Duchastel, J. A. Lalonde, J. P. Lalonde, T. J. Lafraniere, P. E. Poitras.

MIARD—HENRY THOMAS, of Lethbridge, Alta. Born at Coal Creek, B.C., July 19th, 1911; Educ.: B.A.Sc. (C.E.), Univ. of B.C., 1933; 1930-31, chainman and levelman, location survey, 1932, rodman on constrn., 1933-36, rodman, levelman, instr'man on constrn., 1937-39, junior engr. on constrn., 1939-40, engr. in charge, east section, Big Bend Highway; 1940 to date, res. engr. on design, layout and constrn. of aerodromes, and at present, senior asst. engr., Civil Aviation Divn., supervn. of aerodromes in Southern Alberta and Southeastern British Columbia.

References: A. L. H. Somerville, C. K. LeCapelain, N. H. Bradley, C. S. Clendenjng, G. E. Elkington, C. R. Cornish.

O'NEILL—JOHN JOHNSTON, of 489 Grosvenor Ave., Westmount, Que. Born at Port Colborne, Ont., Nov. 12th, 1886; Educ.: B.Sc. (Mining), 1909, M.Sc. (Geology), 1910, McGill Univ.; Ph.D., (Geology), Yale Univ., 1912; Wisconsin Univ., 1912-13; Summers—1906, survey asst., New Welland Canal; 1908, mining, St. Eugene Mine, Moyie, B.C.; 1909-13, field asst., Geol. Survey of Canada; 1913-16, geologist, Canadian Arctic Expedition; 1914-20, geologist, Geol. Survey of Canada; 1920-21, geologist, Whitehall Petroleum Corp. of London, England, in Kashmir and British India; 1921-22, geologist, White Beaver Oil Co., Canada; Consulting Geologist, 1923-24, Atlantic Coast Collieries, Nova Scotia, 1926-28, Victor Syndicate of London, England; 1928-30, Pend Oreille Mines & Metals Co.; 1932-35, special geological work for the Quebec Bureau of Mines; At McGill University, Montreal, as follows: 1921-27, asst. professor of geology, 1927-29, associate professor of geology, 1929-42, Dawson professor of geology and chairman of the Dept. of Geological Sciences. 1935-39, Dean of Science in Faculty of Arts & Sciences; 1938-42, Dean of Graduate Studies & Research.

References: C. M. McKergow, C. V. Christie, J. B. Challies, F. S. Keith, R. J. Durlay, F. W. Gray, G. M. Pitts, R. E. Jamieson.

WARD—WILLIAM ALBERT, of Armdale P.O., Halifax, N.S. Born at Halifax, Oct. 12th, 1911; Educ.: Cert. of Merit (two year Diesel Engrg. Course in Evening Technical School), Corres. Study Divn., N.S. Tech. Coll. 1940; 1930-31, survey party, field dftsmn., Halifax Harbour Commn.; 1932-33, 1934-35, mechanic, Guildford & Sons Ltd., Halifax; 1933-34, 1935-36, constrn. supt., mechanic, dftsmn., R. S. Allen, gen. contractor, Halifax; 1936-37, rodman and instr'man on survey party, 1937-38, office man on paving project, N. S. Dept. of Highways; 1938 to date, engrg. dftsmn., Dept. of Public Works, Halifax, N.S.

References: O. S. Cox, A. G. Tapley, F. Alport, H. Thorne.

## FOR TRANSFER FROM JUNIOR

GRANT—WILFRID JOHN, of 2228 Souvenir Ave., Montreal, Que. Born at Toronto, Ont., August 8th, 1899; Educ.: B.A.Sc., Univ. of Toronto 1922; Summer work: 1918, research and testing lab., Canadian Aeroplanes Ltd., Toronto; 1919, batch instr., milling dept., Goodyear Tire & Rubber Co. Ltd., New Toronto; supply correspondent, Can. Gen. Elec. Co. Ltd., Toronto; 1920, sub-foreman, Canadian Electro Products Ltd.; 1921, engrg. dept., British American Oil Co. Ltd.; 1922-25 (three sessions), demonstrator, Faculty of App. Science, Univ. of Toronto; 1923 (summer), Connaught Labs., process development, commercial production of insulin, i/c actual production; 1924 (summer), junior asst. testing engr., H.E.P.C. Research & Testing Lab., Toronto; Portland Cement and concrete research; 1926-33, instructor, physics, chemistry, maths., Central Technical School, Toronto; Sales Engr. with the following companies: 1934 (May-Aug.), Commercial Chemical Co. Ltd., Leaside; 1937 (Mar.-Sept.), Bruce Ross Ltd., Toronto; 1938 (Jan.-May), Roydes & Edwards Ltd., Toronto; 1939 (July-Aug.), Beverage Supply Co. Ltd., Montreal; 1934 (Aug.-Oct.), asst. chemist, Crosse & Blackwell Ltd.; 1935 (Feb.-May), chemist i/c of production, E. F. Houghton Co. Ltd. of Canada, Toronto; 1935 (Jan. and July-Oct.), chem. engr., asst. to Dr. Knapp, engr. i/c plant constrn., Carbo Ice Ltd., Leaside; May, 1938, to May, 1939, research studies, experimental work, product development 1921-22, geologist, White Beaver Oil Co., Canada; Consulting Geologist, 1923-24, ment, process equipment, development for oil refinery patents; 1939-40, instructor in dftng., Montreal Technical School; 1940 (July-Oct.), mech. dftsmn., Montreal Welding Works; Nov. 1940 and 1942 (Feb.-Mar.), mech. dftsmn. and designer, Associated Clock Industries, Montreal; 1941 (May-Nov.), mech. dftsmn. i/c of tracer squad and redesign of fixtures, John Inglis Co. Ltd.; Dec. 1941-Jan. 1942, dftsmn., Otis-Fensom Elevator Co. Ltd., Hamilton; 1942 (Mar.-May), design and layout of wood room, Brompton Pulp & Paper Co. Ltd., East Angus; 1942 (May-July), designer, punches, dies, cutters, Harrington Tool & Die Co. Ltd., Lachine, Que.; at present, engrg. dept., Fraser Brace Ltd., Montreal. (St. 1921, Jr. 1931).

References: H. A. Babcock, A. H. Heatley, J. G. G. Kerry, E. A. Allcut, R. B. Young, C. R. Young, C. E. Herd.

JACKSON—WILLIAM HAYES, of 85 Ridge Hill Drive, Toronto, Ont. Born at Simcoe, Ont., April 18th, 1915; Educ.: B.A.Sc., Univ. of Toronto, 1939; Commercial Pilot's License—Qualified Test Pilot; R.P.E. of Ont.; 1936, machine shop, Link Belt Co.; with the De Havilland Aircraft of Canada as follows: 1939-41 (22 mos.), designer and dftsmn. i/c Tiger Moth Divn. for latter 6 mos.; 1941 (11 mos.), test engr. and test pilot i/c all experimental testing; Nov. 1941 to date, chief dftsmn. i/c of drawing office. (Jr. 1940).

References: T. R. Loudon, E. A. Allcut, C. R. Young, J. J. Spence, W. S. Wilson, C. F. Morrison, R. W. Angus.

The By-laws provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.\*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described at the September meeting.

L. AUSTIN WRIGHT, General Secretary.

\*The professional requirements are as follows:—

A Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science or engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainment or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

# Employment Service Bureau

## SITUATIONS VACANT

**MECHANICAL DRAUGHTSMAN** experienced in piping and equipment layout, or heating and ventilating work for war work in Montreal. Apply to Box No. 2375-V.

**MECHANICAL ENGINEER** for British Guiana. Some experience on diesels and tractors preferred. Apply to Box 2482-V.

**ELECTRICAL ENGINEER** with at least five years practical experience for work at Mackenzie, British Guiana. Apply to Box No. 2536-V.

**YOUNG GRADUATE ENGINEER** required by machinery supply firm located in Montreal. Some selling experience preferred. State military status. Apply to Box No. 2539-V.

**CIVIL ENGINEER** supervising construction operations in Mackenzie, British Guiana. Apply to Box No. 2549-V.

**MECHANICAL DRAUGHTSMAN**, for important war work in Montreal. Apply to Box No. 2550-V.

**ELECTRICAL ENGINEER** with ten to fifteen years experience. Theoretical electrical engineering. To undertake the various electrical engineering studies requiring ability to handle theoretical problems combined with knowledge of actual system requirements. Apply to Box No. 2557-V.

**MINING ENGINEER** with operating experience for work in Newfoundland. Single man preferred. Apply to Box No. 2558-V.

**ELECTRICAL ENGINEER** for Arvida. Testing and maintenance of system relays. Short circuit studies. Preparation of wiring diagrams, etc. Apply to Box No. 2559-V.

**ASSISTANT WORKS MANAGER** with machine or boiler shop experience, or both, by engineering firm in western Ontario. Permanent job for progressive man not afraid of work. Apply to Box No. 2560-V.

**JUNIOR MECHANICAL ENGINEER** wanted at Arvida, recent graduate with machine shop experience to act as assistant to shop superintendent. Apply to Box No. 2572-V.

**CHEMIST** wanted for Arvida technical control department with a few years' general analytical experience, supervisory work in routine chemical or spectrographic laboratory. Apply to Box No. 2573-V.

**METALLURGIST** or chemical engineer wanted at Arvida with at least one year's manufacturing experience. Apply to Box No. 2574-V.

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.

**CHEMICAL engineer** for work at Shawinigan Falls with general plant or process work experience. Apply to Box No. 2575-V.

**JUNIOR MECHANICAL ENGINEER** for general mechanical work at Shawinigan Falls. Apply to Box No. 2576-V.

**TWO GRADUATE ENGINEERS** or men with sufficient experience in draughting to act as squad leaders of four to six men on reinforced concrete detailing, general equipment layout or mechanical drawing. These men to work along with other draughtsmen but be able to head up the job, lay out the work and check the drawings for issuing. Apply to Box No. 2577-V.

## SITUATIONS WANTED

**MECHANICAL DRAUGHTSMAN, JR.**, graduate of the University of Toronto in Electrical Engineering. Some six years of practical experience with accent on electric motor design, instruments and small tools. Has a background of two years in electric instrument laboratory. Desirous of making a change where his services will be fully utilized and better appreciated. Apply to Box No. 1486-W.

**GRADUATE MECHANICAL ENGINEER**, military exempt. Age 33, married. Detail experience in mechanical departments of paper-making, construction and foundry work. Available immediately. Location immaterial. Desirous of executive or production position with prospects of advancement. Apply to Box No. 1650-W.

**CIVIL ENGINEER**, B.A. sc. Age 33, married. Experience covering heating, air conditioning, mining. Design, construction and maintenance of sewers, aqueducts, streets and highways, including surveying, location, estimating, inspections, drainage and

soundings. Presently employed, but desires advancement. Apply to Box No. 1859-W.

**GRADUATE CIVIL ENGINEER, S.E.I.C.**, experience in surveying and in teaching same, location surveys for roads and railroads, 2 years as construction engineer in oil fields in tropics in charge of roads, earth-moving machinery, anti-malarial drainage, etc. Experience in construction of bituminous pavements. At present engaged in airport construction. Available from September first. Age 30 years. Apply to Box No. 1860-W.

**GRADUATE CIVIL, STRUCTURAL ENGINEER, M.E.I.C.**, middle age. Twenty years' experience estimator, designer, and sales engineer. Excellent references. Open for engagement. Apply to Box No. 2440-W.

**ELECTRICAL ENGINEER**, age 34, twelve years experience in design, manufacture and application of fire protection systems. Good general knowledge of mechanical engineering, experience with tool design machine tools and shop practice. Trained in business administration and accustomed to responsible charge of large staff. Available immediately. Apply to Box No. 2442-W.

**GRADUATE ELECTRICAL ENGINEER, M.E.I.C.**, with twenty-nine years experience in operation construction, repairs and maintenance of paper mill and hydro electric system. Bilingual. Available September first. Apply to Box No. 2443-W.

## FOR SALE

Transit, Buff and Buff Mfg. Five-inch circle, brass telescope and sliding leg tripod. One nick in the vertical half-circle, but no other damage. Thirty-year old instrument, but not much used. Would sell for \$225.00. Apply Box No. 45-S.

## LIBRARY NOTES

(Continued from page 488)

### PHYSICS FOR ENGINEERS

By Sir A. Fleming. Chemical Publishing Co., Brooklyn, N.Y., 1942. 232 pp., illus., diags., charts, tables, 9 x 5½ in., fabricoid, \$3.00.

Present-day knowledge in the realm of physics is summarized with special reference to the requirements of practical engineers. The book starts with the fundamental physical units and ends with atomic transformations, having dealt with various aspects of energy, electricity, electronic emissions, radiation, optics and sound in between.

### PRECISION MEASUREMENT IN THE METALWORKING INDUSTRY

Issued by the New York State Education Department, a reprint of "Measuring Instruments," a Manual of Instruction prepared by the Education Dept. of the International Business Machines Corp., Enlicott, N.Y., 1941. 496 pp., illus., diags., charts, tables, cloth, \$3.75, apply to Roy F. Johncox, Vocational High School, Rochester, N.Y.

This manual was prepared for use in the Factory Training programme of International Business Machines Corporation. Opening with a general statement on measurement, successive chapters are devoted to non-precision line-graduated instruments, precision gauge blocks, plug, ring and snap gauges, thread gauges, dial gauges and test indicators, micrometers and verniers, surface plates and accessories, angle measuring instruments, comparators, optical instruments and surface finish measurement, and measuring machines and hardness testers. The construction and uses of these devices are explained in clear, simple language, profusely illustrated by admirable photographs and drawings, providing an excellent course of instruction.

### PROTECTIVE AND DECORATIVE COATINGS, Vol. 2. Raw Materials, Pigments, Metallic Powders and Metallic Soaps

By J. J. Mattiello. John Wiley & Sons, New York; Chapman & Hall, London, 1942. 653 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$6.00.

This, the second of four volumes in which various authorities will present a comprehensive survey of the protective and decorative coating industry, is devoted to the pigments, metallic powders and metallic soaps. The chemical compositions, manufacturing processes, properties, uses and methods of identification are dealt with in detail. The work is well adapted for use as a textbook, and is also a convenient, complete reference book.

### (The) STORY OF THE AIRSHIP (Non-Rigid), a Study of One of America's Lesser Known Defense Weapons

By H. Allen. Goodyear Tire & Rubber Co., Akron, Ohio, 1942. 74 pp., illus., diagr., maps, tables, 9½ x 6 in., cloth, \$1.00.

This volume, published by the Goodyear Tire & Rubber Company, reviews the history of the airship and the part it played in the first world war. Improvements since that time are also described, and the ways in which airships can be of special use today are pointed out. Attractive photographs add to the interest of the work.

### TABLES OF PHYSICAL AND CHEMICAL CONSTANTS and Some Mathematical Functions.

By G. W. C. Kaye and T. H. Laby. 9 ed. Longmans, Green & Co., New York, London, Toronto, 1941. 191 pp., tables, 10 x 6½ in., cloth, \$5.00.

This well-known publication aims to fill the need for an up-to-date, moderately priced collection of physical and chemical tables which will meet the usual needs in teaching and laboratory work. The new edition has been thoroughly revised and expanded.

### THORPE'S DICTIONARY OF APPLIED CHEMISTRY, Vol. 5

By J. F. Thorpe and M. A. Whiteley, 4th ed. Longmans, Green & Co., London, New York, Toronto, 1941. 610 pp., illus., diags., charts, tables, 9½ x 6 in., lea., \$25.00 (70s.).

Abridged Index to Vols. 1-5 of new edition of Thorpe's Dictionary of Applied Chemistry, paper, \$1.00.

The fifth volume of this standard encyclopedia of chemical technology contains monographs on various important subjects. Fermentation, fertilizers, fibers, the finishing of textile fabrics, fireproofing, food preservation, fuel, the gas industries and glass are given extensive treatment. Minor topics are also covered adequately. The book is indispensable in chemical and technical libraries.

### TIN SOLDERS: a Modern Study of the Properties of Tin Solders and Soldered Joints. (Research Monograph No. 1)

By S. J. Nightingale with an introduction by R. S. Hutton. 2 ed. revised by O. F. Hudson. British Non-Ferrous Metals Research Association, Euston St., London, N.W.1, 1942. 117 pp., illus., diags., charts, tables, 10 x 6 in., cloth, 10s. 6d. (in U.S.A., \$2.75).

Since the appearance of the first edition of this book in 1932, further investigations have been carried on by the Association, mainly upon the creep properties of solders and soldered joints, the results of which are incorporated in this edition. The first section of the book deals with the constitution of the tin solders; their structure; the mechanical properties of the solder alloys; the strength of soldered joints; creep properties of solder alloys and soldered joints; and alloying between the solder and the joint members. The second part discusses such practical considerations as fluxes, spacing, and wiped joints, and the choice of a solder.

### AIR BLAST CIRCUIT BREAKER

The English Electric Company of Canada Limited, St. Catharines, Ont., have issued a 12-page bulletin, No. 112, describing the "Delle System" air blast circuit breakers having the general designation of type AV. These breakers are designed for operation from an external source of compressed air and their field of application lies principally in generating stations and supervised distribution sub-stations. The bulletin, containing diagrams and illustrations, also gives specifications, construction, operation and methods of control. Installation, assembly, disassembly and inspection are described, and every part is illustrated separately showing how they fit together. A table of ratings is also added.

### AUTOMATIC CONTROL FOR BLACKOUTS

"Blackout Control" is the title of a 4-page bulletin being distributed by Burlec Limited, Toronto, Ont., featuring the positive photo-electric blackout control of the United Cine-phone Corporation. Photographs, dimensional drawing and detailed descriptive data are given covering Model 77 for outdoor installation and Model 57 for indoor installation. These units are designed to automatically control any individual lighting circuit in the event of a blackout.

### BRAZING AND WELDING

Issued in single sheet form, "Low Temperature Brazing", Volume 4, No. 3, by Handy & Harman of Canada, Limited, Toronto, Ont., is of particular interest to those engaged in the brazing and welding industry. Two illustrated short articles are presented on speeding munitions production with "Easy-Flo" silver brazing alloy and on rapid training of brazing operators.

### CRUSHERS, PULVERIZERS AND SHREDDERS

Jeffrey Manufacturing Company, Limited, Montreal, Que., have available for distribution a bulletin, No. 722, entitled "The Answer to Your Reduction Problems", which illustrates and describes "Jeffrey" crushers, pulverizers and shredders and shows every unit "on the job".

### ELECTRICAL CONNECTORS

A 4-page bulletin, No. 4243, has been published by Canadian Line Materials Limited, Toronto, Ont., featuring "Burndy" connectors for any electrical connection, with special descriptions and illustrations of four types of connectors, namely, the "Versi-Top" type QPX; the "Versi-Lug" type EA; the "Hottap" type HET and the "Servit" type KS. Tables of specifications are given and a page of illustrations shows a number of other types of connectors.

### FEED WATER HEATING

"Heat Engineering", Volume XVII, No. 2, published by Foster Wheeler Limited, St. Catharines, Ont., features the installation for feed water heating at Oswego Station, which is part of the Niagara Hudson steam and power system of the Central New York Power Corporation. This is followed by several short articles dealing with (a) the construction of tankers, (b) new applications of the "Dowtherm" heating systems, (c) plastic fan blades, and the installation of "S-A" boilers in petroleum refineries.

### FILES

"New Files Perfected" is the title of a new folder being distributed by the Nicholson File Company, Port Hope, Ont., which describes what the company states is "the greatest improvement in file construction in a generation." These hand files are so designed that as the tops of the teeth wear down other cutting edges come in contact with the work to give the file a much longer life. The new tooth construction is said to eliminate side slip.

## The Geologists' Paradise

The province of Nova Scotia is the geologists' paradise because all ages of rocks from Mesozoic down to Precambrian are predominately displayed within a relatively small area.

Fossil ferns and stems found in the coal measures are the palaeo-botanists' delight. Pitching anticlines, synclines and anticlinal domes are prominently displayed in the Precambrian sediments.

The rock exposures around Minas Basin are the museum curators' favourite hunting ground for zeolites.

Shortage of gasoline and tires may curtail your proposed motor trip—but come just the same—the province is well served by the two largest railway systems on the North American continent, and inter-connecting bus lines.

### THE DEPARTMENT OF MINES HALIFAX, NOVA SCOTIA

L. D. CURRIE  
Minister

A. E. CAMERON  
Deputy Minister

### NEW EQUIPMENT

The feature articles in the *Power Specialist*, May and June, 1942, by Canadian Johns-Manville Company, Limited, Toronto, Ont., cover new equipment in use at the plant of the Algoma Steel Corporation Limited at Sault Ste. Marie, Ont., the use of "J-M Transite" in the Leslie Salt Refinery at Newark, California, Cornell's School of Chemical Engineering; the fabrication of a giant castable refractory-lined furnace door, built of "J-M Firecrete" in a 3-ton steel frame; the new "Rawson" couplings for industrial equipment. Editorial items and illustrations of defence jobs complete the issue.



J. A. M. GALILEE,  
VICE-PRESIDENT, N.I.A.A.

J. A. M. Galilee, Assistant Advertising Manager, Canadian Westinghouse Company, Limited, Hamilton, Ont., was elected a vice-president of the National Industrial Advertisers Association, at the annual convention recently held in Atlantic City, N.J.

### INSULATING CONCRETE

Webster & Sons Limited, Montreal, Que., have for distribution a leaflet entitled "Tartan Insulating Concrete", which features this product's use for roof and floor insulation. It is a fireproof, rotproof insulation that is said to fit in with the other permanent type of materials, to have a satisfactory bond to a concrete slab, and to make an ideal base for roofing materials. "Tartan" insulating concrete is mixed and placed like ordinary concrete and weighs only 26 lbs. per cubic foot.

### LIQUID DENSITY RECORDERS

The Foxboro Company, Montreal, Que., have issued an 8-page bulletin, A-264, illustrating and describing Foxboro instruments for the automatic measurement and recording of densities of process liquids. In place of periodic readings by hydrometer and still samples, the Foxboro density recorder records the continuous direct measurement of the flowing liquid. For processes where automatic control of density is important for operating efficiency, the Foxboro Stabilog density controller is supplied. The instruments have identical measuring systems and both use standard Foxboro charts, which may be read in specific gravity, Baume, Brix or other recognized scales.

### PORTABLE ELEVATORS

Mahaffy Iron Works Limited, Toronto, Ont., have published a 24-page catalogue, No. 12E, illustrating and describing the "Revolator" portable elevators. It contains diagrams, dimensions, specifications, capacities and code names for sizes for various models, and action pictures showing a number of different types of applications are also included. Complete data are given for hand and motor powered units with revolvable and non-revolvable bases, and with standard or telescopic frames.

### POWER LINE EQUIPMENT

The leading article in Volume 20, No. 3 of "The Line", published by Canadian Line Materials Limited, Toronto, Ont., deals with the features of C-L-M lightning arresters, which make possible a thorough inspection of arresters while in service. The second article features wired radio controls on street-light circuits, where radio signals, transmitted over telephone-dispatching wires, actuate "on and off" for eight outlying circuits—offering "blackout" potentiality. Other articles include—protecting metal in areas of severe rusting, "Primalite" luminaires, and improvements in street-lighting maintenance.

### REFRACTORY LAGGING

Bulletin No. 327-E, eight pages, being distributed by Quigley Company of Canada, Limited, Lachine, Que., is devoted to a description of "Insulag", a refractory lagging for use on high or low temperature equipment up to 2,200°F. Full details of the properties of "Insulag" are given and its applications are illustrated and described covering the petroleum industry, metallurgical furnaces, ceramic plants and power plants. Its use for general purposes, fire-proofing and weather-proofing are covered and design data are also included.

### SAFETY CANS

Aikenhead Hardware Limited, Toronto, Ont., have issued a folder containing specifications, construction, tables of weights and capacities and various features of two types of "Justrite" safety cans for industrial purposes. These include the "Justrite" automatic oily waste cans and the "approved" safety cans for inflammable liquids.

(Continued on page 492)

(Continued from page 491)

## SNAP GAUGES

A leaflet is being distributed by Bridge Machinery Company, Montreal, Que., illustrating and describing four styles of M-G snap gauges and presenting such outstanding features of these gauges as the locking device, the square measuring pins, the single adjustment and the strength of the gauge frame.

## SHIPPING AND PACKING EQUIPMENT

"Guide to Shipping and Packing Equipment" is the title of a 32-page catalogue just published by Canadian Steel Strapping Company, Limited, Montreal, Que. A varied line of equipment and supplies for packing and shipping is featured, including the "Signode" system of tensional steel strapping from light parcel post to heavy carload shipments. Many applications are shown followed by illustrations and data covering "Signode" stretchers, sealing tools, steel strapping, and accessories. Stencilling machines, inks, brushes and markers are included; also stitching, tacking, stapling and sealing machines and accessories.

## INGLIS MAKES NEW WORTHINGTON DEAL

Back in 1939 Worthington Pump & Machinery Corporation appointed John Inglis Co. Limited, of Toronto, Ontario, as Canadian representatives with the right to manufacture some of the Worthington products in the Dominion. These include reciprocating and centrifugal pumps, condensers, stationary diesel engines and many other lines of industrial equipment.

Within the past few weeks an announcement has been made indicating that the two companies have been drawn still closer together. Worthington Pump & Machinery (Canada) Ltd., has now obtained a ten percent interest in John Inglis Co. Limited and in return has given Inglis a long-term contract to make or sell all of its products in Canada.

Three years ago the John Inglis Co. Limited made agreements with a number of internationally-known organizations, both in Great Britain and the United States, which enabled the Company to offer products which theretofore had not been manufactured in Canada. Included among these companies are Yarrow & Co. Limited, Glasgow, Scotland, makers of Yarrow Marine Boilers, and Parsons Marine Steam Turbine Co. Ltd., Wallsend-on-Tyne, England, makers of Marine Steam Turbines. These connections together with the fact that the original John Inglis Co. Limited had for years been known for its production of Triple Expansion Marine Engines and Boilers of many types, enabled the new Inglis Company under the leadership of Major James E. Hahn and his associates to supply a large amount of equipment for the Canadian Navy and Merchant Marine.

The Inglis Company also made agreements with Aetna-Standard Engineering Co., of Youngstown, Ohio; Lake Erie Engineering Corporation, of Buffalo, N.Y.; Lobdell Car Wheel Company, of Wilmington, Del.; A. O. Smith Corporation, Milwaukee, Wis.; and Erie City Iron Works, of Erie, Penn., thus enabling the Company also to produce equipment for the Oil industry and heavy industries in various fields. Foreseeing the possibilities of war the Company obtained a contract for the manufacture of Bren Machine Guns, which was secured after some years of negotiations in London, England. This, however, proved only a beginning for Inglis becoming a vital factor in the munitions business of Canada. It later obtained additional contracts from both British and Canadian Governments for Bren Machine Guns, Browning Machine Guns, and Boys Anti-Tank Rifles. It is safe to say that the ordnance end of the Inglis business is ten times as large as was envisaged in the beginning.

## DOMINION RUBBER APPOINTMENTS

Mr. George B. Rutherford has been appointed General Manager, Mechanical and Sundries Division, of the Dominion Rubber Company. He was formerly Sales Manager of the company's Mechanical and Sundries Division in Western Canada with headquarters at Winnipeg, Man., and came to Montreal in 1938 as Manager, Special Products' Division. Successively, he became Assistant General Sales Manager, General Sales Manager and in his new appointment will have control of both sales and manufacturing activities of Mechanical and Sundries Division.

Mr. J. A. Porteous was recently appointed Assistant General Sales Manager, Mechanical and Sundries Division of Dominion Rubber Company, Montreal, Que. Mr. Porteous joined the Company seventeen years ago in the General Laboratory, Montreal, subsequently spending several years in field work for the company. In 1938 he was appointed Assistant Sales Manager, Mechanical and Sundries Division, Toronto, and returned to Montreal in 1940 as Manager, Moulded Goods' Division, which position he held to the time of this latest appointment.

## STEEL INDUSTRY IN WAR WORK

Volume 14, No. 2 of "The Steel Constructor" issued by the American Institute of Steel Construction, New York, N.Y., gives examples of war work being done by the steel industry that indicate a trend, and illustrate the unusual service that can be obtained from an industry of such distinctive and versatile talents. Illustrations show the use of steel in fabricating heavy naval guns, field repair cranes, overhead cranes, steel trusses, pontoons, tanks, hammerhead cranes, radio towers, transmission towers, electric furnaces, lock gates and ships.

## MACHINE TOOL MOTORIZING

Drive-All Manufacturing Company, Detroit, Mich., have issued an 8-page catalogue which is fully illustrated and contains the full treatment of a simplified technique of mounting individual motorizing units with standardized brackets on any type of machine tool. It points out the advantages of individual motorizing of belt-driven machines from standpoints of economy, production increase, shop flexibility and appearance and improved working conditions. The catalogue is practical and informative with the kind of application pictures and engineering data that shop men find useful.

## HIGH SPEED ADJUSTABLE HOLLOW-MILLS

Catalogue No. 15, containing eight pages, has just been issued by Carl Wirth & Son, Rochester, N.Y., which illustrates and describes various types of "Kutmore" high speed adjustable hollow-mills, with full specifications for each. The types described are the "Kutmore" Midget; 4-Blade Light Duty; 4-Blade Heavy Duty; 6-Blade Light Duty; and 6-Blade Heavy Duty. "Kutmore" re-sharpening fixtures for the hollow-mill blades are also illustrated and described.

## CONDENSATE CORROSION CONTROL

"H.O.H. Lighthouse", issued by D. W. Haering & Company, Inc., Chicago, Ill., features an article which is devoted to condensate corrosion control and provides a complete case history of the solution of a difficult corrosion problem by the "Haering Development of Steam Treatment" by direct introduction into steam. Photographs of test sections and analytical data conveniently charted for the reader round out this interesting report; considerable space is devoted to seasonal factors in scale and corrosion control.

## PERFORATING DIES

A 4-page folder has been issued by S. B. Whistler Inc., Buffalo, N.Y., which illustrates and describes this Company's new "U-375" adjustable perforating dies, which permit minimum perforating centres of  $\frac{7}{8}$  inch. This folder lists important features and describes special introductory unit, with full size blueprint of the die holder. This unit is compact and up to 25 holes from  $\frac{1}{32}$  inch to  $\frac{3}{8}$  inch diameter can be pierced in  $\frac{1}{16}$  inch mild steel in a single operation on a working surface of 10 inches by 12 inches.

## DORMANT AND SURPLUS STOCKS

With countless plants swinging from peacetime production to war purposes, large amounts of miscellaneous articles are now lying idle in stock rooms or assembly shops. Supplies, of certain metal goods especially, for civilian use, are tapering off and those who need such articles must, therefore, seek them from every available source. Retailers and wholesalers saddled with stocks, dead due to a change in consumer demand, are in a similar position.

Confronted with a situation calling for immediate action, the management-service section of the Wartime Prices and Trade Board's Division of Simplified Practice have set up a dormant stock department which is acting as a clearing house for surplus stocks needed elsewhere. It has already diverted to direct war use many items which might otherwise have gone into the scrap heap. It is a non-profit service, its only objective being to bring buyer and seller together. Sales are made directly between the two principals involved, and no commissions are expected or accepted.

The inventories of many manufacturers contain a host of items for which the owners have no immediate use and of which someone else is probably in pressing need. When supplies cease to be current, they are more often than not disposed of as scrap. The Department deals only in excess or surplus stocks. Its activities do not involve what is known as junk items, but only materials for which the present proprietor has no further use.

Any manufacturer, wholesaler, or retailer who has a list of items lying idle in his factory, warehouse or store, is urged to communicate with the Dormant Stock Department, Management Service Section, Division of Simplified Practice, Wartime Prices and Trade Board, 1903 Metropolitan Building, Toronto, Ont.

**Keep Cylinders at Work**

Return empty cylinders promptly to assure an adequate supply of oxygen and acetylene for use in production for victory

THIS CYLINDER CONTAINS OXYGEN

THIS CYLINDER CONTAINS ACETYLENE

Return Empty Cylinders Promptly

# THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 25

MONTREAL, SEPTEMBER 1942

NUMBER 9



"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

★ ★ ★

## CONTENTS

PUBLISHED MONTHLY BY  
THE ENGINEERING INSTITUTE  
OF CANADA

2050 MANSFIELD STREET - MONTREAL

L. AUSTIN WRIGHT, M.E.I.C.  
*Editor*

LOUIS TRUDEL, M.E.I.C.  
*Assistant Editor*

N. E. D. SHEPPARD, M.E.I.C.  
*Advertising Manager*

### PUBLICATION COMMITTEE

C. K. McLEOD, M.E.I.C., *Chairman*  
R. DeL. FRENCH, M.E.I.C., *Vice-Chairman*  
A. C. D. BLANCHARD, M.E.I.C.  
H. F. FINNEMORE, M.E.I.C.  
T. J. LAFRENIÈRE, M.E.I.C.

READY FOR NIGHT ALARM . . . . .	Cover
<i>(Photo Public Information, Ottawa)</i>	
MECHANICAL FEATURES OF 220-KV. LINES IN ONTARIO, 1940 and 1941 . . . . .	496
<i>A. E. Davison</i>	
TIN CONSERVATION . . . . .	498
PSYCHOLOGY AS APPLIED TO ENGINEERING . . . . .	508
<i>Charles S. Myers</i>	
A CONTRACTOR'S CLAIM FOR EXTRAS . . . . .	515
ABSTRACTS OF CURRENT LITERATURE . . . . .	517
FROM MONTH TO MONTH . . . . .	522
PERSONALS . . . . .	528
<i>Visitors to Headquarters . . . . . 530</i>	
<i>Obituaries . . . . . 530</i>	
NEWS OF THE BRANCHES . . . . .	531
LIBRARY NOTES . . . . .	537
PRELIMINARY NOTICE . . . . .	541
EMPLOYMENT SERVICE . . . . .	543
INDUSTRIAL NEWS . . . . .	544

Price 50 cents a copy, \$3.00 a year: in Canada, British Possessions, United States and Mexico. \$4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, \$2.00 a year.—Entered at the Post Office, Montreal, as Second Class Matter.

THE INSTITUTE as a body is not responsible either for the statements made or for the opinions expressed in the following pages.

# THE ENGINEERING INSTITUTE OF CANADA

## MEMBERS OF COUNCIL - 1942

### PRESIDENT

C. R. YOUNG, Toronto, Ont.

### VICE-PRESIDENTS

\*A. L. CARRUTHERS, Victoria, B.C.  
†H. CIMON, Quebec, Que.

### PAST-PRESIDENTS

†T. H. HOGG, Toronto, Ont.

### COUNCILLORS

†E. D. GRAY-DONALD, Quebec, Que.  
†J. HAIMES, Lethbridge, Alta.  
\*J. G. HALL, Montreal, Que.  
†R. E. HEARTZ, Montreal, Que.  
†W. G. HUNT, Montreal, Que.  
†E. W. IZARD, Victoria, B.C.  
†J. R. KAYE, Halifax, N.S.  
\*E. M. KREBSER, Walkerville, Ont.  
†N. MacNICOL, Toronto, Ont.  
\*H. N. MACPHERSON, Vancouver, B.C.  
\*W. H. MUNRO, Ottawa, Ont.

### TREASURER

E. G. M. CAPE, Montreal, Que.

### GENERAL SECRETARY

L. AUSTIN WRIGHT, Montreal, Que.

†J. L. LANG, Sault Ste. Marie, Ont.  
†G. G. MURDOCH, Saint John, N.B.

†C. J. MACKENZIE, Ottawa, Ont.

†T. A. McELHANNEY, Ottawa, Ont.  
\*C. K. McLEOD, Montreal, Que.  
†A. W. F. McQUEEN, Niagara Falls, Ont.  
†A. E. PICKERING, Sault Ste. Marie, Ont.  
†G. McL. PITTS, Montreal, Que.  
†W. J. W. REID, Hamilton, Ont.  
†J. W. SANGER, Winnipeg, Man.  
\*M. G. SAUNDERS, Arvida, Que.  
†H. R. SILLS, Peterborough, Ont.  
\*J. A. VANCE, Woodstock, Ont.  
\*A. O. WOLFF, Saint John, N.B.

\*For 1942 †For 1942-43 ‡For 1942-43-44

### SECRETARY-EMERITUS

R. J. DURLEY, Montreal, Que.

### ASSISTANT GENERAL SECRETARY

LOUIS TRUDEL, Montreal, Que.

## STANDING COMMITTEES

### FINANCE

DEG. BEAUBIEN, *Chairman*  
J. E. ARMSTRONG  
E. G. M. CAPE  
G. A. GAHERTY  
J. A. McCRORY  
F. NEWELL

### LIBRARY AND HOUSE

W. G. HUNT, *Chairman*  
A. T. BONE  
J. S. HEWSON  
M. S. NELSON  
G. V. RONEY

### LEGISLATION

J. L. LANG, *Chairman*  
R. L. DOBBIN  
R. J. DURLEY

### PAPERS

J. A. VANCE, *Chairman*  
DEG. BEAUBIEN  
K. M. CAMERON  
A. L. CARRUTHERS  
H. CIMON  
J. L. LANG  
G. G. MURDOCH

### PUBLICATION

C. K. McLEOD, *Chairman*  
R. DeL. FRENCH, *Vice-Chairman*  
A. C. D. BLANCHARD  
H. F. FINNEMORE  
T. J. LAFRENIERE

## SPECIAL COMMITTEES

### BOARD OF EXAMINERS AND EDUCATION

R. A. SPENCER, *Chairman*  
I. M. FRASER  
W. E. LOVELL  
A. P. LINTON  
H. R. MacKENZIE  
E. K. PHILLIPS

### GZOWSKI MEDAL

H. V. ANDERSON, *Chairman*  
A. C. D. BLANCHARD  
T. H. JENKINS  
V. A. McKILLOP  
W. H. POWELL

### DUGGAN MEDAL AND PRIZE

J. T. FARMER, *Chairman*  
J. M. FLEMING  
R. C. FLITTON

### PLUMMER MEDAL

C. R. WHITTEMORE, *Chairman*  
J. CAMERON  
E. L. DOBBIN  
O. W. ELLIS  
R. E. GILMORE

### LEONARD MEDAL

JOHN McLEISH, *Chairman*  
A. E. CAMERON  
A. O. DUFRESNE  
J. B. DeHART  
A. E. MacRAE

### JULIAN C. SMITH MEDAL

C. R. YOUNG, *Chairman*  
T. H. HOGG  
C. J. MACKENZIE

### PROFESSIONAL INTERESTS

J. B. CHALLIES, *Chairman*  
J. E. ARMSTRONG  
G. A. GAHERTY  
O. O. LEFEBVRE  
H. W. McKIEL  
J. A. VANCE

### THE YOUNG ENGINEER

H. F. BENNETT, *Chairman*  
J. BENOIT  
D. S. ELLIS  
J. N. FINLAYSON  
R. DeL. FRENCH  
R. F. LEGGET  
A. E. MACDONALD  
H. W. McKIEL

### MEMBERSHIP

J. G. HALL, *Chairman*  
S. R. FROST

### STUDENTS' AND JUNIORS' PRIZES

#### Zone A (Western Provinces)

H. N. Ruttan *Prize*  
A. L. CARRUTHERS, *Chairman*  
E. W. IZARD  
H. N. MACPHERSON

#### Zone B (Province of Ontario)

John Galbraith *Prize*  
J. L. LANG, *Chairman*  
A. E. PICKERING  
J. A. VANCE

#### Zone C (Province of Quebec)

#### Phelps Johnson Prize (English)

DEGASPE BEAUBIEN, *Chairman*  
J. E. ARMSTRONG  
R. E. HEARTZ

#### Ernest Marceau Prize (French)

H. CIMON, *Chairman*  
J. H. FREGEAU  
E. D. GRAY-DONALD

#### Zone D (Maritime Provinces)

Martin Murphy *Prize*  
G. G. MURDOCH, *Chairman*  
G. L. DICKSON  
S. W. GRAY

### INTERNATIONAL RELATIONS

R. W. ANGUS, *Chairman*  
J. B. CHALLIES, *Vice-Chairman*  
E. A. ALLCUT  
C. CAMSELL  
J. M. R. FAIRBAIRN  
O. O. LEFEBVRE  
M. J. McHENRY  
H. H. VAUGHAN  
C. R. YOUNG

### DEFERIORATION OF CONCRETE STRUCTURES

R. B. YOUNG, *Chairman*  
E. VIENS, *Vice-Chairman*  
G. P. F. BOESE  
A. G. FLEMING  
W. G. GLIDDON  
O. O. LEFEBVRE  
J. A. McCRORY  
C. J. MACKENZIE  
J. H. McKINNEY  
R. M. SMITH

### WESTERN WATER PROBLEMS

G. A. GAHERTY, *Chairman*  
C. H. ATTWOOD  
L. C. CHARLESWORTH  
A. GRIFFIN  
D. W. HAYS  
G. N. HOUSTON  
T. H. HOGG  
O. O. LEFEBVRE  
C. J. MACKENZIE  
H. J. McLEAN  
F. H. PETERS  
S. G. PORTER  
P. M. SAUDER  
J. M. WARDLE

### ENGINEERING FEATURES OF CIVIL DEFENCE

J. E. ARMSTRONG, *Chairman*  
P. E. ADAMS  
J. N. ANDERSON  
S. R. BANKS  
H. F. BENNETT  
W. D. BRACKEN  
R. S. EADIE  
E. V. GAGE  
G. A. GAHERTY  
R. J. GIBB  
A. GRAY  
J. GRIEVE  
J. L. LANG  
R. F. LEGGET  
I. P. MACNAB  
J. A. McCRORY  
H. J. McEWEN  
W. L. McFAUL  
C. B. MUIR  
W. H. MUNRO  
G. McL. PITTS  
M. G. SAUNDERS  
W. O. SCOTT  
T. G. TYRER  
H. K. WYMAN

### INDUSTRIAL RELATIONS

WILLS MACLACHLAN, *Chairman*  
E. A. ALLCUT  
J. C. CAMERON  
E. R. COMPLIN  
J. A. COOTE  
W. O. CUDWORTH  
F. W. GRAY  
E. G. HEWSON  
A. M. REID  
W. J. W. REID  
A. ROSS ROBERTSON

### POST-WAR PROBLEMS

W. C. MILLER, *Chairman*  
F. ALPORT  
J. S. BATES  
DEGASPE BEAUBIEN  
A. L. CARRUTHERS  
J. M. FLEMING  
E. R. JACOBSEN  
G. R. LANGLEY  
H. MASSUE  
G. L. MACKENZIE  
D. A. R. McCANNELL  
A. W. F. McQUEEN  
G. McL. PITTS  
D. C. TENNANT

# THE ENGINEERING INSTITUTE OF CANADA

## OFFICERS OF BRANCHES

### BORDER CITIES

*Chairman*, H. L. JOHNSTON  
*Vice-Chair.*, G. G. HENDERSON  
*Executive*, W. P. AUGUSTINE  
 J. F. G. BLOWEY  
 W. R. STICKNEY  
*(Ex-Officio)*, E. M. KREBSER  
 G. E. MEDLAR  
*Sec.-Treas.*, J. B. DOWLER,  
 754 Chilver Road,  
 Walkerville, Ont.

### CALGARY

*Chairman*, H. J. McEWEN  
*Vice-Chair.*, J. G. MacGREGOR  
*Executive*, J. N. FORD  
 A. GRIFFIN  
 H. B. SHERMAN  
*(Ex-Officio)*, G. P. F. BOESE  
 S. G. COULTIS  
 J. B. DEHART  
 P. F. PEELE  
*Sec.-Treas.*, K. W. MITCHELL,  
 803—17th Ave. N.W.,  
 Calgary, Alta.

### CAPE BRETON

*Chairman*, J. A. MacLEOD  
*Executive*, J. A. RUSSELL M. F. COSSITT  
*(Ex-Officio)*, F. W. GRAY  
*Sec.-Treas.*, S. C. MIFFLEN,  
 60 Whitney Ave., Sydney, N.S.

### EDMONTON

*Chairman*, D. A. HANSEN  
*Vice-Chair.*, D. HUTCHISON  
*Executive*, C. W. CARRY  
 B. W. PITFIELD  
 E. R. T. SKARIN  
 J. A. ALLAN  
 E. ROBERTSON  
 J. W. JUDGE  
*(Ex-Officio)*, J. GARRETT  
 R. M. HARDY  
*Sec.-Treas.*, F. R. BURFIELD,  
 Water Resources Office,  
 Provincial Government,  
 Edmonton, Alta.

### HALIFAX

*Chairman*, P. A. LOVETT  
*Executive*, A. E. CAMERON  
 G. T. CLARKE G. J. CURRIE  
 A. E. FLYNN J. D. FRASER  
 D. G. DUNBAR J. A. MacKAY  
 J. F. F. MacKENZIE  
 J. W. MacDONALD  
 G. T. MEDFORTH  
 S. L. FULTZ J. R. KAYE  
*(Ex-Officio)*, S. W. GRAY,  
*Sec.-Treas.*, The Nova Scotia Power  
 Commission,  
 Halifax, N.S.

### HAMILTON

*Chairman*, STANLEY SHUPE  
*Vice-Chair.*, T. S. GLOVER  
*Executive*, H. A. COOCH  
 NORMAN EAGER  
 A. C. MACNAB  
 A. H. WINGFIELD  
*(Ex-Officio)*, W. J. W. REID  
 W. A. T. GILMOUR  
*Sec.-Treas.*, A. R. HANNAFORD,  
 354 Herkimer Street,  
 Hamilton, Ont.

### KINGSTON

*Chairman*, T. A. McGINNIS  
*Vice-Chair.*, P. ROY  
*Executive*, V. R. DAVIES  
 K. H. McKIBBIN  
 K. M. WINSLOW  
 A. H. MUNRO  
*(Ex-Officio)*, G. G. M. CARR-HARRIS  
 D. S. ELLIS  
*Sec.-Treas.*, R. A. LOW,  
 Queen's University,  
 Kingston, Ont.

### LAKEHEAD

*Chairman*, MISS E. M. G. MacGILL  
*Vice-Chair.*, E. J. DAVIES  
*Executive*, J. I. CARMICHAEL  
 R. B. CHANDLER  
 S. E. FLOOK  
 O. J. KOREEN  
 S. T. McCAVOUR  
 W. H. SMALL  
 E. A. KELLY  
 J. S. WILSON  
*(Ex-Officio)*, B. A. CULPEPER  
 J. M. FLEMING  
*Sec. Treas.*, W. C. BYERS,  
 c/o C. D. Howe Co. Ltd.,  
 Port Arthur, Ont.

### LETHBRIDGE

*Chairman*, J. M. DAVIDSON  
*Vice-Chair.*, W. MELDRUM  
*Executive*, R. F. P. BOWMAN G. S. BROWN  
 N. H. BRADLEY  
 C. S. CLENDENING  
*(Ex-Officio)*, J. HAIMES  
 A. J. BRANCH J. T. WATSON  
*Sec.-Treas.*, R. B. McKENZIE,  
 McKenzie Electric Ltd.,  
 706, 3rd Ave. S., Lethbridge, Alta.

### LONDON

*Chairman*, F. T. JULIAN  
*Vice-Chair.*, T. L. McMANAMNA  
*Executive*, F. C. BALL  
 V. A. McKILLOP  
 H. F. BENNETT  
 A. L. FURANNA  
 R. S. CHARLES  
*(Ex-Officio)*, R. W. GARRETT  
 J. A. VANCE  
*Sec.-Treas.*, H. G. STEAD,  
 60 Alexandra Street,  
 London, Ont.

### MONCTON

*Chairman*, H. J. CRUDGE  
*Vice-Chair.*, J. A. GODFREY  
*Executive*, A. S. DONALD  
 E. R. EVANS E. B. MARTIN  
 H. W. HOLE G. C. TORRENS  
*(Ex-Officio)*, F. O. CONDON H. W. McKIEL  
 G. L. DICKSON  
*Sec. Treas.*, V. C. BLACKETT,  
 Engrg. Dept.,  
 C.N.R.,  
 Moncton, N.B.

### MONTREAL

*Chairman*, J. A. LALONDE  
*Vice-Chair.*, R. S. EADIE  
*Executive*, R. E. HEARTZ  
 J. B. STIRLING  
 J. M. CRAWFORD  
 J. COMEAU  
 H. F. FINNEMORE  
 R. C. FLITTON  
 G. D. HULME  
*(Ex-Officio)*, DE G. BEAUBIEN  
 J. E. ARMSTRONG  
 J. G. HALL  
 W. G. HUNT  
 C. K. McLEOD  
 G. McL. PITTS  
*Sec.-Treas.*, L. A. DUCHASTEL,  
 40 Kelvin Avenue,  
 Outremont, Que.

### NIAGARA PENINSULA

*Chairman*, C. G. CLINE  
*Vice-Chair.*, G. E. GRIFFITHS  
*Executive*, A. G. HERR  
 R. T. SAWLE  
 G. F. VOLLMER  
 W. D. BRACKEN  
 J. W. BROOKS  
 J. H. TUCK  
 D. S. SCRYMGEOUR  
*(Ex-Officio)*, A. L. McPHAIL  
 A. W. F. McQUEEN  
*Sec.-Treas.*, J. H. INGS,  
 1870 Ferry Street,  
 Niagara Falls, Ont.

### OTTAWA

*Chairman*, N. B. MacROSTIE  
*Executive*, W. G. C. GLIDDON  
 R. M. PRENDERGAST  
 W. H. G. FLAY  
 G. A. LINDSAY R. YUILL  
*(Ex-Officio)*, K. M. CAMERON  
 C. J. MACKENZIE  
 W. H. MUNRO  
 T. A. McELHANNAY  
 R. K. ODELL  
*Sec.-Treas.*, A. A. SWINNERTON,  
 Dept. of Mines and Resources,  
 Ottawa, Ont.

### PETERBOROUGH

*Chairman*, D. J. EMERY  
*Executive*, C. R. WHITEMORE F. R. POPE  
 I. F. McRAE R. L. DOBBIN  
 A. J. GIRDWOOD  
*(Ex-Officio)*, J. CAMERON  
 H. R. SILLS  
*Sec.-Treas.*, A. R. JONES,  
 5, Anne Street,  
 Peterborough, Ont.

### QUEBEC

*Life Hon.-*  
*Chair.*, A. R. DECARY  
*Chairman*, L. C. DUPUIS  
*Vice-Chair.*, RENÉ DUPUIS  
*Executive*, O. DESJARDINS  
 R. SAUVAGE G. ST-JACQUES  
 S. PICARD L. GAGNON  
 G. W. WADDINGTON  
*(Ex-Officio)*, E. D. GRAY-DONALD  
 R. B. McDUNNOUGH P. MÉTHÉ  
 H. CIMON  
*Sec.-Treas.*, PAUL VINCENT,  
 Colonization Department,  
 Room 333-A, Parliament Bldgs.,  
 Quebec, Que.

### SAGUENAY

*Chairman*, K. H. RIMMER  
*Vice-Chair.*, C. MILLER  
*Executive*, W. E. COOPER  
 J. FRISCH  
 B. BAUMAN  
 G. R. MOXON  
*(Ex-Officio)*, M. G. SAUNDERS  
 N. F. McCAGHEY  
 J. W. WARD  
*Sec.-Treas.*, ALEX. T. CAIRNCROSS,  
 P.O. Box 33,  
 Arvida, Que.

### SAINT JOHN

*Chairman*, D. R. SMITH  
*Vice-Chair.*, A. O. WOLFF  
*Executive*, H. P. LINGLEY  
 C. D. McALLISTER  
 C. C. KIRBY  
*(Ex-Officio)*, F. A. PATRIQUEN  
 V. S. CHESNUT  
 G. G. MURDOCH  
*Sec.-Treas.*, G. W. GRIFFIN,  
 P.O. Box 220,  
 Saint John, N.B.

### ST. MAURICE VALLEY

*Chairman*, VIGGO JEPSEN  
*Vice-Chair.*, J. H. FREGEAU  
*Executive*, E. BUTLER R. D. PACKARD  
 A. C. ABBOTT  
 R. DORION  
 H. J. WARD  
 E. T. BUCHANAN  
 J. GOYAL  
 H. G. TIMMIS  
*(Ex-Officio)*, A. H. HEATLEY  
*Sec.-Treas.*, J. B. SWEENEY,  
 Consolidated Paper Corporation,  
 Grand'Mère, Que.

### SASKATCHEWAN

*Chairman*, A. P. LINTON  
*Vice-Chair.*, A. M. MacGILLIVRAY  
*Executive*, F. C. DEMPSEY  
 N. B. HUTCHEON  
 J. G. SCHAEFFER  
 R. W. JICKLING  
 H. R. MACKENZIE  
 B. RUSSELL  
*(Ex-Officio)*, I. M. FRASER  
*Sec.-Treas.*, STEWART YOUNG,  
 P. O. Box 101,  
 Regina, Sask.

### SAULT STE. MARIE

*Chairman*, L. R. BROWN  
*Vice-Chair.*, R. A. CAMPBELL  
*Executive*, N. C. COWIE  
 C. O. MADDOCK  
 C. R. MURDOCK K. G. ROSS  
*(Ex-Officio)*, J. L. LANG  
 E. M. MacQUARRIE  
 A. E. PICKERING  
*Sec.-Treas.*, O. A. EVANS,  
 159 Upton Road,  
 Sault Ste. Marie, Ont.

### TORONTO

*Chairman*, W. S. WILSON  
*Vice-Chair.*, W. H. M. LAUGHLIN  
*Executive*, D. FORGAN  
 R. F. LEGGET  
 S. R. FROST  
 F. J. BLAIR  
 E. G. HEWSON  
 C. F. MORRISON  
*(Ex-Officio)*, C. R. YOUNG T. H. HOGG  
 A. E. BERRY N. MacNICOL  
 H. E. BRANDON J. J. SPENCE  
*Sec.-Treas.*, S. H. deJONG,  
 Dept. of Civil Engineering,  
 University of Toronto,  
 Toronto, Ont.

### VANCOUVER

*Chairman*, W. O. SCOTT  
*Vice-Chair.*, W. N. KELLY  
*Executive*, H. P. ARCHIBALD  
 I. C. BARLTROP  
 H. C. FITZ-JAMES  
 H. J. MacLEOD  
 R. E. POTTER  
*(Ex-Officio)*, J. N. FINLAYSON  
 T. V. BERRY  
 H. N. MacPHERSON  
*Sec.-Treas.*, P. B. STROYAN,  
 2099 Beach Avenue,  
 Vancouver, B.C.

### VICTORIA

*Chairman*, A. S. G. MUSGRAVE  
*Vice-Chair.*, KENNETH REID  
*Executive*, A. L. FORD  
 B. T. O'GRADY  
 J. B. PARHAM  
 R. BOWERING  
*(Ex-Officio)*, A. L. CARRUTHERS  
 G. M. IRWIN  
 E. W. IZARD  
*Sec.-Treas.*, J. H. BLAKE,  
 605 Victoria Avenue,  
 Victoria, B.C.

### WINNIPEG

*Chairman*, D. M. STEPHENS  
*Vice-Chair.*, J. T. DYMENT  
*Executive*, C. V. ANTENBRING  
 N. M. HALL  
 T. H. KIRBY  
 E. W. R. BUTLER  
 H. B. BREHAUT  
*(Ex-Officio)*, J. W. SANGER  
 V. MICHIE  
 C. P. HALTALIN  
*Sec.-Treas.*, THOMAS E. STOREY,  
 55 Princess Street,  
 Winnipeg, Man.

# MECHANICAL FEATURES OF 220-KV. LINES IN ONTARIO, 1940 AND 1941

A. E. DAVISON

*Transmission Engineer, The Hydro-Electric Power Commission of Ontario, Toronto, Ont.*

Paper presented before the Toronto and Border Cities Branches of The Engineering Institute of Canada on March 19th and April 10th, 1942

The additions which were made to the 220-kv. system of the Hydro-Electric Power Commission of Ontario during 1940 and 1941 have been quite thoroughly reviewed by Messrs. A. H. Frampton and E. M. Wood, especially from an electrical standpoint. Their statement will be found in the January, 1942, issue of *The Engineering Journal*. In that discussion, features of mechanical interest, such as the effects of winds on ice coated conductors, and the fatiguing of conductor and other materials by vibration, are mentioned.

While the principal problem of the transmission engineer is that of keeping conductors clear of electrical faults, and while it is a fact that lightning troubles, very largely having to do with insulation and air clearances of conductors, are the most prolific source of outages of transmission lines, nevertheless, mechanical characteristics are extremely important.

Any type of transmission structure or transport vehicle which is continuously exposed to the elements is almost certain to get into some sort of difficulties sooner or later, or get out of control from time to time because of extreme weather conditions. This is particularly true of long transmission lines because of the extensive and varying territory through which they pass. A transmission line may be 300 to 400 miles long without any intervening controls or sectionalization, with the result that some portion of the line may be surviving an extremely heavy storm



Fig. 1—Transposition tower for double circuit 220 kv. line.



Fig. 2—Anchoring a grillage in soft ground by backfilling with rock.

of some sort while the ends are in comparatively normal weather.

Because transmission works are continuously exposed to the elements, engineers have become familiar with conductor fatigue problems quite as intimately and quite as strenuously as have the makers of high-speed transportation equipment. The result is that it is necessary to think in terms of the fatigue strength or endurance limit of the materials used. Fatigue strength may be of the order of 25 per cent of the ultimate strength. Yield point or elastic limit which frequently is of the order of 50 per cent or more of the ultimate strength should no longer be a unit of reference. If the aluminum, copper, and steel portions of a transmission line are not kept within recognized endurance limits, then it is only a matter of time until incipient failures are evident. As a result of this, some sort of suppressor, tending to limit or absorb this fatiguing energy must be introduced, in order that the useful life of the material may be expected to be increased two or three times. This extension of physical life sought by the introduction of absorbers should, for some of the comparatively taut cables, extend to and beyond the obsolescent life of the works. This overtaking of the physical life of works by obsolescence often happens both with and without suppressors, since engineers cannot always anticipate correctly the locations of load centres and supply centres for a period of 30 years.

Fatiguing, in the case of transmission wires and cables, comes from two sources. First, there is a small almost unobservable aeolian vibration which is insidious. It is slow in creating evident fatigue, but may continue for a considerable part of each day.

The second type of fatigue, sometimes called dancing or galloping, is much less frequent but more strenuous, and men who are about when it happens realize that some mechanical trouble almost immediately may be expected. This other type is due to the effect of wind upon ice coated conductors. These ice coatings may be very thin, and the conductors may be only partially covered. One interesting thing about glaze troubles is that, under war conditions

especially, electricity may be carried in such quantities that the dissipation of energy losses in the form of heat has been found to be sufficient to prevent the formation of ice on the conductors during at least one-third of the glaze storms. The upper sky or ground cables cannot be so warmed.

A number of engineers have spent some time and money trying to establish special routings of power over lines, at times when they may be exposed to glaze storms, by which formations of ice may be prevented. This has been done with some success, and appears to be about the only way this trouble can be effectively countered.

If added heat cannot be supplied until after the glaze has formed, then the air temperatures may be so low for long periods that it would take a great amount of electrical loss to melt the ice.

Conditions for the formation of glaze, like that of the formation of certain types of ice in water as described in a very interesting way by the late Professor Howard T. Barnes in his text-book "Ice Engineering," are very critical. Also, it has been shown that water in a glass container, without any jarring, can be cooled, to a temperature below 32 deg. F. without ice formation, but if the container is jarred slightly, it is possible to have 30 per cent of the water change into ice suddenly. Similarly, it has been shown that a fraction of a degree change in temperature in the vicinity of ice racks changes the ice forming characteristics very materially. So it is in the formation of glaze. It appears that during the glaze-forming period only of most storms the temperature of the water and of the air at the surface of the cable is such that, if there is any appreciable radiation of heat, this critical ice-forming condition can be avoided. In other words, conditions for most storm glaze formation are critical.

So far as the most recently constructed 220-kv. lines in Ontario are concerned, their mechanical stability depends first on their mechanical safety ratios and on the normal radiation of electrically generated heat for protection against loss of circuit in many (35 to 40 per cent) of the storms accompanied with wind at the time of or following the formation of glaze. This was the case during a series of storms during 1941-42. Winds across the line of say 20 miles per hour during the glaze-forming period or shortly afterwards may be expected to cause mechanical, and in all probability electrical, disturbances at some point on the line. Frequently, only one conductor of several performs in one span.

Discussing safety ratios, it has been customary for building designers to use 16,000 lb. per sq. in. or more in tension when steel having an ultimate strength of 64,000 lb. is used. This ratio is sometimes erroneously called a factor of safety of four.

Transmission structures provide safety ratios under test close to that found in buildings as above, assuming of course dynamic pressures.

Wind loadings taken at eight lb. per sq. ft. on the projected area of smooth cylinders compare favourably with 30 lb. on large flat surfaces. Wind pressures in excess of these figures may be found. For instance, the Florida Coast-line train, moving out along the Keys, was blown and washed away a few years ago.

The resistance of transmission structures to winds greater than 60 miles per hour and of the order of 100 or more miles per hour, because of the low incidence of such storms, is within the safety ratio just as is the carrying of eight inches, and in some cases greater, diameter of glaze or rime by a single 1/8-in. or less diameter telephone wire.

There are in Ontario a considerable number of 110-kv. to 132-kv. double-circuit steel-supported transmission lines. There are also on the continent a few 220-kv. structures supporting two circuits and the necessary sky cables. The 220-kv. lines in Ontario are generally single-circuit construction; however, the new line from metropolitan Toronto area (Leaside) to Burlington is double-circuit construction.

It conforms in general to the more orthodox types of double-circuit construction at lower voltages but with greater phase-to-phase and phase-to-ground cable.

The transposition structure differs from most other transpositions at this voltage and for the particular type of construction, in that much greater than usual clearances are provided where one of three phase wires passes under the other two in making a one-third roll. When in this position, it is provided that there shall be as great clearances as there are throughout the more standard spans.

Steel grillages have survived many alternative schemes for anchoring steel transmission structures to earth. Among other schemes there are the "Malone" anchor, a concrete bulb poured around a steel stub set in an eight-inch post hole, at the bottom of which a small charge of explosive creates the area for the 20-in. diameter bulb or anchor; the inverted plate steel disc; and many types of reinforced concrete placed around a steel stub.

The amount of grillage steel is sometimes equal to one-third of that in the super-structure. There is still room for designers to discover a safe less expensive anchorage.

Until recently, a number of organizations have been using templates to fix the four legs and grillages in an excavation while they are being set and while backfilling is being done. This was thought to be an insurance that the foundation would be in such condition that there would be no delay when men had to start work on the super-structure. Latterly it has been found that if there is any careless work, the foundations may sink, or be made otherwise irregular while the backfilling is going on, with the result that the alternative method of setting each leg and grillage independently by using a surveyor's instrument and reference stakes has



Fig. 3—Difficulties of working in the air on a hot day.

been introduced. Apart from the facts that it is found that this procedure is economical, and is in general leaving the foundation members quite as correctly in position, it does have another advantage. In very wet ground, pumps and workmen may be concentrated on one corner, finishing that corner up at the end of one day, thereby eliminating the necessity of pumping out one, two, or three excavations upon completion of work on the fourth so as to set all four legs with a template at one time.

For footings on rock, if two steel channels are secured in a horizontal position to the foundation leg members, and if these members are so punched or bored that they can be adjusted up or down the tower leg, then if two rock bolts, "foxed" and grouted in, placed either side of the main leg member and holding down with a plate or cross angle the upper flanges of the two channels, the result will be a satisfactory anchorage. All nuts of these anchor bolts should be locked. Foundations of this type should preferably be erected by instrument also.

Experience leads to setting tower legs by instrument, especially if there is good superintendence.

There are two prevalent methods of erecting the superstructure. Some organizations, in an attempt to cut down

on the number of man-hours, use elaborate erecting equipment, portable cranes and the like, requiring five to seven men per crew. Others use one team of horses to hoist assembled parts of a tower, and have, as in the alternative above, four men in the air and others to serve them below. In this method a gin pole is erected in the centre of the tower with tackle from its base to the tops of the four erected leg members. The gin pole can then be raised by steps about equal to the individual height of the sectional lengths of leg members. It is not fair to say that for the same man-hour rating the two erection costs are equal; however, that type of erection requiring a large number of man-hours is usually used where man-hours are less expensive, with the result that cost per tower or per ton of superstructure erected is in general the same for these two erection methods.

For the 365 circuit miles of construction finished in 1941, involving over 1,500 structures and requiring approximately 100,000 man-hours of work in the air, accidents were very few indeed, none of these were serious. One which accounted for more than a week of lost time was due to an employee being accidentally struck on the head by the handle of a falling maul.

## TIN CONSERVATION

Four papers presented before a Joint Meeting of the Affiliated Engineering and Allied Societies in Ontario at Toronto, Ont., on May 27th, 1942.

**NOTE**—The four speakers who took part in this important discussion were K. H. J. Clarke, Office of the Metals Controller, Department of Munitions & Supply, Ottawa, Ontario; J. S. Fullerton, Development Engineer, Handy & Harnan of Canada Ltd., Toronto, Ontario; I. I. Sylvester, Chief Inspector, Diesel Equipment, Canadian National Railways, Montreal, Quebec; G. E. Tait, Assistant Manager, Dominion Engineering Co., Ltd., Montreal, Quebec.

### THE METAL SITUATION

K. H. J. CLARKE

Non-ferrous metals in this country are divided into those which Canada produces and exports on a large scale, and the much smaller but extremely important group which we import and of which we are in short supply.

In the former group are copper, nickel, zinc, and lead.

Aluminum, of which we are large producers and exporters, is in a class by itself due to the fact that all the ore must be imported.

The supply picture of this group, which must be reviewed in the light of the overall needs of the United Nations, is not as reassuring as we would like.

Due to the now very urgent armament programmes of the United Nations, shortages of aluminum, nickel, copper, and zinc, already exist in varying degrees.

What may well be one of the most important of Canada's contributions to the combined war effort, is the supply of large quantities of those urgently needed base metals.

Practically all metals and strategic minerals are now under direct allocation in Canada and, as conditions have become increasingly more serious, so, proportionately, have the controls tightened. For example, starting June 1st every single order for wrought copper or copper alloys in such forms as sheet, strip, tubes, pipe and rod placed with a Canadian fabricator must be submitted to the Office of

the Metals Controller for investigation. Orders may not be scheduled without the approval of the Copper Control.

Excellent co-operation on the part of manufacturers and distributors has been shown and Canadians are well satisfied in forgoing the use of Canadian metals in order that they will be available for their allies.

Very important differences exist between the geography and economy of Canada and those of the other allied nations and the few differences in the controls which do exist, mainly in more simplicity of procedure, are based on studies of those factors.

It may be said with assurance that not only will civilian use of these metals decrease very rapidly from this time on, but that also, before many months have passed, many substitutions will have to be made even in war applications to take care of the most pressing war needs.

So much for that which we have; the real troubles, however, exist in that which we have not. Some of the more important of such metals are manganese, chromium, tungsten, vanadium, molybdenum and tin.

### MANGANESE

Manganese is best known by virtue of the fact that it is universally used in the manufacture of steel where it is used both as a scavenger and as an alloying element.

The decision of the present conflict rests in the balance between quantity and quality of the opponents' fighting machines in almost all of which steel is the backbone. A supply of manganese is absolutely vital for the prosecution of the war.

The manganese problem is mainly one of shipping. Aside from a relatively small production in the U.S.A., the sources of supply are the Gold Coast of Africa, Brazil, Cuba, Russia and India. The bulk of supplies for the United Kingdom and Canada come from the Gold Coast where they are subject to the hazard of submarine attack.

## CHROMIUM

It is well known that chromium is one of the most important steel alloying elements in use to-day. From the low alloy engineering steels to the high alloy high temperature alloys chromium is playing a very important part in the war effort.

Supplies were formerly drawn principally from Southern Rhodesia, Union of South Africa, the Philippines, New Caledonia, India and Turkey. There now remain as our chief sources of supply, Rhodesia and South Africa. Shipping again is the problem.

Our increased demand for manganese and chromium is indicated by the fact that since the war began consumption of power in Canada for the production of ferro alloys has increased by more than 650 per cent.

## TUNGSTEN

The most important use of tungsten is in the production of high speed cutting tools which play such an important part in the production of war equipment. Sources are scattered, small quantities being produced in the United States, Australia, and New Zealand, Portugal, Malaya and Burma. By far, however, the largest quantities have been produced in China, reaching the allies over the Burma Road.

## TIN

And now we come to the main subject, which has been the cause of much work and worry during the last few months. More than any other non-ferrous metal, tin seems to be interwoven into the entire fabric of every-day life. First, we have the common *tinplate* container or "tin can" which has contributed so much to the modern bride's peace-of-mind. In pre-war days, tinplate consumed almost 50 per cent of the tin used in Canada. To-day this application, due to the urgent need for food preservation, is a factor of considerable concern.

Since December 7, 1941, intensive research has made tremendous strides in the production of lacquered blackplate and bonderized containers. In the not too distant future it is expected that it will be possible to preserve many of the not too highly acidic foods in these tinless containers. All non-essential uses have, of course, been eliminated, can sizes for essential food stuffs have been enlarged and the use of tinplate for many foodstuffs has been prohibited.

*Solders* are the next largest tin user. All grades are severely rationed and many revisions in specifications to lower tin contents have been made. Scrap solders must be carefully preserved because supplies will become increasingly scarce.

*Babbitt metals* as bearings perform the important function of transmitting mechanical power. The demands made on our supplies for use in naval vessels will leave little high grade material for industrial use.

In the *bronze* field remarkable strides have already been made. The old standby gun metal or 88/10/2 containing 10 per cent of tin has been largely replaced by lower or tin-free alloys and an excellent reduction of tin consumption in this field has already taken place.

The use of tin in *foil* except for special ordnance use has been eliminated and in collapsible tubes is now negligible.

The facts to be faced in the tin situation are very serious. As an indicator and using 1939 statistics, world production of tin was 181,000 tons of which the Malay States, Netherland Indies, Thailand, Indo China and China contributed approximately 115,000 tons or 70 per cent. The Belgian Congo, Nigeria, Bolivia and the small production of the United Kingdom totalled 50,000 tons or 27 per cent. Now there is available to the United Kingdom and Northern

America less than  $\frac{1}{3}$  of the world's supply *providing the ships get through*.

Fortunately Government and consumer stockpiles will help fill the gap until substitutions have been made. The answer, however, is just that. The use of tin must be drastically reduced during the next twelve months.

Canadian technicians, engineers, and artisans can do that job, and meetings such as this one will help speed their efforts.

## SUBSTITUTE SOLDERS

J. S. FULLERTON

The question of substitutions is a vexing one, and will require a great deal of intensive study. Just where to start will be a problem, and the answers may come from unusual places. When the French peasants rioted for lack of bread, Marie Antoinette's flippant suggestion that they eat cake touched off many changes. Now, manufacturers who are having trouble securing brass, copper, stainless steels and certain other materials, especially for non-defence needs, may well give thought to silver. Silver has been available in large quantities in world markets, and a reasonable supply is still assured. Its cost is less than that of several other metals being used in large quantities. Silver is easily worked, and can be had in such forms as sheets, strips, rod, tube and wire, etc. A variety of alloys having diverse and useful properties are also available, as are certain metals clad with silver.

Silver is a by-product; from the production of other heavy metals—gold, copper, nickel, lead, etc., come most of the silver stocks, and as the production of these metals increase, so will production of silver. Greatly accelerated consumption of silver has been noted in the past year. The estimated total for 1941 in the United States and Canada was 80,000,000 ounces of pure silver, against 41,000,000 in 1940, an increase of almost 95 per cent. The quantity to be consumed this year will be far in excess of any previous estimates.

Turning for a moment to the casting procedures, considerable work in research has been done on the inclusion of silver in varying quantities in non-ferrous alloys, and the data on these tests shows potent alloying effect, similar to the benefits obtainable by the addition of nickel to carbon steels. Copper has been improved by the addition of small percentages of silver. This addition adds hardness, which obtains even after soldering operations. In commutator bars, for example, a small percentage of silver insures that hardness will be maintained. Fractional percentages of silver in photo-engravers' plates prevent the softening of cold-rolled copper sheet while it is processed at high temperatures. The addition of silver to copper increases its conductivity. The research work has been on alloys including cupro-nickel, brass, bronze, aluminum bronze, beryllium bronze, everdur, etc. Of interest to the foundrymen may be the fact that silver alloys have been used as a filler material for blowholes in castings. The cost has been low, and the alloys surrounding unchanged by the low heat.

In the case of many articles and small parts requiring extensive fabrication, material costs are often a small part of the total, even though the unit cost of material is high. Silver often fits in well in such cases, and may even enable manufacturing to continue when it would otherwise have to stop for lack of other metals. Silver always has a high reclamation value, and correspondingly increases the intrinsic value of the product in which it is used.

One of the principal items of interest is the question of a substitute for tin-lead solders. Many of the places in industry where these soft solder alloys are being used have been investigated and substitute solders were initiated years and months ago, with better joints resulting. Metals which will stand the heat of low temperature silver brazing alloys can generally be joined by those alloys, and the



Fig. 1—Silver-brazed detonator exploder and threaded collar.

results have been so favourable that the manufacturers have regretted the delay in the use of the new jointing alloys. The following are a few instances where soft solders have been replaced by silver alloys, to advantage:

- Tank spuds and seams.
- Electrical work: bus bars, terminal connections.
- Plumbing work: streamline fittings.
- Refrigeration: vibration proof, corrosion proof, leak proof joints.

These are a few of the places in everyday commercial production where silver makes the joint just as cheaply, more efficiently, and certainly a lifetime job. The flow point of these low temperature alloys runs from 1175 deg. F. to 1600 deg. F. Controlled heating methods, induction heating, spot welders, etc., and a certain amount of design changes, coupled with the use of such insulating materials as spun glass, have made it possible to make joints in places formerly deemed impracticable for any such heats. While the silver alloy cost is high per pound compared to other base metal alloys, yet the cost per joint will generally be comparable, and in many cases will be less. Several examples are cited in the following notes.

In war industries, a great many jobs have come to silver brazing as the production answer to a serious problem.

Figure 1 shows an exploder container for medium calibre shells. The specification for joining this threaded collar to the drawn tube called for either pure tin, brazing, or copper brazing in controlled atmosphere. This worked out as follows:

Pure tin was used by one manufacturer. The production rate was in the vicinity of 30 units per operator per hour. Tin used as a filler cost around 2c per unit.

Copper brazing in hydrogen atmosphere, furnace heat

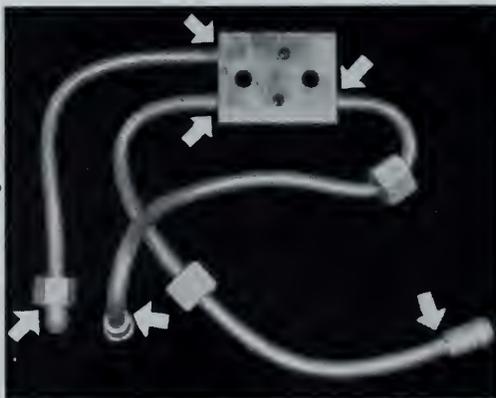


Fig. 2—Oil cooling part for Bofors gun (silver-brazed).

approximately 2100 deg. F. was employed by another manufacturer. Production rate was higher; 75 units being brazed per hour. Unfortunately the high heat and time in heat ruined some of the threaded collars; 25 per cent were rejected unfit, and 35 per cent had to be reconditioned before inspection.

Silver brazing in an atmosphere furnace, with a travelling belt and electric heating, was tried by another manufacturer. The parts were degreased, fluxed, pre-placed rings of the alloy inserted, alloy cost being 1/2c per unit, and the parts entered the furnace without any preheating at a temperature of 1680 deg. F. The time in furnace heat was finally set at two minutes, then into an atmosphere cooling chamber and the assembly, perfectly brazed, emerged clean and ready to be lacquered. The present production schedule is set at 480 per hour, with two operators, and the percentage of rejects is in the vicinity of 1/2 to 1 per cent. Examination of the rejects has shown in every case that it was improper cleaning or fluxing which led to the faulty braze, and as the attention paid to these very important operations, particularly the cleaning, is increased, so do the rejects decrease.

Many other operations for the Department of Munitions and Supply have gone through for silver brazing. Bren guns, Sten guns, Lee-Enfield rifles, Boys guns, etc., etc., have all stood up under exceptionally severe tests, and have proved efficient and both time and money saving. Figure 2 shows the oil cooling chamber for a Bofors anti-aircraft gun. A great many of the parts on radio locators being built here have switched to silver brazing.

The Universal Carriers being manufactured by Ford at



Fig. 3—Oil-relief valve for universal carrier (silver-brazed).

Windsor, generally called Bren Gun Carriers, were originally designed with the fittings to be soft soldered. The two test units made up were taken out to the proving ground, and under the vibration of the vehicle, and the heat of hot motor oil, proved unsuitable, leaking and slipping out of the fittings. The fittings were then ordered silver brazed, and have stood up under every test. The oil relief valve shown in Fig. 3 was originally threaded, the wings positioned, and the joint sealed with silver solder. An improved design was suggested and approved. The fittings are now made with a slot in the wing, in which silver brazing alloy is preplaced, the whole assembly fluxed, slipped into place, positioned, heated until the alloy shows, then the braze is complete. Many of the tank fittings in Valentine and Mark III tanks are being silver brazed.

In munitions work, the alloys have found a very necessary place in the fabrication of carbide-tipped tools for machining. The use of the alloys has permitted rapid inexpensive manufacture of these tools, in special shapes or sizes where necessary, right in the munitions plant. Operators are quickly trained for this type of brazing.

In the short space of this article it is necessary to pass over many of the other places where the alloys have found definite use in war industry, mentioning only the aircraft field, where the use of the alloys has permitted absolutely

sound, leakproof, vibration proof joints to be made, doing away in many places with heavy expensive fittings, and yet making the braze at temperatures far below any chance of embrittlement in the copper tubing. A new method of making up a thermocouple illustrates the joining of dissimilar metals with silver brazing alloys. In the part, we have a copper base, brass ferrule, constantan wire and copper wire, bound with monel wire. All five are united at the base, by means of incandescent carbon heating, and silver alloys.

In the field of the high bronze rods, such as tobin bronze, etc., a number of uses have been found for the silver alloys. A great deal of the strength of the bronze brazing is due to the large mass of cast alloy which surrounds the brazed area. Because of the adherence of bronze to steels and iron, a heavy amount of alloy can be built up, which in itself gives strength. Silver alloys do not depend on bulk to get strength; a bonding of the metals joined is effected by the silver alloy. In non-ferrous metals, this strength is in excess of the parent metal; and in ferrous metals, generally equal to, or slightly below the metals joined. With proper type of joints, amazing results can be achieved with a minimum amount of brazing alloy, and with very low heat, thus protecting the metals joined from the damaging effects of high temperatures.

An example of this is an instrument panel from the Bren Gun Carrier. This panel is formed after punching, and several spuds are affixed for bolting to the carrier frame. They were formerly welded, then the weld cleaned up. Welding time consumed was 88 hours per 1000 units, plus 53 hours for cleaning, scratch-brushing, etc., total 141 hours. Welding material cost \$3.50. Now these spuds are jigged in place, with a ring of the silver brazing alloy preplaced, and heat applied to flow the alloy. Cleaning time is eliminated, and the entire operation takes 53 hours, with a brazing alloy cost of \$6.50 per 1000 units.

Ship-building in Canada has started to use silver alloys in place of spelter and bronze. Many pipe flanges, some ranging up to 14 inch diameter, have been brazed with silver alloys, and have stood up under every test, including some tests too severe for high temperature brazing. Costs have been comparable, time has been saved. More important, material has been saved. A twelve-inch flange, brazed with spelter, requires one pound of brazing metal. The same flange, properly designed, requires one-fifth of a pound of silver brazing alloy.

There are many places however, where neither low temperature silver brazing alloys, bronze brazing alloys or welding rods may be considered, and where the use of the 50-50 tin lead solders, and their various alloys has been, and still is necessary. Some work has been done on substitute alloys for commonly used soft solders, and a brief review of this development seems appropriate.

Silver and lead, in the eutectic of 2½ per cent silver-97½ per cent lead forms quite an efficient solder, which melts and flows at a temperature of 572 deg. F. Tests of silver-lead alloys have shown that they will make joints that have a higher tensile than 50-50 solder. For comparison, at room temperature the shear strength of 50-50 solder is 2580 lb. p.s.i. against 3820 lb. p.s.i. for silver-lead. At elevated temperatures, say 350 deg. F, 50-50 solder has a shear of 441 p.s.i. against 1556 p.s.i. for silver lead. One outstanding improvement of the silver bearing alloys is the increase in creep resistance. Silver-lead alloys, as is the case in tin-rich alloys, are capable of extrusion. Alloys are also available containing lead and silver, with percentages of tin and bismuth, which have low flow points, and are comparable with tin-lead solders. Silver-lead alloys are used to some extent in the construction of airplane radiators.

Two low temperature alloys have been developed, one with silver, zinc and cadmium, melting at 480 deg. F, and flowing at 600 deg. F, and the other with silver and cadmium, melting at 640 deg. F, and flowing at 740 deg. F.

These alloys were developed for special uses, such as soldering electrical terminals, but have certain characteristics which make them suitable for consideration in the present emergency. A comparison of tensile strengths between these alloys and 50-50 lead-tin solder shows some interesting figures:

	Ag-Cd	Pb-Sn
Room Temperature	16,400 lb.	2,500 lb. p.s.i.
300 deg. F.....	4,400	650
400 deg. F.....	2,600	100

These alloys however, while strong under tension, exhibit the brittleness characteristic of all soft solders under bending stresses. One of the principal considerations in the use of either silver-lead or silver-zinc-cadmium is the use of the proper flux. Soft soldering fluxes may be used, but at the temperatures required, which are higher than most of the soft solders, many of these fluxes carbonize, or are not sufficiently stable to be effective. Incidentally, in discussing these solders, it is interesting to note that 2½ per cent silver-97½ per cent lead alloys are cheaper than 50-50 tin-lead alloys.

Having considered the manufacturing field for substitutions and for metal joining, it is desirable to mention the place that silver plating can play in a substitution programme. Many parts that are nickel, chrome, zinc or cadmium plated can be given a silver flash, which will provide a coating that is just as protective, and just as decorative as any of the other metals previously used. A bright finish will be brought up by buffing, and the dull finish that is required on many munitions parts is quite easy to produce. Application of silver on transparent plastic sheeting has possibilities, and such coatings have brilliant lustre when viewed through the plastic, making the plastic sheeting applicable in place of tin and aluminum foils, for example, at least in some places. Transparent molded plastics can be plated on the inside or on reverse with a thin silver film, giving the appearance of silver, yet be light in weight with all the properties of the plastic. Silver is displacing aluminum in reflectors and in surfaces under vacuum. Silver can be coated onto refractories having dielectric properties to form condensers, many of which are needed in radio and related applications. Silver is a metal which has few if any peers in the corrosion-resisting field. Thin, pore-free coats of silver can be applied quickly and at surprisingly low costs.

Silver has found a very prominent place in the field of bearing metals. Research work done in this field has classified the commonest bearings as follows, starting with the least effective all round metals, and finishing with the most effective: babbitts—cadmium base-copper-lead—pure silver—and silver-lead. Pure silver is not entirely trustworthy, and the failures were traced to lack of oiliness. Bearings made of a 3 to 4 per cent lead, balance silver alloy are extremely seizure resistant, and have the necessary physical properties to enable them to carry high loads without mechanical failure. The best method of bonding lead-silver alloys to steel is by electrodeposition. The plating of the alloys is done simultaneously, and then a heat-treating period provides the diffusion and grain structure necessary. Silver-faced steel is highly resistant to galling when in sliding contact with steel, and the process has developed so rapidly that it has multiplied at least 100 times in the past five years. Orders for silver for this purpose are now being placed in millions of ounces. The biggest single field has been the aircraft bearing manufacturers, for aircraft engine bearings subject to high specific loading. Other fields are rapidly examining the possibilities.

In the electrical field, where the alloys have been widely used, and where pure silver is a very essential metal, a leading electrical authority has said that fine silver has been found to be the best all-round material for such lines as contacts, because of the combination of high electrical conductivity, which produces minimum heat due to

the resistance of the contacts, and the high thermal conductivity, which rapidly dissipates such heat as is generated. Contrary to quite widely accepted statements, silver oxide is probably never formed in the operation of the silver contacts. The presence of silver sulphide, which is rapidly formed and commonly present, does not interfere with contact operations, because silver sulphide is of itself a reasonably good conductor, and as soon as moderate heat is generated on the contacts, the sulphide becomes metallic silver again. For medium and high loads, silver is far less likely to stick, due to welding, than are the alloys of platinum and other expensive noble metals.

Silver is one of the most ductile and workable metals known, and combines readily with other metals to make useful alloys that have unusual properties. Research work, followed by actual manufacture, indicates that the addition of several tenths of a per cent of silver to 18/8 stainless steel greatly reduces the pitting action due to salt water corrosion. It gives the stainless much better machining properties, as well as enabling the surface of the steel to attain a much higher polish. Silver provides high thermal conductivity, and high electrical conductivity, has high reflectivity and is the whitest of metals. Some four years ago, a number of the silver producing companies in the United States financed a comprehensive research programme covering silver and silver alloys for general and specific industrial uses. A great deal of valuable data has been accumulated, and of interest may be the mention that much of this data is available in a publication which is on the market entitled *Silver in Industry* by Lawrence Addicks. This research development is still being carried on and its services are available to anyone interested in the application of the alloys.

Some of these applications range over such fields as:

- Silver additions to storage battery grids.
- Sliding electrical contacts.
- Silver-silicon alloys for chemical equipment.
- Silver foil for "spots" in bottle caps.
- Silvering non-metallic bodies (synthetic plastics, etc.)
- Silver-clad metals.

In conclusion, an intriguing thought to most people is the idea of getting tin cans with silver linings. Research work has developed silver plating and practice to the point where metal cans may be produced commercially with a lining of silver in the order of two or three millionths of an inch. This lining is reasonably pore-free, and suitable for the packaging of foods. It is more expensive than tin-plate, but can be considered where the high cost of a quality product would absorb the increase. Heavy metal containers, carrying gallons of fluids, have been manufactured with coating of silver one-thousandth thick, and have been in service for months, with satisfactory results. Tin-lead solders have already been replaced in Canada by silver-lead for the joints on lacquered steel cans. While we in Canada have not yet had the advantages, if any, of canned beer, it made quite a flurry in the States, and a number of silver-lined cans were produced and marketed, for tests. Just to show how a substitute gets in where it was not intended, the bottle people found that if they were to line the interior of the bottle with a millionth of an inch or so of silver, that the beer was not affected by light rays, and would keep cooler longer after removal from refrigeration. So instead of being a competitor to the bottle trade, silver became an ally.

Along with gold, silver long held a special place as a "precious" metal, by contrast with the "base" metals used for everyday purposes. But now silver has shed its party clothes, and has got into overalls. Silver, and silver alloys, which have been used since prehistoric times for the production of silverware, ornaments, religious articles, etc., and as coinage or a medium of exchange, now finds itself a very necessary adjunct to a modern civilization.

The subject of alternative babbitts, in its practical and economic aspects, covers a very broad field, and many factors have to be dealt with in eliminating the tin content, or at least reducing it to an absolute minimum. Tin has been used so generally in the white metal linings which are employed for the surfaces of bearings and so much was written a few years ago regarding its suitability for this purpose that considerable effort will now have to be made to popularize substitute metals. It is hardly necessary to point out that the period when tin base babbitt bearings were in universal use were the days when bearings were not

CONNECTING ROD BIG END BEARINGS

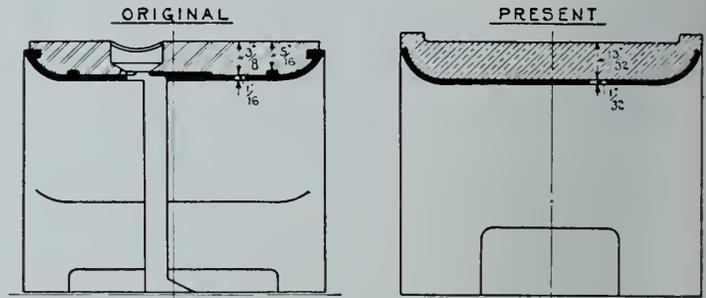


Fig. 4—Improved design with thinner babbitt and bronze backing.

Diameter of crankpin.....	4.75	} Original
Effective length of crankpin.....	2.043	
Projected area of Big End Bearing.....	9.7	
Pressure, lbs. per sq. in. (gas load only).....	4,400	
Pressure, lbs. per sq. in. (gas-inertia).....	3,560	
Rubbing speed in ft. per sec.....	16.5	
Number of Big End bolts.....	2	
Lub. oil pump, capacity in gal. per min. (800 R.P.M.).....	34.1	
No. of cylinders—6 revolutions per min.....	800	

required to carry the extreme loads met with in engineering to-day.

High tin babbitts were found to be unsatisfactory in some fields such as the development of the internal combustion engine for aircraft propulsion. The need for bearings of greater strength, particularly at high temperatures, led to the development of bearings made of copper-lead, lead-bronze, and cadmium alloys, and it would seem that a more extensive use of these would result in a considerable reduction of tin consumption. It is impossible, in such a paper as this, to give an accurate summary of world-wide, or even continent-wide experience, but mention can be made with regard to the lines of improvement which have been worked out in railway motive power with which the writer has been directly connected.

In this field we have had some rather extensive experience with arsenical lead babbitt and details are given of its application on a heavily loaded engine crankshaft bearing as well as on a locomotive crosshead. These two involve both rotary and sliding action commonly found in engines and machinery.

These applications in 1927 were not developed as a result of tin shortage but rather in an effort to remove the cause of bearing failure, or at least improve on the performance of these. A great deal of the credit for the compositions which we employ goes to Mr. Harold Roast, M.E.I.C., consulting chemist and metallurgist of Montreal. Mr. Roast has carried out valuable research on lead base babbitt with additions of antimony and arsenic, which has permitted tin consumption on the Railway to be cut to a small percentage of previous requirements.

Canadian National specifications, which cover three grades of babbitt, are shown in Table I. When this work

was undertaken the number one babbitt, which has a high tin content, was being used very generally. The number three Durite was developed first on diesel engine bearings and its use has been extended to many other applications. The most recent development is the number five Durite which is employed on the crosshead applications above mentioned.

TABLE I

Composition	No. 1	No. 3 Durite	No. 5 Durite
Copper	7.75%	0.25 to 0.50%	None
Tin	87%	1.5 to 2.5%	1.5 to 2.5%
Antimony	5.25%	18 to 19%	5 to 6%
Arsenic	None	0.75 to 1.25%	0.75 to 1.25%
Lead	None	76.75 to 79.5%	90.25 to 92.75%

New bearing metals, in which lead is a much larger constituent than formerly, have been developed and are meeting the exacting demands of modern engineering. These new alloys are mainly of three types, arsenical lead and calcium-lead base alloys containing fractional percentages of other elements and copper-lead alloys.

The first two types, which are in reality alternative babbitts, have been used by the railroads for engine truck and trailer brasses, car journals, bearings, lateral plates in engine trucks, trailer and driving boxes, crosshead gibs and other applications. Until quite recently these types were often used only where there was some special problem of temperature connected with the application. Undoubtedly their use will now be extended to many applications involving normal loads and operating conditions. These alternative babbitts are characterized by a low co-efficient of friction and since the melting point is higher, the metal is harder and stronger at running temperature than the older type, and it is able to stand up better under higher temperatures and pressures.

The other new type of bearing alloy (copper with large quantities of lead) has been used for a number of years on aircraft engines. New designs of automobile motors, placing harder service on bearings, have led to its adoption by some of the leading motor car manufacturers. This also permits higher bearing load, although they are generally employed in connection with crankshafts which are also harder, being of 250 or over Brinell hardness. This type is more of a mechanical mix of bronze and lead and may be thought of as a sponge of bronze in which the cavities are filled with lead, rather than a true alloy of these metals.

#### ARSENICAL LEAD BABBITT APPLIED TO ENGINE SHAFT HAVING HIGH VELOCITY WORK FACTOR

The advent of the high speed diesel engine for railway traction work some seventeen years ago, brought with it many new problems which required solution and one of the most troublesome, related to big end bearing failures. The most common explanation of this is, repeated flexing of the bearing metal with resulting fatigue. The first sign of failure appeared as a small crack in the lining metal and this would continue and extend until most of the babbitt in the high pressure area was loose and broken in small pieces. If this condition was not detected, the detached pieces pounded out, interfering with lubrication, causing excessive heating and final complete collapse of the bearing. Cracking never occurred in the bottom half of the bearing and the main bearings were also practically trouble free. It was realized, however, that the improvement which would correct the trouble with the heavily loaded bearing would also correct the tendency toward weakness in the other bearings. This investigation covered a period of several years and related to a complete line of engines in which the piston speeds were 15 to 18 hundred feet per minute, the rubbing speeds of the big end bearings 15 to 21 feet per second, and the connecting rod loading 2,200 to 3,200 pounds per square inch. As a consequence of the poor results obtained from the bearings in the early days, attempts were made to manufacture bearings in the railway

shops. At first these were not very successful, but the use of a special babbitt with a high lead content together with improved practice regarding its application, has resulted in bearings which operate for an average of about 100,000 miles without replacement.

Those of us who have had to deal with the application of bearings in diesel engines where the load and working conditions are severe, think at once of the proper application of the metal as an important factor, and as this brings up other points where tin could be conserved they will be dealt with briefly.

We learned of certain fundamental essentials which must be observed if a reliable bond is to be obtained between babbitt and steel or babbitt and bronze, the neglect of any of which will produce unsatisfactory results.

(a) It was found that thick layers of babbitt were not as efficient as thin layers and the thickness of 1/32 in. even on a large shaft seemed to be adequate.

(b) Although a sand-blasted metal surface may appear clean to the eye, in reality it is coated with a thin film of foreign material which must be cleaned further with chemicals before it can be tin-plated successfully.

(c) The steel or bronze surface must be absolutely clean and bright before tinning, free from any oxide or foreign matter.

(d) The tin-plated steel or bronze base metal, must at the time the babbitt is poured, be at a temperature higher than the liquefaction temperature of the tin (or tin alloy), in order to secure amalgamation of the tin with the molten babbitt.

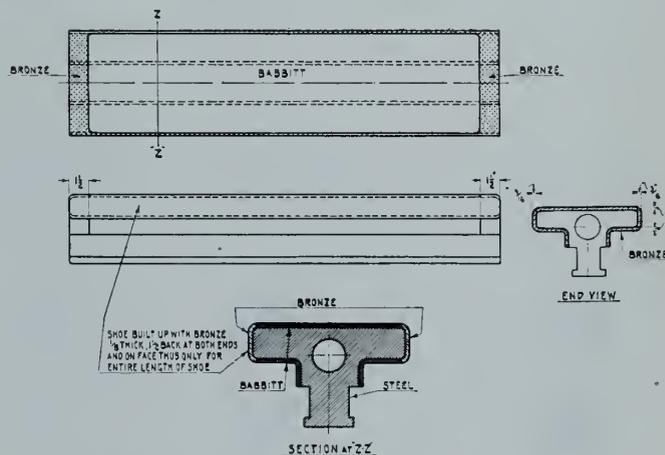


Fig. 5—Method of applying bronze in crosshead wearing face to prevent breakage at edges of arsenical-lead babbitt.

(e) The tin-plate surface must be free from any oxides at the time the babbitt is poured.

(d) A clean steel, bronze or tin-plate surface can finally be assured only by cleaning with the proper flux. The flux, to be effective, must be applied immediately prior to the succeeding operation.

(g) It is advisable to allow the shortest time interval possible between the tinning and pouring operations.

It is recognized that several of the foregoing statements are widely known fundamental precepts for securing a successful babbitting job, but the degree of skill with which they are carried out is of the most vital importance.

The effect of each of several variables involved in the various steps necessary in the pouring babbitted bearings, was studied and evaluated. By changing only one variable during each successive run its individual effect was determined, with the result that by combining or rejecting various variables, a babbitting procedure was developed which resulted in a strong bond.

It was quite evident that tin base metals would adhere



Fig. 6—Failure in high-tin base babbitt bearing.

more easily than lead base combinations. However, when the proper conditions for the application of the lead base metals were established, the bond was actually stronger than with the various tin base babbitts employed heretofore. It was always easier to get a stronger bond with bronze than with steel, and in connection with the bronze it was learned that phosphorus content was found to be unsuitable for the application of lead base babbitt and the best results were obtained with a composition as shown in Table II.

TABLE II

Element	Babbitt Per Cent	Lead-Bronze Per Cent
Copper.....	1.00	77
Lead.....	78.75	15
Tin.....	1.25	8
Antimony.....	18.00	—
Arsenic.....	1.00	—

The application of babbitt to the wearing surfaces of locomotive crossheads is important, both from the quantity of babbitting metal involved and also because of the rather abusive conditions to which this part is subjected. High

speed diesel engine bearings are examples of enclosed operation under flooded lubrication conditions, whereas the crosshead of a locomotive involves sliding action under abrasion with a certain amount of impact and uncertain lubrication.

For many years, babbitts with high tin content, similar to the first item on Table I, were used and the early experiences with arsenical lead babbitt in this application were not entirely successful. There was a feeling that the good ductility of the No. 1 babbitt was necessary. However, a careful consideration of the nature of the failures when No. 3 Durite was used, led to important changes in the crosshead shoes, and finally the development of No. 5 babbitt and improvement in the babbitting process gave the desired results. The arsenical lead babbitts are considerably harder than high tin alloys and there may be a tendency for breaking at the unsupported corners or edges, especially in applications subjected to impact. This appeared to be the case regarding locomotive crossheads and the edges and ends of the shoes were built up by depositing bronze to provide an edge to take the shock and support the babbitt. The bond was also improved as a result of the bronze and this was a factor in obtaining successful operation with No. 5 babbitt which has about 92 per cent lead.

The writer feels that the matter of slight changes in wearing parts, such as the above examples, is likely to be interesting to those contemplating the use of these alternative alloys. We can hardly expect that all applications will be entirely successful at first and it may be necessary to carefully examine the results of the early efforts to determine the improvements which will permit of a drastic reduction in the use of tin.

The wearing parts of crossheads are rebabbitted many times and the dirty and oil saturated metal of these used parts has to be dealt with. These require a more careful cleaning, the use of stronger fluxes and greater care in securing a properly tinned surface before babbitting.

The summation of our experience indicates that alternative bearing metals and alloys are available, and considerable reduction can be expected in tin consumption by extending the use of these to the large variety of bearings which do not have a particularly high velocity load factor.

In the majority of cases, it is a definite advantage to have a thin, rather than a thick, layer of bearing metal and this should result in a further conservation of tin.

Investigation into babbitting procedure, to provide a more perfect bond, will undoubtedly prolong the life of bearings and thus effect a saving in tin.

It is hoped that the review of our experiences in changing over from tin base bearings on the examples above mentioned will be of some value to others who are now faced with this problem.

## ALTERNATIVE BRONZES

G. E. TAIT

It is now well known that there is only a limited supply of tin available for Canada and that this must be conserved for applications where its use is essential to the successful prosecution of the war.

The title of this paper, "Alternative Bronzes," was selected with a purpose. To many people the word "substitute" means using something inferior and they hesitate to change from a conventional material.

It seems appropriate to quote from an editorial entitled "The Shadow of Ersatz" which appeared in "Light Alloys" for May, 1942.

"As was foreseen in Germany and Italy seven or eight years ago, no matter what the problem may be, what the machine must do or how it must do it, there is always more than one way of constructing and designing it.

"For privileged nations and privileged industries, the

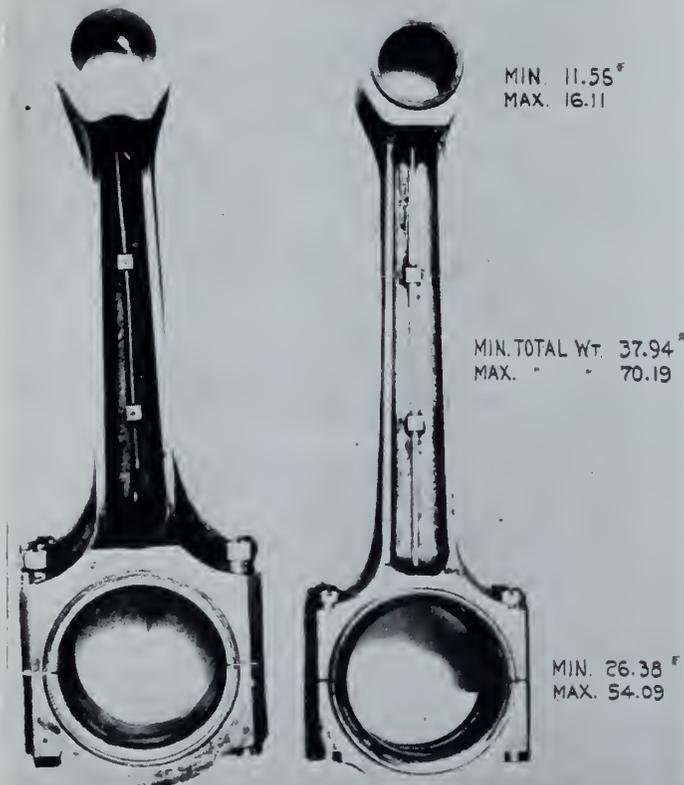


Fig. 7—Original (high-tin babbitt) and improved (arsenical-lead babbitt) design for connecting rod bearings.

easiest way lay in the choice always of the finest materials, conferring, as it were, ante-natal factors of safety proof against all minor errors of design and misapplications in use which are to be expected. But when plant is born under such conditions that its creators know from the beginning that there will be no silver spoon in its mouth, then solid hard thinking must be done.

"The designer or constructor who 'believes' that he cannot do without this or that material is, in a sense, guilty of an insidious form of sabotage. If the machine be required and a traditional material for its construction be not available, then some other composition must replace that which is lacking.

"Again, it is true that, for a number of jobs, one material and one only appears to offer any possibilities of utilization. For much work, however, tradition alone decides whether this or that shall be used. The first reaction to substitution, or, to use a better word, 'replacement,' is that the newer material is considered an understudy to that formerly used; in other words, it is somewhat inferior.

"This attitude is wrong and certainly in no wise contributes to the efficiency required for the successful waging of total war. It appears essential that for self-sufficiency to be progressive it must not be considered as a type of sublimated improvisation. Alternatively, improvisation must be given a higher social status than at present it possesses."

In the field of cast bronzes there are many applications where the use of tin can be dispensed with entirely and many more where the quantity used can be reduced. Also there are certain applications for which we have as yet found no satisfactory alternative to tin bronzes. However, as the development of the alternative bronzes proceeds, these problems are being solved.

It is not intended to go very deeply into the characteristics and properties of these alternatives as this information has been presented in some very complete papers by T. E. Kilgren <sup>①</sup>, H. J. Roast and E. G. Jennings <sup>②</sup>, A. E. Cartwright <sup>③</sup> and others.

In addition to this information the manufacturers of the alloys used as alternatives to gunmetal have available considerable data on their manufacture, properties and applications. As our knowledge of these alloys is steadily increasing, engineers can obtain up-to-date information from this source when considering suitable applications. It must always be kept in mind that the suitability of an alloy for a certain casting depends to a large extent on the design of the part and its operating conditions. It follows, therefore, that the selection of suitable alternative materials calls for close co-operation between the metallurgist and engineer, and an appreciation of all the factors involved.

Large tonnages of cast bronzes are used in ordnance and marine work, and it is the purpose of this paper to discuss the savings in tin bronzes which can be made in these fields. Many of the remarks will also apply to general engineering applications.

In these fields practically all castings were originally specified as manganese bronze or gunmetal. Manganese bronze is essentially an alloy of copper with 25 to 40 per cent zinc and small amounts, generally under 3 per cent, of iron, aluminum and manganese. The exact proportions of these elements vary widely, depending on the physical properties required and the preferences of the manufacturer. Tin is frequently added in amounts from .25 to 1.0 per cent, principally for the purpose of increasing the yield strength. The same effects can be obtained, however, by varying the other elements, and very satisfactory manganese bronzes are being made which do not contain any tin. Tin-free manganese bronzes can be used as alternatives to copper-tin bronzes under certain conditions to be discussed later.

Gunmetal, essentially an alloy of copper and tin, is made to a variety of specifications. One widely used on war work is B.S.S. 383 specifying approximately 88 per cent copper, 10 per cent tin, 2 per cent zinc, with a maximum of 0.5 per cent lead and 1.0 per cent nickel. The minimum tensile strength is 36,000 lb. p.s.i. and the elongation in 2 in. is 12 per cent.

When it became apparent that we were going to be short of tin the main question was to decide on the most satisfactory alternative for gunmetal. As a matter of fact, there are several satisfactory alternatives from which to make a selection.

While the object of this paper is to discuss those special alloys which differ considerably in some respects from gunmetal, and incidentally effect greatest savings in tin, it might be as well to briefly mention others to which it is more closely allied.

For a number of years the alloy 88 per cent copper, 8 per cent tin and 4 per cent zinc has been used in the United States. It has been applied for the same purposes as the 88-10-2 used by British manufacturers and found to be equally satisfactory for practically all purposes. It has the further advantage of being easier to manufacture.

While the 88-8-4 alloy could be applied to cases where the use of gunmetal is considered essential, it cannot be truly classed as an alternative bronze because of its high tin content.

For a great number of applications the specifications have been changed from 88-10-2 by reducing the tin and raising the limits on lead and zinc. In many cases nickel is added up to about 2 per cent to compensate for the lower tin and maintain the strength. Typical alloys being used are 79 per cent copper, 5 per cent tin, 9 per cent lead, 5 per cent zinc, 2 per cent nickel; and 85 per cent copper, 5 per cent tin, 5 per cent lead, 5 per cent zinc.

Such alloys preserve many of the characteristics of gunmetal and will give satisfactory service on many applications. The tensile strength is usually above that specified for gunmetal, 36,000 p.s.i., although actually these alloys are a little softer and will not pass the specification by such a wide margin as good gunmetal. From the foundry angle they are by far the easiest to handle of the alternative bronzes.

When surfaces are in rubbing or sliding contact, as in the case of bearings, alloys of this type offer the most satisfactory alternative to gunmetal available at present. In fact in some cases, particularly where lubrication may be inadequate, they will prove superior to gunmetal.

These alloys are made largely from secondary metal, of which the supply is limited. It is therefore desirable to use one of the tin-free bronzes wherever the characteristics of the alloy will meet the operating conditions.

The principal alternatives to gunmetal, outside of the two types mentioned above, are as follows:

1. Silicon bronze.
2. Manganese bronze.
3. Aluminum bronze.
4. Nickel bronze.

The silicon bronzes are alloys of silicon with one or more other elements in small amounts and copper. They are available in several types, distinguished by the other principal element present. While the silicon bronzes as a class can be compared with the other alloys listed, each type possesses certain characteristics of its own which may make one more suitable than another for a specific application.

Silicon bronzes are sold under a variety of trade names for reasons best known to their manufacturers. The principal types and the more widely known trade names are the following:

- a. Iron-silicon type . . . . . PMG and Cansilloy
- b. Manganese-silicon type Everdur
- c. Zinc-silicon type . . . . . Tombasil and Olympic Bronze
- d. Tin-silicon type . . . . . Hereculoy

While silicon bronzes have only recently been brought to the fore, they are not a new development. Some of the types date back to the Great War. They are being widely used in place of gunmetal, and with certain exceptions to be discussed, they are highly satisfactory.

Manganese bronze has been mentioned before. It is an old established alloy and its characteristics are generally well known.

Aluminum bronze is an alloy of copper with approximately 10 per cent aluminum. Iron is usually included in amounts up to 3 per cent. It is also an alloy which has been well known for a number of years and used successfully for numerous applications. The fact that it has not been more generally applied is due to the foundry difficulties encountered in making castings.

Nickel bronze contains approximately 88 per cent copper, 5 per cent tin, 5 per cent nickel and 2 per cent zinc. It is generally regarded as a gunmetal in which 5 per cent of the tin is replaced by 5 per cent nickel, but its characteristics and properties are considerably altered by the substitution.

In applying any of the above alloys as an alternative to gunmetal, or in fact any regular bronze, most consideration should be given to the manner in which the alloy will behave in service. As far as tensile strength, hardness and resistance to impact are concerned, all four alloys possess properties superior to those of gunmetal. Therefore in applications where strength and toughness are the principal requirements, any of them can be used. Such applications are brackets, bases, gear boxes, levers, cranks and hand-wheels.

Machinery bearings represent probably the largest single application for bronze castings, and it is in this field that some care is required when selecting an alternative material.

Gunmetal is widely used for bearings in English practice, though not as highly regarded as a bearing metal by engineers in this country. Our usual practice is to use a leaded phosphor bronze, an alloy of 80 per cent copper, 10 per cent tin and 10 per cent lead being considered one of the best. As mentioned above the best alternative bearing metals are tin bronzes with the tin content reduced to around 5 per cent. These alloys are softer than the conventional ones but will give satisfactory service for most applications.

None of the four bronzes mentioned as alternatives to gunmetal possess comparable properties as a bearing material. The nickel bronze is the closest to gunmetal, and this material as well as aluminum bronze and some of the silicon bronzes can be used for bearings under certain conditions. Suitable applications are where loads are light and adequate clearance and lubrication can be provided. Design of oil grooves should receive special attention.

Manganese bronze is not suitable for bearings.

There have been some reports of good results being obtained with an iron-silicon bronze containing 0.5 per cent lead, but the limitations of this material have not yet been published.

Bronzes used for worm gearing must possess the same general characteristics as a bearing metal, plus high strength and resistance to fatigue. While all four of the alternative bronzes give satisfactory results if the operating conditions and loads can be arranged to suit their limitations, none of them can be considered as replacing the phosphor bronzes usually used.

Mr. Chester B. Hamilton <sup>④</sup> has done considerable work on this problem during recent months and announced the

development of a couple of promising alloys for this work. One is an alloy of 90 per cent copper, 8 per cent antimony and 2 per cent nickel. The other contains 90 per cent copper, 5 per cent nickel, 3 per cent silicon and 2 per cent silver.

In marine work corrosion resistance is always a factor to be considered. The manganese, aluminum and nickel bronzes all have satisfactory resistance to sea water.

As far as the various silicon bronzes are concerned, there seems to be insufficient data available on which to base conclusions as to their performance. The U.S. Navy has used large tonnages of some of the silicon bronzes in previous years, but the specific applications and results obtained do not appear to be generally known. From the information presently available it would appear that the silicon-manganese type is one of the best for resistance to sea water corrosion.

Gunmetal has been widely used for pressure castings although it is not an ideal alloy for the purpose. Where the use of a tin bronze is necessary better results will be obtained and a saving in tin effected by the use of alloys such as 85 per cent copper, 5 per cent tin, 5 per cent lead, 5 per cent zinc; or 88 per cent copper, 4.5 per cent tin, 1.5 per cent lead, 4.5 per cent zinc, 1.5 per cent nickel.

Excellent pressure castings can be made in any of the silicon bronzes, although consideration should be given to the remarks following on foundry technique, and an alloy selected from which sound castings can be poured with the least trouble.

Manganese and aluminum bronzes make good pressure-tight castings provided that they can be obtained free from porosity and dross. Both of these alloys have a characteristic of forming large quantities of dross during the pouring. This dross gets trapped in the casting and causes leakers. For this reason these alloys are not widely used for pressure castings.

Good pressure castings can be made in the nickel bronze although some foundries have had trouble with porosity. This appears to be chiefly due to the melting practice employed, as the nickel bronze has a greater tendency to pick up gases in the furnace than some of the other bronzes. Good melting furnaces and attention to the recommended procedure for this alloy is necessary.

In selecting an alternative to gunmetal for any particular casting, the foundry technique required must be considered. The average foundryman is familiar with gunmetal, and the gates, risers, and melting technique required. The four alternatives being discussed vary widely in shrinking characteristics and drossing tendencies, and the foundry practice must be modified to suit.

The nickel bronze is the easiest to make, although the melting practice does require some attention. The International Nickel Company has developed a melting procedure for this alloy which should be followed as closely as possible. Considering the moulder's problems, gates and risers only need to be increased slightly, and the alloy has no more tendency to form dross than has gunmetal.

Manganese bronze, and to a still greater extent, aluminum bronze, both present difficulties in the foundry due to their high liquid shrinkage and tendency to form dross when the metal is agitated. Patterns to be cast in these alloys must be made with a greater allowance for contraction than on ordinary bronze. Also machining allowances should be increased by as much as 50 to 100 per cent so that dross on the surface can be machined off. Special provision will usually have to be made for the adequate feeding of heavy sections by the use of risers or chills.

As far as foundry difficulties are concerned, silicon bronzes are generally regarded as midway between gunmetal and manganese bronze, although they tend to act

more like manganese bronze. Extra precautions should be taken to trap dross and to feed heavy sections when changing from gunmetal to silicon bronze.

The melting and pouring practice should be carefully controlled on silicon bronzes, as they are rather more sensitive to variations in temperature than the ordinary alloys.

The different types of silicon bronzes have different founding characteristics. Experience with the iron-silicon, manganese-silicon and zinc-silicon types indicates that the manganese-silicon and zinc-silicon types have the least liquid shrinkage, and therefore require less provision for feeding than the iron-silicon type. The zinc-silicon type possesses the greatest fluidity and is therefore the best for thin-sectioned castings. On the other hand, the zinc-silicon alloy forms the most dross, a characteristic which may lead to trouble on complicated castings.

While the characteristics of nickel bronze, 88-5-5-2, have been discussed as an alternative to gunmetal, it has been included chiefly because it is mentioned in several specifications. From the point of view of metal conservation it is not a satisfactory alternative, in spite of being the easiest to make. This is because its manufacture requires the use of 5 per cent virgin tin and 5 per cent nickel, and we are trying to save both of these materials.

Since the tin shortage developed, there have been numerous changes in specifications made by the naval, army and air force authorities.

For certain types of equipment blanket permission has been given to use an alternative such as silicon bronze wherever gunmetal was specified. In other cases various alternatives are approved for different castings, depending on the operating conditions each will encounter in service.

For army ordnance and aircraft applications there were some specifications such as the T3-A already in effect, which permitted the use of the iron-silicon bronze as an alternative to gunmetal. In a number of individual cases, the use of an alternative material has been approved where the specifications originally called for a copper-tin bronze. Further consideration should be given towards making the use of alternative bronzes more general in this class of work, however.

Instructions have been issued by the British Admiralty Technical Mission, that on castings for naval gun mounts, no tin is to be used except with special permission. The various types of silicon bronze are being used for most applications, although in some cases, manganese bronze, malleable iron or cast steel are considered suitable.

The use of phosphor bronze is generally being continued in worm wheels and bearings. However, for some bearing applications alloys such as 85-5-5-5 have been approved.

On castings for anti-submarine apparatus permission can be obtained to use any suitable alternative, depending on the function of the particular part.

For naval vessel machinery coming within their jurisdiction the British Admiralty Technical Mission has approved the use of the red brass alloy 85-5-5-5 for valves and similar pressure castings. The same alloy and others like it may be used for bearings and similar applications. The nickel and manganese bronzes may be used for such parts as the shells of babbitt-lined bearings, and other parts

where bronze is used on account of its corrosion resisting properties or toughness. The use of silicon bronzes for these applications is also to be developed.

The Royal Canadian Navy has approved the use of three alloys for valves and similar castings. These are 89 per cent copper, 5 per cent tin, 1.5 per cent lead, 4.5 per cent zinc; the 85-5-5-5 red brass and the nickel bronze 88-5-5-2. These alloys may not be used indiscriminately, however, as maximum limits have been set on the pressures and temperatures at which they may be used.

For most unlined bearings 85-5-5-5 can be used as an alternative to gunmetal. Castings for lined bearings and other parts where mechanical strength is the main consideration may be made of one of the silicon or manganese bronzes.

With the proviso that it shall not be used for bearings, aluminum bronze may be used wherever gunmetal was formerly specified. It will usually be more practical, however, to use one of the other alloys due to the foundry difficulties in making good aluminum bronze castings.

In the cases where the use of gunmetal is considered essential on Canadian naval vessels, the 88-8-4 alloy may be used instead of 88-10-2.

For the machinery of cargo vessels a bronze containing 79 per cent copper, 5 per cent tin, 9 per cent lead, 5 per cent zinc and 2 per cent nickel is to be used for all bearings and rubbing surfaces. For the majority of other castings, manganese bronze may be used instead of gunmetal.

This list of alternatives is not intended to be complete, but merely shows the progress that has been made in arranging for the use of alternative bronzes.

It is desirable that the use of other alloys for gunmetal shall cause as little dislocation to the manufacturing processes as possible. While approval of certain alloys has been published for a number of specific applications, the manufacturers have been invited to study the equipment which they are making in the light of their own experience and facilities, and suggest suitable alternatives to the specification authorities concerned. It has been the author's experience, that while all suggestions cannot be accepted, any means of saving tin will be considered.

There is a need for further study of the problems involved in making bronze without tin. Our knowledge of the characteristics of the newer alloys is not yet complete, and there is much work to be done in the development of a tin-free alloy for parts such as bearings. The solution of this problem is not an impossibility, and will contribute much towards our war effort.

#### REFERENCES

- ① Production and Properties of Age Hardenable 5% Nickel Bronze Castings. . . . . T. E. Kilgren  
Transactions American Foundrymen's Association—1938.
- ② Foundry Practice with Copper-Silicon-Iron Bronzes. . . . .  
H. J. Roast and E. G. Jennings  
Transactions American Foundrymen's Association—1941.
- ③ Alternatives to Tin in Cast Bronzes. . . . . A. E. Cartwright  
Paper presented before the Montreal Chapter, American Society for Metals and reprinted in Canadian Metals and Metallurgical Industries—April 1942.
- ④ Tin-free Bronzes for Worm Gears—  
Canadian Metals and Metallurgical Industries—July 1942.

# PSYCHOLOGY AS APPLIED TO ENGINEERING

CHARLES SAMUEL MYERS, C.B.E., M.A., M.D., Sc.D., F.R.S.  
Principal of the National Institute of Industrial Psychology, England

James Forrest Lecture delivered before The Institution of Civil Engineers, London, Eng. on January 13th, 1942  
and published in the February issue of *The Journal of the Institution*.

NOTE: This address is reproduced through the courtesy of the *Journal of the Institution of Civil Engineers* and at the request of the Engineering Institute Committee on Industrial Relations, for the benefit of our members. In the words of the president of the Institution, the James Forrest Lectures are "designed to give members an opportunity of absorbing the wisdom of authorities on subjects which, although related to engineering, might perhaps be a little outside the everyday path trodden by engineers when pursuing their normal activities." The author, Dr. Myers, is the outstanding authority on industrial psychology in Great Britain.

## INTRODUCTION

The first of the annual James Forrest Lectures, established in honour of one who, throughout a period of 58 years, was successively Secretary and Honorary Secretary to this Institution, was delivered in 1893. That which I am privileged to give to-day would therefore have been the fiftieth lecture of this series, had it been continued every year without interruption. By a strange coincidence this year signalizes also the jubilee of the teaching of one of the youngest branches of natural science in Great Britain: the first systematic course of instruction in this country provided in experimental psychology was given likewise in 1893, by the late Dr. W. H. R. Rivers at Cambridge. Of course, the study of the human mind dates from much earlier times, but it was then seldom undertaken in an experimental manner. Contemporary knowledge of psychology had also long before been applied—but again not by scientifically controlled methods—to relevant problems in the fields of medicine, education, and aesthetics.

## AESTHETICS AND ENGINEERING

To aesthetics, in its psychological relations to engineering, I first turn, partly because the Institution of Civil Engineers has of late shown a special interest in this subject, realizing more fully than before that it is a function of the engineer to provide the community with objects which are not merely useful and efficient, but are also, as far as possible, beautiful in appearance and in harmony with their surroundings. I have given this subject first place in my Lecture also because the psychologist has long been engaged in endeavouring to ascertain—it must be admitted with far from complete success—the nature of beauty and the conditions, both mental and environmental, under which our individual experiences of beauty occur.

The psychologist has come to recognize the unique, specific nature of beauty, and, at the same time, its several varieties and the vastly different kinds of "objects" that may evoke it, these "objects" ranging from a warm bath, a glass of vintage port, a surface of uniform colour, an expert's bodily movements, a moral act or state (for example, of heroism, forgiveness, love, or gratitude), a mathematical solution, a scientific experiment, a bridge, engine or machine—ranging from all these to a picture, statue, building, symphony, opera, ballet, piece of prose, poem, or drama. Every one of them may, under certain conditions, be experienced as beautiful, endowed with sensual, perceptual, intellectual, or moral beauty according to the nature of the "object."

What is merely agreeable or pleasing is, of course, not necessarily beautiful: indeed probably by large numbers of people beauty is but rarely—at all events intensely—experienced. They often confuse beauty with other, humbler, experiences such as prettiness; or they may apply to an object the term "beautiful" not because it does, but because it might, arouse the feeling of beauty, just as a

given situation is often termed "interesting" without at the moment actually exciting interest. And what appears to us as constructed with amazing simplicity or technical perfection, or as frankly and clearly expressing the function for the performance of which it has been designed—this also is not necessarily beautiful. Our experience of beauty seems to depend rather upon the presence in us of a specific "aesthetic" mental "set" or "attitude," of the nature and conditions of development of which we know as yet little. We can, however, at once recognize one psychological result of that attitude, namely, our projection of the feeling of beauty into the external object that has evoked it, so that the beauty seems to us to reside in that object and not, as it really resides, in ourselves in consequence of our internal mental activity. Herein beauty differs from most other feelings; for example, we do not regard our emotions of fear or anger as resident in the external object or situation that provokes them.

It is true that we may enumerate in the physical world certain aesthetic "principles," for example, of formal proportion, balance, rhythm, harmony, symmetry, contrast, and unity—even mathematically describable relations—which experience shows to be favourable for the arousal of perceptual beauty. In a certain sense, therefore, but with little regard for strict accuracy, the perceived object may be said to carry to the percipient potentially a "message" of beauty. In some respects these aesthetic principles resemble the metrical and other classical rules of poetical composition: they may all be obeyed and yet the object may fail to evoke beauty, partly because obedience to rules may be aesthetically insufficient or even unnecessary, and partly because the percipient lacks that peculiar aesthetic set or attitude in which alone the actual experience of beauty is possible. Beauty, therefore, cannot be assured by specified external devices: indeed—alike in creation and in appreciation—it may come to us unsought through unpremediated mental activity.

Adopting this aesthetic attitude, we frequently also project, besides beauty, other of our experiences into the "object." We come to endow it with other human qualities and characters, to "personalize" it and to regard it as something existing, as it were, for itself alone—that is to say, as an independent, self-active "subject," rather than as an inanimate "object" of practical worth. Thus we may ascribe to it the human traits of dignity, sincerity, joviality, daintiness, etc. (or the reverse). In this sense it has been said<sup>1</sup> that we "distance" the art-object. And having thus "distanced" it, we proceed, to a varying extent, to become aesthetically "absorbed" in it, to steep ourselves in it—it may be to lose ourselves so completely as to fall into a state bordering on ecstasy.

These acts of "distancing" and subsequent "absorption" are only perfectible when all notions of the serviceableness of the object to us are banished. The sense of beauty, for example, felt for the fair body of a nude woman tends to disappear as soon as sexual desires are roused. So, too, we come to regard the architect as a craftsman rather than as an artist, when the use and purpose of his building for our own ends obtrude themselves too strongly. On the other hand, when we "personalize" the art-object; when we treat it as an independent "subject" endowed with human characters; when, for example, we think how gracefully, majestically, or easily an engineering product fulfills its

<sup>1</sup>Edward Bullough, "Psychical Distance' as a Factor in Art and an Aesthetic Principle," *Brit. J. of Psychol.*, vol. v, pp. 87-118 (1912).

own life-like functions; such thoughts may well conduce to the experience of beauty—as indeed, conversely, will the realization of its unfitness impede the experience of beauty. Their help is clearly illustrated in the beauty that can readily be evoked in us by the modern locomotive, the modern aeroplane, or the modern motor-car, especially when contrasted with their earlier and more clumsy forms. In the evolution of the present designs of these objects, generations of engineers have, usually at least, had no aesthetic interests. They have merely employed with increasing success the most efficient material that they have available, in fitter, neater, and more economic ways, gradually eliminating needless excrescences and obtaining the maximum of power and function with apparently the minimum of effort, whilst at the same time unwittingly improving the form of their structure as they “feel” more intimately and with greater knowledge—even “feel themselves into”—the properties, possibilities, and demands of their everchanging medium which, in so far as such self-subjection occurs, becomes, in a sense, their master.

If, as I have urged, the scientific or practical and the aesthetic attitudes are simultaneously inimical to one another, the engineer may escape from this difficulty by designing a structure initially from the engineering aspect, and then submit his design to the architect, asking him—or he may himself consider sooner or later—what changes in form are desirable in order to make it at least more agreeable to the eye. But the dangers of such patchy, last-minute “tinkering” are avoidable if the architect and the engineer are in close, uninterrupted partnership from the start, or if the engineer has some aesthetic “talent,” or often merely a knowledge of aesthetic principles and some experience of their use. Then, by repeated oscillations between the two attitudes, he will receive some aesthetic guidance throughout the development of his original design. More or less intuitively, but also in part deliberately, he will far better succeed in producing a structure that is both efficient and, at least, not unsightly: he may indeed produce one that appears even beautiful to himself and others.

Alike in the creation and in the appreciation of the beautiful, the development of the aesthetic attitude depends partly also upon other and deeper unconscious mental activities of which at present we have far from complete knowledge. These play a specially important role in the creation of the beautiful. Ordinarily it results, as I have just said, from the more or less intuitive or deliberate use of aesthetic *talent*. But artistic creation arises also as an unexpected uprush of aesthetic *genius* from the unconscious—a sudden “inspiration,” as we call it. If the engineer is endowed with this creative genius of the true artist, he will have long ruminated consciously upon the scientific conditions and practical needs that have to be satisfied in his intended structure; and then, after a period of “incubation,” he will suddenly receive an inspiration of beauty that reveals the form which his design should take. Like other artists, he will thereupon set himself skilfully to express his inspiration, paying due regard to the properties and limitations of his “material” and to practical needs of other kinds. These, of course, differ widely in kind and complexity for the engineer from their significance for the painter, sculptor, poet, or musician.

Although they are simultaneously inimical to one another, we may oscillate, as I have indicated, between the scientific or practical attitude, on the one hand, and that of aesthetic appreciation, on the other. Therefore their incompatibility does not justify us in regarding the aims of engineering and aesthetics as belonging to two distinct vocations. For better or for worse in its long history, artistic production has usually had to serve two masters, the artist who is “out” for self-expression and for “art for art’s sake,” and the receptive society in which he lives. There are many well-known instances where the artist’s products have been unintelligible to his own generation, hide-bound by social culture, tradition, and convention; and their beauty, there-

fore, has not been appreciated until later. But in other ways the artist has always been called on to render social service. In prehistoric times the marvellously beautiful cave-paintings of animals were in all probability designed with the magical purpose of obtaining food. In mediaeval times artistic creation often served, under Church patronage, a religious purpose. At the present day social needs demand the co-operation of artistic and engineering ability. In their abstract forms, the conflict between art and science must be eternal. Just as the pure scientist carries out his laboratory research regardless of its social value, so the pure artist will work solely for his “selfish” expression. But in the more applied, social, forms of art and science, a compromise must be somehow effected without too serious loss to either.

It is true that a knowledge of the principles of aesthetics will not make the engineer an artist unless he be endowed with aesthetic creative ability—with aesthetic “genius” or merely “talent”; but neither will a knowledge of pure and applied physical science suffice to make him an engineer unless he have innate engineering ability—of which I shall have something to say later. The engineer cannot therefore regard aesthetics as something quite foreign to his own profession. For its welfare and ethical development humanity demands from him more than his merely mechanical utilization of the pure and applied physical sciences. This alone is no longer adequate for the satisfaction and contentment of the community—any more than the community is satisfied to-day with the old notion that the function of a successful business concern is merely to provide a fortune for its owners and a living for its employees. It may not always be easy to make, say, a gas-holder or a petrol-pump beautiful; but every product of the engineer can be so designed that at least it presents not an unpleasing appearance in itself, and one that will harmonize agreeably with the environment in which it is to be set up.

#### THE MACHINE AND ITS OPERATIVE

From the psychology of aesthetics I pass to a problem which concerns the youngest branch of applied psychology, known as industrial (or, more accurately, as occupational) psychology, in its relation to engineering. However efficient from the mechanical standpoint, machines and implements designed for industrial use may nevertheless be unsatisfactory from the standpoint of the physical health and fatigue of the operatives and of the ease and comfort of their work. Curiously enough, this defect is less common in machines devised for the use of the general public or the highly skilled expert, for example, the motor-car, the aeroplane, and, I am informed, engineering machine-tools, with the use of which the designer is himself familiar. The engineer needs, however, to pay more consideration to the “human factor” in his design of machines for the factory, where the operatives, very often women, are semi-skilled or virtually unskilled—especially in the case of machines used in the textile industry, boot-and-shoe manufacture, box-making, tobacco-cutting, laundry work, etc.

One of the commonest defects here encountered is the unsatisfactory position or action of the pedal, the operative being forced to sit in a contorted posture to use it, or the pedal descending with rapid acceleration to a sudden stop which sends a harmful jar, with each such stoppage, through the limb and body of the operative. Another equally common defect is the wrong position of controlling levers of the machine, which may be placed needlessly distant, thus involving a fatiguing stretch of the operative’s arm in order to reach them. Often, too, the appropriate height of the working-level is neglected: the feeding-end of the machine may be too high for the comfort and efficiency of the operative, necessitating the use of steps; or the delivery-end may be too low, causing needless stooping. Again, the engineer may fail to consider in his design the height to which heavy raw material will have needlessly to be lifted

on to the machine by the operative, or the equally avoidable noise and vibration to which he will be subject.<sup>1</sup> Psycho-physiological considerations of this kind may clearly call for closer collaboration between the engineer-designer and the industrial psychologist.

#### THE PHYSICAL ENVIRONMENT OF THE OPERATIVE

There is not infrequently need also for such collaboration in problems that confront illuminating, heating, and ventilating engineers. For here again various factors of a psycho-physiological nature affect the success of their work. Satisfactory illumination, for example, depends not merely upon physical candle-power or lumen-output, but also upon appropriate spacing of the lamps in relation to the position of the operative, upon the absence of glare, glitter, contrast, and shadows, upon adaptation, etc.

#### ENGINEERING AND MANAGEMENT

It is not surprising if, until quite recently, the engineer has tended to neglect the "human" aspects of his work. Not so many years ago in this country, the professional engineer was interested mainly in his own ideas, in formulas and diagrams, and in invention and design, concerned with lifeless material and mechanisms. Save in relations with his client, when, of course, clear disinterested exposition, persuasive powers, and regard for the latter's interests are of prime importance, the "human factor"—the thoughts, feelings, and actions of his fellow-beings—relatively seldom occupied his attention. Through environment and habit, and doubtless by inherited inclination, his mental "type" must have approximated to what is now (rather loosely) called "introvert" by the psychologist. The introvert is one ego-centrally "wrapped up" in his own fantasies and ideas, averse from making social contacts, self-critical, easily taking offence, and giving little immediate and outward expression to his feelings. By means of questionnaires, rating-scales, and even tests, psychologists have made frequent attempts to evaluate quantitatively the degrees and directions of introversion—or of its antithesis, extraversion—which different persons may exhibit. And some have aimed at thus giving objective proofs that certain occupational groups, especially engineers and scholars, are more introvert, less extravert, than other occupational groups, notably actors and salesmen. Accepting this distinction, one American psychologist, Dr. W. V. Bingham, has accounted for it on the ground that an "early introversion of personality leads to the development, *through disproportionate exercise*, of one's native interest in mechanism or ideas, at the expense of interest and proficiency in social contacts."<sup>2</sup> But a converse influence is also possible: introversion, or extraversion, may conceivably be, if not initiated, certainly fostered by an individual's innate occupational interests, with their different "drives" and talents. Or again, each may be fundamentally the effect of some common, hereditary, cause.

However this may be, the scope of the engineering profession is unquestionably far wider to-day than it has ever been before. And probably it demands, attracts, and turns out now men of more widely varying personality than formerly. Large numbers of engineers, especially in the United States, are now concerned with salesmanship, a subject to which psychologists have devoted considerable and valuable attention. Moreover, not only the engineering apprentice, but also the engineering undergraduate, tends in later years more and more frequently now to come into touch with administrative or managerial problems under

<sup>1</sup>Fuller details are to be found in Report No. 36 of the Industrial Fatigue Research Board, "On the Design of Machinery in relation to the Operator," by L. A. Legros and H. C. Weston; and in a Paper by G. H. Miles and A. Angles, "Psychology and Machine Design," Journal of the National Institute of Industrial Psychology, vol. iii, pp. 159-61 (1926).

<sup>2</sup>"Personality and Vocation," *Brit. J. of Psychol.*, vol. xvi, pp. 354-62 (1926).

State or Municipal employment or in public utility or private engineering works; here, it has been variously estimated, the chief engineer spends one-half or even more of his time in the human problems and details of Board and Committee meetings and of administration and management. And some of the various daughter-institutions of this Institution, in their respective examinations for Associate Membership (or Graduateship), now include papers in the fundamentals of industrial administration and/or in engineering organization and management<sup>1</sup>. In the syllabuses of these examinations the "human factor" is definitely mentioned<sup>2</sup>. A large proportion of engineer apprentices taking them already hold the Higher National Certificate in mechanical or electrical engineering; and evidence, of satisfactory attendance at these courses in administration, organization, and management can be endorsed on this Certificate. Courses in these subjects are to-day provided by the majority of the Technical Colleges in Great Britain, the Manchester College of Technology having been the first in this country to establish a department of industrial administration (in 1918), and carrying out post-graduate research in the application of the subject to engineering works. Some Colleges also offer one or two years' training in industrial administration to engineers and others who have been already engaged by an employer and are sent there by him for special instruction in business management.

I have read that a wall in the library of the vast building of the American National Engineering Societies bears the following legend:—"Engineering—the art of organizing and directing men and of controlling the forces and materials of nature for the benefit of the human race." In Germany, we were told as far back as 1929 "the teaching of management-subjects *under engineering auspices* is making rapid headway on every hand. Problems of industrial personnel are being approached through scientific research in psycho-technical institutes in the Technical Universities and with an intimate union of engineering and psychology, rather than as a personal art to be expounded by practical executives" (p. 231). "Researches on such problems are considered as properly belonging to the Technical Universities and requiring" the collaboration of engineers and psychologists (p. 259)<sup>3</sup>. In Great Britain, however, administration and management still seldom enter into the curricula of University engineering courses, and, as I shall show, little attempt has been so far made to bring engineering and psychology into relations with one another.

#### INDUSTRIAL PSYCHOLOGY AND SCIENTIFIC MANAGEMENT

The United States was the earliest country to realize the importance of managerial problems for the modern engineer. It was first stressed in that country by the late Dr. Frederick W. Taylor, an engineer of consummate genius, but signally devoid of tact, and by many others who have since endeavoured further to develop what Taylor called "scientific management" and are themselves now, especially in America, termed "industrial" or "efficiency" engineers. These "scientific managers" did some very useful pioneer work on the subject; but almost invariably they failed to pay sufficient regard to the *human* aspects of the problems which they attacked. They tended, from their engineering training and outlook, to regard the operative as a mere

<sup>1</sup>I gratefully acknowledge the ready help and useful information which I have here received from the secretaries of the Institutions of Civil, Mechanical, Electrical, and Production Engineers.

<sup>2</sup>In the syllabus prepared by the Institution of Production Engineers, this term occurs only in the preamble:—"The Council of the Institution feel that although one of the major problems of Production Engineering is that of the human factor... too little attention has been given to this important subject in the Curricula (*sic*) of Technical Schools. In certain Papers, therefore, some questions will be framed....."

<sup>3</sup>"The Investigation of Engineering Education." Bulletin No. 16 of the American Society for the Promotion of Engineering Education. The italics in this paragraph are mine.

machine whose efficient working was to be won through material considerations. They set about to discover what work the operative had to do and the one best and speediest way of doing it, treating him almost as if he were a "robot" mechanism, capable, as it were, of revolving at a uniform speed, in a uniform manner, throughout the hours of his working spell. Consequent on their researches in movement- (or motion-) study, they established "rigid rules for every motion," and they forced each operative into what they termed "the *one* best way of work," regardless of individual human differences that demand differences in the style of expert skill; he was thus allowed no freedom in carrying out the details of his operations. The industrial unrest and strikes produced by these and other unpsychological procedures are now well known; they persisted until, as an experienced American engineer has recently pointed out, "Management... finding that their introduction was always the signal for labour troubles, finally recognized that the problem was, in its essence, psychological<sup>1</sup>."

#### PSYCHOLOGY AND INCENTIVES

Such ignorance, or neglect, of psychological factors on the part of the "efficiency engineer" is again well illustrated in his attitude towards "incentives." Alike in America, in Great Britain, and elsewhere, the term came to be regarded—and indeed is still generally regarded—as equivalent to financial reward. Perhaps this arose from the adoption of the false psychology of the early economist—that in his business life man is actuated solely by the desire for monetary gain. In any case, financial reward, like movement-study, offered a subject readily amenable to measurement. And so, in the early days of "scientific management," Taylor and most of his successors busied themselves in devising many different and rival methods of payment, including "straight" and "differential" piece-rates, bonus and premium systems, "individual" and "group" piece-rate and bonus schemes, etc.

The fixation of the piece-rate, bonus, or premium depends largely upon the amount of pay that the operative may be expected to earn, and the latter involves time-study of the output that may be expected of him—again a subject easily amenable, it seemed, to exact measurement. But in reality the scientific methods of such time-study are only apparent. For after analysing the operative's movements and timing them to a small fraction of a second, the rate-setter has to add "allowances," as he calls them, for delays such as must inevitably arise owing to waiting for raw material or for inspection of the finished product, or because of occasional breakdowns of machinery or of rest-pauses voluntarily taken to dissipate fatigue, etc. But the size of these allowances can only be very roughly guessed at.

Few will deny the necessity and importance of financial incentives. But the psychologist has conclusively shown the complex causes of the demand for them and their uncertain effects. He has shown, too, that financial incentives are a dangerous, and not the most important, form of incentive. They tend, when solely stressed, to develop an atmosphere, inimical to good and loyal service, in which the employee is "out for himself," trying (as he imagines his employer also to be trying) to grab as much money from the business as he can—to *get* as much, and to *give* as little, as he can. Besides financial incentives, praise and interest in, and knowledge about, the work are at least of equal importance, and of psychologically greater value. These are all, however, in great part, "selfish" incentives. The psychologist has established the importance and effectiveness of "social" incentives. The operative is not to be regarded as a "lone hand" in his daily work, but as a member of an industrial group of fellow-workers which has its own psychological characteristics and its own codes of conduct profoundly affecting their every-day thought and act. As a member of

his group, the operative demands security of employment, congenial colleagues, and, above all, sympathetic treatment both by his immediate overseers and by administration and management generally. These comprise, perhaps, the most powerful incentives to efficient work.

Two further incentives are psychologically noteworthy—the willingness of managers to consider and to reward suggestions from the operative that make for more efficient and happier work, and their willingness to inquire into and to consider grievances, often unknown to them—some due to misunderstanding or rumour, but many well-justified and rectifiable. The industrial psychologist finds that the worker is influenced not so much by the actual satisfaction of his grievances as by the evinced willingness of management to investigate them. What the worker resents is indifference to the human and social outcome of mechanically planned administrative policy.

#### PSYCHO-NEUROSES AND OCCUPATIONAL LIFE

Such indifference cannot fail to produce general industrial unrest, due to mental worry, irritation, conflict, and maladjustment, which, if sufficiently severe, results individually in a condition of psycho-neurosis. There is no sharp line dividing the normal from the pathological features of these consequences. For successful management a broad acquaintance with this branch of medical psychology is essential.

#### PSYCHOLOGY AND TIME-STUDY

Yet another illustration may be helpful of the contrast which I have, doubtless in too crude colours, been depicting between the "mechanistic" and the "humanistic" approaches to problems of industrial management. Whereas the industrial engineer employs time-study primarily for the purpose of rate-fixing and for the discovery of the "one best way" of the operative's movements, the industrial psychologist has seen the value of time-study when used for other purposes which do not in the same way cast on the operative any suspicion or aspersion of idleness or involve any attempt to cajole or press him to increase his output.

Time-study has proved invaluable to the psychologist in enabling him to obtain continuous records of output throughout the working spell—"work curves," as he calls them—which reveal to him the presence of boredom, fatigue, or other undesirable features. It is also used by him to estimate the amount of the worker's "unproductive time," so that he may study its causes. And it is used by him to detect bad methods of performing some particular part of the novice's work during his training. In each of these uses the industrial psychologist will repeat his time-study after he has introduced changes, so as to obtain definite objective evidence of the improvements which he may have effected.

By the psychologist time-study is not regarded as an *essential* accompaniment of movement-study. The latter he may be quite content to base merely upon the general principles of good movements already known to him. For him the ultimate purpose of movement-study is rather to train and instruct the novice so that he may avoid the adoption of bad habits of movement, than to force all workers into a single common mould of movement, regardless of their individual mental and physical differences.

#### PSYCHOLOGY AND INDIVIDUAL DIFFERENCES

In every direction the distinctive aim of applied psychology is to study and to take into practical consideration, so far as is possible, individual differences among the operatives. It is, for example, now known that some persons are exceedingly prone to accidents; in one case 50 per cent of a large group of motor-drivers were found to be responsible for more than 80 per cent of the occurring accidents. Accident-prone workers should obviously be removed to less dangerous situations where the risk of injury is less not only to themselves but often also to their fellow-creatures. Or, more effectively, selection tests will be introduced so as to avoid the future engagement of the accident-

<sup>1</sup>Prof. Albert Watson, "The New Techniques in Supervisors and Foremen." London: McGraw-Hill Publishing Co., Ltd., 1940, p. 104.

prone: in one case in the course of 10 years this procedure is said to have reduced the average number of accidents per operative from 1.53 to 0.27 per annum.

We now know, too, that different operatives achieve their best quality and quantity of output under different rates of machine-speed; consequently, the speed of each machine should be variable, so that it may be set to conform to the optimal working conditions of the particular operative who controls it. The irrefutable standpoint of industrial psychology is that the machine is made for the operative, not vice versa.

The psychologist has come to adopt a corresponding standpoint in regard to production-planning: in every case the plan must be fitted as far as possible to those who will have to operate it, not vice versa. Each works, therefore, needs to be studied, as a sick patient is studied, at close quarters, not from the distant, hypothetical, arm-chair. Fixed rules of planning, however useful as affording a theoretical basis, are to be avoided in actual practice, if a maximum smoothness is to be attained in the flow of work. The rigid, quasi-military regime—a standardized type of organization applicable to every individual works of the same class—so dear to the “efficiency engineer,” must be leavened by a large measure of flexibility that will allow for the particular personnel who will be required to follow it, for future variations in quantity and kind of product, for periods of rush and slackness, etc.

#### VOCATIONAL GUIDANCE AND SELECTION

But the most important study of individual differences in occupational life relates to vocational guidance and to vocational selection. The former helps the young person to choose the career for which he is best fitted; the latter helps the employer (or other person) to choose the best applicants for available vacancies. Despite the vast wastage of time and effort and the disappointment caused by the present methods of admitting lads to the engineering profession or industry who later utterly fail to succeed therein, vocational psychology—never so important as at the present day—has not hitherto received great encouragement from the engineer. This is partly due to his natural misunderstanding of its methods. Engineers have commonly regarded psychological tests as they regard many of their own physical instruments of measurement—as only needing a mechanical routine application to provide them with accurate data. They have not taken into consideration the insistent claims of the psychologist that his tests can yield only a part of the information that is required for satisfactory guidance or selection; that the actual score at a test may be of less value than observation of the way in which it is performed; and that the assessment of qualities of character and temperament is fully as important as, if not more important than, the assessment of mental abilities. Up to now no satisfactory tests have been devised for the assessment of such traits of personality. This can be done only by observing the conduct of the applicant while performing the tests, and especially by the interviewer with the help of information received by him from others. The psychologist has, however, undoubtedly improved the interview by making its conduct more systematic and less liable to be influenced by accidental circumstances.

I cannot, of course, enter here in any detail into a description of, and into the principles underlying, the tests which have been devised for guidance and selection in regard to occupational work. But the following brief remarks with special reference to engineering are perhaps worth making. It is widely recognized now that in very varying degrees a single “general” factor of intelligence is involved in all forms of purposeful activity; and that there are also a considerable number of “group” factors, each of which is common to a particular group of activities, and of “special” factors, each of which is peculiar to a single, simple, form of activity. There is undoubtedly a group factor underlying “mechanical” and certain other abilities, which concerns

the readiness to perceive the sizes, shapes, and spatial relations of objects. With this “spatial” factor certain tests that have been devised prove by mathematical analysis to be highly saturated. In the daily work of the engineer this factor is involved in his translation of two-dimensional diagrams into three-dimensional objects, and vice versa (as in the reading and making of drawings), in the pattern-maker's and moulder's ability to imagine the “inverse” of a pattern or object, etc. There is reason to believe that it is also involved in the engineer's “machine sense,” as shown in his ability to realize how a machine works—how its parts fit together, how, if one of the parts is set in motion, another part will move, etc. Tests have also been devised to assess manual dexterity, hand-and-eye co-ordination, and the different abilities required in the different engineering trades; but research is still needed to establish their value more precisely. Little has yet been done to devise tests of creative imagination that are likely to have engineering value.

In one large British engineering works during the past 3 years, the present apprentice supervisor, Mr. Frank Holliday, has been taking an exceptionally active interest in the most recent developments and applications of psychological methods which are likely to be of value in the selection of his company's engineer- and trade-apprentices. He has been employing a group test<sup>1</sup> devised several years ago by Prof. Cyril Burt for the National Institute of Industrial Psychology in order to assess “general intelligence,” and also a battery of several group tests devised by later members of its research staff to assess what is broadly termed “mechanical ability.” In the course of three articles published by Mr. Holliday in *Occupational Psychology* (vols. xiv-xvi, 1940-42), he gives the following results:—Agreement between (i) the gradings based on the candidates' scores at the battery of tests, and (ii) the gradings made about fifteen months later by the Apprentice Supervisor (at that time not Mr. Holliday) occurs five times as frequently as disagreement. But when observations, made during the testing and the subsequent interview, on the candidates' methods of procedure in performing the tests, and on their traits of personality, are taken into account, “the agreement becomes of the order of 95 per cent.” (p. 176).

Results almost identical with these were obtained in an investigation carried out during the previous decade by Miss E. P. Allen and Mr. Percival Smith, on behalf of the Birmingham Education Committee in a junior day Technical School and at the Central Technical College of that city. In these two institutions agreement in 74 and 80 per cent respectively of the 108 pupils tested was found between the scores at the tests<sup>2</sup> and the instructors' independent grading of their pupils in respect of “apprentice ability”; and these figures were raised to 92 and 93 per cent respectively when allowance was made for unsatisfactory temperamental traits observed at the interview or later, such as impulsiveness, unreliability, or the lack of self-confidence, perseverance, initiative, ingenuity, or co-operativeness, which the mere scores at the tests could not indicate. These tests have now been introduced as a routine measure in the selection of boys for entry into the junior Technical Schools of Birmingham. Many boys have been since followed up in their subsequent engineering (or non-engineering) careers and very satisfactory results have been obtained.

For example, in a follow-up, over 2½ years, of 157 boys after leaving a junior Technical School, both the boys and their employers were asked independently and confidentially to report on the suitability of the former for their jobs

<sup>1</sup>A “group test” is applicable to several persons simultaneously; an “individual test” is applied to only one person at a time.

<sup>2</sup>The battery used consisted of seven tests devised by the National Institute of Industrial Psychology. If not less than five of these agreed with the instructors' ranking, the divergence of the other test or two tests was ignored. Since this battery was constructed, some of the component tests have been replaced by others which later research has shown to be of greater predictive value.

under one of three grades—"very satisfactory," "satisfactory," and "unsatisfactory." Of the boys (69 per cent) found to have entered *engineering* (and allied) trades, whose suitability was reported on as "very satisfactory" both by their employers and by the boys themselves, 81 per cent, while at the junior Technical School, had obtained scores in the upper half, and only 19 per cent in the lower half of the scores made at the test battery. On the other hand, of the boys (31 per cent) found to have entered *non-engineering* jobs (clerical, chemical, woodwork, selling, etc.), whose suitability was also reported both by employers and boys as "very satisfactory," only 30 per cent had obtained scores in the upper half, and 70 per cent in the lower half, of the scores made at the test battery. Neither the scores at the intelligence test, nor jobs at which a boy stayed for less than six months, were included in these striking results.<sup>1</sup>

Mr. Holliday's investigations have proved unquestionably (a) the importance of the intelligence test in predicting success in engineering mathematics and in the more theoretical aspects of engineering, and (b) the equal importance of good scores at his battery of tests for success in engineering drawing and in practical work in the shops. After at least a year's knowledge of thirty engineer-apprentices, the apprentice supervisor (then not Mr. Holliday) graded them according to a five-point scale of "excellent," "good," "average," "fair," and "poor." Their scores at the battery of tests, which had been applied earlier by Mr. Holliday, were similarly graded, and this grading was compared with the apprentice supervisor's independent grading. In only six of the thirty cases was there more than one grade-point of difference. A similar comparison, made among forty-one trade apprentices, showed a corresponding difference in only five cases. For these few divergencies, no doubt temperamental unsuitability for engineering, not measured by the test scores, was largely responsible.

Mr. Holliday further concludes that a low score on the battery of tests indicates probable unsuitability for engineering, and that this prediction becomes more certain if the candidate obtains a relatively high score at the intelligence test. On the other hand, if the candidate is to succeed in his theoretical and examination work, his intelligence score must not be too low. A lad with a high score at the test battery and with a very low score at the intelligence test may, however, be excellent in his shop-work—even at such a skilled trade as tool-making.

As supplementary evidence of the promising value of vocational tests for engineering, I will only cite a statement which I have received from the chairman of another well-known engineering company—that psychological testing has proved highly useful both in revealing at the outset pupils of exceptional promise who merit special training, and in drawing deserved attention to cases of disparity between test-scores and the reports received from the school and workshop. These tests, he has also said, "give us within an hour a measure of the boy's suitability which it would take from three to six months to obtain in the works under the control of a foreman." I hope that I have said enough to indicate the remarkable progress recently made in Great Britain towards perfecting psychological methods of engineering guidance and selection. Much, of course, remains to be done. Their future progress, like that of new surgical operations, depends largely upon their actual use: "practice makes perfect."

#### PSYCHOLOGY AND TRAINING

The conclusions which have been reached from investigations conducted in industrial training from the psychological standpoint can hardly be without interest to the engineer. The industrial psychologist's recommendation is that the tasks of workshop training and of production should be

<sup>1</sup>Cf. the three Reports of Research on "The Selection of Skilled Apprentices for the Engineering Trades," published by the City of Birmingham Education Committee, 1931, 1934, and 1939.

isolated, so far as possible, from one another. However unselfish the expert industrial operative may be, his need to maintain his normal output must inevitably reduce his opportunities for giving instruction. Not uncommonly he is found to yield to the temptation of using the novice for his own ends—to aid him in the simpler operations concerned with his own output, instead of training him as he might. Moreover, the experienced operative does not necessarily make a good teacher: sometimes he is innately unfitted to teach, and sometimes he has himself acquired bad habits of work. Investigation has also shown that he may not know the precise movements that he employs, and that, when he performs movements at a lower speed for demonstration purposes, they are often different from those employed by him at his normal rate of movement. The novice is apt to be distracted from learning by the noise and bustle of the shops. Unless unusually intelligent, he may fail to observe and to imitate correctly his instructor's movements. He may become bored because he is too often idle, waiting for the words of explanation that fall too rarely from his instructor's lips.

For all these reasons, the industrial psychologist advises that a specially selected teacher be appointed, qualified by his temperament, intelligence, and skill to give instruction, and that a suitable environment should be chosen for a "school," apart from that of normal production. He regards it as essential that a systematic course of instruction should be planned, comprising two sections: (a) technical knowledge and (b) actual performance of the work. A standardized method of performing the work can easily be devised with the initial help of expert assistance. Complicated time-studies and apparatus are usually unnecessary. The general principles that have guided this standardization of performance must be explained to the novice; laboratory experiments in training in assembly work have shown that if skill is acquired merely by routine practice, it is not transferable to other operations, whereas such transfer occurs when the novice has grasped the reasons for the methods in which he has been instructed.<sup>1</sup>

#### A CONCLUDING PROBLEM

I have tried to make it clear that there is ample room, indeed rather a crying need, for closer co-operation in the future between the engineer and the psychologist. This raises the question whether, how far, and if so, at what stage, the engineer should receive instruction in the principles of aesthetics and in those of industrial psychology. There are some who take the line that, in our Universities at least, the programme of teaching the engineering student is already so overloaded, and his ability to absorb knowledge has so nearly reached its upper limit, that, if any additions to the programme or other changes in it are made, they will be at the cost of sacrificing his opportunities for acquiring, during his undergraduate years, a sound grasp of the physical principles of his subject. Adherents to this school of thought have also urged that at so early a stage of his educational career the engineering student is not mature enough to appreciate instruction in the broad principles of aesthetics and industrial psychology, when he has had but scant experience in designing and is little familiar with workshop conditions. Such subjects, they urge, should find their place in "refresher" courses and be taught considerably later—in post-graduate life.

In contrast to this "stern physical drill" school of thought stands a school demanding from the Universities a far more "liberal culture." Its adherents urge that, especially at the Universities, every vocational education should be broadened, so far as possible, to become (as in every instance it can become) also of general culture value. They ask whether it is wise that, after obtaining his school-leaving certificate, say, at the age of fifteen, the future professional engineer (or indeed any future scientist) should officially receive

<sup>1</sup>Cf. J. W. Cox, "Manual Skill." Cambridge: University Press, 1934. Pp. 162-177.

instruction henceforth solely in those materialistic, scientific, and technical subjects which are most intimately and directly related to the exercise of his future profession. But surely the relative values of the antagonistic principles of "rigid discipline" and of "liberal culture," respectively underlying these two schools of thought can be exaggerated: surely a highly civilized society demands a school in which, by mutual understanding and sympathy, a compromise has satisfactorily blended them. Such a compromise must be different in the case of those who are destined to become (as, in his recent remarkable Address on engineering education to this Institution<sup>1</sup>, the President has aptly termed them) "officers in the army of civilian engineers," and in the case of that far more numerous, but equally important, class who, instead of a broader education adapted to a wider vision, need more specialized instruction and training to become "non-commissioned officers" in this "army."

The study of the "human factor" in occupational life already figures, as I have pointed out, in the examinations established by certain Institutions of Engineers for their Associate Membership (or Graduateship), and as a subject for endorsement on the Higher National Certificate in these branches of engineering. I have, however, advanced grounds for the hope that, in the not too distant future, both syllabuses and teaching may be so revised as to give greater prominence to the psychological—as contrasted with the mechanistic—treatment of problems of administration and management. Since 1931, industrial psychology has been taught as a separate subject in but one English Technical College—that of the County of Staffordshire. Here it has been taken mainly by students of about twenty years of age who have attended evening lectures for the previous five years and have already obtained either the Higher National Certificate in Mechanical Engineering or the City and Guilds Certificate in Machine Shop Engineering. In regard to this course, I am informed by Mr. T. G. Bamford, Principal of the College, that "some of the men find it exceptionally difficult, but the more wide-awake type of mind is keenly interested in it." "As a whole," he concludes, "the class is one which has always been most successful." But the subject serves another purpose. In the first James Forrest Lecture,<sup>2</sup> the late Dr. William Anderson, M. Inst. C.E., alluded to the "tendency among the young and inexperienced to put blind faith in formulas, forgetting that most of them are based on premises which are not accurately reproduced in practice. . . ." So, too, describing in 1936 this

<sup>1</sup>Journal Inst. C.E., vol. 17 (1941-42), p. 2 (Nov. 1941).

<sup>2</sup>Min. Proc. Inst. C.E., vol. cxiv (Session 1892-93, part iv), p. 255.

just-mentioned course of Lectures in industrial psychology in the "Human Factor," Mr. W. G. Emmett, who then conducted it, regards it as having "special value in introducing the student to the so-called 'inexact' sciences," as it dispels the notion held by "the student of physical science, at least in his early stages," that "events in Nature conform with exactness to certain simple laws," (p. 150).

I know of but one other instance where industrial psychology can be taken as a separate subject in engineering examinations, namely, in Glasgow University, where it may be chosen as a graduating subject for the B.Sc. honours degree in mechanical and electrical engineering, among the optional additional subjects prescribed by that University. Both in Scotland and in England, as I have already indicated, the subject finds some place in Technical Colleges in their courses on workshop organization and management when these are provided. For example, at the Royal Technical College, Glasgow—so Mr. James Smith, its Organizer, kindly informs me—an evening class in the subject is offered, attended in 1941 by sixty-three students of the average age of twenty-seven years, the syllabus of which includes such psychological topics as accident-prevention, fatigue-study, and vocational selection, besides the subjects usually comprised under "scientific management." The same college provides a course of instruction in engineering production for day students, the syllabus of which specifically mentions "industrial psychology."

It is clear that the industrial psychologist must similarly receive some training in the special problems of the engineer, if they are to collaborate satisfactorily. At present it is for the engineer to call in the applied psychologist if he thinks that he can be useful to him. It would be as absurd to wish to aim at making the engineer an industrial psychologist as to wish to make him an artist. But so often, when an outside expert's advice can be useful, it is sought too late. This mistake can be prevented only by some knowledge of what the expert can do and when he should best do it. Quite recently, the Education Committee of the Architectural Science Group of the Royal Institute of British Architects issued a report on "The Place of Science in the Architectural Curriculum." In this address I seem to have raised a closely analogous problem for the Engineer—"The Place of Aesthetics and of other fields of Psychology in the Engineering Curriculum." It is one, I am glad to understand, to which the Council of The Institution have already given close and favourable attention, not only envisaging a high educational ideal, but also taking a first and generous step towards carrying it into practical effect.

# A CONTRACTOR'S CLAIM FOR EXTRAS

The King vs. Paradis & Farley Inc.

A CASE OF INTEREST TO ENGINEERS AND CONTRACTORS

The following notes form a synopsis of the "reasons for judgment" in a case recently decided by the Supreme Court of Canada respecting a contractor's claim for extras arising from unforeseen difficulties. The judgment was delivered by Mr. Justice Taschereau, and the case may well prove to be a leading one.

In February, 1937, the tender of the contractor (Paradis & Farley Inc.) for the construction of a wharf at Rimouski, Que., was accepted by the Minister of Public Works acting on behalf of His Majesty the King, and a contract was entered into, embodying the terms and conditions under which the work was to be done.

In May, 1938, the contractor claimed by petition of right the sum of \$160,000, for damages and for additional compensation, and in due course the case was tried by the Exchequer Court, which has jurisdiction in all cases in which the claim arises out of a contract entered into by or on behalf of the Crown. That Court accepted the argument submitted by the contractor, that the plans and specifications were misleading, that the soil in which a certain number of piles were to be driven, was of a different nature and harder than indicated in the boring sheets prepared by the Department, and that a certain portion of the works performed was not covered by the contract. The learned trial Judge reached the conclusion that, for these additional works, not included in the amount of the tender, the contractor was entitled to \$119,597.22. Of this amount, however, he deducted one-third, because he thought there had been loss of time, delay and incompetence attributable to the suppliant. As a result of this deduction, judgment was given for \$79,731.48 with interest and costs.

Both parties then appealed to the Supreme Court of Canada, the Crown asking to have the claim dismissed, and the contractor, as respondent, asking for an increase in the amount awarded by the Court below.

The major item of the contract was the furnishing and driving into the soil at an average depth of 42½ ft. below the river bed, of a number of steel piles of interlocking type, on a double parallel row of 700 ft. long and 100 ft. wide. The unit price for this specific work, tendered by the suppliant, was \$1.95 per sq. ft., and it was submitted that this price was based upon the assumption that the soil into which the piles were to be driven, was of "sand, gravel, few stones, loose clay, stiff and sticky clay, tough clay," as revealed by the boring plans and specifications which were declared to be part of the contract. The driving of these piles into a relatively soft material, as described in the boring indications, did not, it was claimed by the respondent, involve work of a very difficult nature and the unit price of \$1.95 was sufficient to cover the furnishing and the driving of the piles leaving a reasonable profit.

But the respondent submitted that instead of encountering the material it had been led to expect, it encountered what is called "hard-pan", a substance dry in its natural state, devoid of lubricating properties, and plentifully interspersed with large boulders therein embedded, requiring continuous driving for very long periods, and in certain occasions drilling and blasting. And it follows that having done the work after protesting, the respondent was put to very large additional expenses. The claim was not for compensation for works contemplated by the parties and covered by the contract, but was for compensation for other works not foreseen in the agreement, performed *hors du contrat*, under an implied contract; it was for works accepted by the Crown for which no compensation had been paid on a *quantum meruit* basis.

It was particularly on the ground of *quantum meruit* for works unforeseen in the agreement that the respondent sub-

mitted its case, and it was on that ground also that the learned trial Judge allowed an additional compensation.

The specifications contained the following clauses which are the most important and most relevant to the present issue:

"2 (b). STEEL SHEET PILING: Driving interlocking steel sheet piling, where and as shown on plan and as shall be directed by the engineer.

"4. SOUNDINGS AND BORINGS: Soundings, levels and borings have been carefully taken but intending contractors are required to take, before they tender, the soundings, levels and borings they may deem necessary to satisfy themselves as to the accuracy of the information conveyed by plans and specifications.

"SHOULD THE CONTRACTORS find, on the site of the proposed work, any obstruction not shown on the plan, they shall remove such obstruction at their own cost.

"THE CONTRACTORS ARE WARNED that they shall be held entirely responsible and liable for any increase in the cost of the proposed work, if obstructions have to be removed to permit the driving of the steel sheet piles in correct alignment where and as shown on the plan.

"TENDERERS ARE HEREBY GIVEN NOTICE that it shall be taken for granted that the above has been given due consideration in the preparation of their tender.

"6 (3). THE UNIT PRICE TENDERED shall include the cost of purchasing, transporting, painting, driving and boring the piles, and the cost of the removal of obstructions impeding the driving of the piles, if any.

"35. AS IT IS KNOWN THAT DRIVING will be unusually severe, before the Engineer gives authority for the use of any type of steel piling for this work he will require to be provided with satisfactory evidence as to the driving qualities of the section suggested derived from actual experience in practice.

"37. NOTWITHSTANDING THIS, the contractor shall be entirely responsible for the correctness and accuracy to the satisfaction of the Engineer, in spite of all difficulties including risk of piles meeting obstructions of any kind in the course of the pile driving.

## TENDERS AND GENERAL CONDITIONS (FOR UNIT PRICES)

"4. CONTRACT: The contractor would be required to sign a contract similar to the form exhibited at the same time as the plans and specifications.

"7. NO CLAIM FOR EXTRA work or materials of any nature will at any time be recognized or entertained by the Department unless the contractor has first obtained a written order therefor from the Engineer.

"10. PARTIES INTENDING to tender for these works are especially requested to visit the place and site of the proposed work, and make their own estimates of the facilities and difficulties attending the execution of the work, including the uncertainty of weather and all other contingencies.

"37. NO CLAIM FOR EXTRAS will be entertained by the department on account of unforeseen difficulties in the carrying out of the works herein specified."

As already stated, an Order in Council was passed on February 10, 1937, accepting the tender of Paradis & Farley, and on February 23, 1937, a contract was signed between the suppliant and His Majesty the King. In the contract there were the following clauses:

"4. THE WORKS SHALL BE CONSTRUCTED by the contractor, and under his personal supervision, of the best materials of their several kinds and finished in the best and most workmanlike manner and in the manner required by and in strict conformity with this contract, the said specifications and special specifications and the plans and drawings relating thereto, and the working or detailed drawings which may from time to time be furnished (which said specifications and special specifications, plans and drawings are hereby declared to be part of this contract), and to the complete satisfaction of the Engineer.

"45. It is distinctly declared that no IMPLIED contract of any kind whatsoever by or on behalf of His Majesty shall arise or be implied from anything in this contract contained, or from any position or situation of the parties at any time, it being clearly understood and agreed that the express contracts, covenants and agreements herein contained and made by His Majesty are and shall be the only contracts, covenants and agreements upon which any rights against His Majesty are to be founded."

And the last two clauses of the contract read as follows:

"56. This contract is made and entered into by the contractor and His Majesty on the distinct understanding that the contractor has, before execution, investigated and satisfied himself of everything and of every condition affecting the works to be executed and the labour and material to be provided, and that the execution of this contract by the contractor is founded and based upon his own examination, knowledge, information and judgment, and not upon any statement, representation, or information made or given, or upon any information derived from any quantities, dimensions, tests, specifications, plans, maps or profiles made, given or furnished by His Majesty or any of His officers, employees or agents; and that any such statement, representation or information, if so made, given or furnished, was made, given or furnished merely for the general information of bidders and is not in anywise warranted or guaranteed by or on behalf of His Majesty; and that no extra allowance will be made to the contractor by His Majesty and the contractor will make no claim against His Majesty for any loss or damage sustained in consequence of or by reason of any such statement, representation or information being incorrect or inaccurate, or on account of unforeseen difficulties of any kind.

"57. In the event of any inconsistency between the provisions of this contract and the provisions of the specifications forming part hereof the provisions of the specifications shall prevail."

The stand taken by the Crown was that the borings and plans were only indicative of the works which were to be performed, and that the tenderer, under the terms of the specifications, was required to take the necessary soundings, levels and borings to satisfy itself as to the accuracy of the information conveyed by the appellant. It was further alleged that there could not be any additional compensation on a basis of *quantum meruit*, the works executed having been contemplated by the parties and covered by the contract. The obligation assumed by the contractor was not to drive the piles in a SPECIFIED SOIL, but to drive them in a SPECIFIED PLACE, "Where, and as shown on the plan," whatever the unforeseen difficulties might be. It was agreed, that the prices would be held rigidly inclusive, and would cover all contingencies that may happen, and it is obviously for that purpose that clause 37 of the specifications stipulated that "no claim for extras would be entertained by the department on account of unforeseen difficulties in the carrying out of the works herein specified."

It was also said in the specifications, that if the suppliant did find any obstructions not shown on the plans, it was its obligation to remove them at its own cost. And in order to facilitate its task, additional information was made

available as to the conditions of the soil, but one of the officers of the suppliant refused this information, stating that he had a perfect knowledge of the soil at that particular place. But clause 56 of the contract stated that the information given in the plans and the boring sheet was not "guaranteed or warranted by or on behalf of His Majesty," and made a further stipulation that the contractor will make no claim against His Majesty "for loss or damage sustained or on account of unforeseen difficulties of any kind."

It was suggested that the contract contained clauses that should be considered as non-existent, because they went beyond the authority given by the Order in Council. This would have left the respondent free to rely on an implied contract to claim on a *quantum meruit* basis, and would have considerably reduced the devastating effect of clause 56, which in a milder form was also found in the specifications.

But the tender duly signed by the respondent contained a specific clause which precisely covered the point and defeated the objection. This read as follows:

"CONTRACT: The contractor will be required to sign a contract similar to the form exhibited at the same time as the plans and specifications".

The signing of a contract exhibited with the plans and specifications, was a condition of the tender and, therefore, all its clauses were duly authorized by the Order in Council of February 10th and were binding upon the parties, who had a complete knowledge of its contents.

The suppliant tendered to furnish and drive these piles in a soil the nature of which it agreed to investigate, and which the appellant did not guarantee, but merely indicated with the reserves above mentioned, as being of "sand, gravel, few stones, loose clay, stiff and sticky clay, tough clay". The risk was upon the suppliant, and having assumed this risk, it must necessarily bear all the consequences, financial and others, if it misjudged the works to be performed and miscalculated the cost of the enterprise. Expenses incurred for unforeseen difficulties must be considered as being included in the amount of the tender, and the respondent had the legal obligation to execute the contract, for the price agreed upon, in the same way as would have been its indisputable right to benefit, if the soil had been more favourable and easier than foreseen.

In the "reasons for judgment" the learned Judge held that:

"The Court is bound by the terms of the contract, which is the law of the parties. And there is also the statutory law which supports the stand taken by the Crown, and which to my mind has the effect of thoroughly destroying the suppliant's submission. The Exchequer Court, under s. 18 of the EXCHEQUER COURT ACT, R.S.C. 1927, c. 34, has exclusive original jurisdiction in all cases in which the claim arises out of a contract entered into by or on behalf of the Crown. And s. 48 of the same Act limits the jurisdiction of the Court, and does not allow it to grant any additional compensation. This section reads as follows:

"48. In adjudicating upon any claim arising out of any contract in writing the Court shall decide in accordance with the stipulations in such contract, and shall not allow.

"(a) Compensation to any claimant on the ground that he expended a larger sum of money in the performance of his contract than the amount stipulated for therein.

"Having come to the conclusion that the works performed are covered by the contract, it seems impossible to allow any additional compensation, without doing violence to the unequivocal terms of this section."

For these reasons the Court decided that the appeal of the Crown should be allowed, and that the contractor's petition of right as well as his cross appeal should be dismissed, with costs throughout on both issues.

## TWO-STROKE OIL ENGINES

From *Trade & Engineering*, July 1942

### NEW SUPERCHARGED DESIGN

In recent years the application of supercharging, and particularly exhaust gas pressure charging, to four-stroke oil engines has become general. By its adoption the continuous rated output from a given cylinder may be increased by 50 per cent, and in spite of the comparatively high cost of the accessory equipment most marine four-stroke engines and a fair proportion of stationary units are now pressure-charged. This expedient has increased the competitive power of the four-stroke engine in relation to the two-stroke design, and therefore it is natural that attention should be directed to the possibilities of supercharging the latter type. With this end in view, a great deal of experimental work has been carried out in Switzerland by Messrs. Sulzer, and the results, which will undoubtedly lead to important practical progress, have now become available.

The main object of the new system is to reduce the size, weight, and cost of internal-combustion machinery by increasing the mean effective pressure, and hence the specific output. This cannot be accomplished by delivering the exhaust gases to an independent turbine driving a rotary compressor supplying scavenging and charging air on analogous lines to pressure-charging in four-stroke engines. The volume of air would be insufficient at light load, and the engine could not be started.

### USE OF EXHAUST GAS TURBINE

The Sulzer method is to drive the rotary compressor directly or indirectly by an exhaust gas turbine which is coupled to the engine crankshaft through gearing. The unit may then receive energy from the crankshaft, as when starting, or on light load, or may transmit energy to it when the load rises. High supercharging pressures may be employed, but normally the figure will vary between 20 lb. and 70 lb. per sq. in. If raised to between 70 lb. and 85 lb. per sq. in. the output of the engine becomes equal to the power absorbed by the compressor, so that the turbine may be uncoupled from the engine and compressor. The energy is then delivered by the turbine for whatever external purposes may be required, and not by the engine and compressor which together form a unit supplying exhaust or power gas to the turbine. Such a unit thus becomes a power-gas generator, and several plants may be incorporated delivering gas to one common turbine.

As an alternative system the total quantity of scavenging and supercharging air may be obtained from engine-driven reciprocating pumps. The exhaust gas is delivered to a turbine which transmits its energy to the crankshaft by bearing.

After a considerable amount of experimental work, the first industrial engine was built, designed for a supercharging pressure of about 2 atmos. abs., or about 28.5 lb. per sq. in. It is of the opposed piston type with four horizontal cylinders. The exhaust gases are discharged to a turbine, the output from which is transmitted to the crankshaft through gearing. Reciprocating engine-driven pumps supply scavenging and charging air to the cylinders, which have a bore of 190 mm. with a combined piston stroke of 300 mm. The speed is 750 r.p.m., and the rated output of the engine 1,370 B.hp., with a mean effective pressure of 12 kg. per sq. cm., or 170 lb. per sq. in. The fuel consumption of this unit which has run for more than 3,000 hours, is 0.35 lb. per B.hp. hour. The thermal efficiency is thus equal to that of the normal Diesel engine. The turbine runs at 13 times the speed of the engine crankshaft.

In order to demonstrate that equally satisfactory results could be obtained with single-piston engines of large

## Abstracts of articles appearing in the current technical periodicals

diameter, tests were made on a unit of this class of normal design with a diameter of 420 mm., the supercharged pressure being 2 atmos. abs., or 28.4 lb. per sq. in. The output at 450 r.p.m. was 692 B.hp. the mean effective pressure being 10 kg. per sq. cm., or 142 lb. per sq. in.

### LARGE INSTALLATION DESIGNED

In consequence of the results obtained Messrs. Sulzer are now adapting their normal single-piston two-stroke engines of medium and large bore to supercharging on the principle mentioned, and they have also developed a new design to take full advantage of the potentialities of supercharging in various applications. This is also of the opposed piston type, with two shafts, having six cylinders. The cylinder diameter is 180 mm. and the stroke of each piston 225 mm. At 850 r.p.m. the output at one-hour rating is 1,560 B.hp., with a supercharging pressure of 2 atmos. abs. An eight-cylinder engine with the same cylinder dimensions has a one-hour rating of 2,750 B.hp. at 1,000 r.p.m. when supercharged to 2.5 atmos. Its overall length is 17 ft. and maximum height 8 ft.

Plans have been prepared for engines of large size operating on this principle. For a passenger liner similar to the *Oranje* with 37,500 B.hp. machinery, a plant is proposed comprising 10 generators each driven by a supercharged two-stroke two-shaft opposed piston engine running at 450 r.p.m. and having cylinders 320 mm. in diameter with a combined piston stroke of 800 mm. The supercharging pressure is 2.5 atmos. abs., and the mean effective pressure 12.1 kg. per sq. cm.

### CARGO AIRCRAFT

FROM *The Engineer*, (LONDON), JULY 31, 1942

We do not know what is the total current tonnage output from Allied shipyards, but it is possible to get some rough idea of it from the fact that in the United States alone ships are now being launched at an average rate of well over two per day and that before long it should reach three. The majority of these ships are of the "Liberty" type, single-screw vessels of about 14,000 tons displacement, driven by reciprocating steam engines and designed to have a very moderate speed. Contracts for more than 1,500 "Liberty" ships have been placed, all to be delivered by the end of 1943. Nineteen new yards with 171 slipways in all are engaged upon the work. Our American allies have reacted in a characteristic manner to the fact that this output of new ships, supplemented by that of the British Commonwealth, is insufficient to compensate the depredations of the enemy's submarines. A recent suggestion made by Mr. Andrew Higgins, of Louisiana, and Mr. Henry Kaiser, of California—both leading personalities in American wartime shipbuilding circles—that the United States should switch over from the building of ships to the construction of large cargo aircraft has attracted great attention. Certain prominent representatives of the aircraft industry, including Mr. Glenn Martin, are said to be warmly in favour of it.

In detail the suggestion, as ascribed to Mr. Kaiser, is that the nine largest shipyards in the United States should be converted for the mass production of 70-ton cargo-carrying aircraft. The assembly lines, Mr. Kaiser asserts, could be in production within six months and maximum production, at the rate of 5,000 aircraft a year, could be reached in ten months. This programme may appear highly optimistic, but it has to be noted that, according to reports received from America, some of the new wartime shipbuild-

ing yards—and specifically those controlled by Mr. Higgins—have been planned from the outset with the idea that later on they might be employed on the construction of large cargo-carrying aircraft as well as upon that of ships. To the objection already raised by the War Production Board that the scheme would divert materials from factories building aircraft for the armed forces, its advocates reply that an increased use of wood could be resorted to in the construction of the cargo machines. In any event it would have the compensating advantage of setting free a large tonnage of steel for use in the tank, gun, and shell factories. From the operational point of view advocates of the scheme will derive encouragement from the success which has attended the flying of bombers and flying boats from the United States to Great Britain. At the end of a year's working the R.A.F. Ferry Command announces that the aircraft lost on the way across have amounted to less than one-half of one per cent of the total handed to it for delivery. It should, however, be remarked that if the United Nations resorted wholly or in large measure to aerial, instead of sea, transport across the Atlantic, the enemy, finding his submarines deprived of their prey, would in all probability greatly intensify his air activity over the ocean, a step which we would have to counter by providing increased fighter protection, at least in the areas nearest our shores. One important tactical advantage of the scheme would lie in the fact that munitions from the United States would be borne by air right into the heart of this country and would not require transshipment at a comparatively small number of vulnerable ports and subsequent carriage by our hard-pressed railways.

The proposal has undoubtedly a number of attractive features about it, but it requires to be demonstrated that it could "deliver the goods." It must not be overlooked that to be fully effective as a substitute for sea transport it would involve the building of several types of aircraft or at least of one type which could be readily converted for a variety of duties. In particular there would be required machines capable of carrying troops, heavy equipment, such as tanks and guns, food, oil and general cargo. From the aeronautical point of view it is not easy to see how a single design of aircraft could be made adaptable at will for the transport of these varying categories of load, while from the armaments standpoint it seems probable that modifications of design would be required to meet the exigencies of air transport—as, for example, the subdivision of heavy tanks into readily handled sections. The crucial factor is, however, the quantitative one. A 70-ton aircraft would probably have a disposable load of about 35 tons, of which about half would perhaps have to be assigned to the fuel required for the crossing. If an indirect route with intermediate landing and refuelling stations were followed—as would probably be the case—less of the disposable load would have to be assigned to fuel, but it seems doubtful whether the net cargo-carrying capacity could be increased beyond, say, 25 tons. The cargo-carrying capacity of a 14,000-ton "Liberty" ship is about 10,000 tons or a little less, but it would take about four or five times as long as the aircraft—flying indirect—to perform the trip. Quite roughly we may therefore say that in effective cargo-carrying capacity one hundred 70-ton aircraft would be required to replace one "Liberty" ship. On this basis 150,000 aircraft, or, taking Mr. Kaiser's figure, the equivalent of thirty years' output from the converted shipyards, would be required to replace the 1,500 "Liberty" ships now being built or for which contracts have been let. It can therefore be concluded that as a means of providing a complete substitute for sea transport the scheme is impracticable. It seems scarcely more attractive as a means of providing a useful supplement to sea transport. The annual output of 5,000 aircraft would be equivalent in carrying capacity to about fifty "Liberty" ships. This addition would be a useful addition were it really an addition. Actually it would be achieved only by sacrificing the aggregate output of ships from the

nine largest yards in the United States. Those yards, we feel assured, are at present contributing more than the capacity of fifty "Liberty" ships annually to the Allied transportation resources.

## ECONOMIC CONTRIBUTION OF THE COLONIES

From *Trade & Engineering*, July, 1942

Mr. H. Macmillan, Under-Secretary of State for the Colonies, has made a comprehensive statement to the House of Commons on the subject of the economic contribution of the Colonial Empire to the war effort. He said that the West African Produce Control Board had been developed out of the original Cocoa Control Board. It would arrange a steady and consistent buying and price policy for West Africa; and would deal not only with cocoa but with oilseeds, ground nuts, and other commodities. The merchants had become the agents of the Board.

Rubber output in Ceylon had been intensified. Steps had been taken to obtain the maximum possible production in East and West Africa. Neglected plantations were being revived. Abandoned areas of Ceara rubber, mainly situated in Tanganyika, were being exploited. Special officers were being appointed; and they were able to get the assistance of some of the Malayan planters. All types of wild rubber, both in East and in West Africa, were being tapped. Prices had been fixed which it was thought would bring the maximum production. All territories were co-operating in the drive for more rubber. By these means he hoped they might help to fill the gap before the great production of synthetic rubber began in the United States.

## VARIED MINERAL RESOURCES

Minerals—bauxite, wolfram, tin, graphite, copper, zinc, mica, manganese, chrome, iron ore, industrial diamonds—from vast territories in the Gold Coast, Sierra Leone, Nigeria, Northern Rhodesia, Ceylon, British Guiana, and Cyprus, all these were helping in the world drive. The chief anxiety about the production was not so much to increase by every means the productive power of the territories as to secure the transport, harbour accommodation and shipping to take away the products.

Food production had been immensely stimulated. In West Africa they were concentrating chiefly upon rice, vegetables, and dairy produce. In East Africa they were increasing wheat, maize, rye, and other foodstuffs as well as rice. In the West Indies they were trying to diversify agriculture. Twenty-five per cent of the estate lands in Barbados and some other territories were being compulsorily turned over from sugar to food crops, and all other means taken throughout the islands to increase local production. In British Guiana rice was being swiftly extended. In Jamaica they were hoping to help producers to stop growing bananas and start growing foodstuffs for local consumption.

Ceylon, Palestine, and the East African Dependencies which fell within the area of the Eastern Group Conference, were making every possible effort to increase their resources for local manufacture as were all other Colonial territories. In Palestine spare parts were being made and repairs carried out for the Army of the Middle East.

On the subject of the needs of the Colonies Mr. Macmillan said that things, not money, were wanted. Englishmen must do without shirts in order that Africans might have cotton piece-goods. Everything possible was being done to help the transport authorities in the Colonies as regards both equipment and personnel, but it was hard to get either. Progress in procuring locomotives and rolling stock was, however, being made, and by insisting on a reasonable measure of standardization they could be turned out on something approaching mass production lines. Bicycles were needed not only to take Colonial workers to and from their work, but also in some cases for the direct transport of produce. Port facilities too were a great problem as soon,

he hoped, as much tonnage would be handled in a single day as was in peace time handled, in a month.

Apart from the claims of production, there were other great claims upon the man-power of the Colonies. In addition to a magnificent contribution to the fighting services, large numbers had been recruited for the Labour Corps both from West and East Africa as well as from other Colonies, and were performing splendid service.

### THE "BRISTOL" FLYING BOAT

From *The Engineer* (LONDON) July 3rd, 1942

It has now been made known that the Prime Minister made his recent voyage to the United States, also the return journey, in the Royal Mail aircraft "Bristol," of British Overseas Airways. The commander was Captain J. C. Kelly Rogers, who was in command of the "Berwick" when it brought back the Prime Minister from his previous visit to America, and the second in command was Captain A. C. Loraine, who was second in command of the "Berwick." The "Bristol" is a Boeing 314A flying boat, and is one of three such aircraft which operate the British Airways' Atlantic services to the United States and also, in conjunction with other flying boats, to West Africa. These Boeings, it is claimed, are among the largest flying boats in commercial service in the world. The wing span of these machines is more than 150 ft., with a length of 105 ft., and a height of more than 27 ft. When fully loaded they weigh almost 40 tons, and the four engines have a total output of 6,400 B.h.p. These aircraft are designed to carry up to sixty-six passengers, according to the length of the voyage, and the crew is ten in number. They have a cruising range of over 4,000 miles. At present they are carrying over thirty passengers on their Atlantic voyages. The passengers are carried in a number of commodious cabins, which can be converted into sleeping berths at night. There is a private suite aft, and other accommodation includes a purser's office, a cooking galley, and a pantry. Dining accommodation is provided for fourteen passengers at one time. The crew of each flying boat comprises the captain, second captain, first officer (who acts as navigator), two engineer officers, the purser, and two stewards.

### AVRO MANCHESTER

From *Trade & Engineering*, July 1942

One of the newer British-made aircraft which is playing its part in the R.A.F.'s bomber offensive against Germany is the Avro Manchester. Designed by the firm of A. V. Roe and Co., of Manchester, it has been produced in some of the most up-to-date plants in the country, partly by a considerable range of sub-contractors.

#### LARGEST TWIN-ENGINEED BOMBER

The Manchester is probably the largest twin-engineed bomber at present in service in the world. As is usual, it was originally designed to an Air Ministry specification, and production on a large scale was preceded by the manufacture of two prototypes. Perhaps the outstanding feature of the new bomber is its great weight-lifting capacity, but in spite of its size and weight it is extremely manoeuvrable. It is a mid-wing twin-engine cantilever monoplane, with retractable undercarriage.

The engines are two Rolls-Royce Vulture liquid-cooled engines. The maximum power rating is as follows:—1,845 hp. at 3,000 r.p.m. at 5,000 ft. in the low supercharger gear and 1,710 hp. at 3,000 r.p.m. at 15,000 ft. in the high supercharger gear. Fully feathering, three-bladed airscrews of 16 ft. diameter are fitted. Overall dimensions are as follows:—Span, 90 ft. 1 in.; length 68 ft. 10 in.; height, 20 ft.; cross wing area, 1,131 sq. ft.; fuselage, 8 ft. 2 in. wide; length of bomb compartment in fuselage, 33 ft.; undercarriage wheels, 5 ft. 6 in. diameter. Weight is approximately 25 tons all up; maximum speed is stated to be about 300 m.p.h., and maximum range approximately 2,000 miles.

The machine can lift over five tons of bombs, though over what range that great weight can be carried cannot be stated. Armament consists of a total of eight 0.303 Browning machine-guns, carried in three turrets, one in the nose, one mid-upper, and one in the tail. A crew of six or seven is normally carried, dependent on the operation. The larger crew consists of two pilots, one observer (who is also navigator and bomb-aimer) two W/T operators-air-gunners, and two air-gunners.

#### SECTIONAL CONSTRUCTION

The Manchester as a whole has been specially designed in a number of sections to facilitate production, transport, maintenance, and repair. The aircraft structure throughout is skinned with aluminium alloy sheets with flush riveting, which provides a smooth external surface. The fuselage is built up of transverse formers with continuous longitudinal stringers. A canopy is fitted over the pilot's cockpit which gives an excellent view in all directions, including aft. The fighting controller's position is also situated inside this canopy immediately aft of the pilot's seat and affords an excellent view in every direction. A little aft of this position is the navigator's station, and he is provided with a spacious table and adequate stowage for charts, &c. In the roof of the cabin is an astral dome. The W/T operator's station is at the rear end of the navigator's table, just forward of the front spar. At this point an armour-plated bulkhead is fitted across the centre section portion of the fuselage and so arranged as to open up for access on either side of the centre line. Additional armour-plating is provided at the back of the pilot's seat and head and special bullet-proof glass is fitted to give added protection to the fire controller. Certain other vulnerable parts of the aircraft structure and of the turrets are armour-plated. Within the fuselage centre section there is a comfortable rest chair for the general use of the crew. In the fuselage aft the rear spar a mid-upper turret is fitted and various equipment stowages for flares, emergency rations, Thermos flasks, etc. Also in this portion of the fuselage the ammunition boxes are located which carry ammunition by means of tracks to the tail turret.

A walk-way is provided from the tail turret forward to the other crew stations, and the main entrance door to the fuselage is situated on the starboard side just forward of the tailplane, a ladder being provided for easy entrance, this ladder being stowed in the fuselage during flight. Escape hatches for all the crew are provided at suitable points. The bomb-aimer's station is in the nose of the fuselage below the front turret and forward of the pilot's cockpit. The bomb-aimer is surrounded by all his equipment, which is arranged so that it can be easily operated, and he takes his sights through a special clear vision window. The bomb compartment is contained within the fuselage form, the cabin floor above it being specially designed to take housing to carry the various types of bombs employed. Two large doors are fitted to the compartment, and are operated hydraulically. In cases of emergency or in the case of a failure of the hydraulic system the doors can be opened by means of an emergency air system. An interesting point is that provision is made in the electrical circuits to prevent the bombs being released until the bomb doors are open.

All the gun turrets are hydraulically operated. Readily accessible stowages for parachutes are provided at all the crew stations, and oxygen points are likewise provided. Complete communication between the members of the crew is provided by means of "inter-com." De-icing equipment is fitted to the airscrews. The undercarriage is completely retractable and is operated hydraulically. Here again an emergency air system is provided. Fuel is carried in self-sealing tanks in the wings. The main wing is of two-spar construction, each spar consisting of a top and bottom extruded boom bolted on to a single thick gauge web plate. The ribs are aluminium alloy pressings, suitably flanged and swaged for stiffness. A dinghy is carried in the centre

section trailing edge portion of the wing and is automatically operated in a crash landing, and can also be operated by hand. The tail-plane is built up in a similar manner to the wing, with two fins and rudders at the extremities.

#### THE ENGINE

The Rolls-Royce Vulture is a 24-cylinder, liquid-cooled poppet-valve engine, 5 in. bore by 5.5 in. stroke. The cylinders are arranged in four blocks of six on a common crankcase with an angle of 90 deg. between the blocks. The piston, cylinder, and valve gear assembly follows normal Rolls-Royce practice, four valves being used for each cylinder, operated by overhead camshafts. Ignition is by two independent screened magnetos arranged so that the engine will continue to function satisfactorily in the event of a failure of one magneto. A down-draught carburettor is used, which delivers mixture through a two-speed supercharger to two main trunk pipes, each feeding two blocks of cylinders. Electrical starting is used, a generator is fitted, and drives are provided for all the necessary aircraft auxiliary pumps.

### MAGNESIUM PRODUCTION IN THE UNITED STATES

FROM *The Engineer*, (LONDON), JULY 31, 1942

Expansion of the magnesium output to approximately a hundred times the pre-war record has been announced officially by an official of the American War production Board, since it is one of the vital light metals used in aircraft construction, bombs and other munitions. This capacity is expected to be reached in 1942 or early in 1943, the programme calling for rapid expansion of the necessary works, as in the case of aluminium, although the magnesium expansion is on a much larger scale. About 70 per cent of the total output will be produced by electrolytic processes, 20 per cent by the ferro-silicon process, 7 per cent by the carbothermal process, and 3 per cent by processes which at present are in the experimental stage. A large increase in ferro-silicon production is also necessary, since about a pound of this metal is required for each pound of magnesium produced by this method. Some of the new plants will be similar to—but larger than—plants now in operation with electrolytic treatment of sea water, the supply of raw material being unlimited, although its content of magnesium is only 0.13 per cent. Other large plants under construction will use magnesite quarried from inland deposits to produce magnesium oxide sinter in roasters. Calcined magnesia is ground and made into briquettes with coke and peat. This latter material makes the mass spongy or porous, which facilitates the penetration of the chlorine and thus aids the chlorination reaction. Other plants will use calcined dolomite as raw material. Inland salt wells are also being developed as a source of raw material, some of these striking large deposits of sand saturated with rich magnesium chloride brine. A large proportion of the total product will come from the electrolysis of fused magnesium chloride made in various ways from a number of different sources.

### EUROPE VERSUS AMERICA

From *Trade & Engineering*, July 1942

"To-day we own Germany, to-morrow we shall own the world." The declamatory folly of this song of Hitler Youth was the Nazi way of popularizing among the German people a new theory of economics—new as a declared theory, that is to say, for the practice of loot is as old as the cave man. Dr. R. H. M. Worsley submits the doctrine and its application by Germany's "master minds" (to use a phrase increasingly adopted in criminology) to a careful scientific examination in *Europe Versus America* (Cape). It is a book of absorbing interest. Also, it is an astonishing book, for, accustomed as we are becoming to a world turned topsy-turvy, it is still difficult to adjust the mind to the spectacle

of a learned economist scrutinizing bulletins from Bedlam. Alas! That it should be necessary.

Perhaps aloofness from Europe better defines the American attitude between the two wars than the word "rejection" used by Dr. Worsley. The chief interest of the book to English readers, however, dwells less in its chief theme, important as that is in showing the effect of the "new order" on United States economy, than in its account of the methods and world-wide aims of Nazi economics. Even if in their genesis these aims had no world-wide ambitions they inevitably would have acquired them; Hitlerism is caught in its own coils and, running athwart human right and reason, must pursue its fatal course, as Macbeth was driven on from crime to crime. Let any misguided apologist of Nazi economics, if any now exist in the Western Hemisphere, never forget the pronouncement made by Dr. Schacht, its leading doctrinaire and active operator, in 1934, as reported in Ambassador Dodd's "Diary."

"The whole modern world is crazy. Everybody is crazy. And so am I. Five years ago I would have said it would be impossible to make me crazy. But I am compelled to be crazy."

Whence the compulsion? The question need not be answered now that the exponents of craziness for craziness' sake have plunged the world into chaos. Another point to show the inevitability of the "new order" driving over the borders of Europe. If the American people as a whole were unaware of the menace to themselves they must be grateful to Mr. Roosevelt for seeing it in time. It was not only implicit in Nazi behaviour: it was made explicit in Walter Darré's frank declaration in May, 1940: "The economic plans of the 'new order' will cause the United States to have from 30,000,000 to 40,000,000 unemployed." No business deals can be made with people with those designs, and no appeasement satisfy them short of surrender. As Dr. Worsley says, Hitler's Europe "must try with all its might to defeat America, to prevent her from wrecking the very foundations of the 'new order' by demonstrating the prosperity and happiness of a free and democratic union of free men, in contradistinction to the misery of Europe under the Swastika."

National-Socialist economy is essentially a "martial economy," to use Dr. Worsley's name for it. Being predatory, it can operate only in close and constant collaboration with a war machine. Dr. Worsley's book, in its early stages, makes a detailed survey of the principles and practice of this economy past and present, before passing on to answer such questions as: Does Hitler's economy provide for any scheme on which peaceful collaboration can be based? (The answer is emphatically that collaboration is impossible: there can only be defiance, which means war, or acquiescence, which means slavery). What lessons can be derived from its operation in Europe to-day? Is it possible to neutralize the aggressive character of this new Europe-to-be by utilizing the economic technique it has devised for "international collaboration"? The author shows that many of the special proposals of the Schacht-Funk currency plans are already in operation and the effects may be summarized as follows:—

(1) An initial stabilization of the European currencies in their relation to the Reichsmark has been achieved.

(2) The Reichsmark has been made the leading European currency.

(3) Berlin has been made the financial centre of Europe by the setting up of the "Multilateral Clearing" where inter-European payment and exchange control are concentrated.

The German War Economic General Staff occupies to-day a dominating position in European mining, in the heavy industries, in metal and metallurgical works, in chemistry, hydro-electric generation and synthetic production based on substitute materials. It also manages most of the supplies of raw material and is the biggest customer of the European market. If Germany were able to consolidate this

position in Europe there would be no need to ask what place the United Kingdom would hold as a "collaborating Power." The United Kingdom's part in the "new order" would be that of a reservoir of serf labour, and nothing more. Dr. Worsley devotes separate chapters to examining the working of the new economy in France, Belgium, Holland, Norway, and Denmark, and to its effect on Sweden, before dealing with the preparations to organize a Prussianized Europe for an economic offensive against America in order to achieve the aim of world hegemony.

It might appear from the successes so far achieved that this dream, though abominable, is not so crazy as suggested at the beginning of this review. But Dr. Worsley adds a postscript. Hitler has buried the prime of Europe's youth on the Russian front. Instead of rolling in the wealth of grain and oil in Russia he has created a huge desert. The destruction of the scorched earth policy will be felt by all Europe for many years to come. Instead of receiving Russian surpluses, Europe will have to send Russia food to keep off starvation. The Nazi concept of Europe based on Russian resources has been frustrated before the war has ended. Hitler's armies are destroying wealth as well as freedom, and threaten to destroy the wealth of all the world.

## REFUGEES AND INDUSTRY

From *Engineering* (LONDON) July 10, 1942

Engineers, as a class, are not conspicuously enthusiastic students of economic history. Those who are engaged in manufacture may make a fairly close study of the immediate circumstances of their own time and industrial environment, but they do not regard these circumstances, as a rule, in the light of history in the making; their interest extends forward, because they are concerned to predict as accurately as possible the trends upon which their future prosperity depends, but, if it extends into the past at all, beyond the period covered by personal recollections, their views and impressions are commonly bounded by that somewhat vaguely defined and frequently misunderstood sociological transformation known as the Industrial Revolution. The term is a convenient one, but its convenience ought not to lead to misinterpretation of its meaning or the character of the change that it implies. The so-called Industrial Revolution was not a sudden upheaval, comparable to the violent changes in the established order of States to which the word revolution is applied in the political field. It was, in fact, no more than an accelerated evolution; and evolution is an essential condition in any healthy society, continuing inevitably, and not to be delimited by arbitrary divisions of time.

There have been other accelerations of evolution, in plenty, apart from that associated with the advent of the steam engine; some international in their scope, but others of hardly more than local significance. The unknown inventors of the wheel and axle, the windmill, sail propulsion of ships, methods of extracting and working metals, and the early devices for irrigation, have produced changes in the lives of nations quite as important and far-reaching, in their day, as any deriving from the work of Savery, Newcomen and Watt. These are fundamental developments which have become international so long ago that they are now part of the common inheritance of useful knowledge. At some time and place, however, they were not international or even national, but purely local; and an important branch of the studies of the specialists among economic historians is the determination of the means of their dissemination and the courses which it took from one inhabited part of the globe to another. Some part of this diffusion of knowledge is traceable to the influence of trade; but there

must have been still earlier stages in the process, by which the foundations of that trade were first laid, and there is little doubt that the enforced migrations of refugees, both singly and in large communities, played a great part in widening the field of application of most of the industrial arts on which modern civilization is based.

This is a process to which the development of British industry has been particularly indebted in the past. The weaving industry owes much to the Twelfth Century onwards; the exodus from France of the Huguenots, about 100,000 of whom settled in this country, marked the beginning of many local industries in the districts where they settled, glass manufacture being one of particular note; and the foundation of many British families of Dutch origin is traceable to the disturbed conditions obtaining in the Low Countries in the Seventeenth and Eighteenth Centuries. It is not too much to claim that an appreciable part of the long-standing commercial supremacy of Great Britain is attributable to the attraction which the relative freedom of British living conditions has exercised upon men of skill and acumen who have found it impossible to apply their abilities in security on the Continent. The process has developed even more markedly, of course, in the United States, as is evidenced by the diverse nationalities represented by the names of prominent American industrialists, especially during the past half-century or so. As Sir John Hope Simpson, formerly vice-president of the Refugee Settlement Commission at Athens, has observed, there is no instance of a country which has suffered by the assimilation of refugee immigrants.

At the present time, these islands contain a more than usually large population of refugees from the northern and central parts of Europe, whose coming created problems of some complexity in the years immediately preceding the outbreak of war. Their arrival began at a time when the country was only beginning to recover from the prolonged depression and unemployment was still widespread; hence the conditions imposed by the Government that the refugees must re-emigrate as soon as possible, and that they must not engage in many forms of paid employment. In the light of subsequent events, it is open to question whether this latter condition was so wise as it appeared, no doubt, to its sponsors; certainly, it resulted in the departure to other countries, notably the United States, of many skilled scientists and others whose services might have proved a valuable asset in present circumstances. Other refugees, however, did succeed in establishing themselves in this country without infringing the discouraging regulations and have shown once again the value of initiative and determination in overcoming obstacles that might well have been accepted as insuperable in rendering themselves self-supporting and productive members of the community.

Something of what they have accomplished is set forth in a pamphlet\* recently published under the auspices of the Christian Council for Refugees from Germany and Central Europe, and bearing the title which heads this article. Reasons of national security are responsible, presumably, for the anonymity with which the various establishments are veiled, but the illustrations cover the manufacture of leather belting, electric torches, leather and fabric gloves, cotton fabric, and cigarette papers, as well as the printing of silks by a special process. Reference is made, also, to a variety of plastic goods, paint brushes, varnishes, paints and enamels, industrial chemicals, springs, valves, metal tubing and optical glass, among a number of products of less directly engineering interest.

\**Refugees and Industry*. By C. C. Salway, London; Williams and Norgate, Limited.

## THE PRESIDENT'S EASTERN TOUR

On a trip that took him as far as Sydney, N.S., the president visited last month all branches of the Institute east of Montreal. With the nine branches that were included in his western tour last spring, Dean Young has now met with sixteen of the twenty-five branches across the country. He expects to visit the remaining branches in central Canada between now and the end of his term of office.

Everywhere he stopped, the president found enthusiastic and active groups, and he in turn left with members the impression that the Institute could not have been happier in its choice of its chief officer this year. His message to the membership, delivered in a forcible manner, painted a striking picture of the engineers' accomplishments and of the responsibilities that lie ahead of a great professional society in these trying times.

Several officers of the Institute accompanied the president again this year on the whole of the trip, or part-way. The fact that these engineers, occupying positions of importance, take of their time to make these visits is a tribute to the work of the Institute; their presence at these meetings is a contribution to the cause of professional unity. The national character of the Institute was once more illustrated by the fact that at all the meetings there were in attendance members of the Institute from other distant parts of the country whose work had taken them to the particular locality and who cheerfully joined with their confreres in welcoming the president.

Vice-President K. M. Cameron of Ottawa made the complete trip and his knowledge of the country provided for the group a perfect cicerone. Vice-President deGaspé Beaubien of Montreal, joined the party at Moncton and visited all branches from there on. The assistant general secretary also accompanied the president; the personal contacts thus established will certainly be of great help to him in carrying out his work at Headquarters.

The journey began under the best auspices as Councillor J. E. Armstrong of Montreal, chief engineer of the Canadian Pacific Railway Company, acted as host to the group in his private car for that part of the trip to the St. Maurice Valley and to Quebec. The presidential party at these branches also included Past President O. O. Lefebvre, who initiated the presidential visits to all branches of the Institute in 1933, and Past Councillor Huet Massue of Montreal.

In Quebec City, Dean Young and Mr. Cameron were entertained over the week-end by Past President A. R. Decary. The presence at Moncton of Past President H. W. McKiel and Vice-President G. G. Murdoch of Saint John contributed towards a very substantial representation.

At Sydney, members of the branch were the guests of the contractor at the naval base now under construction and, in true engineering fashion, the meeting was held in the cook house. This created an atmosphere of informality and friendliness which accounted for the success of the gathering.

The regional meeting of Council held at Halifax, in conjunction with the president's visit to the branch, holds the distinction, unique it is believed for such a gathering away from Headquarters, of having brought together the immediate past-president, Dean Mackenzie, and vice-presidents from three different zones, Messrs. Beaubien of Montreal, Cameron of Ottawa and Murdoch of Saint John. In addition there were present from outside, Councillor F. W. Gray of Sydney, Mr. G. A. Gaherty of Montreal, chairman of the Committee on Western Water Problems, and General Secretary L. Austin Wright whom business on behalf of National Selective Service had taken to Halifax. It is interesting to recall that during his visit to

## News of the Institute and other Societies, Comments and Correspondence, Elections and Transfers

the western branches last April, Dean Young also presided over a regional meeting of Council at Vancouver.

Past Councillor W. E. Bonn of Toronto joined the party at Saint John where an enthusiastic meeting was held.

The tour successfully ended at Arvida, Que., where the presidential visit coincided with the annual meeting of the Saguenay Branch. Past Councillor Massue of Montreal joined the group again here and Past Councillor Otto Holden made an unexpected appearance at the meeting and brought greetings from the Toronto Branch.

## PROFESSIONAL RECOGNITION IN THE SERVICES

For a long time the Council of the Institute has been interested in the possibility of engineers in the army securing the same professional recognition as is given to doctors of medicine and dentistry. There has been much personal investigation by officers of the Institute, particularly by presidents who have close contacts with officials at Ottawa, and by official correspondence between the Department of National Defence and the General Secretary.

At first glance it appears ridiculous that medical men and dentists should receive extra pay and rank as professional allowances when the engineer does not. The work of one is as professional as the other, in addition to which the engineer takes all the risks that go with the combatant forces. From all parts of Canada protests from individuals and from branches have come to Headquarters, and the Council has been very much concerned about it all.

The correspondence has been spread over a period of three years. There have been sympathetic and encouraging replies, but eventually the answer has been that nothing could be done about it. Throughout all these negotiations there has been close contact with the Association of Professional Engineers of Ontario and the Corporation of Quebec, and lately with the Dominion Council, so that no stone would be left unturned in the endeavour to support the interests of the profession.

The services rendered to the army by engineers are different from those rendered by the other professions. It is difficult to describe or define this professional work because engineers go on from one activity to another and frequently end up in a senior appointment that has nothing to do with engineering. On the other hand the medical man and the dentist stay in the special fields for which they were recruited. They seldom, if ever, leave these fields to take on the added responsibility of leadership and administration which so frequently is assumed by engineers. If a doctor left the medical field to take on other responsibilities he would not continue to receive his professional allowance—nor would the dentist.

Doubtless, considerations such as these have confused the case for the engineer, and have prevented the authorities from setting up allowances comparable to those given for other services. Making due allowance for all this, it still seems possible that for many appointments something could be done to reward for special services rendered.

The serious effect of the failure to distribute these extras equitably is that many excellent young engineers are choosing to go into services other than those requiring their special skill. It has been shown over and over again that an engineer makes much quicker progress and reaches greater heights through the other services. In fact there is a tendency for engineers already in such branches as Ordnance and Engineers to transfer to other branches in order to hasten promotion.

In the Imperial forces professional allowances are made to many engineers. It would seem to be reasonable that similar treatment should be given to Canadians. The case is not simple, but the Institute feels that it should be studied further before it is dismissed entirely.

1943 ANNUAL MEETING

For some time there has been some discussion among officials of the Institute as to the advisability of holding an Annual Meeting next year, other than the formal business meeting required by the by-laws.

During the last war, it was not possible to hold the professional meetings, but present conditions are not at all similar, and the experience both in Canada and the United States, has been that such meetings are unusually well attended. The great majority of the engineers are now engaged on work of primary importance to the war effort and they welcome the opportunity of assembling and discussing their mutual problems. The great success of the last annual meeting, in February, has made it evident that such functions serve a useful purpose at this time.

Acting upon these considerations, Council, at its last meeting held in Halifax, decided that the Annual Meeting of the Institute would be held next year and would be of usual length and nature. In view of the necessity of curtailing transport and of the little time that members can divert from their normal occupations it was further agreed that such a meeting should be held in one of the larger centres, such as Montreal or Toronto. An invitation from the Toronto Branch having been accepted, it is now definite that the Fifty-Seventh Annual General and Professional Meeting of the Institute will be held at the Royal York Hotel, in Toronto, on February 11th and 12th, 1943.

AN OPPORTUNITY FOR MEMBERS' HOSPITALITY IN WAR-TIME

At a recent meeting of Council attention was drawn to the considerable number of sons (and daughters) of members of the Institute who are serving in the Dominion's armed forces. Many of them are stationed in Canada, but away from their homes. It was thought that the wide extent of our membership and our comprehensive branch organization might be utilized to help these young people by providing some measure of hospitality at members' homes, affording a welcome change from the regular routine of army, navy, or air force life. The idea met with general approval.

At most stations in Canada some provision has already been made, both by government and private action, for recreation centres, hostels, and social facilities. The idea in the minds of councillors, however, was something different from this. They thought rather of the suggestion that our members in or near military centres might entertain in their homes the relatives and connections of their fellow-members elsewhere. In this way the young soldiers or airmen would meet people whose calling and social outlook were like those of their own parents. Actually in many of such homes the presence of such visitors would help to make up for the absence of a son or daughter also serving in the forces. How can the introductions needed for this hospitality best be arranged?

It seems plain that such matters would have to pass through the hands of someone at each of our branch centres who has personal knowledge of most of the Institute members living in that branch area. Our branch secretaries have this qualification. No one knows better than the general secretary the indispensable part which these officers take in the activities of the Institute, and the sacrifices of time and energy which they make in doing so. If they are willing to shoulder this additional burden, they will be helping in the war effort, indirectly it is true, but in a very effective way.

Considerable progress has been made in the arrangements for the joint meeting between the American Society of Civil Engineers and The Engineering Institute of Canada. A rough draft of the programme is presented herewith. The details of the technical sessions have not been fully determined, but it has been agreed to include such subjects as structures, construction, highways, power, civilian protection, surveying and mapping.

One whole morning will be devoted entirely to the discussion of manpower controls. Negotiations are under way to secure both from Canada and the United States, the best informed officials in this field. It is expected that following the principal addresses, there will be an extensive discussion.

At the time of going to press, the names of most speakers and authors have been determined, but are being withheld until the complete programme is prepared. Eventually this programme will be sent to all members so that they may be fully informed.

Draft of Programme for Joint Meeting

American Society of Civil Engineers and The Engineering Institute of Canada at Niagara Falls, Ont., October 11th-15th, 1942.

**Sunday, October 11th,** Committees of the Board of Direction, American Society of Civil Engineers.

**Monday, October 12th,** Board Meeting, American Society of Civil Engineers.

**Tuesday, October 13th,** local sections conference, American Society of Civil Engineers delegates from 26 local sections in northeastern part of the United States. Regional meeting of the Council of the Engineering Institute.

**Wednesday, October 14th**

A.M. Greetings from officers of each society followed by a conference on "Manpower Control" based on (a) experience in the United States, (b) experience in Canada.

Luncheon—Address by Dean C. R. Young, President of The Engineering Institute of Canada.

P.M. Technical sessions

Dinner — Dance.

**Thursday, October 15th**

A.M. Technical sessions.

Luncheon—

P.M. Technical sessions.

WEBSTER LECTURES

Headquarters has lately received several requests from members and other sources for copies of the book "Structural Defence Against Bombing" containing the lectures delivered last April by Professor F. Webster, under the auspices of the Institute.

Unfortunately, it has not been possible to comply with those requests on account of the author's own restrictions. The question of distribution of the lectures was discussed at length with Professor Webster before his return to England. The professor insisted that circulation of copies of his notes be limited to those who attended the lectures, in addition to a few other persons whom he mentioned specifically.

A sub-committee of the Institute Committee on the Engineering Features of Civil Defence is preparing an abridged edition of the notes which should be available for wider distribution in the near future. This edition will contain all the original illustrations and the substance of the information given by Professor Webster in the lectures. In some respects, it will be more valuable than the complete edition which had to be issued in a hurry. The information contained in the abridged edition will be classified in such a manner as to make it a useful reference book.

The selection of a dean for a large school of engineering is not an easy matter, especially at a time of stress like the present. Such an officer should possess professional competence, ripe experience in university teaching work, marked administrative ability and a sympathetic knowledge of students and their many difficulties. He should be familiar with the needs of university research work, be something of a financial wizard, and, in addition to a number of other admirable qualities, should have an inexhaustible supply



Dean J. J. O'Neill, M.E.I.C.

of patience and tact. There are not many men who fill such a specification, but the new dean of the engineering faculty at McGill is like his distinguished predecessors in having a good supply of these desirable qualifications.

Realizing the University's responsibility to the large classes of students who are now enrolling in the faculty of engineering to qualify themselves for taking an effective part in Canada's war effort, Dr. Ernest Brown, M.E.I.C., has resigned as Dean of Engineering to devote himself to instruction. During his term as dean, from 1930 to the present, he has had to contend with many difficulties mainly due to the dislocation of economic and industrial conditions and to the violent changes caused by war. He dealt with these promptly and acceptably and now takes a well earned rest from administrative work.

He is succeeded by Dr. J. J. O'Neill, M.E.I.C., a McGill graduate who has had extensive experience in the fields of teaching, administration and research, and has already held two deanships in the university, having been Dean of Science in the Faculty of Arts and Sciences from 1935 to 1939, and Dean of Graduate Studies and Research for the past three years. He now takes up an equally arduous task which is of even greater importance to our supply of men qualified for technical service in the armed forces or in industry.

Dr. O'Neill's early training as a mining engineer was followed by a period of work for the Geological Survey of Canada (he was geologist with the Canadian Arctic Expedition in 1913-16), and by years of practice as an economic geologist in India, Canada and elsewhere, dealing with the geological aspect of engineering work in the production of oil, coal, and metals. After a period of service at McGill as assistant and associate professor, he became Dawson professor of Geology in 1929, and later held the two deanships previously mentioned.

The school of engineering at McGill is fortunate in securing as Dean a man whose long and successful collaboration in engineering work has given him wide knowledge of the problems of engineering education and engineering practice.

In spite of the appalling debit balance of war, there are many significant items on the credit side. Under the stimulus of war, all human activity is greatly speeded up. Political evolution and scientific development stride forward in a few months over new territory which it might ordinarily take decades to capture. For instance, the patient discoveries of medical research are now provided with a testing laboratory which is global in scope. One of the interesting aspects of this accelerating process is the growing interdependence and interrelation of agriculture and engineering. With the critical shortage of raw materials, engineering and chemistry are turning more and more to agriculture. An ever growing portion of the synthetic rubber programme is being based on agriculture; several new processes for the production of high test aviation gasoline from grain alcohol are being closely studied and pilot plants are being rushed to completion; many of the ever widening range of plastics are based on agricultural products. The new methods for the processing of foods such as dehydration, crystallization and quick freezing, coupled with the latest researches in nutrition and scientific farming, are opening up new and exciting possibilities. My associations, as an engineer, with the Department of Agriculture and the Quartermaster Corps have been among my most interesting contacts in Washington. But there is an even more direct way in which engineering and agriculture are working together. Last month, this letter discussed the agricultural and social implications of great construction programmes such as the T.V.A. A week or so ago, I attended an extensive and carefully planned demonstration of mechanized agricultural equipment. The demonstration took place on an experimental farm just outside Washington and lasted about four hours. There are only about ten or twelve visitors at each demonstration and, over the course of several months, most of the important government officials concerned and the representatives of most of the agricultural countries have attended. The day I was there, Canada, Russia and Australia were represented. Most people have heard of the Ford-Ferguson "Unit Type" of agricultural tractor. One of Mr. Henry Ford's defeats was the failure of his Fordson tractor to live up to his expectations. He took it off the market in the United States in the late twenties. Thanks to the invention by an Irishman named Ferguson of an hydraulic linkage and thanks to over ten years of study and experiment, it has now been possible to develop a piece of apparatus which Mr. Ford claims will overcome the hitherto cramping difficulties in the way of mechanized agriculture on a large scale. When tractors were operated by dragging implements behind them, heavy machines were necessary to supply the traction and to counteract the tendency of the tractor to turn back about its own drivers. In the unit system, the plough, or harrow or other equipment is part of the tractor, operated by a finger tip hydraulic control and connected by a triangular linkage so designed as to transmit the thrust against the plough (etc.) into a downward thrust over all four wheels of the tractor. In this way the weight of the tractor and the equipment can be considerably reduced. It is claimed that the reduction would be sufficient to merit, as a wartime measure, the substitution of new light tractors and equipment for old, over-age, heavy types which could be used as much needed scrap metal. The tractor is light enough and the hydraulic control simple enough that young boys and women can replace men operators. Included in a vast and carefully worked out programme are the saving of about a million tons of scrap, the release of just under a million agricultural workers for the services or factories and the saving of a quarter of a billion gallons of gas a year. The demonstration was under the personal direction of Mr. Ferguson. The several little lectures, which interspersed the demonstration, developed the full wartime implications of the programme and then went on to show that, since agriculture would probably be the basic con-

sideration in post-war reconstruction, the future happiness and welfare of mankind was not unconnected with the future of the Ford-Ferguson Unit Tractor. In spite of occasional lapses and in spite of his seventy-nine years, the "Wizard of Detroit" has not lost his touch! Seriously, though, and apart from the merits of this particular programme and equipment, it was borne in upon me that engineers have not done nearly as well for the farmer as they have for his city brother and that agricultural mechanization has been allowed to lag behind industrial mechanization. If agriculture and industry are to pull with equal weight in the double harness of human progress, the balance must be speedily redressed.

Many important positions in Washington are held by women whose names seldom get into print but who wield considerable power and do a great deal of important work. There were several such women as guests at a small luncheon which I attended recently. Miss Vera Michaels Dean, Research Director of the Foreign Policy Association and author of numerous pamphlets and books was there. She talked about American foreign policy in respect to Russia. Miss Bernice Lotwin, Assistant Legal Counsel for the Manpower Board, told us of trends in the mobilization of both manpower and womanpower. Miss Mary Craig McGeachy, who is the representative of the Ministry of Economic Warfare at the British Embassy, is a Canadian whom I had known for some years. Previously, she was the British Dominions Liaison officer on the League of Nations Secretariat at Geneva. The fourth guest was Miss Barbara Ward, the Foreign Editor of the London *Economist*. She graduated in 1935 from Oxford where she took first class honours in three majors—Politics, Economics and Philosophy! She had been to tea at the White House with Mrs. Roosevelt the previous afternoon and was featured in "My Day." During the discussion, a number of interesting points emerged. For instance, support of Russia is important not only from the point of view of maintaining a front against Germany but also in view of the future necessity of a land front against Japan and aid to China. The subjugation of Japan by the tortuous process of reconquering lost Islands, step by step was felt to be an extremely difficult alternative. It was interesting to have explained how the facts and techniques of economic warfare, while serving their present purposes, were being organized to serve as the guide and framework for the reconstruction of the post-war world. It was thrilling to hear of the complete mobilization in Britain of manpower and womanpower and also of time and money. It was good to be told that the controls of total war had lead, not to totalitarianism, but to a new understanding of democracy—not the social service conception of the state caring for the individual—but the vital conception of the state depending upon the total efforts of every individual—in a vast communal effort for survival.

August 24, 1942.

E. R. JACOBSEN, M.E.I.C.

### CORRESPONDENCE

195 Maple Avenue,  
Quebec, Que.

L. AUSTIN WRIGHT, Secretary,  
Engineering Institute of Canada,  
2050 Mansfield Street, Montreal, Que.

Dear Sir:—

A little has been written and much more will be written about rehabilitation after the war. I would like to make an observation to the Committee on Post-War Problems.

In western Canada any rehabilitation will have to be connected directly or indirectly with development in agriculture. It has been proposed by Mr. P. M. Sauder, M.E.I.C., that more land in the southern part of the Prairie Provinces be opened up by the use of irrigation. This is an

excellent project and would provide employment for engineers as well as providing more farm land.

By opening up more agricultural land the engineer should realize that to make this project a success the man placed on the farms must be competent to operate them, as nothing will wreck an irrigation project more thoroughly than incompetent farmers. After the last war many returned soldiers were placed on farms by the Government. Many of these men had no farm training and went through trying times and eventually, had to abandon their land.

The present Government has expressed its intention of placing veterans of the present war on the land. Any new irrigation project would be the obvious place to send these men. With these facts in mind it would be well if the advisers to the Government on any new irrigation project would point out that farmers are skilled in their trade and that farms, especially farms in irrigation areas, are not places for people with no skill at farming.

Engineers are too often guilty of forgetting everything but the technical aspects of projects in which they are interested. In rehabilitation particularly, the human element is, in the final analysis, the only element to be considered. We, as engineers, should be sure that the works of our heads and hands are of real benefit to Canada. By following in the footsteps of C. D. Howe, Hon. M.E.I.C., and taking a vital interest in the problems of Government, we will assure Canada of the answers to her post-war problems.

Yours truly,

(Signed) C. K. HURST, M.E.I.C.,  
R.C.N.V.R.

### MEETING OF COUNCIL

A Regional Meeting of the Council of the Institute was held at the Nova Scotian Hotel, Halifax, N.S., on Friday, August 7th, 1942, convening at ten o'clock a.m.

Present: President C. R. Young (Toronto) in the chair; Past-President C. J. Mackenzie (Ottawa); Vice-Presidents deGaspé Beaubien (Montreal), K. M. Cameron (Ottawa), and G. G. Murdoch (Saint John); Councillors F. W. Gray (Sydney) and J. R. Kaye (Halifax); General Secretary L. Austin Wright, and Assistant General Secretary Louis Trudel. There were also present by invitation—Past-Vice-Presidents F. A. Bowman (Halifax) and S. C. Miffen (Sydney); Past Councillors W. P. Copp, F. W. W. Doane, H. S. Johnston, I. P. Macnab and Harvey Thorne, of Halifax; P. A. Lovett, chairman, S. L. Fultz, immediate past-chairman, and Dr. A. E. Cameron, A. E. Flynn, J. D. Fraser and J. A. MacKay, members of the executive of the Halifax Branch; G. A. Gaherty (Montreal), chairman, Committee on Western Water Problems, and member of the Committee on Professional Interests and the Finance Committee.

The president extended a cordial welcome to all councillors and guests, and asked each person present to rise and give his name, place of residence, and Institute affiliation. He invited everyone to take part in the discussions, as the opinions and advice of past officers would be very helpful to Council.

The general secretary read resolutions which had been submitted by eight of the Institute branches in response to a resolution passed and circulated by the Saint John Branch, urging Council to take immediate action with a view to obtaining for engineers in the armed forces the same recognition in regard to rank and pay as that accorded to members of the medical and dental services.

Mr. Wright pointed out that this matter had been receiving the attention of Council for over three years. Strong representations had been made to the Department of National Defence on several occasions. Considerable correspondence and many interviews had culminated in a letter from the Department dated January 2nd, 1942, stating that no action could be taken. Recent correspondence between the president of the Dominion Council of

Professional Engineers and the Minister of National Defence for Air, indicated that the matter had again been considered by the Defence Council and that the same decision had been reached "that it is not possible to take action to increase the rates of pay for Engineer Officers."

The general secretary outlined briefly some of the difficulties in the way of obtaining such recognition for Engineer Officers. One of the greatest troubles was to define the term "engineer" and to find any officer whose work was restricted to that field. Moreover, enlistment of engineers is not restricted to any one branch of the service. Frequently, members of the profession are in positions where they are not doing professional work. In the case of medical doctors there is no difficulty in defining their work. If a doctor in the active services were not practising his profession he would not receive the professional allowance.

Mr. Wright stated that there were many difficulties in the way, but suggested that the matter might be taken up once more with the Department and if it is found definitely that nothing can be done, an announcement to that effect should be made in the *Engineering Journal*, so that members of the Institute may know that the matter had received the attention of Council.

Past-President Mackenzie was entirely in sympathy with the purpose of the resolutions, but from a personal knowledge of the situation felt that little more could be done at the moment. In his opinion the Defence Council would have no objection to an announcement being made in the *Journal*, but suggested that the matter might be discussed with Major-General Letson.

Following further discussion, it was decided that the general secretary, after consultation with Major-General Letson, should prepare an item for the *Journal*.

A letter was presented from Councillor J. G. Hall, chairman of the Institute's Membership Committee, advising that he had nothing definite to report on at the moment, but his committee would be very glad to have any further suggestions which the members from the Maritime provinces might care to submit.

The main point under consideration by the committee was the method of considering applications for admission to the Institute. In the brief discussion which followed it appeared that members present felt that Council was right in giving weight to the branch recommendation. It was pointed out that under present procedure Council does not make a decision contrary to the branch recommendation without first referring the case back to the branch for further consideration. The discussion was noted for transmission to Mr. Hall.

A brief report was presented from Dr. J. B. Challies, chairman of the Committee on Professional Interests, from which it was noted that satisfactory progress was being made by the Manitoba group in the preparation of a final draft of an agreement between the Institute and the Association of Professional Engineers of Manitoba.

The general secretary submitted comparative figures on the membership in the provinces of Nova Scotia and New Brunswick before and after the signing of the co-operative agreements. These figures showed a substantial increase in both provinces.

The general secretary read a progress report from Mr. W. C. Miller, chairman of the Institute's Committee on Post-War Problems. The membership of the committee to date was noted, seven additional members having been appointed by the president since the last meeting of Council.

It was noted that the committee was now studying the replies received from the Institute branches regarding the questionnaire sent out by Mr. K. M. Cameron's sub-committee on construction projects of Dr. F. Cyril James' Committee on Reconstruction. It was also noted that a summary of the evidence presented by Dr. James before the Parliamentary Committee on Reconstruction and Re-Establishment had been prepared by Mr. Miller, and had

been published in the August number of the *Journal*. The report was accepted and approved.

Mr. Cameron commented briefly on the work of his sub-committee, the principal function of which would be to advise on the machinery that might be set up in connection with construction projects as a means of employment after the war, and consideration of the value of such projects. Mr. Cameron felt that this work offered a splendid opportunity to help in the re-establishment of engineers after the war.

Copies of a progress report of the Special Committee on the Engineering Features of Civil Defence were distributed to the meeting. This report outlined briefly the sequence of events leading to the appointment of the committee. The committee at present consists of thirteen appointed members, five of whom are also branch committee chairmen, and nine branch committee chairmen, who are ex-officio members of the committee. In anticipation of Council's approval, the programme was being carried on under the various headings of the "terms of reference," a revised draft of which was submitted for approval.

Mr. Macnab, chairman of the Halifax Branch committee, reported on the progress being made in Nova Scotia. He had received splendid co-operation in getting his committee organized. With copies of Professor Webster's lectures now available, the committee would be able to start its active work.

The president reported that additional members had been appointed to the committee since the last meeting of Council. In his opinion it was important to note that this committee was working in close co-operation with the Government's A.R.P. Committee under Dr. R. J. Manion.

The general secretary read a report from Mr. Willis MacLachlan, chairman of the Committee on Industrial Relations, from which it was noted that an organization meeting had been held in Toronto on July 25th. Additional members had been appointed to the committee by the President.

The report recommended that certain articles be published in the *Engineering Journal* and that during the year each branch of the Institute should have presented before it a paper dealing with either the broad subject of industrial relations or some phase of it. The committee stands ready to assist branches, if so desired in obtaining suitable speakers to present such papers. The committee has decided on four subjects for study and later report.

The general secretary read a letter from the Institution of Mechanical Engineers, confirming their cabled advice of the award of the James Watt International Medal to Mr. A. G. M. Michell, F.R.S., of Melbourne, Australia, and advising that as it is not likely that Mr. Michell will be able to receive the award personally, it is proposed to ask the High Commissioner for Australia to receive the medal on his behalf at a ceremony to be held at the Institution headquarters some time in January 1943, to which the Institute will be asked to appoint an official delegate.

After some discussion it was decided to ask Lieut.-General A. G. L. McNaughton to represent the Institute on that occasion, or, if he is unable to be present, some other person to be appointed by him.

As chairman of the Finance Committee, Vice-President Beaubien reported that the finances of the Institute were in a sound condition, although he would not recommend any new undertakings at the present time.

Council noted with sincere regret the death of Councillor H. F. Morrissey, of Saint John, N.B., which had occurred in Montreal on June 25th, 1942.

On the motion of Vice-President Murdoch, seconded by Mr. Macnab, it was unanimously resolved that Mr. A. O. Wolff be appointed as councillor to represent the Saint John Branch until the next annual election.

The general secretary read a brief progress report from Mr. H. F. Bennett, chairman of the Committee on the Training and Welfare of the Young Engineer, from which

it was noted that fourteen of the Institute branches had appointed Committees on Student Counselling. The committee hoped that the remaining branches would appoint their committees before the opening of the school year in September. The distribution of the booklet "The Profession of Engineering in Canada" had been extended to cover every English speaking high school in the Dominion. Further copies are being distributed through the branch Student Counselling Committees. The committee emphasizes the necessity of increased activity among the younger members, and further studies of the possibilities in this field are being continued. The committee hopes to make a further report on this phase of its activity before the next annual meeting.

The president reported that a French version of the booklet "The Profession of Engineering in Canada" was nearing completion and would be ready for distribution shortly.

At the annual meeting held in February 1942 the question of prizes for Students and Juniors of the Institute had been referred by Council to Mr. Bennett's committee for consideration, and the committee now presented the following report:

*To the President and Members of Council:*

At the meeting of Council at the Annual Meeting of the Engineering Institute of Canada at Montreal in February, 1942, the question of prizes for Student and Junior members was discussed and the whole matter of these prizes was referred to the Committee on the Training and Welfare of the Young Engineer for their report.

The present prizes consist of the Martin Murphy prize for the Maritime Provinces, the Ernest Marceau prize and the Phelps Johnson prize for the Province of Quebec, the John Galbraith prize for the Province of Ontario, and the H. N. Ruttan prize for the Western Provinces.

This matter was referred to the members of this committee and the twenty-five branches of the Institute on April 8th. Again on July 4th a circular was issued to this same group, especially dealing with this matter of Institute Student and Junior prizes.

Replies have been received from about 50 per cent of the branches, and not one reply has indicated that these prizes should be discontinued. Hearty approval of the prizes was general. Suggestions were made as to the administration of these prizes, and based on this information your Committee is ready to report at this time.

(1) It is recommended that the five Student and Junior prizes be continued with extension if it is financially possible.

(2) The following programme of publicity should be carried out each year in order that every member of the Institute who might be a competitor may be advised of the terms and time of the competition:—

(a) Editorial notice on the subject should be published in the *Journal*.

(b) The President and General Secretary, on their visits to Branches, should emphasize these prizes.

(c) The General Secretary should issue a special letter to each Branch in September of each year, drawing the attention of the Branch Secretary to the prize competition and instructing him as to the circularization of all Junior and Student members of the Branch.

(d) The special branch committee having to do with Junior activities should be urged to follow up this competition and see that papers are presented before the Branch in time for entry.

(e) As far as it is possible, every Branch should hold at least one meeting each year for the Junior members, at which meeting papers entering for these prizes could be read, and in addition, branch prizes given to the extent possible in the separate branches.

(3) It is evident from our investigations that those branches which have specialized in Junior activities have

had considerable success in the presentation of papers suitable for these prizes. This is especially true in the Peterborough Branch where in five successive years a member of that Branch has won the John Galbraith Prize.

Respectfully submitted on behalf of the Committee.

(Signed) HARRY F. BENNETT, M.E.I.C.,  
*Committee Chairman.*

July 30th, 1942.

The general secretary reported that the American Society of Civil Engineers is planning to hold its Fall Meeting in Niagara Falls, Ontario, during the week of October 11th. The first two days would be devoted to committee meetings of the A.S.C.E., and the professional meetings would be held on Wednesday and Thursday, the 14th and 15th. The Society had invited the Institute to participate with it in the meeting, making it clear that the Institute would not be involved in any expense, but would participate by providing speakers for the luncheons and the dinner, and for some of the technical sessions. At a recent conference in Montreal, Mr. Wright and Mr. Seabury had discussed the matter in detail and had drawn up a tentative programme.

The proposal was received with enthusiasm, and it was unanimously agreed that the Institute would participate in and support the joint meeting in every way possible.

By way of recognition of the splendid service rendered to the Institute by Professor Webster during his recent visit to Canada, it was proposed that an Honorary Membership be given to him. Professor Webster, through the medium of lectures to certain branches of the Institute and a series of lectures on "Structural Defence against Bombing," given under the auspices of the Institute in Toronto, as well as by special services rendered to the active service forces and specific industries, had rendered an unusual service both to the Institute and to Canada. The notes of his lectures, which had been published and circulated by the Institute, perhaps constituted the best and most up to date publication on this vital topic. Therefore, on the motion of Past-President Mackenzie, seconded by Vice-President Beaubien, it was unanimously resolved that the name of Professor Frederick Webster, Deputy Chief Engineer, Ministry of Home Security, London, England, be submitted to the next meeting of Council for nomination to Honorary Membership in the Institute. Subsequent to the nomination a ballot will be submitted to all councillors.

Attention having been drawn to the fact that Mr. H. C. Burchell, of Windsor, Nova Scotia, had been a Member of the Institute since 1887, it was unanimously resolved that the greetings of this Council be sent to Mr. Burchell.

A number of applications were considered and the following elections and transfers were effected:

*Admissions*

Members.....	10
Junior.....	1
Students.....	4
Affiliates.....	3

*Transfers*

Juniors to Members.....	2
Students to Members.....	2
Students to Juniors.....	3

A letter was read from Mr. A. A. Turnbull, President of the Association of Professional Engineers of the Province of New Brunswick, expressing regret at his inability to attend the meeting, and extending greetings and best wishes.

On behalf of the past officers present, Colonel Doane expressed sincere thanks to Council for its courtesy in affording them the privilege of attending this meeting.

It was left to the president and the general secretary to decide on the date for the next meeting of Council.

There being no further business, the Council rose at one o'clock p.m.

## ELECTIONS AND TRANSFERS

At the meeting of Council held on August 7th, 1942, the following elections and transfers were effected:

### Members

- Finlayson, Harold Musgrave**, B.Sc. (Civil), (McGill Univ.), hydraulic engr., Shawinigan Water & Power Company, Montreal, Que.  
**Loomis, Dan McKay**, B.Sc. (Mech.), (McGill Univ.), sources officer, tank production bl., Dept. of Munitions and Supply, Montreal, Que.  
**Matte, Raymond E.**, B.A.Sc., C.E., (Ecole Polytechnique), engr., sales dept., Canadian Tube and Steel Products Ltd., Montreal, Que.  
**Millman, Joseph Malcolm**, B.Eng. (Mech. and Civil), (Univ. of Sask.), 12 Ontario Street So., St. Catharines, Ont.  
**O'Neill, John Johnston**, B.Sc. (Mining), M.Sc. (Geol.), (McGill Univ.), Ph.D. (Geol.), (Yale Univ.), Dean of the Faculty of Engineering, McGill University, Montreal, Que.  
**Smith, James Morrison**, B.A.Sc. (Univ. of Toronto), dftsman., Dept. of Highways of Ontario, Toronto, Ont.  
**Steven, James Harry Alexander**, locating engr., Dept. of Public Works, Kamloops, B.C.  
**Walters, Paul W.**, B.A.Sc. (Univ. of Toronto), investigator, organization branch, Civil Service Commission, Ottawa, Ont.  
**Wilson, John Shaw** (Royal Tech. Coll.), president and gen. mgr., Tye Machinery Co. Ltd., Vancouver, B.C.

### Junior

- McQuarrie, Alexander Macrae**, B.Sc. (Elec.), (Univ. of Alta.), aircraft instrument engr., Can. Gen. Elec. Co. Ltd., Peterborough, Ont.

### Affiliates

- Davis, Robert** (Royal Tech. Coll.), hull engr., Wartime Merchant Shipping Ltd., Montreal, Que.  
**Hamel, Joseph Henry** (St. Dunstan's Univ.), supt. and engr. for E. G. M. Cape & Company, at St. John's, Nfld.  
**Hinton, Ralph**, mtce. engr., Queen's University and Kingston General Hospital, Kingston, Ont.

### Transferred from the class of Junior to that of Member

- Gaudefroy, Henri**, B.A.Sc., C.E. (Ecole Polytechnique), B.S. (Elec.), (Mass. Inst. Tech.), asst. professor of mathematics, Ecole Polytechnique, Montreal, Que.

**Roy, Joseph Eugene Leo**, B.A.Sc., C.E. (Ecole Polytechnique), B.Eng. (Elec.), (McGill Univ.), power sales engr., Quebec Power Company, Quebec, Que.

### Transferred from the class of Student to that of Member

- Chapman, Stuart M.**, B.Eng. (Chem.), (McGill Univ.), research associate, Pulp & Paper Research Institute of Canada, Montreal, Que.  
**Harrigan, Mayo Arthur Perrin**, Lieut. (SB), B.Sc. (Elec. & Mech.), (N.S. Tech. Coll.), asst. to the chief engr., H.M.C. Dockyard, Halifax, N.S.

### Transferred from the class of Student to that of Junior

- Leroux, Fred Clements**, B.Sc. (Agric.), (Univ. of Sask.), field and agric. engr., British Columbia Plywoods Ltd., Vancouver, B.C.  
**Peterson, Robert**, B.Sc. (Civil), (Univ. of Sask.), S.M. (Harvard Univ.), asst. engr., P.F.R.A., soil mechanics lab., University of Saskatchewan, Saskatoon, Sask.  
**Watson, John Crittenden**, B.Eng. (Mech.), (McGill Univ.), service engr., Combustion Engineering Corporation Ltd., Montreal, Que.

### Students Admitted

- Campbell, George I.**, B.Sc. (Queen's Univ.), testman, Can. Gen. Elec. Co. Ltd., Peterborough, Ont.  
**Flemming, William Dunlap** (McGill Univ.), asst. field engr., Can. Dredge & Dock Co. Ltd., 67 Queen St., Truro, N.S.  
**Molyneux, Thomas Emmet**, B.Sc. (Civil), (Univ. of Sask.), c/o U.S. Public Roads Administration, Muskwa, B.C.  
**Ormiston, Russell Willson** (Univ. of Sask.), c/o U.S. Public Roads Administration, Muskwa, B.C.

By virtue of the co-operative agreements with the Provincial Professional Associations, the following elections and transfers have become effective:

### Member

- Phillips, George L.**, mining engr., Saint John Dry Dock & Shipbldg. Co. Ltd., East Saint John, N.B.

### Transferred from the class of Junior to that of Member

- Carey, Roger Packard**, B.Eng. (N.S. Tech. Coll.), instr'man., Dept. of Highways, Sackville, N.B.

### Student

- McNally, Reginald Winnett**, B.Sc. (Mech.), (Univ. of Sask.), 2nd Lieut., O.T.C. (W.C.), C.A.A. Wing, Gordon Head, B.C.

## Personals

**H. W. McKiel**, M.E.I.C., past president of the Institute, took office in July as district governor of Rotary International, the world-wide organization which has more than 5,000 clubs with 210,000 members devoted to service to their communities and their countries. Mr. McKiel is Dean of the Science Faculty of Mount Allison University in Sackville, N.B. He is a former president of the Association of Professional Engineers of New Brunswick and the Maritime Chemical Society, vice-president of the Canadian Institute of Chemistry and chairman of the Maritime Branch of the Canadian Institute of Chemistry.

Unanimously elected at Rotary's recent convention in Toronto, Ont., by delegates representing Rotary clubs in more than 50 countries of the world, Mr. McKiel will devote much of his time during his year in office to visiting the 33 Rotary clubs in Nova Scotia, New Brunswick, Newfoundland, Prince Edward Island, Quebec and Maine, U.S.A., which comprise the 192nd district of Rotary International, and advising officers and committeemen on the activities of their clubs. He will serve as district governor until shortly after Rotary's 1943 convention in Philadelphia, Penna., in June.

**A. O. Wolff**, M.E.I.C., district engineer, Canadian Pacific Railway, Saint John, N.B., has been appointed councillor to represent the Saint John Branch of the Institute until the next annual election, replacing Lieut.-Colonel H. F. Morrissey who died recently. He joined the Canadian Pacific Railway Company in 1908 as an instrument man and in 1913 he became an assistant engineer on field work. In 1915 he was appointed division engineer at Brownville Junction, Maine, U.S.A., and in 1929 he was transferred to London, Ont., as a division engineer. In 1930 he became

## News of the Personal Activities of members of the Institute, and visitors to Headquarters

assistant district engineer at Toronto and a year later he received his present appointment.

Mr. Wolff was chairman of the London Branch of the Institute in 1937.

**G. H. Rogers**, M.E.I.C., has been appointed secretary of the Bell Telephone Company of Canada and has moved



G. H. Rogers, M.E.I.C.

from Toronto to Montreal to take over his new duties at the company's head office. He was born and educated in England where he began his career with the National



H. W. McKiel, M.E.I.C.



A. O. Wolff, M.E.I.C.



S. W. Gray, M.E.I.C.

Telephone Company in 1902. He came to Canada in 1906 as a draftsman with the Bell Telephone Company of Canada. A year later he became development engineer and in 1910 he was appointed transmission engineer. From 1913 to 1916 he was on construction work with the company and during the years 1917 to 1920 he was engaged on rate studies and surveys. In 1921 he was appointed general commercial engineer at Montreal, and in 1930 he was named first general commercial manager of the newly established western area, with headquarters in Toronto, a position from which he has just been promoted.

**W. R. Fricker, M.E.I.C.**, has been appointed district engineer of Canadian Westinghouse Company at Montreal. Born in England, he graduated from the Swansea Technical College, Wales, and served his apprenticeship with the Western Engineering Company at Swansea. From 1923 to 1929 he was successively employed as electrical engineer with the Torque Electrical Engineering Company and the Mond Nickel Company, Limited, at Swansea. He came to Canada in 1929 as a district service engineer with Canadian Westinghouse Company at Regina, Sask.

**Paul E. Cooper, M.E.I.C.**, manager of the Thames Board Mills, Limited, at Warrington, Lancashire, England, has recently been appointed president of the local Chamber of Commerce. Born in Ottawa, Mr. Cooper graduated in civil engineering from McGill University in 1923. Upon graduation he joined the Singer Manufacturing Company as a topographical engineer in charge of surveys on the company's limits north of Ottawa. Later he became location engineer in connection with the construction of a standard gauge railroad in the vicinity of Thurso, Que. In 1926 he joined the Canadian International Paper Company and was engaged on mill construction at Gatineau. Later he was resident engineer on construction of the Hydro Electric Development at Kent's Falls, N.Y., for the same firm. In 1930 he became plant engineer in charge of maintenance and construction work at the Piercefield Mill in northern New York State. His services later were transferred to a subsidiary company—the Continental Paper and Bag Corporation—and subsequently he became plant engineer and then manager of the Rumford mill.

Mr. Cooper's association with the Thames Board Mills began in 1936, when he went to Warrington, England, in charge of construction.

**H. M. Howard, M.E.I.C.**, who has been with the Eldorado Gold Mines, Limited, Port Hope, Ont., since the spring, has been appointed mill superintendent of the mine at Great Bear Lake, Port Radium, N.W.T.

**W. I. Shuttleworth, M.E.I.C., R.C.A.F.**, who has been stationed at Gander, Newfoundland, since December, 1941, has been promoted to Flight-Lieutenant and transferred to St. John's, Newfoundland.

**S. W. Gray, M.E.I.C.**, assistant hydraulic engineer of the Nova Scotia Power Commission, has been appointed maritime regional representative of the Wartime Bureau of Technical Personnel with offices at Halifax. He will be assisted by G. F. Bennett, M.E.I.C., and A. D. Foulis, M.E.I.C., who will both act in an honorary capacity.

Mr. Gray, who is on leave from the Nova Scotia government is a councillor of the Institute representing the Halifax Branch. He is also joint secretary of the Halifax Branch and the Association of Professional Engineers of Nova Scotia. He is a past-president of the Association of Professional Engineers.

**G. McL. Pitts, M.E.I.C.**, has been unanimously elected a Fellow of the Royal Institute of British Architects by a special resolution of the Council of the Institute. He was at the same time elected a member of the Council. Mr. Pitts is a councillor of The Engineering Institute of Canada representing the Montreal Branch, is president of the Royal Architectural Institute of Canada, president of the Graduates' Society of McGill University, past-president and councillor of the Province of Quebec Association of Architects and a member of the firm of Maxwell and Pitts, architects, Montreal.

**Flight Lieutenant Cyril G. Carroll, M.E.I.C.**, formerly at the Directorate of Works and Buildings, R.C.A.F. Headquarters, Ottawa, is now Camouflage Officer at Western Air Command of the R.C.A.F., Victoria, B.C.

**H. B. Dickens, M.E.I.C.**, has recently been appointed supervising engineer in the Department of Public Works at Ottawa. He returned to Canada from England last year, after having filled a two-year appointment with the British War Office at Woolwich Arsenal. Later he was attached as a consultant to the General Engineering Company at Toronto.

**C. Neufeld, M.E.I.C.**, has taken a position as assistant engineer in the Bridge Department of the Canadian Pacific Railway at Montreal. He was previously on the staff of the Dominion Bridge Company at Calgary as designing engineer. Mr. Neufeld, who graduated from the University of Saskatchewan in the class of 1935, was the winner of the H. N. Ruttan Prize of the Institute in 1938.

**T. C. Thompson, M.E.I.C.**, has recently returned from overseas, having been invalided out of the army. He had been in England with the Royal Canadian Ordnance Corps. Before enlisting in 1940 he was with the Bell Telephone Company of Canada in Montreal.

**M. M. Price, M.E.I.C.**, has recently been transferred from Port Arthur, Ont., to Prince Rupert, B.C., as assistant division engineer with the Canadian National Railways. He was previously assistant bridge and building master at Port Arthur.

# Obituaries

*The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.*

**W. L. Kent**, M.E.I.C., has recently returned from Nevada, U.S.A., where he was employed with Basic Magnesium Incorporated, and has taken a position with the Northern Construction Company and J. W. Stewart Limited at Vancouver, B.C.

**J. P. Estabrook**, Jr.E.I.C., has recently joined the staff of the Aluminum Company of Canada, Limited, at Shawinigan Falls, Que. He was previously employed with Price Bros. & Company, Limited, at Riverbend, Que., after having graduated from Queen's University in 1939.

**Edward Ryan**, Jr.E.I.C., has taken a position in the Works and Buildings Branch, Naval Service, Department of National Defence at Ottawa, as assistant engineer in charge of progress reports.

**J. G. Belle-Isle**, S.E.I.C., has recently been granted a commission as pilot officer in the navigation branch of the R.C.A.F. He has left for western Canada to attend a course in aerial navigation to qualify as an instructor. Before enlisting he was an engineer in the plant engineering department of the Bell Telephone Company of Canada at Montreal.

A graduate of the Ecole Polytechnique, Montreal, he was the winner in 1938 of the Ernest Marceau Prize of the Institute.

**G. R. McElroy**, S.E.I.C., who graduated from the University of Saskatchewan this year, has accepted a position with the Demerara Bauxite Company, Mackenzie, British Guiana.

**L. J. Ehly**, S.E.I.C., has accepted a position as resident engineer with the Department of Transport, Lethbridge, Alta. He was previously employed with the Royalite Oil Company at Turner Valley, Alta., after graduating from the University of Alberta with the degree of B.Sc., in 1941.

**C. E. McLean**, S.E.I.C., graduated from the University of Alberta this spring with the degree of B.Sc. in civil engineering.

**M. A. Phelan**, M.E.I.C., who has been manager of the Noranda Office of Peacock Bros., Limited, has been transferred to the Toronto office of the company.

**Flying Officer André Aird**, S.E.I.C., has been stationed at No. 9 Repair Depot, St. John's, Que., since last June, after having previously spent several months at No. 6 Depot at Trenton, Ont. Flying Officer Aird is a graduate of the Ecole Polytechnique, Montreal, from the class of 1938.

## VISITORS TO HEADQUARTERS

**Lieutenant Mayo Harrigan**, M.E.I.C., R.C.N.V.R., H.M.C. Dockyard, Halifax, N.S., on August 4th.

**Jules Mercier**, S.E.I.C., Canadian General Electric, Peterborough, Ont., on August 5th.

**N. R. Crump**, M.E.I.C., assistant to the vice-president, Canadian Pacific Railway, Montreal, Que., on August 11th.

**G. H. Thurber**, M.E.I.C., Department of Public Works of Canada, Ottawa, Ont., on August 20th.

**W. C. Wilkinson**, Jr.E.I.C., National Research Council, Ottawa, Ont., on August 21st.

**Major C. B. Bate**, M.E.I.C., R.C.E., St. Johns, Newfoundland, on August 26th.

**J. A. Mersereau**, M.E.I.C., Woodstock, N.B., on August 27th.

**G. A. Campbell**, S.E.I.C., Port of Spain, Trinidad, on August 28th.

**John Maurice Evans**, M.E.I.C., assistant manager of the Department of Development, Shawinigan Water and Power Company, died in the hospital at Montreal after a brief illness on July 28th, 1942. He was born at London, England, on October 7th, 1905, and came to Canada as a youth. He studied engineering at McGill University, Montreal, and he graduated in 1929 with the degree of Bachelor of Science in electrical engineering.

He spent his holidays in the summer with the Canadian Marconi Company one year and another on a field party with the Canadian International Paper Company. He joined the Shawinigan Water & Power Company in June, 1929, and after spending two years on system planning and equipment designing, he was transferred to the Department of Development, devoting his attention to industrial location studies and the development of new loads.



J. M. Evans, M.E.I.C.

During the summer of 1939 he went to England as a member of the delegation representing the Canadian Manufacturers' Association to discuss the possibility of Canadian industry giving assistance to Great Britain in time of war.

Last year when the Department of Trade and Commerce sought a man to act as chairman of the executive sub-committee on export control, Mr. Evans was chosen for this post. A department was organized under the direction of Mr. Evans, whose recommendations remedied an uncertain condition in connection with the issuance of export permits and effected a smooth co-ordination of effort. At the conference held in Toronto of the Canadian Manufacturers' Association on June 9th this year on manufacturing materials and shipping controls, Mr. Evans gave a resumé of the situation affecting export control in Canada. Two weeks later he went into hospital.

Mr. Evans joined the Institute as a Student in 1929, becoming a Junior in 1931. He was transferred to Associate Member in 1937 and in 1940 he became a Member.

**Fred Henry Kester**, M.E.I.C., died suddenly in Detroit, Michigan, on August 6th, 1942. He was born at Richland, Michigan, on September 5th, 1885, and studied engineering at the University of Wisconsin. He entered the employ of The Canadian Bridge Company Limited at Walkerville, Ont., in May, 1907, and with the exception of a short period in 1908-1909 when he left to continue his studies, he remained in that service until June 1, 1941, when because of ill health he retired.

During his active career he performed ably all the tasks connected with the engineering and contracting departments, and rose steadily to become president and general

manager in 1937. The designs which he made and the contracts he took, are distributed throughout Canada and overseas as well. In 1937 he became general manager of



F. H. Kester, M.E.I.C.

the Canadian Steel Corporation Limited at Ojibway, Ont., and of The Essex Terminal Railway. All of these companies prospered under his management.

Mr. Kester's leaving was mourned by his associates, with whom his relations were informal and friendly. His services were highly valued by the directors of the companies he served, and they insisted on his remaining on the active list as consultant.

Death came by heart failure at a time when he was again visiting the companies which he formerly managed. He was a life-long member of the Presbyterian Church of Richland, a member of The Engineering Institute of Canada, the Engineering Society of Detroit, the American Society of Civil Engineers, the New Zealand Institution of Engineers, and of various other organizations. His wife, two daughters, Mrs. E. W. Driedger of Cleveland and Mrs. R. W. Stickney of Windsor, Ont., and a son, William H. Kester of Pittsburgh, an able young engineer, survive him.

Mr. Kester's thorough understanding of all phases of his business and his friendly and effective helpfulness will not pass from the memory of those privileged to have been associated with him.

Mr. Kester joined the Institute as an Associate Member in 1918 and he was transferred to Member in 1926. He was one of the charter members of the Border Cities Branch of the Institute.

**Alexander M. Kirkpatrick**, M.E.I.C., died in Toronto, Ont., on July 1st, 1942. He was born at Chatham, Ont., on April 18th, 1889, and was educated at Queen's University, Kingston, where he graduated in 1911 with the degree of Bachelor of Science in civil engineering. Upon graduation he went for a few months as assistant engineer with the International Commission on the River St. John. From 1912 to 1914 he was in charge of a hydrometric survey party on the Ottawa river. In 1914 he joined the Department of Public Works of Canada and was engaged on surveys for the location of storage and dam sites on the North Saskatchewan river.

He served for eight months with the Royal Air Force in 1918, returning to the Department of Public Works at Ottawa after the war. In 1921 he was transferred to the London, Ont., office and in 1927 he went to the Winnipeg district.

Mr. Kirkpatrick was promoted to the position of district engineer at Charlottetown, P.E.I., in 1936. In October, 1937, he returned to Winnipeg and since then to the time of his death was district engineer for the Department of Public Works in the districts of Manitoba, Saskatchewan, Alberta and Northwest Territories.

Mr. Kirkpatrick joined the Institute as a Junior in 1914 and he was transferred to Associate Member in 1919. He became a Member in 1940.

**Edwin Reginald Millidge**, M.E.I.C., died in Winnipeg on October 20th, 1941. He was born at Antigonish, N.S., on December 22nd, 1881, and received his education at the local St. Francis Xavier University. He began his engineering career with the Nova Scotia Steel and Coal Company at Sydney Mines, N.S., in 1902. Two years later he joined the Transcontinental Railway and until 1910 he was employed in the maritime provinces and Ontario. After a few months in private practice as manager and member of the firm of Robert Grant and Company, engineers and contractors at Edmonton, Alta., he returned to railway engineering with the Canadian Northern Pacific Railway at Kamloops Lake, B.C. in 1911 and remained with the company until 1916 when he became assistant engineer with the Town of New Glasgow, N.S. From 1918 to 1922 he was engaged in farming in Saskatchewan and in June, 1922, he joined the Canadian National Railways as a roadmaster at Albreda, B.C. In 1923 he was transferred to Wabamun, Alta., and from 1927 to the time of his death he was division engineer of maintenance for the Canadian National Railways at Winnipeg.

Mr. Millidge joined the Institute as a Student in 1902, transferring to Associate Member in 1909. He became a Member in 1915.

## News of the Branches

### EDMONTON BRANCH

F. R. BURFIELD, M.E.I.C. - *Secretary-Treasurer*  
L. A. THORSSSEN, M.E.I.C. - *Branch News Editor*

In view of the importance of the Webster Lectures it was felt by the Executive of the Edmonton Branch that the members should have an opportunity to share in some of the information given. Professor Morrison, one of our delegates, kindly consented to address the branch on the subject and accordingly on July 20th, a meeting was arranged and held in Room 14, Medical Building of the University of Alberta. About 35 members and engineering friends were present.

In introducing his subject Professor Morrison read the General Secretary's warning that Professor Webster's Lectures were intended for the engineering profession only and went on to say that he was satisfied that anything he

### Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

would say could not infringe official secrets as it had already appeared in print. He stated that he had only received the notes of the Webster Lectures that afternoon and consequently he had been unable to study them. His slides which were both numerous and well selected were taken from various publications.

The degrees of danger and the effects on morale when taking up various positions during an air raid were illustrated by one slide. The intensity of the blast and of its secondary suction effect were shown and discussed. Various types of shelter were shown and it was noted that the British appeared to find an above ground shelter preferable



Below from left to right: F. Alport, M. H. McManus, Branch Secretary S. C. Miffen and W. H. Graham.



Tea for two—Vice-President de Gaspé Beaubien and Councillor Dr. F. W. Gray.



Below: Chairman J. A. MacLeod welcomes the visitors.

## PRESIDENTIAL VISIT TO CAPE BRETON BRANCH

The dinner meeting was held in the cook house on a construction job at Sydney.

At the head table, from left to right: T. L. McCall, C. H. Wright, H. J. Kelly, Vice-President and General Manager of Dominion Coal and Steel Corporation, C. V. Dunne, Dean Young and J. A. MacLeod.

to buried ones. Possibilities of strengthening existing buildings and designing new ones with greater resistance to collapse were pointed out.

At the conclusion of Professor Morrison's talk the meeting was thrown open for questions and then a vote of thanks was moved by Mr. A. W. Haddow, who stated how much the members present enjoyed the lecture and appreciated the time that Professor Morrison had given to its preparation.

### HALIFAX BRANCH

S. W. GRAY - - - - Secretary-Treasurer  
G. V. ROSS - - - - Branch News Editor

President C. R. Young, on his tour of Institute branches, paid a visit to Halifax on August 7th. He was accompanied by Past-President McKenzie, Vice-Presidents K. M. Cameron, Ottawa; deGaspé Beaubien, Montreal; and G. D. Murdoch, Saint John; General Secretary L. Austin Wright, Assistant General Secretary, Louis Trudel, and Mr. G. A. Gaherty.

A Council meeting attended by twenty-three officers was held at the Nova Scotian Hotel in the forenoon, followed by a luncheon. Through the courtesy of the Royal Canadian Navy, the visitors were entertained during the afternoon by a launch trip around "An Eastern Canadian Port."

A dinner meeting was held in the evening at the Nova Scotian Hotel. President Young's address, **The Institute and the Engineering Profession**, was heard with keen interest by ninety members.

Other speakers were Deputy-Mayor G. S. Kinley, who

welcomed the visitors on behalf of the City, C. J. Mackenzie, K. M. Cameron, deGaspé Beaubien, and L. Austin Wright. P. A. Lovett was chairman of the meeting.

### MONCTON BRANCH

V. G. BLACKETT, M.E.I.C. - Secretary-Treasurer

On August 3rd the Moncton Branch received an official visit from Dean C. R. Young, president of the Engineering Institute of Canada, accompanied by Vice-President K. M. Cameron and Assistant General Secretary Louis Trudel. The presidential party was greeted, on arrival, by branch officers. They were then taken on a motor tour of the surrounding country, viewing the incoming tidal bore of the Petitcodiac river and later visiting Moncton's Magnetic Hill, where so many eminent members of the profession have temporarily lost faith in the infallibility of the law of gravitation.

In the evening a dinner meeting was held in honour of the president. H. J. Crudge, chairman of the branch presided and twenty-five members and guests were present. F. O. Condon extended a welcome to the visitors, and he was followed by Councillor G. L. Dickson and A. A. Swinerton, secretary-treasurer of the Ottawa Branch.

The first of the guest speakers, Vice-President Cameron, stressed the need for the study of post-war problems. It will be the duty of the engineer and the Engineering Institute, he said, to see what can be done in the future development of the great resources of the country in order that work may be provided when the armed forces are demobilized.

# THE PRESIDENT VISITS THE HALIFAX BRANCH



*Above:* The head table at the dinner meeting: Vice-President K. M. Cameron, Councillor J. R. Kaye, President C. R. Young, Chairman P. A. Lovett, Past-President C. J. Mackenzie.



*Left:* L. M. Allison, Sub-Lieut. R. G. McFarlane, O. S. Cox, R. L. Norman, Sub-Lieut. I. M. Fraser, R. G. Shatford.

*Right:* A. G. Mackay, W. G. Macdonald, A. D. Nickerson, P. C. Hamilton, G. J. Currie, E. S. Henrikson.



*Below:* Jeffrey Marshall, J. E. Forbes, Deputy Mayor G. S. Kinley, L. Austin Wright.



*Right:* G. A. White chats with C. D. Martin.



*From left to right:* F. A. Bowman, W. P. Copp, F. H. Sexton, C. S. Bennett, A. E. Flynn, S. L. Fultz.

*Left to right:* F. Alport, H. M. Davy, G. G. Dunbar, D. G. Dunbar, R. B. Stewart, D. C. Duff.

## PRESIDENTIAL VISIT TO THE QUEBEC BRANCH



Dr. O. O. Lefebvre, J. E. Armstrong and Major E. D. Gray-Donald.



Past-President A. R. Decary, President Young and Chairman L. C. Dupuis.



Jean Morency, Gustave St-Jacques, Huet Massue and G. B. Mitchell.

Mr. Trudel spoke of the work the Institute is doing and stated that the membership has now reached 5,575, an all time high.

The president in his address told of the part that engineers are playing in the war. War is full of emergencies and crises and engineers are the persons who are most accustomed to meeting emergencies. When the end of the war is in sight, engineers must not slacken their efforts. The Institute must prepare to be stronger and more useful than ever before. It will be necessary for the welfare of the country to look after the selection and guidance of young men who are interested in engineering and see that those with the right qualifications are encouraged.

At the conclusion of the address, Dean H. W. McKiel spoke in appreciation of the president.

The meeting closed with the singing of the National Anthem.

The following morning H. A. Fuller took the visitors on an inspection of the new coal unloading facilities at Pointe du Chene.

### SAGUENAY BRANCH

A. T. CAIRNCROSS, M.E.I.C. - *Secretary-Treasurer*

The Annual Meeting of the Saguenay Branch of the Institute was held at Arvida on August 13th, 1942.

During the afternoon a party of about sixty members was conducted in small groups on a tour of inspection of the 1,000,000 hp. development at Shipshaw, about five miles distant from Arvida. Motor cars and guides were provided through the courtesy of Mr. A. O. Hawes of the Aluminum Company of Canada, Ltd.

At 7.00 p.m. seventy-three members gathered at the Saguenay Inn for the Annual Dinner Meeting, which was held in the Grill Room.

The meeting was opened by the retiring chairman, Mr. N. F. McCaghey, who proposed a toast to the King and the President of the United States.

The annual reports were read by the acting secretary, Mr. J. G. D'Aoust, and were approved by the meeting.

The chairman then called upon Dean C. R. Young, president of the Institute, to address the gathering.

Dean Young thanked the Branch for the welcome extended to himself and his party. He regretted that Mr. L. Austin Wright, the general secretary, was unable to be present, but said that in his absence Louis Trudel, the assistant secretary, was carrying on in an able manner.

The president in his address emphasized the need for the Institute to carry on its activities in a vigorous way during the war period. He said that the United States Societies were all active and showed no signs of folding up. At the present time the demand for engineers is unusually great because engineers are required to head up new enterprises and assume important posts in the armed forces.

The president told about the co-operative agreements entered into by the Institute and the Professional Societies in the provinces of Nova Scotia, New Brunswick, Alberta, and Saskatchewan, and outlined the advantages to be obtained through them.

An outline was given of the work being done by the Committee, appointed by the Institute, under the chairmanship of Mr. Bennett, to study the Training and Welfare of the Young Engineer. The Committee has issued to English secondary schools across Canada a booklet entitled "The Profession of Engineering in Canada," and within a short time a similar booklet will be issued in French to all French secondary schools.

The tour of Professor F. Webster, sponsored by the Institute, was recalled, and Dean Young said that it was of inestimable value to the Institute and to Canada at large. In Toronto, Professor Webster gave a course of lectures to a group of about one hundred and eighty engineers, and the Institute printed, at its own expense, the technical information presented. As some of the information submitted in this course was considered to be of a confidential nature, it has not been made public in the printed form.

Dean Young told about the formation of the Federal-appointed Committee on Post-War Reconstruction Problems, under the chairmanship of Dr. F. Cyril James, principal of McGill University. In this line of endeavour the Institute is not taking a directly active part, but indirectly it is supporting the movement whenever possible. On the James Committee and its Sub-committees are prominent members of the Institute who are in close touch with headquarters on all matters in which they may be of help.

In closing his remarks the president said that all engineers should recognize the doctrine of trusteeship and have a full understanding of their social obligations. The duty of the engineer is not to drive a hard bargain for his own or his employer's immediate benefit, but it is to act fairly under all circumstances. The engineer, to arrive at his just recognition, has to learn that all technological advances must be introduced only after the good of the whole population has been considered.

Following the talk by Dean Young, the chairman called upon several of the visiting members to say a few words.

Mr. K. M. Cameron, vice-president of the Institute, and chief engineer of the Department of Public Works, Ottawa, spoke about the James Committee and said it was totally independent of any political party. Mr. Cameron, chairman of the Sub-committee on Construction Projects, said that it was the duty of this committee to study projects that would be available after the war to take up the slack in unemployment. The Sub-committee had distributed questionnaires asking members and Branches of the Institute to report on the lines which they considered post-war reconstruction should follow.

## SAGUENAY BRANCH ANNUAL MEETING



*Top left:* F. W. Bradshaw, James Shanly and M. G. Saunders.  
*Top right:* W. R. Mackay, Roland Marcotte, M. Luscombe, W. J. Thompson, D. P. MacNeil and E. W. McKernan.  
*Centre left:* J. G. D'Aoust, A. T. Cairncross, Otto Holden of Toronto and J. W. Ward.  
*Centre right:* E. G. Allwright, G. B. Moxon and H. Sirson.

*Bottom left:* The younger set, starting at 6 o'clock in a clockwise direction, Jean Flahault, H. T. Kummen, Yvon Cousineau, Gaston Dufour, L. P. Cousineau, R. S. Bleakley, H. A. Estabrook, B. L. Davis, J. E. Pepall and B. E. Surveyer.

*Bottom right:* Jacques Vinet, Rosaire Saintonge, H. J. Lemieux, Noel Dixon, R. B. Brosseau and Gilbert Proulx.

Vice-president de Gaspé Beaubien, who accompanied Dean Young on his tour of the Eastern Branches, expressed his pleasure at being a member of the visiting party, and said that the knowledge gained through the travel more than compensated for the time spent away from his professional duties.

Mr. Otto Holden, chief hydraulic engineer of the Hydro-Electric Power Commission of Ontario, expressed his pleasure at being present and wished the Branch every success in its endeavours.

Mr. McCaghey invited Mr. R. H. Rimmer, chairman-elect, to take charge of the meeting. The new chairman thanked the members for the honour conferred upon him, and introduced the 1942-43 executive.

### SAINT JOHN BRANCH

G. W. GRIFFIN, M.E.I.C. - Secretary-Treasurer

A dinner meeting in honour of Dean Young, president of the Institute, was held by the branch on August 10th at the Admiral Beatty Hotel. David R. Smith, chairman of the branch, presided.

In his address, the president said that never before had the engineer played so important a part or gained so much recognition as he has in to-day's important events. In either peace or war he must be a man of sound, straightforward thinking with rigorous standards and principles.

The scarcity of trained technicians which confronted the government in many fields, including engineering, worried the government considerably and it has now begun to finance worthy students while in college. The task which the Institute has been called on to perform, he stated, has been to select and guide the men who are to enter engineering colleges so that those suited to the profession may go on and those unsuited may be directed into other professions.

In regards to post-war reconstruction, Dean Young said that now was the time for the engineers to plan, and plan wisely for the future, or "we shall again find ourselves in as bad a mess after the war as we were before it."

K. M. Cameron and deGaspé Beaubien, vice-presidents; Louis Trudel, assistant general secretary of the Institute, and G. A. Gaherty of Montreal, also spoke.



Left—In the background: G. M. Brown of Saint John. In front: R. M. Scrivener and W. E. Bonn of Toronto. Right: C. D. McAllister, F. A. Patriquen and A. O. Wolff, all of Saint John.

Mr. Cameron appealed for better recognition for students and junior members, who should be stirred to greater action.

Mr. Trudel told of the work the Institute is doing and revealed that the membership had reached the high figure of 5,575. He extended an invitation to all members to visit the headquarters of the Institute in Montreal.

### ST. MAURICE VALLEY BRANCH

J. B. SWEENEY, S.E.I.C. - *Secretary-Treasurer*

Mr. R. N. Fournier, Industrial Heating Specialist with Canadian General Electric was guest speaker to the St. Maurice Valley Branch at a dinner meeting held at the Chateau de Blois in Three Rivers on June 25th.

Mr. Fournier gave an illustrated talk on the subject **Electric Heat in Industry**. The first part of the lecture was devoted to electric heat treating furnaces, their types and common applications. Mr. Fournier pointed out some of the applications in which these furnaces are being used in direct munitions manufacture. The speaker also covered the various types of control equipment which is available and the types of gas atmosphere used in furnaces as a protection of the work against oxidation and decarbonization.

The second part of the lecture included a discussion of various small heating devices and their many applications in industrial plants.

The last part of the lecture was devoted to a discussion and demonstration of the fundamentals of the Infra Red method of heat treating, a spectacular development, in this field which has received much publicity in recent years.

Infra Red heating and drying is the name given to the technique of using reflectors to control the radiation of incandescent lamps and directing this radiation against the work to be heated. The principle involved is that any incandescent body will emit energy in the form of radiation, the most efficient way of transferring heat energy. In travelling through the air from a hot body, the electromagnetic rays lose very little of their heat in the air and give up their energy only when they strike and are absorbed by some object.

The percentage of radiation that is absorbed by a surface is usually described as the absorption factor which varies from 5 to 95 percent. This radiation gives its heat up to the work as quickly as the work will absorb it and as a result the work temperature is higher than the surrounding atmosphere. Insulation therefore serves no useful purpose. Draft shields are used, however, to redirect radiation which is not absorbed by the work or reflected by it.

Due to limitations in the design of the lamps and reflecting equipment it has been found that ten watts per sq. in. is the maximum amount of radiation that can be directed on any work and owing to the absorption limitations 600 deg. F. is about the maximum working temperature which has been obtained successfully.

The great majority of Infra Red applications have been

made for paint baking at a work temperature of from 300 to 400 deg. F. In this connection, there are two types of paints, one having an oil base and the latest type with a synthetic resinous base. The former dries mainly by oxidation which is only slightly affected by heat. In the latter the drying takes place by a polymerization process, a chemical change which takes place very rapidly at the baking temperature.

The colour has a great influence on the rapidity with which the baking temperature may be reached, black and other dark paints being the best, as a result it is often advantageous to apply the heat to the unpainted side of the work. Similarly the fastest drying will take place on light gauge material rather than on castings.

Infra Red is also being used for drying photographic prints, blue prints, plastic parts, glue and for curing thin rubber sheets. Some work is also being done in speeding up the drying of printing inks on the modern high speed presses.

Mr. J. H. Fregeau, branch councillor, thanked the speaker for his very interesting talk.

The St. Maurice Valley Branch met on July 30th, to welcome President Young and his party on their tour of Eastern Branches. Convening at the Laurentide Club in Grand'Mère, all members of the branch and our guests, the district members of the Association of Professional Engineers of the Province of Quebec, were given the opportunity of meeting members of the Headquarters Party.

The body then assembled for dinner at the Laurentide Inn, after which several members of the Presidential Party spoke on the various activities of the Institute.

In introducing Dean Young to the meeting, Chairman Viggo Jepsen dwelt on the president's high professional standing both in a civil and military capacity.

The president proceeded to outline the various Institute committees which were actively engaged in furthering Canada's war effort and of the assistance which council was giving to the various governmental departments, and the part that Canadian engineers led by General McNaughton are playing in winning the war.

Speaking to members of the Association of Professional Engineers who were present, Dean Young discussed the Institute's committee for professional advancement which co-operated with the former body. Bearing in mind the



Huet Massue explains it to H. J. Ward and J. H. Fregeau, while Dean Young gauges the lumber stock pile at Grand'Mère.

common interests of our two professional bodies, President Young felt that the present move for joint membership was commendable and would present a broader view of the term "professional engineer" to the general public.

In closing, mention was made of the excellent work which is being done by H. F. Bennett's Committee for Student Guidance, which intended to offer its assistance to post-graduate engineers, to point out the value of developing the individual personality and assist in making professional connections.

Dr. A. H. Heatley, thanked the president for his message and was pleased to say that the organization of Student Guidance Committees in the St. Maurice Valley had been completed.

Chairman Jepsen introduced Past-President Lefebvre who commented on some of the president's remarks and pointed out to the junior engineers present that a degree simply gave him the right to continue his studies without supervision. In closing Dr. Lefebvre spoke in French pointing out the value of Institute connections as a continuing

common ground of understanding among French and English engineers of the province.

Vice-President Cameron reported on the progress of his Committee on Post-War Reconstruction and asked the body to give some serious thoughts to a works programme which would continue employment in the probable post-war recession period.

Councillor Armstrong of Montreal gave a brief account of the progress made to date in the newly formed Committee on Engineering Features of Civil Defence which is working in close co-operation with Dr. Manion of the Dominion Government.

Louis Trudel, assistant general secretary, gave an excellent review of all current activities of the Institute with emphasis on internal affairs.

Mr. H. Massue, past-councillor of the Montreal Branch, also accompanied the party.

An exceptionally large number of members of the branch were on hand to renew acquaintance with the Headquarters party, and contributed to a very successful meeting.

## Library Notes

### ERRATUM

#### Definitions of Electrical Terms American Standard C12

Under Additions to the Library in the August Issue of the *Journal* the price of this volume was quoted as \$1.00 in Canada. The correct price is \$1.15 in Canadian funds if ordered through the Canadian Engineering Standards Association. It is 8 x 11 in., containing over 300 pages.

### ADDITIONS TO THE LIBRARY TECHNICAL BOOKS

#### Analytic Geometry:

Charles H. Lehmann. N.Y., John Wiley and Sons, Inc., 1942. 6 x 9¼ in., \$3.75.

#### Molecular Films, the Cyclatron and the New Biology:

Essays by Hugh Stott Taylor, Ernest O. Lawrence and Irving Langmuir. New Brunswick, Rutgers University Press, 1942. 6¼ x 9¼ in., \$1.25.

#### National Building Code:

Prepared under the joint sponsorship of the National Housing Administration, Department of Finance and the Codes and Specifications Section, National Research Council of Canada. Ottawa, National Research Council publication No. 1068 (1942). 6 x 9 in., \$1.00.

#### Mathematics of Modern Engineering:

Vol. 2, *Mathematical Engineering*. Ernest G. Keller. N.Y., John Wiley and Sons, Inc., 1942. 6 x 9¼ in., \$4.00.

#### Machine Shop Yearbook and Production Engineers' Manual:

Editor H. C. Town. London, Paul Elek Publications (1942). 5¼ x 8½ in., 25/ plus 9d postage.

#### Canadian Engineering Standards Association:

Standard Specification for Oil Circuit-Breakers: C77-1942, \$0.50—Standard Specification for Pole Line Hardware: C83-1942, \$0.75.

### REPORTS

#### Society of Naval Architects and Marine Engineers:

Yearbook 1942.

### Book notes, Additions to the Library of the Engineering Institute, Reviews of New Books and Publications

#### Civil Service Commission of Canada:

*Thirty-third annual report for the year 1941.*

#### Ontario, Department of Mines:

*Fiftieth annual report being vol. 50, No. 1, 1941.*

#### Quebec Streams Commission:

*Twenty-sixth report for the year 1937.*

#### University of Illinois—Engineering Experiment Station:

*A photoelastic study of stresses in gear tooth fillets:—Moments in I-Beam bridges: Bulletin Series No. 335, 336.—Numerical procedure for computing deflections, moments and buckling loads: Reprint series No. 23.—Papers presented at the sixth short course in coal utilization:—Combustion efficiencies as related to performance of domestic heating plants: Circular series No. 43, 44.*

#### The Institution of Structural Engineers:

*Report of Foundations: part 1—Foundations in disturbed ground.*

#### U.S. National Bureau of Standards:

*Progress report No. 2—Compressive properties perforated cover plates for steel columns issued in co-operation with the American Institute of Steel Construction.*

#### Edison Electric Institute:

*Specifications for standard current transformers for primary circuits.—Specifications for indicating and cumulative demand register scales.*

#### Institute of Radio Engineers:

*Standards on Radio Wave Propagation: Pt. 1, Measuring methods—Pt. 2, Definitions of terms—Standards on Facsimile: Definitions of terms.*

#### Bell Telephone System—Technical Publications:

*Paper dielectrics containing chlorinated impregnants.—Macromolecular properties of linear polyesters.—Brittle point of rubber upon freezing.—Chain structure of linear polyesters—trimethylene glycol series.—Monographs No. 1336-1339.*

#### Electrochemical Society:

*Electrothermal ferro-alloy production in Brazil.—Phosphorus furnace reactions.—Theory of oxidation and tarnishing of metals.—Direct current conversion equipment in the electrochemical industry.—The theory of the potential and the technical practice of electrodeposition.—Location of ground faults on series electrolytic cell systems.—Preprints No. 81-29, 30, 31, 32 and 82-4 and 5.*

### BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet the books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

#### AIRCRAFT ENGINE AND METAL FINISHES

By M. A. Coler. Pitman Publishing Corp., New York and Chicago, 1942. 128 pp., illus., diags., tables, 8½ x 5½ in., cloth, \$1.50.

A brief description of current American practice in finishing the exterior surfaces of aircraft engines and similar parts is provided in this small book. It is intended for readers confronted by real problems, but who have little knowledge of finishing procedures. Therefore, much of the text is devoted to the principles underlying these procedures, with particular attention to organic finishes.

#### AIRCRAFT RIVETING, a Guide for the Student

By E. B. Lear and J. E. Dillon. Pitman Publishing Corp., New York and Chicago, 1942. 118 pp., illus., diags., charts, tables, 8½ x 5½ in., cloth, \$1.25.

The subject of riveting is covered broadly, with emphasis upon certain practical aspects of its most important functions, and is presented in a volume of handy size.

#### ANALYTIC GEOMETRY

By C. H. Lehmann. John Wiley & Sons, New York, 1942. 425 pp., diags., tables, 9 x 6 in., cloth, \$3.75.

A textbook for a first course in plane and solid analytic geometry. Special features are the completeness of the investigations of each topic, the construction of tables summarizing closely related results, a fuller treatment of solid analytic geometry than is usual in elementary texts, and the large number of exercises included.

#### **CHEMICAL REFINING of PETROLEUM** (American Chemical Society Monograph Series No. 63)

By V. A. Kalichevsky and B. A. Stagner. rev. ed. Reinhold Publishing Corp., New York, 1942. 550 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$7.50.

This monograph is a comprehensive review of the literature of the chemical treatment of petroleum and its products. Treatment with sulfuric acid and with alkaline reagents, the use of absorbents and solvents, antideionants and inhibitors of oxidation and gum formation are included. There are many bibliographic footnotes and extensive lists of patents. The new edition has been revised and in part rewritten.

#### **ELECTRIC POWER STATIONS, Vol. 2**

By T. H. Carr, with a foreword by Sir L. Pearce. D. Van Nostrand Co., New York, 1941. 440 pp., illus., diagrs., charts, tables, 9 x 5½ in., cloth, \$9.00.

The aim of this two-volume English book is to provide an account of the general principles that govern the design, construction and operation of electric power stations, which will assist the designer to choose, from the plant available, that which best fulfills the conditions to be met, and to arrange it in the most economical way. The present volume deals with the electrical equipment and station organization and costs.

#### **ELECTRICAL TRANSMISSION and DISTRIBUTION REFERENCE BOOK**

By Central Station Engineers of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., 1942. 570 pp., illus., diagrs., charts, tables, 12 x 8½ in., cloth, \$5.00.

This book, offered as a successor to William Nesbitt's "Electrical Characteristics of Transmission Circuits," brings together, in convenient form for reference, a large amount of practical, up-to-date information on the design and operation of transmission and distribution systems. Each chapter is by a specialist in the subject, and nearly all chapters have bibliographies. Appendices contain tabulated statistical data on transmission lines, power systems and transformer circuits.

#### **ELEMENTARY STRUCTURAL ANALYSIS and DESIGN, Steel, Timber and Reinforced Concrete**

By L. E. Grinter. Macmillan Company, New York, 1942. 383 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$3.75.

A brief, simple treatment of the subject, intended for students of architecture and mechanical and electrical engineering and others interested in buildings and miscellaneous structures, but not in bridge design. While greatest emphasis is placed on steel structures, considerable attention is given to reinforced concrete, and timber is treated adequately. Special chapters on timber roof trusses and on column footings are included.

#### **ELEMENTS of PRACTICAL AERODYNAMICS**

By B. Jones. 3 ed. John Wiley & Sons, New York; Chapman & Hall, London, 1942. 459 pp., illus., diagrs., charts, maps, tables, 9½ x 6 in., cloth, \$3.75.

This is a simple exposition of the subject, intended for classroom use. This edition has been revised and rearranged, and new material has been added.

#### **Great Britain, Department of Scientific and Industrial Research**

#### **FOOD INVESTIGATION Special Report No. 52. The MODE of OCCURRENCE of FATTY ACID DERIVATIVES in LIVING TISSUES, a Review of Present Knowledge**

By J. A. Lovern. His Majesty's Stationery Office, London, 1942. 36 pp., 9½ x 6 in., paper, (obtainable from British Library of Information, 30 Rockefeller Plaza, New York, \$0.25).

This pamphlet is a review of the investigations of lipoidal matter which have appeared during the last ten years or so. An extensive bibliography is involved.

#### **Great Britain, Ministry of Works and Buildings. FIRST REPORT of the COMMITTEE on the BRICK INDUSTRY**

His Majesty's Stationery Office, London, 1942. 24 pp., maps, tables, 9½ x 6 in., paper, (obtainable from British Library of Information, 30 Rockefeller Plaza, New York, \$0.15).

This report presents the state of the industry in Great Britain, considers war-time and post-war probable demands, and makes recommendations toward increased efficiency and economy in manufacture.

#### **Great Britain, Ministry of Home Security, Home Security Circular No. 75/1942**

#### **SHELTER DESIGN and STRENGTHENING—CONSOLIDATING CIRCULAR**

His Majesty's Stationery Office, London, 1942. 21 pp., diagrs., 13 x 8½ in., paper, (obtainable from British Library of Information, 30 Rockefeller Plaza, New York, \$0.30).

Modified designs for "standard" shelters are given, which afford a much greater degree of protection at small increase in cost. Methods of strengthening existing shelters are also described.

#### **Great Britain, Ministry of Works and Buildings. STANDARD SCHEDULE of PRICES, January, 1942.**

His Majesty's Stationery Office, London, 1942. 87 pp., tables, 8½ x 6 in., paper, (obtainable from British Library of Information, 30 Rockefeller Plaza, New York, \$0.30).

Schedule covers building and civil engineering work in the erection of camps, stores, factories and similar structures within the Government scheme of building operations.

#### **HANDBOOK of MECHANICAL DESIGN**

By G. F. Nordenholt, J. Kerr and J. Sasso. McGraw-Hill Book Co., New York and London, 1942. 277 pp., diagrs., charts, tables, 11 x 8½ in., cloth, \$4.00.

This volume, the material of which has appeared previously in *Product Engineering*, presents practical methods and procedures which have been in use in engineering designing departments. Chapters cover: Charts and tables for general arithmetical calculations; the Properties of materials; Beams and structures; Latches, locks and fastenings; Springs; Power transmission elements and mechanisms; Drives and controls; and Design data on production methods. The information is chiefly presented as charts, monograms and tables and in several hundred excellent drawings.

#### **HANDBOOK of SHIP CALCULATIONS, CONSTRUCTION and OPERATION**

By C. H. Hughes. 3 ed. McGraw-Hill Book Co., New York and London, 1942. 558 pp., illus., diagrs., charts, tables, 7 x 5 in., lea., \$5.00.

This reference work brings together conveniently a large amount of practical inform-

ation frequently wanted by those who design, build and operate ships. The new edition has been thoroughly revised and largely rewritten.

#### **HEAT TRANSMISSION**

By W. H. McAdams. McGraw-Hill Book Co., New York and London, 1942. 459 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$4.50.

In this volume which is sponsored by the National Research Council, the fundamentals of heat transmission are presented in form for study and for reference. The available data have been collected from all sources, reduced to a common basis and correlated, and the results presented in formulas and graphs for use in engineering design. This edition incorporates much new material accumulated during the last decade. There is a bibliography of nearly eight hundred papers.

#### **HOW to PLAN a HOUSE**

By G. Townsend and J. R. Dalzell. American Technical Society, Chicago, 1942. 525 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, \$4.50.

The steps in planning a dwelling, from the selection of the type of house to the choice of plumbing and heating fixtures, are described in detail, in clear, simple language. Structural design, planning, etc., are considered. The book is intended for those intending to build homes and for professional builders.

#### **HYDROLOGY. (Physics of the Earth—IX)**

Edited by O. E. Meinzer. McGraw-Hill Book Co., New York and London, 1942. 712 pp., illus., diagrs., charts, maps, tables, 10 x 7 in., cloth, \$7.50.

This is the final volume of a series of monographs prepared under the direction of a committee of the National Research Council. The series covers the physics of the earth and aims "to give to the reader, presumably a scientist but not a specialist in the subject, an idea of its present status, together with a forward-looking summary of its outstanding problems." The present volume on hydrology first describes the two basic processes, precipitation and evaporation. The processes of storage and transfer of the water are then treated at length and followed by a chapter on the physical and chemical work done by the natural waters in the course of their circulation. Chapters are devoted to the hydrology of limestone and lava-rock terranes. Each chapter has a bibliography.

#### **INDUSTRIAL CAMOUFLAGE MANUAL**

By K. F. Wittmann. Reinhold Publishing Corporation, New York, 1942. 128 pp., illus., diagrs., tables, 11 x 8½ in., paper, \$4.00.

This interesting book presents experiments and experiences developed in the classrooms and camouflage laboratory of Pratt Institute. The presentation is largely by drawings and photographs. Principles, methods and materials are described and demonstrated on models and by actual installations.

#### **INDUSTRIAL FURNACES, Vol. 2**

By W. Trinks. 2 ed. John Wiley & Sons, New York; Chapman & Hall, London, 1942. 351 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$5.00.

As in the first edition of this well-known treatise, this volume is devoted primarily to practice and is intended especially to aid in the selection, installation and operation of furnaces. The discussion covers Fuels and sources of heat energy, Combustion devices and heating elements, Control of furnace temperature and atmosphere, Labor-saving appliances and the Comparison of fuels and types of furnaces. Much of the book has been rewritten, to include new developments.

## INDUSTRIAL MANAGEMENT

By A. G. Anderson, M. J. Mandeville and J. M. Anderson. Ronald Press Co., New York, 1942. 612 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$4.50.

This text is a revision of "Industrial Engineering and Factory Management," in which the emphasis has been shifted from technical and labor problems to the relations that exist between industry and society as a whole. Starting with a presentation of the contacts of a company with the public, the work describes the development of industrial management, the organization of a company, the location, construction and equipment of the plant, product simplification and standardization, relations with employees, and control devices for waste elimination and co-ordination of activities.

## (An) INTRODUCTION to CONTROL ENGINEERING

By E. S. Smith. Apply to author, 114-57 176th St., St. Albans, Long Island, N.Y., 1942. Paged in sections, diags., charts, tables, 11 x 8 in., paper, \$2.00, including separate pamphlet of figures.

These notes represent lectures on control and its applications in the process industries, given by the author for an Engineering, Science, Management and Defence Training course at Pratt Institute. The book is intended for those actively working with industrial measuring and controlling instruments and is intended as an introduction to the basic principles that underly the solution of specific problems.

## Introduction to the THEORY of ELASTICITY for Engineers and Physicists

By R. V. Southwell, 2 ed. Oxford University Press, New York, 1941. 509 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$10.00.

The first edition, which appeared in 1936, was intended to provide a text for students pursuing advanced studies in elasticity and for engineers who needed a wider knowledge of elastic theory than was demanded formerly, to deal with the problems arising from higher speeds in machinery, the use of light metals in structures, etc. This edition is substantially a reproduction of the first, with the correction of a few errors and some minor additions.

## The LINEMAN'S HANDBOOK

By E. B. Kurtz, 2 ed. McGraw-Hill Book Co., New York and London, 1942. 650 pp., illus., diags., charts, tables, 7½ x 5 in., lea., \$4.00.

This work gives a clear presentation of procedure and methods of line construction, accompanied by an introductory explanation of electrical principles and electric systems. The new edition has been thoroughly revised, and new chapters have been added on rural lines, tower-line erection, pole-top resuscitation, safety and rural-line operation and maintenance.

## MARINE DIESEL HANDBOOK

By L. R. Ford. Diesel Publications, New York, 1942. 896 pp., illus., diags., charts, tables, 9 x 6 in., fabrikoïd, \$7.00 (\$8.00, foreign countries).

The machinery of a modern motorship is described and explained in this hand-book, designed for those in charge of operation and maintenance. The principles of the Diesel engine, the types in use and their construction are explained. Chapters deal with fuel, propulsion methods, Diesel-electric drives, supercharging, propellers, speed regulation, suppression of vibration and noise, electricity on the motorship, and accessory equipment.

## MASS SPECTRA and ISOTOPES

By F. W. Aston. Longmans, Green & Co., New York; Edward Arnold & Co., London, 2 ed., 1942. 276 pp., illus., diags., charts, tables, 9 x 5½ in., cloth, \$7.00.

This book, by the leading worker in the field, has been revised in the light of developments since 1933. It opens with an historical review, describes the apparatus and methods used in producing and analyzing mass spectra, the elements and their isotopes, and discusses the theoretical conclusions. A complete account of the analyses of all the elements and the ways in which they were obtained is included for the first time.

## MATHEMATICS DICTIONARY, compiled from the literature and edited by G. James and R. C. James.

The Digest Press, Van Nuys, Calif., 1942. 259 pp.+22 pp. of tables, formulas and symbols, diags., charts, 9½ x 6 in., cloth, \$3.00.

This dictionary is based upon modern textbooks, and aims to give the meaning of the basic mathematical words and phrases, and to cover exhaustively all terms from arithmetic through the calculus, including the technical terms commonly used in the application of these subjects. Many illustrative examples and figures are included, and an appendix provides a number of useful mathematical tables.

## MECHANICS of AIRCRAFT STRUCTURES

By J. E. Younger, 2 ed. McGraw-Hill Book Co., New York and London, 1942. 396 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$4.00.

The fundamental principles and methods involved in the construction of all-metal airplanes are presented in organized form and as simply as possible for student use. The data upon design and structural analysis are recent. The first edition, published in 1935, was entitled "Structural Design of Metal Airplanes."

## METALLURGY of COPPER

By J. Newton and C. L. Wilson. John Wiley & Sons, New York; Chapman & Hall, London, 1942. 518 pp., illus., diags., charts, maps, tables, 9½ x 6 in., cloth, \$5.00.

The aim of this book is to present the various methods used in extracting copper from its ores and refining it to commercial grade. Related subjects, such as ore dressing and the properties and uses of copper, are outlined briefly. Some examples of modern practice are included to illustrate the application of the methods described.

## MOTION and TIME STUDY APPLICATIONS

By R. M. Barnes. John Wiley & Sons, New York, 1942. 188 pp., illus., diags., charts, tables, 11 x 8½ in., paper, \$1.75.

This volume supplements the author's "Motion and Time Study" by providing case material and research data illustrative of that text. Much of the material here is the result of researches in the application of motion and time study to specific problems, as carried out at the University of Iowa.

## National Physical Laboratory, Metrology Department, NOTES on GAUGE MAKING and MEASURING.

Great Britain, Department of Scientific and Industrial Research, London, January, 1942. 68 pp., diags., charts, tables, 10 x 7 in., paper (obtainable from British Library of Information, 30 Rockefeller Plaza, New York, \$0.60).

This pamphlet has been prepared by the National Physical Laboratory for the assistance of firms who are entering the field of gauge making, as a guide in overcoming initial difficulties. It includes notes on the manufacture and measurement of gauges, together with descriptions of suitable measuring apparatus. The text covers the simpler

types of plain and form gauges, but does not consider screw gauges.

## PETROLEUM ENCYCLOPEDIA, "Done in Oil"

By D. D. Leven, edited and revised by S. J. Pirson. Ranger Press, New York, 1942. 1084 pp., illus., diags., charts, maps, tables, 9 x 6 in., fabrikoïd, \$10.00.

A comprehensive presentation of the whole oil industry, with emphasis upon the economic and financial aspects. The place of petroleum in world economics; methods of finding, producing, transporting, refining and marketing oil; oil industry financing; the oil royalty business; and the regulation of securities and markets are described in clear, non-technical language.

## PRINCIPLES of MAGNAFLUX INSPECTION

By F. B. Doane, 2 ed. Magnaflux Corp., Chicago, Ill., 1942. 288 pp., illus., diags., charts, tables, 9 x 6 in., cloth, \$2.50.

The principles of this method of inspection, its advantages, its fields of use and its technique are presented. This new edition has been enlarged and improved. More photographs of Magnaflux patterns have been included; new material has been added on detectable defects, interpretation and welding; and the bibliography has been enlarged.

## PRINCIPLES of RADIO

By K. Henney, 4 ed. John Wiley & Sons, New York; Chapman & Hall, London, 1942. 549 pp., illus., diags., charts, tables, 8 x 5 in., cloth, \$3.50.

The aim of the author has been to present the principles of radio in a form adapted to students with little electrical or mathematical background. The book is intended primarily for trade schools and for self-instruction. This edition has been revised and brought up to date.

## RATIONED RUBBER, What to Do About It

By W. Haynes and E. A. Hauser. Alfred A. Knopf, New York, 1942. 181 pp., diags., charts, 8 x 5 in., cloth, \$1.75.

In this small book, intended for the man in the street, two experienced chemists give a clear, readable account of the rubber situation to-day. The story answers most of the questions that every one is asking.

## Report of a Conference on the ORIGIN of OIL, conducted by the Research Committee of the American Association of Petroleum Geologists, April 5th, 1941, Houston, Texas.

Publ. by American Association of Petroleum Geologists, P.O. Box 979, Tulsa, Okla., 1941. 81 pp., illus., tables, manifold, 11 x 8½ in., paper, \$1.00.

The pamphlet is a stenographic report of an informal round-table discussion at Houston, Texas, on April 5, 1941, which was attended by thirty-six well-known geologists and chemists interested in the subject.

## REPORT WRITING

By C. G. Gaud, H. F. Graves and L. S. S. Hoffman. Revised edition. Prentice-Hall, New York, 1942. 332 pp., diags., blueprints, charts, tables, 9½ x 6 in., cloth, \$2.75.

This is an excellent presentation of certain principles of composition and rhetoric to the special field of the report, intended for use as a college text and for independent study. No fundamental changes have been made in the new edition, but the illustrative material and specimen outlines and reports have been replaced by recent items, the rules for abbreviations have been changed to standard ones, and a section on letters of application has been added.

**REPORTS on PROGRESS in PHYSICS, Vol. VIII (1941), edited by W. B. Mann**

*Physical Society, Exhibition Road, London, S.W.7, England, 1942. 372 pp., illus., diags., charts, tables, 10 x 7 in., cloth, \$5.25, postage included.*

The purpose of these valuable reports is to help the physicist to keep himself informed of the advances constantly being made in those departments of physics in which he has not specialized. To this end, each annual volume contains papers by specialists upon various important fields, accompanied by extensive bibliographies. This volume deals with advances in physics up to the middle of 1941.

**ROTARY DRILLING HANDBOOK**

*By J. E. Brantly. 3 ed. rev. Palmer Publications, New York, Los Angeles and London, 1942. 420 pp., illus., diags., charts, tables, 7½ x 5 in., fabrikoid, \$5.00.*

Presents, in a very practical manner, the equipment and methods used in the oil industry. The book is intended as a manual for those actually engaged in drilling and is confined to methods used in the more difficult fields of this country. This edition has been thoroughly revised.

**SHEET-METAL PATTERN DRAFTING**

*By F. J. O'Rourke and edited by J. A. Moyer. McGraw-Hill Book Co., New York and London, 1942. 189 pp., diags., charts, tables, 9½ x 6 in., cloth, \$2.00.*

This text is intended to familiarize the reader with the basic principles that must be applied in laying out patterns on sheet metal. These principles are illustrated by application to many practical problems of the various kinds that arise in everyday shopwork.

**SOURCE BEDS OF PETROLEUM**

*By P. D. Trask and H. W. Patnode. American Association of Petroleum Geologists, Box 979, Tulsa, Okla., 1942. 566 pp., diags., maps, tables, 9½ x 6 in., cloth, \$4.50.*

This book is the report of an investigation carried out jointly by the American Petroleum Institute and the U.S. Geological Survey during the last ten years, upon the origin and environment of source beds of petroleum. The properties of individual samples of sediments from many oil fields in most of the producing regions of the United States were studied in order to ascertain whether or not any of these properties were related to the distance of the sediments from known oil zones. The regional studies are presented in detail, with the conclusions reached.

**STRATIGRAPHIC TYPE OIL FIELDS, edited by A. I. Levorsen**

*American Association of Petroleum Geologists, Box 979, Tulsa, Okla., 1941. 902 pp., illus., diags., charts, maps, tables, 9½ x 6 in., cloth, \$5.50.*

This volume contains detailed descriptions of thirty-seven American oil pools of the stratigraphic type, contributed by various petroleum geologists. "It is intended as a factual background on which a further approach may be made to the causes of oil and gas accumulation and also as a basis for the reasoning necessary to future oil-field discovery." (Preface). An extensive bibliography is included.

**STRUCTURAL THEORY**

*By H. Sutherland and H. L. Bowman. 3 ed. John Wiley & Sons, New York; Chapman & Hall, London, 1942. 368 pp., diags., charts, tables, 9½ x 6 in., cloth, \$3.75.*

The basic conceptions and principles of structural theory relating to trusses, rigid frames and space frameworks are presented in this texthook, which covers the subject as commonly taught in our technical schools. In this edition there has been considerable revision and enlargement in the parts devoted to rigid-frame construction and, to a lesser extent, in other sections.

**THEORETICAL NAVAL ARCHITECTURE**

*By E. L. Attwood, revised by H. S. Pengelly. Longmans, Green & Co., New York, London, Toronto, 1942. 526 pp., diags., charts, tables, 8 x 5 in., cloth, \$5.00.*

The purpose of this well-known textbook is to provide students and draftsmen with an explanation of the calculations that continually have to be performed, and of the principles underlying them. Copious examples illustrate the rules. This issue of the book is the nineteenth printing, apparently of the revised edition which appeared in 1931.

**THIS FASCINATING RAILROAD BUSINESS**

*By R. S. Henry. Bobbs-Merrill Co., New York and Indianapolis, 1942. 526 pp., illus., diags., charts, 9 x 6 in., cloth, \$3.50.*

A very readable, yet unusually detailed and comprehensive account of American railroading, is provided in this volume, which should be of interest both to laymen and to railroad men. Every aspect of railroading as a business is covered, and while the subject is primarily the railroad companies of to-day, much historical information is included. The author is an experienced railroad man.

**UNITED STATES TENNESSEE VALLEY AUTHORITY. The Chickamauga Project**

*(Technical Report No. 6) Tennessee Valley Authority, Treasurer's Office, Knoxville, Tenn., 1942. 451 pp., illus., diags., charts, maps, tables, 9½ x 6 in., cloth, \$1.00.*

Facts concerning the planning, design, construction and initial operations of the Chickamauga project of the Tennessee Valley Authority are presented in this report. Unusual and unprecedented features and methods are described in some detail, while common procedures and practices receive rather brief treatment. Chapter bibliographies, a section on costs and a statistical summary are included.

**VOLUMETRIC ANALYSIS, Vol. 1. Theoretical Fundamentals**

*By I. M. Kolthoff and V. A. Stenger. 2nd rev. ed. Interscience Publishers, New York, 1942. 309 pp., diags., charts, tables, 9½ x 6 in., cloth, \$4.50.*

The theoretical considerations underlying the methods of volumetric analysis are comprehensively discussed. Basic principles are stated for neutralization, ion combination and oxidation-reduction reactions. The operation and utilization of various types of indicators are considered. The later chapters deal with special considerations, such as absorption and coprecipitation phenomena and various methods for the determination of the equivalence-point.

**WHAT STEEL SHALL I USE?**

*By G. T. Williams. American Society for Metals, Cleveland, Ohio, 1941. 213 pp., illus., diags., charts, tables, 9 x 6 in., cloth, \$3.50.*

The many factors which bear upon the selection of the best available steel for any given purpose are briefly and clearly presented. These factors include physical properties, metallurgical aspects, availability of proper treatment, considerations in fabrication and economic aspects. Suggestions for further reading accompany each chapter.

**WHAT THE CITIZEN SHOULD KNOW ABOUT CIVILIAN DEFENSE**

*By W. D. Binger and H. H. Railey. W. W. Norton & Co., New York, 1942. 183 pp., diags., 8½ x 5½ in., cloth, \$2.50.*

This book presents the advice of an experienced civil engineer and a writer upon military affairs as to proper methods of dealing with the civil problems arising out of enemy air action. The various types of bombs are described, and instructions as to protection against them given. Construction of shelters, preparation of blackouts, fire control and gas are dealt with, as well as other matters.

# PRELIMINARY NOTICE

of Applications for Admission and for Transfer

FOR ADMISSION

August 28th, 1942.

The By-laws provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.\*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described at the October meeting.

L. AUSTIN WRIGHT, General Secretary.

\*The professional requirements are as follows:—

A Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupillage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science or engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainment or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

COLE—DONALD LORNE, of 185 Crescent St., Peterborough, Ont. Born at Lansing, Mich., U.S.A., June 25th, 1918; Educ.: B.Sc. (Elec.), Univ. of Toronto, 1941; 1937-40 (summers), with the H.E.P.C. of Ontario, asst. to elec. supt., operation staff, etc.; 1941-42, test course, and April 1942 to date, junior engr., aircraft instrument engrng., Can. Gen. Elec. Co. Ltd., Peterborough, Ont.

References: J. Cameron, A. L. Malby, G. R. Langley, D. V. Canning, B. Ottewell.

DELL—CHARLES ADIN ORIN, of 2237 Pine Grove Ave., Niagara Falls, Ont. Born at Niagara Falls, June 30th, 1901. Educ.: I.C.S., Elec. Engrg., 1932; R.P.E. of Ont.; 1927-30, distribution planning & dftng., Niagara Electric Service Corp. Niagara Falls, N.Y.; 1930-39, meter & relay testing & gen. meter lab. testing, Niagara Falls Power Co.; 1939-40, plans & specifications, etc., Buffalo Niagara Electric Power Corp.; 1940 to date, elec. designing dftsman., H. G. Acres & Co., Niagara Falls, Ont.

References: H. E. Barnett, W. D. Bracken, C. G. Cline, J. H. Ings, A. W. F. McQueen, M. F. Ker.

EASTON—WALLACE MOFFATT, of 41 Maple Ave., Shawinigan Falls, Que. Born at Renfrew, Ont., June 27th, 1908; Educ.: B.Sc. (Mech.), 1931, Mech. Engr. (Extramural), 1935, Clarkson College of Technology, Potsdam, N.Y.; 1928-30 (summers), distribution mtee., Niagara-Hudson Corp., Potsdam; 1931-33, dftsman., 1933-36, sales engr., estimating, cost acctg., 1934-36, asst. sec'y., Jeffrey Mfg. Co. Ltd., Montreal; with Consolidated Paper Corporation Ltd., Shawinigan Falls, as follows: 1936-38, dftsman., 1938-40, chief dftsman., 1940, asst. to divn. engr., and 1940 to date, asst. divn. engr.

References: E. B. Wardle, V. Jepsen, W. A. E. McLeish, E. R. McMullen, E. T. Buchanan.

FORTIN—RENE, of 3527 Wellington St., Verdun, Que. Born at Montreal, Sept. 25th, 1908; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1929; 1929-30, gen. engrng., Z. Langlais, Quebec; 1930-33 and 1938-40, concrete designer, Associated Engineers Ltd., Montreal; 1933-34, field engr., road constrn., Arm. Sciotte; 1936-37, constrn. inspr., Viau & Venne, Architects; 1939-40, professor of mechanics, Ecole Polytechnique, and 1940 to date, designing engr., concrete, steel & wood, for B. R. Perry, M.E.I.C., conslgt. engr., Montreal.

References: B. R. Perry, G. J. Papineau, J. A. Lalonde, A. Circe, A. Duperron, S. A. Baulne.

JOMINI—HARRY, of Mackenzie, Demerara, British Guiana. Born at Winnipeg, Man., Jan. 2nd, 1910; Educ.: B.Sc. (Civil), Univ. of Man., 1935, B.Sc. (Mining), McGill Univ., 1937; 1928 & 1931 (summers), C.P.R. constrn. dept.; 1929-30, C.N.R. land survey dept.; Summer work as follows— 1932-33, Island Lake Gold Mines, Ventures Ltd., 1934, prospecting, 1935, Dom. Govt. Geol. Survey, 1936, Hollinger Gold Mines, constrn. engr., Preston East Dome Mine; 1937, lab. asst., 1937-38, engr., technical data dept., Dorr Engineering Co. Inc., New York; with the Demerara Bauxite Co. Ltd., as follows: 1939-40, asst. mining engr., 1940-41, engr. i/c washing plant, 1941 to date, railroad supt.

References: A. W. Whitaker, Jr., P. H. Morgan, T. H. Henry, G. H. Herriot, W. G. McBride.

LAPEYRE—JEAN, of 5750 Darlington Ave., Montreal, Que. Born at Castres (Tarn), France, June 24th, 1899; Educ.: Ingénieur Diplômé de l'Ecole Polytechnique (1921) et de l'Ecole Supérieure d'Electricité de Paris (1927); 1928-40, Govt. appointed engr. Industry of Armament, Paris, France; Under contract by British Govt. in North America (United Kingdom Technical Mission), 1940-41, Sorel Industries Limited 1941 to date, Engineering Products of Canada Ltd.

References: C. J. Desbaillets, W. F. Drysdale, J. W. Simard, A. Circe, L. Trudel.

LAWTON—HERBERT CLARENCE, of 127 Wright St., Saint John, N.B. Born at Saint John, April 17th, 1890; Educ.: I.C.S.; 1907-19, Vaughan Electric Co. Ltd., Saint John, N.B.; Allis-Chalmers Bullock, Montreal (1911—May-Oct.); 1919-28, Webb Electric Co., Saint John; 1928 to date, electrical contractor, 68 Thorne Ave., Saint John, N.B. (Applying for admission as Affiliate).

References: F. P. Vaughan, H. A. Stephenson, D. R. Webb, G. G. Murdoch, G. G. Hare.

MILLS—ALFRED ARTHUR, of 683 Melrose Ave., Verdun, Que. Born at Midhurst, Sussex, England, Jan. 23rd, 1895; Educ.: Diploma, Engrg. Course, Bennet College, Sheffield, England, 1923; 1911-14, machine shop ap'tice, G.T.R., Montreal; 1917-20, millwright, Dorman Long Ltd., England; 1921-24, partner in gen. engrg. shop, England; 1926-30, mech. dftsman., St. Hyacinthe Engrg. Works, Montreal; 1930 to date, dftsman. & plan surveyor, boiler & pressure vessel inspection branch, Quebec Provincial Government. (Applying for admission as Affiliate).

References: N. S. Walsh, J. Leblanc, G. Agar, R. E. MacAfee, P. F. Stokes.

MILLS—CECIL GORDON, of Trail, B.C. Born at Farnham, Que., June 2nd, 1903; Educ.: B.Sc. (Elec.), McGill Univ., 1926; 1921-25 (summers), on constrn. work; 1925-26, Montreal Armature Works; 1930-41, asst. relay engr., 1941-42, field engr. (constrn.), Montreal Light Heat & Power Cons., Montreal; At present, elec. engr., West Kootenay Power & Light Co., Trail, B.C.

References: H. Milliken, L. L. O'Sullivan, L. A. Kenyon, R. M. Walker, B. K. Boulton, E. W. Knapp.

McINTYRE—JACOB SPENCE, of Toronto, Ont. Born at Peterborough, Ont., Oct. 7th, 1890; Educ.: B.A.Sc., Univ. of Toronto, 1915; 1910-11, A. R. Williams Mach. Co.; 1913-14, Morrow & Beatty Ltd.; 1916-17, Jencks Machine Co. Ltd.; 1917-27, mech. engr., H.E.P.C. of Ontario; 1927-31, gen. supt., Corbett Construction Co., Pittsburgh; 1931-34, mech. engr., Dodge Mfg. Co.; 1934-37, equipment engr., Dept. of Northern Development, Toronto; 1937-38, mech. engr., Canadian Car & Foundry Co. Ltd., Montreal; 1938-39, design engr., General Motors Corp., Oshawa, Ont.; 1939-40, mech. engr., Dominion Foundries & Steel, Hamilton, Ont.; 1940-41, prin. mech. engr., Canadian Marconi Company, Montreal; 1941 to date, chief mech. engr., Armstrong Wood & Co., Toronto, Ont.

References: F. A. Gaby, F. B. Goedike, A. M. Mackenzie, T. F. Francis, W. P. Dobson, R. L. Dobbin.

NORTON—ALAN DOUGLAS, of 3 Manor Lodge, So. John St., Fort William, Ont. Born at Gomshall, Surrey, England, Sept. 1st, 1912; Educ.: Night classes in aeronautics & struct'l steel design; 1932-35, shop experience; 1935-37, production control dept., set up and supervised production planning system; 1937 to date, with Canadian Car & Foundry Co. Ltd., Aircraft Divn., Fort William, Ont. 1937-38, setting up production system, incl. production planning; 1937-39, i/c jig & tool design and control for special contracts; 1939, sent to England for special studies; 1940, continued tool design & supervision; Aug. 1941, project supervisor, s/c tool design & methods control; June 1942 appointed chief tool designer, engr. dept., & supervisor, tool & methods dept. (Applying for admission as Affiliate).

References: D. Boyd, H. Scheunert, E. M. G. MacGill, W. L. Bird, H. G. O'Leary.

PASCOE—THOMAS, of Suffield, Alta. Born at Tyldesley, Lancs., England, Sept. 30th, 1895; Educ.: Cert. Mine Surveyor, Great Britain and Alberta. Cert. Mine Manager, Great Britain, Sask. & Alberta; 1911-14, ap'ticed with Messrs. F. E. & L. P. Jacob, mining engr., Port Talbot, South Wales; 1914-19, Overseas, Capt., Royal Engrs. & Royal Artillery; 1919-22, completed experience with Messrs. Jacob; 1922-24, mine surveyor, group of collieries for Messrs. Jacob—underground & surface, surveys and layouts, royalties & engrg. works; 1924-25, mgr., Parcy-bryn Collieries Ltd., Port Talbot, South Wales; 1927-28, engr. & surveyor, A.B.C. Coal Co. Ltd. Newcastle Coal Co. Ltd.; 1928-29, mine surveyor, 1929-33, pitboss, 1933-39, mgr., Mountain Park Collieries Ltd., Mountain Park, Alta.; 1941 (Jan.-March), mgr., Hinton Collieries Ltd., Hinton, Alta.; June 1941 to date, senior asst. engr., M.D. No. 13, i/c constrn. of experimental station, Suffield, Alta.

References: M. Cranston, F. M. Steel, J. W. Young, J. R. Wood, H. LeM. Stevens Guille.

**PATTERSON—WILFRED ERNEST**, of 4578 Lambert Ave., Montreal, Que. Born at Vancouver, B.C., Jan. 16th, 1900; Educ.: B.Sc. (Chem. & Met.), Queen's Univ., 1924. R.P.E. of Ont.; 1918-19, British Chemical Co.; 1919-20, Canadian Westinghouse Co.; 1920-21, North American Cyanamid Co.; 1921-26, with G. F. Sterne & Sons Ltd.; 1926-40, G. F. Sterne & Sons Ltd. & Sternon Laboratories Ltd., as constg. chem. engr.—i/c all plant development & mfg. control, serving as chief chemist to G. F. Sterne & Sons Ltd., and managing-director, Sternon Laboratories Ltd.; 1940-42, Allied War Supplies Corporation, i/c technical group of Ammunition Filling Divn.; at present, technical director, Merck & Co. Ltd., Montreal.

References: H. G. Acres, H. M. Scott, W. P. Dobson, E. P. Muntz, S. R. Frost, W. L. McFaul, L. A. Wright.

**POULIOT—ADRIEN**, of Quebec, Que. Born at Saint Jean, Ile d'Orleans, Que., Jan. 4th, 1896; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1919. M.Sc., Laval Univ., L.Sc. (Maths.), Sorbonne, Paris; 1920-23, engr., Dept. Public Works, Quebec; 1922-24, lecturer in maths., 1924-28, asst. professor in maths., 1928, professor of differential and integral calculus, 1938-40, secretary, Faculty of Science, director, Dept. of Mathematics, and 1940 to date, Dean of the Faculty of Science, Laval University, Quebec, Que.

References: A. B. Normandin, I. E. Vallee, A. O. Dufresne, O. O. Lefebvre, H. Cimon.

**RANSOM—ROSMORE HOWARD**, of 5975 Cote St. Antoine Road, Montreal, Que. Born at Westmount, Que., Dec. 8th, 1909; Educ.: B.Eng., McGill Univ., 1935; 1931 (summer), rodman, etc., W. G. Hunt, M.E.I.C.; 1934-35, lab. asst., Bennett Limited, Chambly Canton, Que.; 1935-36, transitman, Noranda Power Development; 1936-37, production work & dftng. (understudy to plant mgr.), Canadian Potteries Ltd., St. Johns, Que.; 1940-42, maths. & science teacher, West Hill High School, Montreal; At present taking Officers' Training Course, R.C.A.F.

References: W. G. Hunt, G. J. Dodd, E. S. Holloway, T. H. Wardleworth, E. R. Jacobsen, E. Brown.

**REYNOLDS—THEODORE**, of Montreal, Que. Born at Farnham, Que., July 20th, 1888; Educ.: I.C.S. and private tuition in mech. engr.; 1906-10, Laurie Engine Works, apticeship, afterwards in dftng. office; 1910-11, machine shop foreman & asst. supt., Jeffrey Mfg. Co. Ltd.; 1911-13, machine shop foreman, Dominion Safe & Vault Co.; 1913-15, supt., St. Lawrence Welding & Engineering; 1915-30, steam engr., Singer Mfg. Co., St. Johns, Que., chief engr., Lesage Packing & Fertilizer Co., chief engr., Canada Malting Co., erecting engr., Ross & Greig, boiler inspr.; 1934 to date, stationary engineman examiner and asst. chief inspr. for boilers, of the Province of Quebec. (Applying for admission as Affiliate.)

References: J. Leblanc, N. S. Walsh, P. P. Vinet, A. S. Wall, R. Boucher.

**SARAULT—GILLES EDOUARD**, of 2711 Gouin Blvd. West, Montreal, Que. Born at Montreal, March 16th, 1909; Educ.: B.Eng. (Elec.), McGill Univ., 1934; 1932-34 (summers), Beauharnois Power Constrn., Laurentian Forest Protective Assn., Canadian Electronics; 1934-37, Northern Electric Co. Ltd., 1937-38, engr. in charge, CBF transmitter, and 1938-42, regional engr. for Quebec province, Canadian Broadcasting Corp.; At present, lecturer, Dept. of Elec. Engrg., Laval University, Quebec, Que.

References: R. Dupuis, J. A. Ouimet, A. Frigon, R. Boucher, C. V. Christie.

**THOMSON—JOHN**, of Mackenzie, Demerara, British Guiana. Born at Carlisle, Scotland, May 24th, 1902; Educ.: 1st Class Board of Trade Steam Cert. with motor endorsement; 1919-25, apticeship with Dalmeington Iron Co. Ltd.; 1925-27, junior engr., 1930-31, 1st asst. on watch, diesel main & auxiliary engines, 4th engr., 1928-34, full charge of watch on main & auxiliary engines, British India Steam Nav. Co. Ltd.; 1934-35, fitter, 1935-36, on technical staff, Handley Page Aircraft Ltd.; 1936-40, senior asst. mech. engr., and at present, plant supt., Demerara Bauxite Co. Ltd., Mackenzie, Demerara, British Guiana.

References: A. W. Whitaker, Jr., P. H. Morgan, F. L. Lawton, G. B. Flaherty, R. W. Emery.

**WYLLIE—JAMES MURDOCK**, of Riverside, Ont. Born at Kincardin, Ont., Oct. 13th, 1910; Educ.: I.C.S. Diploma, Struct'l Engrg., 1934. Private study; With the Canadian Bridge Company, Ltd., as follows: 1929-34, aptice in dftng. dept., 1934-37, struct'l steel dftsmn., 1937-40, struct'l. steel designer & estimator, 1940 to date, engr., contracting dept.

References: C. M. Goodrich, P. E. Adams, J. H. Bradley, T. H. Jenkins, E. M. Krebsler, H. L. Johnston, G. E. Medlar.

#### FOR TRANSFER FROM JUNIOR

**BATES—HAROLD CAREY**, of Stratford, Ont. Born at Toronto, Ont., Feb. 3rd, 1892; Educ.: B.Sc. (Civil), Queen's Univ., 1917; 1913-16 (summers), Toronto Harbour Commission; 1917-19, asst. divn. engr., mtce. of way, G.T.R.; 1920-21, transitman, etc., 1921-22, field engr., H.E.P.C. of Ontario; 1923-25, asst. engr. on constrn. & mtce. of outside plant, 1926-33, dist. engr. i/c constrn., design & mtce. of outside plant, Bell Telephone Company of Canada; 1934-35, instr'man., & chief of party, Dept. of Nor. Dev. of Ontario; 1936, res. engr., Sutcliffe Engrg. Co.; 1937-38, res. engr. on constrn. for A. B. Crealock, Constg. Engr., Toronto; 1938-40, chief asst. to Fred A. Bell, Engin county engineer & O.L.S.; 1940-41, county engr., & road supt., County of Lanark; at present, county engr. & road supt., County of Perth, Ontario. (St. 1916, Jr. 1920.)

References: N. D. Wilson, E. G. Hewson, R. M. Smith, J. A. P. Marshall, W. L. Dickson, F. A. Bell.

**BAXTER—GORDON BRUCE**, of Three Rivers, Que. Born at Quebec, Que., Sept. 29th, 1901; Educ.: B.Sc. (Elec.), McGill Univ., 1926; 1922-26 (summers), dftsmn., St. Lawrence Paper Mills; 1927-37, drfsmn., and 1937 to date, asst. elec. supt., Canadian International Paper Company, Three Rivers, Que. (St. 1924, Jr. 1929.)

References: C. H. Champion, J. F. Wickenden, E. W. R. Butler, A. C. Abbott, J. H. Fregeau.

**BENOIT—JACQUES EMMANUEL**, of Montreal, Que. Born at Montreal, July 16th, 1909; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1933; 1929-31 (summers), Dept. Rlys. & Canals; 1932 (summer) and 1933 (May-Nov.), instr'man., A. Janin Construction Co., Montreal; 1934-37, sales engr., and 1937 to date, district sales mgr., Wallace & Tiernan Ltd., Montreal. (St. 1933, Jr. 1938.)

References: J. A. Lalonde, O. O. Lefebvre, C. C. Lindsay, C. E. Hogarth, C. K. McLeod.

**COLPITTS—CECIL ASHTON**, of 725—8th Ave. No., Saskatoon, Sask. Born at Winnipeg, Man., Jan. 23rd 1907; Educ.: B.Sc. (C.E.), Univ. of Man., 1933; 1926-28 and 1928-34 (summers) constrn. dept., C.P.R.; 1934-41, transitman, operating dept., 1941, roadmaster and Dec. 1941 to date, divn. engr., C.P.R., Saskatoon, Sask. (Jr. 1937.)

Reference: C. H. Fox, R. C. Harris, J. N. Finlayson, G. W. Parkinson, A. K. Sharpe.

**DENTON—ALLAN LESLIE**, of Ripples, N.B. Born at Scotchtown, N.B., Oct. 12th, 1904; Educ.: B.Sc. (Elec.), Univ. of N.B., 1932; 1929-30-31 (summers), gen. constrn. work, A. P. Dupuis, Detroit, elec. dept., Atlantic Sugar Refinery, Saint John, N.B., checker on tower line, N.B. Electric Power Commn.; 1933-34, with Rothwell Coal Co., Minto, N.B.; 1934-41, with Lamaque Mining Company, practical mining experience, incl. one year in engrg. office. For last three years, part-time instr'man. and part. time surveying and mapping; Nov. 1941 to date, Navigation Instructor, R.C.A.F., Chatham, N.B. (St. 1932, Jr. 1937.)

References: E. O. Turner, J. Stephens, S. R. Weston, M. W. Black, A. R. Moffat.

**DICKSON—WILLIAM LESLIE**, of Marmora, Ont. Born at Stellarton, N.S., June 7th, 1908; Educ.: B.Sc. (Elec.), N.S. Tech. Coll., 1929. B. Eng. (Mech.), McGill Univ., 1940; 1927-29, asst. to Advisory Board on Fuel Investigation (N.S. Govt.); 1930-31, test course, 1930-31, induction motor design engr., Can. Gen. Elec. Co. Ltd.; 1931, substation constrn., 1931-37, test engr., N.B. Electric Power Commn.; 1938-40, at McGill; 1940 to date, asst. chief engr., Delora Smelting & Refining Co. Ltd., Marmora, Ont. (St. 1930, Jr. 1936.)

References: C. R. Whittemore, J. Cameron, J. Stephens, C. M. McKergow, T. H. Dickson.

**DODDRIDGE—PAUL WILLIAM**, of Toronto, Ont. Born at Quebec, Que., June 29th, 1904; Educ.: B.Sc. (E.E.), Univ. of N.B., 1928. R.P.E. of Ont.; 1923-24 and 1925-26-27 (summers), rodman, asst. timber cruiser, transitman, Donnacona Paper Company; 1928-29, test dept., 1929-32 and 1935 to date, asst. engr., switchgear section, apparatus sales dept., Can. Gen. Elec. Co. Ltd., Toronto, Ont. (St. 1928, Jr. 1936.)

References: W. E. Ross, B. I. Burgess, A. F. Baird, J. Stephens, H. R. Sills.

**FISHER—SIDNEY THOMSON**, of Ile Perrot, Que. Born at Wieseville, Alta., Aug. 8th, 1908; Educ.: B.A.Sc., Univ. of Toronto, 1930; Summers 1925-26, instr'man. Dept. Public Works, Alta., 1927-28, instr'man., City of Edmonton; 1928-29, transmission engr., Northern Electric Co. Ltd., Montreal. With latter company to date as follows: 1932-34, research products engr. dept., 1934-39, asst. development engr., 1939-41, sales engr., 1941 to date, development engr. & sales engr., special products divn. (St. 1927, Jr. 1935.)

References: H. J. Vennes, J. S. Cameron, A. B. Hunt, J. J. H. Miller, P. L. Debney, R. W. Boyle, H. J. MacLeod, A. W. Haddow, C. V. Christie.

**EVANS FOX—EDWARD CECIL**, of Wyndmoor, York Mills, Toronto, Ont. Born at Coaticook, Que., Nov. 29th, 1899; Educ.: Mech. Engrg. Course, Canadian Ingersoll Rand Diploma, Mech. Engr., I.C.S. Capt. in Military Engrg. Courses at Halifax, Niagara-on-Lake & Kingston (R.M.C. for Capt.); 1918-20, mech. engr., Canadian Ingersoll Rand, Sherbrooke, Que.; 1920-21, asst. instr'man., rly. constrn., Quebec Central Rly.; 1921-25, struct'l. engrg., McGregor & McIntyre, Toronto; 1925-27, struct'l. engr., Bethlehem Steel Co. specializing in dftng., design & field work; 1927, asst. engr. on rly. constrn., James Bay extension; 1927-28, one of erection engr. on Royal York Hotel; 1928-30, Dominion Bridge Co. Ltd., field work & dftng.; 1931-32, Dept. of Highways of Ont.; 1932-33, surveys, North York Township; 1933-35, Toronto Wholesale; 1935 to date, field engr., John T. Hepburn Ltd., Toronto, Ont. (Capt. on Reserve—Military Engineers). (St. 1921, Jr. 1923.)

References: C. S. L. Hertzberg, E. C. Kirkpatrick, H. N. Gzowski, J. M. Oxley, E. M. Proctor, H. W. Tate, E. T. Bridges.

**LAIRD—DAVID WILLIAM**, of Fort William, Ont. Born at Victoria, B.C., Sept. 20th, 1909; Educ.: B.Sc. (Civil), Univ. of Man., 1942; 1928-31 (30 mos), rodman, etc., highway constrn., reclaim, br., Prov. of Man.; 1940-41, civilian dftsmn., works & bldgs. divn., No. 2 T. C., R.C.A.F., Winnipeg; 1941 (Apr.-Oct.), constrn. engr., Thunder Bay Harbour Improvements, Gen. Contractors, Port Arthur, Ont.; 1941 to date, designing engr., C. D. Howe & Co. Ltd., Port Arthur, Ont. (St. 1939, Jr. 1940.)

References: A. E. Macdonald, G. H. Herriot, A. J. Taunton, J. J. White, J. N. McNeil, J. M. Fleming.

**MATHESON—MURRAY ALEXANDER**, of Talara, Peru. Born at Port Hawkesbury, N.S., Sept. 30th, 1907; Educ.: B.Sc. (Mech.), Univ. of Sask., 1933; 1933-34, engr. asst., control equipment, meters, etc., 1934-36, plant engr. asst. to mech. supt., Imperial Oil Limited, Regina; 1937-38, chairman, refinery technical cte., Sarnia Refinery, Imperial Oil Limited; 1938-39, acting chief engr., Talara Oil Co., Barranca Bermeja, Colombia; 1939 to date, asst. chief engr., Talara Refinery, International Petroleum Co. Ltd., Talara, Peru. (Jr. 1936.)

References: B. P. Rapley, G. E. Kent, I. M. Fraser, W. O. Longworthy.

**POWELL—JOHN GILES**, of 62 Fairlawn Ave., Toronto, Ont. Born at Toronto, May 8th, 1909; Educ.: B.A.Sc. (Civil), Univ. of Toronto, 1932. R.P.E. of Ont.; 1929-32 (summers), dftsmn. & instr'man., Gore, Naismith & Storrie, constg. engrs., Toronto. 1932 to date, continuously employed by above firm (now Gore & Storrie), as drfsmn., estimator, concrete designer, struct'l. steel designer, water works, sewer, sewage disposal, & power development design, etc. (St. 1932, Jr. 1936.)

References: W. Storrie, N. G. McDonald, J. F. MacLaren, R. C. Harris, C. R. Young, A. U. Sanderson.

**STEWART—LESLIE BAXTER**, of Rapide Blanc, Que. Born at Antigonish, N.S., July 21st, 1903; Educ.: B.Sc. (Elec.), McGill Univ., 1927; 1926 (summer), electrician, Aluminum Co. of Canada, Arvida; 1927 to date, with the Shawinigan Water & Power Company, as follows: 1927-29, student aptice course, 1929-32, elec. tester, 1932-39, gen. design & testing, power house engrg. office, 1939 to date, powerhouse supt., hydro electric power station, Rapide Blanc, Que. (St. 1925, Jr. 1932.)

References: G. Rinfret, H. J. Ward, H. K. Wyman, A. C. Abbott, E. T. Buchanan.

**SUDDEN—EDWIN ALEXANDER**, of 343 High Park Ave., Toronto, Ont. Born at Galt, Ont., Sept. 6th, 1900; Educ.: B.A.Sc., Univ. of Toronto, 1926. R.P.E. of Ont.; 1923-24, contractor's asst., Troy & Webster, Galt, Ont.; 1925, O.L.S. asst., O. Rolison, M.E.I.C.; 1926-30, detailing, checking, designing, Canadian Bridge Company, Walkerville, Ont.; 1930-33, Township of Etobicoke, Islington, Ont., design & supervision of constrn. of sewage & water works plants; 1937 to date, design engr., hydraulic dept., H.E.P.C. of Ontario, Toronto, Ont. (St. 1926, Jr. 1928.)

References: D. T. Alexander, R. C. Leslie, C. R. Young, O. Holden, J. R. Montague, D. D. Whitson, D. Cameron.

**YOUNG—WILLIAM HUGH**, of East Angus, Que. Born at Ottawa, Ont., Feb. 16th, 1909; Educ.: B.Sc. (Mech.), Queen's Univ., 1934; 1934-41, field engr. & dftsmn., Howard Smith Paper Mills Ltd., Cornwall, Ont.; Jan. 1942 to date, mtce. supt. Brompton Pulp & Paper Company, East Angus, Que. (Jr. 1936.)

References: L. T. Rutledge, H. E. Meadd, A. L. Farnsworth, D. Ross-Ross, E. P. Wilson.

#### FOR TRANSFER FROM STUDENT

**ARCHAMBAULT—GEORGES LOUIS**, of Arvida, Que. Born at Outremont, Que., Mar. 21st, 1915; Educ.: B.Eng. (Mech.), McGill Univ., 1939. R.P.E. of Que.; 1925, 1937-38 (summers), geol. surveying, mech. drawing, garage mechanic; 1939-41, sales & service engr., Brown Instruments; 1941-42, sales & service engr., Peacock Bros. Ltd.; at present on mech. staff, Aluminum Co. of Canada, Arvida, Que. (St. 1937.)

References: deG. Beaubien, A. Surveyer, L. A. Duchastel, R. H. Rimmer, B. Bauman.

**AUCLAIR—CHARLES A.**, of 1690 St. Hubert St., Montreal, Que. Born at Loretteville, Que., Feb. 15th, 1915; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1941. R.P.E. of Que.; 1937-40 (summers), surveying & road constrn., Prov. Govt.; 1941, engrg. staff, Beauharnois Light Heat & Power Co.; At present, gen. engrg., A. Surveyer & Co., Montreal, Que. (St. 1939)

References: A. Surveyer, E. Nenniger, J. G. Chenevert, C. G. Kingsmill, A. O. Dufresne.

**BELANGER—LUCIEN**, of 249 St. Catherine Road, Outremont, Que. Born at Montreal, July 1st, 1915; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1942; 1938-39 (summers), dftng., A. Belanger & Sons, Montreal; 1940-41 (summers), surveying, Quebec Roads Dept.; May 1942 to date, mech. dftsmn., Engineering Products Co. Ltd., Montreal. (St. 1940.)

References: J. A. Lalonde, R. Boucher.

(Continued on page 543)

# Employment Service Bureau

## SITUATIONS VACANT

**MECHANICAL ENGINEER** for British Guiana. Some experience on diesels and tractors preferred. Apply to Box 2482-V.

**ELECTRICAL ENGINEER** with at least five years practical experience for work at Mackenzie, British Guiana. Apply to Box No. 2536-V.

**JUNIOR MECHANICAL ENGINEER** wanted at Arvida, recent graduate with machine shop experience to act as assistant to shop superintendent. Apply to Box No. 2572-V.

**METALLURGIST** or chemical engineer wanted at Arvida with at least one year's manufacturing experience. Apply to Box No. 2574-V.

**CHEMICAL engineer** for work at Shawinigan Falls with general plant or process work experience. Apply to Box No. 2575-V.

**TWO GRADUATE ENGINEERS** or men with sufficient experience in draughting to act as squad leaders of four to six men on reinforced concrete detailing, general equipment layout or mechanical drawing. These men to work along with other draughtsmen but be able to head up the job, lay out the work and check the drawings for issuing. Apply to Box No. 2577-V.

**PERMANENT POSITION** in Toronto or Montreal areas with a large industrial fire insurance organization. Previous experience in this work is not necessary. Applicant must be a technical graduate with manufacturing or engineering experience and possess a good personality. Several months training with full pay will be given. Please send photograph with letter. Apply to Box No. 2588-V.

**JUNIOR MECHANICAL ENGINEER** wanted at Kingston, Ontario, recent graduate. Apply to Box No. 2589-V.

**GRADUATE MECHANICAL ENGINEER**, preferably a man with paper mill experience to specialize in sale and installation of material handling equipment. Apply to Box No. 2590-V.

## SITUATIONS WANTED

**INDUSTRIAL ENGINEER**, M.E.I.C., Age 40, Canadian, Married, desires position as production manager or other executive capacity. Presently employed but desires change to plant on war work. Understands layout thoroughly. Location, Toronto area. Salary dependent on responsibility, minimum \$3,600. Apply to Box No. 717-W.

**MECHANICAL DRAUGHTSMAN**, J.R.E.I.C., graduate of the University of Toronto in Electrical

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to **THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.**

Engineering. Some six years of practical experience with accent on electric motor design, instruments and small tools. Has a background of two years in electric instrument laboratory. Desirous of making a change where his services will be fully utilized and better appreciated. Apply to Box No. 1486-W.

**GRADUATE MECHANICAL ENGINEER**, military exempt. Age 33, married. Detail experience in mechanical departments of paper-making, construction and foundry work. Available immediately. Location immaterial. Desirous of executive or production position with prospects of advancement. Apply to Box No. 1650-W.

**CIVIL ENGINEER**, B.A. sc. Age 33, married. Experience covering heating, air conditioning, mining, Design, construction and maintenance of sewers, aqueducts, streets and highways, including surveying, location, estimating, inspections, drainage and soundings. Presently employed, but desires advancement. Apply to Box No. 1839-W.

**GRADUATE CIVIL ENGINEER**, S.E.I.C., experience in surveying and in teaching same, location surveys for roads and railroads, 2 years as construction engineer in oil fields in tropics in charge of roads, earth-moving machinery, anti-malarial drainage, etc. Experience in construction of bituminous pavements. At present engaged in airport construction. Available from September first. Age 30 years. Apply to Box No. 1860-W.

**ELECTRICAL ENGINEER**, age 34, twelve years experience in design, manufacture and application of fire protection systems. Good general knowledge of mechanical engineering, experience with tool design machine tools and shop practice. Trained in business administration and accustomed to responsible charge of large staff. Available immediately. Apply to Box No. 2442-W.

**GRADUATE ELECTRICAL ENGINEER**, M.E.I.C., with twenty-nine years experience in operation construction, repairs and maintenance of paper mill and hydro electric system. Bilingual. Available September first. Apply to Box No. 2443-W.

**GRADUATE B.Sc., S.E.I.C.**, Age 26, enthusiastic and energetic. Keenly interested in fields of industrial engineering and chemistry. Bilingual. All round technical training and three years of engineering office experience. Presently employed but desirous of change where services will be more fully utilized. Apply to Box No. 2445-W.

## TRANSITS AND LEVELS WANTED

The Department of Munitions and Supply at Ottawa is desirous of procuring:

15 transits 5" with vertical circle theodolite including tripod case and accessories.

19 8" telescopic levels—Dumpy including tripod case and accessories.

Second-hand instruments will be acceptable providing they are in good condition and have the following:

Transit

- (a) Not less than 5 in. horizontal circle.
- (b) Vertical circle.
- (c) Read to minutes.
- (d) Carrying case tripod.
- (e) Plump bob, objective shade.
- (f) Adjusting keys.

Level

Dumpy pattern preferred but not absolutely essential, must have:

- (a) Telescope not less than 8 in.
- (b) Carrying case and tripod.
- (c) Objective shade.
- (d) Adjusting keys.

Please communicate direct with: L. L. Price, Director, General Purchasing Branch, Dept. of Munitions and Supply, Ottawa.

## PRELIMINARY NOTICE (Continued from page 542)

**CAMPBELL—GERALD ARTHUR**, of Port of Spain, Trinidad. Born at Montreal, August 25th, 1915; Educ.: B.Sc. (Civil), Univ. of N.B., 1938; 1937 (summer), surveying, mill location & water supply, Fraser Companies, Ltd.; 1937-38, asst. instructor in surveying, Univ. of N.B.; 1938 (summer), power line location, N.B. Electric Power Comm.; 1938-39, dftsmn., Dept. of Lands & Mines, N.B.; 1939, highway location, Caribbean Constrn. Co., Trinidad; 1938 (July-Oct.), inspr., asphalt paving, Milton Hersey Co.; 1939-41, asst. civil engr., civil & constrn. section, United British Oilfields of Trinidad, Ltd.; At present, airport constrn., gen. field engrg. work, Walsh & Driscoll Company, Port of Spain, Trinidad. (St. 1937).

References: J. Stephens, E. O. Turner, A. F. Baird, F. O. White, J. J. R. Scanlon.

**CONKLIN—MAURICE**, of 470 Viau St., Montreal, Que. Born at Gledhowe, Sask., Feb. 15th, 1914; Educ.: B.Eng. (Mech.), Univ. of Sask., 1938; 1938-39, mech. dept., Algoma Steel Corporation; 1939-40, gen. engrg., John T. Hepburn Co. Ltd., Toronto; 1940-41, design of shell lathes, Defence Industries Ltd.; 1941-42, tool design, Canadian Vickers Ltd.; at present, tool designer, Canadian Propellers Ltd., Montreal, Que. (St. 1938).

References: C. Stenbol, J. L. Lang, D. Cameron, R. C. Flitton.

**DOBSON—RICHARD NESBITT**, of 28½ Rupert St., Amherst, N.S. Born at Dunnville, Ont., Nov. 9th, 1912; Educ.: B.Eng., McGill Univ., 1935; 1933-1934, inspection dept., Consumers Glass Co.; 1935-36, production dept., Dominion Engrg. Co. Ltd.; 1936-41, dftsmn., engr. i/c tooling & engrg., Turcot-Anson divn., and at present, asst. works mgr., Amherst plant, Canadian Car and Foundry Co. Ltd. (St. 1933).

References: E. F. Viberg, N. B. MacRostie, C. D. Wight, T. M. Moran, D. Boyd.

**FILION—PAUL**, of Montreal, Que. Born at Montreal, Mar. 12th, 1911; Educ.: B.Eng. (Chem.), McGill Univ., 1936; 1933 (summer), asst. to hydrographic engrs., Dept. of Marine, Ottawa; 1935 (summer), plant control lab., Canadian Industries Ltd., Windsor, Ont.; 1937-40, inspr. & fire protection engr., sprinklered risk dept., Canadian Underwriters Assn. Montreal; 1940 to date, engr., fire prevention dept., Reed, Shaw & McNaught Ltd., Insurance Engineers & Brokers, Montreal. (St. 1936).

References: J. B. Phillips, A. A. Ferguson, R. B. Brosseau, T. H. Bacon, A. J. Foy, A. J. Wise, G. Graham, L. Trudel.

**FLAHAULT—JOHN E.**, of Arvida, Que. Born at Montreal, Aug. 23rd, 1914; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1938. B.Sc. (Met.), Carnegie Institute of Technology, 1940; 1937-38-39 (summers), with Aluminum Co. of Canada; 1941 to date, shift engr., at present, supervisor in potrooms, Arvida works, Aluminum Co. of Canada, Arvida, Que. (St. 1936).

References: A. W. Whitaker, Jr., A. Frigon, A. Circe, McN. DuBose, J. A. Lalonde, A. C. Johnston.

**HIBBARD—ASHLEY GARDNER**, of Montreal, Que. Born at Sillery, Que., Dec. 2nd, 1914; Educ.: B.Eng. (Civil), McGill Univ., 1941; 1929-38 (6 summers) with Quebec Central Rly., chairman, dftsmn.; 1937 (summer), instr'man., Crepeau & Cote, Sherbrooke; 1939, surveying & gen. office work on highway constrn., Newton Construction Co.; 1939-40 (summers), instr'man., Quebec Roads Dept.; 1941 to date, dftsmn., C.P.R., bridge engrg. dept., Montreal. (St. 1937).

References: A. R. Ketterson, G. E. Shaw, F. H. Hibbard, R. E. Jamieson, F. M. Wood.

**HUGGARD—JOHN H.**, of Kenogami, Que. Born at Norton, N.B., Apr. 14th, 1911; Educ.: B.Sc. (E.E.), Univ. of N.B., 1935; 1935-36, lineman & survey work, N.B. Hydro Commission; 1936-37, instr'man., N.B. Dept. of Highways; 1937-38, instr'man., Sutcliffe Co. Ltd., New Liskard, Ont.; 1938-39, instr'man., Dept. of Highways Ontario; 1939-40, electrician, on constrn., Anor Gold Mines; 1940-41, area engr. & field engr., Fraser Brace Ltd.; 1941 to date, area engr. for H. G. Acres Co. Ltd., at Shipshaw power development. (St. 1935).

References: P. C. Kirkpatrick, C. Miller, F. Astels, W. F. Campbell.

**LEMIEUX—HENRI JULIEN**, of 6294 de Normanville St., Montreal, Que. Born at Montreal, June 22nd, 1915; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1939; R.P.E. of Que., 1939 (May-June), supervn. on tests of ore dressing & reclamation at Federal labs., Ottawa; 1939 (3 mos.), designing engr. & dftsmn., Truscon

Steel Co. of Canada; 1939-40, designing engr., Dept. Public Works of Quebec; 1940-41, sales & service engr., Anti-Hydro of Canada Ltd., Montreal; 1941-42, with Foundation Co. of Canada Ltd., at present, office engr., at Shipshaw, Que. (St. 1938).

References: W. N. Cann, R. Strickland, H. V. Serson, N. Dixon, P. H. Morgan.

**MAHOUX—RAYMOND JEAN**, of 1225 Bernard Ave. West, Outremont, Que. Born at Orleans, France, Nov. 3rd, 1913; Educ.: B. Eng. (Mech.), McGill Univ., 1937; 1937-39, asst. master mechanic, Laurentide Divn., Consolidated Paper Corp.; 1939-40, asst. production supervisor, aircraft divn., Canadian Car & Foundry Co. Ltd., Montreal; 1940 to date, chief planner, Delorimier plant, Federal Aircraft Ltd., Montreal. (St. 1937).

References: R. DeL. French, C. M. McKergow, L. Trudel.

**MCBRIDE—JAMES WALLACE**, of Cambridge, Mass. Born at Winnipeg, Man., Feb. 26th, 1915; Educ.: B. Sc. (E.E.), Univ. of Man., 1938. S.M. (Aero), Mass. Inst. Tech., 1940. Candidate for Sc.D. at M.I.T. expecting to complete requirements in 1943; 1939-41, research asst. to Dr. H. Peters, on boundary layer studies with, impressed pressure gradients, misc. academic work, incl. airplane design, airplane structures and general aeronautics, in special defence courses. Also misc. consult. work; at present, research associate, Divn. of Industrial Co-operation, Massachusetts Institute of Technology, Cambridge, Mass. (St. 1938).

References: E. P. Fetherstonhaugh, A. E. Macdonald, G. H. Herriot, N. M. Hall, J. T. Dymont.

**ROLESTON—PHILIP REGINALD**, of 220 Fraser St., Quebec, Que. Born at Georgetown, British Guiana, May 1st, 1903; Educ.: 1921-23, two years completed in mech. engrg., McGill Univ.; 1920-21, apt'ice in iron foundry, 1923-25, statistical clerk on engrg. tests, 1925-29, instr'man., Abitibi Power & Paper Co., Iroquois Falls, Ont.; 1929-35, conducting steam boiler tests, pump tests, heating & ventilating tests, also instr'man., 1935-39, asst. control supt., and 1937 to date, control dept. supt., Anglo-Canadian Pulp & Paper Mills Ltd., Quebec, Que. (St. 1923).

References: J. O'Halloran, G. K. Addie, E. L. Goodall, E. W. McBride, R. H. Farnsworth, E. D. Gray-Donald.

**SMITH—ARTHUR JAMES EDWIN**, of Winnipeg, Man. Born at Walthamstow, Essex, England, Sept. 10th, 1912; Educ.: B.A.Sc. (Civil), Univ. of Toronto, 1935; 1928-34 (summers), underground constrn. & mtce. depts., Bell Telephone Company of Canada, Toronto; 1935, surveyor, Jas. A. Wickert Co., Toronto; 1936, Canadian Allis Chalmers Ltd., constrn., gold milling plants at Red Lake, Ont., and inspecting engr. at Toronto; 1937-39, i/c Winnipeg office, sales & service, hydraulic mining & power equipment, for same company; 1939-40, Lieut., 12th Field Co., R.C.E., Jan 1940 to date, Works Office, i/c design, estimate & constrn. of internment camps, military camps & barracks, No. 10 Coy., R.C.E. Hdqrs., M.D. No. 10, Winnipeg (Promoted to Capt., June, 1941). At present attending Company Commanders' Course at Kingston. (St. 1935).

References: E. V. Caton, C. P. Haltalin, T. E. Storey, W. F. Riddell, J. D. Peart.

**STANLEY—JAMES PAUL**, of 559 Lansdowne Ave., Westmount, Que. Born at Westmount, Aug. 15th, 1915; Educ.: B.Eng. (Mech.), McGill Univ., 1938. R.P.E. of Que.; 1936-37 (summers), with Robert Mitchell Co. Ltd., and Algoma Steel Corp.; 1938-41, with Stevenson & Kellogg Ltd., Newspaper Association of Canada—proration programme and costs; 1941 to date, Flying Officer, Aeronautical Engrg. Divn., R.C.A.F. Hdqrs., Ottawa. (St. 1938).

References: C. M. McKergow, P. Kellogg, L. J. Scott, T. M. Moran, C. W. Crossland.

**YATES—JOHN MUNRO**, of 11 Sherwood Ave., Toronto, Ont. Born at Toronto, June 24th, 1905; Educ.: Diploma in Architecture & Bldg. Constrn., Ontario Training College (Technical Teachers), Hamilton, Ont. Teacher's Cert. in Dftng., 1937; 1924-27, junior dftsmn., Browne & Cavell, Toronto; 1927, dftsmn. for Willis Chipman, C.E., Toronto; 1927-29, dftsmn., Browne & Cavell; 1929-30, dftsmn., Bell Telephone Co. of Canada; 1930-32, dftsmn. on highway design, grading & surveys, Ontario Dept. of Highways; 1934-36, dftsmn. on mining mill layout and mining machy., General Engineering Company (Canada) Ltd., Toronto; 1937-38, dftsmn., Ontario Dept. of Highways; Feb. 1938 to date, instructor in mech. dftng. & blueprint reading, Central Technical School, Toronto, Ont. (St. 1933).

References: A. Hay, E. D. W. Courtice, W. L. Saunders, R. F. Oglivy.

## BOILERS, RADIATORS AND WATER HEATERS

Warden King Limited, Montreal, Que., have issued a 32-page catalogue entitled "1942 Heating Catalogue," which is thoroughly illustrated throughout and data are presented in an attractive and convenient manner. The catalogue describes only those hot water and steam boilers, radiators and radiator hangers, and domestic hot water heaters which are still being manufactured by the company. The boilers include the "Viking" series for low cost and small homes to large buildings and the "Daisy" type. Dimensional drawings and tables of dimensions and capacities are used throughout; two pages of heating data and conversion equivalents are also included.

## CARBIDE CUTTING TOOLS

A 48-page booklet, vest pocket size, entitled "Instructions for Users of Kennametal Steel Cutting Carbide Tools," is being distributed by Kennametal of Canada Limited, Hamilton, Ont. This contains information and illustrations dealing with the selecting, designing, using, brazing and grinding of Kennametal tools.

## CARBOLOY CARTRIDGE CASE DIES

Bulletin No. D-113, 12 pages, being distributed by Canadian General Electric Company, Limited, Toronto, Ont., covers standardized carboloy dies for small arms ammunition. Specifications are given of all standard carboloy die sizes for .30 and .50 armor piercing jackets, tracer and ball jackets, cartridge cases, etc., and a section is devoted to operator training covering the finishing and servicing of carbide dies. Details on equipment required, etc., are also included.

## ELECTRIC SWITCHES

Canadian Line Materials Limited, Toronto, Ont., have published a bulletin, No. 4246, four pages, featuring the company's type "MK-39" switches and illustrating the principle of design that ensures high pressure at both blade ends. Dimensional drawings, tables and specifications are included.

## GRINDING WHEELS

A 4-page folder is being distributed by Canadian Fairbanks-Morse Company, Limited, Montreal, Que., which consists mainly of a handy list of "Norton" grinding wheels, with their designating numbers, for use in sharpening various types of tools including cutters, reamers, drills, taps, dies, broaches, thread chasers, dies, etc. Three types of wheels are featured, namely, the "Norton" metal bonded diamond wheel for offhand grinding of single point tools; the "Norton" resinoid bonded diamond wheel for tool and cutter grinding of multiblade carbide tools; and the "Norton" Crystolon for those who prefer a vitrified wheel.

## HIGH SPEED STEEL

Jessop Steel Company, Limited, Toronto, Ont., have just issued a 12-page bulletin, No. 242, describing the new Jessop "TCM" high speed steel. Information regarding its advantages and performance, analysis, typical applications and heat treating procedure are covered in detail.

## LIGHTING FOR AIRCRAFT INDUSTRY

"Lighting for the Aircraft Industry" is the title of a bulletin being distributed by The Holophane Company, Limited, Toronto, Ont. This bulletin contains comprehensive information on the subject and features the economies resulting from adequate lighting in aircraft plants. Accurate tables are given for arriving at costs and economic comparisons of various lighting methods. Also included are easy-to-use illumination charts which give predetermined information of expected lighting results.

## Industrial development — new products — changes in personnel — special events — trade literature

### JENKINS APPOINTMENTS

Mr. John J. Bancroft was recently elected Vice-President and Managing Director of Jenkins Brothers Limited, Montreal, succeeding Mr. James H. Webb, retired. Mr. Bancroft joined this organization in 1922 as a junior clerk and in 1930 was appointed Accountant and Office Manager. In 1940 he became a Director of the Company, with the position of Comptroller and in December of the same year was appointed Treasurer and Assistant Manager.

Mr. Herbert H. Gee has been appointed Vice-President in charge of sales and re-elected Secretary of Jenkins Brothers Limited, Montreal. Mr. Gee is one of the "Diamond Associates" of this organization, having served in many capacities during the past thirty-four years. In 1920 he was transferred to Toronto as Sales Representative and later was made Manager of Sales for the province of Ontario. He was elected a Director of the Company in 1931 and two years later returned to Montreal as Secretary and Director of Sales.

Mr. Walter S. Beazley has been appointed to the position of Assistant Manager of Jenkins Brothers Limited, Montreal. Mr. Beazley joined the Company nineteen years ago and has served in several capacities. In 1926 he was appointed Purchasing Agent and remained in this position until his recent appointment as Assistant Manager.

### LEATHER BELTING FOR SHORT-CENTER DRIVES

Canadian Fairbanks-Morse Company, Limited, Montreal, Que., have just issued a leaflet describing the "Research" leather belts of the Canadian Graton & Knight Limited, with particular reference to their use for short-center drives. The advantages of leather belting are listed and opposite each item the additional advantages of "Research" belting are also listed.

### NEW COMPANY FORMED

Until recently Gunit & Waterproofing Limited have been the sole licensees in Canada for the "Preload System" of concrete construction, and it has just been announced that a separate company has been formed under the name of The Preload Company of Canada Limited, with offices at Montreal, Toronto and Halifax. The company will specialize in designing and building "Preload" tanks, silos, domes, pressure vessels and all containers and carriers of liquids and dry materials.

### POLE LINE HARDWARE

Canadian Engineering Standards Association, Ottawa, Ont., have issued Specification C83-1942-Pole Line Hardware, covering purchasing requirements for pole line hardware used by utilities engaged in power supply, electric traction, or communication transmission. It is divided into three parts: I—General, II—Material and Manufacture, III—Drawings. In order that review of new information and drawings on new or existing standard hardware items can be added from time to time, this Specification is issued in loose-leaf form under a special binder.

### PRECISION MILLING MACHINE

A 4-page bulletin being distributed by Bridge Machinery Company, Montreal, Que., describes, with large illustrations, the "Jefferson" milling machines. These include the screw and power feed, and the hand lever feed machines in both floor and bench mounting types. Complete details are given with full specifications. Attachments for these machines are also illustrated and described.

### MANUFACTURING RIGHTS

The Meehanite Metal Corporation, Pittsburgh, Pa., has announced that the Otis Fensom Elevator Company, Limited, Hamilton, Ont., has been granted manufacturing rights for Meehanite castings.

### STEEL STRAPPING

Acme Steel Company of Canada, Limited, Montreal, Que., have issued an 8-page folder, Form Ad32, entitled "Steel Strapping Shipments," and is reprinted from the company's 1942 Packaging Catalogue. Included are tables of sizes, weights and footages for both nailed and nailless types of strapping; tables of recommended sizes of strap for given package weights. A series of sketches reveal shipments of various types being reinforced for safe arrival and photographs illustrate strap applications to a variety of items ranging from salt pork to army trailers, chemicals, crated planes, pulleys, tile, metal tubes and textiles. Various "Acme" accessories, designed to speed up strap application, are illustrated and described.

### TAPS AND TAPPING

Greenfield Tap & Die Corporation of Canada, Limited, Galt, Ont., have prepared in manual form a 128-page book entitled "Facts About Taps and Tapping," which is divided into three parts. Part I, 32 pages, is a glossary of screw thread terms and description of taps and their uses; each type of tap is illustrated. Part II, 30 pages, presents factors governing the proper selection and use of taps. Part III, 66 pages, contains a series of tables with dimensional drawings, showing tap dimensions and tolerances, thread forms, etc.

### TEMPERATURE REGULATORS

A 14-page bulletin, No. 600, just published by Sarco Canada Limited, Toronto, Ont., features the company's self-operated temperature regulators for water heaters and industrial process applications. Operating and construction details are shown by cut-away sketches. Installation recommendations, applications and specifications are also included.

### VOLTAGE REGULATORS

Ferranti Electric Limited, Toronto, Ont., are distributing a 4-page reprint of an article by H. R. Osborne, B.Sc., Designing Engineer of the company, which appeared in the June 15th, 1942, issue of Electrical News and Engineering. The article is entitled "Increasing Line Capacity with Voltage Regulators." The company invites requests for its Bulletin No. 398 on Voltage Regulators which includes regulation charts for distribution lines, and replaces former Bulletin No. 397.

### APPOINTED CANADIAN DISTRIBUTORS

Hope Machinery Company, 21 King Street East, Toronto, Ont., have been appointed Canadian distributors for Drive-All Manufacturing Company, Detroit, Mich. Drive-All specializes in the manufacture of individual drives for machine tools, and is widely represented throughout the United States.

### WATER METER TESTING AND REPAIRING

A 16-page booklet and cover, entitled "Economies of Water Meter Testing and Repairing," has been issued by Neptune Meters Limited, Toronto, Ont. This booklet was planned and issued by the company with the idea that the information it contains would be of value to the water works engineer in his effort to conserve equipment. All details covered by the title of the book are clearly and concisely dealt with and are supported by a number of photographs.

# THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 25

MONTREAL, OCTOBER 1942

NUMBER 10



PUBLISHED MONTHLY BY  
THE ENGINEERING INSTITUTE  
OF CANADA  
2050 MANSFIELD STREET - MONTREAL

L. AUSTIN WRIGHT, M.E.I.C.  
*Editor*

LOUIS TRUDEL, M.E.I.C.  
*Assistant Editor*

N. E. D. SHEPPARD, M.E.I.C.  
*Advertising Manager*

#### PUBLICATION COMMITTEE

C. K. McLEOD, M.E.I.C., *Chairman*  
R. DEL. FRENCH, M.E.I.C., *Vice-Chairman*  
A. C. D. BLANCHARD, M.E.I.C.  
H. F. FINNEMORE, M.E.I.C.  
T. J. LAFRENIÈRE, M.E.I.C.

"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

★ ★ ★

## CONTENTS

HARVARD TRAINER . . . . .	Cover
<i>(Photo Public Information)</i>	
AN ENGINEER LOOKS AT MUSIC . . . . .	548
<i>S. T. Fisher, M.E.I.C.</i>	
CAN PROFESSIONAL EDUCATION BE LIBERALIZED? . . . . .	554
<i>Dean C. R. Young, M.E.I.C.</i>	
THE SIGNIFICANCE OF INDUSTRIAL RELATIONS . . . . .	557
<i>E. A. Allcut, M.E.I.C. and J. A. Coote</i>	
PRONENESS TO DAMAGE OF PLANT THROUGH ENEMY ACTION . . . . .	559
<i>Hal Gutteridge</i>	
THE USE OF AIR-LOCKS . . . . .	563
<i>G. O. Boulton</i>	
REGULATIONS AFFECTING THE CONSTRUCTION INDUSTRY . . . . .	571
ABSTRACTS OF CURRENT LITERATURE . . . . .	574
FROM MONTH TO MONTH . . . . .	578
PERSONALS . . . . .	589
Visitors to Headquarters . . . . .	591
Obituaries . . . . .	591
NEWS OF THE BRANCHES . . . . .	592
LIBRARY NOTES . . . . .	594
PRELIMINARY NOTICE . . . . .	596
EMPLOYMENT SERVICE . . . . .	599
INDUSTRIAL NEWS . . . . .	600

Price 50 cents a copy, \$3.00 a year: in Canada, British Possessions, United States and Mexico. \$4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, \$2.00 a year. —Entered at the Post Office, Montreal, as Second Class Matter.

THE INSTITUTE as a body is not responsible either for the statements made or for the opinions expressed in the following pages.

# THE ENGINEERING INSTITUTE OF CANADA

## MEMBERS OF COUNCIL - 1942

### PRESIDENT

C. R. YOUNG, Toronto, Ont.

### VICE-PRESIDENTS

\*A. L. CARRUTHERS, Victoria, B.C.  
†H. CIMON, Quebec, Que.

### PAST-PRESIDENTS

†T. H. HOGG, Toronto, Ont.

### COUNCILLORS

†J. E. ARMSTRONG, Montreal, Que.  
\*A. E. BERRY, Toronto, Ont.  
†S. G. COULTIS, Calgary, Alta.  
†G. L. DICKSON, Moncton, N.B.  
\*D. S. ELLIS, Kingston, Ont.  
\*J. M. FLEMING, Port Arthur, Ont.  
\*I. M. FRASER, Saskatoon, Sask.  
\*J. H. FREGEAU, Three Rivers, Que.  
\*J. GARRETT, Edmonton, Alta.  
†F. W. GRAY, Sydney, N.S.  
\*S. W. GRAY, Halifax, N.S.

†E. D. GRAY-DONALD, Quebec, Que.  
†J. HAIMES, Lethbridge, Alta.  
\*J. G. HALL, Montreal, Que.  
†R. E. HEARTZ, Montreal, Que.  
†W. G. HUNT, Montreal, Que.  
†E. W. IZARD, Victoria, B.C.  
†J. R. KAYE, Halifax, N.S.  
\*E. M. KREBSER, Walkerville, Ont.  
†N. MACNICOL, Toronto, Ont.  
\*H. N. MACPHERSON, Vancouver, B.C.  
\*W. H. MUNRO, Ottawa, Ont.

### TREASURER

E. G. M. CAPE, Montreal, Que.

### GENERAL SECRETARY

L. AUSTIN WRIGHT, Montreal, Que.

### SECRETARY-EMERITUS

R. J. DURLEY, Montreal, Que.

†J. L. LANG, Sault Ste. Marie, Ont.  
†G. G. MURDOCH, Saint John, N.B.

†C. J. MACKENZIE, Ottawa, Ont.

†T. A. McELHANNEY, Ottawa, Ont.  
\*C. K. McLEOD, Montreal, Que.  
†A. W. F. McQUEEN, Niagara Falls, Ont.  
†A. E. PICKERING, Sault Ste. Marie, Ont.  
†G. McL. PITTS, Montreal, Que.  
†W. J. W. REID, Hamilton, Ont.  
†J. W. SANGER, Winnipeg, Man.  
\*M. G. SAUNDERS, Arvida, Que.  
†H. R. SILLS, Peterborough, Ont.  
\*J. A. VANCE, Woodstock, Ont.  
\*A. O. WOLFF, Saint John, N.B.

\*For 1942 †For 1942-43 ‡For 1942-43-44

### ASSISTANT GENERAL SECRETARY

LOUIS TRUDEL, Montreal, Que.

## STANDING COMMITTEES

### FINANCE

DEG. BEAUBIEN, *Chairman*  
J. E. ARMSTRONG  
E. G. M. CAPE  
G. A. GAHERTY  
J. A. McCRORY  
F. NEWELL

### LIBRARY AND HOUSE

W. G. HUNT, *Chairman*  
A. T. BONE  
J. S. HEWSON  
M. S. NELSON  
G. V. RONEY

### LEGISLATION

J. L. LANG, *Chairman*  
R. L. DOBBIN  
R. J. DURLEY

### PUBLICATION

C. K. McLEOD, *Chairman*  
R. DEL. FRENCH, *Vice-Chairman*  
A. C. D. BLANCHARD  
H. F. FINNEMORE  
T. J. LAFRENIERE

### PAPERS

J. A. VANCE, *Chairman*  
DEG. BEAUBIEN  
K. M. CAMERON  
A. L. CARRUTHERS  
H. CIMON  
J. L. LANG  
G. G. MURDOCH

## SPECIAL COMMITTEES

### BOARD OF EXAMINERS AND

#### EDUCATION

R. A. SPENCER, *Chairman*  
I. M. FRASER  
W. E. LOVELL  
A. P. LINTON  
H. R. MacKENZIE  
E. K. PHILLIPS

### GZOWSKI MEDAL

H. V. ANDERSON, *Chairman*  
A. C. D. BLANCHARD  
T. H. JENKINS  
V. A. McKILLOP  
W. H. POWELL

### DUGGAN MEDAL AND PRIZE

J. T. FARMER, *Chairman*  
J. M. FLEMING  
R. C. FLITTON

### PLUMMER MEDAL

C. R. WHITTEMORE, *Chairman*  
J. CAMERON  
R. L. DOBBIN  
O. W. ELLIS  
R. E. GILMORE

### LEONARD MEDAL

JOHN McLEISH, *Chairman*  
A. E. CAMERON  
A. O. DUFRESNE  
J. B. DEHART  
A. E. MacRAE

### JULIAN C. SMITH MEDAL

C. R. YOUNG, *Chairman*  
T. H. HOGG  
C. J. MACKENZIE

### PROFESSIONAL INTERESTS

J. B. CHALLIES, *Chairman*  
J. E. ARMSTRONG  
G. A. GAHERTY  
O. O. LEFEBVRE  
H. W. McKIEL  
J. A. VANCE

### THE YOUNG ENGINEER

H. F. BENNETT, *Chairman*  
J. BENOIT  
D. S. ELLIS  
J. N. FINLAYSON  
R. DEL. FRENCH  
R. F. LEGGET  
A. E. MACDONALD  
H. W. McKIEL

### MEMBERSHIP

J. G. HALL, *Chairman*  
S. R. FROST

### STUDENTS' AND JUNIORS' PRIZES

#### Zone A (Western Provinces)

##### H. N. Ruttan Prize

A. L. CARRUTHERS, *Chairman*  
E. W. IZARD  
H. N. MACPHERSON

#### Zone B (Province of Ontario)

##### John Galbraith Prize

J. L. LANG, *Chairman*  
A. E. PICKERING  
J. A. VANCE

#### Zone C (Province of Quebec)

##### Phelps Johnson Prize (English)

DEGASPE BEAUBIEN, *Chairman*  
J. E. ARMSTRONG  
R. E. HEARTZ

##### Ernest Marceau Prize (French)

H. CIMON, *Chairman*  
J. H. FREGEAU  
E. D. GRAY-DONALD

#### Zone D (Maritime Provinces)

##### Martin Murphy Prize

G. G. MURDOCH, *Chairman*  
G. L. DICKSON  
S. W. GRAY

### INTERNATIONAL RELATIONS

R. W. ANGUS, *Chairman*  
J. B. CHALLIES, *Vice-Chairman*  
E. A. ALLCUT  
C. CAMSELL  
J. M. R. FAIRBAIRN  
O. O. LEFEBVRE  
M. J. McHENRY  
H. H. VAUGHAN  
C. R. YOUNG

### DETERIORATION OF CONCRETE STRUCTURES

R. B. YOUNG, *Chairman*  
E. VIENS, *Vice-Chairman*  
G. P. F. BOESE  
A. G. FLEMING  
W. G. GLIDDON  
O. O. LEFEBVRE  
J. A. McCRORY  
C. J. MACKENZIE  
J. H. McKINNEY  
R. M. SMITH

### WESTERN WATER PROBLEMS

G. A. GAHERTY, *Chairman*  
C. H. ATTWOOD  
L. C. CHARLESWORTH  
A. GRIFFIN  
D. W. HAYS  
G. N. HOUSTON  
T. H. HOGG  
O. O. LEFEBVRE  
C. J. MACKENZIE  
H. J. McLEAN  
F. H. PETERS  
S. G. PORTER  
P. M. SAUDER  
J. M. WARDLE

### ENGINEERING FEATURES OF CIVIL DEFENCE

J. E. ARMSTRONG, *Chairman*  
P. E. ADAMS  
J. N. ANDERSON  
S. R. BANKS  
H. F. BENNETT  
W. D. BRACKEN  
W. P. BRERETON  
R. S. EADIE  
E. V. GAGE  
G. A. GAHERTY  
R. J. GIBB  
A. GRAY  
J. GRIEVE  
J. L. LANG

R. F. LEGGET  
I. P. MACNAB  
J. A. McCRORY  
H. J. McEWEN  
W. L. McFAUL  
C. B. MUIR  
W. H. MUNRO  
G. McL. PITTS  
M. G. SAUNDERS  
W. O. SCOTT  
T. G. TYRER  
H. K. WYMAN

### INDUSTRIAL RELATIONS

WILLS MACLACHLAN, *Chairman*  
E. A. ALLCUT  
J. C. CAMERON  
E. R. COMPLIN  
J. A. COOTE  
W. O. CUDWORTH  
F. W. GRAY  
E. G. HEWSON

A. M. REID  
W. J. W. REID  
A. ROSS ROBERTSON

### POST-WAR PROBLEMS

W. C. MILLER, *Chairman*  
F. ALPORT  
J. S. BATES  
DEGASPE BEAUBIEN  
A. L. CARRUTHERS  
J. M. FLEMING  
E. R. JACOBSEN

G. R. LANGLEY  
H. MASSUE  
G. L. MACKENZIE  
D. A. R. McCANNELL  
A. W. F. McQUEEN  
G. McL. PITTS  
D. C. TENNANT

# THE ENGINEERING INSTITUTE OF CANADA

## OFFICERS OF BRANCHES

### BORDER CITIES

*Chairman*, H. L. JOHNSTON  
*Vice-Chair.*, G. G. HENDERSON  
*Executive*, W. P. AUGUSTINE  
 J. F. G. BLOWEY  
 W. R. STICKNEY  
 (Ex-Officio), E. M. KREBSER  
 G. E. MEDLAR  
*Sec.-Treas.*, J. B. DOWLER,  
 754 Chilver Road,  
 Walkerville, Ont.

### CALGARY

*Chairman*, H. J. McEWEN  
*Vice-Chair.*, J. G. MacGREGOR.  
*Executive*, J. N. FORD  
 A. GRIFFIN  
 H. B. SHERMAN  
 (Ex-Officio), G. P. F. BOESE  
 S. G. COULTIS  
 J. B. DEHART  
 P. F. PEELE  
*Sec.-Treas.*, K. W. MITCHELL,  
 803—17th Ave. N.W.,  
 Calgary, Alta.

### CAPE BRETON

*Chairman*, J. A. MacLEOD  
*Executive*, J. A. RUSSELL M. F. COSSITT  
 (Ex-Officio), F. W. GRAY  
*Sec.-Treas.*, S. C. MIFFLEN,  
 60 Whitney Ave., Sydney, N.S.

### EDMONTON

*Chairman*, D. A. HANSEN  
*Vice-Chair.*, D. HUTCHISON  
*Executive*, C. W. CARRY  
 B. W. PITFIELD  
 E. R. T. SKARIN  
 J. A. ALLAN  
 E. ROBERTSON  
 J. W. JUDGE  
 (Ex-Officio), J. GARRETT  
 R. M. HARDY  
*Sec.-Treas.*, F. R. BURFIELD,  
 Water Resources Office,  
 Provincial Government,  
 Edmonton, Alta.

### HALIFAX

*Chairman*, P. A. LOVETT  
*Executive*, A. E. CAMERON  
 G. T. CLARKE G. J. CURRIE  
 A. E. FLYNN J. D. FRASER  
 D. G. DUNBAR J. A. MacKAY  
 J. F. F. MacKENZIE  
 J. W. MacDONALD  
 G. T. MEDFORTH  
 (Ex-Officio), S. L. FULTZ J. R. KAYE  
*Sec.-Treas.*, S. W. GRAY,  
 The Nova Scotia Power  
 Commission,  
 Halifax, N.S.

### HAMILTON

*Chairman*, STANLEY SHUPE  
*Vice-Chair.*, T. S. GLOVER  
*Executive*, H. A. COOCH  
 NORMAN EAGER  
 A. C. MACNAF  
 A. H. WINGFIELD  
 (Ex-Officio), W. J. W. REID  
 W. A. T. GILMOUR  
*Sec.-Treas.*, A. R. HANNAFORD,  
 354 Herkimer Street,  
 Hamilton, Ont.

### KINGSTON

*Chairman*, T. A. McGINNIS  
*Vice-Chair.*, P. ROY  
*Executive*, V. R. DAVIES  
 K. H. McKIBBIN  
 K. M. WINSLOW  
 A. H. MUNRO  
 (Ex-Officio), G. G. M. CARR-HARRIS  
 D. S. ELLIS  
*Sec.-Treas.*, R. A. LOW,  
 Queen's University,  
 Kingston, Ont.

### LAKEHEAD

*Chairman*, MISS E. M. G. MacGILL  
*Vice-Chair.*, E. J. DAVIES  
*Executive*, J. I. CARMICHAEL  
 R. B. CHANDLER  
 S. E. FLOOK  
 O. J. KOREEN  
 S. T. McCAVOUR  
 W. H. SMALL  
 E. A. KELLY  
 J. S. WILSON  
 (Ex-Officio), B. A. CULPEPER  
 J. M. FLEMING  
*Sec. Treas.*, W. C. BYERS,  
 c/o C. D. Howe Co. Ltd.,  
 Port Arthur, Ont.

### LETHBRIDGE

*Chairman*, J. M. DAVIDSON  
*Vice-Chair.*, C. S. DONALDSON  
*Executive*, A. G. DONALDSON G. S. BROWN  
 N. H. BRADLEY  
 (Ex-Officio), J. HAIMES  
*Sec.-Treas.*, R. B. McKENZIE,  
 McKenzie Electric Ltd.,  
 706, 3rd Ave. S., Lethbridge, Alta.

### LONDON

*Chairman*, F. T. JULIAN  
*Vice-Chair.*, T. L. McMANAMA  
*Executive*, F. C. BALL  
 V. A. McKILLOP  
 H. F. BENNETT  
 A. L. FURANNA  
 R. S. CHARLES  
 (Ex-Officio), R. W. GARRETT  
 J. A. VANCE  
*Sec.-Treas.*, H. G. STEAD,  
 60 Alexandra Street,  
 London, Ont.

### MONCTON

*Chairman*, H. J. CRUDGE  
*Vice-Chair.*, J. A. GODFREY  
*Executive*, A. S. DONALD  
 E. R. EVANS E. B. MARTIN  
 H. W. HOLE G. C. TORRENS  
 (Ex-Officio), F. O. CONDON  
 G. L. DICKSON H. W. McKIEL  
*Sec. Treas.*, V. C. BLACKETT  
 Engrg. Dept., C.N.R.,  
 Moncton, N.B.

### MONTREAL

*Chairman*, J. A. LALONDE  
*Vice-Chair.*, R. S. EADIE  
*Executive*, R. E. HEARTZ  
 J. B. STIRLING  
 J. M. CRAWFORD  
 J. COMEAU  
 H. F. FINNEMORE  
 R. C. FLITTON  
 G. D. HULME  
 (Ex-Officio), DE G. BEAUBIEN  
 J. E. ARMSTRONG  
 J. G. HALL  
 W. G. HUNT  
 C. K. McLEOD  
 G. McL. PITTS  
*Sec.-Treas.*, L. A. DUCHASTEL,  
 40 Kelvin Avenue,  
 Outremont, Que.

### NIAGARA PENINSULA

*Chairman*, C. G. CLINE  
*Vice-Chair.*, G. E. GRIFFITHS  
*Executive*, A. G. HERR  
 R. T. SAWLE  
 G. F. VOLLMER  
 W. D. BRACKEN  
 J. W. BROOKS  
 J. H. TUCK  
 D. S. SCRYMGEOUR  
 (Ex-Officio), A. L. McPHAIL  
 A. W. F. McQUEEN  
*Sec.-Treas.*, J. H. INGS  
 1870 Ferry Street,  
 Niagara Falls, Ont.

### OTTAWA

*Chairman*, N. B. MacROSTIE  
*Executive*, W. G. C. GLIDDON  
 R. M. PRENDERGAST  
 W. H. G. FLAY  
 G. A. LINDSAY R. YUILL  
 (Ex-Officio), K. M. CAMERON  
 C. J. MACKENZIE  
 W. H. MUNRO  
 T. A. McELHANNEY  
 R. K. ODELL  
*Sec.-Treas.*, A. A. SWINNERTON,  
 Dept. of Mines and Resources,  
 Ottawa, Ont.

### PETERBOROUGH

*Chairman*, D. J. EMERY  
*Executive*, C. R. WHITTEMORE F. R. POPE  
 I. F. McRAE R. L. DOBBIN  
 A. J. GIRDWOOD  
 (Ex-Officio), J. CAMERON  
 H. R. SILLS  
*Sec.-Treas.*, A. R. JONES,  
 5, Anne Street,  
 Peterborough, Ont.

### QUEBEC

*Life Hon.-*  
*Chair.*, A. R. DECARY  
*Chairman*, L. C. DUPUIS  
*Vice-Chair.*, RENE DUPUIS  
*Executive*, O. DESJARDINS  
 R. SAUVAGE G. ST-JACQUES  
 S. PICARD L. GAGNON  
 G. W. WADDINGTON  
 (Ex-Officio), E. D. GRAY-DONALD  
 R. B. McDUNNOUGH P. MÉTHÉ  
 H. CIMON  
*Sec.-Treas.*, PAUL VINCENT,  
 Colonization Department,  
 Room 333-A, Parliament Bldgs.,  
 Quebec, Que.

### SAGUENAY

*Chairman*, R. H. RIMMER  
*Vice-Chair.*, C. MILLER  
*Executive*, W. E. COOPER  
 J. FRISCH  
 B. BAUMAN  
 G. B. MOXON  
 (Ex-Officio), M. G. SAUNDERS  
 N. F. McCAGHEY  
 J. W. WARD  
*Sec.-Treas.*, ALEX. T. CAIRNCROSS,  
 P.O. Box 33,  
 Arvida, Que.

### SAINT JOHN

*Chairman*, D. R. SMITH  
*Vice-Chair.*, A. O. WOLFF  
*Executive*, H. P. LINGLEY  
 C. D. McALLISTER  
 C. C. KIRBY  
 (Ex-Officio), F. A. PATRIQUEN  
 V. S. CHESNUT  
 G. G. MURDOCH  
*Sec.-Treas.*, G. W. GRIFFIN  
 P.O. Box 220,  
 Saint John, N.B.

### ST. MAURICE VALLEY

*Chairman*, VIGGO JEPSEN  
*Vice-Chair.*, J. H. FREGEAU  
*Executive*, E. BUTLER R. D. PACKARD  
 A. C. ABBOTT  
 R. DORION  
 H. J. WARD  
 E. T. BUCHANAN  
 J. JOYAL  
 H. G. TIMMIS  
 (Ex-Officio), A. H. HEATLEY  
*Sec.-Treas.*, E. E. WHEATLEY  
 Consolidated Paper Corporation,  
 Grand'Mère, Que.

### SASKATCHEWAN

*Chairman*, A. P. LINTON  
*Vice-Chair.*, A. M. MacGILLIVRAY  
*Executive*, F. C. DEMPSEY  
 N. B. HUTCHEON  
 J. G. SCHAEFFER  
 R. W. JICKLING  
 H. R. MacKENZIE  
 B. RUSSELL  
 (Ex-Officio), I. M. FRASER  
*Sec.-Treas.*, STEWART YOUNG  
 P. O. Box 101,  
 Regina, Sask.

### SAULT STE. MARIE

*Chairman*, L. R. BROWN  
*Vice-Chair.*, R. A. CAMPBELL  
*Executive*, N. C. COWIE  
 C. O. MADDOCK  
 C. R. MURDOCK K. G. ROSS  
 (Ex-Officio), J. L. LANG  
 E. M. MacQUARRIE  
 A. E. PICKERING  
*Sec.-Treas.*, O. A. EVANS,  
 159 Upton Road,  
 Sault Ste. Marie, Ont.

### TORONTO

*Chairman*, W. S. WILSON  
*Vice-Chair.*, W. H. M. LAUGHLIN  
*Executive*, D. FORGAN  
 R. F. LEGGETT  
 S. R. FROST  
 F. J. BLAIR  
 E. G. HEWSON  
 C. F. MORRISON  
 (Ex-Officio), C. R. YOUNG T. H. HOGG  
 A. E. BERRY N. MacNICOL  
 H. E. BRANDON J. J. SPENCE  
*Sec.-Treas.*, S. H. deJONG  
 Dept. of Civil Engineering,  
 University of Toronto,  
 Toronto, Ont.

### VANCOUVER

*Chairman*, W. O. SCOTT  
*Vice-Chair.*, W. N. KELLY  
*Executive*, H. P. ARCHIBALD  
 I. C. BARTROP  
 H. C. FITZ-JAMES  
 H. J. MacLEOD  
 R. E. POTTER  
 (Ex-Officio), J. N. FINLAYSON  
 T. V. BERRY  
 H. N. MacPHERSON  
*Sec.-Treas.*, P. B. STROYAN  
 2099 Beach Avenue,  
 Vancouver, B.C.

### VICTORIA

*Chairman*, A. S. G. MUSGRAVE  
*Vice-Chair.*, KENNETH REID  
*Executive*, A. L. FORD  
 B. T. O'GRADY  
 J. B. PARHAM  
 R. BOWERING  
 (Ex-Officio), A. L. CARRUTHERS  
 G. M. IRWIN  
 E. W. IZARD  
*Sec.-Treas.*, J. H. BLAKE,  
 605 Victoria Avenue,  
 Victoria, B.C.

### WINNIPEG

*Chairman*, D. M. STEPHENS  
*Vice-Chair.*, J. T. DYMENT  
*Executive*, C. V. ANTENBRING  
 N. M. HALL  
 T. H. KIRBY  
 E. W. R. BUTLER  
 H. B. BREHAUT  
 (Ex-Officio), J. W. SANGER  
 V. MICHIE  
 C. P. HALTALIN  
*Sec.-Treas.*, THOMAS E. STOREY,  
 55 Princess Street,  
 Winnipeg, Man.

# AN ENGINEER LOOKS AT MUSIC

S. T. FISHER, M.E.I.C.

Development Engineer, Special Products Division, Northern Electric Company, Limited, Montreal, Que.

Paper presented before the Montreal Branch of The Engineering Institute of Canada on March 12th, 1942

Music is an art, not a science; our appreciation of it is emotional and not intellectual. We must resist any suggestion that music should or could be trained into a mechanical mode, but music is the art of producing agreeable sounds, and sound is the subject with which acoustics, a science, is concerned. The production and transmission of sound, and the physiology of the sense of hearing are topics in which engineers may be interested, without presumption and it is these which will be considered.

This paper is intended to demonstrate that:

Musical theory where it touches on the intervals employed in harmony is in a state of great confusion;

The scale universally used for keyboard instruments, the tempered (diatonic) scale, inadequately translates musical conceptions, and its weaknesses should be recognized;

The just (diatonic) scale is in full accord with the spirit of music and the letter of physical laws, and in the light of modern instrumentalities, could now be adopted; and that

Electrical musical keyboard instruments can be designed in a practical form to play the just scale in all keys.

Tones separated by discrete pitch intervals are a universal tradition in modern Western music. An octave of seven notes is usually employed and this is the diatonic scale.① In addition, in accordance with an almost universal tradition, five additional intervals are inserted, which break up the five larger intervals of the seven-note scale. Most music—particularly music by the classic masters—is written in the seven-note scale. In modern music there is an occasional tendency to write in the twelve-note scale. This scale has its most familiar embodiment in the piano and it is not an exaggeration to say that the keyboard mechanism of the piano has been made the basis of the modern system of music. The scale can be conveniently thought of as it appears on the piano keyboard. If we take the note C as the starting note for an octave, then the seven notes of the diatonic scale are played by the white digitals of the piano and the five additional tones which divide the larger intervals of the diatonic scale are played by the black digitals.

It is advisable to guard at the outset against a common misconception; this is the idea that scales are made first, and music afterwards. *Scales are made in the process of creating music.* If music consisted only of single-note melodies, the requirements to be met by a scale would allow the widest latitude in choosing the intervals. Modern Western music, however, employs harmony as its most important feature, and it is necessary therefore that certain groups of notes of our scale, sounded simultaneously, should form harmonious chords. The physical criterion for harmoniousness in a chord is that the ratio of the frequencies of its component tones may be expressed as the ratio of small integers. The smaller the integers the more marked is the consonance. The application of this law to the diatonic scale fixes the intervals between the notes as seen in Table I:

TABLE I

Note.....	C	D	E	F
Ratio.....	1	9/8	5/4	4/3
Name.....	Unison	Second	Third	Fourth
Interval ..		9:8	10:9	16:15
				9:8
Note.....	G	A	B	C
Ratio.....	3/2	5/3	15/8	2
Name.....	Fifth	Sixth	Seventh	Octave
Interval ..	10:9	9:8	16:15	

In the first line are the letter names of the notes of the scale, in the key of C, in the second line are the ratios of their frequencies to the leading note, and in the third are the musical names of the intervals obtained by sounding

together each of the notes of the scale with the leading note. These intervals form a version of the diatonic scale called the *just scale*. The fourth line shows the pitch or frequency ratios between adjacent notes. It will be noted that three sizes of intervals exist, those represented by pitch ratios of 9:8, 10:9 and 16:15.

In Western music three triads or groups of three notes are considered the foundation of the system of harmony. These chords are the triads having frequency ratios 4:5:6 formed with their lowest note a fifth below the key note, the sub-dominant; on the keynote, the major triad; and a fifth above the key note, the dominant. In the octave shown above, these triads are CEG, FAC, and GBD, giving this arrangement:

C D E F G A B C D	
4—5—6	Major
4—5—6	Subdominant (raised an octave)
4—5—6	Dominant

It will be seen that these three triads define every note in the diatonic scale and fix the ratios at the values listed above. Each triad has a total compass of a fifth.

The major diatonic scale includes no other notes than these, but we have a tradition of centuries standing which divides the five larger intervals 10:9 or 9:8 approximately in half, so that a scale is formed of twelve approximately equal intervals. It is therefore necessary for the playing of modern music to insert a note between C and D, a note between D and E, a note between F and G, a note between G and A, and a note between A and B. The note between C and D for instance is called either C# (C sharp) or D<sup>b</sup> (D flat); which of these two names is used need not concern us at this point.

The major diatonic scale is that given above and can be thought of as being formed on the three major triads. Another scale also is in general use, the minor scale. This is supposed to be derived from the Greek Aeolian mode, just as the major diatonic scale is said to be derived from the Greek Lydian mode.

Table II shows what seems a less academic but more realistic suggestion as to the origin of the minor scale. If the intervals of the major scale are reversed, that is, if a descending scale is set up with the intervals in the same order as they occur when ascending the major scale, then we have a new scale, and it is found that this rigorously meets the requirements of harmony.

TABLE II

MINOR							
Note..	C	D <sup>b</sup>	E <sup>b</sup>	F	G	A <sup>b</sup>	B <sup>b</sup>
Ratio	1/2	8/15	3/5	2/3	3/4	4/5	8/9
	1	16/15	6/5	4/3	3/2	8/5	16/9
Interval	16/15	9/8	10/9	9/8	16/15	10/9	9/8
MAJOR							
Note.....	C	D	E	F	G	A	B
Ratio.	1	9/8	5/4	4/3	3/2	5/3	15/8
Interval		9/8	10/9	16/15	9/8	10/9	9/8
							16/15

By definition, a minor triad is an inversion of a major triad; that is to say, the major triad 4:5:6 which has a ratio of 5:4 (major third) between the two lower notes, and a ratio of 6:5 (minor third) between the two upper notes, becomes in the minor 10:12:15. The ratio of 6:5 (minor third) now exists between the lower notes and the

ratio 5:4 (major third) between the two upper notes. This is shown in Table III.

TABLE III

Note.....	B <sup>b</sup>	C	D <sup>b</sup>	E	F	G	A <sup>b</sup>	B <sup>b</sup>	C
Ratio.....	8/9	1	16/15	6/5	4/3	3/2	8/5	16/9	2
		10	12	15					
		10	12	15					
				10	15	12			

This table defines four more notes of the scale and the only one now missing is that lying between F and G which we could call F<sup>#</sup>. F<sup>#</sup> does not belong in either the scale of C major or the scale of C minor, and therefore probably need not be defined in these keys; since, however, it may be necessary occasionally as a decorative note it is well to add it.

The only two possible ratios which meet the requirement that the notes must bear the ratio of small integers to the key note are 11/8 and 17/12; of these two 11/8 is preferable. Another reason for choosing this interval would be that the scale should provide as many as possible harmonics to the key note, and it will be seen that the 11/8 value provides the 11th harmonic. This then is the value that should be used.



Fig. 1—The effect of changing key in the just scale is to shift the frequencies of some of the notes; this is necessary because of the unequal intervals. Logarithms of the ratios are plotted.

It is apparent that none of the possible ways of setting up a scale—progressions by fifths, by fourths, or by thirds—will give the octave note, since all these ratios are prime to one another. The extremely complicated treatment of diatonic scale structures that exists in musical literature is brought about solely by the fact that the tone sources of traditional instruments can not be adjusted in frequency to form a new scale for each key change. Figure 1 shows the difficulty graphically.

Throughout the ages musicians have ascribed definite characteristics to different keys. It will be realized that in theory this is quite a mistaken idea, but that in practice, due to the inability to shift keys in any of our scales without also revising the scale intervals, there is some justification for the idea that different keys have different characteristics. Something which is equally wide spread is to ascribe definite characteristics to each note in the octave; this is nothing but superstition, and has no physical basis whatever. The Chinese apparently initiated this custom and the character they ascribed to each note of the scale is as follows:

- do —Heavy but easy, like a cow lowing at drinking water.
- re —Clear and quick, like a sheep having lost its companion.
- mi —Defensive and careful, like a pheasant lighting on a branch.
- so —Overflowing and quick, like a pig screaming.
- la —Scattered and hollow, like a horse neighing in the desert.

If this appears to be funny it is no more so, and much more poetic, than the description current in the teaching of music to school children in English to-day:

- do —Strong and firm.
- re —Rousing or hopeful.
- mi —Steady or calm.
- fa —Desolate or awe-inspiring.
- so —Grand or bright.
- la —Sad or weeping.
- si —Piercing or sensitive.

Three other scales beside the Just Scale are of importance—one of them, the Tempered Scale, of outstanding importance. They are:

1. Pythagorean Scale. This scale is obtained as a succession of perfect fifths; by going up in pitch intervals of a fifth, the following notes are obtained:

- C G D A E B F<sup>#</sup> C<sup>#</sup> G<sup>#</sup> D<sup>#</sup> A<sup>#</sup> F

This gives a twelve-note scale and was quite satisfactory for the limited range of Greek music; the more so because harmony as we know it was not employed. For modern music, this scale is defective because the next fifth above F is not, as it should be, C. Despite the deficiencies of this scale, it is today in use in a modified form, since the stringed instruments of the orchestra tune their strings in fifths.

2. The Pythagorean Scale was followed by the Mean-Tone Scale in which the octave is tuned in a series of perfect major thirds and the note which comes between the notes of each major third is half-way between them. The Mean-Tone Scale was largely used during the Middle Ages and in fact was in general use for keyboard instruments up to the time the Tempered Scale was introduced, which in England was about 1850, and on the continent about 70 years earlier. The Mean-Tone Scale had several advantages, but permitted modulation into only a limited number of keys and this led to its eventual abandonment.

3. Tempered Scale. This is the scale universally used today for keyboard instruments and therefore nominally by all musicians. It is based on the simple arrangement that an octave is divided into twelve equal intervals of a semi-tone, each of which, therefore, has a frequency ratio of the 12th root of two. This scale has the great virtue that it permits modulation without limitation. This is shown graphically by Fig. 2. It has the disadvantage that many of the harmonic intervals are quite inaccurate. Fortunately, the interval of a fifth (nominal frequency ratio 3:2) is very close and this is the most important interval in harmony. However, the intervals of a third and a sixth, which are also of frequent occurrence, are very poor, being about a third of a semi-tone too large. The Tempered Scale, therefore, presents the disadvantages that many subtle effects in music which depend on variations in consonance of different intervals, are largely obscured by the fact that intervals which should sound quite consonant, such as thirds, are somewhat dissonant. By virtue of its make-up, the Tempered Scale has the same harmonic intervals in any key. In the Mean-Tone Scale or the Just Scale, when an instrument is tuned in one key, the harmonic structure is changed perceptibly for the other keys, if the scale is not retuned. In the Tempered Scale a change of key means only a change of pitch. The graphical comparison of the Tempered and Just Scale intervals is shown in Fig. 3. Table IV gives the frequencies (cycles per second) of twelve notes in the two scales, and in the triads, and indicates the amount of dissonance which may occur.



Fig. 2—The effect of changing key in the tempered scale is simply to shift the pitch of the music. No readjustment of scale intervals is involved. Logarithms of the ratios are plotted.

The shortcomings of the Tempered Scale have been familiar to musicians and physicists alike since it was first adopted. Helmholtz in 1860 pointed out its serious defects and suggested that in a generation or two the Tempered Scale might have a very marked effect on the acuteness of appreciation for harmony. It appears that his predictions have been fulfilled to a large extent and that the return of a strict perception of harmony is only possible by replacing the Tempered Scale with the Just Scale. Helmholtz' comments on the differences between the Tempered and the Just Scale are worth quoting at some length because they outline clearly the reasons leading up to the work described in this paper. These paragraphs show that the deficiencies

of the Tempered Scale have been fully recognized, as has been the excellence of the (7-note) Just Scale. And yet until the present, no practical solution has been obtained for the application of the Just Scale to keyboard instruments.

TABLE IV

Note.....	C	D <sup>b</sup>	D	E <sup>b</sup>	E	F	F <sup>♯</sup>	G
Interval.....	1st	Min. 2nd	Maj. 2nd	Min. 3rd	Maj. 3rd	Maj. 4th	Min. 5th	Maj. 5th
Tempered....	500	530	561	595	630	668	707	748
Just.....	500	533	563	600	625	667	688	750
Note.....	A <sup>b</sup>	A	B <sup>b</sup>	B	C	D <sup>b</sup>	D	
Interval.....	Min. 6th	Maj. 6th	Min. 7th	Maj. 7th	8ve			
Tempered....	794	841	892	944	1000	1060	1122	
Just.....	800	833	889	938	1000	1067	1125	

TRIAD	Scale	Major	Minor
Major	Tempered	500 : 630 : 748	500 : 595 : 748
	Just	500 : 625 : 750	500 : 600 : 750
Sub-Dominant	Tempered	668 : 841 : 1000	668 : 794 : 1000
	Just	667 : 833 : 1000	667 : 800 : 1000
Dominant	Tempered	748 : 944 : 1122	748 : 892 : 1122
	Just	750 : 938 : 1125	750 : 889 : 1125

The following excerpts are from the 4th English edition of Helmholtz's "Sensations of Tone":

"As regards musical effect, the difference between the just and the equally tempered, or the just and the Pythagorean intonations, is very remarkable. The justly intoned chords, in favourable positions . . . possess a full and, as it were, saturated harmoniousness; they flow on, with a full stress, calm and smooth, without tremor or beat. Equally tempered or Pythagorean chords sound beside them rough, dull, trembling, restless. The difference is so marked that everyone, whether he is musically cultivated or not, observes it at once. . .

"Modern musicians who, with rare exceptions, have never heard any music executed except in equal temperament, mostly make light of the inexactness of tempered intonation. . . .

"There can be no question that the simplicity of tempered intonation is extremely advantageous for instrumental music, that any other intonation requires an extraordinarily greater complication in the mechanism of the instrument, and would materially increase the difficulties of manipulation, and that consequently the high development of modern instrumental music would not have been possible without tempered intonation. But it must not be imagined that the difference between tempered and just intonation is a mere mathematical subtlety without any practical value. That this difference is really very striking even to unmusical ears is shown immediately by actual experiments with properly tuned instruments. . . .

"Finally, we cannot, I think, fail to recognize the influence of tempered intonation upon the style of composition. The first effect of this influence was favourable. It allowed composers as well as players to move freely and easily into all keys, and thus opened up a new wealth of modulation. On the other hand, we likewise cannot fail to recognize that the alteration of intonation also compelled composers to have recourse to some such wealth of modulation. For when the intonation of consonant chords ceased to be perfect, and the differences

between their various inversions and positions were, as a consequence, nearly obliterated, it was necessary to use more powerful means, to have recourse to a frequent employment of harsh dissonances, and to endeavour by less usual modulations to replace the characteristic expression, which the harmonies proper to the key itself had ceased to possess."

It must be realized that the Tempered Scale has been adopted solely because it will permit changing into different keys without any change in the melodic or harmonic structure. Since the intervals in the Just Scale or the Mean-Tone Scale are unequal, if a modulation from one key to another is to be made, then of necessity the scale must be readjusted so that it can maintain the exact sequence of intervals in the new key. With conventional keyboard instruments, this is not possible and the Tempered Scale is the only practical solution. At various times proposals for new keyboards have been made. A complication of the keyboard is not, however, a practical approach to the problem because of the considerable difficulty it adds to the work of the performer. It is, however, the only possible approach to a solution, in the case of traditional instruments.

With the introduction of electrical methods of producing musical tones we have, for the first time, the facility offered to us of key changes which will be strictly harmonious on an instrument tuned in the Just Scale. This is true only because the frequencies of the tone generators of electrical instruments can be instantaneously and accurately readjusted.

Modulation from one key to another in music always takes place in some integral number of fifths. The usual plan on which modulation progresses in a piece of music is to move upwards in pitch—or in the musical phrase, in the dominant direction—by some number of fifths, say four or five, less an exact number of octaves, and then to progress downwards in pitch one fifth at a time until the starting point is reached. It is apparent that no number of modulations by fifths, by thirds, by fourths, or any other interval within the octave can exactly equal any number of octaves since the ratios involved are all prime to one another. It is, therefore, an artificial arrangement in the piano keyboard which makes twelve fifths equal to seven octaves and involves the approximation  $128 = 129.75$ . This approximation results in the limitation of Tempered Scale music to twelve keys, using as the key notes the twelve notes of the octave. This again is an artificial limitation, and any number of keys are theoretically possible in the Just Scale.

The musical theories of harmony are largely obscured and confused by the fact that they are predicated on a series of ideas based sometimes on the Just Scale, sometimes on the Mean-Tone Scale, and sometimes on the Tempered Scale. For instance, in piano music the key of six sharps, F<sup>♯</sup>, and the key of six flats, G<sup>b</sup>, use the same notes in the Tempered Scale and yet the chords of these two keys are given different names and different characteristics are ascribed to them. A violin is tuned with its strings in the Pythagorean scale, that is perfect fifths apart, and yet violinists ordinarily play in the Tempered Scale. The horns and some other wind instruments in the orchestra obtain their tones as a series of harmonics and to this extent their instruments are tuned in the Just Scale; but the intermediate notes that are inserted by means of valves are tuned to agree with the Tempered Scale. It is well established that singers with accurate ears singing without accompaniment strike just intervals quite accurately, but when they sing with a keyboard instrument accompanying them, change their intonation to suit the Tempered Scale intervals.

These anomalies and inaccuracies are not generally recognized by musicians; as a result, the existing theory of harmony merely classifies existing habits without any factual or scientific basis. Existing harmonic usage has three defects:

1st—It has not explored all harmonic possibilities;

2nd—Due to the inaccuracy of many of the intervals as sounded on conventional instruments, the exact consonance of many combinations is missed and the difference between good consonance and poor consonance is very much less marked than it should be.

TEMPERED	{	1	$(\sqrt[12]{2})^2$	$(\sqrt[12]{2})^4$	$(\sqrt[12]{2})^6$	$(\sqrt[12]{2})^8$	$(\sqrt[12]{2})^{10}$	$(\sqrt[12]{2})^{12}$	2
		1.000	1.122	1.260	1.350	1.498	1.692	1.888	2.000
JUST	{	1	$\frac{9}{8}$	$\frac{5}{4}$	$\frac{4}{3}$	$\frac{3}{2}$	$\frac{5}{3}$	$\frac{15}{8}$	2
		1.000	1.125	1.250	1.333	1.500	1.667	1.875	2.000

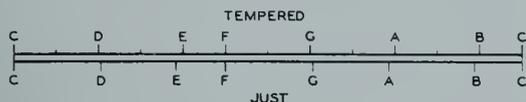


Fig. 3—Comparison of tempered and just scales. Logarithms of the ratios are plotted.

3rd—The substitution of one triad for another to which it is approximately equal has led to a meagreness in the harmonic structure of modern music which has resulted in non-harmonic writing, such as modern chromatic music.

That complications will be introduced into an electrical musical instrument by the use of the Just Scale is demonstrated by Fig. 1. It is seen that a digital on the keyboard must have access to a considerable number of slightly differing frequencies if exact harmonic ratios are to be preserved in all keys. In conventional instruments, this is an insurmountable obstacle. It has been judged so by Helmholtz, and all other writers in the field.

For example, Sir Hubert Parry in his monumental "Art of Music" says, "An ideally tuned scale is as much of a dream as the philosopher's stone. A scale system may be fairly tested by what may be done with it and that scale which afforded Bach, Beethoven, Schubert, Wagner and Brahms ample opportunities to produce the works they did is as perfect as their musical art required. It will probably be a good many centuries before any new system is justified by such a mass of great artistic works as the one which the instincts and efforts of our ancestors have evolved for our advantage."

Sir William Bragg has this to say on the subject: "The composer who tries to write in a perfect scale fights with the laws of arithmetic in a battle which he could never win."

Electrical instruments are not new in themselves but the idea of tuning them in the (twelve-note) Just Scale and providing means by which this scale can be adjusted correctly for each key signature appears to be original. On reading Helmholtz's comments it is entirely credible that such an invention will make a profound impression on musicians. Development of practical forms of instruments appears to be of importance. One of the most obvious ways to approach the problem is to take a highly-developed instrument such as the Hammond (Electric) Organ and redesign it in such a way as to make this proposal workable.

The Hammond Organ<sup>®</sup> consists of a number of rotary generators driven from a single synchronous motor. There is one generator for each note of the keyboard plus some extra generators for harmonics that lie beyond the keyboard range. All these generators produce tones which lie almost exactly on the Tempered Scale. It should be noted that the Hammond instrument in its harmonic make-up differs from conventional pipe organs because all the frequencies used in the synthesis of any musical quality lie on the Tempered Scale; in other words, natural harmonics are entirely suppressed and tempered harmonics are substituted. This avoids the serious clash that occurs in conventional pipe organs between natural harmonics and tempered fundamentals which lie very close together. In no instrument other than the Hammond Organ, to the author's knowledge, are tempered harmonics used, and while the results may not be immediately perceptible to

the lay ear, the characteristic harmoniousness of the Hammond Organ, which becomes apparent after some familiarity with it, must be ascribed to this basic improvement.

The application of the Just Scale to the Hammond Organ<sup>®</sup> or to other instruments of this general character is carried out as follows: The tone wheels and gears are changed so that the frequencies of the generators lie on the Just Scale. The usual synchronous driving motor is replaced by a much larger synchronous motor, in the case of the standard Hammond Organ by, say, a one-quarter horse-power motor, with a heavy flywheel. This motor is coupled to the main drive shaft through a 15-position gear set, including 15 magnetic clutches. Thus the drive can be at any one of 15 speeds, depending on which clutch is operated, and the speed may be instantaneously changed by operating any other clutch. The clutches are operated from a row of 15 pushbuttons arranged along the base of the instrument and intended to be actuated by the left foot. These pushbuttons are marked with key signatures from C<sup>♯</sup> to C<sup>b</sup> and (including the natural key) permit the playing in 15 major and 15 minor keys. This appears to be adequate for practically all music now existent. When the pushbutton for the key of C is operated—that is, the natural major key—the motor speed is such that middle A is 440 cycles per second and all other tones on the keyboard are exactly in the Just Scale. The instrument then can be played in the key of C in the Just Scale. There is no question of the use of tempered or natural harmonics. A number of additional generators must be added in each octave to take care of some harmonics of notes other than the key notes. If it is wished to change the instrument so that it can be played in the key of E, then the pushbutton marked "E" is depressed. This will release the "C" clutch and operate the "E" clutch and the speed of the main drive shaft will be changed to 5/4 of its former speed. The instrument will therefore, be raised in pitch in the ratio 5/4 and upon playing on the white notes as before, i.e., in the key of C major, the instrument will sound in the key of E. Since all the harmonics and added generators are changed in the same ratio, the organ is still in the Just Scale and this scale is correctly tuned for the pitch in which it is being played. It will be noted that except for accidentals, in major keys the performer need only learn to play on the white notes. The instrument then always plays as though the music were in the natural key and it sounds in the key corresponding to the pushbutton which is operated.

It will be noted from Table II that there is always a minor key which uses the same frequencies as each of the major keys. Each pushbutton therefore would be labelled with two names and a single key signature. For instance one of the pushbuttons—that for the key of D, say—would be labelled "D—2<sup>♯</sup> major—1<sup>b</sup> minor." To each of these pushbuttons would be wired a small illuminated indicator with the same label as the pushbutton. These indicators would be mounted in a row between the two manuals so that the organist is always aware what key his instrument is tuned for.

It will be seen that this organ is a transposing instrument and that existing music could not be readily played on it unless it were written in the key of C. All organ music would have to be transcribed to this key, with the key signature in which it is to sound marked separately. Minor keys would have to be transcribed to the naturally corresponding minor. The key-signature indication could very well take the form of an added note below the bass staff and as far as the performer is concerned would be simply one more note to be played, which he could play with his left foot. To avoid confusion with the bass notes, the key-note names could be used. Such an instrument as this would be learned much more readily than present day conventional keyboard instruments. The student would no longer be obliged to master the complicated and cumbersome scheme of key signatures which music has evolved. The playing position of his hands on the keyboard would

never be changed and the black notes would only be necessary for accidentals or for minor keys. The student, therefore, would devote the major part of his energy to the artistic development of his music rather than to the mastering of the mere mechanics of notation. That this instrument could not be put into use immediately is fully appreciated; that an instrument of this general character should eventually become widely used is, however, maintained. A sufficient interval of time must elapse to permit the transcription of a large amount of existing music into the natural key before such a scheme could be of much use. The ultimate advantages are beyond argument. Such a transposing instrument is readily evolved from a Hammond Organ or similar device because of the simple nature of the mechanism for speed changing. It will be apparent that the transposing feature can be readily applied also to the instrument to be described next.

Another instrument which is adaptable practically is the Hammond Novachord<sup>4</sup>; this is typical of all instruments which obtain their tones from vacuum-tube oscillators. In the Novachord twelve oscillators forming the top twelve notes of the keyboard are employed, and all other tones are obtained through a frequency-dividing and harmonic-generating system. The addition of an elaborate control system allows tones of any general form to be obtained. The instrument not being restricted to steady-state tones as is the Hammond Organ, it will, with reasonable accuracy, imitate most of the conventional instruments. Using this sort of an instrument as a basis, the author would suggest a new instrument<sup>5</sup> tuned in the Just Scale as follows:

A row of pushbuttons will be provided along the base of the instrument intended to be operated by the left foot. These buttons, of which there will probably be 15, will be labelled with 15 key signatures from C<sup>#</sup> to C<sup>b</sup> which, in the major keys is from seven sharps to seven flats and in the minor keys from four sharps to ten flats. Each of these pushbuttons will operate a 12-contact relay and the circuit is so arranged that only one relay can be operated at a time. Above the manual appear 15 illuminated signals which indicate which relay is operated. To each of the 12 contacts of each relay is wired a small condenser and these condensers are the tuning condensers of the 12 oscillators. When any relay is actuated, therefore, the 12 oscillators are adjusted to frequencies corresponding to the 12 condensers that are cut into the circuit. Since all other tones on the instrument are derived from the 12 tones of the top octave, it follows that all the frequencies on the keyboard are governed by each pushbutton.

It is readily seen what possibilities are provided. This instrument can be made a transposing instrument such as the organ already described, if the tuning condenser is chosen of such a value as to step the whole octave upwards or downwards by a uniform amount as different relays are operated. It can also be arranged to be played exactly as conventional instruments are played by merely adjusting the frequencies of the notes of the octave so that for any desired key the frequencies will occur in the correct sequence. We should find ourselves with an instrument which is played exactly as a piano or an organ is played today, but which will sound in the Just Scale. It will be possible on this instrument to have an additional pushbutton which would tune the instrument in the Tempered Scale if for any reason this were desired, as for example, in order to play chromatic music.

A third type of instrument which would provide a typical application of the Just Scale is as follows. This is a new instrument, which would use a keyboard exactly as does the Novachord for example, and could only be constructed to operate on the Just Scale. It would not be feasible for the Tempered Scale and apparently for that reason nothing similar has been devised before. The basic idea in this instrument is that all tones are obtained from a single generator. This may be a vacuum tube oscillator, a commutator device, a magnetic generator or simply a 60-cycle

wave obtained from the power mains. All other tones are derived from this single frequency by means of harmonic generators or multivibrators—that is, frequency multipliers or dividers. For example, if the 60 cycle power supply is used as a source then A 440 in the key of C is obtained as the third sub-harmonic of the 22nd harmonic, and all other notes on the keyboard can be obtained by similar multiplications and divisions which are possible by well-known circuit arrangements.

In order to change key, two possibilities are open:

1. If it is desired to make a transposing instrument, then the frequency of the single source can be increased or decreased by the factor required for the key change, and all tones in the keyboard can be shifted accordingly.

2. If it is desired to make a non-transposing instrument, another scheme can be used. In this scheme the frequency of the key note in some octave on the keyboard is obtained from the single-frequency source by a process of multiplication and division, and all other notes on the keyboard are obtained from this key-note frequency. In order to change key it is necessary to set again the new key note from the single-frequency source and to switch control of the other keyboard notes to the new key note. It will be realized that the switching problem is not severe since it is only necessary to reset frequencies of a single octave and all the other octaves will fall into step.

One of the serious design difficulties in electrical musical instruments is that the nominal power rating of the amplifier-loudspeaker system, which is based on negligible distortion for a sine wave, cannot be approached when complex waves formed from many harmonic components in random phase relation are transmitted. This reduction in power output is due to the possibility at any instant of the amplitudes of all the components adding arithmetically, so that the voltage or current peak is the arithmetical sum of all the components, while the loudness of the power output is only the root-mean-square sum. In an instrument tuned to the Just Scale, such as any one of the three described, it is possible to fix the phase of all the components of a tone so that the peak amplitudes of all the waves could never add up at any instant. Even in an instrument tuned in the Tempered Scale this is worth doing, since the octave components, that is the sub-harmonics, and the second, fourth and eighth harmonics, are exactly correct and a precise phase relation can be maintained.

Let us look at some of the considerations involved in any scale arrangement other than those already discussed.

1st—The theory of harmony as taught in the schools says that in any key, a triad can be set up on each of the seven notes of the scale. This is supposed to hold for either the major or the minor scale. Tables V and VI list these triads in one major key, and one minor key.

It is seen that, in the major, two triads are incorrect, and that one (D Min.) must be set two fifths higher in D major and the other (G seventh) must be set one fifth higher, in G Major. Of the triads of the minor scale, four can be left in this key, and three must be shifted: G seventh to E minor, D minor to B minor, and E seventh to C<sup>#</sup> minor. It is thus apparent that the classical theory is not correct for any scale arrangement whatever.

2nd—In modulating, apparently the usual pattern is to move several steps in the dominant direction, and then to return to the starting point, or a fifth below it, one step at a time. This means that as much as possible, chords should be unchanged in moving into adjacent keys. For example, it would be desirable to have the chords of the following keys use notes of the same frequencies.

F Major	C Major	G Major
D Minor	A Minor	E Minor

This is particularly true of the 7th chords, which seem to be largely used in modulation.

3rd—These choices should be checked against one of the previous criteria: that in order to permit expansion of musical ideas and to enrich the composers' harmonic resources, there should be as many as possible harmonics of the tonic present in the scale.

TABLE V  
TRIADS OF C MAJOR

Name	Notes	Desired Ratios	Actual Ratios in C Major A Minor	Key necessary for Desired Ratios
C	C E G	4: 5: 6	4: 5: 6	C Maj. A Min.
D Min.	D F A	10: 12: 15	10-1 8: 12: 15	D Maj. B Min.
E Min.	E G B	10: 12: 15	10: 12: 15	C Maj. A Min.
F	F A C	4: 5: 6	4: 5: 6	C Maj. A Min.
G	G B D	4: 5: 6	4: 5: 6	C Maj. A Min.
A Min.	A C E	10: 12: 15	10: 12: 15	C Maj. A Min.
G 7	(G) B D F	(4): 5: 6: 7	(4): 5: 6: 7-1/9	G Maj. E Min.

4th—From the foregoing it can be deduced that a minor key must use the frequencies of the major with the same name. It is apparent that so far as the listener is concerned, the harmonic structure of the music must be the same, whether produced by a transposing or by a non-transposing instrument.

It would seem appropriate at this point to emphasize that the Just Scale must not be considered an ideal scale; it is simply the best scale to fit our existing tradition of music played in the seven-note diatonic scale, with the conventions we have evolved regarding modulation and harmony. The Just Scale does not, and no scale ever did, fit the classical theory of music. Everything here proposed is in some degree a compromise and the only way in which conclusive decisions can be obtained as to whether these compromises are the correct ones is by a statistical analysis of a representative amount of existing musical compositions. That this work should be undertaken there is no question; by whom and when are very different queries. Whoever does it must possess a sound knowledge of music as it is written and played. It is not arithmeticians who make musical scales; scales are made by those who write and play music. Our new scale must make musical literature, as it now exists, possible and pleasing; and if our changes are to be justified, must add new meaning now obscured by the Tempered Scale. This latter motive might be better phrased by saying that it must allow instrumental music to reproduce physically the plain intention of the written work, written by composers whose conception of musical intervals was subjective, and who were not influenced by the inexactnesses of the instruments on which,

TABLE VI  
TRIADS OF A MINOR

Name	Notes	Desired Ratios	Actual Ratios in C Major A Minor	Key necessary for Desired Ratios
A Min.	A C E	10: 12: 15	10: 12: 15	C Maj. A Min.
G 7	(G) B D F	(4): 5: 6: 7	(4): 5: 6: 7-1/9	G Maj. E Min.
C Aug.	C E G#	16: 20: 25	16: 20: 25	C Maj. A Min.
D Min.	D F A	10: 12: 15	10-1/8: 12: 15	D Maj. B Min.
E	E G# B	4: 5: 6	4: 5: 6	C Maj. A Min.
F	F A C	4: 5: 6	4: 5: 6	C Maj. A Min.
E 7	(E) G# B D	(4): 5: 6: 7	(4): 5: 6: 7-1/5	E Maj. C#Min.

in fact, the music was performed. That the great masters were not much influenced by the theory of music as taught in the schools, there seems no doubt. It appears to the author, from a limited knowledge of present-day teaching of the theory of music, that such teaching is largely classifications of prejudice and habit, having no scientific basis, and what in fact is much the same thing, no basis in music as it is played and written.

From such an analysis we want to know what modulation sequences are used, and how commonly; what are the chords used, and in what keys should they sound, so that the texture, the continuity and the feeling for tonality, are best preserved. From these data, collected from the great mass of important and commonly-played compositions, properly evaluated, the best possible arrangement of the Just Scale, thoroughly in accord with our tradition of music, could be evolved. Without such information we can only examine some possible scales and form conjectures as to the correct solution of the problem.

The paper as delivered was followed by a demonstration of oscillograms showing major and minor chords in the just and tempered scales. The tones were generated by oscillators, and were made audible through an amplifier and loudspeaker.

Grateful acknowledgement is made to Prof. B. deF. Bayly of the University of Toronto for his untiring assistance backed by an extensive knowledge and deep understanding of both music and acoustics; to Dr. and Mrs. L. C. Marsh of Ottawa and Mr. W. C. E. Wiseman of Toronto; to Mrs. E. A. Laporte of Montreal; to Mr. E. M. Hill of Bell Telephone Laboratories, New York; to Mr. C. B. Fisher of Washington and Mr. H. M. Smith of Sackville; and to Mr. André Durrieux of Montreal.

#### REFERENCES

- ①S. T. Fisher, "Electrical Production of Musical Tones" *Engineering Journal*, June 1939.
- ②L. Hammond, U.S. Patent No. 1,956,350.
- ③S. T. Fisher, U.S. Patent No. 2,273,768.
- ④L. Hammond, U.S. Patent No. 2,126,682.
- ⑤S. T. Fisher, U.S. Patent No. 2,293,499.

# CAN PROFESSIONAL EDUCATION BE LIBERALIZED?

C. R. YOUNG, M.E.I.C.

*Dean of the Faculty of Applied Science and Engineering, University of Toronto and  
President of The Engineering Institute of Canada*

An Address delivered at the Second Canadian Hazen Conference, Chaffey's Locks, Ont., on June 25th, 1942

There is in the subject that has been assigned to me an implication of existing narrowness of professional education. No one having at least a passing acquaintance with professional or educational literature can deny either the implication, or the frequency of the question in which it is embedded.

As a representative of one of the professions at which the questioner's shaft is aimed, may I at once admit some justification in his selection of a target. In Marcus Aurelius there is much to promote humility, but for an engineer never more than in his query:

"Dost thou not see, how even those that profess mechanic arts, though in some respects they be no better than mere idiots, yet they stick close to the course of their trade, neither can they find in their heart to decline from it."

Some little comfort is left to the engineer, however, in the realization that he is not the sole object of the current castigation. The charge of serving narrow and ruinous ends has been met fairly by President Willard E. Hotchkiss, of the Armour Institute of Technology, in his observation that

"Whether the machine is an instrument of advance or of retrogression depends not upon the machine but upon those who determine the ends for which the machine is employed."

I am afraid that many of those who speak of liberalization of professional education believe that everything would be very satisfactorily and quickly adjusted if the recipients of it would merely acquire some of the techniques of the critics. That would be very simple—no more than a shift from one narrowness to another.

One has only to read the summaries of theses presented to our universities for the degree of Doctor of Philosophy to perceive the extraordinary specialization in many of the investigations. It would be strange indeed if some of those here present had not been bored beyond measure by persons expounding intricate specialties under the guise of high culture. There are philosophical, literary, and artistic bores as well as scientific ones.

Students engrossed in the detail of professional courses may find comfort in an observation of John C. Parker, at one time President of the American Institute of Electrical Engineers:

"Courses in the liberal arts are neither liberal nor art if they fail to get beyond the mechanics of preparation or the minutiae of research. Too often this is precisely what does happen. The invasion of the scientific method into the humanities has done wonders for research but often at the expense of the liberalizing and human values in the subject matter. Too often the attractions of scholarship have resulted in slovenly and frightfully mechanical processes in the elemental preparatory courses, perhaps with the thought that scholarship is great and elemental teaching only a painful incident thereto."

Lest it be charged that this is but the view of an apologist for an upstart amongst the professions, consider the testimony of Nicholas Murray Butler. In his opinion, the decline and fall of classical scholarship in American education has been brought about largely by the teachers of the classics supplanting an understanding of the ancient world with unimportant specialization thereby pushing "far into the background the vitally important art of interpretation which is the essential element of real teaching."

In the search for an adequate answer to the question that has been posed, it will be necessary to discover, if such be

possible, not only the objectives of professional education, but, as well, the characteristics of present-day professional education, and, if the scope and methods be inadequate, means by which the situation may be bettered.

## OBJECTIVES OF LIBERALIZATION

It is, of course, very generally assumed that liberalization in itself is desirable. For what reasons is this true? Of those who might be called upon for an answer, most would doubtless reply that the justification of liberalization is the development amongst persons in the professions of a greater awareness of the universe and of the problems that will confront them in dealing with it; a more sympathetic understanding and juster appreciation of life; an increased mental and emotional flexibility and capacity for performing one's full duty to society.

There is, too, the seldom admitted but important factor of pure enjoyment. Without a wholesome satisfaction in life and what it has to offer, the professional worker, in common with others, will be unable to discharge his full duty to the society of which he forms a part. One cannot suppress a feeling of pity for Darwin, who confessed that although in early life he found delight in literature and art he came, through too intense scientific preoccupation, to the point where he could not endure a single line of poetry and found Shakespeare so intolerably dull that it nauseated him. His taste for pictures and music almost vanished. With supreme regret he acknowledged that the loss of these tastes means a loss of happiness, which may be injurious to the moral character by enfeebling the emotional part of one's nature.

## WHAT IS A PROFESSION

Notwithstanding the never-ending debate as to what constitutes a profession, no one has been able to formulate a compact definition of it. There are, however, certain characteristics that by common consent attach to this type of vocation.

Manifestly, one who undertakes to serve his fellows as a practitioner in a specialized field must be technically competent. However broad his education, his advice will be useless, if not dangerous, unless his knowledge and experience of the art that he practices is sound and thorough.

Society expects to find unimpeachable moral character in its professional personnel. The conduct of the practitioner should not be merely good enough to satisfy the law.

He must be a man of sound education, with evidences of learning in at least one direction. Despite the pretensions of certain callings, there are no unlearned professions. Abraham Flexner has pointed out that a profession must of necessity have its roots deep in cultural and idealistic soil. Its essence is free, unhampered, resourceful intelligence applied to the comprehension and solution of problems. Its primary objectives are intellectual and altruistic.

Perhaps the most vital element of a profession is the principle of trusteeship. One who seeks the services of a physician, a lawyer, or an engineer puts his whole case, possibly involving his financial security, or even his life, into the hands of his adviser. He is not qualified to judge of the sufficiency of the measures that will be taken in his behalf. He must repose complete trust and confidence in his adviser. Upon the latter rests the burden of discharging the trust with strict regard to the long-range welfare of the client or patient. No substitutions, shortcuts, or savings of time or effort are admissible. Upon the faithfulness of observance of this principle of trusteeship the status of a profession largely rests.

One expects of a professional man a wholesome and conscientious regard for the welfare of the community and the country in which he resides. The objectives of liberalization do not, of course, necessarily require that a member of a learned profession should participate extensively in public activities that have no association with his profession. The great British journal *Engineering* some years ago put the matter thus:

"The status that attaches to the professions of arms, of law and of medicine . . . can owe but little to the excursions of individuals from these professions into directive commercial or legislative offices, such as have long been whole-time occupations to those who have achieved any eminence therein."

Of those whose eminence in the professions is universally recognized, comparatively few owe it to notable participation in general public activities. The development of that supreme mastery of professional technique now demanded by the client or patient requires the full time and energy of even the most robust of men.

A little while ago one of the greatest advocates in Canada laid aside his gown and will appear no more in earthly tribunals. It was widely said, without a trace of disparagement, that the law was his first and his last love. And yet few men in this country have been accorded an equal measure of commendation and admiration. Year in and year out, juniors and law students flocked to the courts in which he pleaded to study his technique and revel in his lucid and vigorous examination and argument. One who was called upon publicly to appraise this simple practitioner of the law stated he "never knew a citizen more highly respected by people who did not know him." Such is the reward of one, who without excursions into other fields, practiced his profession as an art with all the devotion of a man of robust and ardent temperament.

#### REMEDY BY CURRICULAR ADDITIONS

Any statement of the desirability of liberalization inevitably elicits the obvious suggestion of adding certain liberalizing or cultural subjects to the curriculum. Unfortunately, the sack is already full and before anything else can be put in something must be taken out. So sweeping have been the recent advances in professional knowledge and so importunate have been the demands of potential employers for training in techniques and specialties that curriculum framers have had a difficult time.

Certain half-way or collateral subjects have been introduced, such, for example, as Psychology, Economics, Law and Management. But while these doubtless have some liberalizing value, they have found their way into the curricula largely by reason of a tolerance reposing on their assumed usefulness as collateral with strictly professional subjects.

It is unfortunate that the professional schools devote relatively small attention to traditional liberalizing subjects, such as English, History, Philosophy, and Art. While in the American engineering colleges, subjects of this type are frequently offered as electives and, in the case of a minority of students, serve a useful purpose, most students entering a professional school have their minds much too closely focused on those subjects that appear to them of very direct utility in the practice of their professions. Inclusions made with the obvious purpose of civilizing professional students excite a scantiness of interest that is little short of derision. The beneficiaries are disposed to exert no more effort than is required to obtain a bare standing in them.

The very limited success that has attended the introduction of so-called liberalizing subjects is not due to any lack of merit in the subjects themselves but to other circumstances. Amongst those who are admitted to the universities are some who are unsuited to professional life in its higher reaches. But that does not explain all. It may well be that the cultural subjects are placed at the wrong end of the

curriculum, and I am becoming increasingly convinced that the teaching of them is seriously at fault.

With a view to getting the general and non-professional subjects "out of the way" so that the upper years may be wholly devoted to what are deemed strictly professional matters, it has been the common practice to attempt liberalization in the lower years. Nothing could more certainly alienate the interest of the student. Young men just out of high school are eager to embark upon new and exciting studies having direct bearing upon the profession that they propose to enter. When they find that a substantial portion of the first, and perhaps the second, year is to be devoted to studies that appear no different from those that have so long engrossed their attention, they are disappointed.

President Wickenden, of the Case School of Applied Science, has presented a radical but challenging alternative. Says he:

"We have no quarrel with liberal education, nor with the doctrine that it is best for many young people to lay first a foundation of culture and then to erect upon it a superstructure of competency. But we hold that there are even more young people who will do better to lay first a foundation of competency and to build upon it a superstructure of culture and of social understanding."

Dean Emeritus Dexter S. Kimball, of the College of Engineering of Cornell University, has expressed a similar thought when confronted with the apathy with which freshmen engineers view liberalizing subjects. It is his view that

". . . if such subjects are presented to him a little later on when he is somewhat more mature and has had his technical curiosity satisfied by a few stiff courses in calculus, mechanics, etc., he will take to liberalizing subjects much more readily."

In order to meet the problem of curricular congestion arising out of additions of liberalizing subjects, it has been proposed that the professional courses be lengthened. While in medicine, dentistry, and architecture this has been found practicable, it is the experience of the engineering colleges that a professional course for a first degree will meet with only mild response if it is longer than four years. Most young men of the vigorous, adventurous, and enterprising type feel that four years is a sufficiently long period to spend in college. While as an aid to attaining the higher reaches of the profession a lengthened course would be desirable, it must be admitted that a great deal of the engineering of the world can be performed with competence and satisfaction to the employer by men who have completed a course of only four years' duration.

#### CULTURAL INHERENCES IN PROFESSIONAL SUBJECTS

Whatever broadening or liberalizing may be attempted in the professional schools will have scant efficacy unless it permeates the professional subjects themselves. Elliot D. Smith has set out the principle thus:

"A final fundamental of professional education is that its broadening elements should be integral not external, that students should be developed in human and social power, not by 'side courses,' but by ways of study that interpenetrate their technical professional development."

Approached in the proper spirit, a professional subject may be found to have a moving cultural contact. President Charles W. Eliot, himself a chemist, observed, with a wealth of experience and unsurpassed depth of appreciation that "anything useful may be cultural."

Assertion of a need for liberalization of professional courses has in most cases been based on the assumption that cultural value resides only in certain traditional subjects of study ordinarily found in the curricula of Faculties of Arts. From that view I must dissent. Dean Kimball has adequately dealt with this hypothesis. Said he:

"No study is of itself liberalizing and what is liberalizing to one man is vocational to another. Latin and Greek

may be strictly utilitarian to the archaeologist while liberalizing to the engineer. A knowledge of some industrial pursuit will be vocational to the man who is making a living thereby, while a knowledge of the same art may be very liberalizing to a divinity student. The student of the humanities and classics can lay no claim to liberal education unless he knows something about the great fields of science and industry and the human interests involved that surround and affect him for good or evil on all sides. The student of science and the man interested in industry will find many things made plainer and his horizon greatly enlarged by studying the recorded experience of those who have preceded him. No man in fact can lay claim to a liberal training if his education has narrowed his vision so that he sees only the importance of his own particular field; and the most liberal of studies may be very narrowing in its effects if it is not related to vital matters."

Students in the professional courses have often been chided for their devotion to "tool courses," upon a mastery of which their technical competency will depend. But we should not forget that devotion to the classical languages that attended the revival of learning in central Europe was prompted by the practical necessity of revealing the richness of culture preserved in the ancient manuscripts. Latin and Greek were the "tool courses" by which that treasure was recovered. As President Hotchkiss, of Rensselaer Polytechnic Institute, has pointed out, since a man could not be educated unless he knew Latin and Greek—the tools by means of which he had to obtain an education—it came to be accepted that if a man knew these languages he must therefore be cultured and if he did not know them, he was uncultured.

Any attempt to separate cultural from non-cultural subjects is attended by absurdities. President Compton, of the Massachusetts Institute of Technology, has pointed out that

"It was a cultural pursuit to delve into a study of the tools and machines of the cave men or the Egyptians, but not to try to understand the science and the machines of the civilization in which we actually live."

One may well ask at what point in a study of the development of human progress enquiry ceases to be cultural and becomes vulgar.

To go further, may I suggest that in the development of artistic appreciation some regard for the product of the professions has its place. Art attains the heights when it appeals to the imagination and stimulates thought. Judged by this criterion, many of the works of the engineer, for example, are artistic in the highest sense. In the words of President Compton

"To deny the artistic element in an engineering masterpiece and designate it as merely a material arrangement of concrete and steel is every bit as uncultural as to see in a masterpiece of painting only an arrangement of daubs of paint."

As one who has witnessed the development of many young engineers, I am impressed with the fact that there is in the study and practice of engineering much that merits a cultural recognition comparable with that accorded the more conventional fields of study. There is as fruitful a source of emotional uplift in observing and computing the hypnotic surface profile of green water pouring over the crest of a well-designed dam as in dissecting an obscure Elizabethan drama or in recording the change in shape of the amoeba. No adequate reason exists for characterizing as uncultured the man who by preference has become engrossed in the history and philosophy of the heat engine and of what that device has meant to civilization but who still remains ignorant of the music of Bach. Why should we hail as cultured one who is adept in the technique of the fingering or the plucking of strings but who is contemptuous of the applied

science that has mastered the field of vibration and has made possible the majestic pipe organ?

#### HUMANIZING THE TEACHING

Whether the stuff of culture be derived from inclusions of subjects that have come to be designated as liberalizing or from the professional courses themselves, it will remain embedded in its matrix unless extracted by sympathetic and discerning teachers. Not everyone is capable of effecting this much to be desired result, but I am sure that every one of you here will recall teaching that lent fascination to traditionally repulsive subjects.

A distressing barrier to progress has arisen from the common acceptance by the teacher of the view that students in the professional courses must of necessity abhor efforts to liberalize them and almost instinctively develop resistance to the process. An attitude of defeatism is acquired by those whose task it is to perform one of the most vital functions of teaching in the professional schools. Hope of pronounced betterment cannot be entertained until this is overcome.

A source of wide and enduring interest may be opened out by a sympathetic treatment of the historical and biographical aspects of the professions. Who, of his profession, is not moved by a portrayal of the struggles and achievements of Pasteur, of Blackstone, or of James Watt?

To those of logical mind there is allurements in breaking through departmentalized knowledge and tracing the fascinating patterns of principles that interpenetrate or interweave many sciences and arts? No surer source of delight exists for the mentally alert than to discover that principles and laws that he believed to be confined within the framework of his own science have their exact counterpart in other sciences with which he had hitherto been wholly unacquainted.

Every normal human being has a wholesome interest in the long and arduous struggle of the human race towards enlightenment and freedom. A moving spectacle it is, made the more so by a realization that one's own profession has had some influence on that progress. In the furtherance of this realization lies a worthy task for the teacher—the task of making clear, as Dr. W. P. Cohoe has put it, that

"Culture may be attained by following the commonplace to its origins and by integrating the knowledge so gained with every phase of human activity."

Of necessity, those in the professional courses must in some manner buttress themselves with a solid body of hard facts. It is the duty of teachers to assist in the process of acquisition. That assistance will not only be the more effective from the practical point of view, but will be welcomed by the student if it is touched with some little lightness and play of fancy.

Glass is a commonplace commodity in the world's commerce. There is more to it, however, than a mixture of solidified silicious materials moulded, rolled or cut to the desired form. A record of the influence of its manufacture and use on human life and pursuits when understandingly told is a drama of no mean power. George J. Overmyer has given some hint of it in his soliloquy of glass. Thus, to cite a few sentences:

"I am created of the admixture of Earth's minerals formed by the alchemy of time.

"I am born transformed in the blasting heat of fiery furnace.

"In molten mass I am tediously fashioned by the hand of cunning Artisan—or fed into the maw of intricate machine.

"I assume ten thousand hues of all the spectrum—either transparent, translucent or opaque—upon my maker's will.

"I admit the Heavenly light to hovel, palace or cathedral, and yet repel cold winter's howling breath.

"I correct my master's impaired sight and thus bestow

enjoyment of the printed word—and all of Nature's beauties roundabout.

"I magnify his minute, unseen enemies and thereby do I promote his health and happiness.

"I form the gossamer thread from which is fashioned fine raiment—yet too the insulation of his dwelling.

"I reveal to him the mysteries of his Universe—carrying his vision to the illimitable reaches of the outer stars.

"Through me he learned to chart the Firmament—to plot the orbits of the Planets and predict the courses of the Comets and Eclipses."

Few scientific subjects more appal the beginner than does Organic Chemistry with its complicated structural arrangements of molecules. The possibilities of presenting such a subject with a degree of charm that lures the student pleasantly along are seen in that delightful paper "Building Invisible Edifices" by H. I. Knowles.

#### CONCLUSION

Attainment of liberalization in the professional courses is possible only through a combination of favorable influences. Without their concurrence the results will be unimpressive.

Those who are admitted to the professional schools must give evidence of capacity for professional life and all that it entails. The raw material must be at least promising,

although one need not go so far as Gibbon, who, when speaking of the worthless Commodus, son of the Emperor Marcus Aurelius, remarked that

"The power of instruction is seldom of much efficacy, except in those happy dispositions in which it is almost superfluous."

We must by some means make sure of the constitutional receptivity of the student in the broadening programme. Surface treatment will not suffice. As John C. Parker has said:

"It is not a matter of hanging some academic trappings on the outside of a boor or of training his tongue trippingly to repeat phrases or to refer to events in history which have left him, as a man, quite unmoved."

Those subjects which are to serve as a vehicle for liberalization may be deliberate inclusions made for that purpose or, to a greater extent than has generally been realized, may be the regular professional subjects.

Upon the teacher himself more than any other factor, the process of liberalization will depend. All programmes and procedures fall to the ground unless they are permeated by the sympathetic insight and evangelistic fervor of one who is born to teach. Once again, it all depends upon our ability to find a Mark Hopkins.

## THE SIGNIFICANCE OF INDUSTRIAL RELATIONS

E. A. ALLCUTT, M.E.I.C.

*Professor of Mechanical Engineering, University of Toronto, Toronto, Ont.*

and

J. A. COOTE

*Assistant Professor of Mechanical Engineering, McGill University, Montreal, Que.*

**NOTE:—In the following article, written at the request of the Institute Committee on Industrial Relations, by two of its members, the authors define the nature of the problems usually comprised under the term "industrial relations." The Committee proposes, as part of its programme, to have other articles prepared on the subject and published from time to time in the *Journal* in order to stir up the interest of members in this important aspect of our social and economic organization.**

"Industrial Relations" comprise the whole range of human problems that arise within the structure of modern industry and, because of the size and complexity of these problems, they are now generally handled by executives specially chosen for that purpose. Engineers, by virtue of their experience, are well qualified for this work and are frequently selected for it but, if they approach the problem in the wrong way, their scientific training may prove to be a liability rather than an asset.

In the words of one of them\*: ". . . these very characteristics which distinguish engineering training and render engineers not only useful but indispensable in our modern industrial programme, tended to handicap us by inducing a certain indifference to problems that were not wholly technical in nature. I wonder if there is a single one of us who in his individual development in industry, did not become so absorbed with responsibilities of a specific technical nature that he unconsciously over-rated the importance of the exact engineering aspects of business and under-rated the significance of many factors which were not susceptible of ready analysis and measurement. How long will it take us to realize that the most important of these non-measurable elements is that human entity that we call an employee?"

\* Engineering Training and the Human Factor in Industry, by P. M. Russell. *Journal of the Society for the Advancement of Management*, May, 1937.

. . . We have recently become aware that the magnificent controls which can be applied to materials and to production processes are rendered valueless when a group of individuals decide to stop working and just sit down. The human factor in industry has with relative suddenness become a perplexing enigma for all levels of management, and many an engineer who has an excellent technical record finds himself facing a new problem in human behaviour—a problem which exhibits a great many unknown qualities, mentalities, skills and responses which are difficult enough to identify and much more difficult to analyse and appraise."

This implies that the reactions of many people to a given set of conditions are prompted rather by prejudice than by reason. With this proviso, methods of approach that have been applied successfully to the solution of other industrial problems may be used in the analysis of "industrial relations." The ground is not wholly unfamiliar.

The primary object of industry is to create wealth, or to add value to material by making it more useful or desirable to those who wish to acquire or use it. The more desirable the result and the smaller the expenditure of material and labour to obtain that result, the greater is the amount of wealth\*\* produced. On the other hand, waste of materials or labour reduces the amount of wealth produced and the result is a social loss.

This implies the existence of *human* losses as well as *material* losses, and the objective of the "Industrial Relations" section of an organization is to investigate the causes of such losses and to suggest or apply the necessary remedies. In structural engineering, graphical and mathematical analyses are employed to ascertain whether the material comprising a structure is being used to the best advantage,

\*\*The word "wealth" is used here in its broadest sense and refers to the degree of physical comfort and mental development made possible to the community as a whole.

or whether its distribution introduces redundancy or other sources of weakness. In heat engineering, balance sheets are drawn up to indicate the important losses, which are thereupon scrutinized to discover if and how they may be reduced or eliminated.

Similarly, with the human element, an idle or discontented employee is a source of weakness and a focus of infection within the organization. Friction in an industry or business is similar in its effects to friction in a mechanism—it generates heat and reduces efficiency. The task of the industrial relations department is either to remove the abrasive element or to apply the right kind and amount of lubricant.

The immediate consequence of the Industrial Revolution during the first half of the Nineteenth Century was a concentration of attention on the importance of *mechanisms* and humanity in general suffered from the deplorable social conditions that resulted from that policy. It required agitation which approached the scale of a civil war to ameliorate this condition, even to a minor extent.

The growth of industrial concerns into large corporations also divorced ownership from management and substituted the relationships of groups for those of individuals. As a consequence, it no longer was possible for managers to know individually the background and characteristics of their employees and to make allowances for their peculiarities and personal problems. Therefore, some means had to be provided whereby recorded data might take the place of personal knowledge, at least to some extent. This process was accelerated during the First World War when, as now, skilled labour was a scarce commodity and had to be employed with the utmost economy. The influx into industry of enormous numbers of unskilled workers and women, many of whom had never before seen the inside of a factory, intensified the problem and accentuated the need for its solution. During the post-war period of adjustment, the importance of the human factor continued to grow and personnel problems received more attention than ever before, so that the personnel department became a recognized part of most industrial concerns.

The first contact of the prospective employee with industry is through the employment department. This office has, or should have, a series of specifications for each kind of job and its objective is to fit the characteristics of the applicants to one or more of these specifications, so that misfits will be avoided as far as possible. The high cost of labour turnover is now generally appreciated and the old policy of more or less indiscriminate "hiring and firing" is discredited.

In many instances, vocational guidance and selective tests are used to assist in this process, though it is doubtful whether the latter are so universally valuable as their proponents assert. After their engagement, a judicious system of training and education may not only increase the value of the operators on their own particular jobs, but may also indicate those employees who are most worthy of advancement. A good promotion policy is an essential part of the scheme, as an employee who is discontented and is looking for another position is not only working inefficiently himself but probably is also a centre of unrest.

Most industrial disputes are caused by disagreements over

wages, working hours, or instability of employment. The fair apportionment of the increased value produced by industry between owners, management, labour and the community is a complex problem, and the present methods of mass bargaining, however inevitable they may be, are at best a very rough approximation to the ideal. One essential factor is that the system of wage payment used shall be as simple as possible, since the worker is immediately suspicious of any system that he cannot understand. Again, the reward should be proportional to the service rendered and, if in the form of a bonus or premium, should be paid as quickly as possible. The principal reasons for the failure of many co-operative and profit sharing schemes have been the small returns from them and the remoteness of the reward. The wages paid also should bear some relationship to the cost of living, as this fixes their real value in purchasing power. This may be done, as at present, by the use of a "cost of living index" but it seems to be difficult to devise an index that reflects the actual cost of living in each individual case.

Many potential disputes have been avoided or settled by works councils, which are set up in various industries to discuss matters of general importance, to bring to the attention of the management causes of dissatisfaction and in some instances to act as arbiters in disciplinary cases.

The high costs of accidents and lost time due to illness have directed attention to questions of health and safety, so that most firms of any considerable size now have adequate medical services, first aid and safety devices, but these are not sufficient unless the workers are educated and instructed in their proper use. This education must originate with the management, as otherwise satisfactory results will not be obtained. Closely allied with these matters are the provision of adequate meals and suitable housing, particularly in localities where new industries are being set up, and the provision of comfortable working conditions in offices and factories. The latter involves the provision of proper heating, ventilating and lighting appliances, clean workshops and suitably designed working places, as an uncomfortable worker is likely to produce work that is poor both in quality and quantity.

Most workers are exposed in a greater or lesser degree to anxiety for the future; the triple spectres of ill health, unemployment and old age are always near, and therefore unemployment insurance, health insurance, and pension schemes are now considered to be integral parts of any large industrial organization.

It is not the purpose of the writers to describe these functions in detail, but rather to indicate the ground that is covered by the term "industrial relations." It is a difficult and complex part of the system but its proper functioning is essential to the well being of any individual concern and indeed to the community as a whole. The importance of the proper maintenance of mechanisms is universally appreciated, but the greater importance of the proper maintenance of personnel is not always realized. Important as these questions are now, they will become increasingly so in the post-war period and, therefore, the Committee on Industrial Relations has been appointed to keep Canadian engineers in touch with this situation to the end that industrial peace may be obtained and maintained.

# PRONENESS TO DAMAGE OF PLANT THROUGH ENEMY ACTION

HAL GUTTERIDGE, M.I.MECH.E.,  
Consulting Engineer, London, Eng.

Paper presented at an Extra General Meeting of the Institution of Mechanical Engineers, London, Eng., on Friday, 27th February, 1942, and reproduced with the kind permission of the Institution.

**SUMMARY**—The paper endeavours to set out the probable proneness to damage, from enemy action, of various types of factory plant under risks due to war time conditions, and to put forward the probable extent of damage to individual items of plant. The kind of damage considered is that resulting from the dropping of high-explosives and incendiary bombs from aircraft. The paper excludes consideration of damage arising from other kinds of enemy activity.

The term "plant" is here intended to include all the equipment machinery and accessories installed for the operation of a factory or industrial establishment.

## PROBABILITIES OF THE EXTENT OF DAMAGE

Observations have indicated that the extent of the damage likely to occur is a function mainly of the type of bomb and the place where it falls, the type of building construction, the inflammability of materials adjacent to any fire, and the physical characteristics of the various items of plant. It is proposed, therefore, to examine each of these contributing factors in turn, to see how far each is likely to influence the result.

## KINDS OF BOMBS AND THEIR EFFECTS

The amount of damage caused by a high-explosive bomb will depend—apart from its explosive capacity and nearness to the item under examination—on the type of building construction and, in a lesser degree, on its size, and number of floors, and the position of adjacent buildings. The effect of an incendiary bomb will depend primarily on the type of roof construction. If the roof can resist the penetration of the incendiary bomb and is not itself inflammable (being thus a "protective level," as Colonel Guy Symonds<sup>1</sup> aptly termed it), fire will be prevented. If, however, the roof does not stop the passage of the incendiary bomb through it, the result will depend upon the resistance of the floors below and the proximity of inflammable material, whether the latter be constructional or materials in process of manufacture. A frequent source of danger in this respect is the existence of insufficiently protected lift shaft heads, light wells, and confined spaces between buildings through which the bomb can penetrate to the interior.

It can be expected that the fire risk per unit area of plan will be greater in multi-floor than in single-story buildings for, in addition to the possibility of bombs penetrating the "protective level," the exposed wall area is open to the entry of incendiary bombs which may descend at an angle of 16-46 deg. to the vertical, the angle depending upon the height from which they were released.

Fire is found to be usually much more destructive than blast with its accompanying flying debris. This comparison holds even when the damaged item is close to the point of impact of a high-explosive. It is easier to provide measures satisfactory to counter the effects of blast than the effects of incendiary bombs for once fire has taken a firm hold, it has potentialities in spreading ("communicated fire") which do not usually arise in high-explosive bombing attacks. The blast is of momentary duration and local in its effective range, but fire may be prolonged beyond the period of time which the exposed materials can withstand the heat without change of condition. Generally, it can be expected that the occurrence of fire will considerably increase the amount of the loss in value of the factory plant involved.

<sup>1</sup>See Jl. Roy. Soc. Arts, 1941, vol. 89, No. 4589 (13th June), "Fire Prevention Under War Conditions."

## GENERAL SURVEY OF BUILDINGS

The extent and severity of the damage to the plant will depend upon the protection given to it by the building and therefore the first observations to be made when carrying out a rapid approximate estimation of the damage will concern the building or buildings, as follows:

1. The site.
2. The construction and state of the building.
3. The walls, roofs, and floors.
4. The drainage.

### 1. THE SITE

The site of the building and its position in relation to any other nearby buildings which also are affected gives the first general impression of the extent and severity of the damage which may be expected and provides an indication of the work involved in reinstating the damaged plant. The position of the boilers and other ancillary plant will be observed, also whether they are housed in the affected building or not. If a building has collapsed completely, necessitating a replanning of the plant, the position of these services may influence the new plan.

Communicated fires from adjoining buildings can be prevented by providing an adequate artificial break between the buildings by bricking-up all openings in the side wall exposed to possible communicated fires. At the same time the wall forming the "exposed" side should be carried up to a height well above the roof level.

### 2. THE STRUCTURAL ASPECT

The type of building construction least likely to suffer from the effects of a bomb explosion is that type which is sufficiently resilient to recover its former position without strain or disintegration. Momentarily, after the explosion, the structure may have to adjust itself rapidly to very unequal air pressures on different parts, which may set up strong forces in its various members. Such stresses require proper continuity of reinforcement, or soundly jointed structures, with beams and columns acting as one unit, a feature which is only found in steel-framed buildings or in those of reinforced concrete construction.

The latter construction has shown its undoubted great superiority in resisting aerial attack in comparison with the old type of building, in which the walls bearing the loads are of brick or stone.

In the composite type of building, where the interior structure is of steel beams and columns, with external walls of brick to support the outward ends of the beams (each member being free to act independently) the resistance to aerial attack is of a much lower order than that of the steel-framed or reinforced concrete building; it is, in fact, little better than the structure composed wholly of brick. With existing buildings of the composite type, adequate strength at joints and bracing of the interior members is one of the minimum requirements for comparative safety.

In all steel frame and other types of construction the design should be such as to localize the effect of the bomb and hence to minimize progressive structural failure.<sup>2</sup>

<sup>2</sup>This aspect of design has been specially dealt with, so far as it concerns the roofs of single-story buildings, in War Time Building Bulletin, 1940, Nos. 1, 4 and 5 (H. M. Stationery Office). See also Report on Buildings Damaged by Air Raids, and Notes Relative to Reconstruction, (Inst. Structural Eng., London), 1941.

### 3. THE WALLS, ROOFS, AND FLOORS

The walls of a modern factory are not part of the structure. If they are external walls their purpose is mainly to keep out the weather, to allow light and air into the interior, and to preserve the air conditions within the factory. If internal, they form the necessary divisions of the area. They may act as protective walls or be used for other non-structural purposes. If, therefore, in a modern steel-framed building, all the walls have been blown out, the danger of collapse need not be anticipated.

Protective walls are arranged to divide the factory into a number of "cells" so that the effect of a bomb explosion will be localized. The number of cells depends upon the nature and arrangement of the plant and the operations carried on. It is usually possible in existing works, both engineering and industrial, so to arrange the walls that a high degree of protection is achieved without interference to the work of the factory.

In future factory layout, this aspect of protection will be incorporated in the design as a matter of good practice. As examples, in a glass-bottle works, the vulnerable brick-built tank furnaces would be separated by the concrete silos holding the raw material so that at least half the works would be saved in the event of an explosion; in a single-floor light engineering works the different types of machines would be separated into convenient cells by dwarf walls, so as not to interfere with production; in a Portland cement works, the rotary kilns, susceptible to dislodgement by blast, would be set lower to the ground than usual, with a protective wall or with the clinker or cement silos between them.

On the other hand, in factories with brick-built load-bearing wall construction, collapse of the walls will generally cause a complete collapse of the structure, with consequent severe damage to the plant. If the walls at ground floor level are at least 14 in. thick, there is reason to expect that plant inside those walls will be protected from blast and flying debris which may come from outside.

Roofs and floors of solid concrete strengthened with filler joists or steel reinforcement give more protection against bombing than floors in which lightness has been obtained by the use of hollow tiles or other means. With floors of the latter type, therefore, the damage to the plant can be expected to be greater. In single-story buildings of light steel frame or reinforced concrete construction, the roofs are not usually designed to be proof against incendiary bombs and in such cases the damage will be of a different character, for the bomb will fall directly upon the plant. In this type of factory the division of the floor into cells by protective walls designed to localize the effects of bombs or fire is particularly applicable.

### 4. THE DRAINAGE

If drainage is not adequate to deal with the abnormal conditions during a fire when large quantities of water may have to be conducted away, the consequent flooding is likely to damage plant which has been submerged. Particularly susceptible in this respect are electric motors and electrical equipment generally.

#### CONCLUSIONS ON GENERAL SURVEY OF BUILDINGS

(a) The extent of damage to the plant is likely to be the least where the factory building is of steel or reinforced concrete construction in which all beams and columns are properly jointed to each other to form one structural unit.

(b) The building should be so designed that conditions permitting "spreading collapse" are minimized; composite types of brick and steel beam construction require adequate bracing to render a building comparatively safe from aerial damage.

(c) Walls 14 inches thick will protect internal plant from flying debris from outside.

(d) Solid concrete floors and roofs properly strengthened with filler joists or other reinforcement are superior to lighter

floors of hollow-tile or other lightweight construction against air attack.

(e) Adequate drainage to conduct away the abnormal quantities of water present during fire-fighting will reduce the damage to plant at or below ground level.

#### SURVEY OF PLANT

The five main causes of damage to factory plant consequent upon an enemy attack from the air are:

1. Direct hit from a high-explosive bomb.
2. Blast pressure wave from bomb explosion usually accompanied by flying splinters and debris.
3. Fire caused directly by incendiary bombs, or indirectly by high-explosive bombs.
4. Damage from debris falling from above.
5. Flooding or drenching by water.

Each of the causes has a different effect on different types of plant. In other words, each type of plant has a proneness to damage, depending upon its physical characteristics, which can be indicated beforehand. All plant can be classified in this respect and limits set out within which the damage is likely to fall. Two examples will illustrate the method. The first example, a blacksmith's anvil, is unlikely to suffer any damage from any of the causes mentioned above except in an extreme set of conditions, in which it might be exposed to a direct hit or to intense heat. Such an item would have a minimum proneness to damage. The second example, at the other extreme, would be typified by some recording control equipment such as a thermostat, thermograph, or gas composition recorder. Such apparatus would be severely damaged by any of the above causes if they were near; in other words, the proneness to damage of such equipment would be high.

It is convenient to denote this variable proneness to damage by a number which will indicate the percentage of the value of the item (in its condition just before the incident) which has been lost by the damage it has suffered. This might be called the "damage proneness number," or "d.p.n."

The anvil referred to above could therefore be given a set of limits, to represent the damage likely to occur in average cases, of between 0 and 5, while the d.p.n. of the control equipment could be expected to fall between 70 and 100. These limits must, of necessity, refer to average cases; and whether the figure should be towards the higher limit or the lower limit or whether, in an exceptional case, the figure should be outside the limits, must depend on the judgement of the experienced engineer at the inspection.

As an example between these extremes, a totally enclosed air compressor can be taken. It can be expected that the totally enclosed body and bedplate will not be harmed by the causes mentioned other than a direct hit or persistent fire; but the gauges and pipe connections are subject to damage by blast or falling debris and, if they are carried away, they will fracture the flanges on the body. Such an item could therefore be given a damage proneness number ranging between 30 and 50 in average cases.

In seeking to establish these limits, the physical characteristics of the item will affect the result in every case except where extreme conditions have occurred. By this method, the limits of probable damage can be narrowed down and placed on a firmer basis, as an aid to the trained observer, in the rapid approximate estimation of the plant value lost.

Generally, factory plant can be classified in terms of damage proneness somewhat as follows. Heavy all-metal equipment for the heavy engineering industries, in the form of rolling mills, large presses, steam hammers, etc., will have a low damage proneness number; whilst in light high-speed machines used in cotton weaving and spinning, packaging machines for tea, margarine, etc., the damage proneness number will have a comparatively high value. The lighter equipment employed in engineering factories, such as lathes, shaping machines, grinding machines, etc., are, in average

cases, likely to suffer damage to parts other than the beds or bases when exposed to blast or fire and the damage proneness number may be expected to lie between 20 and 50; it may be somewhat higher if the electric motor drive has been exposed to heat or flooding. If efficient dwarf protective walls were provided, the damage proneness number would lie towards the lower limit.

Intricate machines of lighter construction will need a much greater proportion of its replacement value to be expended in repair (in relation to the proportion of actual damage) because of the high cost of assembly; on the other hand, the cost of removal and reinstallation will be considerably less than for plant of a heavier type. Again, heavy machines of an intricate nature, such as looms, will have high damage proneness numbers, despite their great weight, due to the large number of delicate parts and to the high precision required.

The high-speed automatic type of machine constructed of fabricated steel has a greater chance of survival than a machine made of cast iron, for the combination of toughness and malleability of the former is, in these conditions, a superior characteristic to the brittleness of the cast iron. Sheet metal equipment in any form, such as milk pasteurizers, fan casings, and ducts, suffer severely for they offer a large area ill-supported to resist a suddenly applied atmospheric pressure followed by an equally sudden subatmospheric pressure. Failure takes place by tearing at rivet holes, followed by general crumpling of the plate. Where exposure to blast, falling debris, or fire has occurred, a damage proneness number between 60 and 90 may be expected.

The proneness to damage is also affected by the extent of the surface of the item exposed to the blast. The blast is resisted by the weight of the item and by any anchorage that it may have to a secure foundation. Thus it is convenient to classify such plant (excluding items held down to their foundations) in terms of the ratio of the weight (in pounds) to the exposed area (in square feet). The application of this criterion assumes a structurally sound item and a rigid surface. Thus a Lancashire boiler, when full of water, would have a high ratio of weight to exposed area.

A recent experience can be cited in which two Lancashire boilers set side by side were 50 yds. from the point of detonation of a large-capacity high-explosive bomb. The side wall of the nearer boiler was at right angles to the line of the blast. The result was a movement of both boilers 1 in. away from the source of the explosion, the rupturing of the boiler settings, and the fracturing of all steam pipes on the top of the boilers.

## FACTORY SERVICES

### PIPING

The general practice of attaching service piping to the most convenient point of support has persisted despite the many advantages in accessibility, clean layout, absence of obstruction, and protection from fire or other damage which is realized by placing such piping below the ground floor level in covered channels, with vertical branches only to the points to be supplied. An added reason for such treatment is provided by the threat of air raids, for piping not so arranged is particularly vulnerable to blast, fire, or falling debris. It cannot be too strongly impressed that the supply services carried by such piping are the arteries supplying lifeblood to the machines without which they cannot operate. Factory piping should therefore receive the attention which its importance warrants, and improvements should be sought in the following directions:

1. The total length of the service lines should be as short as possible.
2. The piping should be duplicated within reasonable limits, the second line being far enough away from the first to avoid the possibility of one bomb destroying both.
3. Adequate protection should be given by placing the piping underground, or disposing it in other ways.

If piping is attached to the structural members and total collapse of the building takes place, the piping will become

a total loss with a damage proneness number approaching 100, for none of it, except the valves, is worth recovering. If, however, the piping has been placed underground, then even with a total collapse of the building, only the vertical "runs"—and these are the less important—will be lost; and the damage proneness number may be expected to lie between 40 and 80.

### ELECTRICAL POWER AND LIGHTING

The cables for the supply of electricity, as well as electric motors, switchgear, etc., are particularly vulnerable to blast, fire, falling debris, and especially to flooding. As with piping for the various services, the cables should be run in channels, watertight in this case, with vertical leads to the points of consumption. All main supply cables should be duplicated; they should be laid underground, far enough apart to prevent the possibility of one bomb affecting both of them.

Electric motors are particularly susceptible to damage from these causes but their strong body casing protects them from falling debris. They also offer a high resistance to blast by virtue of their high ratio of weight to exposed area and because of their secure fastening to their bases. Even so, it is a frequent experience to find the feet fractured and the motor dislodged. The coils and windings, although so comparatively well protected, are easily damaged by flying debris and flooding; if flooding alone has caused the damage they can sometimes be reconditioned by drying. A general damage proneness number for all electrical motor equipment, including attendant switchgear but excluding distribution mains, may range from 50 to 80 in average cases.

In generating stations, protection for the turbine-generator set can be provided by building a separate reinforced concrete structure.

### BOILERS

From the viewpoint of this survey, boilers can be classified into two general classes: the first includes Cornish, Lancashire, and fire-tube boilers of that category; and the second comprises vertical and water-tube boilers. Boilers of the first type are heavy objects when filled with water; they are set low, near the ground, and are well bedded, with sides mostly shrouded with brickwork. They offer a high ratio of weight to exposed area, and suffer little damage in themselves, although the steam connections above are likely to receive injury from flying debris. The damage proneness number for the first type of boiler is likely to be between 10 and 30 if the boiler settings have not been disturbed. A case of exceptional damage by blast to a boiler installation of this type has already been cited under the heading "Factory Services."

The second class of boiler is more susceptible to damage than the first, for such boilers are built as comparatively high structures, securely held to their foundations, with a high centre of gravity. The damage proneness number of this class may be between 40 and 70.

### INSPECTION OF DAMAGED PLANT AND RAPID ESTIMATE OF LOSS IN VALUE

For the rapid approximate estimate of the loss in value of the damaged plant, the following order of observations is suggested:

1. A general inspection of all buildings on the site and of the adjacent buildings, to obtain a comprehensive impression of the extent of the damage likely to have taken place.
2. Inquiries as to the type of bomb which caused the damage, whether the factory had received a direct hit, and if fire followed, where and for what period did the fire continue.
3. If a fire occurred, whether it burned itself out or was quenched by water.
4. A detailed inspection of the type of building construction, its condition, and whether any collapse had taken place.
5. A detailed examination, as far as possible, of the whole

of the plant, its layout, nature, and the condition of all the items damaged.

6. Ascertainment of the value of all the damaged items, the value to be that immediately before the incident.

7. Preparation of a schedule showing all items, or groups of items, of damaged plant; the damage proneness number of each in the light of the conditions to which the item was exposed; and the corresponding loss in value. By summing the individual losses, the total loss is obtained, which can be expressed as a percentage of the total former value.

An example of a schedule of a possible case is given below.

A factory of three floors covering  $\frac{1}{2}$  acre in one building of load-bearing brick construction with internal joists and columns not soundly jointed together, receives a direct hit from a high-explosive bomb of large calibre. The result, it is supposed, is the total collapse of the factory, with fire breaking out in one part of the building among inflammable materials in process of manufacture. The fire, however, did not spread. In such a case, the schedule given in Table I might reflect the state of affairs in an approximate estimation of the loss in value of the plant.

Each of the items in Table I will be made up of a number of units, of various types and values, each of which would have been given a damage proneness number, so that the

TABLE I. APPROXIMATE ESTIMATE OF DAMAGE

ITEM	Value of item, £	Damage proneness number	Value of loss £
Processing plant.....	20,000	50	10,000
Packaging equipment.....	4,000	75	3,000
Conveyers.....	1,000	100	1,000
Refrigeration plant.....	6,000	50	3,000
Electrical equipment.....	3,000	80	2,400
Service piping.....	3,000	100	3,000
Boilers.....	4,000	30	1,200
Miscellaneous.....	3,000	50	1,500
Motor vehicles.....	2,000	50	1,000
	<u>46,000</u>		<u>26,100</u>

actual items shown represent totals for groups of individual items. The total loss for the whole of the factory plant works out, therefore, at a little over 56.7 per cent of its actual value.

#### REINSTATEMENT OF DAMAGED PLANT

Whether the damage to the plant had been extensive or trivial, the same procedure is necessary for reinstatement of the plant. The approximate estimate of the loss in value will have provided the necessary information upon which to base the decision as to the future programme in regard to the re-establishment of the plant.

In the case of a totally collapsed building, if it is decided to rebuild upon the same site, the work involved falls into two parts. The first part consists of clearance from the site of all debris and plant and the dispatch of the damaged plant for repair. It is well to note here that much further damage may be done to the plant in taking it down, disentangling it from the debris, and loading it on to the removal

vehicles, so this work should only be carried out by competent men. It is usually preferable to return the damaged plant to the makers rather than to other firms.

The second part of the programme is the repair of the equipment, the planning of its subsequent layout, the construction of the building to suit the new layout, and the reinstatement of the plant leading to the re-establishment of the factory. Where only a portion of the structure and the plant has been damaged, it is usually possible to adjust the remainder of the plant so that partial production can be realized. Continuity of output is thus maintained and the staff productively employed. Ingenuity assisted by experience will dictate how much can be done in that direction and as long as some of the special-purpose plant has survived, the replacement of general-purpose equipment such as boilers, pumps, motors, etc., does not present so great a difficulty, since such items are standard commercial equipment obtainable from a number of manufacturers.

Plant sent for repair necessitated by enemy action should be overhauled for normal wear and tear at the same time. The total cost of repairs should be allocated therefore to two accounts. No. 1 account would show the cost of repair of damage due to enemy action including the cost of removal, carriage outwards, dismantling at the repair shops, reassembly, testing, and storage until the new building is ready, return carriage, re-erection, and testing as a unit. No. 2 account would show the cost of overhaul for normal wear and tear. From these accounts the actual value of the loss on repairable items will be ascertained.

In the case of a complete reconstruction, the opportunity should be taken to lay out the plant in the light of modern practice, so that, with a building to suit the layout, the factory will represent the best economical arrangement, both as regards cost of outlay and in operation.

In principle, a factory is a place in which certain changes are made in raw materials so as to increase their value. Therefore, for the enterprise to be profitable, these changes must be carried out at a cost suitably less than the increase in value of the raw materials in their changed form. In the new layout of the factory plant, the following steps are taken:

1. A "flow-line" diagram is prepared, in which every process through which the raw materials pass from their reception to their dispatch, is shown diagrammatically in sequence, together with the type of service required by each process. This diagram illustrates the qualitative aspect.

2. A "quantity-line" diagram (a development of the flow-line diagram) is prepared, to show the *number* of machines or units of equipment required and the quantity of each service supply needed for each process.

3. The disposition of machines or equipment is planned to the best productive advantage.

4. The building is constructed to suit the layout, to support each item in its proper position relative to the other items of plant, and to protect the plant from the weather, enemy attack, and other causes of damage.

5. The plant is erected, the supply services installed, and the whole plant set to work.

# THE USE OF AIR-LOCKS<sup>1</sup>

G. O. BOULTON, M.E., M.I.E.AUST.

Chief Engineer, Messrs. M. R. Hornibrook, Limited, Brisbane, Australia.

(ABRIDGED)

**SUMMARY**—The subject of work in compressed air is reviewed. Detailed reference is made to operations which were carried out in Brisbane for the foundations of the Story Bridge. For "stage decompression" in air-locks a chart is developed with a uniform standard of protection, in the terms of the theory, over a wide range of working conditions.

## INTRODUCTION

Compressed air has been employed for little more than a century as a means of access to subaqueous work. It is now used extensively in the construction of foundations, tunnels and harbour works and for the purpose of submarine salvage.

From a suitably arranged working chamber, the water is displaced to the required level by the introduction of compressed air. The workmen are admitted through air-locks such as that shown in Fig. 1. They are compartments of variable pressure fitted with two doors, one of which communicates with the atmosphere and the other with a shaft or passage leading to the working chamber. In material-locks, facilities are added for the handling of materials.

The flexible diving dress and the diving bell are other devices used for working under pressure, differing only in mechanical detail.

Through exposure to compressed air the workmen may suffer ill effects. Ear injury may be brought about if the pressure is altered too rapidly and a complaint known as "compressed-air illness," "caisson disease" or "divers' palsy," may follow inadequate decompression. Other sources of danger exist and precautions must be taken against them. The first essential of safety, however, is proper air-lock control.

Working pressures, except in the case of divers, have never exceeded 60 lb. per sq. in. above the atmosphere. The various regulations in force overseas make no provision for pressures greater than 50 lb. per sq. in., which in some quarters are prohibited. A code prepared by the Standards Association of Australia in 1938, was extended to 60 lb. per sq. in., following the operations here described.

## FOUNDATIONS OF THE STORY BRIDGE

The construction of the Story Bridge<sup>2</sup> across the Brisbane River occupied a period of five years, from April, 1935, to July, 1940.

Compressed air was used on the southern approach, in five piers adjacent to the river. Six cylinders 14 ft. 6 in. dia. were sunk at Piers 25, 26, and 27, two cylinders 26 ft. dia. at Pier 28, and two rectangular caissons 32 ft. by 39 ft. at Pier 29 on the river bank. All were of reinforced concrete with cutting edges of structural steel.

The cutting edges were supported on the surface of the ground, where sections of the concrete shells were cast upon them. They were sunk at intervals by open excavation, while further sections were added to the required height. By this means the alluvial material at the site was penetrated almost to rock. Plugs of tremie concrete were then cast in the dredge-wells near the bottom, to enclose the working chambers shown in Fig. 2. When air-locks had been installed, the cutting edges were benched into the rock and sealed with concrete under compressed air.

The working pressures required for the different piers are shown in Table IV. They had been estimated from the ground-water levels at the site, and at Pier 29 at least 54 lb. per sq. in. was anticipated.

<sup>1</sup>Published through the courtesy of the Institution of Engineers of Australia.

<sup>2</sup>"Story Bridge, Brisbane," by J. A. Holt, *Jour. I.E.Aust.*, Vol. 11, No. 1, Jan., 1939, p. 1.

In the absence of a useful precedent for working beyond 50 lb. per sq. in., existing rules of operation had to be extended. A review of the subject showed how this could be done and also provided grounds for radical adjustments of method.

Locking operations were commenced in June, 1936, and completed in June, 1937. Compressed-air illness was kept in check and no fatalities or cases of permanent injury occurred.

## RATE OF COMPRESSION

Compression should be carried out as rapidly as possible in order to shorten the period of exposure, besides saving time. The rate must be controlled, however, to prevent injury to the workmen's ears.

In the cavity of the middle ear which is isolated by the ear-drum, the pressure is not adjusted immediately when external conditions are changed. Thus, the membrane is subjected to unbalanced pressure and discomfort is caused. Equilibrium is restored, in normal cases, by the natural

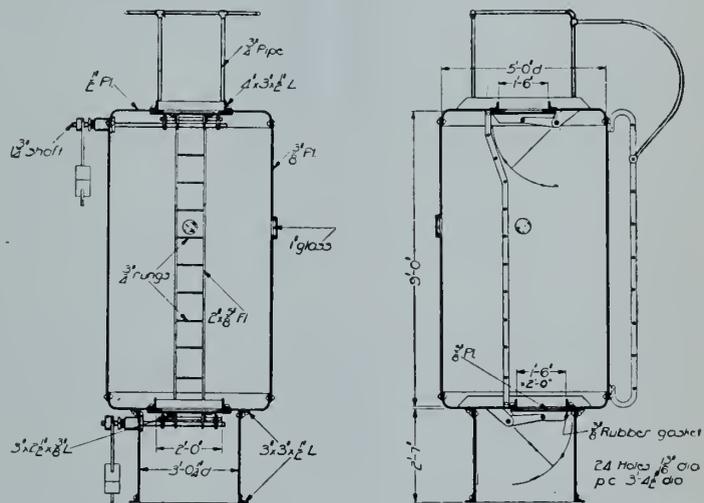


Fig. 1—Showing Sectional Elevations of Man-lock.

admission of air through the eustachian tube, a narrow passage which leads to the middle ear from the back of the nose. If it fails to function, or the change is too rapid, acute pain will result, with possible injury.

Similar trouble may be experienced with other air-filled cavities of the head, through blockage of the channels which connect them to the nose.

By defects of the eustachian tubes and sinuses, a number of men are rendered unfit for employment. Obstruction of a temporary nature can be brought about by colds.

The air in the middle ear tends to assume a volume inversely proportional to the absolute pressure, according to the gaseous laws. The change of volume and consequent discomfort arising from a uniform rate of pressure change, must, therefore, be less when the pressure is high. It would appear logical to increase the speed of compression with the absolute pressure. To some extent this can be done, but allowance must be made for interruptions, which are required from time to time in order to relieve distress.

In industrial regulations the subject of compression is generally ignored, or slow obsolete rates are specified.

In diving practice, the importance of fast compression is recognized. The usual speed for the individual diver is too fast for use in air-locks, however, on account of the number of men and their lack of personal control.

For the Story Bridge work, trials were made and a mean compression rate of 5 lb. per min. was found to be suitable. Schedules of operation prepared on this basis were maintained without great difficulty. The same rate was adopted for the fast stage of decompression, in incidental conformity with the American rule.

### COMPRESSED-AIR ILLNESS

Compressed-air illness is an after-effect of exposure, caused by the liberation of nitrogen bubbles from solution in the blood and tissues of the body. Its nature was determined in 1878 by Paul Bert, a French physiologist.

The atmospheric oxygen and carbon dioxide have other complex reactions which may become dangerous, with no direct bearing, however, upon the occurrence of compressed-air illness.

The nitrogen does not enter into chemical combination, but it is soluble in the blood and a state of saturation is maintained at the surface of the lungs, where intimate

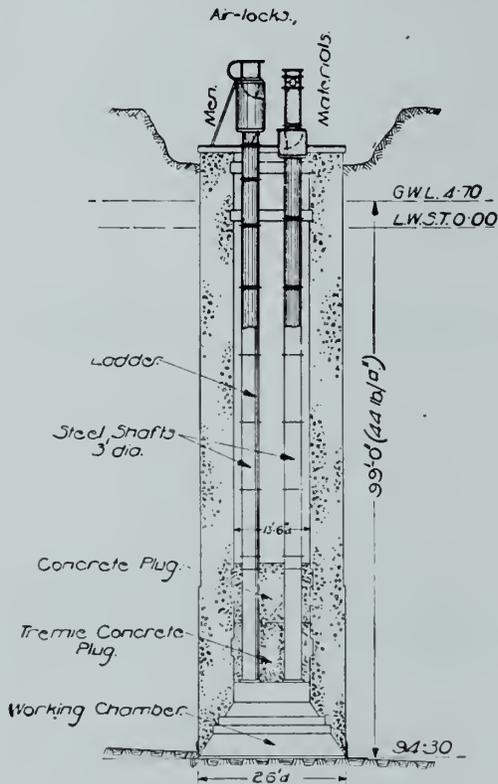


Fig. 2—Cylinder 28E.

contact is made. When compressed air is breathed, the blood leaves the lungs with an increased pressure of nitrogen in solution. In circulation it is brought into contact with the semi-liquid tissues of the body in which the solution pressure, at first normal, is lower. Nitrogen is transferred, therefore, and the content of the tissues is gradually built up. If the duration of exposure is sufficient, equilibrium is reached and the pressure of nitrogen in the tissues equals its partial pressure in the air—0.79 of the total air pressure.

The dissolved nitrogen is known to be harmless, so long as it remains in solution. When the pressure of the air is reduced below that of the nitrogen in the tissues, supersaturation is brought about, with a tendency for bubbles to be formed. The return to atmospheric conditions should be regulated so that dangerous supersaturation is avoided. When this is done the excess nitrogen is conveyed back to the lungs by the blood, and there discharged from solution without harm.

Compressed-air illness may result from faulty decompression, accidental variations or the presence of highly susceptible men. It is difficult to eliminate, but the number of cases can be kept very low if reasonable precautions are taken.

The symptoms vary widely with the location and extent of the bubbles set free. The most common forms are localized pain, dizziness, vomiting attacks, collapse, and paralysis. They rarely appear before the workmen have left the locks, and generally soon after exit.

### HALDANE'S THEORY OF DECOMPRESSION

The "uniform" decompression originally used occupied considerable time, and a more efficient course has been developed.

Modern methods are based upon the work of a British physiologist, Dr. J. S. Haldane. As a member of the Admiralty Deep Diving Committee of 1906, he was responsible for the introduction of "stage" decompression. It was found that the pressure could be lowered at once to half its absolute value, even after long exposure, without causing ill effects. By conducting the decompression rapidly to this point, and then slowly to its completion, no risk was added and much time could be saved.

Haldane wrote as follows: "Practical experience of work in compressed air shows that even with very rapid decompression, no symptoms of caisson disease occur with an absolute pressure of less than two atmospheres and that symptoms are very rare and slight until the pressure rises beyond 2.3 atmospheres, or 19 pounds per square inch. . . . Now, if it is possible to decompress rapidly and with safety from two atmospheres, or a little more, to one atmosphere, it seemed likely that it would be possible to decompress with equal safety from four atmospheres to two, or from six to three, since the volume of gas tending to be liberated would be the same in each case. Experiment showed that this was the case, and that the danger of rapid decompression depends, not on the absolute difference between the initial and final pressure, but on the proportion between the two pressures. If this proportion is only 2, or 2.3 to 1, the decompression is safe; if, on the other hand the proportion is 3 or 4 to 1, the decompression is dangerous."

In the stage method, the first rapid reduction of pressure and the slow completion of the decompression were governed by the same principle, that bubbles do not form unless a fairly definite degree of supersaturation is reached. A safe relation was maintained between the absolute pressure of the air and that of the dissolved nitrogen.

It was shown that the pressure of nitrogen is adjusted at different rates in different parts of the body, according to their relative capacity and the nature of the blood supply. Adjustment is retarded, for instance, by the presence of fat, which dissolves about six times as much nitrogen as the blood. For analytical purposes the tissues were divided into five groups, assumed to become "half-saturated" or half desaturated after a given alteration of pressure," in 5, 10, 20, 40 and 75 minutes, respectively. The last rate was that determined for the slowest parts.

Haldane showed that the margin of safety should be approached throughout the decompression. Not only is the discharge of nitrogen accelerated in this way, but its continued solution in the "slow" tissues is also checked early.

### DECOMPRESSION PRACTICE

The stage method was accepted by the British Admiralty in 1906, for the decompression of divers. The extensive tables which Haldane compiled appear in the *Admiralty Diving Manual*. They have been adopted, in turn, by nearly all the navies and deep water diving authorities of the world. In their use the diver's ascent is controlled by reductions of depth called "stages," shown in Fig. 3, which have given the method its name.

In construction work, where air-locks are used, the halted stages of diving practice are not readily applied. The fast and slow reductions of pressure are more conveniently made at different uniform rates. In tunnels where approach chambers, maintained at an intermediate pressure, are traversed by the men, the periods of constant pressure shown in Fig. 4 are interposed.

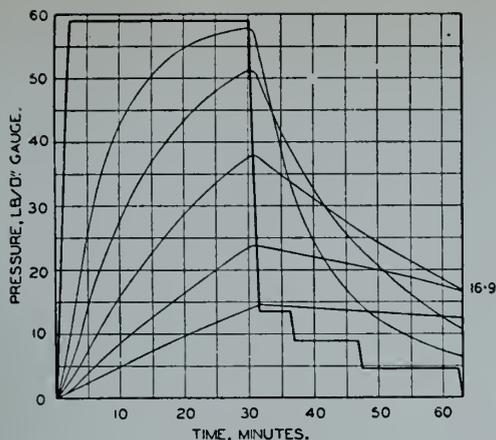


Fig. 3—Stage Decompression of Divers, according to the Diving Manual.

Table I<sup>1</sup>, the form of which is suitable for decompression in air-locks, was published by Haldane in 1907. Its practical value is small, however, on account of its limited detail. No comprehensive guide became available until the Report of The Institution of Civil Engineers<sup>2</sup> was circulated in 1936. This may account for the widespread use of inefficient procedure which continued in the intervening years.

TABLE I.

HALDANE'S TABLE—SHOWING RATE OF DEPRESSION IN CAISSON AND TUNNEL WORK

Working Pressure in lb. per sq. in.	Number of minutes for each pound of decompression after the first rapid stage		
	After first three hours exposure	After second or third three hours exposure, following an interval for a meal	After 6 hours or more of continuous exposure
18-20	2	3	5
21-24	3	5	7
25-29	5	7	8
30-34	6	7	9
35-39	7	8	9
40-45	7	8	9

Uniform decompression is still applied in some countries. It is contended that Haldane's method sets up excessive stress in the system, inducing organic reactions by which the regular process of desaturation is disturbed.<sup>3</sup> There is no evidence to support this opinion and much is known to discount it.

In America and in parts of continental Europe a compromise is used, in which the first rapid reduction extends to half the gauge working pressure only, instead of half the absolute, shown by Haldane to be safe.

For the piers of the Story Bridge, it was decided to follow the stage method completely, by carrying the first reduction of pressure down to half the absolute. The extent of the slow stage was determined from the theory, which was developed mathematically for the purpose.

MATHEMATICAL DEVELOPMENT OF THEORY

It is assumed that the blood leaves the lungs with a solution pressure of nitrogen equal to the partial pressure in the surrounding air. The pressure in the tissues is varied by an exchange of nitrogen with the circulating blood.

Referring to the diagram, Fig. 5.—

<sup>1</sup>"The Hygiene of Work in Compressed Air" by J. S. Haldane, M.D., F.R.S.—*Jour. of the Royal Society of Arts*, Vol. 56, 1907-8.

<sup>2</sup>The Institution of Civil Engineers, "Report of the Committee on Regulations for the Guidance of Engineers and Contractors for Work carried out under Compressed Air." London, 1936.

<sup>3</sup>International Labour Office, Geneva; Occupation and Health—No. 166, Compressed Air Work.

$\theta$  represents the external air pressure, in absolute units.  
 $a$  " its linear rate of change.  
 $n$  " the proportion of nitrogen in the air breathed (0.79 for atmospheric air).  
 $\phi$  " the solution pressure of nitrogen in the tissues, in absolute units.  
 $t$  " time.

$\theta_0, \phi_0, t_0$  are respective values at the outset.

From the physical laws it follows that, at any point

$$\frac{d\phi}{dt} = k\{n(\theta_0 + at) - \phi\}$$

Therefore,

$$\phi = \phi_0 + nat + \left\{n\theta_0 - \phi_0 - n\frac{a}{k}\right\} (1 - e^{-kt}) \dots \dots \dots (I)$$

The particular values of  $k$  for the different groups of tissues are as follows: For those which become "half-saturated" in—

- 5 minutes,  $k = 0.1386$  (A)
- 10 "  $k = 0.06932$  (B)
- 20 "  $k = 0.03466$  (C)
- 40 "  $k = 0.01733$  (D)
- 75 "  $k = 0.009242$  (E)

Equation (1) is general, but for ordinary conditions, in which  $n$  remains constant, a more convenient form can be secured.

Let  $P$  represent the gauge pressure of the air (above atmospheric), lb. per sq. in.

$p$  " the gauge pressure of air which would exert nitrogen pressure equal to that in the tissues, lb. per sq. in.

If the normal pressure of the atmosphere is 15 lb. per sq. in.

$$\theta = P + 15$$

$$\phi = n(p + 15).$$

By substitution in equation (1)

$$p = p_0 + at + \left\{P_0 - p_0 - \frac{a}{k}\right\} (1 - e^{-kt}) \dots \dots \dots (2)$$

Equation (2) was used in the preparation of Figs. 3 and 6. The calculations made for the values of  $k$  and for plotting Fig. 6 are given in an Appendix to the original paper.

THE PRESSURE RATIO

For safe decompression, as defined by Haldane, the ratio  $\frac{15 + p}{15 + P}$  should not exceed 2.0 to 2.3 at any time in any of the five tissue groups. In his recommended air-lock practice, when the first rapid reduction of pressure has been made, the ratio is a little less than 2.0. During the slow period which follows, it is increased slightly to not more than 2.3 at the conclusion.

Uniform decompression implies a ratio of 1.0, or less, at the outset, with a large progressive increase. In the American procedure, as shown in Table II, conditions are clearly intermediate.

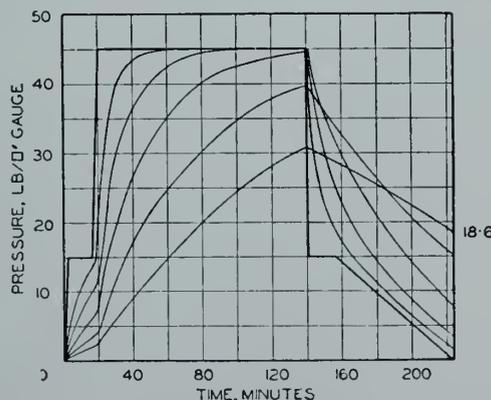


Fig. 4—Stage Decompression Adapted to Tunnelling Work.

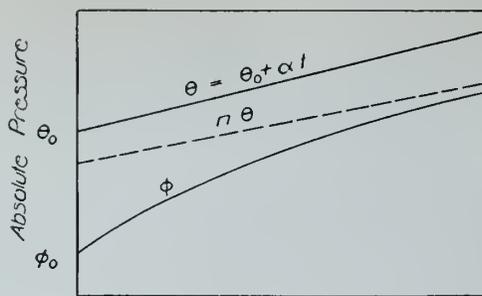


Fig. 5.

In all methods generally used the ratio reaches its highest value, and the danger of bubble formation is therefore greatest, when atmosphere pressure is restored. In practice, symptoms rarely arise beforehand.

Thus, the final ratio is the theoretical index of protection. Alternatively, the final value of  $p$  may be taken, since the two are related directly. Final ratios of 2.0 and 2.3 are represented by values of  $p$  equal to 15 and 19 lb. per sq. in., respectively.

It is inferred that positive protection should result when the value of  $p$  at exit is 15 lb. per sq. in., and that symptoms should be "rare and slight" when it is kept below 19 lb. per sq. in.

#### PRACTICAL STANDARDS OF PROTECTION

It would appear at first sight that the standard of maximum protection, corresponding to 15 lb. per sq. in. at exit, should generally be applied. Time can be saved, however, and the discomfort of long decompression reduced, if a small proportion of compressed-air illness is accepted.

It is understood that the Admiralty diving tables were compiled to provide a final solution pressure of nitrogen in the tissues corresponding to 18 lb. per sq. in. gauge pressure of air. Figure 3 is typical of a number of cases checked, in which only slight variations were found. Haldane's table for decompression in air-locks, reproduced as Table I, gives consistent values of the same order. The proportion of unsuccessful decompressions experienced in the use of both is said to be small, but no numerical records can be found.

Much higher values have been applied in American work. It is reported by Sir Henry Japp<sup>1</sup>, who introduced stage decompression in New York in 1908, during the construction of the Pennsylvania Railroad East River Tunnels, that the "nitrogen pressure in the blood" (meaning its air equivalent), was regulated to 27 lb. per sq. in. on emergence. At 40 lb. per sq. in. working pressure, the method gave 139 cases in 8,510 decompressions, or 1.63 per cent. In 1909 he recommended 25 lb. per sq. in. as a standard for general adoption.

The modified stage method used in America to-day has been developed over a number of years in the State of New York, without apparent theoretical guidance. The regulations made have been altered, from time to time, in the direction of safety. The present code and its forerunner, which is widely retained by authorities outside New York, are summarized in Table II. The results of analyses given, though irregular, indicate an approach to Haldane's standard in the amended code.

Dr. Levy's records,<sup>2</sup> taken from the Public Service Commission tunnels which were driven under the East River between 1914 and 1919, show a high degree of immunity from an adaptation of the former New York code. Only 680 cases resulted from 1,361,461 decompressions, equal to 0.05 per cent. The adjustments of procedure which were made to meet the special requirements of tunnelling work are incompletely described however, and a better knowledge of the conditions would be needed to analyse the protection given.

Australian experience in the foundations of the Grey Street Bridge is analysed in Table III. Values of  $p$  at exit, calculated from the records, are shown beside the percentages of compressed-air illness which occurred.

In the case of the Story Bridge, the six shallow foundations, which were air-locked first, were made the subject

<sup>1</sup>"Caisson Disease and its Prevention" by Henry Japp, *Trans. Amer. Soc. C.E.*, Vol. 65, 1909.

"The Prevention of Compressed Air Sickness," by Sir Henry Japp. *The Structural Engineer*, March and July, 1935.

<sup>2</sup>"Compressed-Air Illness and its Engineering Importance," by Edward Levy, U.S. Bureau of Mines, Technical Paper 285, Washington, 1922.

TABLE II.  
ANALYSIS OF AMERICAN REGULATIONS

Code	Working pressure, lb. per sq. in.	Working periods, hours			Assumed time of compression, minutes	Time of decompression, minutes*	Calculated value of $p$ , lb. per sq. in., after		
		First shift	Rest	Second shift			First shift	Rest	Second shift
Various, based on old New York code.	22	4	½	4	3	14.7	18.3	13.6	19.2
	29	3	1	3	4	19.3	22.3	12.2	23.0
	34	2	2	2	5	34	20.7	6.4	21.0
	40	1½	3	1½	5	40	21.2	3.7	21.2
	45	1	4	1	6	45	20.0	2.1	20.0
	50	¾	5	¾	6	50	19.2	1.0	19.2
New York	18	4	½	4	3	9	16.1	11.6	16.4
	26	3	1	3	4	17.3	20.5	10.8	20.9
	33	2	2	2	5	33	20.3	6.2	20.4
	38	1½	3	1½	5	38	20.5	3.5	20.6
	43	1	4	1	5	43	19.4†	1.8	19.4†
	48	¾	5	¾	6	48	18.7	1.0	18.7
	50	½	6	½	6	50	16.5	0.5	16.5

\*Decompression to one-half the maximum gauge pressure at the rate of five pounds per minute, and the remainder at a uniform rate.  
†See Fig. 8.

of experiment. By the use of graphs compiled from the theory the index was varied between 15 and 23 lb. per sq. in. In 1422 decompressions, 15 cases of compressed-air illness arose, generally following the use of higher values, when the symptoms were also more severe. The observations were consistent with Haldane's definition of the safe limit as 19 lb. per sq. in.

In Pier 28 W, a constant final value of 18.5 lb. per sq. in. was applied and 0.77 per cent. of recompressions were required. In the three remaining foundations, the index was reduced to 18.0 lb. per sq. in., and the number of cases was close to 0.5 per cent. in each case, as shown in Table IV.

Later work was carried out in Brisbane in the Pinkenba sewer, between November, 1940, and March, 1941, at a working pressure from 22 to 23 lb. per sq. in. The decompression was adjusted to secure a final value of 16.0 lb. per sq. in., and compressed-air illness was reduced to two minor cases in 771 decompressions, or 0.26 per cent.

Figure 7 has been plotted from the theory, to a constant index of 18.0 lb. per sq. in., in a form convenient for general use. Under conditions similar to those which existed in the works described, about one half per cent. of cases, with few severe symptoms, can be expected from its use.

When greater protection is desired, the time of decompression may be adjusted, but no purpose could be served by reducing the value of  $p$  at exit below 15 lb. per sq. in.

#### PRESSURE LIMITS

Figure 7 covers working pressures up to 60 lb. per sq. in. above the atmosphere.

The pressure which men can sustain with safety is limited by the toxic effect of the oxygen<sup>1</sup> in highly compressed air. Its concentration is not sufficient for this to appear within the present range of construction work.

In the Admiralty diving tables, which are known to be safe, ordinary procedure is specified to a depth of 204 ft. or 91.5 lb. per sq. in. Additions recently made provide for descents of 300 ft. by the use of special apparatus in which an oxygen respirator is employed in decompression to reduce the period.

#### THE EFFECT OF DOUBLE SHIFTS

More often than not, the workmen's day is divided into two shifts, with a period of rest between them. At the commencement of the second shift the tissues contain residual excess nitrogen which affects their subsequent condition. Thus, their nitrogen content at the conclusion is greater than it was at the end of the first shift.

Table II shows the calculated values of  $p$  at the end of

<sup>1</sup>See Chapter IX of *Caisson Sickness* by Dr. Leonard Hill, published by Edward Arnold, London, 1912.

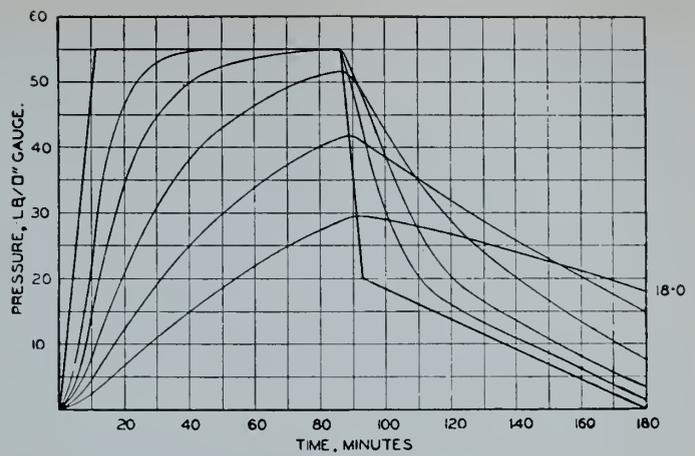


Fig. 6—True Stage Decompression used on the Story Bridge.

both periods under the American codes. An extract is extended graphically in Fig. 8. In general it can be seen that the difference is very small.

In both the Grey Street and Story Bridge foundations, two shifts were worked daily at six hours sequence. Analysis showed that the increase in the solution pressure of nitrogen at the end of the second shift, compared with the first, was negligible.

#### RATE OF CIRCULATION

In the development of Haldane's theory and the analyses made by its use, a constant rate of blood-circulation has been assumed.

It is known that the normal rate may be increased as much as ten times<sup>1</sup> by strenuous exercise. Whilst so large a variation is not to be expected in the course of ordinary work, nevertheless some difference must arise between the periods spent at work and under decompression.

The workmen are usually urged to exercise themselves in the air-locks, to increase the value of the decompression.

Apparent discrepancies in different sets of records, as well as the notably erratic proportions of compressed-air illness experienced from day to day, may be accounted for to some extent by variations of physical activity.

#### REPORT OF THE INSTITUTION OF CIVIL ENGINEERS

The Report of the Committee of The Institution of Civil Engineers, already mentioned, gives practical rules for the supervision of work in compressed air. The main feature is its table of stage decompression, of much wider application than anything published before.

<sup>1</sup>*Caisson Sickness* by Dr. Leonard Hill, published by Edward Arnold, London, 1912.

TABLE III.  
GREY STREET BRIDGE RECORDS

Working pressure, lb. per sq. in.	Time of compression, minutes	Period of work at face, hours	Time of exposure to working pressure, hours*	Time of decompression, minutes†	Calculated value of $p$ at exit, lb. per sq. in.	Cases of compressed-air illness recorded, number per cent. of decompressions
37	18.5	2	2¼	51	20.8	1.2 per cent. of 1,890
41	20.5	1½	1¾	58	20.3	0.0 per cent. of 1,458
45	22.5	1½	1¾	64	21.6	0.9 per cent. of 1,236
47	23.5	1½	1¾	67	22.4	1.1 per cent. of 1,462
48	24	1½	1¾	69	22.7‡	2.9 per cent. of 1,135
					Total	1.1 per cent. of 7,181

\*To the periods worked at the face, ¼ hour has been added for the time occupied in changing shifts.

†Decompression to one half the maximum gauge pressure at the rate of 2 lb. per min., then five pounds at the rate of 1 lb. per min., then five pounds at the rate of ½ lb. per min., then to atmospheric pressure at the rate of ½ lb. per min.

‡See Fig. 10.

Obviously the table has been compiled by the use of Haldane's theory, but the method of its compilation is not recorded.

When the Report became available in 1936, the investigations undertaken in Brisbane were already well advanced. They were completed independently, with closely parallel results. Difference arose, however, on several points.

It can be shown that the decompression table provides varied values of the final pressure index, from about 18 lb. per sq. in. for high working pressures, which is quite satisfactory, to 22 lb. per sq. in. when the working pressures are low. The protection afforded at low working pressures, in terms of the theory, therefore appears inadequate. The meagre explanatory notes included, fail to establish the safety of the departure made.

Discretionary curtailment of the decompression period is suggested in the Report, provided the number of cases requiring recompression in any one week is not allowed to exceed 2 per cent. Observations show that more than one per cent. makes excessive demands upon the medical staff and may cause anxiety amongst the men.

The fixed period of two minutes specified for the rapid stage of decompression, is more logical than the nominal rate applied in Brisbane. In view of local experience, however, it appears too fast. For average workmen the time might well be doubled.

#### CONTROL OF DECOMPRESSION

In the pressure gauges attached to the locks, accurate calibration is necessary. All gauges should be tested throughout the working range.

The air-locks used on the Story Bridge were operated by attendants stationed outside. By way of instruction to them and to assist operation, a decompression dial was provided at each air-lock, mounted near a clock beside the pressure gauges. Each dial consisted of a fixed card marked like the face of a clock, with a disc pinned in the centre

on which the course of decompression had been plotted. Its starting point is set by rotation to match the minute hand of the clock, which then indicates the gauge readings required. The inner disc must be changed with an alteration of working pressure or time of exposure, and a number should be kept on hand to cover possible variations.

#### RECOMPRESSION

It has long been known that the symptoms of compressed-air illness usually disappear on return to work. This led to the use of recompression for treatment, and it is still the only effective remedy known. The pioneer of the subject was Sir Ernest Moir, a British engineer, by whom the first medical air-lock was built.

All works of any consequence are now equipped with a medical lock. A steel cylinder is divided by a bulkhead into two compartments. Each is fitted with an air-tight door, two bunks, glass ports for observation and a "medicine-lock" for the transmission of packages from the outside. The bunks are provided with blankets to keep the patients warm. The valves and gauges for controlling the pressure are located outside the lock.

In an emergency, recompression may be carried out with confidence by anyone acquainted with its principles. Medical supervision of the patients and their treatment is generally desirable, however, because the diagnosis is sometimes uncertain and complications may arise requiring direct medical aid.

The pressure should be increased rapidly to its original working level, despite the disappearance of symptoms before it is reached. Some authorities recommended a pressure above the original, but this may not be possible when the lock is supplied with air from the same source as the works.

Recompression usually gives complete relief at once. The effect is less marked, however, when its application is delayed until the tissues have been actually damaged.

TABLE IV.  
STORY BRIDGE RECORDS

Foundation	Date of work	Working pressure range, lb. per sq. in.	Time of compression, minutes	Period of work at face, hours	Time of exposure to working pressure, hours*	Time of decompression, minutes	Value of <i>p</i> at exit, lb. per sq. in.	Number of decompressions	Cases of compressed-air illness recorded	Cases per cent. of decompressions
25 W	15/6/36 23/6/36	24 30	5 6	1½	1¾	Varied	Varied 15 to 23 lb. per sq. in.	233	6	2.6
25 E	30/6/36 4/7/36	22 28	4 6	1½	1¾			196	0	0.0
27 W	13/7/36 18/7/36	35 40	7 8	1½	1¾			247	6	2.4
27 E	20/7/36 25/7/36	40 42	8 8	1½	1¾			228	3	1.3
26 W	27/7/36 4/8/36	22 27	4 6	1½	1¾			287	0	0.0
26 E	5/8/36 12/8/36	26 32	5 6	1½	1¾			231	0	0.0
28 W	12/8/36 8/9/36	38 42	8 8	1½	1¾	48 62	18.5	908	7	0.77
28 E	24/8/36 3/9/36	40 44	8 9	1½	1¾	57 71	18.0	531	3	0.56
29 E	23/2/37 15/4/37	50 55	10 11	1	1¼	77 94	18.0†	4,403	23	0.52
29 W	29/4/37 1/6/37	50 57	10 11	1	1¼	77 103	18.0	3,813	17	0.45
							Totals	11,077	65	0.59

\*To the periods worked at the face, ¼ hour has been added for the time occupied in changing shifts.

†See Fig. 11.

Relief is brought about by a reduction of the bubbles in size. For permanent results they need to be redissolved. To this end the pressure may be maintained for twenty minutes, more or less, according to the method followed. In the Admiralty practice, decompression is commenced at once, provided all symptoms have disappeared, but the rate is so slow that the result is practically the same. Tables of rates for various conditions are given in the *Diving Manual*. Even if the working pressure has been maintained for a period, a reduced rate of decompression should be applied, with particular caution as atmospheric pressure is approached.

Most patients can be cured completely, but the symptoms sometimes recur and treatment has to be repeated. In such cases the rate of decompression should be further reduced.

Late treatment is the principal cause of failure. The workmen should be warned, therefore, to report suspected symptoms at the earliest opportunity.

The breathing of oxygen from a respirator in the medical lock is a recognized means of assisting the cure, at present not widely used.

#### GENERAL PRECAUTIONS

Susceptibility to compressed-air illness varies with individuals and conditions. Unsuitable men should be eliminated by medical examination and, wherever possible, the health of the workmen should be placed under medical supervision.

The air-locks should be protected from extremes of temperature and reasonable facilities provided in and about the works to reduce discomfort and fatigue. Proper dressing sheds, with hot shower-baths are necessary. In Queensland hot coffee is supplied to each shift after decompression.

Certain standards must be satisfied in the supply of compressed air.

#### SUPPLY OF COMPRESSED AIR

Fresh air contains about 0.03 per cent of carbon dioxide. An increase to 3 per cent is hardly noticeable at atmospheric pressure, resulting only in deeper breathing than usual. Greater proportions cause distress and ultimately lead to suffocation.<sup>1</sup> Concentration has the same effect, whether brought about by an increased percentage at atmospheric pressure or by raising the pressure of the air. Thus, the safe partial pressure in the atmosphere should not be exceeded in compressed air.

The breathing of one person produce 0.014 to 0.045 cu. ft. of carbon dioxide per minute, measured at atmospheric pressure, for respective conditions of rest and work.<sup>2</sup> In the case of divers, the only source of increase is their breathing. To prevent the concentration in the helmet of a diver at work, from rising above 3 per cent. of an atmosphere, air must be supplied at the rate of  $0.045/0.03 = 1.5$  cu. ft. per min., measured at the working pressure. This is the quantity specified for Admiralty divers.

Haldane suggested that in caissons and tunnels, to make the effects of carbon dioxide "practically inappreciable," its partial pressure should not be allowed to exceed 1 per cent of an atmosphere. To provide for the breathing of the persons present, a minimum ventilation of 5 cu. ft. per man per minute, measured at the existing pressure, would suffice if the air were properly distributed.

In practice a larger supply is needed to overcome uneven distribution in the working chamber and to remove additional quantities of carbon dioxide, as well as carbon monoxide and other poisonous gases, introduced from various sources. Wastage of air through the material locks and elsewhere must also be replaced.

<sup>1</sup>See "The Hygiene of Work in Compressed Air," by J. S. Haldane, M.D., F.R.S., *Jour. of the Royal Society of Arts*, Vol. 56, 1907-8.

<sup>2</sup>See *The Diving Manual*, 1936, p. 28.

On the Story Bridge works, provision was made to supply at least 12.5 cu. ft. of compressed air per man per minute to the working chambers and 5 cu. ft. per man per minute to the man-locks. At Pier 29, where the maximum conditions occurred, 10 men were located at one time in the working chamber and 10 (to 20) men in the locks. Therefore, the requirements were  $(10 \times 12.5) + (10 \times 5) = 175$  cu. ft. per min., measured at the working pressure of 54 lb. per sq. in. In terms of "free air" i.e. air measured at atmospheric pressure, the volume was— $175 \times 69/15 = 805$  cu. ft. per min.

Air was supplied by three compressors each 13 in.  $\times$  14½ in., of displacement 570 cu. ft. per min. Their individual output was 450 to 500 cu. ft. of free air per minute. Two were kept at work under ordinary circumstances and the third, acting normally as a standby, was also brought into commission after explosives had been fired in the working chamber, to assist in clearing away the fumes. Smaller machines supplied high-pressure air for operating pneumatic tools.

The compressors were driven by electric motors. No standby source of power was installed because the risk of interruption was remote, and the quantity of air stored in the working chamber and receivers was always ample for the safe withdrawal of the men. The one failure which occurred caused no anxiety and little inconvenience.

The main supply of compressed air was delivered into each man-lock shaft, just below the man-lock, to ensure the

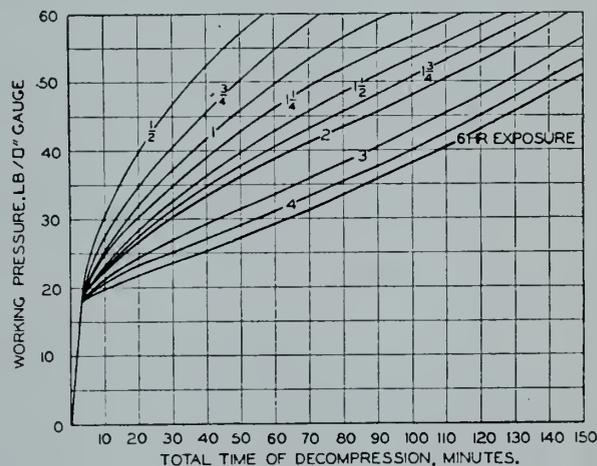


Fig. 7—Decompression Chart, for  $p = 18.0$  lb. per sq. in. at exit.

distribution of fresh air to vital points. From the inlet it had to pass down the man-lock shaft shown in Fig. 2, to the working chamber, or else through a by-pass pipe and valve to the man-lock. From the working chamber sufficient air for ventilation was generally exhausted under the cutting edges and a certain amount passed upwards through the material-locks, whenever they were operated. Below each material-lock a safety valve was fitted, to provide against blockage at the cutting edges, and an exhaust valve for blow-down purposes.

The quality of the air is important, and the intake should be arranged to secure a clean supply. Contamination in the compressors should be reduced by the use of good machines and selected lubricants. Facilities for removing oil from the compressed air should also be provided. On the Story Bridge works an "after-cooler" of tubular type was used. When the compressed air is chilled by circulating water, most of the oil it contains is carried off with the moisture condensed.

The efficiency of the workmen is affected by the temperature, humidity and movement of the air, which constitute "air-condition." The temperature can be controlled to some extent. The humidity cannot be reduced much below saturation by any practicable means, but appreciable movement can be induced by the system of

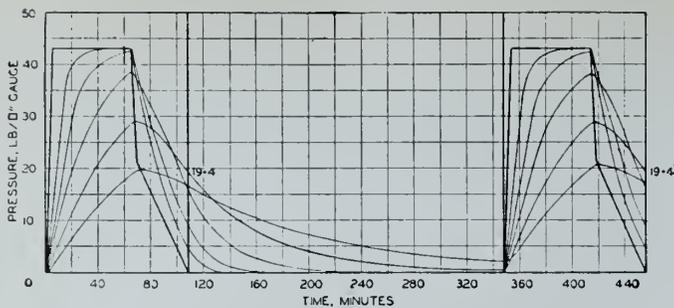


Fig. 8—Double Shifts, under the New York Code.

ventilation already described. Air condition in the working chambers of the Story Bridge foundations was checked by the medical staff from time to time. In Pier 29 E, fourteen sets of readings taken during the day and night, under different conditions of external weather, showed little variation. The wet-bulb and dry-bulb registrations were practically identical, ranging from 76° to 80° F., with an average of 78.7°. The mean velocity of the air, determined from readings of the kata thermometer, was 145 ft. per min. The conditions, though severe, are within the limits endorsed by authorities<sup>1</sup> for industrial operations.

#### CONCLUSION

The preparation of this paper was prompted by the fact that the theory of stage decompression has not previously been developed in engineering literature. Its proper use has been restricted to diving, whilst in construction work it has been regularly misapplied.

There appears no ground for departure from the principles established by Dr. Haldane.

#### APPENDIX

*Report on Workers in Compressed Air during the Construction of Piers 29 East and 29 West of the Story Bridge—between 22/2/1937 and 4/6/1937.*

Messrs. M. R. Hornibrook (Pty.) Ltd.,  
BRISBANE.

Dear Sirs,

I have pleasure in presenting this report on certain medical aspects of the work done on piers 29 east and west, under compressed air;

- |  |       |
|--|-------|
| 1. Total number of persons entering Caisson..... | 159   |
| 2. Total number of decompressions.....           | 8,216 |

<sup>1</sup>The American Society of Heating and Ventilating Engineers, Guide, 1936.

- |  |                       |
|--|-----------------------|
| 3. Cases of sickness treated in Hospital Lock<br>(Group I).....            | 40 = 0.49%            |
|  | of all decompressions |
| 4. Cases with symptoms re-entering man-locks for relief<br>(Group II)..... | 27 = 0.33%            |
|  | of all decompressions |

I do not think that the cases in Group II have previously been listed in figures published for work in compressed air, and believe that only cases of such severity as those in Group I were recorded. If this is so we may fairly compare the cases in Group I alone, with previous figures.

Doing this we find that the freedom from compressed air illness during this work compares quite favourably with that in other large works elsewhere, in spite of a mean pressure some 10 to 15 lb. per square inch higher. The mean pressure here was approximately 52 lb. per square inch.

*Age.*—The mean age of all men entering the locks differed by so little from the mean age of the men included in Group I that we may fairly say—that there is no evidence that in carefully selected workers, caisson sickness is any more common among older men. The oldest person entering the caisson was in his sixtieth year and he made a large number of descents without mishap.

Older men with previous experience of this work, appear to fare better than younger workers without experience.

*Treatment of Sickness.*—I believe that the sufferer should be compressed to the working caisson pressure as soon as possible and there maintained for thirty minutes. Decompression is on the same principle employed in the working locks but twice as long is taken in lowering from one half absolute to atmospheric pressure.

A second decompression does not seem worthwhile unless the recurrence of symptoms is severe. Other methods of making the patient more comfortable seem to be more effective. If severe symptoms do recur, recompression should certainly be employed a second and even a third time.

*Health of the Workers.*—There is no evidence that any worker was permanently injured, with the exception of one man, in whom deafness may be due to this work.

More shifts were missed as the result of other sickness as the weather became colder, and it would seem sound both from an economic and an humanitarian viewpoint, to arrange that future work of this kind is done as far as possible during the summer months.

*Working Conditions.*—These were investigated with Wet and Dry Kata thermometers.

In the working chamber, temperatures were quite satisfactory in relation to the excellent ventilation provided. The value of the after-cooler in removing oil and excess water from the air supply is undoubted. I do not think that any improvement can practicably be expected here.

Trying extremes of temperature were experienced by workers in the locks whilst entering and leaving the caisson. It should be well worth while testing the value of some method of overcoming this—by wet bagging in summer and a coil of steampipe in winter, for example.

I trust that this will be of some value to you in the future.

Thanking you for your co-operation and assistance,

I am,

Yours faithfully,

(Signed) KEITH A. MOORE,  
Medical Officer.

7/6/1937.

# REGULATIONS AFFECTING THE CONSTRUCTION INDUSTRY

At the request of the Controller of Construction, we are pleased to reproduce Order No. 12, issued last month, regulating the use of material in the construction of ALL BUILDINGS IN CANADA. Appended to this order is certain information which may be useful to engineers in the construction industry.

It should be noted that the following order does not in any way alter the licensing requirements and licenses must be obtained from the Controller of Construction as required, nor does this order relieve any person from the necessity of complying with the provisions of any other applicable order or regulations of any controller or administrator.

Warning is given that when projects are being planned which will require the use of any materials or equipment whose source of origin is the United States, the Priorities Office of the Department of Munitions and Supply in the locality or in Ottawa should be consulted as soon as possible. Unless this is done promptly, serious delays may be encountered in ascertaining whether such supplies are or can be made available.

## CONTROLLER OF CONSTRUCTION

### Order No. 12

#### (CONSTRUCTION MATERIALS—CONSERVATION)

Dated September 22, 1942

The increasing demands of the war, and transportation difficulties arising therefrom, have seriously affected the available supply of certain materials essential to the war effort. Great Britain and the other United Nations are looking to this country for increasing supplies of raw materials and goods and in other materials Canada must look to the United States for a larger percentage of her requirements. It is imperative, therefore, that the use of all such materials be curtailed where not absolutely essential. Certain of these materials are, in normal times, used in the construction of buildings and in most cases, substitutes are available in other materials.

Therefore, pursuant to the powers vested in the Controller of Construction by Order in Council P.C. 660, dated the 30th day of January, 1942, and by any other enabling Order in Council or Statute, and with the approval of the chairman of the Wartime Industries Control Board, and the concurrence of the Steel Controller, the Metals Controller, the Oil Controller, the Timber Controller, the Controller of Supplies, and the Co-Ordinator of Metals Administration,

I HEREBY ORDER AS FOLLOWS:

1. In the construction, repair, alteration of, or any addition to, any of the following:

- Dwellings,
- Apartment buildings,
- Office buildings,
- Warehouse buildings having floors for load not exceeding 200 pounds per square foot,
- Stores, show rooms or other buildings for trade purposes,
- Theatres, halls or other buildings for amusement or recreational purposes,
- Churches or ecclesiastical buildings,
- Schools or educational buildings,
- Administrative buildings or institutions (except hospitals),
- Hotels,
- Clubs,
- Museums or galleries,
- Libraries,
- Banks or other buildings for financial purposes,
- Funeral parlours,
- Farm buildings or stables,
- Storage buildings, sheds or outbuildings,

(a) THE FOLLOWING MATERIALS MUST NOT BE USED:

1. Structural steel (including window lintels),
2. Steel stairs (including fire escapes),
3. Steel siding or roofing (including galvanized iron or steel) except for flashings,
4. Metal sash, doors, trim or furring,
5. Steel or iron railings,
6. Metal lath (except for reinforcing at joints and corners),
7. Stainless steel in any form (except fully manufactured articles),
8. Aluminum or aluminum alloys,
9. Copper or brass tubing or pipe,
10. Copper or brass alloy—sheet or plate (including flashings, downpipes, etc.),
11. Copper or copper alloy extruded shapes,
12. Copper or copper alloy screening,
13. Sheet zinc,
14. Nickel or nickel alloys in any form (except nickel plated articles),
15. Metal lockers and furniture,
16. Metal bins, partitions and shelving,
17. Rubber in any form including reclaim (except manufactured articles),
18. Cork in any form (except manufactured articles),
19. Tin or tin alloys (excluding solder),

AND

(b) The following materials must be conserved in use to the greatest possible extent:

1. Reinforcing steel,
2. Steel piping,
3. Cast iron piping,
4. Galvanized iron,
5. Copper wiring,
6. Lead or lead alloys in sheet form,
7. Linoleum,
8. Douglas fir timber,
9. Douglas fir plywood,
10. All imported hardwoods,
11. Asphalt paving, roofing, flooring.

2. For the construction, repair or alteration of, or any addition to, factories, hospitals, warehouses having floor for load exceeding two hundred pounds per square foot, manufacturing plants, munition plants, shipyards, power plants, mines, processing plants, public utilities, and all other structures not included in Section 1 of this Order:

(a) THE FOLLOWING MATERIALS MUST NOT BE USED:

1. Steel plate roofing,
2. Steel stairs,
3. Metal sash,
4. Steel plate flooring,
5. Steel and iron railings,
6. Metal doors and trim (except kalamein doors where fire hazard exists),
7. Metal partitions, bins, lockers or shelving,
8. Metal furniture or counters,
9. Aluminum or aluminum alloys,
10. Copper or copper alloy roofing, flashings or downpipes,
11. Copper or copper alloy extruded shapes,
12. Sheet zinc,
13. Tin or tin alloys in any form (excluding solder),
14. Rubber in any form including reclaim (except manufactured articles),

AND

(b) The following materials must be conserved in use to the greatest possible extent:

1. Structural steel (including window and door lintels),
2. Reinforcing steel,
3. Metal lath,
4. Copper or copper alloy sheet, pipe and wiring,
5. Copper or copper alloy screens,
6. Nickel and nickel alloys in any form (excluding nickel plated items),
7. Lead or lead alloys in sheet form,
8. Cork in any form (except manufactured articles),
9. Douglas fir plywood,
10. Structural Douglas fir timbers,
11. All imported hardwoods,
12. Asphalt for paving, roofing or flooring.

3. The design of all buildings must be economical in the use of all building materials. Wiring must be planned to use the least possible conduit, copper wire, bus bars and connections. Heating must be planned for the least possible use of piping. Location of lavatories, kitchens, etc., must be so placed that the least possible drainage connection and water connection is required.

In dwellings or apartment houses, location of bathrooms, kitchens and laundries must be planned so that only one cast iron sewage stack will be required for each self-contained dwelling place.

4. The Controller of Construction may vary the provisions of this Order, add other materials and things to the above lists or exempt any construction or use of construction materials from the prohibitions of this Order where he shall deem it advisable.

5. This Order does not in any way affect or modify any Order of the Steel Controller, the Metals Controller, the Oil Controller, the Timber Controller, the Controller of Supplies, or the Administrator of Fabricated Steel and Non-Ferrous Metals, and any Order for permission for use, or prohibition of use, given or made by any of them within his jurisdiction will supersede and govern over the requirements of this Order.

6. This Order shall come into effect on the date hereof.

C. BLAKE JACKSON (Signed)  
*Controller of Construction.*

Approved

R. C. BERKINSHAW (Signed)  
*Chairman, Wartime Industries Control Board.*

NOTE: Any correspondence with regard to this Order should be addressed to the Controller of Construction, Department of Munitions and Supply, 85 Richmond Street West, Toronto, Ontario.

#### THE CONTROLLER APPENDS THE FOLLOWING FOR THE GUIDANCE OF THE CONSTRUCTION INDUSTRY

The use of the following materials are under direct control of controllers or administrators as noted:

*Steel*—structural, reinforcing, plate and shapes—new or second hand. Regardless of other requirements permit must be obtained for use, regardless of ownership, from:

The Steel Controller,  
Department of Munitions and Supply,  
Ottawa.

*Cast Iron Pipe and Steel Pipe* not including cast iron soil pipe. Regardless of other requirements permit must be obtained from:

The Steel Controller,  
Department of Munitions and Supply,  
Ottawa.

*Public Utility Extensions* to serve new construction (such extensions must be made to existing leads, lines or mains). Permits must be obtained by public utility from:

The Metals Controller,  
Department of Munitions and Supply,  
Ottawa.

*Copper or Brass Pipe*—Cannot be used except with special permission of:

The Metals Controller,  
Department of Munitions and Supply,  
Ottawa.

*Manila Rope*—Use prohibited by:

The Controller of Supplies,  
Department of Munitions and Supply,  
Ottawa.

*Rubber*—Use of crude, reclaim and scrap rubber prohibited by:

The Controller of Supplies,  
Department of Munitions and Supply,  
Ottawa.

(Manufactured articles, if already in stock, may be used.)

*Metal Lockers, Metal Bins, Metal Shelving, Metal Counters, Metal Partitions*, under control of:

The Controller of Supplies,  
Department of Munitions and Supply,  
Ottawa.

*Refrigeration, Air-Conditioning and Comfort-Cooling Equipment*—Cannot be installed except on permit from:

The Controller of Supplies,  
Department of Munitions and Supply,  
Ottawa.

*Cork*—Ground cork for insulation purposes or cork insulation board cannot be used except by special permission of:

The Controller of Supplies,  
Department of Munitions and Supply,  
Ottawa.

*Gas Heating*—Use of gas for heating restricted in certain areas. Refer to:

The Power Controller,  
Department of Munitions and Supply,  
P.O. Box 2400, Place d'Armes,  
Montreal.

*Oil Heating Equipment*—Installation prohibited except by special permission of:

The Oil Controller,  
Department of Munitions and Supply,  
15 King Street West,  
Toronto.

*Asphalt*—The use of asphalt for construction or maintenance of any roof or road is prohibited except by permit from:

The Oil Controller,  
Department of Munitions and Supply,  
15 King Street West,  
Toronto.

*Coal Tar*—The use of coal tar for construction or repair of public or private roads is prohibited except by permit from:

The Controller of Chemicals,  
Department of Munitions and Supply,  
Ciba Building,  
1235 McGill College Ave.,  
Montreal.

*Commercial Electric Lighting*—Replacement or renewal of existing commercial or industrial lighting fixtures or lighting installations cannot be undertaken without permission of:

Mr. A. L. Brown,  
Administrator of Electrical Equipment  
and Supplies,  
Wartime Prices and Trade Board,  
Aldred Building,  
Montreal.

*Metal Sash*—Cannot be used except with permission of:

Mr. H. H. Foreman,  
Administrator of Fabricated Steel and  
Non-Ferrous Metals,  
Wartime Prices and Trade Board,  
Toronto General Trust Building,  
Toronto.

The above list is not necessarily complete and changing conditions will no doubt bring other materials under special permit. This is issued for guidance only.

*Order No. 1 of W.I.C.B.* requires compliance with the terms of U.S. Preference Rating Orders or Certificates.

*Order No. 2 of W.I.C.B.* makes conditions as to use of goods or services or surplus goods or supplies obtained under permit or order of any Controller.

#### CONSTRUCTION CONTROL LICENSES

This Order does not alter or affect the licensing requirements as required by Order in Council P.C. 660/42 and Orders of the Controller of Construction.

Applications for licenses where required must be made on required forms to:

The Controller of Construction,  
Department of Munitions and Supply,  
85 Richmond Street West,  
Toronto, Ont.

Applications for projects in Province of British Columbia *only* should be submitted to:

Mr. R. J. Lecky,  
Secretary, B.C. Construction Control  
Advisory Committee,  
342 West Pender Street,  
Vancouver.

Applications for construction of, repair of, or equipment installations to Grain Storage Warehouses in the Prairie Provinces *only* should be submitted to:

The Chairman,  
Grain Warehouse Construction Control  
Advisory Committee,  
423 Main Street,  
Winnipeg.

#### SUGGESTIONS FOR THE CONSERVATION OF MATERIALS

*Lintels*—Over doors or windows: brick or stone arch or precast concrete beam.

*Load Bearing Framing*—Timber mill construction, with laminated wood floors where necessary to suit load, or where semi fireproof construction necessary.

*Roof Framing*—Timber. When long span required use timber truss. Experts on design should be consulted.

*Roofing*—Avoid whenever possible the use of petroleum asphalt owing to the shortage of petroleum products.

*All Wood Framing*—Use the smallest sizes possible giving necessary strength. Avoid the use of B.C. fir and other western timber where possible.

*Terrazzo Floors*—Use plastic, stone or marble divider in place of metal.

*Sash*—Use wood sash. Avoid the use of steel sash.

*Chimney Stacks*—Avoid the use of metal. Radial Brick for large stacks. Owing to restrictions on electric and gas stoves, chimney facilities for kitchen should be considered.

*Flashing*—Use galvanized iron except around drainage stacks which should be sheet lead.

*Drainage Pipes*—Use glazed tile underground except where soil conditions preclude its use. Interior stacks should be the lightest weight allowed by local by-laws. Careful

planning can reduce the amount of pipe required. Cast iron and steel pipe must be conserved.

*Water Pipes*—Plumbing must be carefully planned to use the least amount of galvanized steel pipe possible. Copper or brass pipe cannot be used except with special permission of the Metals Controller.

*Heating*—Boilers: use cast iron where possible rather than steel. Radiators must be cast iron. The use of copper fin type radiators must be avoided. Piping must be planned to use the least amount of pipe by weight possible.

*Domestic Hot Water Tanks*—The smallest size that will serve requirements must be used. No copper or copper alloy tanks can be used.

*Wiring*—Wiring must be planned to use the minimum amount of copper wiring. The use of conduit and BX cable must be avoided where possible. Knob and tube work should be used wherever possible. Switching and fusing should be so planned to use the least possible number of switch boxes. Outlets not immediately necessary should be marked for installation after the war.

*Kitchen and Bathroom Fittings*—Avoid the use of Monel metal, stainless steel, copper, zinc or aluminum except for faucets and drain connection.

*Nickel and Nickel Alloys*—Avoid the use of any nickel or nickel alloys.

*Reinforcing*—Reinforced concrete for foundations or footings must not be used except when ground conditions make its use imperative. Concrete work should be increased in thickness to preclude the use of steel reinforcing. Reinforced structures must be planned so as to use more concrete and less steel reinforcing. The Portland Cement Association have made studies of such problems and their data should be consulted.

*Weather Stripping*—Use felt or wool type or storm windows. The use of copper weather stripping must be avoided.

*Plywood*—The use of B.C. fir plywood should be avoided where possible.

*Screens*—Use black iron screens or cloth screens.

*Insulation*—Use rock wool, glass fibre or fibre boards. The use of cork should be avoided.

*Public Utilities*—Construction should be planned in locations where electrical, telephone, gas, water and sewage facilities are already constructed. The extension of such facilities are under control and will be curtailed except for essential war projects.

*General*—There is at this date no serious shortage of the following materials and these should be substituted for others where possible:

Stone,  
Brick,  
Cement,  
Concrete (not reinforced),  
Tiles,  
Glazed or unglazed tile pipe and flue lining,  
Wood shingles,  
Asbestos,  
Sand and gravel,  
Plaster,  
Plaster Board,  
Stucco—but use of wire lath must be avoided,  
Fibre boards,  
Glass—except bottle glass,  
Rock wool.

The changing conditions may make the supply of the above materials difficult locally or generally at any time, and local supply should be checked with suppliers before starting construction.

# Abstracts of Current Literature

## ENGINEERS IN THE ARMY

From *The Engineer*, LONDON, ENG., AUGUST 21, 1942

In 1923 Lord Weir recommended that all the mechanical engineers in the many corps or branches of the Army should be amalgamated and incorporated in the Corps of the Royal Engineers, which, in any country less illogical than ours, would be taken to mean the engineers to the Army. His advice was not followed. Some five or six years later, Lord Milne, when Chief of the General Staff, presided over a committee to consider a similar proposition, of which he himself was in favour. The proposal was again rejected, largely no doubt because the Army Council had no senior engineer who could advise it regarding the implications of such a momentous change. Hence, when preparations were made in earnest for a mechanical war which could be averted only by a miracle, the Army found itself without a unified engineering organization, and with no mechanical engineer in a sufficiently high position to give the necessary authoritative advice direct to the Army Council. No doubt Lord Weir foresaw this difficulty in 1923, and it is safe to state that had his advice been accepted then, it would not have been necessary for Sir Ronald Charles to deplore, as he did in a recent letter to *The Times*, the great paucity of the engineering staff at his disposal when he was Master-General of Ordnance at the War Office.

From debates in Parliament it is obvious that Members of both Houses have felt uneasy that engineers and scientists are not being utilized to the best advantage by the Army, and as shown in our leading article on this subject in our issue of June 12th, it is clear that the Army has lagged far behind in granting recognition to the overwhelmingly increased importance of engineering in general and its engineers in particular. Had it been more receptive of this new idea, the lead we had in aggressive tank warfare in 1918 might well have been maintained twenty years later when the present world war began. Entirely new mechanized equipment was clearly a very expensive item in rearmament, and doubtless Hitler traded on the fact that his potential opponents throughout Europe would be chary of laying down sufficient sums of money to counter his expenditure on Panzer troops. In the very early days of warfare, the soldier was fairly well self-contained. Given his food and drink, the weapon in his hand was his main standby. As, however, time passed, more and more did he become dependent on fresh supplies sent up from some base to replenish the evergrowing weight of missiles being launched by him and to make good the wastage of his heavy equipment in the course of battle. Thus the engineering problems have increased out of all knowledge, but the recognition of the importance of the engineer has not kept pace with the desired provision, nor has he been given the requisite status to enable him to pull his full weight in the time available. Apart from the soldiers whose principal duty is to fight in the front line—cavalry, armoured corps, infantry—there are many other corps in the army—Royal Engineers, Signals, R.A.S.C., R.A.M.C., R.A.O.C., and now the recently formed R.E.M.E., a corps which it has taken twenty years of consideration and three years of war to force into existence. The heads of these corps are only Major-Generals, except in the case of the R.A.M.C. whose head is a Lieutenant-General, with many Major-Generals to support him for strictly corps duties. We may well ask why the R.A.M.C. is singled out for such an honour? Is it because the power of the British Medical Association, speaking with one voice, has ensured a just position for members of its profession, whereas there has never been one engineering voice to bring home the essential importance of that profession? We acknowledge the pressing need of medical science in war, for many an earlier campaign has been lost by disease rather than by force of arms, whereas in the wars

## Abstracts of articles appearing in the current technical periodicals

of this century our troops have been kept in wonderful health and heart, thanks to the preventive watchfulness of our medical organization. Although its senior officers do not command fighting troops in the field, we agree that the ranks of the R.A.M.C. are fully justified. It must be pointed out, however, that the labours of that corps are largely defensive in object—to prevent losses and retrieve casualties. Is there not a pressing need to assemble the engineers to force the offensive?

We do not yet know exactly what is envisaged as the final rôle of the R.E.M.E., but welcome as is this step of forming a new corps, it will hardly meet the needs of a mechanized army if it is to be concerned solely with repairs and maintenance. There are higher responsibilities which could and should be placed upon it, such as the provision and training of mechanical engineers for design, test, and investigation. We trust that even if its head is only to be a Major-General, as is the case of the other and older corps, preparations are in hand to make a post or posts external to the corps, with a higher rank to which in due course the most senior mechanical engineer can be promoted and in which he can give advice with a broad outlook, on the same level of seniority and with the same measure of authority as a member of the Army Council. Until such a step is taken we fear that mechanical engineering on which the offensive needs and spirit of our Army depend so greatly, will not come by its own, for why should the cream of our young engineers seek to join a service which is neither sufficiently consulted nor honoured?

## ELECTRIC DRIVE FOR SHIP PROPULSION

From *Trade & Engineering*, LONDON, ENG., AUGUST 1942

Opinion about the electric drive for ship propulsion has undergone many changes since the early years of the century when the first successful application was accomplished in the Russian-built shallow-draught tanker *Vandal*. The machinery comprised three 120 h.p. single-acting Atlas oil engines driving direct-current dynamos with separate propulsion motors for the three propellers. Each generator was normally connected direct to its corresponding motor with a Ward-Leonard system of variable voltage control to give speed regulation, but cross connections between any dynamo and motor could be made as necessary.

Though the advantages provided in comparison with contemporary alternative propelling arrangements were generally regarded as justifying the higher first cost, so that the outlook for this new development seemed promising, there was little further advance until Mavor's proposals for using alternating-current were put into practice in this country in the Diesel-electric vessels *Electric Arc* and *Tynemouth* during the years 1911 to 1913. The advantages of these pioneer installations and subsequent applications of the Diesel-electric drive were continually being neutralized by the advances made with direct-coupled or geared oil engine machinery and the system never gained much favour, only 70 vessels, over 100 tons gross, with this mode of propulsion being included in the classified returns of shipping. Diesel-electric alternating-current propulsion was, however, reintroduced in 1936 by the Hamburg Amerika Line in the cargo liner *Wuppertal*, in which three 1,900 kw. alternators at 2,000 volts pressure supplied power to a single-screw 6,800 s.h.p. propulsion motor, and several other vessels with generally similar equipment have since been completed. Diesel-electric drive has also been regaining favour in America for special applications, such as tugs, ferries, and dredgers, on a system developed by the General Motors

## THE AVRO "LANCASTER" HEAVY BOMBER

From *The Engineer*, LONDON, ENG., AUGUST 14, 1942

In this new bomber, designed and built by A. V. Roe and Co., Ltd., the United Nations have a vehicle of aerial destruction unparalleled in the history of the world, and to be produced in such numbers that it will rapidly take its place in the forefront of the weapons which, together, will bring victory to the Allied cause.

Already, but a few months after its completion, the "Lancaster" has helped powerfully by night to batter Cologne and Essen, with bombs of the heaviest calibre. By day it carried out the epic raid on Augsburg, and the raids on Danzig and Flensburg. Its future achievements depend upon the decisions of Bomber Command.

### DEVELOPMENT

Behind the design and construction of the "Lancaster" there lies some thirty-two years of aircraft manufacturing experience and development, for the Avro Company has been one of Britain's foremost aircraft constructors since before the last war of 1914-18. In every way this new bomber is a worthy successor of its famous ancestors, the Avro "504 K," the "Tutor," the "Anson," and the "Manchester."

From the initial flights and the report of the Ministry of Aircraft Production testing staff it was soon obvious that the Allied cause had now what has since been aptly styled by many pilots a "war winner."

The "Lancaster" heavy bomber is now in production in many factories of the Avro group, and in the factories of other large British aircraft manufacturing firms. It is also being built in one of Canada's largest aircraft factories.



The Avro Lancaster.

### GENERAL DESIGN AND CONSTRUCTION

As will be appreciated from the accompanying engraving, showing one of a series of "Lancasters" on the ground, with another circling around in the air, the new bomber has particularly graceful lines and a pleasing appearance, perhaps rarely seen in large military aircraft. In design it may be described as a mid-wing four engine all-metal cantilever monoplane, with a retractable undercarriage. In general, it is powered by four Rolls-Royce "Merlin XX" liquid-cooled engines, which have given such a good account of themselves in other bombers and fighter aircraft. Other engines, notably the Bristol "Hercules," are also being fitted to the "Lancaster." An outstanding feature is its great ease of control, and this, coupled with its high speed, is of great defensive value. Heavy defensive armament is also carried in four Parnall power-operated gun turrets working on the Fraser and Nash hydraulic system.

Corporation using a high speed V-type two stroke engine in standard units.

The landmark in the employment of the turbo-electric drive was the decision of the United States Naval Department, before the last war, to adopt it in their capital ships. An experimental installation of 7,100 s.h.p. had been carried out in the collier *Jupiter* in 1913, and the satisfactory results obtained led to the adoption of the system in the *New Mexico* and *California* classes of battleships and subsequently in the aircraft-carriers *Lexington* and *Saratoga* with their 210,000 s.h.p. installations. It might have been thought that the case for the electric drive had been fully established by these applications, but enthusiasm for the system has been spasmodic and it has been adopted to a limited extent only.

### HIGH-PRESSURE STEAM

The use of super-pressure steam conditions in the Nord-deutscher Lloyd vessels *Potsdam* and *Scharnhorst* suggested the future trend of development with the electric drive, and it was readopted in America in tanker tonnage for the Atlantic Refining Company, having machinery of 5,000 s.h.p. with steam at 625 lb. pressure and 920 deg. F. temperature. The *John D. Gill*, the seventh vessel to be fitted with this improved version of the electric drive is nearly ready. Another interesting example of the turbo-electric drive in conjunction with relatively high steam conditions is afforded by the *Kairouan*, which was put in hand for the Marseilles North Africa service just before the outbreak of war. This vessel was to have two 9,020 kw. turbo-electric sets, supplied with steam at 570 lb. pressure and 800 deg. F. temperature from La Mont forced-circulation steam generators and driving twin-screw propulsion motors of 24,000 s.h.p. aggregate output. She is understood to be approaching completion. The future position of the turbo-electric drive has been greatly influenced by the decision of the United States Maritime Commission to adopt it in the 123 tankers of the C2/S.E./A1 type, with a carrying capacity of 18,000 tons, which have been included in its expanded shipbuilding programme for delivery this year and during 1943. The first vessels of the type have been launched and are now fitting out. The power plant comprises a single alternator driving a single propulsion motor developing 6,000 s.h.p., and moderate steam conditions of 450 lb. pressure and 750 deg. F. temperature are being used in order to eliminate the use of special heat-resisting materials of construction. The large-scale experience which will be provided by these vessels is likely to have a marked influence on post-war policy by bringing out the advantages of the system.

### SPEEDING UP RADIOLOCATION

FROM ROBERT WILLIAMSON\*

By the last train to leave free Czechoslovakia there came to Britain the drawings for a new type of soldering iron which has beaten everything else for speed in Britain's aircraft, radiolocation and tank factories.

It is the invention of a Czech manufacturer who, with very little money and only two cases of personal luggage, passed the German Army of Occupation as they were crossing the frontier. When he arrived in London, he concentrated his whole attention on his new "quick" soldering iron, realizing how vital a part so simple a tool plays in war production and maintenance.

Put to its first speed test at radio control and transmitting stations, the tool is now supplied from a South Wales factory at the rate of three to four thousand a week to radiolocation centres, aerodromes, shipyards, ordnance factories, telephone exchanges and in a wide range of general factories.

Feature of the new soldering iron is that it is equally effective when used with the new soldering alloys with lower tin content introduced in Britain to save stocks of tin.

\*London Correspondent of the *Engineering Journal*.

### Principal Dimensions

Span . . . . .	102 ft.
Length . . . . .	69 ft. 4 in.
Height . . . . .	20 ft.
Gross wing area . . . . .	1,297 sq. ft.
Depth of fuselage . . . . .	8 ft. 2 in.
Width of fuselage . . . . .	5 ft. 9 in.
Main undercarriage wheel . . . . .	5 ft. 6 in. dia.
Length of bomb compartment in fuselage . . . . .	33 ft.
Weight of aircraft fully loaded . . . . .	Approx. 30 tons
Maximum speed . . . . .	Approx. 300 m.p.h.
Maximum range . . . . .	Approx. 3,000 miles
Maximum bomb load . . . . .	Approx. 8 tons
Type of engine . . . . .	Rolls-Royce "Merlin XX"
Number of engines . . . . .	Four
Maximum power with low gear supercharger . . . . .	1,260 B.H.P. at 12,250 ft.
Maximum power with high gear supercharger . . . . .	1,175 B.H.P. at 21,000 ft.
Type of airscrew . . . . .	Three-bladed, 13 ft. dia. fully feathering
Armament: Four Parnall gun turrets, one in nose, one mid- upper, one mid-under, and one in the tail	
Number of guns . . . . .	Ten Browning, 0.303 in.
Number of crew carried . . . . .	Can be seven

The keynotes of the "Lancaster" design are ease of production, easy transport, and easy maintenance and repair. The design, the makers claim, lends itself to rapid and relatively cheap production, as the entire machine is built up of numbers of components which are manufactured largely as separate and self-contained units, and are easy to transport and to assemble. Full 100 per cent interchangeability has been aimed at and achieved, and this coupled with ease of construction, has contributed largely to the ease of maintenance and repair. The fuselage is built up of transverse formers with continuous longitudinal stringers, whilst the main wing is of two-spar construction, each spar consisting of a top and a bottom extruded boom bolted on to a single thick gauge web plate. The wing ribs are made from aluminium alloy pressings, suitably flanged and swaged for stiffness. The tail-plane is built on similar lines to the wing, with twin fins and rudders at its extremities. The entire surface of the aircraft is skinned with aluminium alloy sheets secured by flush riveting, giving a smooth external surface. The undercarriage, which is of the Dowty type, is operated hydraulically and is completely retractable inside the in-board engine nacelles, the doors, which are connected to the retracting gear, being so designed that a clean nacelle is given when the undercarriage is retracted. Fuel is carried in six self-sealing fuel tanks, enclosed in petrol-tight welded aluminium sheet casings, which are carried in the wings of the machine. De-icing equipment is also fitted. At the centre section trailing edge portion of the wing a dinghy is stowed, which is automatically freed when making a crash landing, while provision for hand operation is also made.

The interior of the fuselage is equipped to meet all modern requirements. A canopy is fitted over the pilot's cockpit, which gives an excellent view in all directions, including aft. Inside the canopy immediately aft of the pilot's seat is the fighting controller's position, which again is provided with views in all directions. Slightly aft of this position is the navigator's station, with a table and provision for charts. There is an astral dome in the roof of the cabin. The wireless operator's station is at the rear end of the navigator's table, just forward of the front spar.

An armour-plated bulkhead is fixed across the centre section of the fuselage at this point, and it is so designed that it can be opened for access on either side of the centre line. The back of the pilot's seat is armour plated, and there is also an armour plate behind his head. Certain other vulnerable parts of the aircraft structure and also parts of the gun turrets are armour plated, whilst at the fighting con-

troller's position special bullet-proof glass is fitted in order to provide added protection.

Within the centre section of the fuselage the oxygen bottles are stowed in a crate, the top cover of which is upholstered and provides a comfortable rest bed with an adjustable back rest. Aft of the rear spar a mid upper turret and a mid under turret are fitted, together with the various equipment stowages for flares, emergency rations, etc. The ammunition boxes are placed in this portion of the fuselage and ammunition is transported to the tail turret by means of tracks. A robust walkway along the entire length of the fuselage is provided, and the entrance door is on the starboard side, just forward of the tailplane. The fuselage is entered by a ladder which is stowed during flight. At various suitable points throughout the fuselage there are escape hatches for all members of the crew.

The bomb aimer's station is in the nose of the fuselage below the front turret and forward of the pilot's cockpit. All the bomb-sighting equipment and bomb-release gear is fixed in this compartment, and the bomb aimer takes his sight through a clear-vision window made of laminated glass optically ground. The bomb compartment is contained within the fuselage form, and the cabin floor above, which is of robust construction and constitutes the backbone of the fuselage, is specially designed to take the housings to carry the various types of bomb employed. The two doors which open and close the bomb compartment are hydraulically operated. A further point of interest in connection with the bomb doors is that the electrical circuits are so arranged that the bombs cannot be released until the bomb doors are open. In cases of emergency or in case of a possible failure in the hydraulic system, the bomb doors and also the retractable undercarriage can be operated by means of an emergency compressed air system. There is intercommunication between all the members of the crew, and there are readily accessible stowages for parachutes provided at all the crew stations, along with easily reached oxygen points.

### THE ENGINEER IN U.S.S.R.

FROM *The New York Times*, SEPTEMBER 6, 1942

A new social class is emerging and rising to dominance in Soviet Russia, composed not of proletarians nor the old, loyal Bolsheviki, but of the young production engineers in whose hands economic control and administration has been unified, Dr. Solomon M. Schwarz declares in a report on "Heads of Russian Factories" made public recently.

In the study, which was prepared in connection with a war research project on social and economic controls in Germany and Russia under the auspices of the Graduate Faculty of Political and Social Science of the New School for Social Research, Dr. Schwarz asserts that the Communist party in Russia is no longer a workers' party, but "to an increasing extent it has become the party of the officers of the various branches of economy and administration."

According to Dr. Schwarz's findings, Russia has gone through a type of managerial revolution, with the trained executives becoming a new privileged class. "Even the most glorified Stakhanov workers were somewhat out of place" at the Communist party congress in 1939 after the great purge of 1936-38, he says, and not one of them was elected to the central committee.

As the new type of leader is promoted, the proletarian worker is subordinated, and by a 1940 decree the worker is denied the privileges of free higher education for his children. Moreover, the children of workers are obliged to take vocational training, but those of engineers, attending higher schools at which tuition fees are charged, are exempted. The promotion of workers within the industry has been abandoned, exceptional work being rewarded by bonuses and other wage premiums.

"It is characteristic of recent developments that the young engineers are being increasingly promoted, not only in industrial plants but everywhere, especially in the Communist party offices and the general administration."

Dr. Schwarz writes, "Engineers in the Soviet Union constitute to-day almost a third of the government, a phenomenon not to be observed anywhere else."

This vast social change was still in process when Germany attacked Russia and the ensuing conflict may affect the trend, but it was a process that has its roots back in the difficulties Russia has experienced with the problems of administration, he says.

In 1919, the end of the civil war, Russian factories were placed under the dual control of directors, who were Communist party members, and technical assistants inherited from the earlier regime. A conflict of authority and interests developed and in 1928 there began far-reaching changes in the personnel of factory administration, accomplished by purge, terrorization and political trials.

A plan was instituted for providing specific training for industrial management and under it young Communists, mainly of proletarian origin, were given accelerated specialist courses by the thousands. In 1932, Dr. Schwarz finds, it was openly acknowledged that the scheme had failed as a result of lowering the levels of technical training and the plan was revised to provide more thorough training. The influx of manual workers was thus limited and the emphasis of proletarian back-ground was neglected.

In the great purge of 1936-38 the old party wheel horses who had risen to directorial posts were ousted and the new type of leader was placed in charge of industrial plants.

"These new leaders were younger, often scarcely out of school, and they had a better and more systematic education than the 'Red specialists' who had preceded them," he says. "They were more interested in their professions, less interested in political problems."

The new leaders are conscious from their school days that they form a separate social stratum. Most of them leaned toward authoritative thinking and are completely devoted to Stalin as the embodiment of the economic rise and the international strengthening of the country.

"They accepted as natural the fact that this rise was dearly paid for, that the bulk of the toiling masses remained in dire want," Dr. Schwarz declares. "Their interest was not in social problems, but in the strong State that built up the national economy."

As a result, he concludes, the friction between the party apparatus and the general administration has died out.

## CHARACTERISTICS OF ENEMY AIRCRAFT

From *Army Ordnance*, WASHINGTON, D.C. SEPT.-OCT., 1942

Descriptions and available performance figures of more than fifty types of combat aircraft in use by Japan, Germany, and Italy have been made available to the people of the United Nations by the British Air Ministry and the United States Army Air Forces.

Of the thirty-one Japanese combat types listed, nine are army and navy fighter planes whose chief characteristics include comparative lightness in weight and engines of comparatively low horsepower. Protective armor for personnel is lacking in almost every case, and armament consists generally of 7.7-mm. machine guns—approximately the same as the American and British caliber .30. Some types, however, are armed with 20-mm. cannon. A more recent type is armed with four machine guns and two 20-mm. cannon. Horsepower of these single-engined Japanese fighters ranges from 650 to 850 at the most effective heights, whereas the four German pursuit planes listed are driven by engines developing 1,200 horsepower.

The German fighters are marked by the more frequent use of 20-mm. cannon, generally higher speeds, and greater protective armor for the pilots. The Heinkel 113 and the Messerschmitt 109F, for example, both single-engined fighters, weigh approximately 5,700 and 6,000 pounds respectively, as compared with an approximate average of 4,400 pounds for the Japanese pursuits. The German fighter aircraft listed also are armed with 7.9-mm. machine guns—approximately caliber .31.

Each of the five Italian fighter planes listed is armed with at least two 12.7-mm. machine guns which compare almost exactly with the American caliber .50. Italy also uses 7.7-mm. machine guns fixed in the wings and firing forward in the fuselage. The Italian planes generally provide armor plating for crew protection which makes them considerably heavier than the Japanese planes of the same comparative class, although rated horsepower for the Fiat G50 and CR42 and the Macchi C. 200 is 840 horsepower. The Macchi C. 202, which is rated as having a maximum speed of 330 miles an hour at 18,000 ft. and a cruising speed of 300 miles an hour, is powered with a 1,200-horsepower engine.

No Japanese twin-engine fighter planes are listed, although descriptions are given for the German Messerschmitt 110, powered with two 1,200-horsepower liquid-cooled engines, and the Junkers 88, driven by two motors of the same power; and the Italian Breda 88, powered with two air-cooled motors.

The German JU 88, night-fighter version of a similarly designed twin-engined ship used for long-range and dive-bombing missions, carries minimum armament of three 7.9-mm. machine guns or three 20-mm. cannon in the nose of the fuselage in addition to 7.9-mm. machine guns protecting the rear and the underside. It has an approximate maximum speed of 290 miles an hour at 18,000 ft. The ME 110, with a service ceiling of 32,000 ft., is armed with at least four 7.9-mm. machine guns and two 20-mm. cannon firing forward, in addition to machine-gun protection for the rear.

The Breda 88 has a rated maximum speed of 310 miles an hour at 13,500 ft., a service ceiling of 28,500 ft., a range of 900 miles, and is armed with three 12.7-mm. machine guns in the fuselage and two 7.7's in the wings.

The German Gotha 242 troop-carrying glider has a crew of two pilots and can accommodate twenty-one other fully equipped soldiers. It is armed with four machine guns, and carries a wheeled undercarriage which can be dropped.

The German Focke Wulf 200K is a 24-ton long-range bomber driven by four 850-horsepower motors. This ship has a range of approximately 2,400 miles and a bomb capacity of 3,300 lb. Minimum armament includes a 20-mm. cannon and five 7.9-mm. machine guns. Its duties include long-range sea reconnaissance, ship strafing, mine-laying, and work in conjunction with submarines. The Junkers 87—the dive bomber used extensively in Europe during the early stages of the war—is powered by a single liquid-cooled engine of 1,150 horsepower, has a bomb capacity of 1,100 lb. and is armed with two 7.9's in the wings and one of similar caliber to protect the rear.

The only 4-engined Japanese ship listed is the Awanishi T97 navy flying boat, reported to be based on the S42 Sikorsky flying boat. The Jap ship is a monoplane powered with four 900-horsepower air-cooled motors and has an approximate range of 1,500 miles with 3,500 lb. of bombs. This ship carries a crew of ten men and is armed with two machine-gun turrets.

Two Italian bombers—the Savoia-Marchetti 79 and the Cant Z1007—are powered with three engines; The SM79 with three Alfa-Romeo 780-horsepower air-cooled motors, and the Z1007 with three Piaggio 1,000-horsepower air-cooled engines. The latter ship is of all-wood construction, has a range of 800 miles and a bomb capacity of 2,600 lb. The SM79 is of mixed wood and metal and can carry a bomb load of 2,200 lb. 1,000 miles. Of longer range is the Italian Fiat BR20, a twin-engined bomber with a capacity of 2,200 lb. and a range of over 1,150 miles.

The Japanese Mitsubishi T97, on the other hand, powered with two 870-horsepower air-cooled motors, can carry 4,400 lb. of bombs over a range of 1,180 miles, and the Kawasaki T97 can carry either 1,100 lb. of bombs 1,250 miles or 4,400 lb. of bombs 240 miles. Japanese army types of single-engined bombing and reconnaissance planes include the Nakajima T94, the Kawasaki T97, the Mitsubishi T97 in two variations, the Mitsubishi T98 in two types, and the Showa T99.

## INDUSTRIAL RELATIONS A LEGITIMATE FIELD FOR INSTITUTE ACTIVITIES

If there be too frequent evidences of industrial discord and unrest in this country, it is not due to any lack of effort on the part of well-meaning persons to obviate them. Unfortunately, that effort has very largely been exerted after the fact. So long as the industrial machine appears to be operating smoothly, no one concerns himself about it, lest the nicely balanced mechanism be disturbed. When neglect of maintenance on the human plane brings friction or breakdown, feverish efforts are put forth to set matters right, but with no more treatment than that necessary to get it running again. There has been little fundamental overhauling or reconstruction. Whatever has been done is for the most part in the nature of makeshift, fashioned to obviate the particular kind of trouble that has then arisen.

Any lasting freedom from the human ills that beset the industrial world can come only from a searching, courageous and profound study of the relationships of employer and employee and the just position of each in the social structure. What is it that men of good will work for and how best can each, having regard to his ability and aspirations, achieve that objective?

To the solution of this problem, now become vastly complicated by intense industrialization, a sustained, calm and impartial examination and study must be directed. Occupying, as they do, a strategic position off the direct line of authority between the employer and the great mass of non-professional employees, while having relations of the greatest importance to both, engineers are peculiarly fitted to undertake such an investigation. For this reason the Council of the Institute, at its meeting in Toronto on April 25 last, established a Committee on Industrial Relations which was later charged with far-reaching duties.

Amongst the useful services already performed by the Committee is that of placing before the membership of the Institute the succinct and clarifying statement of the significance of industrial relations prepared by Professors E. A. Allcut and J. A. Coote which appears elsewhere in this issue. What they have written will commend itself. The situation there presented should be taken to heart by every educated man in this country and not least by the members of the engineering profession.

C. R. YOUNG.

## THE INSTITUTE'S PRIZES FOR STUDENTS AND JUNIORS

A good way to test one's knowledge—or lack of knowledge—of a subject is to write a paper about it. The result is often surprising to the would-be author, who may discover that he has an unexpected talent for expressing himself clearly on some technical matter, or, on the other hand, may find gaps in his store of professional information which need to be filled. In any case his effort deserves encouragement, for it helps the young engineer to acquire the art of clear and concise writing, gives him practice in discussion, and incidentally makes him better known to his fellows and to senior engineers whose acquaintance may be helpful.

These are only some of the reasons why the Institute has always included among its prizes, several for which only Students and Juniors of the Institute are eligible. The council attaches so much importance to this feature, that the Institute Committee on the Young Engineer has been asked to report specially as to the working of the present scheme of regional prizes for Students and Juniors. These prizes consist of the Martin Murphy Prize for the maritime provinces, the Ernest Marceau and the Phelps Johnson Prizes for the province of Quebec, the John Galbraith Prize

## News of the Institute and other Societies, Comments and Correspondence, Elections and Transfers

for the province of Ontario, and the H. N. Ruttan Prize for the western provinces. Their names commemorate five eminent Canadian engineers, each of whom held a leading position in the region with which his name is associated.

The prizes (of books or instruments) are given annually for the best papers presented by Students or Juniors of the Institute in each vice-presidential zone. All papers presented to his branch by a Student or Junior in good standing are eligible for consideration.

After consultation with the various branch executives, the Committee, under the chairmanship of Mr. H. F. Bennett, has reported favourably to Council as to the continuation of the present prizes, and indeed recommends an extension of the scheme if financially possible. It is also recommended that such publicity be given to these prizes as will bring them to the attention of every member of the Institute who might be a competitor. This is being arranged for.

It goes without saying that an active, vigorous body of Students and Juniors is essential for the future welfare of the Institute. From among these young engineers will come our branch executives and our Institute officers and members. Mr. Bennett's Committee, in its report, lays stress on the fact that those branches which have specialized in junior activities have obtained results which have amply repaid them. But in this matter much depends upon the attitude of our senior members, who can help by giving encouragement to the student and junior members with whom they are in frequent contact, drawing their attention to the Institute prizes as announced in the *Journal*, and urging them to take advantage of their Institute membership by participating in its activities.

## A REFERENCE BOOK ON CIVIL DEFENCE

The Institute pamphlet entitled "Structural Defence Against Bombing" is now available for distribution.

This book was carefully edited by a special sub-committee of the Institute Committee on the Engineering Features of Civil Defence. The information has been assembled under several chapters and sub-headings, resulting in a very useful reference book for all engineers interested in civil defence. It contains 79 illustrations and eight tables. The following extract from the foreword will give an idea of the subjects covered in these pages:

"This book is published in order to make available to Canadian engineers and architects a record of some of the experiences and practices of British authorities in regard to structural air raid precautions, so that in the event of emergency arising in this country the necessary action can be taken without loss of time and on the most efficient and economical lines.

Civil defence experience was gained in Britain under 'active service' conditions, with the enemy literally at the gates and boasting of his ability and intention to destroy the cities. At the same time that experience was supplemented by scientific research on a very comprehensive scale; and circumstances imposed the strictest economies in materials and labour. A great quantity of invaluable information has thus been gathered on the subject; and, while it is realized that differing conditions in Canada will not always permit of the rigid application of protective measures developed overseas, yet the main principles must be the same and will form a solid basis for civil defence in this country.

In these pages is presented an outline of methods of protection against aerial attack designed to give citizens sufficient security to carry on their work by day and to get their rest at night, and to prevent undue dislocation of industrial plants and public services. The unusual loads that have to be dealt with are discussed, together with the extensive departures from normal engineering design that are entailed in the protective expedients. It must be realized that when the problem to be faced involves the effects of a thousand pounds or more of metal and explosives falling with the speed of sound, there can be no substitute for well-founded, logical and proved solutions. A great burden of responsibility therefore lies upon the engineering profession when it is called upon to deal with such matters.

A word of warning should be added with regard to amateur and unofficial expedients such as are put forward commercially from time to time. The public should be cautioned against using proprietary types of air raid shelters and other protective devices that have not received the approval of properly qualified engineers."

In view of the very favourable comments received from those who attended the lectures given in Toronto, Council felt under obligation to make the information available in convenient form to the whole engineering profession in Canada and it is now pleased to present this handbook with the hope that it may be useful.

The book contains 56 pages and it is of 8½ x 11 in. format, with heavy paper cover. It may be secured at Institute Headquarters at \$1.00 a copy.

## CIVIL DEFENCE ACTIVITIES

At its last meeting, Council directed that the information contained in the progress reports presented from time to time by the Committee on Engineering Features of Civil Defence be published in the *Journal* in order that members may be familiar with the work that is being done by the Institute on this vital matter.

The report presented at the October meeting of Council shows that twenty of the twenty-five branches have now completed their organization and are actively engaged in the study of local conditions.

It has been suggested to all Branch Committees that they make contact with the architects and contractors in their respective areas, with a view to organizing, perhaps as the Toronto Branch Committee has already done, to deal jointly with engineering matters arising out of damage done by enemy action.

Professor R. F. Legget's subcommittee on men, plant and materials for repairs to major engineering structures and works has completed its exploratory work and is now proceeding with the main part of its assignment. In this it has seemed that the desirable first step should be arrangements for close co-operation between the Royal Architectural Institute of Canada, the Canadian Construction Association and the Engineering Institute of Canada.

Professor Legget has met with Mr. G. McL. Pitts, President, R.A.I.C., and Mr. E. V. Gage, representing Mr. J. B. Stirling, President, C.C.A., to discuss the common problems of the three organizations as they affect the work of this sub-committee. He presented for preliminary discussion a memorandum relative to organization for emergency repairs to works and buildings, a matter in which all three organizations are mutually interested. The discussion led to approval of the principle of his memorandum by those present, and the decision to lay it before the governing body of each of the three organizations for preliminary approval and, if so approved, for authority to proceed with the development of a joint presentation to proper governmental authorities.

The matter was laid before the Council of the Institute at

its meeting on September 19th. After extended discussion, Council approved the submission in principle and authorized Professor Legget to proceed with the preparation of a joint submission. Council also granted to President Young final power of approval of this submission insofar as the Engineering Institute is concerned.

It is expected that after the other organizations have had opportunity to act upon the same preliminary submission there will be a further meeting of the representatives of the three organizations.

The Toronto Branch Committee, under the chairmanship of Mr. John Grieve, has issued a circular letter to all those within its area who attended Professor Webster's Toronto lectures telling of the formation and terms of reference of the Institute Main Committee, and of the formation of the Toronto Branch Committee and what it is doing, and asking for suggestions.

The Toronto Branch Committee has initiated the formation of a Joint Committee of the Toronto Branches of The Engineering Institute of Canada, the Royal Architectural Institute of Canada and the Canadian Construction Association, to deal with matters of mutual interest in the engineering features of civil defence. This Joint Committee has found that the Toronto Builders' Exchange has already set up machinery by which the equipment, materials and men normally under the control of each of its members would in an emergency be placed at the disposal of all of them as required. The Toronto Branch of the Engineering Institute and of the Royal Architectural Institute are setting up machinery to make technical personnel similarly available.

The Toronto Joint Committee has made contact with Judge I. M. Macdonell, Chairman of Dr. Manion's Provincial ARP Committee, has offered him the co-operation, jointly or severally, of the organization it represents and has made certain suggestions to him which it is hoped will match into the framework of the plan being prepared by Professor Legget's subcommittee jointly with the Royal Architectural Institute of Canada and the Canadian Construction Association.

The Saskatchewan Branch Committee has submitted to the Institute Committee a list of nine questions dealing with high explosive bombs, fire hazards and air raid shelters. As these questions dealt with matters pertinent chiefly to the work of Mr. G. McL. Pitts' subcommittee, they were submitted to that subcommittee for preparation of a reply. That reply has been prepared on the basis of all information available to Mr. Pitts' subcommittee and has been transmitted to the Saskatchewan Branch Committee.

The organization of the Halifax-Cape Breton Branch Committee is well under way. Subcommittees are being set up to deal separately with matters having to do with shelters, incendiary bombs, strengthening of existing buildings, repairs to existing buildings in case of damage, repairs to and protection of plants and industrial buildings, and protection of public utility services. The work of some of these subcommittees is well under way. As soon as the organization is completed the committee will contact Hon. F. R. Davis, Chairman of Dr. Manion's Provincial ARP Committee and Major Osborn Cromwell, Director of Civil Defence for the City of Halifax.

The Saguenay Branch Committee is studying Professor Webster's lecture notes and has made contact with Mr. M. Gaboury, Chairman of Dr. Manion's Provincial ARP Committee.

A sub-committee of the Institute Committee on the Engineering Features of Civil Defence, under the chairmanship of Mr. H. F. Bennett has now completed the edition of the booklet on "Structural Defence Against Bombing" and this volume should be available for distribution about the same time as this *Journal* comes out.

At the request of Council and as an aid to members interested, a list is given herewith of the literature available

in the Institute's library on the subject of air raid precautions and civil defence. Not all of this material is applicable to Canadian conditions, but it is hoped that in the near future we may be able to publish a complete bibliography on this subject which would indicate the publications that might be of interest in this country.

### Literature on

## AIR RAID PRECAUTIONS AND CIVIL DEFENCE

in

### THE ENGINEERING INSTITUTE LIBRARY

#### BOOKS

##### Design and construction of air-raid shelters:

*In accordance with the civil defence act 1939, for "unspecified" areas and other purposes.* Donovan H. Lee. London, Concrete Publications Ltd. (1940). 86 pp.

##### On guard against gas:

*An account of the principles of gas warfare and of the steps to be taken by the ordinary citizen to defend his family.* H. A. Sisson. London, Hutchinson and Co. 91 pp.

##### Air raid precautions in museums, picture galleries and libraries:

*Printed by order of the Trustees of the British Museum, 1939.* 59 pp.

##### Air defence and the civil population:

*H. Montgomery Hyde and G. R. Falkiner Nuttall.* London, The Cresset Press Ltd., 1938. 215 pp.

##### A.R.P.:

*J. B. S. Haldane.* London, Victor Gollancz Ltd., 1938. 296 pp.

##### Planned A.R.P.:

*Based on the investigation of structural protection against air attack in the Metropolitan Borough of Finsbury by Tecton, Architects.* London, The Architectural Press, 1939. 138 pp.

##### Design, cost, construction and relative safety of trench, surface, bomb-proof and other air-raid shelters:

*Orc N. Arup.* London, Concrete Publications Ltd., 1939. 63 pp.

##### Civil protection:

*The application of the civil defence act and other government requirements for air raid shelters, etc.,* by F. J. Samuely and Conrad Wilson Hamann. London, The Architectural Press, 1939. 165 pp.

##### What the citizen should know about civilian defence:

*Walter D. Binger and Hilton H. Railey.* N.Y., Norton and Co. Inc., (c. 1942). 185 pp.

##### Civil defence:

*A practical manual presenting with working drawings the methods required for adequate protection against aerial attack.* 3rd. ed. C. W. Glover. London, Chapman and Hall Ltd., 1941. 804 pp.

#### STANDARDS

##### \*British Standards Institution. 28 Victoria Street, London, S.W.1. A.R.P. Series:

No. 1—Heavy aggregates for shelters constructed in situ. Jan. 1940.

No. 2—Bituminous paint and bituminous compound for the protection of steelwork. August, 1939.

No. 3—Electric hand-lamp (fitted with primary battery or unspillable accumulator). August 1939, revised May, 1940.

No. 4—Fitted cistern suitable for the decontamination of anti-gas oilskin clothing. November, 1939.

No. 5—Chemical closets for use in shelter accommodation. September, 1939.

No. 6—Shelter lighting (shelters for 50 persons (210 sq. ft.) or multiples thereof up to 200 persons). October 1939, revised March, 1941.

No. 7—Electric lighting of report and control centres. September, 1939, revised March, 1941.

No. 8—Galvanized wire netting and cloth for protection against flying glass. December, 1939.

No. 10—Rubber gaskets for rendering doors and windows gas tight. September, 1939.

No. 11—Adhesive tape for repairing gas-proofing material, repairing damaged material, sealing apertures and cracks, etc. September, 1939.

No. 12—Petroleum jelly for sealing gas-tight doors, etc., September, 1939.

No. 14—Window blind material (paper). December, 1939.

No. 15—Light-locks at entrances to buildings. February, 1940.

No. 16—Methods of providing low values of illumination (not exceeding 0.002 foot candle). February, 1941.

No. 18—Fluorescent and phosphorescent paint (excluding radioactive materials) for A.R.P. purposes. July, 1940.

No. 19—Adjustable hinge. October, 1939.

No. 20—Methods for providing even illumination of low intensity (0.02 foot-candles). September, 1939, revised January, 1940.

No. 21—Methods for providing even illumination of low intensity (0.2 foot-candles). October 1939, revised January, 1940.

No. 23—Obscuration value for textile material for curtains and method of testing. November, 1939.

No. 26—Reduced scheme for the lighting of shelters where a.c. mains are available. January, 1940, revised March, 1941.

No. 27—Testing incombustible material resistant to incendiary bombs. February, 1940.

No. 30—Gauges for checking low values of illumination (0.001 to 0.2 foot-candle). September, 1940.

No. 31—Ventilation for buildings in conditions of black-out. July, 1940.

No. 32—Illuminated and non-illuminated A.R.P. signs. May, 1940.

No. 33—Stirrup pumps. October, 1940, Supplement, June, 1940.

No. 35—Illuminated display cabinets. December, 1939.

No. 36—Headlamp masks for motor vehicles. January, 1941.

No. 37—Street lighting under war-time conditions. January, 1940, revised May, 1940.

No. 38—Traffic paints. June, 1940.

No. 39—Testing fire retardent timber treatment by exposure to the action of an incendiary bomb. February, 1940.

No. 40—Bleach ointment (anti-gas ointment No. 1). April, 1940.

No. 41—Front lamps for tram-cars. April, 1940.

No. 43—Closet for use in air-raid shelters. April, 1940.

No. 47—Testing incombustible material to provide a minimum standard of protection against incendiary bombs. August, 1940.

No. 48—Fabric-bitumen emulsion treatment for roof glazing. September, 1940.

No. 52—Simple portable standard of brightness (including notes on the measurement of low values of brightness). December, 1940.

No. 53—Detection of incendiary bomb fires by heat-sensitive devices. February, 1941, revised March, 1941.

No. 54—Electrical heating of shelters (shelters for 50 persons or multiples thereof.) February, 1941.

#### Great Britain. Ministry of Home Security. Research and Experiments Department. Bulletins.

C 1—New design methods for strutting of basements, etc.: Notes on load factor. April, 1940.

C 2—Consolidation of earth covering on Anderson shelters. June, 1940.

C 3—The propping of reinforced concrete beams. July, 1940.

C 4—The protection of glass in hospitals. August, 1940.

C 5—Steps that should be taken to increase the resistance of "umbrella" type shed roofs to collapse due to air attack. July, 1940.

C 6—Damage to cast iron pipes in works. July, 1940.

C 7—The protection of factory glazing. July, 1940.

C 8—Structural damage caused by recent air raids to some single storey buildings. August, 1940.

C 9—The protection of plate glass windows. September, 1940.

C 10—Translucent substitutes for glass. March, 1942.

C 11—Chemical fire extinguishers: their application to incendiary bombs and resultant fires. September, 1940.

C 12—Single storey wartime factory design. October, 1940.

C 13—Obscuration, ventilation and protection from glass in large buildings. November, 1940.

C 14—Refuge room dormitories. March, 1941.

C 15—Strengthening steel framed shed buildings against collapse due to air attack. December, 1940.

C 16—Notes on indoor (anti-debris) shelters. February, 1941.

C 17—Luminescent materials and their wartime uses. June, 1941.

C 18—Recent developments in protective wall design for factories. June, 1941.

C 19—Welding for the repair of steel framed shed buildings and for strengthening their resistance to air attack. July, 1941.

C 20—The construction of reinforced brick walls for surface shelters and similar protective buildings. June, 1941, revised September, 1941.

C 21—Wooden indoor (anti-debris) table shelter. August, 1941.

C 22—Automatic devices for the detection of incendiary bombs. September, 1941.

C 23—Technical notes on the structural protection of buildings against incendiary bombs. October, 1941.

C 24—Protective walls in single storey factories. Methods of heightening and strengthening existing walls. March, 1942.

C 25—Protected accommodation in large buildings of load-bearing wall construction. April, 1942.

C 26—Timber shelters for countries where timber is plentiful and steel difficult to obtain. April, 1942.

C 27—Shelter design by Professor J. F. Baker. April, 1942.

\*Available through the Canadian Engineering Standards Association, National Research Building, Ottawa, Ont.

**Great Britain. Ministry of Labour and National Service.  
Department of Scientific and Industrial Research. War  
Time Building Bulletins.**

- No. 3—Type designs for small huts.  
No. 5—Economic type designs in reinforced concrete for single storey factories.  
No. 8—Part 1A—Walls for factory buildings; Part 1B—Columns for factory buildings. Part 2—Tubular steel trusses and purlins for factory buildings. Part 3—A system of heating for wartime factories.  
No. 9—Conservation of cement and of clay bricks.  
No. 11—Precautions for concreting and bricklaying in cold weather.  
No. 12—Emergency pipe repairs.  
No. 13—The fire protection of structural steel work.  
No. 14—Centreless arch designs.  
No. 15—Standard designs for single storey factories for war industries with notes on siting and layout.  
No. 15A—Supplement to Bulletin No. 15.  
No. 16—Jointing mortars for brickwork.  
No. 17—Resistance of reinforced concrete structures to air attack.  
No. 18—Fire stops for timber roofs.  
No. 19—Economy of timber in building.

**Great Britain. Ministry of Home Office and Home Security  
Air Raid Precautions Department:**

Memorandum No. 12—Protection of windows in commercial and industrial buildings.

Memorandum No. 16—Emergency protection in factories.

Handbook No. 5—Structural defence.

Handbook No. 9—Incendiary bombs and fire precautions.

Pamphlets—Memorandum on the revised code "Air raid shelters for persons working in factories, mines and commercial buildings."

Pamphlets—Air raid precautions to be taken by users of ammonia.

Pamphlets—Your home as an air raid shelter.

**MISCELLANEOUS PUBLICATIONS**

**Fire-detection devices:**

With special reference to the detection of incendiary bombs. London, The Institution of Electrical Engineers, February, 1941.

**Proneness to damage of plant through enemy action:**

London, The Institution of Mechanical Engineers, February, 1942.

**British cities at war:**

A report by James L. Sundquist for the American Municipal Association. Chicago, Public Administration Service, Publication No. 76. 110 pp.

**Information secured in Britain by American observers:**

Principally based upon questions prepared by the National Technological Civil Protection Committee. N.Y., Polygraphic Company of America, Inc., April, 1941.

**Specification for stock-pile asphalt paving mixtures for making quick repairs of bombed surfaces:**

N.Y., The Asphalt Institute, Construction Specification CP-1, March, 1942.

**The Institute of Civil Defence—London:**

Journal. Issued bi-monthly since December, 1938.

**Air raid precautions as related to building design:**

S. D. Lash. The Engineering Journal, Vol. 25, No. 1, January, 1942.

**Some of the engineering implications of civilian defence:**

Walter D. Binger. The Engineering Journal, Vol. 25, No. 4, April, 1942.

**WARTIME BUREAU OF TECHNICAL PERSONNEL**

**Monthly Bulletin**

In order to facilitate the centralization of certain bodies operating under the Department of Labour, and to secure more space for its expanding activities, the Bureau's offices have been moved from the Confederation Building to the Motor Building at 238 Sparks Street, Ottawa.

Early in August, the Bureau opened its fifth regional office in Halifax with the arrival there of Mr. S. W. Gray, M.E.I.C., who had come from Halifax to spend a month in the Bureau to become familiar with its policy and activities, as reported in the July Bulletin. Owing to the fact that industrial activities in the Maritimes are rather widely dispersed, it would be difficult for the Halifax representative to cover all the Maritime territory without being in the field for too great a portion of his time. To cover centres away from Halifax, the Bureau was fortunate in securing the services, on a purely honorary basis, of two Halifax

engineers, Mr. A. D. Foulis, M.E.I.C., and Mr. G. F. Bennett, M.E.I.C., whose business activities require one or the other to make frequent business trips to most of the industrial centres in the Maritime region. They are available to supplement the services of the Bureau's official representative.

A native of Ottawa, Mr. Bennett is a graduate of McGill University in electrical engineering. After his graduation, he was with the Canadian Westinghouse Company Limited at Hamilton, Ontario, and later was Sales Engineer for the same Company in Halifax. In 1941, he resigned to become Managing Director of Foulis and Bennett Electric Company Ltd., a firm representing a number of well known electrical companies.

Mr. Foulis was born in Yarmouth, Nova Scotia, and is a graduate of Acadia University and Nova Scotia Technical College in mechanical engineering. Formerly associated with the Canadian Fairbanks-Morse Company, Ltd., he resigned to establish Foulis Engineering Sales Ltd. to represent many Canadian and American manufacturers in the mechanical and electrical fields. To take care of rapidly expanding business, he formed the Foulis and Bennett Electric Company with Mr. Bennett.

At the same time, arrangements were made to have honorary representation in the district immediately surrounding Quebec City, where Dr. Paul E. Gagnon, M.E.I.C., has consented to represent the Bureau in such matters as may come up from time to time. Dr. Gagnon is a member of the Bureau's Advisory Board, past President of the Canadian Chemical Association, Honorary Treasurer of the Canadian Institute of Chemistry, and President of the Graduate School of Laval University, as well as Director of the Departments of Chemistry and Chemical Engineering of the Faculty of Science.

The Director, Mr. H. W. Lea, M.E.I.C., visited Halifax shortly after that office was opened, thus completing a series of visits, initiated earlier in the year, to all regional offices. Advantage has been taken of these visits to discuss local Bureau problems, to further necessary co-operation with local National War Services Boards, and to discuss technical personnel problems with various provincial authorities with a view to ensuring the greatest possible degree of co-operation from the Governments of the provinces concerned.

In order to co-ordinate the work of all regional offices, one of the Bureau's officers is specifically charged with dealing with regional contacts, so that the established policy may be uniformly observed across the country, and so that new matters of interest may be passed on in a systematic way without delay.

Negotiations were completed for the seconding to the Bureau of Colonel G. W. Beecroft from National Defence Headquarters to deal with the large volume of work involved in contacts with the three defence services. Colonel Beecroft took up his duties with the Bureau in the middle of August, and there is already ample evidence of the wisdom of making such an arrangement. By mail, by personal interview at Ottawa, and by reference from regional offices, there is a steady flow of requests for guidance, particularly from young engineers and scientists who are in need of impartial advice as to where best their technical qualifications might be used in one of the services. Apart from these cases of individuals, it is now possible to devote further thought and discussion to broader questions, such as the possible use of certain technical groups on the establishment of one or other of the armed forces in such a way that definite need will be met on one hand, and that opportunities will be available for service on the other.

Colonel Beecroft saw service in the last war, and is a graduate in engineering from the University of Toronto. He was employed with Imperial Oil Limited and International Petroleum Company, Limited in their South American oil fields, and at Head Office in Toronto for 15 years. He went overseas in January, 1940, with No. 2 Army Field Workshop, R.C.O.C., and commanded that unit from

May, 1940, to August, 1941. On return to Canada, he served in the Directorate of Mechanical Maintenance in the M.G.O.'s Branch at National Defence Headquarters as Acting Chief Ordnance Mechanical Engineer.

The Bureau's classification sheet, which is used in conjunction with registration of technical personnel, was revised in June so as to include a number of fields of pure science which had previously not been specifically mentioned. This has facilitated the registration, of a large number of men engaged in the field of pure science, under classifications which more closely identify with their training and experience.

### WASHINGTON LETTER

One gets a better perspective of Canada's war effort from a vantage point outside the country. In the same way, the accomplishments of the United States may look better from Ottawa than they do from Washington. Nevertheless, one of the things which has struck me most forcibly, as the result of talking in Washington to people from all over the world, is the high regard in which Canada's war effort is held. An equally high regard is also held for the manner in which Canada has accomplished the transition from peace to war. Her wartime legislation—the organization of her various wartime boards—her rationing and price control schemes have all been watched with close attention and considerable approval.

The national income of the United States is sixteen times that of Canada. This is a better measure of productive capacity than population. On the basis of a ratio of sixteen to one, Canada, who had no aircraft industry shortly before the war, will this year produce on a relative basis as many aircraft as it is expected will be produced in the United States in the same period. (This is exclusive of the engines which are not made in Canada). On the same basis, the merchant shipping tonnage which is scheduled to go down Canadian ways this year will be relatively twice the American programme. Of course, Canada had a head start. The figures next year may look quite different. Nevertheless, it is recognized that Canada has achieved amazing results in a very short time. For instance, gun production has always been regarded as the special task for established and long experienced armament firms. Within three years and starting from grass roots, Canada now has in production some thirty types of guns ranging from service rifles to heavy naval and anti-aircraft guns, and experts from the United States are now going to Canada to study the new methods evolved in Canadian gun plants. I have frequently been told that the Canadian job of machine tooling for war production compares very favourably with that of any other country in the world.

Some people here are puzzled and inclined to be a little critical over Canada's failure to introduce conscription for overseas service, but they realize that the Canadian army is the relative equivalent, on a population ratio, to an American army of about six million.

In the matter of war organization, people in Washington complain of the division of U.S. control—of the multiplicity of boards and organization—and of the lack of stability regarding the bodies themselves. The War and the Navy Departments, the War Production Board, the Board of Economic Warfare and the Office of Lend-Lease Administration, and the Office of Price Administration are the major bodies controlling the United States war effort. In Canada the functions of all these bodies is centralized in the comparatively streamlined Department of Munitions and Supply which, in turn, is closely interlocked with the civilian side through the Wartime Prices and Trade Board.

In international relations between U.S. and Canada, an excellent and, in many senses, a pioneer job is being done by the Joint War Production Committee and its ten joint technical sub-committees in co-ordinating all phases of

Canadian and American War Production. It is to be hoped that the foundations of our future relations are being as carefully prepared for our political co-operation as they are for our industrial co-operation.

It would not do, however, for Canada to be complacent or self-satisfied with result of achievements to date. In this regard, the attitude presently prevailing in official circles in the United States is the more salutary one. Within a few days of each other, we recently had four pronouncements from eminent authorities to the effect that America's war effort must be drastically stepped up. In his Lend-Lease report to Congress, the President said that the United States had only achieved a little more than fifty per cent of its maximum war production. Mr. Donald Nelson appealed to people to take up the slack in our wasteful economy. He declared that, from now on, our war effort is "going to hurt." Nobody who has access to the mass of limitation orders, restrictions, and prohibitions which the War Production Board issues from day to day under his direction will doubt that he means what he says. In a very wide range of commodities, the people of the United States are living "off the shelf" and when the shelves are empty, there won't be any more! Mr. Nelson was backed up by a nationwide address by Ambassador Grew, recently "returned" from the Far East, who told the American people some home truths. On top of all this, General Lewis B. Hershey, National Selective Service director, warned that America is going to need an army of from ten to thirteen million men.

Talking about U.S. production, it will probably be of interest to engineers to note the re-entry into the active direction of the General Electric Company of Owen D. Young and Gerard Swope which was announced as I write this letter. The well-nigh fabulous collaboration of these two men in building up the General Electric Company is one of the great stories of industrial development. Charles E. Wilson and Phillip D. Reed, who took over from Swope and Young a few years ago, have both been called to Washington. Reed has been an official of the War Production Board for some time, while Wilson has only just been appointed as chairman of the Production Executive Committee of the same organization. This committee, will, if I read the signs right, become an important and powerful body. One of its members is Lt.-Gen. Brehon B. Somervell.

Over in Arlington, across the Potomac, the new Pentagon Building of the War Department is filling up. Designed under the direction of Lt.-Gen. Somervell when he was in charge of Army construction, this building is supposed to be the "largest in the world." The first occupants moved in about six months ahead of schedule. Built at a cost of about \$31,000,000, the Pentagon Building will have a floor space of over 4,000,000 square feet and will house over 30,000 people under one roof who were previously distributed in some 24 buildings about Washington. Of course, the Army is growing so fast that many of these 24 buildings will still be required for new personnel. The traffic problem created by this building, and the somewhat smaller Navy building not far away, is being taken care of by a special series of roadways and two new pontoon bridges over the Potomac.

Life in Washington, though hectic, has its compensations. In spite of temporary construction, Washington is still a beautiful city. There is much of interest for the historian or scientist or antiquarian. One may still sit under the stars, in the shadow of the Lincoln Memorial, and hear Lily Pons and André Kostelanetz; one may still attend the various affairs at Embassies and Legations, mixing with great and near great; one may still find persisting the habits and equipment of a former standard of expensive living. In spite of all this, nobody in Washington these days ever escapes very far from the major preoccupation. The war, either directly or indirectly runs like a leitmotif through all activities both social and business. The other evening we were having dinner under a romantic moon on the terrace

of the famous Shoreham Hotel overlooking the swimming pool, coloured fountains and Rock Creek park beyond. Some time previously, I had visited the War Department to discuss food problems, including dehydration plant and equipment with a certain colonel. Well, I saw the good colonel on the dance floor, in this romantic setting, in the company of a very attractive blonde. As he danced by, I overheard only one word of his conversation. It was "dehydration!"

E. R. JACOBSEN, M.E.I.C.

## VOCATIONAL GUIDANCE MANUAL

The Engineers' Council for Professional Development has recently issued a booklet designed to help engineers and committees acting in an advisory capacity to high school students who consider entering the engineering profession. It is entitled "Manual for Committees of Engineers Interested in Engineering Education and the Engineering Profession" and is published with a separately-bound appendix addressed to the student as a prospective engineer.

This guidance manual offers a general procedure recommended to individuals or groups in the profession for presenting to high school students the aims and essentials of engineering education, the aptitudes required and the types of civilian organizations and armed forces employing engineers. It presents material on the organization and selection of these committees representing local sections of national societies or local engineering clubs and societies, and points out the necessity of co-operation on the part of these committees with the vocational guidance programmes already established in the secondary schools, and with other local and professional groups who are interested in the problem of helping young people select their career.

Direct aids in counseling are given in outline form, and the advisors are urged to present their case in the form of (1) general talks to student bodies, (2) explanations of a more technical nature to small groups of boys having a definite interest in civil, electrical, or other branches of engineering, (3) essay contests limited to 500-word papers on the subject of "Why I Believe I Should be an Engineer," and (4) when practical, inspection trips and motion pictures. A list of books and pamphlets on vocational guidance, especially in relation to engineering, constitutes a final section of the booklet. The booklet purposes to make available to high school students who will qualify for and are interested in engineering, full information on the engineering field, so that engineering colleges may be supplied, for their regular or accelerated beginning classes, with competent freshmen who will persist until the training is completed.

The appendix is designed for use by the student in supplying biographical and educational background, and should be reviewed by the advisory committee or counselor prior to a conference with the candidate.

The Committee on Student Selection and Guidance of E.C.P.D. reports that advisory committees have been established in several centres of the United States and that in New York City alone, 3,000 boys have, during the year, been enlightened on the scope of the engineering profession.

In Canada, under the inspiration of the Institute Committee on the Training and Welfare of the Young Engineer, fourteen branches have organized Student Counseling Committees. As a result of the distribution by the Institute, in secondary schools, of the booklet "The Profession of Engineering in Canada, Information for Prospective Students," several requests for additional information and counsel have been received at Headquarters and have been referred to the Branch Committees in the regions where the inquiries originated. Copies of E.C.P.D.'s vocational guidance manual have been distributed to these Branch Committees and should be of great assistance to them in this work.

## CORRESPONDENCE

### Editor's Note:

At the regional meeting of Council in Halifax, pleasure was expressed at the good health and continued activity of Mr. H. C. Burchell, who has been a Member of the Institute since 1887. Greetings were sent to him from the meeting, and the following letter has been received in acknowledgment. The brief history outlined contains a life-time of activity in the professional and administrative field. It should be particularly interesting and inspirational to young members of the profession.

EASTERN LIME COMPANY LIMITED,  
WINDSOR, N.S.

September 10th, 1942.

Mr. L. Austin Wright, M.E.I.C.,  
General Secretary, The Engineering Institute of Canada,  
2050 Mansfield Street, Montreal, P.Q.

Dear Mr. Wright:

More than I can express do I appreciate the kind remembrance of the Council and its members at their Halifax meeting on August 7th. It happened to be my eighty-seventh birthday.

That was a day of reminiscence. Let me recount in brief outline some of my professional history.

Mount Allison and McGill Universities in the early seventies.

Nova Scotia, Colorado, Rocky Mountain and Chicago City Belt Line railways.

Missouri coal area investigation for C.B.Q. Copper mining.

Newfoundland, Deputy Minister of Public Works and Chief Engineer, comprising dry docks and railway building and operation. Railway Commissioner, Management of Government Telegraphs, Chairman of St. John's City Council; for a time, all concurrent.

Director of Public Works, British Honduras.

Cement manufacturing, and now lime and limestone.

Two missions to Britain and to Continental countries (France, Germany and Denmark), one for the Government of Newfoundland and one for my company.

Fifty years of married life. My wife was a daughter of F. N. Gisborne, a charter member of the Institute.

These few notes of a long record beginning in the early days of the general practitioner may interest you.

Many thanks for the warm expression of good will and good wishes from the Council and from your good self.

Yours sincerely,

(Signed) H. C. BURCHELL, M.E.I.C.

ROYAL ARSENAL, Woolwich, England,  
June, 1942.

L. Austin Wright, Esq.,  
General Secretary,  
The Engineering Institute of Canada,  
Montreal, P.Q., Canada.

Dear Mr. Wright:

May I tender my sincere personal thanks to The Engineering Institute of Canada for the kindness shewn to U.K. members in remitting annual fee.

Regularly each month since I returned from Canada I have been receiving my copy of *The Engineering Journal* and I look forward to the time when I shall be able to renew acquaintance with the many friends I made whilst in Canada.

Your personal offer of assistance at any time is much appreciated and I shall be glad if you will convey my thanks and best wishes to the Council at their next meeting.

Yours very sincerely,

(Signed) C. S. H. LEHEUP, M.E.I.C.

## BIBLIOGRAPHY PUBLISHED ON ELECTRICAL SAFETY

The third bibliography of technical literature entitled "Bibliography on Electrical Safety, 1930-1941" has just been published by the American Institute of Electrical Engineers. This publication, sponsored by the AIEE committee on safety, is designed to make available a fund of information on electrical safety which should be of special interest at a time when accident prevention is of national importance. A list of American and Canadian applicable standards, specifications, and safety codes is also included. Information on safety published before 1930 may be located through bibliographies accompanying articles listed.

The items in this bibliography are divided into sections according to subject matter as follows:

- A. Electrical Accidents and Their Causes.
- B. Accident Prevention Methods.
- C. Safety Codes and Standards.
- D. Effects of Electric Shock.
- E. Resuscitation.

The "Bibliography on Electrical Safety, 1930-1941" is a 16-page pamphlet, 8½ by 11 inches. It may be obtained from AIEE headquarters, 33 West 39th Street, New York, N.Y., at 25 cents per copy to Institute members (50 cents to non-members) with a discount of 20 per cent for quantities of 10 or more mailed at one time to one address. Remittances, payable in New York exchange, should accompany orders.

Members of the Engineering Institute may obtain copies of the bibliography at 25 cents each from their own Headquarters. This is made possible owing to the exchange arrangements between the Institute and American Societies.

## LAVAL OPENS NEW DEPARTMENT OF ELECTRICAL ENGINEERING

On September 23rd, the Université Laval in Quebec formally opened its new Department of Electrical Engineering, in the presence of a large group of important government, educational, and industrial personages. Mgr. Camille Roy, Rector of Laval University, and Mr. Adrien Pouliot, M.E.I.C., Dean of its Faculty of Science, both spoke briefly and presented Mr. René Dupuis, M.E.I.C., the Director of the new department, who gave a brief history of the foundation of the department, acknowledged the financial support of the Quebec government, and outlined the programme which it was hoped to follow.

Laval University has been giving degrees in Medicine, Law, Theology, and Arts, for over ninety years, but has only recently extended its activities to the field of pure and applied science. To-day, its Faculty of Science gives degrees in Mathematics, Physics, Chemistry, Biology, and Geology, as well as in Chemical, Mining, Metallurgical, Forestry and Electrical Engineering. The department just created will give young men in Quebec and lower St. Lawrence regions additional opportunities to enter a field in which there now exists a pressing demand for qualified engineering graduates.

The new course at Laval has been organized largely along the lines of the training given by the Department of Electrical Engineering at McGill University and thanks are due to Professor C. V. Christie and Professor G. Wallace of McGill for their advice and collaboration. During the first and second year, all engineering students follow the same basic training in mathematics, physics, chemistry, drawing, etc. In the third year, they are grouped according to the specialty that they have chosen; electrical engineering students are given basic theory in electrical circuits and machinery. In the fourth year, they may take either the

power or the communications option. In view of the importance of communications in the present war and the great effect that present-day developments in the electronic field will have on civil life after the war, considerable attention will be given at Laval to the communications field.



Main Electrical Laboratory.

The equipment of the new laboratories has been hindered by the difficulty of obtaining electrical apparatus; nevertheless, apparatus is now available to carry out normal instruction in all subjects of the curriculum. The facilities include laboratories devoted to machines, meters and relays, illumination, small apparatus, radio and telephone, and an electrical shop. A flexible distribution system provides the following currents in all laboratories; 230-115 volts D.C., 220-110 volts A.C. single-phase, 220 and 110 volts A.C., three-phase. The experimental equipment includes a 40 kw. D.C. generator driven by a 50 hp. induction motor, a 10 hp. D.C. generator set, a 10 hp. A.C. phase displacement dynamometer set, a 10 hp. D.C.-A.C. motor generator set, a 5 kw. synchronous converter, a 5 hp. squirrel-cage, induction motor, a 5 kw. six-phase mercury vapour rectifier, a 1½ kw. three-phase mercury vapour rectifier, three 2½ kva. transformers, one 30-ampere three-phase variac, three 50-ampere core type variable inductances, several resistor banks, variable condensers, and a wide assortment of measuring apparatus and meters of all ranges. A typical 2,200 volts distribution line has been set up for instruction in transmission line working. A feature of the illumination laboratory is a room with movable partitions and ceilings which will permit practical tests of reflecting surfaces, luminaires, etc. The communications laboratory already contains a cathode ray oscillograph, an electronic switch, an ohmmeter-voltmeter-milliammeter, a tube tester and numerous small components. The shop is equipped with a lathe, drill, press and wide assortment of tools.

The University has aimed at getting for its teaching staff engineers from the electrical industry who have had varied and successful experience in the electrical field. Mr. René Dupuis, M.E.I.C., who takes charge of the department as Director, studied at McGill and graduated in electrical engineering from the University of Nancy, France, comes from the staff of the Quebec Power Company where he was assistant-superintendent. The Assistant-Director, Mr. E. A. Bouchard, graduated in civil and electrical engineering from the Ecole Polytechnique, Montreal, and obtained a Master's degree in electrical engineering from the Massachusetts Institute of Technology; he was with the Shawinigan Water & Power Company for several years. Mr. G. E. Sarault, M.E.I.C., a graduate of McGill University in electrical engineering, was previously regional engineer for Quebec province with the Canadian Broadcasting Corporation and will teach communications. The department has received strong support from the provincial Government and the electrical industry in general. The Shawinigan Water & Power Company and the Quebec Power Company have contributed three scholarships of 250 dollars each and

prizes amounting to 100 dollars for the electrical students, as a token of their keen interest and their confidence in the new department. The Canadian Porcelain Company, Northern Electric Company, R.C.A. Victor, Montreal Light, Heat & Power Company, Rivière-du-Loup Power, Saguenay Power Company, the City of Quebec, the Hôpital du St-Sacrement in Quebec, have all made valuable contributions to the laboratories.

## MEETING OF COUNCIL

A meeting of the Council of the Institute was held at Headquarters on Saturday, September 19th, 1942, at ten thirty a.m.

*Present:* President C. R. Young in the chair; Vice-President K. M. Cameron; Councillors J. E. Armstrong, E. D. Gray-Donald, J. G. Hall, R. E. Heartz, W. G. Hunt, G. M. Pitts, and J. A. Vance; Secretary Emeritus R. J. Durley, General Secretary L. Austin Wright, and Assistant General Secretary Louis Trudel.

The recommendation of the Finance Committee that the two new Institute medals which had been authorized at the February meeting of Council, be known as (1) The T. C. Keefer Medal for papers on civil engineering, and (2) The R. A. Ross Medal for papers on electrical engineering, was approved unanimously. No action was taken regarding the preparation of designs or the procuring of dies for the new medals.

The general secretary reported that considerable progress was being made with regard to the Annual Meeting, which would be held at the Royal York Hotel, Toronto, on Thursday and Friday, February 11th and 12th, 1943. Mr. Ross Robertson has been appointed chairman of the Finance Committee, and Professor R. F. Leggett chairman of the Papers Committee.

The papers will be of a war nature and will feature three of the important committees recently appointed by Council—Post-War Problems, Civil Defence and Industrial Relations. One professional session will be devoted to a discussion on manpower in the United States and Canada. It is hoped to continue the custom established in recent years of having as special guests the presidents and secretaries of the American Societies. Interesting plant visits will also be arranged. The social functions will be of an informal character.

Mr. Hall, chairman of the Institute's Membership Committee, reported that his committee had studied item by item the resolution of the Toronto Branch regarding the consideration of applications for membership, which had been referred to it by Council some time ago. The committee presented a detailed report, and recommended (1) that Council send to each branch a memorandum for their guidance in considering applications for admission; and (2) that a form or chart be used by all branches in reporting their findings and recommendations to Council.

Mr. Gray-Donald thought it would be a great help if instructions or rules for the guidance of the branches in considering applications were drawn up. He felt that at the present time the classification of Institute Affiliate was being given to candidates who were not eligible for full membership, and who were not ready to take the Institute examinations. His understanding of that classification was that it should be given to persons, not necessarily engineers, whose past experience and attainments would add to the prestige of the Institute.

Mr. Hall pointed out that that classification, as well as that of Branch Affiliate, had been reported on some time ago by the Membership Committee which was still endeavoring to find an appropriate name for Branch Affiliates that would distinguish them from Institute Affiliates. His interpretation was that an Institute Affiliate might be a person of a very high calibre but not necessarily an engineer.

Mr. Pitts presented a suggestion that joint membership in the Institute and a professional association should be

recognized by some new designation such as P.M.E.I.C. He thought this might be a senior classification in the Institute which would attract persons who were not now members of an association and the Institute. The president pointed out that this was an entirely new suggestion which might properly be referred to the Institute Membership Committee for consideration and report.

Following further discussion, on the motion of Mr. Hall, seconded by Mr. Vance, it was unanimously resolved that the report of the Membership Committee be adopted, and that copies be sent to all branches and members of Council with a request for an expression of opinion on the draft form suggested for the use of branch executive committees.

On the motion of Mr. Vance, seconded by Mr. Heartz, it was unanimously resolved that Dr. J. S. Bates and Mr. Huet Massue be appointed members of the Committee on Post-War Problems.

In presenting the progress report of his Committee on the Engineering Features of Civil Defence, Mr. Armstrong stated that since the last council meeting his committee had made rapid progress. Some of the work had now advanced to a stage that required some action by Council in order that further progress might be made.

Three additional branches had appointed branch committees although seven of the branches had not yet taken this action. The president pointed out that the Cape Breton Branch would not appoint a committee as it was co-operating with the Halifax branch under the chairmanship of Councillor I. P. Macnab.

Mr. Armstrong then commented on his report item by item. His committee was still co-operating with Dr. Manion's committee on A.R.P., but there was nothing special to report at the moment in that connection. The main committee is keeping in close touch with the branch committees. The sub-committee on protection against bombing, etc., was at work under the chairmanship of Councillor G. M. Pitts, but no report had yet been received from that committee.

Professor Legget, Chairman of the Sub-Committee on Men, Plant and Materials for Repairs to Major Engineering Structures and Works, has been very active. He is proceeding carefully with the appointment of personnel for his sub-committee with a view to having its membership such as to serve as the centering points throughout Canada for currently carrying on the work of the sub-committee during an emergency. He has tentatively in mind a representative in the maritime provinces, in Quebec, in Ontario, in the prairie provinces and in British Columbia. In the meantime, the Toronto Branch Committee has offered to assist him in any way possible.

Professor Legget is now in touch with H. W. Lea, Director, Wartime Bureau of Technical Personnel, in regard to men and with H. H. Bloom, Administrator, Farm and Construction Machinery, Wartime Prices and Trade Board, in regard to plant, but has not yet made the type of contact he desires in connection with materials. An attempt is being made to develop a single contact in connection with priorities for repair materials, if, as and when required, Such a contact should save much time in an emergency as compared with the probable alternative of approaching each material Controller concerned in each individual case of damage.

President Young expressed Council's thanks and appreciation of the tremendous amount of work which Mr. Armstrong and his committee had done. The report represented one of the finest pieces of work ever undertaken by the Institute.

In response to a request from the secretary of the Canadian Chamber of Commerce, it was unanimously resolved on the motion of Mr. Vance, seconded by Mr. Gray-Donald that Vice-President deGaspé Beaubien be nominated as the Institute's representative on the board of directors of the Canadian Chamber of Commerce for the year 1942-1943.

A number of applications were considered and the following elections and transfers were effected:

## ELECTIONS AND TRANSFERS

At the meeting of Council held on September 19th, 1942, the following elections and transfers were effected:

ADMISSIONS	
Members.....	7
Juniors.....	3
Students.....	7
Affiliate.....	1
TRANSFERS	
Junior to Member.....	4
Student to Member.....	1
Affiliate to Member.....	1

It was noted that the next meeting of Council would be held at the General Brock Hotel, Niagara Falls, Ontario, on Tuesday, October 13th, 1942, convening at two o'clock p.m.

The Council rose at one forty p.m.

### "LIONS' GATE BRIDGE" PAPER AVAILABLE IN REPRINT FORM

The excellent paper by S. R. Banks, M.E.I.C., on "The Lions' Gate Bridge" published in four instalments in recent issues of the *Journal*, has been reprinted under one cover. This unabridged edition contains 60 pages and is amply illustrated.

The paper, which was awarded the Gzowski Medal of the Institute for 1941, is a faithful record of the various phases of the work on the design at Montreal, and the construction at Vancouver, of the longest suspension bridge in the Dominion. The main divisions of the paper indicate its scope: Substructure; Design and Fabrication of Superstructure; North Viaduct; Erection of Superstructure; Electrical Installation; Particulars Regarding Contracts and Personnel.

Copies of the reprint may be obtained at 30 cents each from Headquarters.

### LIST OF NOMINEES FOR OFFICERS

The report of the Nominating Committee, as accepted by Council at the meeting held on September 19th, 1942, is published herewith for the information of all corporate members as required by Sections 19 and 40 of the By-laws:

#### LIST OF NOMINEES FOR OFFICERS FOR 1943 AS PROPOSED BY THE NOMINATING COMMITTEE

PRESIDENT.....	K. M. Cameron.....	Ottawa
VICE-PRESIDENTS:		
*Zone "A" (Western Provinces).....	W. P. Brereton.....	Winnipeg
*Zone "B" (Province of Ontario).....	L. F. Grant.....	Kingston
*Zone "C" (Province of Quebec).....	C. K. McLeod.....	Montreal
COUNCILLORS:		
†Vancouver Branch.....	C. E. Webb.....	Vancouver
†Edmonton Branch.....	E. Nelson.....	Edmonton
†Saskatchewan Branch.....	A. M. Macgillivray.....	Saskatoon
†Lakehead Branch.....	H. G. O'Leary.....	Fort William
†Ottawa Branch.....	N. B. MacRostie.....	Ottawa
†Toronto Branch.....	H. E. Brandon.....	Toronto
†Border Cities Branch.....	G. E. Medlar.....	Windsor
	J. F. Bridge.....	Sandwich
†London Branch.....	J. A. Vance.....	Woodstock
†Kingston Branch.....	A. Jackson.....	Kingston
†Montreal Branch.....	E. V. Gage.....	Montreal
	J. A. Lalonde.....	Montreal
†St. Maurice Valley Branch.....	H. J. Ward.....	Shawinigan Falls
†Saguenay Branch.....	J. W. Ward.....	Arvida
†Saint John Branch.....	J. P. Mooney.....	Saint John
†Halifax Branch.....	C. Scrymgeour.....	Dartmouth

\*One vice-president to be elected for two years.

†One councillor to be elected for two years.

‡Two councillors to be elected for three years each.

#### Members

- Langevin, Louis Emilien**, B.A.Sc., C.E. (Ecole Polytechnique), constg. engr., 513 Rachel St. East, Montreal, Que.  
**Magnant, Daniel Armand**, B.A.Sc., C.E. (Ecole Polytechnique), development engr., Bouchard plant, Defence Industries Limited, Ste. Therese, Que.  
**Swinton, Kurt Rudolf**, B.Sc., M.Sc. (Technical Univ., Vienna), Lieut., R.C.C.S., on staff of Director of Signals Design, Army Engrg. Design Br., Dept. of Munitions & Supply, Ottawa, Ont.  
**Theriault, L. Leon**, B.Sc. (Univ. of N.B.), motor vehicle dept., Dept. of Public Works, Fredericton, N.B.  
**Tourigny, Charles E.**, B.A.Sc., C.E. (Ecole Polytechnique), director of customers' service bureau, Shawinigan Water & Power Company, Montreal, Que.  
**Van den Broek, Jan A.**, B.Sc. (Univ. of Kansas), Ph.D. (Univ. of Mich.), professor of engineering mechanics, University of Michigan, Ann Arbor, Mich.  
**Watts, Thomas Ord**, B.Sc. (Queen's Univ.), works mgr., Sutton-Horsley Co. Ltd., Toronto, Ont.

#### Juniors

- Caverly, Jefferson Austin**, B.Eng. (Geol.), (Univ. of Sask.), exploration engr., for Howe Sound Co. of New York, at Snow Lake, Man.  
**Dillon, Eldridge Arthur**, B.Eng. (N.S. Tech. Coll.), student engr., Can. Gen. Elec. Co. Ltd., Peterborough, Ont.  
**Laari, William**, B.A.Sc. (Univ. of Toronto), jr. field engr., Canadian Allis Chalmers Mfg. Co., Toronto, Ont.

#### Affiliate

- Swanston, Murray Maxwell**, Flying Officer, R.C.A.F. Station, Gander, Nfld.

*Transferred from the class of Junior to that of Member*

- Charlewood, Charles Benjamin**, Lieut., R.C.A., B.Sc. (Mech.), (McGill Univ.), c/o British Columbia House, 1-3 Regent St., London, S.W.1, England.  
**Grant, Wilfrid John**, B.A.Sc. (Univ. of Toronto), engrg. dept., Fraser Brace Ltd., Montreal, Que.  
**Jackson, William Hayes**, B.A.Sc. (Univ. of Toronto), chief dfsman., De Havilland Aircraft of Canada Ltd., Toronto, Ont.  
**Petursson, Hannes Jon**, B.Sc. (Univ. of Man.), instr'man., Dept. of Highways of Ont., Longlac, Ont.

*Transferred from the class of Student to that of Member*

- Miller, Dudley Chipman Raphael**, B.A.Sc. (Univ. of Toronto), supt. of optical shops, Research Enterprises Limited, Toronto, Ont.

*Transferred from the class of Affiliate to that of Member*

- Haltrecht, Arnold**, M.E. (Tech. Univ. of Darmstadt), elec. engrg. lab., National Research Council, Ottawa, Ont.

#### Students Admitted

- Albert, Leo Maurice** (St. Francis Xavier Univ.), P.O. Box 458, Edmundston, N.B.  
**Boulet, Lionel** (Laval Univ.), 172 St. Olivier St., Quebec, Que.  
**Edwards, George Robert** (N.S. Tech. Coll.), Improver 1st., H.M.C. Dockyard, Halifax, N.S.  
**Near, Frank Manning** (Univ. of Toronto), 39 Alexandra Blvd., Toronto, Ont.  
**Provias, Peter** (McMaster Univ.), R.C.A.F. (Air Crew), No. 3 Manning Depot, Edmonton, Alta.  
**Syme, Thomas Duff** (Univ. of B.C.), 8208 Hudson St., Vancouver, B.C.  
**Tulk, Egbert Gordon** (N.S. Tech. Coll.), electrician's helper, H.M.C. Dockyard, Halifax, N.S.  
**Vail, Bert Frank** (N.S. Tech. Coll.), 953 Barrington St., Halifax, N.S.

### COMING MEETINGS

**Canadian Institute on Sewage and Sanitation**—Ninth annual convention, Royal York Hotel, Toronto, October 29-30.

**Interprovincial Highway Conference** at Seigniory Club, Montebello, Que., October 28-29.

**Canadian Good Roads Association**—Annual general meeting in Conference Hall of Seigniory Club, Montebello, Que., at 5 p.m., October 29. Secretary-treasurer, Geo. A. McNamee, New Birks Bldg., Montreal, Que.

# RULES GOVERNING AWARD OF INSTITUTE PRIZES

## THE SIR JOHN KENNEDY MEDAL

A medal, called the "Sir John Kennedy Medal," was established in 1927, to be awarded under the following rules in commemoration of the great services rendered to the development of Canada, to engineering science and to the profession by the late Sir John Kennedy, past-president of The Engineering Institute of Canada.

- (1) The medal shall be awarded by the council of the Institute, at intervals of not less than two years, but only when the occasion warrants, as a recognition of outstanding merit in the profession or of noteworthy contribution to the science of engineering or to the benefit of the Institute.
- (2) As a guide in making the award, the council of the Institute shall take into consideration the life, activities and standing in the community and profession of the late Sir John Kennedy.
- (3) Awards shall be limited to corporate members.
- (4) At the beginning of the year of award, all members of Council shall be asked for their recommendations, supported by reasons, for the award of the medal, which must be submitted to council not later than May first. The council of the Institute shall then give consideration to the recommendations, but will not necessarily adopt any of them. If, in the opinion of the council, no corporate member of the Institute thus recommended is of sufficient merit or distinction, no award shall be made.
- (5) The award shall be decided by letter ballot of the council in a form to be prescribed by the council. The ballot shall be mailed to each member of the council and shall state the date of the council meeting at which it is proposed to canvass the ballot, which shall not be less than twenty days after the issue of the ballot. Unless at least twenty-five votes are cast there shall be no award. There shall be no award if more than two negative votes are cast.
- (6) Announcement of an award shall be made in *The Engineering Journal* and at the annual meeting, and, if possible, the presentation shall take place at that meeting.

## THE JULIAN C. SMITH MEDAL

This medal was founded in 1939 by a group of senior members to perpetuate the name of the late past-president of the Institute. It is awarded for "achievement in the development of Canada." The inaugural awards—eleven in number—were made in 1940 and 1941, but subsequent awards are limited to not more than two each year.

The general secretary shall ask each past-president and each vice-president of the Institute for nominations, which shall be submitted to a committee of three consisting of the president and two members of Council appointed by him. This committee may select not more than two names from the nominations, which name or names shall be submitted by open letter ballot to all councillors not later than October first of each year. At least twenty days shall elapse before the ballot is closed. Unless at least twenty-five votes are cast there shall be no award. There shall be no award if more than two negative votes are cast.

It is possible that some special occasion—a centenary celebration or the like—may arise when it would evidently be desirable to award more than two Julian C. Smith medals. In such a case departure from the prescribed limit may be permitted, but only if authorized by a formal resolution of Council, stating the special reasons for the action.

## DUGGAN MEDAL AND PRIZE

A prize of a medal and cash to a combined value of approximately one hundred dollars was established in 1935, to be given each year from the proceeds of a donation by Past-President G. H. Duggan, D.Sc., LL.D., M.E.I.C., for the purpose of encouraging the development of the branches of engineering in which he practised.

The prize will be awarded for the best paper presented to the Institute in accordance with the following rules:

- (1) Competition shall be open to all members of the Institute.
- (2) The papers shall be presented to the Institute either at the regular meeting of a branch or at a professional meeting of

the Institute, or directly to Headquarters. They shall not have been presented previously to any other body or meeting.

- (3) Papers to be eligible for this competition shall deal with subjects concerning the use of metals for structural or mechanical purposes. Without limiting the generality of the foregoing, it is suggested that the following topics come within this category; viz.: the economic and theoretical elements of design, fabrication, machinery, transporting, erecting, the investigation of problems or failures, methods of overcoming difficulties, new methods of design or manufacturing, the recording of tests, and other features that add to engineering knowledge.
- (4) Papers shall be the bona fide production of the author and proper credit shall be given for any assistance received from other parties, partners or reports. The relation of the author to the work shall be clearly stated. Papers shall be compiled and arranged with proper regard to literary value and shall constitute worthy contributions to the records of the engineering profession.

In judging the competition consideration will be given to the personal knowledge and appreciation of the problems and processes involved and the joint application of theoretical and practical considerations to the execution of the subject which are displayed on the part of the author.

- (5) The papers shall be judged by a committee of three corporate members, eminent in the corresponding branch of the profession, appointed for the purpose by council as required.
- (6) The award shall be made only when a paper of sufficient merit is presented. The prize year shall be from July 1st to June 30th and papers must be presented to Headquarters of the Institute by the 30th day of June.
- (7) The prize shall be awarded at the annual meeting.

## THE GZOWSKI MEDAL

A gold medal, called "The Gzowski Medal," is provided from the fund established in 1889 by Col. Sir Casimir Gzowski, A.D.C., K.C.M.G., late past-president of the Institute, and will be awarded according to the following rules for papers presented to the Institute.

- (1) Competition for the medal shall be open only to those who belong to the Institute.
- (2) The award of medals shall not be made oftener than once a year, the medal year shall be the year ended June last previous to the annual meeting at which the award is to be made.
- (3) The papers entered for competition shall be judged by a committee of five, to be called the Gzowski Medal Committee, which shall be appointed by the council as soon after the annual meeting of the Institute as practicable. Members and Honorary Members only shall be eligible to act on this committee.
- (4) Papers to be eligible for competition must be the bona fide production of those who contribute them, and must not have been previously made public, nor contributed to any other society in whole or in part.
- (5) The medal shall be awarded for the best paper of the medal year, provided such paper shall be adjudged of sufficient merit as a contribution to the literature of the profession of civil engineering, but not otherwise.
- (6) In the event of the committee not considering a paper in any one year of sufficient merit, no award shall be made; but in the following year or years, it shall be in the power of the committee to award the accumulated medals to the authors of different papers which may be deemed of sufficient merit.
- (7) The medal shall be suitably engraved by the Institute, and shall be handed to the successful authors at the annual meeting, or be given to them as soon afterwards as possible.

### THE LEONARD MEDAL

A gold medal, called "The Leonard Medal," is provided from the annual proceeds of a fund established in 1917 by the late Lieut.-Col. R. W. Leonard, and will be awarded in accordance with the following rules for *papers on mining subjects* presented either to The Canadian Institute of Mining and Metallurgy or to The Engineering Institute of Canada.

- (1) Competition for the medal shall be open to those who belong to The Canadian Institute of Mining and Metallurgy or to The Engineering Institute of Canada.
- (2) Award shall be made not oftener than once a year, and the medal year shall be the year ended June last previous to the year in which the award is made.
- (3) The medal shall be presented at annual meetings of The Engineering Institute of Canada.
- (4) A committee of five shall judge the papers entered for competition, all of whom shall be members both of The Canadian Institute of Mining and Metallurgy and The Engineering Institute of Canada, this committee to be appointed by the council of The Engineering Institute of Canada.
- (5) All papers presented shall be the work of the author or authors and must not have been made previously public, except as part of the literature of The Canadian Institute of Mining and Metallurgy or The Engineering Institute of Canada.
- (6) Should the committee not consider the papers presented in any one year of sufficient merit, no award shall be made, but in the following year, or years, the committee shall have power to award the accumulated medals or to award a second prize in the nature of a silver medal, or a third prize of books to be selected by the committee.
- (7) The medal shall be suitably engraved, containing the name of The Engineering Institute of Canada, and the words, "The Leonard Medal" together with the adopted design, and on the reverse side the name of the recipient, the date and any other inscription that may be decided upon by the committee.

### THE PLUMMER MEDAL

A gold medal, called "The Plummer Medal," is provided from the annual proceeds of a fund established in 1917 by J. H. Plummer, D.C.L., and will be awarded according to the following rules for *papers on chemical and metallurgical subjects* presented to the Institute.

- (1) Competition for the medal shall be open to those who belong to The Engineering Institute of Canada, and to non-members if their papers have been contributed to the Institute and presented at an Institute or Branch meeting.
- (2) Award shall be made not oftener than once a year, and the medal year shall be the year ended June last previous to the year in which the award is made.
- (3) The medal shall be presented at annual meetings of The Engineering Institute of Canada.
- (4) A committee of five shall judge the papers entered for competition, all of whom shall be members of The Engineering Institute of Canada, and shall be appointed by the council of the Institute.
- (5) All papers presented shall be the work of the author or authors and must not have previously been made public, except as part of the literature of The Engineering Institute of Canada.
- (6) Should the committee not consider the papers presented in any one year of sufficient merit, no award shall be made, but in the following year, or years, the committee shall have the power to award the accumulated medals or to award a second prize in the nature of a silver medal, or a third prize of books to be selected by the committee.
- (7) The medal shall be suitably engraved, containing the name of The Engineering Institute of Canada, and the words, "The Plummer Medal," together with the adopted design, and on the reverse side the name of the recipient, the date and any other inscription that may be decided upon by the committee.

### PRIZES TO STUDENTS AND JUNIORS

- (1) Five prizes may be awarded annually for the best papers presented by Students or Juniors of the Institute in the vice-presidential zones of the Institute, as follows:—

The H. N. Ruttan Prize,—  
in Zone A—The four western provinces.

The John Galbraith Prize,—  
in Zone B—The province of Ontario.

The Phelps Johnson Prize,—  
for an English Student or Junior in Zone C—The province of Quebec.

The Ernest Marceau Prize,—  
for a French Student or Junior in Zone C—The province of Quebec.

The Martin Murphy Prize,—  
in Zone D—The Maritime provinces.

- (2) Awards shall only be made if, in the opinion of the examiners for a zone, a paper of sufficient merit has been presented to a branch in that particular zone.
- (3) The winner of a prize shall be required to specify such technical books or instruments as he may desire to the total value of approximately twenty-five dollars when suitably bound and printed or engraved, as the case may be.
- (4) The award of prizes shall be for the year ending June thirtieth. On that date, each branch secretary shall forward to the examiners for his particular zone all papers presented to his branch by Students and Juniors during the prize year, regardless of whether they have been read before the branch or not.
- (5) The prizes shall be awarded only to those who are in good standing as Students or Juniors of the Institute of June thirtieth following the presentation of the paper.
- (6) The papers must be the bona fide production of those contributing them and must not have been previously made public or contributed to any other society in whole or in part. It is to be understood, however, that a paper which has won or been considered for a branch prize is nevertheless eligible for the Institute Prize. No paper shall be considered for more than one of the five prizes.
- (7) The examiners for each zone shall consist of the vice-president of that zone and two councillors resident in the zone, appointed by council. In the case of Zone C, two groups of examiners shall be appointed under the two vice-presidents, one for the English award and one for the French award. The awards shall be reported to the annual meeting of the Institute next following the prize year, and the prizes presented as soon thereafter as is reasonably possible.

### PRIZES TO UNIVERSITY STUDENTS

In 1930 Council established eleven cash prizes of twenty-five dollars each for competition among students of Canadian engineering schools, in the year prior to the graduating year. Awards are now made annually to the following institutions:

University of Alberta  
University of British Columbia  
Ecole Polytechnique, Montreal  
Laval University, Quebec  
University of Manitoba  
McGill University  
University of New Brunswick  
Nova Scotia Technical College  
Queen's University  
Royal Military College  
University of Saskatchewan  
University of Toronto.

It is the desire of council that the method of their award shall be determined by the appropriate authority in each school or university, so that a prize may be given to the student in any department of engineering who has proved himself most deserving, not only in connection with his college work, but also as judged by his activities in the student engineering organization, if any, or in the local branch of a recognized engineering society.

It is not necessary for the recipient to belong to the Institute, and in this respect the prizes are quite distinct from those offered to Students and Juniors of the Institute, or from the prizes which are offered by a number of our branches to the Students attached to them.

It is felt that the establishment of these prizes not only aids deserving students, but assists in developing their interest in engineering societies' work, and in the resulting acquirement and interchange of professional knowledge.

**Fraser S. Keith**, M.E.I.C., is the new president of the McGill Graduates Society. Graduating with honours in 1903, Mr. Keith remained on the staff for a year as senior demonstrator in the electrical department. Following a number of years devoted to technical journalism, he went to Vancouver where he was engaged in concrete construction and the manufacture and sale of concrete materials.

Returning East early in 1915, he became eastern manager of technical publications with the MacLean Publishing Company. He became managing editor of *Construction* in Toronto, from which position he was appointed to the position of first full-time secretary of the Canadian Society of Civil Engineers, which changed its name to "The Engineering Institute of Canada" a year later. Mr. Keith designed and inaugurated for the Institute the *Engineering Journal* and was its first editor and manager.



Fraser S. Keith, M.E.I.C.

In 1925 Mr. Keith resigned to accept the position which he still occupies, that of manager of the Department of Development of The Shawinigan Water and Power Company, Montreal.

**Gordon McL. Pitts**, M.E.I.C., retiring president of the McGill Graduates Society has been elected to the Board of Governors of his University. Mr. Pitts is a member of the Council of the Institute as well as president of the Royal Architectural Institute of Canada.

**James B. Woodyatt**, M.E.I.C., has been elected first vice-president of the McGill Graduates Society. Graduated from the class of 1907 he served an apprenticeship with the Canadian Westinghouse Company Limited and during the winter of 1908 and 1909 he carried out investigations of ice conditions in the Gulf and River St. Lawrence for the government. Later he was a sales engineer for Allis-Chalmers-Bullock Company Limited and in 1910 he became superintendent of the Sherbrooke Railway and Power Company, being appointed general manager in 1916, and in 1920 vice-president. In 1925 he became president of the company. Mr. Woodyatt is also vice-president and general manager of the Power Corporation of Canada, Limited.

**R. E. Stavert**, M.E.I.C., vice-president of the Consolidated Mining and Smelting Company of Canada Limited, has been elected to the Executive Committee of the McGill Graduates Society.

**G. E. Booker**, M.E.I.C., is now employed by Wartime Housing Limited and is on loan to Gore and Storrie, consulting engineers of Toronto. For the past few years Mr. Booker had been on the staff of the Bathurst Power and Paper Company, at Bathurst, N.B.

## News of the Personal Activities of members of the Institute, and visitors to Headquarters

**R. H. Rimmer**, M.E.I.C., is the newly elected chairman of the Saguenay Branch of the Institute. Born at Burlington, N.C., U.S.A., he was educated at the University of North Carolina, where he graduated as bachelor of science in chemical engineering in 1918. Upon graduation he joined the United States Navy as a chemist and inspector. From 1919 to 1922 he was with E. I. DuPont de Nemours Company at Wilmington, Del., as a chemist. In 1922 he joined the research bureau of the Aluminum Company of America at Badin, N.C., as a chemical engineer and remained in the bureau till 1928 when he was transferred to the Aluminum Company of Canada, Limited, at Arvida, Que. In 1930 he became assistant superintendent of the Aluminum plant at Arvida. At present he is in charge of the research and development work at Arvida.

**Major A. Sidney Dawes**, M.E.I.C., has recently been elected to the board of Montreal Light, Heat and Power Consolidated. Educated at Montreal High School and McGill University, where he graduated as a bachelor of science in 1910, Mr. Dawes began his engineering career as an apprentice in the Canadian Westinghouse Company's shops at Hamilton, Ont. Early in 1914, he joined the Atlas Construction Company but on the declaration of war enlisted in the Canadian Field Artillery.

Proceeding to France in 1915 he was twice wounded, received his captaincy in 1917; a year later he was promoted major and awarded the Military Cross. On demobilization he rejoined the Atlas Construction Company, of which he is presently president and managing director.

Major Dawes is president and managing director of the Belmont Construction Company, vice-president of Federal Aircraft Limited, president of the Windsor Mills Elementary Flying School—now a part of the British Commonwealth Air Training Plan—and a director of the Reliance Insurance Company.

**J. E. St. Laurent**, M.E.I.C., has been appointed vice-president of the National Harbours Board at Ottawa. He had been chief engineer of the River St. Lawrence Ship Channel, Department of Transport, Montreal, since 1937. He was previously with the Department of Public Works in Ottawa. Mr. St. Laurent graduated from the Ecole Polytechnique, Montreal, in 1909 and since then has been employed in various capacities throughout Canada with the above department. He was for a time district engineer at Port Arthur and also at Winnipeg. He has been in Ottawa since 1925.

**Captain F. S. Jones**, M.E.I.C., has been promoted to the position of chief engineer of the River St. Lawrence Ship Channel's Branch of the Department of Transport at Ottawa. Mr. Jones joined the department in 1916 upon his graduation from the University of New Brunswick and he has been assistant chief engineer since 1937. During the last war he served overseas with the Royal Canadian Engineers and received the Military Cross.

**J. M. M. Lamb**, M.E.I.C., has been appointed district engineer of the Department of Transport at St. John, N.B., succeeding Lieutenant-Colonel H. F. Morrisey, M.E.I.C., who died last summer. Mr. Lamb received his engineering education at the University of New Brunswick. He has been in the service of the Dominion Government for the last 29 years, having joined the Department of Public Works as assistant engineer in 1913.

**R. E. Farmer**, M.E.I.C., division engineer with the Canadian Pacific Railway at Woodstock, N.B., has been transferred to the same position at Sudbury, Ont.



S. G. Porter, M.E.I.C.



Augustus Griffin, M.E.I.C.



G. P. F. Boese, M.E.I.C.

**S. G. Porter, M.E.I.C.**, a past president of the Institute, has recently retired from the position of manager of the Department of Natural Resources of the Canadian Pacific Railway at Calgary, Alta. He has occupied this position since 1927. Mr. Porter joined the company in 1918 as superintendent of operation and maintenance of the southern section of the Canadian Pacific Railway irrigation system with headquarters at Lethbridge. Mr. Porter will succeed P. L. Naismith as chairman of the Advisory Committee to the Department of Natural Resources and will continue as president of the Lethbridge Collieries Limited, which position he has held since the establishment of the collieries.

**Augustus Griffin, M.E.I.C.**, for the past year assistant manager of the Department of Natural Resources of the Canadian Pacific Railway at Calgary has taken over as manager of the department succeeding S. G. Porter who has retired.

Mr. Griffin has been in the service of the Company since 1918. He was born in Visalia, California. In 1906 he graduated from the University of California with the degree of B.Sc. in civil engineering, specializing in irrigation. From 1906 to 1918 he supervised a number of irrigation projects in California, and in the latter year came to Canada as superintendent of operation and maintenance of the Canadian Pacific Railway's Eastern Section Irrigation Project at Brooks, Alta., where he remained until 1935. In 1932 he succeeded the late Mr. A. S. Dawson as chief engineer of the Department of Natural Resources. In 1935 his headquarters were moved to Strathmore, Alta., where he supervised the operation of the Company's Western Section Irrigation Project. He is a recognized authority on irrigation, both in Canada and the United States, and for two years he was chairman of the Irrigation Division of the American Society of Civil Engineers.

The Department of Natural Resources has under its jurisdiction the administration of the Company's lands, townsites, irrigation works, petroleum, gas and coal rights, and timber properties, and covers in a general way the natural resources of the Company in western Canada.

**G. P. F. Boese, M.E.I.C.**, has been appointed chief engineer of the Department of Natural Resources, Canadian Pacific Railway, following Mr. A. Griffin, who succeeded to the management of the Department on the retirement of Mr. S. G. Porter, effective September 1st.

Mr. Boese was educated in England and came to Canada in 1907. He entered the Engineering Department of the railway that year and was subsequently engaged on points, including Ottawa, Montreal, Hamilton, the Laurentians (Quebec), the north shore of Lake Superior, and the north shore of Lake Ontario where, until coming west in 1915, he was resident engineer on construction work.

During the past 25 years Mr. Boese has been connected with the Department of Natural Resources and most of that period he was engaged as assistant to the chief engineer for the Company's irrigation projects in Alberta. He has been chairman of the Calgary Branch of the Institute and also a member of Council.

**S. D. Lash, M.E.I.C.**, is now assistant professor of civil engineering at Queen's University, Kingston, Ont. He joined the teaching staff at Queen's last year as a lecturer in civil engineering.

**T. A. Carter, M.E.I.C.**, is now with the Aluminum Production Company of India in Travancore, South India. Since his graduation in electrical engineering from Queen's University in 1931 he has been employed with the Saguenay Power Company in northern Quebec.

**W. G. Jewitt, M.E.I.C.**, who was employed with Consolidated Mining and Smelting Company at Goldfields, Sask., has been transferred to the company's plant at Yellowknife, N.W.T.

**Henry Jasen, M.E.I.C.**, is now employed with the Aluminum Company of Canada at Montreal.

**John Middleton, M.E.I.C.**, has recently been admitted as an associate member of the Institute of Naval Architects, London, Eng. He is an assistant engineer in the Department of National Defence, Naval Service, Ottawa.

**C. E. Wright, M.E.I.C.**, is now employed in the Special Products Division of the Northern Electric Company, Montreal. He was previously located at Winnipeg, Man., as an inspecting engineer with the Western Canada Insurance Underwriter's Association.

**A. M. Thurston, Jr., M.E.I.C.**, was appointed, last June, plant manager of the Dominion Electric Protection Company at Montreal. He joined the company in December 1941, after having been five years with the Shawinigan Water and Power Company at Montreal. He graduated in electrical engineering from McGill in 1936.

**Gordon T. Tibbo, S.E.I.C.**, is now employed with Colas Newfoundland Limited as chemist and production engineer. He served as Sub-Lieutenant in the R.C.N.V.R. from December 1940 to November 1941, when he was discharged as medically unfit. Mr. Tibbo graduated in mechanical engineering from the Nova Scotia Technical College in 1940.

**H. F. Duffy, S.E.I.C.**, is now employed with the Saguenay Power Company at Arvida, Que. He was previously located at Fredericton, N.B., having graduated in electrical engineering from the University of New Brunswick, in 1939.

# Obituaries

*The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.*

**C. E. Demers**, S.E.I.C., is now employed with H. G. Acres Company on the Shipshaw power development at Kenogami, Que. He is a graduate of Queen's University in the class of 1941.

**E. M. Cantwell**, S.E.I.C., has joined the staff of the Consolidated Mining and Smelting Company Limited at Yellowknife, N.W.T. He graduated last spring from McGill.

**Bernard Beaupré**, S.E.I.C., has been granted a fellowship by the Kellogg Foundation and has entered the University of Toronto where he will do post-graduate work in health engineering. Mr. Beaupré graduated from the Ecole Polytechnique of Montreal in 1941 and spent the past year on the staff of Dominion Bridge Company, Limited, at Montreal.

**Robert Davis**, Affiliate E.I.C., has recently returned with the Dominion Bridge Company, Limited, in Toronto, Ont., after having been on loan for a few months to the Wartime Merchant Shipping at Montreal. Mr. Davis has been with the Dominion Bridge Company since he came to Canada from Scotland in 1923.

**Anthony B. Rossetti**, S.E.I.C., is employed with Defence Industries Limited, Montreal. He graduated last spring in mechanical engineering from the Nova Scotia Technical College.

**W. D. Mackinnon**, S.E.I.C., is now employed by No. 2 Training Command, R.C.A.F., Works and Buildings Division as junior engineer at No. 5. Air Observers School Winnipeg, Man. He graduated in civil engineering from the University of Manitoba in 1941.

## VISITORS TO HEADQUARTERS

**H. G. Angell**, M.E.I.C., recently returned from Bermuda, on September 2nd.

**H. J. Hamilton**, Wartime Bureau of Technical Personnel, Ottawa, Ont., on September 2nd.

**P. E. L'Heureux, Jr.**, E.I.C., Department of Roads, Sherbrooke, Que., on September 5th.

**H. P. Moller**, M.E.I.C., Lake St. John Power and Paper Company, Dolbeau, Que., on September 8th.

**M. Fast**, S.E.I.C., Aluminum Company of Canada, Shawinigan Falls, Que., on September 12th.

**N. D. Paine**, M.E.I.C., from Kenogami, Que., on September 16th.

**John D. Johnson**, American Consul, Montreal, Que., on September 17th.

**S. D. Lash**, M.E.I.C., Queen's University, Kingston, Ont., on September 17th.

**P O J. B. Sweeney**, S.E.I.C., Eastern Air Command, Halifax, N.B., on September 18th.

**K. M. Cameron**, M.E.I.C., Chief Engineer, Department of Public Works, Ottawa, Ont., on September 19th.

**J. Gordon Kirkwood**, S.E.I.C., Canadian Bridge Company, Windsor, Ont., on September 22nd.

**Gustave St-Jacques**, M.E.I.C., Public Service Board, Quebec, Que., on September 23rd.

**M. S. Mitchell**, S.E.I.C., Foothills, Alta., on September 25th.

**W. V. Morris**, S.E.I.C., Aluminum Company of Canada, Winnipeg, Man., on September 25th.

**P O Jean Dessaulles**, S.E.I.C., Bombing and Gunnery School, R.C.A.F., Mont Joli, Que., on September 26th.

**Willie Harry Baltzell**, M.E.I.C., died at his home in Pittsburgh, Pa., on September 2, 1942. Born in Washington County, Maryland, U.S.A., on August 4th, 1868, he moved to Pittsburgh in 1891 where he entered the steel business as chief engineer for the Schoenberger Works. When the plant was merged with the American Steel and Wire Company he became district engineer of that company. Later he was chief engineer of the Donora works of the United States Steel Corporation and then he went with the Canadian Steel Corporation at Ojibway, Ont. He retired in 1938 and returned to Pittsburgh.

In 1911 to 1914 he designed and built the noted Midland Works of the Crucible Steel Company of Pittsburgh (subsidiary of the Crucible Steel of America). This plant was known to be the most modern plant in the country at that time. Carefully designed for future development, economically constructed, and operating with less manpower than any competitors, its capitalization per ton of steel made it the ranking plant in the steel world. It is still keeping pace with modern methods of to-day.

During the first World War about 1914 to 1915 he designed and built furnaces for the Aetna Chemical Company at Heidelberg, near Pittsburgh, where the famous Rittman process—producing tri-nitro-toluol (T.N.T.)—was being used. Here he developed certain valuable formulae for that work.

He was a life member of the American Society of Mechanical Engineers and the Engineers Society of Western Pennsylvania. He also held memberships in the Association of Iron and Steel Engineers, American Iron and Steel Engineers and the Association of Mining and Metallurgical Engineers.

Mr. Baltzell joined the Institute as a Member in 1920. He was instrumental in the establishment of the Border Cities Branch in which he remained very active.

**Lawson B. Porter, Jr.**, E.I.C., died in the hospital at Fredericton, N.B., on March 30, 1942. Born at Albert, N.B., on February 20, 1908, he received his engineering education at the University of New Brunswick. In the years 1929 and 1930 he was engaged in electrical inspection with Cadillac Motors, at Detroit, Mich. From 1930 to 1938 he was employed with the Saint John Harbour Commission at Saint John, N.B., in charge of field surveys. From 1938 to 1940 he was associated with Mr. Clare Mott, architect of Saint John, N.B., on the construction of several buildings. He joined the staff of the Newfoundland Railway as bridge engineer in St. John's in 1940 and up to his death he was in charge of the field construction on the programme for the rehabilitation of the main line bridges.

Mr. Porter joined the Institute as a Junior in 1938.

**Philip Reynolds**, M.E.I.C., died suddenly at his home at Dorset, England, on July 22, 1942. Born at Swindon, Wiltshire, Eng., on January 29, 1878, he received his education at Swindon Technical School. He served his apprenticeship from 1895 to 1900 with the Great Western Railway and came to Canada in 1901 as marine engineer with the Canadian Pacific Railway at Vancouver. From 1904 to 1915 he was employed in the Mechanical Department of the Canadian Pacific Railway. In 1915 to 1916 he was employed with the Imperial Munitions Board. From 1916 to 1920 he was engaged in the production of munitions as superintendent for L. M. Lymburner Limited, at Montreal. From 1921 to 1923 he was chief draftsman of the St. Lawrence Welding and Engineering Company at Montreal. In 1923, he was appointed chief engineer of the Shell Oil Company of Canada, Limited, Toronto, Ont., a position from which he retired in 1937. At that time he returned to live in Wiltshire, Eng.

Mr. Reynolds joined the Institute as a Member in 1932.

**Harry Randall Webb, M.E.I.C.**, died in a mountain accident at Mount Serrail, near Banff, Alta., on September 6th, 1942. He was born at Lucan, Ont., on January 13, 1900, and was educated at Victoria High School in Edmonton and at the University of Alberta, where he received the degree of Bachelor of Science in engineering in 1921 and of Master of Science in 1922. Upon graduation he joined the staff as a lecturer in civil engineering. In 1928 he became assistant professor and in 1932 he was appointed associate professor of civil engineering. For several years he carried on consulting work outside the university and took a leading part in important engineering projects in Canada and eastern United States.

Last year he was resident engineer in charge of construction of the Minnewanka dam, just outside of Banff. When he met his death, he was engaged in the work connected with the construction of an impounding reservoir at Lake Kananaskis. He had been investigating streams in the neighbourhood to obtain a better idea of the potential water supply.

Professor Webb joined the Institute as a Student in 1919, transferring to Junior in 1927. He became an Associate Member in 1932 and transferred to Member in 1938. He was chairman of the Edmonton Branch of the Institute in 1934. Professor Webb was instrumental in bringing about



**H. R. Webb, M.E.I.C.**

the agreement between the Institute and the Association of Professional Engineers of Alberta, and for the past three years he had been registrar of the Association. At the University he was closely connected with the Students' Engineering Society and was a former honorary president.

## News of the Branches

### HAMILTON BRANCH

A. R. HANNAFORD, M.E.I.C. - *Secretary-Treasurer*  
W. E. BROWN, J.E.I.C. - *Branch News Editor*

On the afternoon of August 7th, the completed work of the Shand Dam, near Fergus, Ont., was officially opened by Premier Mitchell Hepburn. The day was ideal and a large number of invited guests were received by the Grand River Conservation Commission together with a considerable crowd from the surrounding country. Our chairman, S. Shupe, and other officers and members of the Hamilton Branch were among the invited guests.

Before the Premier was introduced, William Philip, chairman of the Grand River Conservation Commission, reviewed the history of the work and gave great praise to W. H. Breithaupt, who was the first to envisage a plan to

### Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

control the river and expressed his pleasure that Mr. Breithaupt was able to be present to see his dream come true. Mr. Philip paid special tribute to H. G. Acres for the masterly manner in which he carried out his part of this great achievement. On being introduced by C. Gordon Cockshutt, chairman of the old Grand River Board of Trade, the Premier of Ontario was given a rousing reception as he rose to speak.

Mr. Hepburn congratulated all those who had contributed to the realization of a cherished dream—the scientific control of the waters of the Grand river. The Shand Dam and the other projects completed in connection with it would ensure an ample water supply in the dry season and would eliminate pollution from industrial wastes. It would ensure no repetition of the disastrous floods of the past, particularly the flood of 1929. He spoke at length on war matters and said that there was far too much apathy, with enslavement facing us, even in Canada. His closing remark was, "I now declare the Shand Dam officially opened."

The secretary of the Commission, Captain Roberts, had prepared refreshments in the form of sandwiches, cake and soft drinks for the guests and a great many of the spectators had the pleasure of being guests of the Commission at this stage of the occasion.

The event was a great success but space does not permit mention of all the distinguished politicians, engineers, contractors, etc., who were present.



**The Shand Dam.**

### LONDON BRANCH

H. G. STEAD, JR., E.I.C. - *Secretary*  
A. L. FURANNA, JR., E.I.C. - *Branch News Editor*

The first meeting of the Branch after the summer recess was held on Friday night, September 25, 1942, at which the guest speaker was Dr. A. E. Berry, Director of Sanitation, Engineering Department of Health, Toronto.

The speaker was introduced by Mr. W. C. Miller. Dr. Berry is a graduate in civil engineering and public health of the University of Toronto. His chosen subject was

## Some Changing Concepts in Public Health Engineering.

Dr. Berry first described public health engineering. It deals with water supply, sewage and milk, with its objective the control of disease and human welfare. The changing concepts are brought about in many ways. They are linked with chemistry, bacteriology, medicine and research; but they are also affected by advertising, shows and confusion which tend to sway public opinion.

Water supplies can be the origin of many serious epidemics as they were in England and in Europe. Although the general principles of filtration have changed little throughout the years, the technique has changed. The introduction of mechanical equipment has given better control. Recently, much work has been done in the development of taste control. These new techniques have made it possible to lower the quality of the water accepted and at the same time raise the standard of the final product.

In discussing sewage treatment, Dr. Berry stated that there are two predominant viewpoints on the use of streams for sewage dilution. Fishermen argue that no sewage should be permitted in streams unless 100 per cent treated, so as not to be detected. However, the sewage engineer maintains that the stream may be used to dispose of all sewage possible, provided that harmful bacteria has been removed. There are many new concepts in the actual treatment of sewage. Old settling tanks have been replaced by mechanical devices to remove sediment. Of course, screens can remove solids and sludge, but 100 per cent treatment can not be accomplished by screens alone. In the bacterial treatment, trickle filters, although an old process, have come back into common use, due to new development in rapid filters. This treatment is ideal for small plants. Recently, chlorine has become recognized in the treatment of bacteria and in certain cases up to 99 per cent treatment has been obtained with chlorine alone. But, due to the fact that chlorine can not completely attack solids, the remaining one per cent pollution may be dangerous and thus some other form of treatment is necessary in conjunction with chlorine.

For the collection of refuse there are also two points of view, namely, dumps and incinerators. Of course, incinerators are ideal, but their cost is often excessive. Dumps are controllable. They are very inexpensive and when properly covered with earth, the refuse harmlessly rots away. There has been no record of any case where a dump was proved to be a menace to public health, but some have been found to have damaged surrounding property.

With reference to bathing, the speaker claimed that there is a real need for chlorination.

The last topic to be discussed by Dr. Berry was the pasteurization of milk. This process too has been subject to change. While the old flash pasteurization method was in vogue for some time, it was replaced by a system in which the milk was held at a low temperature for a period of time. However, the second method was then replaced by its predecessor which is now accepted as the best method. To-day 90 per cent of the milk in Ontario is being pasteurized.

### OTTAWA BRANCH

A. A. SWINNERTON, M.E.I.C. - *Secretary-Treasurer*  
R. C. PURSER, M.E.I.C. - *Branch News Editor*

At the noon luncheon held at the Chateau Laurier on Wednesday, 16th September, the Ottawa Branch was favoured with an address by the national president, C. R. Young, of Toronto. Dean Young was introduced by Vice-President K. M. Cameron, with the local chairman, N. B. MacRostie, presiding.

The president spoke on the past year's activities and stated that it was one of the best in the Institute's history. Regarding the future he predicted that there would be more and better engineers in this country than ever before. Then the "great backlog of invention and discovery" will

be utilized by the large number who will be technically trained.

He stated that he did not agree with those who said that the Institute should curtail its activities during war time. To do so, he said would be to miss many great opportunities. "We are not going back to the old methods of engineering," he remarked, "We are going ahead."

### VANCOUVER BRANCH

P. B. STROYAN, M.E.I.C. - *Secretary-Treasurer*  
P. PEEBLES, M.E.I.C. - *Branch News Editor*

The Vancouver Branch opened its winter programme with a well attended meeting in the Medical-Dental building on Thursday, September 17. The address was entitled "**The Failure of the Tacoma Narrows Bridge**," and given by A. H. Finlay, Associate Professor of Civil Engineering at the University of British Columbia.

The collapse of the Tacoma Narrows Bridge was one of the most serious engineering failures ever to occur on this continent. This six million dollar structure had been designed by an eminent engineer having many successful major structures to his credit. It was fabricated and erected using the best materials and highly skilled labour. Why should a structure upon which no expense and skill was spared collapse after only four months of use? An official report has been submitted after very careful investigation and study but the question cannot yet be answered completely. It can only be said that failure was caused through a behaviour not previously encountered in large suspension bridges, and admittedly not understood by structural engineers. A brief description of what took place some time prior to and just before failure will serve to indicate the complexity of the problem to be solved before a complete answer is possible.

The Tacoma Narrows Bridge had a main span of 2,800 ft. and the main cables were 39 ft. centre to centre. This made it a very slender structure in terms of the ratio of floor width to centre span. It represents the climax of a tendency in suspension bridge design towards such slenderness which can be seen in several of the large bridges constructed during recent years. Perhaps too large a step had been taken in that direction in this case; yet it received the same careful study and was subject to the same methods of analysis as other structures which are rendering satisfactory service. Another departure from more conventional previous designs was the 8 ft. deep plate girder stiffener, in place of the more common stiffening truss. The floor system was fastened at about the mid-height of this girder.

As soon as the bridge was completed it began to give evidence of its slenderness by a vertical wave motion of the deck during light winds. Although this movement of the deck gave some concern to the owners and designers of the bridge, it was not thought that failure would occur. Some steps were taken to analyze this behaviour and to determine what remedies might be possible, if any. The Washington Toll Bridge Authority, owners and operators of the bridge, financed the construction of a 50 ft. model of the structure at the University of Washington, under the direction of Prof. F. B. Farquarson of that institution.

After extensive tests with the model, holding down cables were installed under the side spans of the bridge which effectively reduced the motion of those spans. Hydraulic buffers were set at the towers to take the shock and prevent damage due to movement of the floor. It was proposed but not put into effect, to install a type of fairing mounted on brackets outside of the stiffening girders to act as streamlining and break the main force of winds blowing laterally against the stiffening girders. Contracts for this work were let but nature intervened and failure took place before the work could be done. Its effectiveness can only be surmised since the idea was based upon tests made on models of short sections of the deck.

On the morning of failure a stiff wind blew up the sound,

but its velocity was only half that for which the structure had been designed. The usual vertical wave motion was taking place and traffic was using the bridge. The waves were long and undulating, presenting 5 waves with 9 nodal points and a vibration period of 36 cycles per min. On other occasions the motion had varied from one-half to 5 complete waves and the period from 8 to 36 cycles per min., depending on wind velocity. Lateral deflection of the main span was less than 2 ft., though it was designed for a maximum deflection of 20 ft. The floor was not twisting and both girders appeared to vibrate together.

About an hour before failure, the motion changed suddenly from 5 waves to one wave with a node at the mid point and at each tower. The period became 14 cycles per min. Quite as suddenly, the two sides got out of phase with each other, and the roadway began to twist as one side in the trough of a wave was opposite a point at the crown of the wave. Sighting along the span, one saw lamp posts which should have been in line, cross each other at an angle of 90 degrees, indicating that the floor was tilted at 45 degrees. Under these conditions, Prof. Farquarson, who was on the structure at the time, was just able to make his way back to the towers by following the traffic line in the centre. During this time the side spans were practically stationary. The above motion continued for nearly an hour, subjecting the suspender ropes to terrific pulls, before the first section, probably 30 ft. long, dropped out at the center of the span. Shortly afterwards a section about 600 ft. long fell into the

sound and very soon the balance of the centre span was gone. The sudden release of dead load caused the towers to swing shorewards an estimated 27 ft., and the side spans to drop 60 ft. The towers did not collapse and the side spans remained intact.

The speaker summed up this dramatic episode by stating that in one sense the bridge destroyed itself. Self-induced vibration, increased by the forces which it produced itself, built up to a point which the structure could not stand. Such vibrations are very rare, and are not studied by structural engineers. They occur in ice laden transmission lines and in a few other instances, but prior to the catastrophe described were not considered in the realm of structural engineering. It is to be hoped valuable information will be secured from studies now under way at the University of Washington in a specially constructed wind jet, which will render impossible any repetition of failure such as that of Tacoma Bridge.

The address concluded with the showing of two reels of motion pictures. The first, taken during the four months the bridge was in use, and the second showing what occurred just prior to failure as well as the actual collapse, gave an impressive visual account of what took place. Great credit is due Prof. Farquarson, who photographed the scenes.

The meeting was presided over by W. O. Scott, branch chairman, and a hearty vote of thanks was proposed by Major J. R. Grant. Fifty-five members and guests were present.

## Library Notes

### CANADIAN ENGINEERING STANDARDS ASSOCIATION

#### APPROVALS DIVISION

On and after September 1st, 1942, by mutual agreement between the National Research Council and the Canadian Engineering Standards Association, the listing of equipment and materials found, after examination and testing, to comply with the requirements of appropriate specifications respecting fire hazard, will be undertaken by the Canadian Engineering Standards Association, instead of by the National Research Council as formerly.

Such equipment and materials will be tested in laboratories named by the Canadian Engineering Standards Association, under a procedure similar to that now followed by the National Research Council. Listing will be based upon the laboratory report of the tests.

The following equipment and materials will be accepted for testing and listing by the Canadian Engineering Standards Association on and after the above-mentioned date. Acceptance of other similar items will be considered on receipt of application.

#### Domestic Oil-Burning Equipment:

- Automatic Furnace Burners (Gun Type).*
- Manual Range and Heater Burners (Shell Type and Pot Type).*
- Cooking Stoves (Shell Type and Pot Type).*
- Space Heaters (Shell Type and Pot Type).*
- Water Heaters, Storage and Side-Arm (Shell Type and Pot Type).*
- Radiant-Flame Heaters (Thermal Vaporizing Type).*

#### Domestic Gasoline-Burning Equipment:

- Cooking Stoves (Thermal Vaporizing Type).*
- Space Heaters (Thermal Vaporizing Type).*
- Radiant-Flame Heaters (Thermal Vaporizing Type).*

### Book notes, Additions to the Library of the Engineering Institute, Reviews of New Books and Publications

#### Gasoline Safety Cans:

#### Degreasing Solvents:

As from the above mentioned date, all listings granted by the National Research Council will be cancelled. Equipment and materials previously listed by the National Research Council will be granted temporary listing by the Canadian Engineering Standards Association, on application, on a basis of the former National Research Council listing.

Adjustments will be made, where necessary, respecting such National Research Council Factory Inspection and Labelling Service Agreements as are in force at the time of the above-mentioned transfer of authority.

Manufacturers desiring to have equipment or materials listed under the Canadian Engineering Standards Association fire hazard testing procedure, should apply to the Canadian Engineering Standards Association for application forms and information relative to test procedure, annual listing, fees, etc.

Address all inquiries to The Secretary, Approvals Division, Canadian Engineering Standards Association, 3010 National Research Building, Ottawa.

#### TECHNICAL BOOKS

#### Engineering Mechanics:

*2nd ed. Frank L. Brown, N.Y., John Wiley and Sons, Inc., 1942. 6 x 9 in. \$4.00.*

#### Strength and Properties of Materials:

*John Elberfeld, N.Y., Harper and Brothers, 1942. Rochester Technical Series. 6 1/4 x 9 1/4 in. \$1.75.*

#### Machine Shop Practice:

*Sherman B. Hagberg, N.Y., Harper and Brothers, 1942. Rochester Technical Series. 8 1/2 x 11 in. \$2.50.*

#### Wood and Charcoal as Fuel for Vehicles:

*2nd ed., revised and enlarged. R. Ruedy, Ottawa, National Research Council, 1942. 8 1/4 x 10 1/2 in. \$2.00 (N.R.C. Publication No. 1074).*

#### Canadian Engineering Standards Association:

*Construction and test of Electric Ranges: C. 22.2—No. 61—1942. 50c.*

#### REPORTS

#### Purdue University—Engineering Bulletin:

*Heat transfer by natural and forced convection—Research series No. 84—Proceedings of the twenty-eighth annual Road School held at the University January, 1942*  
*Management personnel responsibility for all-out war effort: proceedings of the Personnel and Industrial Relations Conference held at the University May, 1942—Extension series No. 53 and 54.*

#### Northwestern University:

*Announcement of courses in the Technological Institute for the year 1942-43.*

#### Hydro-Electric Power Commission of Ontario:

*Thirty-fourth annual report for the year ended October 1941.*

#### Electrochemical Society:

*Current leakage through cascaded cells—Preprint No. 82-6.*

#### Cornell University—Engineering Experiment Station:

*Some factors influencing the heat output of radiators—Bulletin No. 29.*

## Power Corporation of Canada:

Annual report for the year ending June, 1942.

## Asphalt Institute:

Specification for sand-asphalt base and surface courses (hot mix type), July, 1942.

## BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet the books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

### AIRCRAFT YEAR BOOK for 1942, 24th Annual Edition

Edited by H. Mingos. *Aeronautical Chamber of Commerce of America, New York, 1942. 693 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, \$5.00.*

The 1942 issue of this annual, like its predecessors, is intended to provide a record of all important happenings during the past year in aviation. An accurate, concise account of aviation's part in the war, of our army and navy air forces, of the government's part in training and education and of government civil aviation forms a large part of the book. Air transport facilities, private flying, civilian defence, airports and airways receive due attention. Aircraft designs are shown and much statistical material is included.

### ANGLO-POLISH TRANSLATION OF WORKSHOP TERMS (Słownictwo Warsztatowe Angielsko-Polskie)

Compiled by W. Bastyr and E. Paszkowski, edited and published by the Association of Polish Engineers in Great Britain, 18 Devonshire Street, London, W.1, 1941. 43 pp., diagrs., 7 x 5 in., paper, 3s.

This pamphlet contains drawings of about five hundred Polish and English machine-shop terms, accompanied by drawings which remove all uncertainty as to meanings. The publication is sponsored by the Association of Polish Engineers in Great Britain.

### BAUGHMAN'S AVIATION DICTIONARY AND REFERENCE GUIDE, Aero-Thesaurus

By H. E. Baughman. 2 ed. Aero Publishers, 120 North Central Ave., Glendale, Calif., 1942. 906 pp., illus., diagrs. charts, tables, 9½ x 6 in., leather, \$6.50.

This work presents in one volume a useful dictionary of terms and abbreviations used in aviation, a directory and a large amount of reference information upon flying, aircraft design and aircraft production. The material included is eminently practical, and the book answers most ordinary questions very satisfactorily. The new edition has been thoroughly revised, and enlarged by the addition of many new terms.

### DIESEL ENGINES, a Complete Diesel Home Study Course

Edited by L. H. Marrison and others. Diesel Publications, New York, 1942. 824 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$8.00.

This volume provides the would-be Diesel engineer with a practical course of study, suited to self-instruction. The presentation is clear and simple, and is largely descriptive and non-mathematical.

### IRON PIONEER: Henry W. Oliver 1840-1904

By H. O. Evans. E. P. Dutton & Co., New York, 1942. 370 pp., illus., diagrs., maps, tables, 9 x 6 in., cloth, \$3.50.

This interesting book tells the story of a prominent Pittsburgh industrial leader of a generation ago. Oliver played an important part in the development of the Minnesota orefields and the Bisbee copper district, and

in railroad building in the Pittsburgh region. His biography contains much information on the steel industry.

### MACHINE SHOP PRACTICE (Rochester Technical Series)

By S. B. Hagberg in collaboration with M. S. Corrington and R. M. Biehler. Harper & Brothers, New York and London, 1942. 311 pp., illus., diagrs., charts, tables, 11 x 8½ in., cloth, \$2.50.

This textbook is one of a series developed at the Rochester Athenaeum and Mechanics Institute as a part of its programme for developing teaching materials which are practical in nature and closely related to the actual requirements of various jobs in industry. It is a shop workbook, intended to be used at the machine or bench by the student, which provides a series of projects of increasing difficulty which will enable the student to master the fundamental processes and skills involved in machine shop work.

### (The) MACHINE SHOP YEARBOOK AND PRODUCTION ENGINEERS' MANUAL

Edited by H. C. Town, foreword by Sir A. Herbert. Paul Elek Publications, Africa House, Kingsway, London, W.C.2, 1942. 558 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, 25s.

The first issue of what is planned as an annual reference book on engineering practice, this volume presents a variety of useful information. The first section consists of a number of articles on timely topics, such as machineability, diamond tools and grinding, by well-known specialists. Section two is a review of established practice in machine work, illustrated by descriptions of typical machines. The final section contains extensive abstracts of important recent papers on materials, heat treatment, testing, machinery, etc., selected from American and European journals.

### MACHINERY'S HANDBOOK for Machine Shop and Drafting-Room

By E. Oberg and F. D. Jones. 11 ed. Industrial Press, New York, 1942. 1,815 pp., diagrs., tables, 7½ x 4½ in., fabrikoid, \$6.00.

This popular reference book is too well-known to need description. It presents a great store of practical information on machine design and shop practice, of the kind constantly wanted by mechanical engineers, draftsmen and machinists. The new edition has been revised thoroughly.

### MANUAL OF MOMENT DESIGN

By J. Singleton. American Institute of Steel Construction, New York; H. M. Ives & Sons, Topeka, Kansas, 1941. 146 pp., illus., diagrs., charts, tables, 10 x 7 in., fabrikoid, \$4.00.

This book is intended to provide the designer with a ready method of calculating the bending moments in prismatic continuous beams and frames, and to eliminate much of the drudgery of computation. The user is assumed to be conversant with the theory of continuity.

### MOLECULAR FILMS, THE CYCLOTRON AND THE NEW BIOLOGY

Essays by H. S. Taylor, E. O. Lawrence and I. Langmuir. Rutgers University Press, New Brunswick, N.J., 1942. 95 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$1.25.

These essays by three distinguished scientists present historical and contemporary concepts that will help to solve some of the most difficult problems in biology. Dr. Taylor provides the historical background with a review of scientific thought during the last two centuries. Dr. Lawrence describes the cyclotron and calls attention to its promise as a means for studying biological problems. Dr. Langmuir presents the surface-film method of investigation, describes some results obtained and suggests further uses.

### National Research Council, HIGHWAY RESEARCH BOARD, PROCEEDINGS of the Twenty-First Annual Meeting, held at Johns Hopkins University, Baltimore, Md., Dec. 2-5, 1941

National Research Council, Washington, D.C., 1942. 561 pp., illus., diagrs., charts, tables, maps, 10 x 6½ in., cloth, \$3.25.

These Proceedings bring together the records of the important investigations of highway problems carried out during the past year, as reported by various committees of the Board. Questions of finance, economics, design, materials, construction, maintenance, traffic, safety and soils are discussed by engineers of wide experience.

### PLASTICS

By J. H. DuBais. American Technical Society, Chicago, 1942. 295 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, \$3.00.

This book is written for users of plastics who wish practical information concerning these materials. The history and origin of the various types and the sources of their raw materials are explained. Their physical, chemical and electrical properties are discussed, as well as their advantages and defects. Due attention is paid to their fabrication, and information on design is presented. The work will be very useful to engineers and designers.

### SHIP REPAIR AND ALTERATION

By G. V. Holiday and W. E. Swanson. Cornell Maritime Press, New York, 1942. 378 pp., diagrs., charts, tables, 7 x 5½ in., lea., \$2.75.

The handbook is a practical reference work for shipfitters, especially those engaged in altering and repairing ships. Part one describes methods of carrying out hull repairs of all kinds. Parts two and three present the mathematical and geometric knowledge needed by the shipfitter. Part four deals with the development and layout of sheet-metal work. Other features are mathematical tables and a glossary of shipbuilding terms and abbreviations.

### STRENGTH AND PROPERTIES OF MATERIALS (Rochester Technical Series)

By J. Elberfeld. Harper & Brothers, New York and London, 1942. 150 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$1.75.

This textbook aims to present, in one small volume, the essential information on materials needed by those engaged in the various industries, and is intended a preparation for courses in tool, machine and structural design. Only elementary mathematical knowledge is necessary.

### WATER HANDBOOK, Chemical Analyses and Interpretations

Published by W. H. and L. D. Betz, Frankford, Phila., Pa., 1942. 64 pp., illus., diagrs., charts, tables, 11 x 8½ in., paper, spiral binding, 50c.

This handbook is in two parts. Part one gives clear, definite directions for water analysis, covering all the tests commonly used in industrial plant control and presenting simple methods which do not require previous chemical experience. Part two discusses the interpretation of the tests and their application to plant control.

### WELDING HANDBOOK

American Welding Society, New York. 1942 ed. 1,593 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, \$6.00 in U.S.A.; \$6.50 in foreign countries; \$5.00 to members.

The aim in preparing this work has been to give engineers an authoritative, up-to-date reference book on the technical phase of welding. The physics and metallurgy of welding, the weldability of steels, welding processes, brazing, soldering, facing, metal spraying, metal cutting, metals used, training, inspection, safety, design and testing of welds, and applications are discussed. Each topic is treated by a committee of experts.

# PRELIMINARY NOTICE

of Applications for Admission and for Transfer

FOR ADMISSION

September 28th, 1942.

The By-laws provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.\*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described at the November meeting.

L. AUSTIN WRIGHT, General Secretary.

\*The professional requirements are as follows:—

**A Member** shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupillage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science or engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

**A Junior** shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

**A Student** shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

**An Affiliate** shall be one who is not an engineer by profession but whose pursuits, scientific attainment or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

**GREEN—LAWRENCE JOHN**, of Norwood Grove, Man. Born at Winnipeg, July 17th, 1899; Educ.: B. Arch., Univ. of Man., 1926; 1922-23, dftsmn., Albert Kahn, Detroit; 1923-26, dftsmn., Zachary T. Davis, Chicago; 1927-28, chief dftsmn., Oman & Lilienthal, Chicago; 1928-29, chief dftsmn., Maurice L. Bein, Chicago; 1929-31, office mgr., chief dftsmn., and chief engr., A. A. Stoughton, Winnipeg (now of New York); 1931-42, i/c of struct., elec., mech., and acoustical engr. in own office—Green, Blanksten, Russell & Ham, Architects, Reg'd Architects in Ontario, Manitoba, Sask., Alta., and B.C. Personally engineered acoustical work and sound isolation in about 40 theatres, 3 radio broadcasting studios, offices, etc. Also process steam and low pressure steam in hospitals, convents and hotels; at present, engr. (mech.), in Works & Bldgs. Branch, Naval Services of Canada, Ottawa, Ont.

References: N. M. Hall, E. P. Fetherstonhaugh, W. F. Riddell.

**LACE—GEORGE SUTTON**, of 424 Tweedsmuir Ave., Westboro, Ont. Born at Liverpool, England, Aug. 22nd, 1898; Educ.: Central Technical School, Liverpool; 1914-19, ap'tice marine engr., Clover, Clayton & Co., Liverpool; 1927-29, inspr., aircraft constrn., Canadian Vickers Ltd., Montreal; 1929-30, inspr., aircraft constrn., Curtiss Reid Ltd., Montreal; 1930-36, air engr., eastern divn., Canadian Airways; 1936-37, chief engr., Eastern Canada Air Lines, Moncton, N.B.; 1937-40, station engr., Atlantic Divn., Nfld. & New York, Imperial Airways; 1940-41, foreman, aircraft engine overhaul, Ottawa Car & Aircraft; 1941 to date, engineer officer, Aircraft Production Branch, Dept. of Munitions & Supply, Ottawa, Ont. (Developing sources of manufacture, in Canada, of engine parts, and technical advisor on operation of engine overhaul plants controlled by dept.).

References: D. Giles, L. B. Rochester, C. O. Wood, S. H. Wilson, J. L. Smith, E. P. Murphy.

**LAURIAULT—WILFRID ELDIGE**, of Montreal, Que. Born at Montreal, Nov. 24th, 1899; Educ.: B.A.Sc., Civil Engr., Chem. Engr., Ecole Polytechnique, 1922; Q.L.S., R.P.E. of Que.; 1922, asst. engr., Dept. of Lands & Forests; 1923, asst. engr., Belgo Paper Company, Shawinigan Falls; 1924-26, professor, School of Paper-making, Three Rivers; 1926-28, asst. supt. and tech. engr., Quebec Pulp & Paper Co., Chicoutimi; 1928-34, engr., technical service, City of Montreal; 1935 to date, consulting engineer and Quebec Land Surveyor, Montreal, Que.

References: G. R. MacLeod, J. A. Beauchemin, J. A. Lalonde, O. O. Lefebvre, E. Prevost, F. J. Leduc, L. Trudel.

**RIDDELL—JOHN MORRISON**, Major, R.C.E., of 21 Findlay Ave., Ottawa, Ont. Born at Toronto, March 9th, 1892; Educ.: B.A.Sc., Univ. of Toronto, 1916. D.L.S., O.L.S.; 1911-13 (summers), asst. on Ontario and Dominion surveys; 1914-16, Junior geodetic engr.; 1916-19, overseas, Lieut. and Capt., Candn. Engrs.; 1919-26, surveys engr., Geodetic Survey of Canada; 1926-29, senior asst. engr., Dominion Parks Branch; 1929-41, district engr., Geodetic Survey of Canada; 1941, enlist for active service with 3rd Reserve Field Coy., R.C.E., and at present, Officer Commanding, 28th, Field Coy., R.C.E. (A).

References: N. J. Ogilvie, J. L. Rannie, J. M. Wardle, N. B. MacRostie, C. A. Price.

**SAINTONGE—JEROME**, of 564—12th Street, Arvida, Que. Born at Valleyfield, Que., Feb. 22nd, 1912; Educ.: B.A., Seminaire de Valleyfield, 1934; I.C.S. and private study; 1937 (summer), helper in machine shop; 1937-38, checking from drawings, 1938-40, collecting data, measurements, etc., for catalogue of mech. equipment, and from August 1940 to date, inspector of mech. equipment, Arvida Works, Aluminum Company of Canada.

References: M. G. Saunders, B. E. Bauman, J. W. Ward, R. H. Rimmer, L. A. Cantin.

**WIDEMAN—NORMAN EDWARD**, of 100 Summit Ave., Port Arthur, Ont. Born at Markham, Ont., Nov. 9th, 1903; Educ.: B.A.Sc. (E.E.), Univ. of Toronto, 1927. R.P.E. of Ont.; with the H.E.P.C. of Ontario as follows: 1927-29, engr.-in-training, 1929-36, district meter engr. at Stratford, London and Chatham; 1936-40, district relay and meter engr., Hanover; 1940 to date, relay and meter engr., Thunder Bay system and Patricia District of Northern Ontario properties.

References: R. J. Askin, J. M. Fleming, E. L. Goodall, T. M. S. Kingston, E. M. G. MacGill, R. B. Young.

## FOR TRANSFER FROM JUNIOR

**COWIE—NORMAN CLAUDE**, of 26 Coulson Ave., Sault Ste. Marie, Ont. Born at Espanola, Ont., Oct. 2nd, 1907; Educ.: B.A.Sc., Univ. of Toronto, 1931; Previous to 1929, summer and one whole year, gen. machine shop, foundry and elec. mtec. experience, Northern Foundry & Machine Co. Ltd., and Algoma Steel Corp.; 1929 (summer), elec. dftng., Algoma Steel Corp. Ltd.; with the Great Lakes Power Co. Ltd., as follows: 1930 (summer), elec. dftng., 1931-32, engr. on switchboards, etc., 1932-37, gen. hydroelectric power system mtec. and operation engr., 1937-38, gen. power plant operation and mtec., also design layout, etc., power house supervn., Dec. 1938 to date, gen. operation and mtec. engr., estimates, assisting supervisory work, assistance with investigation of new power sources, work on property records, system analysis and design. (Jr. 1931).

References: A. E. Pickering, R. A. Campbell, E. M. MacQuarrie, L. R. Brown, A. M. Wilson.

**DAVIS—WILLIAM ROE, Jr.**, of Montreal, Que. Born at Calgary, Alta., June 28th, 1909; Educ.: B.Sc. (E.E.), Univ. of Alta., 1934; 1928-30 and 1931-33 (summers), dftsmn., and engr. asst., 1934-35, asst. engr., hydrographic survey, and 1934-36, asst. engr., transmission and distribution, Calgary Power Co. Ltd.; 1936 to date, asst. elec. engr., design and constrn., Montreal Engineering Co. Ltd., Montreal, Que. (Jr. 1935).

References: G. A. Gaherty, J. H. McLaren, G. H. Thompson, J. T. Farmer, H. B. LeBourveau, W. E. Cornish.

**FORBES—DONALD ALEXANDER**, of Kenogami, Que. Born at Fort William, Scotland, May 14th, 1907; Educ.: B.Sc. (Civil), Univ. of Sask., 1934; 1928-30, rodman, 1930-32, instr'man., Sask. Dept. Highways; 1934-35 (summers), dftsmn., C.N.R., chief of party, water resources survey, Dept. of Mines; 1936-37, dftsmn., 1937-40, asst. divnl. engr., mill mtec. design and supervn., 1940-41, general asst., assisting mill mgr. in operating problems, Consolidated Paper Corporation, Port Alfred, Que.; 1941 to date, asst. to chief engr., Price Bros. & Co. Ltd., Kenogami, Que. (Jr. 1936).

References: G. F. Layne, N. F. McCaghey, E. B. Wardle, F. W. Bradshaw, C. H. Jette, A. Cunningham.

**FORD—JOHN NORMAN**, of Calgary, Alta. Born at Calgary, May 6th, 1909; Educ.: B.Sc. (E.E.), Univ. of Alta., 1934; 1934-36, mtec. work, Prairie Power Co., Regina; 1936-40, junior engr. course, 1940 to date, constrn. and mtec. engr., Calgary Power Company, Calgary, Alta. (Jr. 1940).

References: H. B. LeBourveau, J. McMillan, H. B. Sherman, T. D. Stanley, W. J. Gold.

**FULLERTON—ROLAND McNUTT**, of Arvida, Que. Born at Halfway River, N.S., Oct. 25th, 1906; Educ.: B.Sc. (E.E.), N.S. Tech. Coll., 1933; 1930-31 (summers), N.S. Dept. of Highways, and Canada Electric Co., Amherst, N.S.; 1935-37, electrician on constrn. at various mines in north western Quebec; 1937-38, asst. engr., Northern Electric Co. Ltd., Montreal; 1938, asst. engr., 1938-39, asst. to power engr., 1939-40, plant engr., Ise Maligne station, Saguenay Power Company Ltd.; 1940 to date, shift engr., Arvida Works, Aluminum Co. of Canada Ltd. (St. 1931, Jr. 1937).

References: McN. DuBose, F. L. Lawton, J. W. Ward, A. C. Johnston, J. R. Hango.

GORDON—HAROLD COWAN MORTON, of Westville, N.S. Born at Leven, Scotland, Oct. 9th, 1899; Educ.: B.Sc. (Mining), McGill Univ., 1923; 1923-28, mining engr. dept., Dominion Coal Company; 1929, res. engr. and asst. supt., Nova Scotia Steel & Coal Co.; 1929-37, asst. mining engr., Acadia Coal Company & Cumberland Railway and Coal Company; 1937-41, asst. to gen. mgr. (coal divn.), Dominion Steel & Coal Corp., Jan. 1942 to date, president and gen. mgr., Acadia Coal Co. Ltd., Old Sydney Collieries Ltd., Stellarton, N.S. (Jr. 1924).

References: T. L. McCall, F. W. Gray, W. S. Wilson, S. C. Miffien.

GUENETTE—JOSEPH ANTOINE PAUL, of St. Jerome, Que. Born at Montreal, June 13th, 1908; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1939; 1935-36 (summers), Royal Canad. Sch. of Signals, Camp Borden; 1938, health inspr., Quebec Prov. Board of Health; 1939-40, efficiency engr., Dupresne, McLagan & Associates, Montreal; 1940, asst. res. engr., Quebec Roads Dept.; Feb. 1941, asst. engr., City of Outremont; 1941-42, industrial engr., and Jan. 1942 to date, head of planning dept., Regent Knitting Mills Co. Ltd., St. Jerome, Que. (St. 1936, Jr. 1941).

References: L. A. Wright, L. Trudel, J. P. Leroux, J. A. A. P. Bourgeois, A. Frigon, P. P. Vinet, deG. Beaubien.

HIGGINS—EDGAR CLARENCE, of Toronto, Ont. Born at Montreal, March 28th, 1894; Educ.: Montreal Technical School—maths. and strutt. engrg. Dominion Bridge Company—2 years night classes. I.C.S. and private study; R.P.E. of Ont.; 1912-19, draftsman, Dominion Bridge Co. Ltd.; 1919-20, draftsman, Phoenix Bridge Co. Ltd.; 1920-21, checker and designer, Canadian Allis Chalmers; 1921-22, draftsman, 1922 to date, asst. engr., supervising design of power house superstructures, transformer stations, galvanized steel structures, operators' colonies, etc., H.E.P.C. of Ontario, Toronto, Ont. (Jr. 1921).

References: H. E. Brandon, J. W. Falkner, O. Holden, A. H. Hull, H. L. Wagner.

LYNCH—JOHN FRANKLIN, of Brownsburg, Que. Born at Fredericton, N.B., Sept. 25th, 1905; Educ.: B.Sc. (E.E.), 1929, B.Sc. (C.E.), 1933, Univ. of N.B.; 1928 (4 mos.), student helper, Can. Gen. Elec. Co. Ltd.; 1929-32, engr., Northern Electric Co. Ltd.; 1934-37, asst. elec. engr., to H. C. Moore, E.E.; 1937-39, highway engr., Dept. of Public Works of N.B.; 1940, asst. res. engr., 1940 to date, res. engr., Defence Industries Limited, Brownsburg, Que. (Jr. 1932).

References: A. B. McEwen, D. A. Killam, J. Stephens, A. F. Baird.

NEILSON—CHARLES SHIBLEY, of 1156 Windermere Road, Toronto, Ont. Born at Harrowsmith, Ont., Oct. 19th, 1902; Educ.: B.Sc. (Civil), Queen's Univ., 1926; 1926-33, detailing and checking, and surveying, Canadian Bridge Co. Ltd., Walkerville, Ont.; 1934 (summer), foreman, Brockville Divn., Ont. Dept. of Highways; 1934-36, asst. supt. of constrn., Kingston Lumber Co., Kingston, Ont.; 1936, checking and estimating, Canadian Bridge Co. Ltd., 1936-39, checking, Hamilton Bridge Company, Hamilton; 1939 to date, squads boss, layout, checking and estimating, Canadian Bridge Co. Ltd., Walkerville, Ont. (St. 1925, Jr. 1931).

References: D. T. Alexander, W. G. Mitchell, P. E. Adams, G. V. Davies, H. J. A. Chambers.

WELLWOOD—FRANK ELVIN, of Toronto, Ont. Born at Richmond Hill, Ont., Apr. 22nd, 1902; Educ.: B.A.Sc., Univ. of Toronto, 1925. R.P.E. of Ont.; 1925, draftsman, Canadian Bridge Co., Quebec Development Co., and Aluminium Co. of Canada; with the latter company at Arvida, as follows—1925-26, designer, 1926-27, engr. (field concrete), 1927, engr. (field-indus. bldg.); 1927-29, engr., examiner of plans, 1929-32, asst. to chief concrete engr., City Architects' Dept., Toronto; 1932 to date, asst. to plan examining engr., Dept. of Bldgs., City Hall, Toronto, Ont. (St. 1921, Jr. 1929).

References: L. A. Lee, G. L. Wallace, A. H. Harkness, J. M. Oxley, E. A. H. Menges, P. M. Thompson.

WILLIS—EDWIN AUBREY, of 170 Main St., Ottawa, Ont. Born at Bolton, Lancs., England, Dec. 16th, 1908; Educ.: Matric., Univ. of London, England; Grad. in Electricity, Ottawa Technical School. I.C.S. Diploma in Elec. Engrg.; 1928-35, lab. asst., and 1935 to date, electrician, Electricity & Gas Inspection Laboratory, Dept. of Trade & Commerce, Ottawa, Ont. (Jr. 1939).

References: H. A. Dupre, R. W. Guy, B. G. Ballard, E. O. Way, R. H. Field.

#### FOR TRANSFER FROM STUDENT

AIRD—JOSEPH ANDRE PHILIPPE, of St. Johns, Que. Born at Montreal, Nov. 14th, 1914; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1938; 1938 (summer) power houses, Shawinigan Falls, Que.; 1938-41, apprenticeship course Shawinigan Water & Power Co.; 1941 (6 mos.) Sch. of Aeronautical Engrg., 1941-42, No. 6 Repair Depot, Trenton; at present, Flying Officer i/c of depot inspection, No. 9 Repair Depot, R.C.A.F., St. Johns, Que. (St. 1936).

References: G. J. Papineau, J. A. Lalonde, L. Trudel, A. S. Runciman.

ASSELIN—HECTOR, of 5685 Gatineau Ave., Montreal. Born at Montreal, Nov. 3rd, 1914; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1939; R.P.E. of Quebec; 1938 (summer), inspr. for Ministry of Health, Prov. of Quebec; 1939 (summer), J. Eng. Quay Inc., consltg. engrs., Montreal; 1939 to date, engr. with Arthur Surveyer & Co., Montreal. (St. 1937).

References: A. Surveyer, J. G. Chenevert, E. Nenninger, J. A. Lalonde, A. Circe.

BOISCLAIR—ROBERT, of 1320 Demontigny St., Montreal, Que. Born at St. Marcel, Que., Dec. 14th, 1914; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1942; 1937-41 (summers), Dept. of Roads, Prov. of Quebec; 1942 (June-Aug.), engr. estimator, at Gander, Nfld., for Atlas Construction Co., of Montreal; Aug. 1942 to date, engr., Aluminum Co. of Canada, Arvida, Que. (St. 1938).

References: R. Boucher, S. A. Baulne, A. Circe, O. O. Lefebvre, A. Gratton.

BOUTILIER—TREMMAINE THOMPSON, of 1499 Bishop St., Montreal, Que. Born at Hammond Plains, N.S., July 29th, 1913; Educ.: B. Eng. (E.E.), N.S. Tech. Coll., 1936; 1936 (summer), bituminous paving inspection, Milton Hersey Co. Ltd.; with Northern Electric Co. Ltd., Montreal, as follows: 1937 (summer), final test and inspection, radio dept., 1937-38, transformer dept., 1938, radio receiver, engr. dept., 1938-40, production engr., electric organ assembly dept., technical responsibility for mfr: 1940-42, production planning, various types of communications and other electrical equipment, July 1942 to date, manufacturing engr., transformers and coils. (St. 1937).

References: D. S. Nicoll, G. H. Burchill, A. B. Hunt, J. J. H. Miller.

BOWERING—REGINALD, of Victoria, B.C. Born at Winnipeg, Man., June 16th, 1913; Educ.: B.Sc. (C.E.), Univ. of Man., 1938. M.A.Sc., Univ. of Toronto, 1939; 1937-38 (summers), International Nickel Co., Sudbury; May 1940 to date, public health engr. and chief sanitary inspr., Prov. Board of Health of B.C., Victoria, B.C. (St. 1936).

References: K. Moodie, K. Reid, G. M. Irwin, A. E. Macdonald, A. E. Berry, A. H. Perry.

BUTEAU—LUCIEN, of Quebec, Que. Born at Montreal, Sept. 30th, 1913; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1937; 1936, Quebec Bureau of Mines; with the Bell Telephone Company of Canada as follows—1938-40, asst. engr. on toll pole line constrn., reconstr. and relocation; 1940, underground conduit and cable constrn.; 1941-42, toll cable constrn., exchange plant reconstr., rural pole line reconstr., and at present, field engr. on constrn. of aerial, block and underground telephone plant, and on design of toll, exchange and rural poll lines, plant engr., eastern divn., Quebec District. (St. 1936).

References: J. Saint Jacques, P. Vincent, G. St. Jacques, A. E. Pare, D. Rhodes.

COTE—JOSEPH LEON, of Montmagny, Que. Born at Isle Verte, Que., March 17th, 1914; Educ.: B.A., Laval Univ., 1939; with the Quebec Power Company as follows: 1939, elec. operator, D.C. and A.C.; 1939-40, dftng., surveying, street lighting, engrg. dept.; 1940, line constrn., sub-station installns.; 1940-41, power house operation and mtee; March 1941 to date, Lieut., Administrative and Training Officer, Le Regiment de Montmagny, Montmagny, Que. (St. 1940).

References: J. Saint Jacques, R. Dupuis, H. A. Gauvin.

CREPEAU—MARCEL, of Quebec, Que. Born at Montreal, Nov. 12th, 1914; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1938; R.P.E. of Quebec; 1938 to date, engr. on mtee. of bridges, Dept. of Public Works, Que. (St. 1936).

References: J. E. Chevalier, R. Marchand, J. G. O'Donnell, P. Vincent, L. Martin.

CUTHBERTSON—CHARLES CASSELLS, of Shawinigan Falls, Que. Born at Glasgow, Scotland, Nov. 27th, 1913; Educ.: B.Sc. (Chem. Engrg.), 1938, B.Sc. (Chemistry) 1939, Queen's Univ.; 1939 (summer) gold assayer, metallurgical lab., Canadian Industries, Ltd., Toronto; 1939-40, chief chemist; 1940-41, supervisor, Caustic Finishing Dept., and at present Process supervisor, Alkali Works, Canadian Industries Ltd., Shawinigan Falls, Que. (St. 1939).

References: A. H. Heatley, H. K. Wyman, E. R. McMullen, W. A. E. McLeish, M. Eaton, H. J. Ward.

DAVIS—HAROLD ARTHUR, of 247 Simcoe St. N., Oshawa, Ont. Born at Dunrobin, Ontario, Sept. 26th, 1910; Educ.: B.Sc. (Mech.) Queen's Univ., 1938; 1938-39, mech. lab. instructor, Queen's Univ., Kingston; 1939 to date, supt. coil spring production and plant engr., Ontario Steel Products Co. Ltd., Division "A", Oshawa, Ont. (St. 1939).

References: L. M. Arkley, L. T. Rutledge, A. Jackson, H. G. Conn.

DeGUISE—YVON, of Quebec, Que. Born at Verdun, Que., Mar. 10th, 1914; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1937; R.P.E. of Quebec; 1935 (summer) surveying; 1936 (summer) oper. in substation, Shawinigan Water & Power Co., Victoriaville; 1937-39, test course, Canadian General Electric Co., Peterborough and Toronto; 1939 to date, civil engr., Hydraulic Service, Dept. of Lands & Forests, Prov. of Quebec. (St. 1936).

References: A. B. Normandin, A. E. Pare, P. Vincent, A. Lariviere, Y. R. Tasse.

DEMBIE—THOMAS, of Toronto, Ont. Born at Toronto, August 25th, 1914; Educ.: B.A.Sc., 1936, M.A.Sc. (Civil), 1937, Univ. of Toronto; R.P.E. of Ont., 1937 to date, with the Dominion Bridge Co. Ltd. as follows: plate and boiler dept.; estimating and designing (3 years), dwg. office (6 mos.), mech. estimating and design (6 mos.); 1941 to date, estimating and design dept. of McGregor-McIntyre Divn., Toronto, Ont. (St. 1934).

References: C. R. Young, A. R. Robertson, D. C. Tennant, G. P. Wilbur, A. S. Wall.

DESLAURIERS—CHARLES EDOUARD, of Quebec, Que. Born at St. Sauveur, Que., Nov. 2nd, 1913; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1940; R.P.E. of Que.: 1935-40 (summers) dftng., design, surveying, etc., Ricard and Royer, Quebec, and Quebec Streams Commission; 1940 (June-Nov.), production engr. and machine design, Sorel Industries, Ltd.; at present, engr. with hydraulic service, Dept. of Lands & Forests of Quebec. (St. 1940).

References: A. B. Normandin, O. O. Lefebvre, H. S. Steenbuch, A. E. Pare, P. Vincent, S. Plamondon.

DUCKETT—WILLIAM ANDERSON, of 13 Dollard Ave., Montreal South, Que. Born at Montreal, Nov. 10th, 1913; Educ.: B. Eng. (Elec.), McGill Univ., 1937; 1934-35-36 (summers) engr's asst., marine survey, St. Lawrence River, Dept. of Marine; with the Bell Telephone Company of Canada as follows: 1937, student engr. course, 1938, line constrn., 1939-40, install. and mtce., 1941 to date, asst. engr. on design of outside telephone plant. (St. 1935).

References: C. V. Christie, C. G. Cline, N. A. Thompson, L. E. Ennis, W. J. S. Dorman.

FRASER—THOMAS BRYANT, of Franquelin, Que. Born at Montreal, Aug. 19th, 1902; Educ.: Central Technical School, Toronto. I.C.S. Surveying and Mapping Elementary concrete design, Wilson Engrg. Corp., Cambridge, Mass.; 1919 (summer), township surveys; 1921, rodman, H.E.P.C. of Ont.; 1922-23, instr'man, Atibiti Company, Iroquois Falls; 1924-25, instr'man, Sutcliffe Co., New Liskeard; 1926, chief of party, Wayagmack Pulp & Paper Co.; 1926-27, asst. field engr., 1927-30, res. engr., 1931-32, supt., Anticosti Corp.; 1932-34, field engr., Marien-Wilson, Montreal; 1935-36, supt., St. Lawrence Airways; 1936-37, logging engr., Ontario Paper Company; 1937 to date, plant mgr., Quebec North Shore Paper Co., Franquelin, Que. (St. 1922).

References: A. I. Cunningham, M. H. Jones, A. A. Wickenden, H. W. Sutcliffe, J. M. Gilchrist.

FRIGON—RAYMOND A., of Outremont, Que. Born at Montreal, Feb. 24th, 1915; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1940. M.Sc., Mass. Inst. Tech., 1941; Dec. 1941 to date, asst., materials testing and research laboratory, Ecole Polytechnique, Montreal, Que. (St. 1937).

References: S. A. Baulne, R. Boucher, A. Circe, T. J. Lafreniere, J. A. Lalonde.

GODDARD—ALBERT REGINALD, of 696 Strathcona St., Winnipeg, Man. Born at Winnipeg, Oct. 2nd, 1914; Educ.: B.Sc. (C.E.), Univ. of Man., 1939; 1939-40, Dept. of Mines & Nat. Resources, Man. Govt.; 1940 to date, Dept. of National Defence, works and bldg., No. 2 T.C., R.C.A.F., at present, junior asst. engr. (St. 1937).

References: G. H. Herriot, A. E. Macdonald, E. P. Fetherstonhaugh, N. M. Hall, A. J. Taunton.

GOHIER—ROCH EDOUARD, of 29 St. Ours Road, Sorel, Que. Born at Montreal, June 15th, 1914; Educ.: B. Eng. (Met.), McGill Univ., 1939; 1936 (summer), dftsmen and instr'man, Aluminum Co. of Canada, Arvida; 1938 (summer), flue gas analysis and research lab., Canadian Copper Refiners Ltd., Montreal East; 1939-40, asst. engr., i/c heat treating and lab., International Foils Ltd., Cap de la Madeleine; 1940 to date, metallurgist, Sorel Industries Ltd., Sorel, Que. (St. 1937).

References: A. Surveyer, C. K. McLeod, E. Gohier, J. A. Lalonde, deG. Beaubien.

HASELTON—WILLIAM BEVERLEY, of Beebe, Que. Born at Beebe, April 30th, 1911; Educ.: B.Sc. (Civil), Univ. of N.B., 1934; 1934-35, surveying and mapping, Consolidated Paper Corporation, Grand Mere, Que.; 1935 to date, manager and operator, The W. M. Haselton Granite Quarries, Beebe, Que. (St. 1934).

References: J. Stephens, E. O. Turner, L. A. Wright, L. Trudel.

HOPKINS—ALBERT PARKER EUGENE, of Toronto, Ont. Born at Toronto, August 9th, 1915. Educ.: B.A.Sc., Univ. of Toronto, 1937; R.P.E. of Ont., 1932-36 (summers), asst. to supt., surface constrn., underground mining, at various gold mines; 1937 (summer), asst., Ontario Geol. Survey; 1939-41, engr. i/c diamond drilling, trenching, geophysical prospecting, etc., for Percy E. Hopkins, consltg. engr.; 1941, underground sampler, Hollinger Gold Mines; 1941-42, field engr., Keewatin Explorations Ltd.; May 1942 to date, asst. engr., Hallnor Gold Mine, Pamour, Ont. (St. 1937).

References: O. Holden, J. F. Robertson, A. D. Campbell, H. E. T. Haultain, C. G. Williams.

HOPKINS—ALFRED, of Shawinigan Falls, Que. Born at Bishop's Falls, Nfld., April 2nd, 1914; Educ.: B. Eng. (E.E.), N.S. Tech. Coll., 1936; with Canadian Westinghouse Co. Ltd., Hamilton, Ont. as follows: 1936-38, engr. ap'tice, 1938-40, switchboard dftng., special apparatus design, etc., 1940-42, ignition rectifiers, engrg. dept., and at present, supervision of rectifier installn., service dept. (St. 1937).

References: F. H. Sexton, H. A. Cooch, D. W. Callander, J. T. Thwaites.

HUBBARD—SEWELL FORTESCUE, of 3429 Peel St., Montreal, Que. Born at Quebec, Que., Aug. 8th, 1913; Educ.: B. Eng. (Chem.), McGill Univ., 1938; 1935 (summer), bench chemist, St. Lawrence Sugar Refineries, Montreal; 1937 (summer), paper machines, Anglo-Canadian Pulp & Paper Mills; 1939-40, with Mallinckrodt Chemical Works, Montreal—iodine and bromide depts., inspr. of finished chemicals, lab. work, 1940-42, i/c of organic dept., mfg. sulfa drugs—reorganized dept.—layout and installn. of equipment, etc.; at present with Stormont Chemicals Limited, Cornwall, Ont. (St. 1938).

References: S. E. Oliver, C. M. McKergow, J. B. Phillips, E. Brown, J. Ruddick.

KENNEDY—DORWIN ELMORE, of 103 Silver Birch Ave., Toronto, Ont. Born at Toronto, Sept. 4th, 1916; Educ.: B.A.Sc., Univ. of Toronto, 1940; 1940 (2 mos), dftsmn. with G. L. Wallace, consltg. engr.; July 1940 to date, junior engr., H.E.P.C. of Ontario, Toronto, Ont. (St. 1940).

References: O. Holden, J. R. Montague, F. W. Clark, S. W. B. Black, E. B. Hubbard, C. R. Young, R. F. Leggett.

KENNEDY—HAROLD EDWARD, of 9 Castle Frank Crescent, Toronto, Ont. Born at Toronto, May 13th, 1914; Educ.: B.Sc. (Mech.), Queen's Univ., 1937; 1934-35-36 (summers), experimental lab. work, etc., with Aluminum Co. of Canada, Toronto; 1937-41, strucl. designer and dftsmn., Shawinigan Engineering Company; 1941 to date, strucl. designer and dftsmn., H.E.P.C. of Ontario, Toronto, Ont. (St. 1937).

References: J. A. McCrory, A. L. Patterson, J. D. Stott, A. S. Poe, R. C. McMordie E. B. Dustan.

KENT—A. DOUGLAS, of Arvida, Que. Born at Halifax, N.S., Jan. 13th, 1915; Educ.: B.Sc., Queen's Univ., 1937; 1936 (summer), engr., Gibson Mfg. Co., Guelph, Ont.; 1936-38, engr., General Steel Wares, London, Ont.; 1938-40, sales engr., Sheldons Ltd., Galt, Ont.; 1940-41, lecturer and demonstrator, Queen's University Kingston; 1941 to date, factory supt., Aluminum Co. of Canada, Arvida, Que. (St. 1935).

References: L. T. Rutledge, L. M. Arkley, R. F. Leggett, M. G. Saunders.

KERFOOT—JOHN GRENVILLE, of 89 l'Esperance St., St. Lambert, Que. Born at Prescott, Ont., Aug. 11th, 1913; Educ.: B.Sc., Queen's Univ., 1936; with Phillips Electrical Works Ltd. as follows: 1935 (summer), lab. inspection, 1936-37, tool, jig and fixture design, 1938-39, telephone contract engr., 1940, night shift supervisor, tool room, engr. i/c tool and material procurement, etc.; 1940, tool and fixture design on small arms ammunition, 1941, i/c dftng room, 1942, shift supervisor, production tool dept., and at present, tool engr. i/c tool design and development, Defence Industries Ltd., Verdun, Que. (St. 1936).

References: H. W. Lea, A. C. Rayment, H. B. Hanna, L. T. Rutledge, L. M. Arkley.

LACOMBE—JEAN LOUIS, of Baie Comeau, Que. Born at Sherbrooke, Que., July 9th, 1910; Educ.: B. Eng. (Civil), McGill Univ., 1937; 1937-38, instr'man, and constrn. engr., Ontario Paper Company; 1938-40, dftsmn. and concrete designer, Truscon Steel Co. of Canada; 1940 to date, dftng, mtce. and mech. designer, Quebec North Shore Paper Co., Baie Comeau, Que. (St. 1937).

References: W. G. Reekie, R. DeL. French, L. Trudel, P. G. Gauthier, D. Anderson.

LEFORT—JEAN, of 4051 Lacombe St., Montreal, Que. Born at Montreal, Jan. 7th, 1915; Educ.: B. Eng., 1936, B.C.L., 1939, McGill Univ.; Junior engr. with the following firms: 1939, Atlas Constrn. Co., 1939-40, Saguenay Power Company, 1940-41, Dufresne, McLagan and Associates, and 1941 to date, Stevenson & Kellog Ltd., Montreal. (St. 1935).

References: P. Kellogg, L. J. Scott, E. H. McCann, C. Miller, T. M. Moran.

LEROUX—GEORGE GUSTAVE, of Montreal, Que. Born at Montreal, Feb. 10th, 1915; Educ.: B. Eng., McGill Univ., 1940; 1937-38 (summers), McIntyre Porcupine Gold Mines & Siscoe Gold Mines; 1939 (summer) and 1940, asst. engr., aviation divn., Dept. of Transport; 1940-42, R.C.A.F., instructor in navigation, and at present, Flight-Lieut., asst. chief instructor, No. 8 Air Observer School, Ancienne Lorette, Que. (St. 1939).

References: R. E. Jamieson, R. DeL. French, G. J. Dodd, F. M. Wood, C. M. McKergow.

LEVINE—SAMUEL DAVE, of Newark, N.J. Born at Selkirk, Man., May 28th, 1913; Educ.: B.A.Sc. (Chem.), Univ. of Toronto, 1940; 1937 (summer), British Tire Co. of Canada Ltd., Lachine, Que.; 1938 (summer), with R. Thomas Pollock, consltg. engr., New York; Nov. 1940 to date, examiner, Inspection Board of the United Kingdom and Canada, at Buffalo, N.Y., Harrison, N.J., and at present, Newark, N.J. (St. 1937).

References: C. E. Sisson, J. J. Spence, M. B. Watson, W. B. Dunbar, W. S. Wilson.

LITTLE—HARRY, of 5409 Vanutelli Ave., Montreal, Que. Born at Darlington, England, March 15th, 1907; Educ.: 1922-28, mech. engr. course (night classes), Darlington Technical College; 1922-28, engrg. ap'tice, Darlington Railway Plant & Foundry Co., and 1928-29, junior dftsmn. with the same company; 1929-31, dftsmn. on mtce. and new equipment, Aluminum Co. of Canada Ltd., Arvida, Que.; 1932, dftsmn. on fully automatic domestic oil burners, Canadian Oil Heating Corporation, Montreal; 1932-33, dftsmn. on oil burners, E. & T. Fairbanks Co. Ltd., Sherbrooke, Que.; 1934-37, sales engr., 1937-40, asst. sales mgr., 1940-42, sales mgr., and April 1942 to date, sales mgr. and director, R. & M. Bearings Canada Ltd., Montreal. Also—June 1942 to date, director of Aircraft Bearings Ltd., Toronto. (St. 1931).

References: R. S. Eadie, J. Smith, J. T. Farmer, M. G. Saunders, J. W. Ward, C. H. Champion, J. A. Ogilvy.

LONDON—WOODROW P., of 908 Roberts St., Niagara Falls, Ont. Born at Millinocket, Me., U.S.A., Jan. 28th, 1914; Educ.: B.Sc. (E.E.), Univ. of N.B., 1934; 1935-36, dftsmn., N.B. Electric Power Commn.; 1937-38, dftsmn., 1938-41, engr., mech. design and layout (mtce. and various constrn. projects), Bathurst Power & Paper Co. Ltd.; 1941 to date, designing dftsmn., mech. design and layout (steam and hydro-electric plants), H. G. Acres & Co. Ltd., Niagara Falls, Ont. (St. 1934).

References: J. Stephens, G. E. Booker, A. W. F. McQueen, H. E. Barnett, J. H. Ings.

LOVE—EDWIN REGINALD, of Winnipeg, Man. Born at Reading, England, Jan. 18th, 1912; Educ.: B.Sc. (E.E.), Univ. of Man., 1934; R.P.E. of Man. 1930 (summer), rodman and calculator, Slave Falls Plant, City of Winnipeg Hydro Electric System; 1934 (Aug.-Oct.), relief sub-station attendant, Winnipeg Electric Co.; 1934-35 (summers), private tutor in engrg. subjects; 1934-35 and 1935-36, demonstrator i/c elec. and mech. engrg. labs., Univ. of Man.; 1936-38, graduate ap'tice course, and 1938-40, sales engr., elec. apparatus, Canadian Westinghouse Co. Ltd., Hamilton, Winnipeg and Regina; Oct. 1940 to date, with the R.C. Signals, C.A. (Active), at present, Capt. 2nd in Command, School of Instruction, Canadian Signal Training Centre, Kingston, Ont. (St. 1931).

References: E. P. Fetherstonhaugh, J. W. Sanger, E. V. Caton, E. S. Braddell, A. E. Macdonald, G. H. Herriot.

MENARD—RAYMOND, of 7995 Casgrain St., Montreal, Que. Born at Montreal, May 20th, 1914; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1939; 1937-38 (summers), Quebec Streams Commn.; 1938-39 (summers), testing lab., Le Controle Technique; 1939 to date, res. engr., Dept. of Roads, Prov. of Quebec, Montreal, Que. (St. 1937).

References: E. Gohier, S. A. Baulne, J. A. Lalonde, A. Gratton, J. O. Martineau.

MULLINS—HARRISON ALEXANDER, of 4931 Coronet Ave., Montreal, Que. Born at Herschel, Sask., Nov. 23rd, 1912; Educ.: B.Sc. (E.E.), Univ. of Man., 1937; 1936-37, Kipp-Kelly Ltd., Winnipeg; 1937-38, Maloney Electric Toronto; 1938-39, Taylor Electric Mfg. Co., London, Ont.; March 1940 to date, asst. project engr., Defence Industries Ltd., Montreal. (St. 1937).

References: C. H. Jackson, M. W. Kerson, E. P. Fetherstonhaugh, A. B. McEwen.

MCCOLEMAN—HUGH ALEXANDER, of 3440 Peel St., Montreal, Que. Born at Redcliff, Alta., March 11th, 1914; Educ.: B.Sc. (E.E.), Univ. of Alta. 1936; 1936-39, asst. electrician, shift engr., and asst. plant engr., Dominion Glass Company Ltd., Redcliff, Alta.; 1939-40, surveyor, Canada Land & Irrigation Co. Ltd., Medicine Hat, Alta.; 1940, gen. engrg. dept., 1941 to date, elec. dept., on layout and detail drawings of elec. installns. in new plant and extensions, Aluminum Co. of Canada, Montreal, Que. (St. 1936).

References: H. J. MacLeod, C. A. Robb, D. W. Hays, W. E. Cornish, S. R. Banks, D. G. Elliot.

McMATH—JOHN PROCTOR CLARK, of 3811 Prudhomme Ave., Montreal, Que. Born at Ranfurly, Alta., Nov. 3rd, 1913; Educ.: B.Sc. (E.E.), Univ. of Alta., 1936; 1932-36 (summers), municipal surveys; 1937 to date, design engr., wires and cables, Northern Electric Co. Ltd., Montreal, Que. (St. 1936).

References: N. L. Morgan, N. L. Dann, W. G. Tyler, W. E. Cornish.

NADEAU—YVON, of 128 St. Laurent St., Louiseville, Que. Born at St. Hilaire, Que., Sept. 26th, 1912; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1940; 1937-38-39 (summers), highway constrn. in Quebec and N.B.; 1940-41, res. engr., Dept. of Roads, Prov. of Quebec; at present, instr'man and asst. engr., Fraser Brace Co. Ltd., La Tuque, Que. (St. 1939).

References: A. Circe, R. Boucher, A. Gratton, F. S. Small, A. Morrissette.

OSTIGUY—JOSEPH EPHREM MAURICE, of 52 Grove Ave., Granby, Que. Born at St. Hyacinthe, Que., Nov. 20th, 1912; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1938; 1937-38 (summers), instr'man, etc., and 1938 to date, asst. divnl. engr., at Waterloo, Que., for the Dept. of Roads, Prov. of Quebec. (St. 1936).

References: A. Circe, A. Gratton, J. A. Lalonde, L. Trudel, P. P. Vinet.

PARK—FILLMORE ROBERT, of Ottawa, Ont. Born at Port Arthur, Ont., May 5th, 1914; Educ.: B.Sc. (E.E.), Univ. of Alta., 1936; 1937-39, power apparatus specialist and special products sales, Northern Electric Co. Ltd., Calgary, Montreal and Vancouver; 1939-40, instr'man and office man., Dept. of Transport, Calgary; 1940-41, junior asst. engr., R.C.A.F. works and bldgs., Dept. of National Defence, Calgary; 1941 to date, junior research engr. radio divn., National Research Council, Ottawa, Ont. (St. 1936).

References: R. W. Boyle, J. McMillan, C. A. Davidson, N. B. LeBourveau, W. F. Sutor.

RIOUX—JOSEPH HENRI RENE, of 66 Blvd. Benoit XV, Quebec, Que. Born at Montreal, July 3rd, 1915; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1938, R.P.E. of Que.; 1936 (summer), Geol. Surveys; 1937 (summer), surveys and res. engr., 1938-40, res. engr., and August 1940 to date, asst. divnl. engr., Divn. No. 4, Dept. of Roads, Quebec, Que. (St. 1936).

References: R. A. Lemieux, G. F. St. Jacques, J. O. Martineau, E. Gohier, P. Vincent, J. P. Lecavalier, T. M. Dechene.

ROBILLARD—RICHARD FRANCOIS, of 3076 Maplewood Ave., Montreal, Que. Born at L'Original, Ont., April 3rd, 1912; Educ.: 1924-30, classical course, Univ. of Ottawa; 1930-33, dftsmn., Truscon Steel Co. of Canada, Montreal; 1935-39, asst. engr. in design and installn. of automatic fire sprinkler systems, Grinnell Co. of Canada; 1939-40, asst. mgr., and 1941 to date, mgr., H. G. Vogel & Co. Ltd., automatic fire sprinkler systems, Montreal, Que. (St. 1930).

References: A. J. Foy, A. J. Wise, G. Grsham, G. L. Wiggs, B. R. Heavysedge.

ROWAN—RUSSELL GILLESPIE, of 549 King Street, Peterborough, Ont. Born at North Monaghan Twp., Ont., Dec. 20th, 1914; Educ.: B.Sc., Queen's Univ.; 1940; 1939 (summer), on constrn. for Algoma ore properties, New Helen Mine, Ontario; 1941 to date, engrg. asst., prov. district plant dept., Bell Telephone Co. of Canada, Montreal, Que. (St. 1939).

References: W. J. S. Dormer, L. E. Ennis, D. S. Ellis, J. B. Baty, L. T. Rutledge.

SAINTONGE—JEAN-JACQUES ROSAIRE, of Port Alfred, Que. Born at Valleyfield, Que., Nov. 7th, 1910; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1937, R.P.E. of Que.; 1933-36 (summers), instr'man, 1937-41, res. engr., Dept. of Roads, Prov. of Quebec; at present, asst. plant engr., Port Alfred Divn., Consolidated Paper Corporation Limited. (St. 1936).

References: C. H. Jette, F. W. Bradshaw, E. B. Wardle, E. Gohier, L. Trudel, A. Gratton, A. Circe, A. Frigon.

SHEARER—JOHN ALEXANDER, of 140 Cedar St., Sudbury, Ont. Born at Fredericton Jct., N.B., July 6th, 1914; Educ.: B.Sc. (Civil), Univ. of N.B., 1941; 1936-38 (summers), rodman, N.B. Dept. of Highways; 1941 (summer), rodman, and 1941 to date, transitman, C.P.R., at present at Sudbury, Ont. (St. 1941).

References: E. O. Turner, J. H. Moore, A. O. Wolff, L. M. Duclous, J. Stephens.

SINCLAIR—GEORGE, of 171 King Ave., Columbus, Ohio. Born at Hamilton, Ont., Nov. 5th, 1912; Educ.: B.Sc., 1933, M.Sc., 1935, Univ. of Alta. Three years post-graduate study, Ohio State Univ.; 1936-37, asst. dept. of elec. engrg., Univ. of Alta.; 1937-39, broadcasting Corp., Grande Prairie, Alta.; 1941 to date, asst. investigator, war research project, Ohio State Research Foundation. (St. 1933).

References: R. S. L. Wilson, H. J. MacLeod, W. E. Cornish, I. F. Morrison.

STAFFORD—JAMES WALTER, of 48 Maple Ave., Shawinigan Falls, Que. Born at Lethbridge, Alta., Nov. 25th, 1913; Educ.: B.Sc. (E.E.), Univ. of Alta., 1937; 1935-36 (summers), highways br., Prov. of Alta., Northern Alta. Rlys.; 1936-37, dftsmn., Aluminum Co. of Canada; 1937-38, junior engr., 1938, plant engr., 1938-39, asst. power engr., and 1939-41, test engr., Saguenay Power Company; 1941-42, elec. supt., plant No. 1, and July 1942 to date, gen. elec. supt., plants No. 1 and No. 2, Shawinigan Works, Aluminum Company of Canada Ltd. (St. 1936).

References: A. W. Whitaker, Jr., McN. DuBose, F. L. Lawton, C. Miller, M. G. Saunders, R. S. L. Wilson.

TORRINGTON—FRANK DELBRIDGE, of 7 Argyle Ave., St. Lambert, Que. Born at Davidson, Alta., Oct. 9th, 1912; Educ.: B.Sc. (Mech.), Univ. of Sask., 1940; 1936-39 (summers), mining work, Sylvanite Gold Mine, Kirkland Lake, Ont.; 1940, Acme Screw Gear, Toronto; 1940-41, A.I.D. (Aircraft Inspection), Dept. of National Defence; 1941 to date, Flying Officer, Aeronautical, Engrg. Branch, R.C.A.F. (St. 1940).

References: C. J. Mackenzie, I. M. Fraser, R. A. Spencer, W. E. Lovell, S. Young.

WALLIS—WILLIAM HERBERT CYRIL, of 1227 Sherbrooke St. W., Montreal, Que. Born at Montreal, July 13th, 1914; Educ.: B.Sc. (Civil), Univ. of N.B., 1936; 1936-40, inspection work, etc., Donald Inspection Co., Montreal, Que.; 1940-41, Flying Officer, Works & Bldgs. Divn., R.C.A.F., constrn. of schools for joint air training plan. 1941 to date, Pilot Officer, R.C.A.F. Air Crew, instructing in service aircraft. (St. 1936).

References: J. Stephens, A. F. Baird, E. O. Turner, J. R. Donald, P. F. Sise, E. R. Smallhorn, C. D. Harrington.

WELDON—GEORGE HORACE, of 267 Woodlawn St., Winnipeg, Man. Born at Winnipeg, June 7th, 1914; Educ.: B.Sc. (E.E.), Univ. of Man., 1936; 1936 (summer), paving inspr., Manitoba Good Roads Board; 1937-38, layout work on dam and transmission line constrn., Power Corporation of Canada; 1940 to date, supervisor, Defence Industries Limited, Winnipeg. (St. 1937).

References: H. L. Mahaffy.

WOODS—GEORGE MAITLAND, of 681 Godin Ave., Verdun, Que. Born at Lang, Sask., June 1st, 1913; Educ.: B.Sc. (Mech.), Univ. of Sask., 1941; 1933-37, boilerman and stillman, Hi-Way Oil Refinery, Rosetown, Sask.; 1937-38, rodman, 1938-39, instr'man, 1939-40, acting district engr., N. W. of Saskatchewan, water rights br., Dept. Natural Resources, Regina; 1940, constrn. engr. and acting res. engr. at air ports, Dept. of Transport, Regina; 1940-41, foreman, and at present, senior foreman, Defence Industries Limited, Verdun, Que. (St. 1940).

References: C. J. McGavin, I. M. Fraser, N. B. Hutcheon, E. K. Phillips, F. H. Barnes.

# Employment Service Bureau

## SITUATIONS VACANT

**MECHANICAL ENGINEER** for British Guiana. Some experience on diesels and tractors preferred. Apply to Box 2482-V.

**ELECTRICAL ENGINEER** with at least five years practical experience for work at Mackenzie, British Guiana. Apply to Box No. 2536-V.

**JUNIOR MECHANICAL ENGINEER** wanted at Arvida, recent graduate with machine shop experience to act as assistant to shop superintendent. Apply to Box No. 2572-V.

**PERMANENT POSITION** in Toronto or Montreal areas with a large industrial fire insurance organization. Previous experience in this work is not necessary. Applicant must be a technical graduate with manufacturing or engineering experience and possess a good personality. Several months training with full pay will be given. Please send photograph with letter. Apply to Box No. 2588-V.

**JUNIOR MECHANICAL ENGINEER** wanted at Kingston, Ontario, recent graduate. Apply to Box No. 2589-V.

**GRADUATE MECHANICAL ENGINEER**, preferably a man with paper mill experience to specialize in sale and installation of material handling equipment. Apply to Box No. 2590-V.

**GRADUATE ENGINEER** or man with sufficient experience in draughting to act as squad leader of four to six men on reinforced concrete detailing, general equipment layout or mechanical drawing. This man to work along with other draughtsmen but be able to head up the job, lay out the work and check the drawings for issuing. Apply to Box No. 2577-V.

**CERAMIC ENGINEER** for work at Arvida Que. Apply to Box No. 2591-V.

**CHEMICAL OR METALLURGICAL ENGINEER** with flotation experience for work in fluoride department at Arvida, Que. Apply to Box No. 2592-V.

**MINING, METALLURGICAL OR CHEMICAL ENGINEERS** for work at Arvida, Que. Apply to Box No. 2593-V.

**CHEMICAL ENGINEERS** for work at La Tuque, Que. Apply to Box No. 2594-V.

**CIVIL ENGINEER** with some pile driving experience for work at Mackenzie, British Guiana. Apply to Box No. 2595-V.

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to **THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.**

**ELECTRICAL ENGINEER** for plant and townsite electrical maintenance work at Mackenzie, British Guiana. Apply to Box No. 2596-V.

## SITUATIONS WANTED

**INDUSTRIAL ENGINEER, M.E.I.C.** Age 40, Canadian, Married, desires position as production manager or other executive capacity. Presently employed but desires change to plant on war work. Understands layout thoroughly. Location Toronto area. Salary dependent on responsibility, minimum \$3,600. Apply to Box No. 717-W.

**MECHANICAL DRAUGHTSMAN, J.R.E.I.C.**, graduate of the University of Toronto in Electrical Engineering. Some six years of practical experience with accent on electric motor design, instruments and small tools. Has a background of two years in electric instrument laboratory. Desirous of making a change where his services will be fully utilized and better appreciated. Apply to Box No. 1486-W.

**CIVIL ENGINEER, B.A. sc.** Age 33, married. Experience covering heating, air conditioning, mining. Design, construction and maintenance of sewers, aqueducts, streets and highways, including surveying, location, estimating, inspections, drainage and soundings. Presently employed, but desires advancement. Apply to Box No. 1859-W.

**GRADUATE CIVIL ENGINEER, S.E.I.C.**, experience in surveying and in teaching same, location surveys for roads and railroads, 2 years as construction engineer in oil fields in tropics in charge of roads, earth-moving machinery, anti-malarial drainage, etc. Experience in construction of bituminous pavements. At present engaged in airport construction. Available from September first. Age 30 years. Apply to Box No. 1860-W.

**GRADUATE ELECTRICAL ENGINEER, M.E.I.C.**, with twenty-nine years experience in operation construction, repairs and maintenance of paper mill and hydro electric system. Bilingual. Available September first. Apply to Box No. 2443-W.

## TRANSITS AND LEVELS WANTED

The Department of Munitions and Supply at Ottawa is desirous of procuring:

15 transits 5" with vertical circle theodolite including tripod case and accessories.

19 8" telescopic levels—Dumpy including tripod case and accessories.

Second-hand instruments will be acceptable providing they are in good condition and have the following:

- Transit
- Not less than 5 in. horizontal circle.
  - Vertical circle.
  - Read to minutes.
  - Carrying case tripod.
  - Plumb bob, objective shade.
  - Adjusting keys.

Level

Dumpy pattern preferred but not absolutely essential, must have:

- Telescope not less than 8 in.
- Carrying case and tripod.
- Objective shade.
- Adjusting keys.

Please communicate direct with: L. L. Price, Director, General Purchasing Branch, Dept. of Munitions and Supply, Ottawa.

## The Enemy Stops Short

When an individual, either as an enemy agent or as an honest person who believes what he says, whispers that Canada's Victory Loan Bonds will not be cashed after the war, he does not go far enough. To be consistent, and fair, he should add that any future condition in this country which would cancel out the value of Victory Bonds would also make life insurance policies worthless. He should explain that savings accounts would be wiped out. He should point out that one dollar bills, five dollar bills or any other kind of currency, including silver coins, would be just something to toss into the ash can.

Victory Bonds cannot be set aside as something separate and apart from other obligations of this, our country. They are just as sacred a "promise to pay" as the one dollar bills we carry in our pockets.

These bonds are held by the people of Canada. And the only way through which they can be repudiated would be by a decision of the people of Canada not to pay themselves back.

The pessimist is out of order in Canada. The assets and resources of this country which back this loan from the people are billions and billions of dollars in excess of the loan total. Even with all the borrowing that has had to be done since the start of the war in 1939, the interest cost of Canada's total debt to this date, is only 189 million dollars a year.

Canada can and will meet indebtedness of that size. Fifty years from now our children and our children's children will likely smile at the small financial problem which we thought was so big.

# BUY VICTORY BONDS

### AIRCRAFT SANDING

An 8-page booklet, Form No. S106, just issued by Sterling Tool Products Company, Chicago, Ill., and Toronto, Ont., is entitled "Hints on Aircraft Sanding," and presents some thirty hints and directions on how to speed production by the use of the "Sterling Speed Bloc" sander. The sander is air-driven, mounted on casters, and has numerous other features which add to its efficiency and convenience of operation.

### THE CIRCUIT

The July, 1942, issue of "The Circuit," published by Canadian Line Materials Limited, Toronto, Ont., deals with "Electric Cable for Use in War Time," and the first article reviews this important subject pointing out the trend towards the use of paper, varnished cambrie, and synthetic rubber insulations and the elimination of rubber for this purpose. Testing electrical connectors in the laboratory is described in the second article, and is followed by a third entitled "Shall the Code Become the Engineer's Football."

### CONVEYING AND ELEVATING EQUIPMENT

"The Labor Saver," Volume 189, issued by Stephens-Adamson Manufacturing Company of Canada, Limited, Belleville, Ont., contains a series of brief amply illustrated articles featuring the use of this company's conveying and elevating equipment in handling products in a wide variety of plants. These include coal at the power plant of the United States Naval Academy; the elevating and storage of sulphur in a pulp plant; the conveying of ores in mining; conveying and loading cement; handling baggage at a passenger terminal; handling chemicals for water treatment at plants of thirteen cities in California; the conveying of walnuts; the elevating of anthracite; handling food products; and the conveying of shellac.

### FIREPROOF WALLBOARD

Gypsum, Lime & Alabastine Canada, Limited, Toronto, Ont., have published a 4-page folder outlining the advantages of "Gyproe" fireproof wallboard, particularly for the walls and ceilings in the remodelling of industrial plants, offices, stores and private residences.

### FLOW METERS

"Flow Meters by Cochrane" is the title of a 56-page catalogue being distributed by Cochrane Corporation, Philadelphia, Pa., covering the company's complete line of flow meters. Besides describing electric, mechanical, linometer (area), ring balance, liquid level and weir meters, it also covers the new 2-pen electric flow recorder with ratio indicating pointer, an improved low pressure (1 in. to 10 ins. water differential) electric type meter, and the ultra high pressure (6,000 psi) ring balance meter. This catalogue also includes a discussion of flow metering benefits and complete listings of specifications and ranges.

### GRITS AND GRINDS

Vol. 33, No. 5 of "Grits & Grinds," published by Norton Company of Canada, Limited, Hamilton, Ont., features an article on the reconditioning of plug gauges, worn undersize in service, not only once but several times by hard chrome plating and finishing to original size. A comparative means of grading cylindrical surface finish by means of a set of finish standards is also featured and is followed by a description of two new motion pictures, "Cutter Grinding" and "The Cylindrical Grinder." Special large refractory burner blocks for billet heating, heat treating and annealing furnaces are featured in the final article.

### FUSE CONNECTORS

A leaflet issued by Vaughan Bedell & Company, Toronto, Ont., under the title "Modernize Your Old Fuses," gives full details of the "Signalite Fuse Converter" which may be quickly and easily attached to fuses at present in use. These fuse converters provide the features of "Signalite" fuses whereby a signal light will instantly indicate which fuse has blown. They can be removed from a blown fuse and attached to a replacement or renewed fuse in a few seconds.

### HAND SAW FILING

"Saw Filing, too, is an Art!" is the title of a 4-page bulletin prepared by Nicholson File Company, Port Hope, Ont., which contains simple instructions for sharpening hand cross-cut saws and hand rip saws. These concise instructions are set in large easily read type and are accompanied by illustrations. They are given under the following headings: holding the saw; jointing; shaping teeth; setting; filing the hand cross-cut saw; and filing the hand rip saw. Each heading represents one of the four operations, the first three being similar for both the cross-cut and the rip saws while the fourth is slightly different for the two types of saws.

### HOME CONSERVATION PLAN

Alexander Murray & Company, Limited, Montreal, Que., are distributing a 16-page booklet entitled "Introducing the Donnacona Wartime Home Conservation Plan." This booklet deals with the questions arising when the building or renovating of a home is considered under present day conditions. It answers many questions starting with the first, "Can I do it?" Materials available are dealt with and a section is devoted to the conservation of each of the following: fuel, funds, space, health, values and efficiency. Various "Donnacona" and "Murray" building products are illustrated and described.

### ILLUMINATED MAGNIFIER

The Boyer-Campbell Company, Detroit, Mich., have issued a 4-page bulletin describing this company's product "Super Sight," which combines magnification and properly directed light. The bulletin outlines how "Super Sight" is adapted to close inspection, fine assembly and precision machines. It is supplied with either 4-in. or 5-in. lenses and, besides the standard models with various brackets for bench and machine, there is a model with both fluorescent and vaporproof lighting. A supplementary folder describes this same principle of properly directed light, plus magnification, as adapted to first aid and hospital use.

### JOINING AND REPAIRING PIPE

A 12-page bulletin, Form 402B, just issued by Dresser Manufacturing Company, Limited, Toronto, Ont., is entitled "How to Join and Repair Pipe." The subject matter is covered in a most comprehensive manner, accompanied by numerous illustrations and drawings. It features "Dresser" couplings and repair devices and the ease and rapidity with which the work can be done. The details covered include various styles of pipe joints and how to do the joining; how to stop leaks in pipe and pipe joints; "Dresser" repair sleeves for repairing major breaks; various types of fittings; fittings for every purpose and other "Dresser" products for special conditions.

### MAINTENANCE AND CONSTRUCTION OF BUILDINGS

The Tremco Manufacturing Company (Canada) Limited, Toronto, Ont., have published a 20-page bulletin entitled "Tremco Quick Reference Guide," which provides useful information for users of the company's products—caulking compounds, glazing compounds, paints and roofing products. The text is well illustrated and is given under the following headings; roof maintenance; floors and floor maintenance; caulking and pointing; glazing greenhouses; waterproofing and damp-proofing; bonding compounds; interior painting; exterior painting; and miscellaneous coatings.

### MANUAL ON PAINTING

A 48-page manual (revised edition) being distributed by Imperial Varnish & Color Company, Limited, Toronto, Ont., is a very comprehensive treatment of the subject of painting and is thoroughly indexed. Each paragraph is numbered so that any particular item can be easily located. The text is arranged under a number of general headings, including exterior painting, interior painting, enamel work and varnishing, floor treatment, roof protection and decoration, new wood finishes, interior decoration, etc.

### MAP OF EASTERN HEMISPHERE

A folded map, 18½ ins. by 24½ ins., in colour, showing the Eastern Hemisphere as well as part of the Western Hemisphere with distances between important points, has been issued by Canadian Line Materials Limited, Toronto, Ont. Information is also included on air raid precautions and bombs.

### OXY-ACETYLENE TIPS

"An Aid to Better Welding" is the title of the leading article in Vol. XVII, No. 5, July, 1942, "Dominion Oxy-Acetylene Tips," published by Dominion Oxygen Company, Limited, Toronto, Ont. This article thoroughly illustrates construction details of a homemade welding positioner, fabricated at a moderate cost. With it, welding jobs up to 500 lbs. in weight can be readily clamped on the table top and then quickly rotated to any position so that welds otherwise done in the vertical or overhead position can be made in the flat position. Other articles include: suggestions to get best results in bevel-cutting operations; repairing a pulp-beater drum; removing "Dutchmen" from salvaged pipe fittings; reduced cost by stack-cutting, and a page on precautions and safe practices.

### PENCILS, ERASERS, PENS, ETC.

Eberhard Faber Pencil Company of Canada, Limited, Toronto, Ont., have for distribution a 40-page catalogue, No. C-1, which contains illustrations, descriptions and specifications covering this company's extensive line of pencils, erasers, mechanical pencils, fountain pens, crayons, stamp pads, etc.

### PORTABLE ELEVATORS

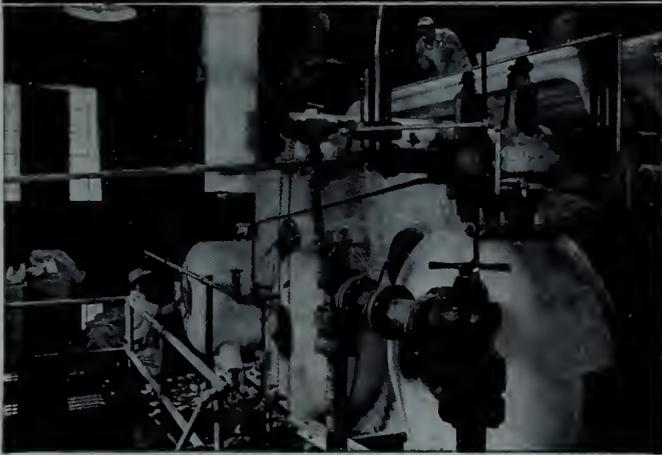
Catalogue No. 12-E, 24 pages, just issued by Mahaffy Iron Works, Toronto, Ont., features the company's "Revolver" portable elevator. Various models are illustrated with a description of each part indicated on the illustrations; dimensional drawings are included with tables of dimensions. A large number of illustrations show these elevators in operation and indicate the wide range of applications of the various models.

(Continued on page 46)

STEAM PIPE INSULATION

J-M 85%  
Magnesia

The Most Widely  
Used Specification  
in Power Plant  
Insulation for  
More Than 50 Years



**FOR PIPE COVERING . . .** J-M 85% Magnesia Pipe Insulation is furnished in 3-ft. sections or segments in the following thicknesses: Standard, 1½", 2", 2½", Double Standard and 3" (Double Layer). Often used as a second layer, outside of J-M Superex, where pipe temperatures are above 600° F.



**IN BLOCK FORM . . .** J-M 85% Magnesia Blocks are furnished 3"x 18", 6"x 36", 12"x 36", in thicknesses of 1" to 4". Weight, about 1.4 lb. per sq. ft., per 1" thick.

**. . . and for good reasons**

At service temperatures up to 600° F., no insulation delivers more thoroughly satisfactory performance than J-M 85% Magnesia. That's a fact that's been proved time and again in power plants of every type. Light in weight, readily cut and fitted, J-M 85% Magnesia is easy to install. On the job, it provides ample mechanical strength, long life and high insulating efficiency. Engineers agree that, wherever used, J-M 85% Magnesia assures permanently economical service.

Consult your nearest J-M District Office today about your Magnesia requirements, or write direct to Canadian Johns-Manville Co., Limited, 199 Bay St., Toronto.

PI-10

**JOHNS-MANVILLE**  
INDUSTRIAL INSULATIONS  
For every temperature . . . for  
every service condition



# I.C.S.

## SPECIALIZED TRAINING

FOR

### THE ENGINEERING PROFESSION

International Correspondence Schools are equipped to provide the non-university man with the specialized training necessary to enable him to study for the examinations of engineering societies and associations. I.C.S. Home Study Courses are of particular interest to prospective applicants for membership in any of these organizations.

I.C.S. courses for examinations are arranged with the object of preparing the candidate for his examinations in the shortest possible time, while omitting no features of his training conducive to thoroughness and diversity of knowledge.

Each candidate will receive the individual attention of a vocational and educational specialist. The candidate's examination courses will be arranged to comply with his individual requirements and his rate of progress will be affected by no other student. He will proceed as rapidly as his ability, his study time and his application will permit. He will be allowed ample time to complete his I.C.S. course and will receive full answers to any questions he may need to ask which come within the scope of his course.

The subjects in which I.C.S. training is available include:

- High School Subjects
- Elementary Physics and Mechanics
- Strength and Elasticity of Metals
- Drawing
- Chemistry
- Chemical Engineering
- Civil Engineering
- Electrical Engineering
- Mechanical Engineering
- Mining Engineering
- Structural Engineering

**AN INVITATION**—You are invited to send for information about I.C.S. training. You incur no obligation. Just mark and mail the coupon.

International Correspondence Schools,  
Canadian Limited,  
Department H-4,  
Montreal, Canada.

Please send me complete information on I.C.S. training for engineering.

Name.....

Address.....

Employed by.....

# Industrial News

(Continued from page 600)

## PORTABLE FIRE EXTINGUISHERS

Pyrene Manufacturing Company of Canada, Limited, Toronto, Ont., have prepared a 6-page folder entitled "Directions for Inspecting, Recharging and Maintaining Portable Fire Extinguishers." At this time, when it is more important than ever to keep fire extinguishers in good order in shops, industries, garages and other places where fire hazard is present, this folder is of particular interest to all those responsible for fire prevention. Various types of extinguishers are described, with details regarding the care and recharging of each. A sectional drawing of the "Pyrene" fire extinguisher is used to illustrate a description entitled "The Inside Story of Pyrene."

## THE POWER SPECIALIST

The July-August, 1942, issue of *The Power Specialist*, which is issued by Canadian Johns-Manville Company, Limited, Toronto, Ont., features an article dealing with the aid being rushed from the American continent to the allied nations on the Eastern war front. This interesting article is accompanied by photographs. The second article describes the new 50,000 kw. turbo-generator unit added to the plant of the Toledo Edison Company's Acme station. Following this, the unusual features of the San Francisco radio station KPO are described and illustrated. A short illustrated item deals with cutting core-making costs and is based on ten years' experience in an Ohio foundry. A final short article is entitled "An Economic Life for Packings?" and embodies suggestions for the correct installation as a means of securing longer life for packings.

## RUBBER IN ACTIVE SERVICE

A 32-page booklet issued by Dunlop Tire & Rubber Goods Company, Limited, Toronto, Ont., tells how to keep rubber in active service. Everyone realizes that it is necessary to conserve the life of rubber products now in active service and this illustrated booklet will prove of value as it describes common causes of excess wear and failures in rubber installations in industrial plants together with methods of avoiding these and of proper maintenance of all industrial rubber products.

## TEMPERATURE AND HUMIDITY CONTROL

The Canadian Powers Regulator Company, Limited, Toronto, Ont., have for distribution a 4-page bulletin, No. 2520, which features the "Powers" thermostatic water controller for shower baths and wash sinks; No. 11 temperature regulator for industrial processes; pneumatic system of automatic temperature control for offices, factories, process rooms, etc.; and air operated controls for dryers, kilns, tanks, vats, cooking kettles, retorts, etc.

## TUBE CLEANERS

Bulletin No. Y-11, 8 pages, prepared by Elliott Company, Springfield, Ohio, features the latest "Elliott-Lagonda" development in refinery tube cleaners, designated as the "1100 series," which has a double ball-thrust motor. Illustrations show the component parts of these cleaners, typical combinations of motors and cutter heads, details of the cutter heads, cleaners for small and curved tubes, drills and flexible joints, and other specialties. Each item is fully described.

## SOLVENT DEGREASING AND ALKALI CLEANING

Under the title "Scientific Metal Cleaning—Royalene Processes," the Canadian Hanson & Van Winkle Company, Limited, Toronto, Ont., are distributing a 12-page bulletin describing solvent degreasing and vapor, immersion and spray types of "Royalene" degreasing machines. These are fully described and are followed by illustrations of recent installations in Canadian plants. The company's line of alkali compounds for cleaning and stripping metal products is included with descriptions of each and details of Magnet "A", the alkali electro-cleaning process.

## STEAM GENERATORS

Vapor Car Heating Company of Canada, Limited, Montreal, Que., have prepared a 22-page catalogue featuring the "Vapor-Clarkson" steam generators, which have been designated as "Packaged Steam" due to their efficiency, compactness and the rapidity with which these modern "recirculating" units generate steam. In addition, the catalogue includes several types of valves (reducing, motorized, shut-off and safety); traps; metallic joints; thermostatic controls; a motorized valve and damper; heat exchanger; a command alarm; stratomotor and thermo-balancer; a newly designed cooling system thermostat that sets a new standard in controlling gas and diesel engine operating temperatures. These items are especially adaptable to the marine, industrial, institutional, aviation and refinery fields. A spread of typical layouts, showing uses of the generator and necessities are also included.

## TECHNIQUE OF PLYWOOD

I. F. Laucks Ltd., Granville Island, Vancouver, B.C., have just published a book by Charles B. Norris of the Lauxite Corporation entitled "Technique of Plywood." This includes the thirty chapters of technical information on plywood which originally appeared in "Hardwood Record." These articles cover all phases of plywood manufacture and are written from a technical standpoint, primarily for engineers, designers and users of plywood. The book has been divided into five main sections under the following headings: "Strength, Deformation and Elastic Stability of Plywood"; "Elastic Theory of Wood and Plywood"; "Manufacture of Plywood"; "Warpage of Plywood"; "Bending, Moulding and Embossing of Plywood." It has an attractive red plastic binding over heavy duty covers, and is being sold for \$2.50 per single copy, postpaid, and may be obtained by writing to the company.

## WATERPROOFINGS AND CONCRETE FLOOR TREATMENTS

A 4-page bulletin just issued by Sternson Structural Specialties Limited, Brantford, Ont., contains detailed descriptions and applications of the following products; plaster bond and stain-proofing; cut stone backing paint; foundation coating and damp-proofing; colourless water-proofing; stearate paste; integral hardener and accelerator; concrete accelerators; concrete floor hardener; heavy duty metallic floor hardener; caulking and stone pointing plastics; iron waterproofing; iron bond for concrete floor toppings; protective coatings; and decorative waterproofing.

# THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 25

MONTREAL, NOVEMBER 1942

NUMBER 11



"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

★ ★ ★

## CONTENTS

PUBLISHED MONTHLY BY  
THE ENGINEERING INSTITUTE  
OF CANADA

2050 MANSFIELD STREET - MONTREAL

I. AUSTIN WRIGHT, M.E.I.C.  
*Editor*

LOUIS TRUDEL, M.E.I.C.  
*Assistant Editor*

N. E. D. SHEPPARD, M.E.I.C.  
*Advertising Manager*

### PUBLICATION COMMITTEE

C. K. McLEOD, M.E.I.C., *Chairman*  
R. DEL. FRENCH, M.E.I.C., *Vice-Chairman*  
A. C. D. BLANCHARD, M.E.I.C.  
H. F. FINNEMORE, M.E.I.C.  
T. J. LAFRENIÈRE, M.E.I.C.

ON THE ALASKA HIGHWAY . . . . .	Cover
<i>(Photo Wartime Information Board)</i>	
CAUSES AND EFFECTS OF DAMAGE TO ELECTRICAL MACHINERY AND SWITCHING . . . . .	604
<i>C. A. Laverty, M.E.I.C.</i>	
THE EFFECT OF WET COAL ON PULVERIZER AND BOILER PERFORMANCE . . . . .	609
<i>Murray D. Stewart, S.E.I.C.</i>	
MOVING A COAL BRIDGE AT THE ALGOMA STEEL CORPORA- TION LTD. . . . .	615
<i>D. C. Tennant, M.E.I.C.</i>	
THE SUPERCHARGING OF TWO-STROKE DIESEL ENGINES . . .	618
<i>F. Oederlin</i>	
WARTIME NATIONAL EFFICIENCY . . . . .	621
<i>G. A. Gaherty, M.E.I.C.</i>	
SALVAGE AND SUBSTITUTES . . . . .	623
MAN-POWER CONTROL IN CANADA . . . . .	624
BROTHERS OF THE BRIDGE . . . . .	625
<i>A. L. Carruthers, M.E.I.C.</i>	
ABSTRACTS OF CURRENT LITERATURE . . . . .	627
FROM MONTH TO MONTH . . . . .	632
PERSONALS . . . . .	643
<i>Visitors to Headquarters</i>	
<i>Obituaries</i>	
NEWS OF THE BRANCHES . . . . .	646
LIBRARY NOTES . . . . .	650
PRELIMINARY NOTICE . . . . .	653
EMPLOYMENT SERVICE . . . . .	656
INDUSTRIAL NEWS . . . . .	657

Price 50 cents a copy, \$3.00 a year: in Canada, British Possessions, United States and Mexico. \$4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, \$2.00 a year. —Entered at the Post Office, Montreal, as Second Class Matter.

THE INSTITUTE as a body is not responsible either for the statements made or for the opinions expressed in the following pages.

# THE ENGINEERING INSTITUTE OF CANADA

## MEMBERS OF COUNCIL - 1942

### PRESIDENT

C. R. YOUNG, Toronto, Ont.

### VICE-PRESIDENTS

\*A. L. CARRUTHERS, Victoria, B.C.  
†H. CIMON, Quebec, Que.

### PAST-PRESIDENTS

†T. H. HOGG, Toronto, Ont.

### COUNCILLORS

†E. D. GRAY-DONALD, Quebec, Que.  
†J. HAIMES, Lethbridge, Alta.  
\*J. G. HALL, Montreal, Que.  
†R. E. HEARTZ, Montreal, Que.  
†W. G. HUNT, Montreal, Que.  
†E. W. IZARD, Victoria, B.C.  
†J. R. KAYE, Halifax, N.S.  
\*E. M. KREBSER, Walkerville, Ont.  
†N. MACNICOL, Toronto, Ont.  
\*H. N. MACPHERSON, Vancouver, B.C.  
\*W. H. MUNRO, Ottawa, Ont.

### TREASURER

E. G. M. CAPE, Montreal, Que.

### GENERAL SECRETARY

L. AUSTIN WRIGHT, Montreal, Que.

†J. L. LANG, Sault Ste. Marie, Ont.  
†G. G. MURDOCH, Saint John, N.B.

†C. J. MACKENZIE, Ottawa, Ont.

†T. A. McELHANNEY, Ottawa, Ont.  
\*C. K. McLEOD, Montreal, Que.  
†A. W. F. McQUEEN, Niagara Falls, Ont.  
†A. E. PICKERING, Sault Ste. Marie, Ont.  
†G. McL. PITTS, Montreal, Que.  
†W. J. W. REID, Hamilton, Ont.  
†J. W. SANGER, Winnipeg, Man.  
\*M. G. SAUNDERS, Arvida, Que.  
†H. R. SILLS, Peterborough, Ont.  
\*J. A. VANCE, Woodstock, Ont.  
\*A. O. WOLFF, Saint John, N.B.

\*For 1942 †For 1942-43 †For 1942-43-44

### SECRETARY-EMERITUS

R. J. DURLEY, Montreal, Que.

### ASSISTANT GENERAL SECRETARY

LOUIS TRUDEL, Montreal, Que.

## STANDING COMMITTEES

### FINANCE

DEG. BEAUBIEN, *Chairman*  
J. E. ARMSTRONG  
E. G. M. CAPE  
G. A. GAHERTY  
J. A. McCRORY  
F. NEWELL

### LEGISLATION

J. L. LANG, *Chairman*  
R. L. DOBBIN  
R. J. DURLEY

### PAPERS

J. A. VANCE, *Chairman*  
DEG. BEAUBIEN  
K. M. CAMERON  
A. L. CARRUTHERS  
H. CIMON  
J. L. LANG  
G. G. MURDOCH

### LIBRARY AND HOUSE

W. G. HUNT, *Chairman*  
A. T. BONE  
J. S. HEWSON  
M. S. NELSON  
G. V. RONEY

### PUBLICATION

C. K. McLEOD, *Chairman*  
R. DEL. FRENCH, *Vice-Chairman*  
A. C. D. BLANCHARD  
H. F. FINNEMORE  
T. J. LAFRENIERE

## SPECIAL COMMITTEES

### MEMBERSHIP

J. G. HALL, *Chairman*  
S. R. FROST

### STUDENTS' AND JUNIORS' PRIZES

**Zone A (Western Provinces)**  
H. N. Ruttan *Prize*

A. L. CARRUTHERS, *Chairman*  
E. W. IZARD  
H. N. MACPHERSON

**Zone B (Province of Ontario)**  
John Galbraith *Prize*

J. L. LANG, *Chairman*  
A. E. PICKERING  
J. A. VANCE

**Zone C (Province of Quebec)**

Phelps Johnson *Prize (English)*

DEGASPE BEAUBIEN, *Chairman*  
J. E. ARMSTRONG  
R. E. HEARTZ

Ernest Marceau *Prize (French)*

H. CIMON, *Chairman*  
J. H. FREGEAU  
E. D. GRAY-DONALD

**Zone D (Maritime Provinces)**

Martin Murphy *Prize*

G. G. MURDOCH, *Chairman*  
G. L. DICKSON  
S. W. GRAY

### INTERNATIONAL RELATIONS

R. W. ANGUS, *Chairman*  
J. B. CHALLIES, *Vice-Chairman*  
E. A. ALLCUT  
C. CAMSELL  
J. M. R. FAIRBAIRN  
O. O. LEFEBVRE  
M. J. McHENRY  
H. H. VAUGHAN  
C. R. YOUNG

### DETERIORATION OF CONCRETE STRUCTURES

R. B. YOUNG, *Chairman*  
E. VIENS, *Vice-Chairman*  
G. P. F. BOESE  
A. G. FLEMING  
W. G. GLIDDON  
O. O. LEFEBVRE  
J. A. McCRORY  
C. J. MACKENZIE  
J. H. McKINNEY  
R. M. SMITH

### WESTERN WATER PROBLEMS

G. A. GAHERTY, *Chairman*  
C. H. ATTWOOD  
L. C. CHARLESWORTH  
A. GRIFFIN  
D. W. HAYS  
G. N. HOUSTON  
T. H. HOGG  
O. O. LEFEBVRE  
C. J. MACKENZIE  
H. J. McLEAN  
F. H. PETERS  
S. G. PORTER  
P. M. SAUDER  
J. M. WARDLE

### ENGINEERING FEATURES OF CIVIL DEFENCE

J. E. ARMSTRONG, *Chairman*  
P. E. ADAMS  
J. N. ANDERSON  
S. R. BANKS  
H. F. BENNETT  
W. D. BRACKEN  
W. P. BRERETON  
R. S. EADIE  
E. V. GAGE  
G. A. GAHERTY  
R. J. GIBB  
A. GRAY  
J. GRIEVE  
J. L. LANG  
R. F. LEGGET  
I. P. MACNAB  
J. A. McCRORY  
H. J. McEWEN  
W. L. McFAUL  
C. B. MUIR  
W. H. MUNRO  
G. McL. PITTS  
M. G. SAUNDERS  
W. O. SCOTT  
T. G. TYRER  
H. K. WYMAN

### INDUSTRIAL RELATIONS

WILLS MACLACHLAN, *Chairman*  
E. A. ALLCUT  
J. C. CAMERON  
E. R. COMPLIN  
J. A. COOTE  
W. O. CUDWORTH  
F. W. GRAY  
E. G. HEWSON  
A. M. REID  
W. J. W. REID  
A. ROSS ROBERTSON

### POST-WAR PROBLEMS

W. C. MILLER, *Chairman*  
F. ALPORT  
J. S. BATES  
DEGASPE BEAUBIEN  
A. L. CARRUTHERS  
J. M. FLEMING  
E. R. JACOBSEN  
G. R. LANGLEY  
H. MASSUP  
G. L. MACKENZIE  
D. A. R. McCANNELL  
A. W. F. McQUEEN  
G. McL. PITTS  
D. C. TENNANT

### BOARD OF EXAMINERS AND

#### EDUCATION

R. A. SPENCER, *Chairman*  
I. M. FRASER  
W. E. LOVELL  
A. P. LINTON  
H. R. MACKENZIE  
E. K. PHILLIPS

#### GZOWSKI MEDAL

H. V. ANDERSON, *Chairman*  
A. C. D. BLANCHARD  
T. H. JENKINS  
V. A. McKILLOP  
W. H. POWELL

#### DUGGAN MEDAL AND PRIZE

J. T. FARMER, *Chairman*  
J. M. FLEMING  
R. C. FLITTON

#### PLUMMER MEDAL

C. R. WHITTEMORE, *Chairman*  
J. CAMERON  
R. L. DOBBIN  
O. W. ELLIS  
R. E. GILMORE

#### LEONARD MEDAL

JOHN McLEISH, *Chairman*  
A. E. CAMERON  
A. O. DUFRESNE  
J. B. deHART  
A. E. MacRAE

#### JULIAN C. SMITH MEDAL

C. R. YOUNG, *Chairman*  
T. H. HOGG  
C. J. MACKENZIE

#### PROFESSIONAL INTERESTS

J. B. CHALLIES, *Chairman*  
J. E. ARMSTRONG  
G. A. GAHERTY  
O. O. LEFEBVRE  
H. W. McKIEL  
J. A. VANCE

#### THE YOUNG ENGINEER

H. F. BENNETT, *Chairman*  
J. BENOIT  
D. S. ELLIS  
J. N. FINLAYSON  
R. DEL. FRENCH  
R. F. LEGGET  
A. E. MACDONALD  
H. W. McKIEL

# THE ENGINEERING INSTITUTE OF CANADA

## OFFICERS OF BRANCHES

### BORDER CITIES

*Chairman*, H. L. JOHNSTON  
*Vice-Chair.*, G. G. HENDERSON  
*Executive*, W. P. AUGUSTINE  
 J. F. G. BLOWEY  
 W. R. STICKNEY  
 (Ex-Officio), E. M. KREBSER  
 G. E. MEDLAR  
*Sec.-Treas.*, J. B. DOWLER,  
 754 Chilver Road,  
 Walkerville, Ont.

### CALGARY

*Chairman*, H. J. McEWEN  
*Vice-Chair.*, J. G. MacGREGOR  
*Executive*, J. N. FORD  
 A. GRIFFIN  
 H. B. SHERMAN  
 (Ex-Officio), G. P. F. BOESE  
 S. G. COULTIS  
 J. B. DEHART  
 P. F. PEELE  
*Sec.-Treas.*, K. W. MITCHELL,  
 803-17th Ave. N.W.,  
 Calgary, Alta.

### CAPE BRETON

*Chairman*, J. A. MacLEOD  
*Executive*, J. A. RUSSELL M. F. COSSITT  
 (Ex-Officio), F. W. GRAY  
*Sec.-Treas.*, S. C. MIFFLEN,  
 60 Whitney Ave., Sydney, N.S.

### EDMONTON

*Chairman*, D. A. HANSEN  
*Vice-Chair.*, D. HUTCHISON  
*Executive*, C. W. CARRY  
 B. W. PITFIELD  
 E. R. T. SKARIN  
 J. A. ALLAN  
 E. ROBERTSON  
 J. W. JUDGE  
 (Ex-Officio), J. GARRETT  
 R. M. HARDY  
*Sec.-Treas.*, F. R. BURFIELD,  
 Water Resources Office,  
 Provincial Government,  
 Edmonton, Alta.

### HALIFAX

*Chairman*, P. A. LOVETT  
*Executive*, A. E. CAMERON  
 G. T. CLARKE G. J. CURRIE  
 A. E. FLYNN J. D. FRASER  
 D. G. DUNBAR J. A. MacKAY  
 J. F. F. MacKENZIE  
 J. W. MacDONALD  
 G. T. MEDFORTH  
 S. L. FULTZ J. R. KAYE  
*Sec.-Treas.*, S. W. GRAY,  
 The Nova Scotia Power  
 Commission,  
 Halifax, N.S.

### HAMILTON

*Chairman*, STANLEY SHUPE  
*Vice-Chair.*, T. S. GLOVER  
*Executive*, H. A. COOCH  
 NORMAN EAGER  
 A. C. MACNAB  
 A. H. WINGFIELD  
 W. J. W. REID  
 W. A. T. GILMOUR  
 A. R. HANNAFORD,  
 354 Herkimer Street,  
 Hamilton, Ont.

### KINGSTON

*Chairman*, T. A. McGINNIS  
*Vice-Chair.*, P. ROY  
*Executive*, V. R. DAVIES  
 K. H. McKIBBIN  
 K. M. WINSLOW  
 A. H. MUNRO  
 (Ex-Officio), G. M. CARR-HARRIS  
 D. S. ELLIS  
*Sec.-Treas.*, R. A. LOW,  
 Queen's University,  
 Kingston, Ont.

### LAKEHEAD

*Chairman*, MISS E. M. G. MacGILL  
*Vice-Chair.*, E. J. DAVIES  
*Executive*, J. I. CARMICHAEL  
 R. B. CHANDLER  
 S. E. FLOOK  
 O. J. KOREEN  
 S. T. McCAVOUR  
 W. H. SMALL  
 E. A. KELLY  
 J. S. WILSON  
 (Ex-Officio), B. A. CULPEPER  
 J. M. FLEMING  
*Sec. Treas.*, W. C. BYERS,  
 c/o C. D. Howe Co. Ltd.,  
 Port Arthur, Ont.

### LETHBRIDGE

*Chairman*, J. M. DAVIDSON  
*Vice-Chair.*, C. S. DONALDSON  
*Executive*, A. G. DONALDSON G. S. BROWN  
 N. H. BRADLEY  
 (Ex-Officio), J. HAIMES  
*Sec.-Treas.*, R. B. MCKENZIE,  
 McKenzie Electric Ltd.,  
 706, 3rd Ave. S., Lethbridge, Alta.

### LONDON

*Chairman*, F. T. JULIAN  
*Vice-Chair.*, T. L. McMANAMNA  
*Executive*, F. C. BALL  
 V. A. McKILLOP  
 H. F. BENNETT  
 A. L. FURANNA  
 R. S. CHARLES  
 (Ex-Officio), R. W. GARRETT  
 J. A. VANCE  
*Sec.-Treas.*, H. G. STEAD,  
 60 Alexandra Street,  
 London, Ont.

### MONCTON

*Chairman*, H. J. CRUDGE  
*Vice-Chair.*, J. A. GODFREY  
*Executive*, A. S. DONALD  
 E. R. EVANS E. B. MARTIN  
 H. W. HOLE G. C. TORRENS  
 (Ex-Officio), F. O. CONDON  
 G. L. DICKSON H. W. McKIEL  
*Sec. Treas.*, V. C. BLACKETT,  
 Engrg. Dept.,  
 C.N.R.,  
 Moncton, N.B.

### MONTREAL

*Chairman*, J. A. LALONDE  
*Vice-Chair.*, R. S. EADIE  
*Executive*, R. E. HEARTZ  
 J. B. STIRLING  
 J. M. CRAWFORD  
 J. COMEAU  
 H. F. FINNEMORE  
 R. C. FLITTON  
 G. D. HULME  
 (Ex-Officio), DE G. BEAUBIEN  
 J. E. ARMSTRONG  
 J. G. HALL  
 W. G. HUNT  
 C. K. McLEOD  
 G. McL. PITTS  
*Sec.-Treas.*, L. A. DUCHASTEL,  
 40 Kelvin Avenue,  
 Outremont, Que.

### NIAGARA PENINSULA

*Chairman*, C. G. CLINE  
*Vice-Chair.*, G. E. GRIFFITHS  
*Executive*, A. G. HERR  
 R. T. SAWLE  
 G. F. VOLLMER  
 W. D. BRACKEN  
 J. W. BROOKS  
 J. H. TRUCK  
 D. S. SCRYMGEOUR  
 (Ex-Officio), A. L. McPHAIL  
 A. W. F. McQUEEN  
*Sec.-Treas.*, J. H. INGS  
 1870 Ferry Street,  
 Niagara Falls, Ont.

### OTTAWA

*Chairman*, N. B. MacROSTIE  
*Executive*, W. G. C. GLIDDON  
 R. M. PRENDERGAST  
 W. H. G. FLAY  
 G. A. LINDSAY R. YUILL  
 (Ex-Officio), K. M. CAMERON  
 C. J. MACKENZIE  
 W. H. MUNRO  
 T. A. McELHANNEY  
 R. K. ODELL  
*Sec.-Treas.*, A. A. SWINNERTON,  
 Dept. of Mines and Resources,  
 Ottawa, Ont.

### PETERBOROUGH

*Chairman*, D. J. EMERY  
*Executive*, C. R. WHITTEMORE F. R. POPE  
 I. F. McRAE R. L. DOBBIN  
 A. J. GIRDWOOD  
 (Ex-Officio), J. CAMERON  
 H. R. SILLS  
*Sec.-Treas.*, A. R. JONES,  
 5, Anne Street,  
 Peterborough, Ont.

### QUEBEC

*Life Hon. Chair.*, A. R. DECARY  
*Chairman*, L. C. DUPUIS  
*Vice-Chair.*, RENE DUPUIS  
*Executive*, O. DESJARDINS  
 R. SAUVAGE G. ST-JACQUES  
 S. PICARD L. GAGNON  
 G. W. WADDINGTON  
 (Ex-Officio), E. D. GRAY-DONALD  
 R. B. McDUNNOUGH P. METHÉ  
 H. CIMON  
*Sec.-Treas.*, PAUL VINCENT,  
 Colonization Department,  
 Room 333-A, Parliament Bldgs.,  
 Quebec, Que.

### SAGUENAY

*Chairman*, R. H. RIMMER  
*Vice-Chair.*, C. MILLER  
*Executive*, W. E. COOPER  
 J. FRISCH  
 B. BAUMAN  
 G. B. MOXON  
 (Ex-Officio), M. G. SAUNDERS  
 N. F. McCAGHEY  
 J. W. WARD  
*Sec.-Treas.*, ALEX. T. CAIRNCROSS,  
 P.O. Box 33,  
 Arvida, Que.

### SAINT JOHN

*Chairman*, D. R. SMITH  
*Vice-Chair.*, A. O. WOLFF  
*Executive*, H. P. LINGLEY  
 C. D. McALLISTER  
 C. C. KIRBY  
 (Ex-Officio), F. A. PATRIQUEN  
 V. S. CHESNÖT  
 G. G. MURDOCH  
*Sec.-Treas.*, G. W. GRIFFIN,  
 P.O. Box 220,  
 Saint John, N.B.

### ST. MAURICE VALLEY

*Chairman*, VIGGO JEPESEN  
*Vice-Chair.*, J. H. FREGEAU  
*Executive*, E. BUTLER R. D. PACKARD  
 A. C. ABBOTT  
 R. DORION  
 H. J. WARD  
 E. T. BUCHANAN  
 J. JOYAL  
 H. G. TIMMIS  
 (Ex-Officio), A. H. HEATLEY  
*Sec.-Treas.*, E. E. WHEATLEY,  
 Consolidated Paper Corporation,  
 Grand Mère, Que.

### SASKATCHEWAN

*Chairman*, A. P. LINTON  
*Vice-Chair.*, A. M. MACGILLIVRAY  
*Executive*, F. C. DEMPSEY  
 N. B. HUTCHEON  
 J. G. SCHAEFFER  
 R. W. JICKLING  
 H. R. MACKENZIE  
 B. RUSSELL  
 (Ex-Officio), I. M. FRASER  
*Sec.-Treas.*, STEWART YOUNG  
 P. O. Box 101,  
 Regina, Sask.

### SAULT STE. MARIE

*Chairman*, L. R. BROWN  
*Vice-Chair.*, R. A. CAMPBELL  
*Executive*, N. C. COWIE  
 C. O. MADDOCK  
 C. R. MURDOCK K. G. ROSS  
 (Ex-Officio), J. L. LANG  
 E. M. MacQUARRIE  
 A. E. PICKERING  
*Sec.-Treas.*, O. A. EVANS,  
 159 Upton Road,  
 Sault Ste. Marie, Ont.

### TORONTO

*Chairman*, W. S. WILSON  
*Vice-Chair.*, W. H. M. LAUGHLIN  
*Executive*, D. FORGAN  
 R. F. LEGGET  
 S. R. FROST  
 F. J. BLAIR  
 E. G. HEWSON  
 C. F. MORRISON  
 (Ex-Officio), C. R. YOUNG T. H. HOGG  
 A. E. BERRY N. MacNICOL  
 H. E. BRANDON J. J. SPENCE  
*Sec.-Treas.*, S. H. deJONG  
 Dept. of Civil Engineering,  
 University of Toronto,  
 Toronto, Ont.

### VANCOUVER

*Chairman*, W. O. SCOTT  
*Vice-Chair.*, W. N. KELLY  
*Executive*, H. P. ARCHIBALD  
 I. C. BARLTROP  
 H. C. FITZ-JAMES  
 H. J. MacLEOD  
 R. E. POTTER  
 (Ex-Officio), J. N. FINLAYSON  
 T. V. BERRY  
 H. N. MACPHERSON  
*Sec.-Treas.*, P. B. STROYAN,  
 2099 Beach Avenue,  
 Vancouver, B.C.

### VICTORIA

*Chairman*, A. S. G. MUSGRAVE  
*Vice-Chair.*, KENNETH REID  
*Executive*, A. L. FORD  
 B. T. O'GRADY  
 J. B. PARHAM  
 R. BOWERING  
 (Ex-Officio), A. L. CARRUTHERS  
 G. M. IRWIN  
 E. W. IZARD  
*Sec.-Treas.*, J. H. BLAKE,  
 605 Victoria Avenue,  
 Victoria, B.C.

### WINNIPEG

*Chairman*, D. M. STEPHENS  
*Vice-Chair.*, J. T. DYMENT  
*Executive*, C. V. ANTENBRING  
 N. M. HALL  
 T. H. KIRBY  
 E. W. R. BUTLER  
 H. B. BREHAUT  
 (Ex-Officio), J. W. SANGER  
 V. MICHIE  
 C. P. HALTALIN  
*Sec.-Treas.*, THOMAS E. STOREY,  
 55 Princess Street,  
 Winnipeg, Man.

# CAUSES AND EFFECTS OF DAMAGE TO ELECTRICAL MACHINERY AND SWITCHING

C. A. LAVERTY, M.E.I.C.

Electrical Inspector, The Boiler Insurance and Inspection Company of Canada, Montreal, Que.

Paper delivered before the Peterborough Branch of The Engineering Institute of Canada on December 11th, 1941

## INTRODUCTION

This paper will deal briefly with some of the difficulties encountered and knowledge gained in over ten years of inspecting, testing, and repairing electrical machinery, for The Boiler Inspection and Insurance Company of Canada. The equipment involved has included all types of electrical machinery as well as steam and water turbines, and is fairly representative of that rated below 25,000 hp. in service throughout the plants of eastern and central Canada. In general, the paper will first describe the work done by the inspectors of the above company. Secondly, it will point out some weaknesses in design, installation and maintenance of electrical machinery. Finally, it will suggest closer contact between those who design and those who use electrical apparatus in order that the best interests of all concerned may be served.

## INSURANCE

The insurance of electrical machinery was started in Canada in 1923 to meet a demand for a service similar to that provided since 1875 in the boiler and pressure-vessel field. Machinery insurance provides an inspection service

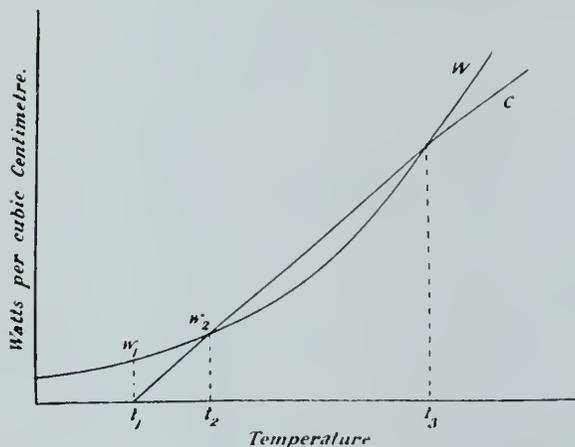


Fig. 1—Heat generated in insulating material compared with heat lost to cooling medium.

to prevent accidents, supplemented by an insurance contract which will reimburse the assured for any accidental damage to insured equipment. It is this inspection service that is of primary interest to plants insured throughout the country.

This service could not continue to be sold to more and more plants, if experience had not shown that regular inspection by an outside party improves plant operation and reduces losses due to accidental damage. A company such as that named above would not spend 30 to 40 per cent of its revenue for its inspection service, if results did not justify that expenditure.

The company's records show that when this insurance of electrical equipment was begun, the accident frequency was 105.3 accidents per year for each 1,000 insured objects. In 1935, the accident frequency was 43.4 and in 1940 it was 33.6.

To indicate what coverage an insurance policy will provide and to give some picture of the accidents for which it will pay damages, the following standard definition of an accident, contained in each insurance policy may be given.

It is:

“a sudden and accidental breaking, deforming, burning out or rupturing of the object or any part thereof, which manifests itself at the time of its occurrence by immediately preventing continued operation or by immediately impairing the functions of the object and which necessitates repair or replacement before its operation can be resumed or its functions restored.”

The only troubles not covered are normal wear and tear and such items as carbon brushes, fuses and lamps.

An insurance inspector has to be vigilant to prevent losses from becoming excessive on the equipment under his care. Naturally, it is not possible to prevent all accidents. In some cases, there are no signs of impending failure and in others, the cost of locating the trouble-provoking conditions is too great. When accidents do occur, it is also the inspector's job to decide on necessary repairs and then see that these repairs are carried out according to good practice and in the least possible time.

## CAUSES OF TROUBLE

The causes of trouble on electrical equipment will be discussed under the following headings:

1. Design
2. Service
3. Location
4. Maintenance
5. Voltage surges
6. Age

## DESIGN

The design of electrical equipment may be further divided into mechanical design and electrical design.

We find that 30 per cent of our accidents are due to premature failure of electrical insulation. Nearly all of these failures are insulation breakdowns between the turns of a coil or between the coil and the iron circuit of the machine. About four per cent are due to creepage across dirty insulation and the resultant flashover after a carbonized or conducting path is formed.

It is generally agreed that the great majority of insulation failures are due to overheating of the insulating materials. This is perhaps not strictly true for pure mica or asbestos where the insulating material does not burn but rather is disrupted or punctured by the voltage stresses applied. It must be remembered that even mica and asbestos are usually dependent on varnishes or gums to hold them in place and all binders are affected by heat.

This then is a straight electrical design problem. It involves the computation of expected voltage stresses and the choosing of type of insulation and the amount required to provide a reasonable margin for safe operation. Adequate provision for the dissipation of the heat generated due to the losses in the machine is very important. Relatively small voltages will cause the failure of the best insulation if the heat is not carried away.

All insulating materials are poor conductors of heat and in all insulating materials energy losses occur due to the applied voltage stresses. Each insulated coil that is installed has a definite ability to transfer heat from the copper to the air, iron, oil or other cooling medium. This heat transfer may be stated in watts per degree difference in temperature between the copper and the cooling medium. Failure, in most cases, is due to the weakening of the insulation owing

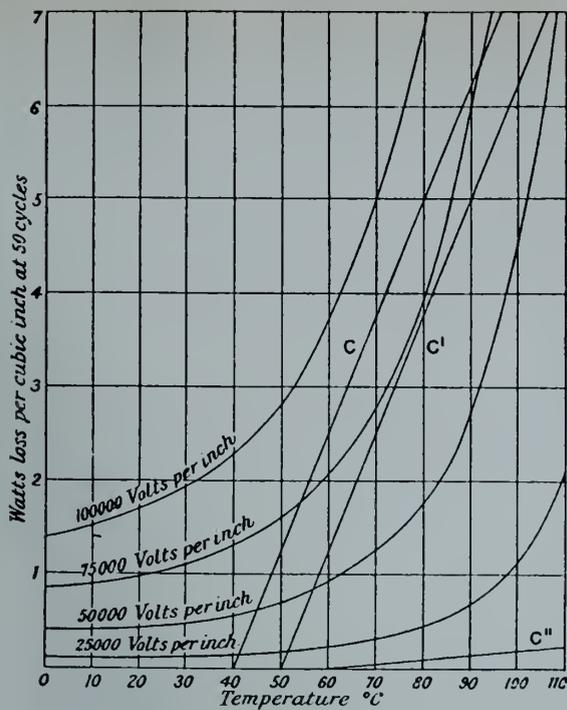


Fig. 2—Results of tests on rope-paper insulation at various voltages and cooling conditions.

to normal aging or high temperatures until it will not withstand the voltage stresses applied to it in normal service.

A book entitled "Specification and Design of Dynamo-Electric Machinery" written by Miles Walker, Professor of Electrical Engineering at the University of Manchester, England, was published in 1920. In this book, the author presents a number of curves showing the losses in insulating materials when subjected to voltage stresses at different temperatures and with varying rates of cooling.

Some curves from this book are reproduced as they are of considerable interest. Figure 1 is a typical curve to show the watts loss per cu. cm. of insulating material plotted against temperature. Let  $W$  represent the watts converted into heat in a given piece of insulating material when subjected to a certain voltage stress at various temperatures, and let  $C$  represent the rate at which this heat is carried away from the insulation. The curve  $C$  is essentially a straight line, the slope of which indicates the type of cooling; the steeper the slope, the better the cooling conditions. Under most conditions encountered the curve  $C$  will cut the curve  $W$  in two places. Let  $t_1$  equal the ambient temperature, that is the temperature of the air or cooling medium surrounding the insulation, then  $W_1$  is the watts lost at this temperature. The insulation will start to heat and as the losses increase with an increase in temperature, the losses will also increase. This process will continue until the temperature  $t_2$  is reached at which point the losses are  $W_2$  watts. The temperature under normal conditions will not increase above this point as the watts removed from the insulation due to cooling conditions represented are also  $W_2$ . If some abnormal temporary change should take place, which increases the losses or decreases the rate of cooling the temperature might rise higher than  $t_2$ , but as long as the temperature  $t_3$  is not reached, the temperature would soon return to  $t_2$  once normal conditions were re-established, since the rate of cooling in watts for any temperature between  $t_2$  and  $t_3$  is in excess of the insulation losses due to voltage stresses for the same temperature. However, if the temperature should for any reason rise above  $t_3$ , then the losses in watts due to voltage stresses are always greater than the watts dissipated in cooling and therefore, the temperature will continue to rise until the insulation fails.

The shape of the curve  $W$  will differ for different kinds of insulating material and will also depend upon the purity,

dryness, etc. of the material. The shape of the curve for any particular piece of insulation will also vary for different voltage stresses and different frequencies.

Figure 2 shows the plotted results of tests made on a  $\frac{1}{4}$  in. thickness of built up rope-paper, which was dry and had been treated with varnish. The arrangement was such that the ambient temperature could be accurately controlled. It should be pointed out that for the curve shown for 100,000 volts per inch, the test was 25,000 volts at 50 cycles on a  $\frac{1}{4}$  in. thickness test specimen. The same is true of the other curves. Again on these curves, are shown three straight lines representing cooling conditions. It will be noted that for the line  $C$ , the ambient temperature is 40 deg. C. and the rate of cooling is such that for a 32 deg. C. difference in temperature, four watts per sq. in. will be dissipated. This rate of cooling shows stable conditions with regard to temperature for all tests except those shown by the curve marked 100,000 volts per inch. It is interesting however, to note what happens if the ambient temperature rises to 50 deg. C. as shown by the cooling line  $C'$ . The rate of cooling is the same as before and the only change is in the ambient temperature, yet the result is that the curve marked 75,000 volts per inch is now unstable. A third line  $C''$  is shown representing very poor cooling condition, an ambient temperature of 60 deg. C. and only  $\frac{1}{4}$  watt per sq. in. for 50 deg. difference in temperature.

It may be of interest to state that common design practice in this country is to allow voltage stresses of from 25,000 to 30,000 volts per inch. In fact, stressing the insulation in excess of 35 volts per mil is liable to result in brush discharge effects or so called corona action unless special precautions are taken.

Finally, Fig. 3 is presented to show what will happen if the frequency is varied, other conditions remaining unchanged, with a test voltage of 4,500 volts which gave unstable results at 50 cycles. A change in frequency of three cycles gives a stable condition. Curve  $N$  is interesting as it shows a curve for changing frequencies. Unstable conditions are indicated by an increase in the upward slope of the curve of watts lost.

From these curves, it is not difficult to see how small departures from designed ratings can easily cause large changes in heating and could be responsible for an insulation failure for which the designer could not be held responsible.

In the author's opinion, the electrical design of most electrical equipment in Canada is reasonably good. It is true that instances of poor design and cases of poor workmanship in building electrical equipment are met with. However, the percentage of such cases is not large.

The factor of safety provided by present design practice is probably less than for similar apparatus built fifteen years ago. But we have to-day a better and more accurate knowledge of the characteristics and behaviour of all

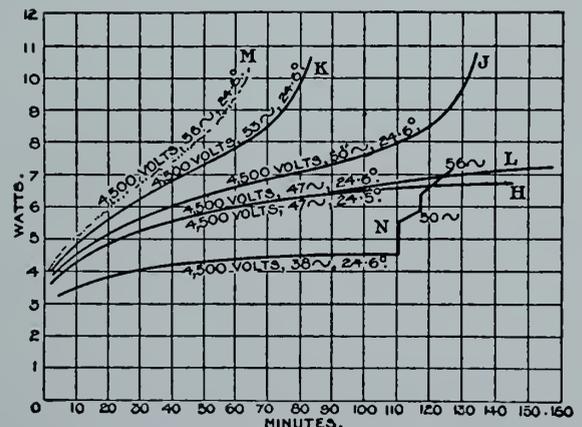


Fig. 3—Results of tests showing effect of change of frequency on stability of conditions.

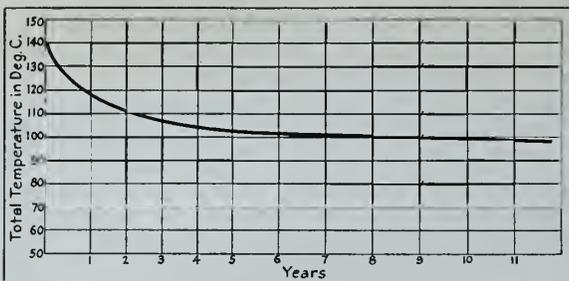


Fig. 4—Curve showing the relation of the life of fibrous insulation (motor windings) to the constant temperature to which it is subjected. Data from the work of Lamme and Steinmetz. (From *Maintenance Engineering*, OCTOBER, 1931.)

materials used in electrical apparatus. It is therefore, possible to eliminate unnecessary iron, copper or insulation.

Regarding the mechanical design of electrical machinery, there is certainly room for improvement, particularly in the design of small parts. Large parts such as frames, tanks and bedplates are usually well designed and strong enough for the required service.

The difficulty might be explained by assuming that electrical designers are usually not strong on mechanical design, which would be understandable. In some cases, however, there is evidence that they have not even considered the characteristics of detailed mechanical parts used in their designs.

This criticism will no doubt be resented by some. In that case let the designers go out into the field and discuss their mechanical design details with the engineers and maintenance staffs of plants using their equipment. If this were done, a few of the designers would return still convinced that the criticism was not justified. The majority, however, would be a whole lot wiser and better for the experience.

As previously stated, most mechanical troubles are on the smaller parts of electrical apparatus. Usually the difficulties are not serious, but are due to simple mistakes that often can be and are corrected in the field. In order to be more specific, here are some of these details that have been criticized in different plants.

They are such things as: fan blades that are mechanically weak, field poles that are not secure on the pole pieces, squirrel cage windings that prevent the removal of a field pole, connections that vibrate and break due to lack of proper support, fuse clips and switch blade contacts that do not have sufficient tension to maintain contact, side strains on insulators, banding wires that are not strong enough, small bolts where larger ones are essential, no provision for expansion and contraction, sharp metal corners pressing on soft insulation, loose iron and loose supporting fingers in magnetic circuits, oil throwing bearings, and lack of space for wiring of control apparatus.

For example, there have been  $\frac{3}{8}$  in. bolts which were provided on a control panel to take a 100 amp. terminal, reduced voltage compensators that were practically inaccessible for repair or maintenance, grounds in terminal boxes because the box was so small that the wires had to be forced into place, thereby cutting the insulation, or perhaps a long screw to hold the cover, that had gone halfway through the wires. Oil throwing bearings have caused many a motor to fail. To-day these are much better in design, chiefly due to forced changes resulting from the competition presented by ball and roller bearings.

The reason why many of these errors have not been corrected must be because designers are not informed about them.

#### SERVICE

The service given by electrical equipment depends upon the kind of load it carries. A steady load within its rated capacity is best for any piece of electrical equipment. Shock loads cause trouble. Frequent starting and stopping, or the resultant expansion and contracting of insulation

and conductors, is hard service. This abnormal service is recognized by charging higher insurance rates for hoist motors, elevator motors, crane motors, etc. In this regard, it is of interest to note that, based on a five-year period, the loss frequency on elevator, crane, conveyor and excavator motors is 80.4 compared to 62.7 for other types of service.

There is also the fact that it is difficult to provide proper economical protection for motors on intermittent duty. This is due to the fact that frequent starting and the heavy starting currents involved would cause relays set for say 125 per cent full load current, to be tripped by the starting loads.

While these comments deal specifically with motors and generators, the same experience is encountered on other apparatus of an enclosed or semi-enclosed type. For example, transformers used on indirect arc furnaces, while specially designed, take a nasty beating due to the nature of the load. It is also possible to cause voltage surges on the high tension side of furnace transformers due to the intermittent arc on the low tension side when a new charge is being heated.

#### LOCATION

The location of equipment will affect its operation. This is due in different cases to dirt interfering with normal ventilation, acid or alkali atmospheres causing the insulation to deteriorate rapidly, flying abrasive material cutting the insulation, high ambient temperatures giving the same result as overload, and many other conditions which result in abnormal operation or operation which was not contemplated when the unit was designed.

Standard motors are often installed where semi-enclosed or totally enclosed motors should be used. Equipment to be used in locations that present abnormal service conditions should be specially designed to provide the best available protection against these conditions.

#### MAINTENANCE

The maintenance procedures of different plants vary widely in their effectiveness. All sorts of practices are met



Fig. 5—Showing burning of stator iron laminations of a 450 hp. mine hoist motor. This motor failed during a lightning storm. Three teeth of the laminations were cut away before this picture was taken in order to show the extent of the iron damage at the root of the teeth.

with. The inspector finds electrical equipment that has not been overhauled for years and also equipment that is completely overhauled at least once every six months.

There are far too many plants with practically no maintenance programme, which keep no records and do not attempt to make regular inspections of their electrical apparatus. Such plants go along blissfully waiting for accidents to occur, each accident is considered a bit of bad luck. Repairs are usually rushed and poorly executed. The errors of inadequate maintenance are very evident to-day when increased production schedules have put the plant equipment to the test, and it has failed to provide dependable service.

An insurance company very properly insists on a certain minimum standard of maintenance. It is felt that money expended to keep electrical equipment in good repair will be returned with interest in the form of increased production with fewer shutdowns due to accidents.

Regular inspections by insurance company inspectors will improve plant maintenance, decrease accidents and thus, insure more efficient use of productive equipment: Each inspector is informed through a bulletin service of all important accidents that take place in insured plants; he is, therefore, able to give the plants under his care the benefit of the experience gained in all of the plants covered by the whole inspection organization.

A few illustrations will show how such service has prevented forced shutdowns due to accidents. Some ten years ago, it was decided to take insulation resistance readings on turbine generator fields at different speeds. These readings were in some cases found to vary with speed. It was suspected that this indicated a change in the position of the windings and realized that if this were true, a failure could soon be expected. This test has been used repeatedly during the last ten years and as a result more than 30 defective fields have been taken out of service. To date, there has been no case where the indications of the tests were incorrect. With regard to protective devices, it is found that many of them have not been tested and will not operate when tests are applied. Some years ago, an inspector tested 50 relays in a plant where insurance was asked. Out of the 50 relays, 37 would not operate. It is also common experience to find relays that are not applied correctly and even some that are not properly connected. Thermal relays are difficult to apply as the method of rating used by different manufacturers is very confusing. The current to trip in a definite time, would seem to be the correct rating of any overload device, but this method of rating is seldom used on overload thermal relays.

Linseed oil, transformer oil, and no oil at all, have been found in motor and generator bearings. Inspectors discover lubricating oil in small transformers and starting compensators. Fuses bridged with solid wire are a commonly encountered condition; often there is just a heavy wire and no fuse cartridge at all. Even thermal relays are bridged and often solder is used to replace the low temperature alloys used in some thermal relays and fuses.

The following experience shows what strange things can sometimes be done without causing trouble. In a certain machine shop a 50 hp. motor had to be inspected. It was mounted in an inverted position, hung from the ceiling, was running in a satisfactory manner and seemed in fairly good condition. The air gap was even. However, it was difficult to understand why it was running in this position without trouble. The man who looked after this motor and oiled the bearings stated that he did so once each day by putting oil in at the oil-level indicating cups. Actually the end bells were upside down, and the oil rings could not turn. The only change made when the motor was inverted had been to turn the oil level indicating cups around 180 degrees. Perhaps someone else can explain why these bearings had continued in service for five years without excessive wear.

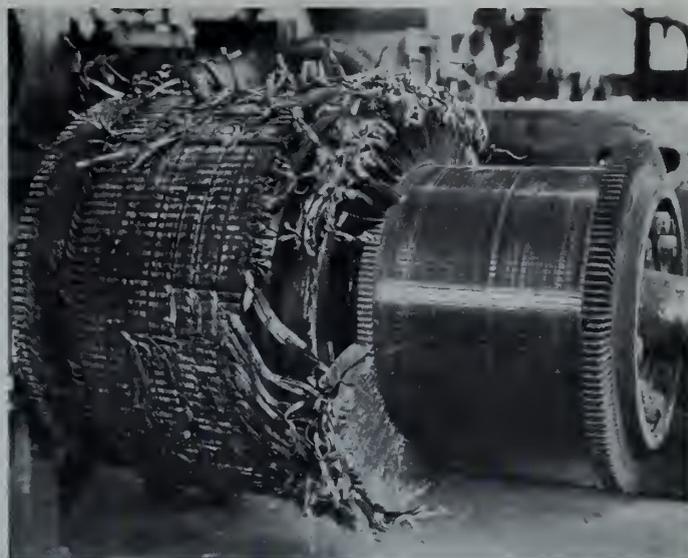


Fig. 6—Showing armature of paper machine drive generator after an accident which caused the banding wires to fail and allow the armature conductors to be thrown out of the slots.

#### VOLTAGE SURGES

Records show that about 25 per cent of the accidents for which damages are paid are due to voltage surges. Many of these could have been prevented if proper surge protective equipment had been in service with a plant grounding system of reasonably low resistance.

The effectiveness of lightning arresters has often been questioned, particularly when applied on low voltage circuits. To-day, however, much better protective equipment is available, and it appears that this newer equipment is effective in reducing the number of failures due to voltage surges.

As an illustration of this, take one case of such an installation in a very bad lightning area in the province of Quebec. This particular plant had a very bad history up until about five years ago, when the protective system was brought up to date. Failures had taken place nearly every year on at least one of the two generators in service. Finally, the practice was to shut the plant down as soon as a lightning storm started.

The generators were 2,200 volt and were connected to a fairly long exposed line. One generator was rewound, the iron restacked, and proper protective equipment installed.

This plant has been operated full time for the last five years and no further trouble has been encountered even though plants located all around it have continued to suffer from voltage surges. On some equipment, such as transformers, it is common practice to provide extra insulation on the coils nearest to the line to protect against voltage surges. This same practice is followed by some English manufacturers in building motors and generators.

#### AGE

The age of the insulation is a very definite factor in the failure of this insulation due to stresses, either electrical or mechanical, that are applied to it in normal service. Any particular form of insulation has built into its original design a definite ability to withstand applied stresses. As the years of service increase, the strength of the insulation is reduced and finally the resistance is reduced below the level of the applied stress and failure results.

Many factors may contribute to the aging of electrical insulation. Some of these are: abuse, lack of proper maintenance, corrosive atmospheres, mechanical damage, etc. However, even if we could eliminate these conditions, which are abuses of one type or another, it is definitely true that the life of any insulation is limited by the aging of the materials which make up the insulation. The expected life varies from six to eight years for street car motors to per-

haps as much as 25 years for some other classes of equipment. These figures are open to question and some organizations claim an average life of as much as forty years on some equipment.

It seems probable from the data available that an average life of forty years is decidedly optimistic and does not represent actual experience.

More failures occur as electrical equipment gets older. A recent illustration of the effects of aging has been afforded in connection with the direct current generators used to provide power for paper machine drives; most of these units



Fig. 7—Showing damage to armature and field coil winding of a paper machine drive generator. The accident was due to the banding wire supporting the armature conductors breaking or burning and allowing the armature conductors to come out of the slots.

were installed between 1928 and 1930. The last two or three years there has been an epidemic of failures in different plants which can only mean that the average life of these generators under their conditions of service is less than fifteen years. The percentage of these failures in different plants is so high and the trouble so general that no other conclusion can be reached.

In 1931, a curve was published in *Maintenance Engineering* showing the life in years for non-fibrous insulation plotted against the temperature of operation. This curve shown in Fig. 4 is from the work of Lamme & Steinmetz. It will be noted that for a temperature of 100 deg. C., the life is shown as seven to ten years. At 110 deg. C., it is only two years and at 140 deg. C., failure is to be expected in a very short time.

#### EFFECTS

The effects of damage to electrical machinery are many and varied. One certain effect is loss of use of the equipment, and loss of plant production. There is also the expense of making repairs or replacing the damaged object.

Another common effect is ensuing fire which can and often does cause more damage than the electrical failure. Sometimes, this fire is confined to the object that fails and in other cases, extensive damage outside the object results.

The possibility of ensuing fire is recognized when insulating oil is used. It is not so well known that fire often causes extensive damage to the windings of motors, generators and other rotating equipment.

A few illustrations will show what has happened in a few instances.

A small oil-filled potential transformer in a power plant failed and the tank was ruptured and the oil caught fire. Before this fire was under control, further electrical failures occurred. The result was over \$100,000 of damage and a plant out of service for some weeks.

Ten grinder motors were closed in on full voltage with the wheels loaded. The control battery was out of service, so the protective devices could not operate. In a very few minutes, the starting windings failed and the electric arc set the stator coil insulation on fire. A complete rewind of all motors was necessary. The plant was out of service for about three weeks. The repair bill was over \$100,000.

Another effect that may be encountered is an explosion of oil vapour. There was one rather odd case of this type, a few years ago. The oil vapour above the oil line in a transformer (not of the conservator type) was ignited, probably owing to a flashover of one of the high tension bushings. The tank was square and the explosion split the tank from top to bottom. Black smoke was deposited on a wall 20 ft. away. The oil did not catch fire and the coils were not damaged. In most instances, oil vapour explosions are not so accommodating and many cause serious damage.

Finally, there is another effect of electrical damage and that is the possibility of endangering human life. One fairly frequent example of this type is the failure of a common disconnecting switch when opened under load. These switches have the operating handle on the right hand side and the hinges for the switch box door on the left. An operator will naturally use his right hand to operate the switch and then if trouble develops, the door blows open and he is facing the electric arc. The result varies, but at best, it is a burned face, right arm and usually burns on the body. This type of accident seems preventable and should be provided against by the designer. First, a disconnecting switch should be able to interrupt rated current or else be provided with an ammeter to show when it is safe to operate it. Second, the door could be so hinged as to provide protection to the operator.

#### SUMMARY

Summing up the results of his experience, the author believes that there are many improvements that should be made in the design, maintenance, application and protection of electrical equipment. The common causes of failure are inadequate design, improper application, indifferent maintenance, abuse, voltage surges and old age. The results are damage to the objects themselves and sometimes to other apparatus, expensive repairs, lost production and possibly injury to operators and staff.

One method of approaching a solution to some of the problems encountered, is to gather complete information on the reason for the failures and when an analysis indicates that changes are necessary to prevent further failures, to see that these changes are made.

An equally important and very necessary procedure is to raise the standard of maintenance to an adequate level. It is in this field that insurance inspectors are playing an increasing part. Mistakes have been made in the past and others will be made in the future, but in this way only, can we develop a better and more effective inspection organization. We have already assembled a mass of information on the causes of electrical failures and, more important, are learning to recognize the presence of accident provoking conditions. As the years pass by, this knowledge will be added to, and accident frequency will be further reduced. In this way, the insurance inspector will continue to make his contribution to the economical operation of plants throughout the country.

# THE EFFECT OF WET COAL ON PULVERIZER AND BOILER PERFORMANCE

MURRAY D. STEWART, S.E.I.C.

Engineering Department, Babcock-Wilcox and Goldie-McCulloch, Limited, Galt, Ont.  
Now serving as a Lieutenant with the Royal Canadian Ordnance Corps, Overseas.

Paper presented before the Hamilton Branch of The Engineering Institute of Canada, December 16, 1940

## 1. INTRODUCTION AND STATEMENT OF THE PROBLEM

The "free" or surface moisture in coal is from two sources:

1. That which comes from the seam in the mine from which the coal is taken, and which is traceable largely to seepage from the surface, and to other underground waters;
2. That which is acquired by the coal, either in transit or in storage, from the action of the elements.

The surface moisture present in coals grading from anthracite to high-grade bituminous rarely exceeds ten per cent; in coals grading from medium-grade to low-grade bituminous, and lignites, it may amount to between 30 and 40 per cent. These are the percentages as given in the proximate analysis. It frequently happens in boiler operation that a coal, normally containing a small amount of moisture, may pick up a large amount between mine and boiler furnace. In such a case, the boiler design, and the choice of pulverizing equipment is made as if the moisture content were normally large. This is a problem of considerable importance in Canada, and in other countries where heavy precipitation in the form of rain and snow is the rule.

The presence of large amounts of such moisture causes numerous difficulties in the design and operation of pulverized coal equipment, and affects, in varying degrees, the performance of the steam generating unit.

For every type of coal, the proximate and ultimate analyses, the higher heating value, and the grindability\* can be determined. The designer bases his estimates of the coal requirements and performance of the boiler on the ultimate analysis. In many cases, however, the customer will state only the proximate analysis, the grindability, and the mine from which the coal is to be taken, in which case, an ultimate analysis must be selected which most nearly fits the information submitted. For pulverizer firing, the expected moisture in the coal "as fired" is also required.

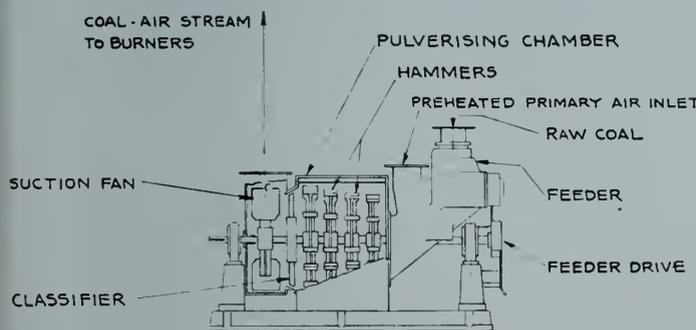


Fig. 1—Pulverizer: impact type.

By "coal as fired" is meant the condition of the coal when it enters the firing equipment, whether it is some form of stoker or a coal pulverizer. A mixture of coal and moisture (and some other foreign material) is fired, and the amount of the combustible constituents per pound, and ultimately, the calorific value of the coal, are reduced by the moisture which enters with it. All moisture, whether in the fuel, combustion air or resultant from the combustion of hydrogen causes a heat loss. Therefore, the greater the percentage of surface moisture in the coal, the greater will

\*See paragraph 4 in this paper.

be this loss, with a consequent lowering of the efficiency of the boiler.

In addition to the effect that surface moisture has on the purely thermal aspects of boiler design, it was early found to have more important effects on the performance of pulverizers and their auxiliary equipment. An investigation of the effect of this factor on the design and economical operation of pulverizers follows.

## 2. TYPES OF PULVERIZERS

A study of grinding processes is necessary for a proper understanding of the effect of moisture on pulverizer performance. Pulverizers are designed to operate on one of two basic principles of grinding, viz., impact and attrition. In most mills, however, both processes take place simultaneously, one process being secondary to the basic principle from which the mill design was evolved.

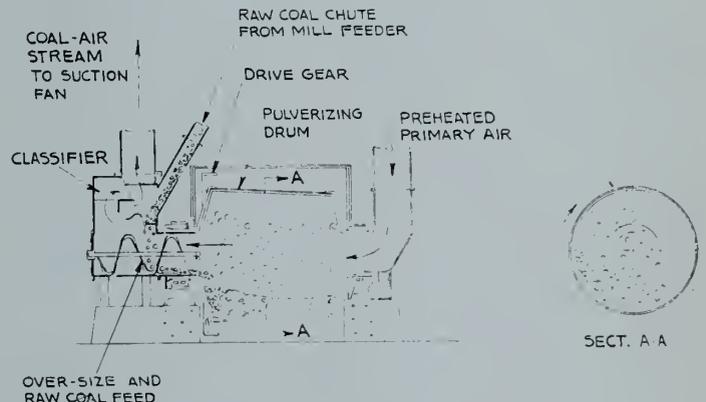


Fig. 2—Pulverizer: ball-mill type.

All pulverizers are swept by air, which is passed through by either a pressure or a suction fan, and which carries the coal to the burners. This air, called the primary, or transport air, is part of the total combustion air, and is generally heated for the double purpose of drying the coal, and improving ignition. However, if the inlet temperature is not sufficiently high to permit the primary air to cope with wet coal, various troubles arise in operation.

Most modern steam generating units burning pulverized coal are fired directly from the pulverizers, and this paper deals only with this type of installation. Therefore, no consideration is given to the bin, or storage system of firing pulverized coal, which has its own distinctive problems, as well as those encountered in direct firing.

### A. IMPACT PULVERIZERS

In pulverizers of the impact type, illustrated in Fig. 1, a series of hammers or beaters are keyed to a shaft, and revolve in a pulverizing chamber. The coal enters the mill from a feeder, and after crushing is drawn by a suction fan through some form of classifier before delivery to the burner pipes. The classifier rejects over-size particles, and returns them to the pulverizing chamber for further treatment. It can be adjusted to secure the proper coal fineness. All impact mills operate at high speeds, ranging from 1,000 to 2,000 r.p.m., and pass a practically constant volume of primary air at all loads. They have practically no reserve capacity.

### 3. MECHANICAL PROBLEMS ARISING FROM THE USE OF WET COAL

Bearing in mind the mechanics of grinding and pulverizing processes, it is now possible to consider the effects on mechanical operation resulting from an increase in moisture content. These can be seen best by considering the path that the coal takes from the coal car until it has passed through the pulverizer.

It frequently happens that the raw coal remains in the bunker for some time before use, permitting the surface moisture present to collect and drain to the bottom of the bunker. Provision must be made for tapping this water off, in order to prevent the acid, formed from the sulphur in the coal and the water, from rotting the bunker, coal pipe, scales and feeder. The possibility of the coal bridging in the bunker, starving the pulverizer and losing ignition at the burner is also serious. A severe explosion in the furnace may result if the coal suddenly starts feeding again.

The coal is carried from the bunker to scales, if installed, and then enters the raw coal pipe. This pipe must be straight-sided, and as nearly vertical and free from bends as possible to prevent plugging, and starving the feeder. Considerable trouble has been experienced in the past, and is still encountered when the feeders handle wet coal. The coal may hang up in the feeder gates, or the choking in the coal pipe and feeder proper will overload the feeder motor. This causes it either to trip out and stop the feed completely, or causes erratic feeding. Another source of erratic feeding, which occurs sometimes in feeders of the table type, is slippage between the wet coal and the table. This has been remedied by using tables faced with abrasives. The plugging of the coal chute into the mill has caused trouble, but this is obviated to a considerable extent if the mill temperature is sufficiently high, since a certain amount of drying will then take place.

The troubles arising with wet coal between the scales and the mill proper, indicate the absolute necessity for adequate areas, simplicity of design, and freedom from devious paths. It is preferable, also, to locate the feeder so that only a very short chute into the mill is required.

The handling of wet coal is a troublesome problem, and demands a special study for each case, but some measure of success in handling wet coal has been attained by maintaining the feeder and raw coal pipe at 140-150 deg. F. This can be accomplished in several ways. In pulverized coal-fired boiler installations, a flue gas air preheater is frequently installed, and some of the preheated air may be drawn off from it, and passed into the coal pipe. Steam air heaters can also be employed, but the possible temperature is limited by the available steam pressure. Flue gas is sometimes used, and unlimited heat is then available, but

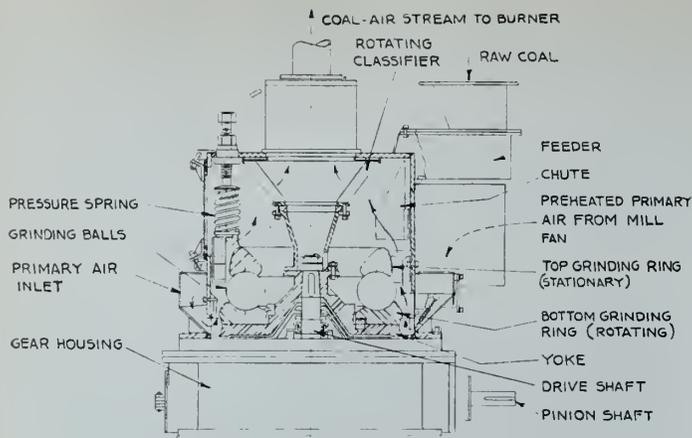


Fig. 3—Pulveriser: ball-bearing type.

#### B. ATTRITION PULVERIZERS

Pulverizers of the attrition type fall into two distinct classes, the ball-mill type, in which balls, free to move in any direction, pulverize the coal in a rotating drum, and those which operate on the ball-bearing principle, or the ring-and-roller principle.

In the ball-mill, shown in Fig. 2, the balls move with the coal bed up the inside of the drum in the direction of rotation. At this stage they tend to move towards the drum wall because of the centrifugal force exerted, and they grind by rolling over the coal, and by collision with each other. As the balls and coal move higher, some of the balls will tumble down the wall, grinding as they go. Others continue on until their weight overcomes the centrifugal force, and they also fall back into the coal bed, at which time the grinding is by impact. Thus the point at which the balls leave the wall of the drum is dependent upon its speed of rotation. It is also evident that both grinding processes take place at the same time, the impact action being scarcely secondary to the basic process of attrition.

The raw coal is fed through one of the trunnions carrying the drum, which is hollow for this purpose. The powdered coal is withdrawn by a suction fan through the inlet trunnion, and the classifier, and delivered to the burners. The primary air is varied with the boiler load. The reserve capacity is very high.

In Fig. 3 is shown a pulverizer which operates on the ball-bearing principle, and employs a vertical thrust-bearing arrangement of grinding balls and grinding rings. One or two rows of balls are used, depending upon the capacity required. The pressure on the balls, and hence the fineness of the coal, is controlled by heavy springs on the top grinding ring, an arrangement which enables wear to be taken up if required. This ring "floats", and is prevented from turning, while the lower grinding ring is driven through bevel gears. Raw coal is fed to the centre of the mill, and works through to the outside of the grinding elements by centrifugal force, where it is picked up by the air stream. From here it is carried through a classifier to the burner pipes. This type of mill can operate under pressure or suction. The primary air is varied with the boiler load.

Figure 4 illustrates a pulverizer of the roller, or bowl type. The rollers run against a horizontal bull-ring, which is driven through a worm and gear. The pressure is applied to the rollers by heavy springs, which enable wear to be taken up when necessary. The raw coal is fed to the centre of the mill, and thrown by centrifugal force between the rollers and the bullring. The powdered coal is withdrawn through the classifier by a suction fan. The primary air is varied with the boiler load as before.

Attrition pulverizers operate at low speeds, which range from 35 to 300 r.p.m., and generally have good reserve capacity.

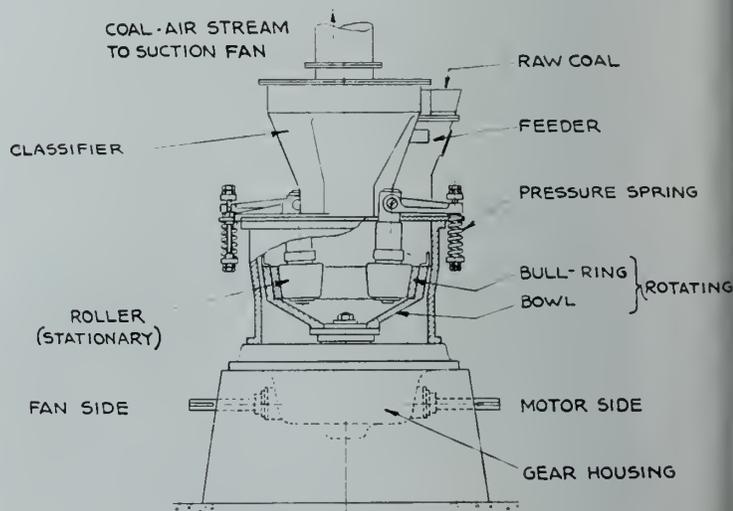


Fig. 4—Pulveriser: roller-ring type.

tempering air must generally be admitted. This reduces the safety attendant upon its use, because the oxygen in the tempering air is at high temperature, with the consequent risk of fire.

Consider the actual grinding of coal in the impact mill. When the coal is wet, the resistance to fracture is increased, that is, the coal is less friable than when dry. Thus, a blow that would shatter dry coal completely is resisted, resulting in incomplete fracture and coarse coal. The moisture present tends to ball up what fine coal there is, and these lumps and the coarse pieces of coal are rejected by the classifier and work back to the pulverizing chamber. A continuation of this condition reduces the capacity, and will ultimately plug the mill, thereby losing ignition.

The ball-mill crushes in a very deep bed and is, therefore, very susceptible to trouble with wet coal, since drying at the coal inlet is very incomplete. The wet coal tends to pack, and hence cushions the pulverizing action to a considerable extent. It will be recalled from the study of ball-mill mechanics, that the balls and coal tend to work up the side of the drum in the direction of rotation. Therefore, any intimate mixing of the heated air and coal is difficult to achieve, because the air will take the line of least resistance, and flow over the coal bed rather than through it. Under such conditions of packing and cushioning, the capacity will fall off considerably.

In pulverizers operating on either the ball-bearing or roller-ring principle, the grinding action is under the positive control of heavy springs. The enormous pressing and squeezing action which they exert is comparable to that in the mangle, or "wringer", and not only pulverizes the coal, but releases most of the surface moisture. The grinding elements are very massive, and their thermal capacity is high. They run at quite a high temperature because of their contact with the hot primary air, and because of the energy input to the mill which ultimately appears as heat. Therefore, the grinding elements contribute considerable drying action, and the mill can handle fairly wet coal even when the primary air temperature is low. Reference to Fig. 10, which shows curves of primary air temperature versus surface moisture, indicates that, up to three per cent moisture, the primary air must exert a cooling effect to maintain the proper mill outlet temperature.

#### 4. THE ECONOMIC ASPECTS OF FIRING WET COAL

##### A. PRELIMINARY DISCUSSION

With the advent of pulverized coal firing, some determination of the ease with which a coal sample could be ground was necessary for design purposes. Rittinger's law,

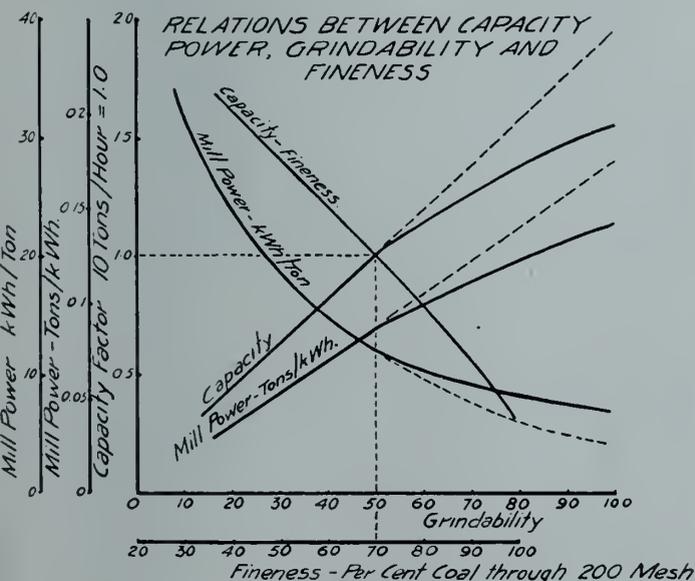


Fig. 5.

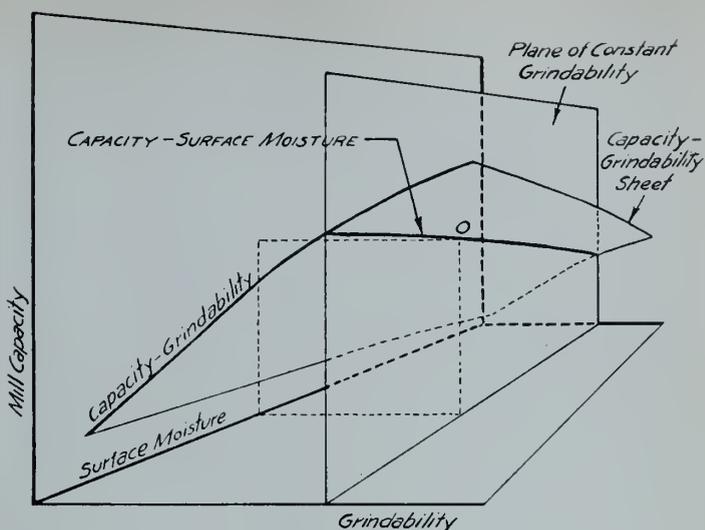


Fig. 6—Pulveriser performance sheet.

which states that the work done is proportional to the new surface produced (and hence to the reciprocal of the particle diameter), provided a starting point from which Hardgrove evolved a workable scale of grindability. In this scale, the grindability index is the ratio of new surface produced by grinding the coal sample under standard conditions, to the new surface produced in a similar way in an easily-pulverized sample of coal which has been assigned a grindability of 100\*. Hence the grindability increases with the ease of grinding; generally it is highest in the bituminous coals, and lowest in the anthracites.

Since grindability is an intrinsic property of coal, and hence comparable to the specific gravity, it is possible to determine, for any given pulverizer, the relationships existing between it and the power required for grinding, capacity and fineness. A typical set of these relations is shown in Fig. 5.

It follows from Rittinger's law that the capacity and power required will vary directly with the grindability, that is, a straight-line relationship exists between them. This is illustrated in Fig. 5 by the broken power and capacity lines. For any particular mill, this condition is almost true up to a certain point, and then the relationship departs from the straight-line law and becomes a curve. In Fig. 5 this deviation occurs at 50 grindability. At this point the mill can be considered to have unit capacity, and in this example ten tons per hour equals a capacity factor of 1.0.

To this capacity, a standard fineness, of say 70 per cent of the coal through 200 mesh, can be assigned, and all observations depending upon fineness can be corrected to this figure. There are two power curves shown; one is given in tons per kilowatt hour, and is similar to the capacity curve; the other is the familiar reciprocal curve of kilowatt hours per ton capacity.

Rittinger's law is founded on the assumption that the products of grinding are removed as formed. In coal pulverizers this is accomplished by the primary air, which sweeps the mill continuously, and delivers the powdered coal to the burners as it is produced. With coal of low grindability the capacity is low and the fineness high, because the coal stays longer in the mill and takes more power. Hence scavenging of the fines by the primary air is more thorough, and the capacity curve follows the straight-line law as shown. Above the deviation point the reverse conditions prevail, scavenging is less complete, and the grinding action is cushioned by the fines. The departure of the capacity curve from the straight line is indicative of the amount of cushioning taking place.

\*The "standard coal" is taken from the Upper Kettanning seam in Somerset County, Pennsylvania. It is a semi-bituminous coal of the following proximate analysis: Volatile matter . . . 17.45 per cent  
Fixed carbon . . . 72.88 " "  
Ash . . . 7.67 " "

The power curves show that more power is required with coals of low grindability, and less with coals of high grindability, a condition which follows necessarily from the application of Rittinger's law. Also evident is the increase in power requirements above the straight-line conditions with coals of high grindability. This is consequent upon the incomplete scavenging and resulting cushioning action which occurs with such coals.

Grindability is now determined on a standard machine which operates on the ball-bearing grinding principle—an attrition process. During the preliminary stages of development of the grindability scale, however, a machine, operating on the mortar-and-pestle principle—an impact process—gave results comparable with those obtained from the ball-bearing machine. This is evidence of the fundamental nature of grindability. The application of the grindability capacity-power relationships to pulverizer design must be made with care, however, because of the differing power requirements of different types of mills, and generally these factors must be determined experimentally.

The surface moisture present in coal is a variable quantity. Therefore, a third axis, having a scale of per cent surface moisture can be added at right angles to the axes shown in Fig. 5. The variation occurring in the capacity-grindability curve is shown in Fig. 6, and a similar treatment can be applied to the other relationships. It can be seen that, at any given percentage of moisture, a curve similar to the initial one can be drawn. By plotting curves for an infinite number of values of moisture, a capacity-grindability "sheet" is formed, giving the three-dimensional problem which occurs when a mill handles different kinds of coal. Since the customer specifies the coal which he expects to burn, the grindability is settled at once, and a plane of constant grindability cuts all the performance sheets, giving the pulverizer performance curves shown in Figs. 7, 8, 9 and 10.

#### PULVERIZER PERFORMANCE

The performance curves in Figs. 7, 9 and 10 are based on the actual calculations for a typical modern, medium-sized, pulverized coal-fired steam generating unit, which supplies steam for both power and process work. They are, therefore, typical of the conditions prevailing in modern pulverizer practice. The pulverizer happens to employ the ball-bearing grinding principle. The steam flow, steam pressure, total steam temperature and feed-water temperature remain constant throughout the investigation. It is then possible to see the effect on the performance of a given mill resulting from changes in the surface moisture in the coal.

The coal "as fired" is a mixture of coal and moisture (and foreign material) when it enters the pulverizer. Here the moisture flashes into superheated steam in the heated

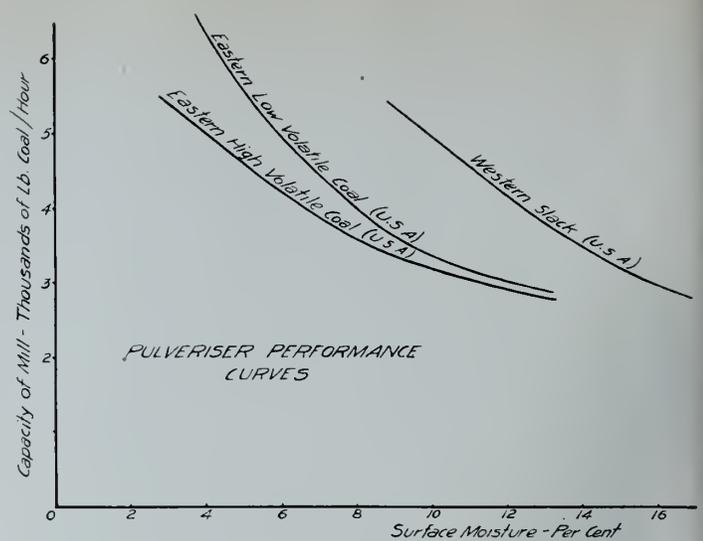


Fig. 8.

primary air, and on contact with the hot grinding elements. This action leaves only the dry coal out of the coal "as fired," and its percentage decreases in a straight line with increased moisture. Therefore, this line indicates mill capacity. It will be noted, however, in Figs. 7 and 8, that the capacity-surface moisture relations are curves indicating that other capacity-reducing action is taking place.

With an increase in moisture the friability of coal decreases, and therefore more energy is required in the pulverizing process. Consequently, in a given mill, a longer time will be taken to reduce the coal to the required size, because the numerous over-size particles produced are returned by the classifier for further treatment. This action reduces the capacity of the mill. The fines tend to cushion the grinding action, and the tendency increases with the wetness of the coal. These two factors operate on the straight-line variation of capacity with moisture, giving the curves shown.

The decrease in friability with increasing moisture gives rise to a decrease in fineness similar to the decrease in mill capacity. The pulverizing process is interfered with by packing and cushioning, resulting in the decrease in the per cent coal through 200 mesh shown in Fig. 7.

It has been noted that the mill capacity decreases with decreased friability, and it might be inferred therefrom that the power requirements for mill and fan would rise with increasing moisture in coal. Operational experience has shown this to be the case, and the general form of the resulting power curves is shown in Fig. 9.

The mill power curve depends upon two factors, the power required for grinding, and the additional power necessary to overcome packing and cushioning action. With no cushioning action or packing, the power would vary almost directly with the moisture content of the coal, because the friability is a function of the moisture content. But, since one of the results of decreased friability is increased packing and cushioning, an increasingly larger increment of power must be added. This will vary with the type of mill. The resulting curve is concave upwards.

The coal level in ball-mills, and in ball-bearing type mills varies with the boiler load, and this variation has been used to operate the control on the mill feeder. With increased moisture the capacity falls, and the resultant rise in the coal level increases the pressure drop or mill differential. The fan will then require more power to deliver the necessary primary air. Depending upon the fan characteristics, the power curve is concave upwards to a more or less degree, and may, as shown, ultimately intersect the mill power curve.

By adding together the power curves for mill and fan, a curve of total power is obtained. It is seen that the rising

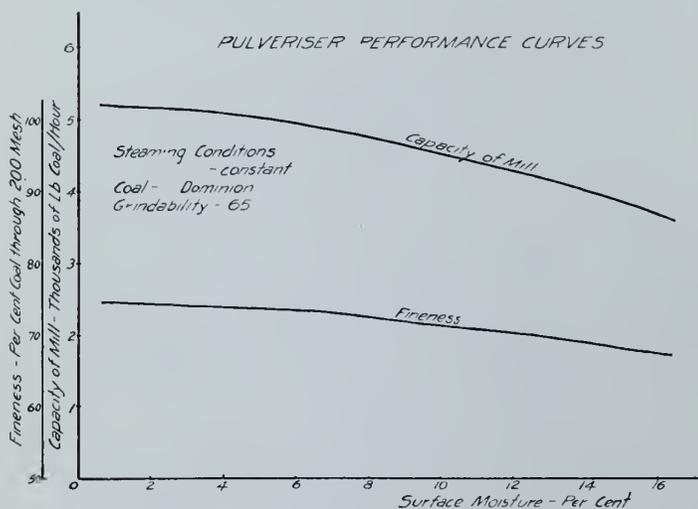


Fig. 7.

PULVERISER PERFORMANCE CURVES

Steaming Conditions - constant  
Coal - Dominion  
Grindability - 65

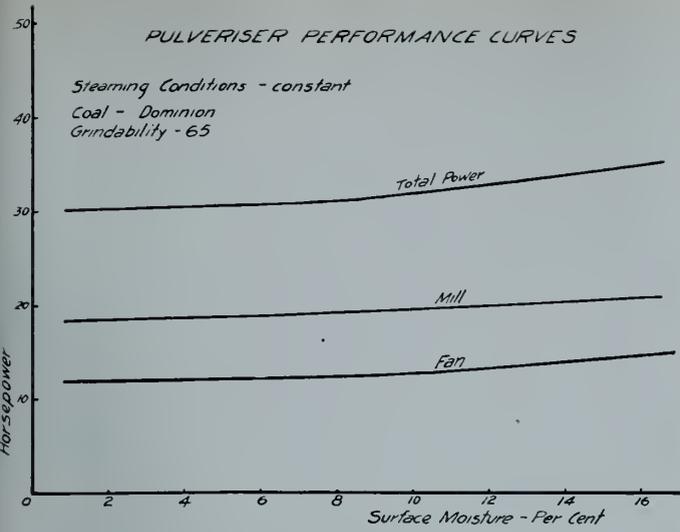


Fig. 9.

characteristics of both curves give a marked increase in the total power requirements with an increase in surface moisture, which is of considerable importance in a pulverized coal installation.

The necessity for drying coal for pulverizer firing presents numerous problems. In the early days, the bin, or storage system of firing was employed, and driers were necessary adjuncts. With the desire to utilize the advantages of direct firing, some form of mill drying was essential, and to-day this is almost invariably done with preheated air.

Experiment and operation have shown that a desirable outlet temperature for the primary air is about 150 deg. F. Using this figure as a basis, the minimum inlet temperature of the primary air to give complete drying can be determined for any given mill capacity, and Fig. 10 shows typical temperature-moisture relationships. Since the mill inlet temperature required depends only upon the moisture content, it increases in a straight line, and the ordinate between this and the mill outlet temperature line is a direct measure of the heat necessary to dry the coal.

The reason for finely pulverizing coal is to make it readily ignitable, and the mill operating temperature is limited by this fact. The primary air must be hot enough to dry the coal without being hot enough to coke or ignite it either in the pulverizer or burner pipe, and this consideration dictated the prevailing mill outlet temperature. This is controlled by admitting tempering air from the room to the primary air duct, thus modifying the temperature at the mill inlet.

The thermal capacity of the coal-air stream influences the ignition at the burners and the flame characteristics, and it increases with the surface moisture. The superheated steam arising from the moisture is thoroughly mixed with the coal, and before ignition can take place its temperature must be further raised. This is done at the expense of the furnace heat, with a consequent minute lowering of the furnace temperature. The effect on burner operation and flame characteristics is very small because of the accurate control available in modern practice.

5. SUMMARY

Before drawing final conclusions on the pulverizing and firing of wet coal, a brief review should be made of modern direct-fired boiler practice. Very generally speaking, it is not always economical to fire with pulverized coal if the peak steaming rate is less than about 25,000 lb. of steam per hour. Satisfactory pulverizer and burner equipment, however simple, is expensive and the increase in boiler efficiency, secured by its use over other modern alternatives, will scarcely justify the capital cost, and the subsequent costs of pulverizing and delivering the coal to the furnace.

In Fig. 11 is shown the relationship between boiler efficiency and surface moisture. When moisture is carried into the furnace with the coal as superheated steam at about 150 deg. F., it will be further superheated until it has reached the temperature of the furnace. This means a considerable absorption of heat, much of which is not then available for transfer through the boiler tubes, water-walls and superheater. Some of this heat is returned, but most of it is still in the vapour when it leaves the furnace because of the high exit gas temperature. A certain amount of this heat can be recovered in an economizer or an air preheater. There is, however, a limit set to this means of recovery, because of the corrosion, due to the presence of gases such as sulphur dioxide in the flue gas, which results if condensation takes place. This corrosive attack on the surfaces of the heat recovery equipment causes serious maintenance troubles. To prevent condensation, the latent heat of vaporization must be kept in the moisture, and hence the largest portion of the heat absorbed from the furnace is lost, and the possible boiler efficiency lowered thereby. Therefore, with increased moisture, the boiler efficiency will fall off as shown.

Actually, the decrease in efficiency is small; in the installation under consideration the drop is one per cent with an increase in moisture from two to twelve per cent. Such a loss is variable, but might be serious with expensive coal, if sustained for any considerable time. Generally, the effect of the moisture on the pulverizer performance is of more importance.

As shown in Fig. 7, the fineness of the coal in per cent through 200 mesh falls with increasing surface moisture, in this case from 74.5 per cent at two per cent moisture to 70.5 per cent at 12 per cent moisture—not a serious decrease. Although the fineness through 200 mesh is spoken of very frequently in pulverizer work, it, alone, is not a proper criterion for judging pulverizing performance. It is, of course, a very desirable coal size to have in quantity, but only if it can be secured without excessive power consumption. Far more desirable is powdered coal containing a very high percentage of sizes smaller than 100 mesh, because it is the particles of size 100 mesh or larger which cause furnace troubles. Besides, such fineness can be secured for a lower power input, and the coal burns almost as well. The fall in coal fineness with increased moisture is only important if large particles are produced in quantity resulting in the formation of slag on the tubes and furnace walls.

It has already been shown that the capacity decreases with increased moisture in the coal, and curves, indicating the decrease, are shown in Figs. 7 and 8. The difference noticeable in the shape is due, not to the coal, but to the different types of pulverizer equipment used. Since both mills have about the same capacity, it can be seen that one having a capacity curve such as in Fig. 7, would be more

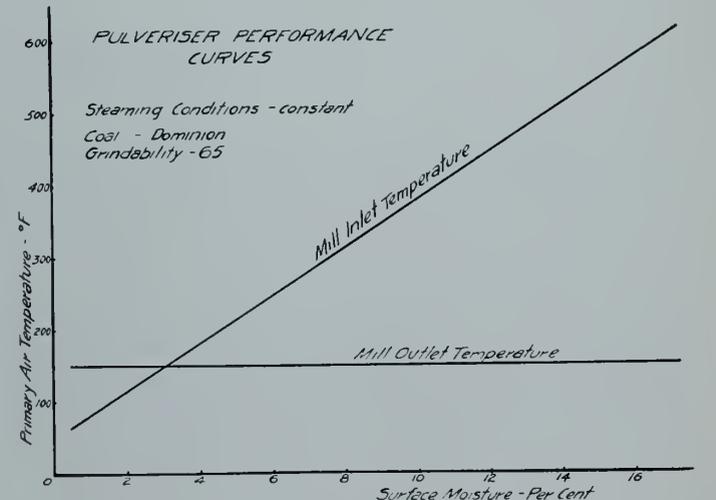


Fig. 10.

desirable than its competitor, because of its greater sustained capacity over the medium moisture range. The general fact that each type of pulverizer has its own peculiar characteristics is also clearly shown. This was indicated in the preliminary considerations of the grinding process.

In modern boiler practice, two medium-sized pulverizers, each capable of carrying over half the boiler load, are frequently installed per furnace rather than one large one. This procedure enables the medium loads to be carried more economically, because one mill will be operating at a fairly high percentage of its capacity. It also assures one mill in

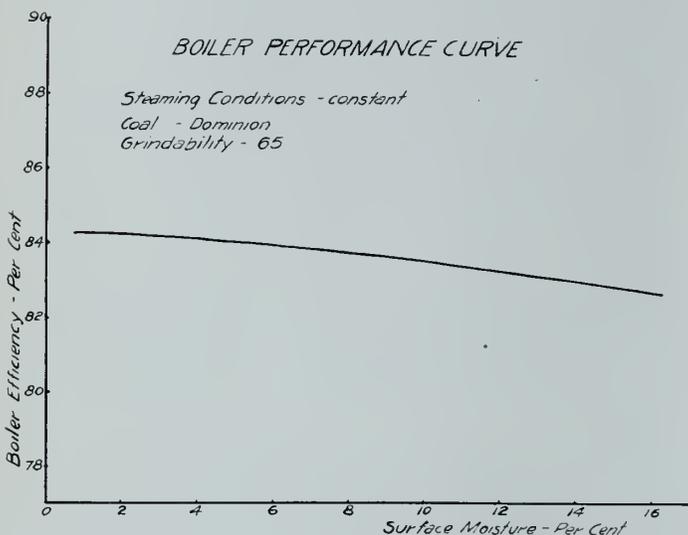


Fig. 11.

reserve in case of break-down, thus keeping the boiler on the line. But if wet coal is being fired at a medium load, the resulting reduction in pulverizer capacity may make it necessary to put on another pulverizer to keep the steam flow constant. Therefore, one mill, or both, with equalized coal output, will be operating below its best kilowatt hour per ton rating, with a resulting increase in milling costs.

The increase in mill and fan power with increased moisture necessitates the careful selection of coal with this factor in mind. It indicates also the desirability of suitable storage facilities to prevent the undue accumulation of moisture,

and the resulting troubles previously discussed. The use of lowgrade bituminous coal, and lignite, with their high percentage of surface moisture, is practically eliminated in pulverized firing unless the moisture content can be reduced to a manageable figure.

The mill inlet temperature required increases with the moisture, and here the economical size of the air preheater is a limiting factor. If the necessary temperature cannot be obtained by this means, flue gas may have to be used, and passed through a Davy screen before entering the mill. With an air preheater the necessary conditions for drying may be secured either by using a high inlet temperature, or by passing more air. Both these conditions are governed by the boiler size; the second is governed by the ability of the mill to handle the air. High temperatures may not be attainable without an expensive air preheater on medium-sized installations, and a further limit is set by the minimum allowable flue gas exit temperature necessary to prevent the condensation of water vapour.

In view of the present limitations of pulverizers when handling wet coal, reasonably complete information on boiler requirements is necessary to enable the engineer to design equipment suitable for proposed boiler plant, or for modifications to existing installations if they are desired.

#### ACKNOWLEDGEMENTS

To the engineering and sales staffs of Messrs. Babcock-Wilcox and Goldie-McCulloch Limited, and to Professor R. C. Wiren, M.E.I.C., of the University of Toronto, the author expresses his sincere thanks for their assistance in the preparation of this paper.

#### REFERENCES

1. The Ball-Bearing Principle of Grinding—R. M. Hardgrove. The Babcock & Wilcox Company, New York, N.Y. Bull. F-907A.
2. Grindability of Coal—R. M. Hardgrove. Trans. A.S.M.E., Vol. 54, Paper FSP-54-5.
3. An Analysis of Crushing and Pulverizing Operations—L. T. Work. Trans. A.S.M.E., Vol. 55, Paper RP-55-6.
4. The Relation Between Pulverizing Capacity, Power and Grindability—R. M. Hardgrove. The Babcock & Wilcox Company, New York, N.Y., Bull. 3-148.
5. Selection of Coal for Pulverized Firing—B. E. Tate. Trans. A.S.M.E., Vol. 60, Jan., 1938, Paper FSP-60-3.
6. Combustion of Pulverized Coal—Henry Kreisinger. Trans. A.S.M.E., Vol. 60, May, 1938, Paper FSP-60-8. Discussion: Trans. A.S.M.E., Vol. 61, Jan. 1939.
7. Discharge Temperatures from Pulverizers—Ollison Craig. Trans. A.S.M.E., Vol. 61, July, 1939.

## EXPLOSIVES FROM WOOD

Several million dollars annually are now being saved in the manufacture of certain types of military explosives produced in Canada through the utilization of Canadian wood pulp as a source of cellulose instead of importing cotton linters.

Wood cellulose has been used in Canada for a good many years in the manufacture of "Cellophane" and rayon but it is only since the beginning of the war that research and development has been undertaken to adapt wood pulp to the manufacture of nitrocellulose, the base for certain types of high explosives required for military purposes.

The use of cellulose-bearing wood pulps, quite plentiful

in Canada, has not only eliminated the importation of cotton linters from the United States, thus effecting a considerable saving in foreign exchange but has also considerably reduced the raw material costs without in any way impairing the quality or effectiveness of the resultant product.

One Canadian wartime explosives plant has been operating on wood pulp for over a year, while two others have been using this domestic type of cellulose exclusively now for six months and two months respectively. Canada, therefore is one of the first of the United Nations to adopt large scale production of military explosives from her own domestic supplies of chemical wood pulps.

# MOVING A COAL BRIDGE AT THE ALGOMA STEEL CORPORATION, LTD.

D. C. TENNANT, M.E.I.C.

*Engineer, Ontario Division, Dominion Bridge Company Limited, Toronto, Ont.*

Paper presented at a joint meeting of the American Society of Civil Engineers and The Engineering Institute of Canada, at Niagara Falls, Ont., on October 15th, 1942

The war has greatly accentuated an ever increasing demand for steel and nowhere are the resulting problems so acute as with the steel producing mills themselves. One of the by-products of this situation at the Algoma Steel Corporation in Sault Ste. Marie, Ontario, is the necessity for practically doubling the size of the coal and coke storage area. The present coal yard, 300 ft. wide and 1,600 ft. long, is fed by railway coal cars that ride a steel trestle about 25 ft. high running longitudinally along the middle of the area, and is served by two travelling coal bridges running on longitudinal rails and spanning 300 ft. transversely. These bridges are of the usual type, supported at a clear height of 55 feet on a shear leg at one end and a pier leg at the other, the pier leg being splayed out sufficiently at the top to give stability to the structure and so resist tractive forces from the bucket trolley, while the shear leg is merely a bent supporting the other end of the bridge and capable of a certain amount of movement at the bottom to take up inequalities in track level or gauge. The general arrangement of the bridge is shown in Fig. 1.

The Algoma Steel Corporation decided to increase the coal area by providing another similar coal yard about 900 ft. to the north of the present one, leaving one of the bridges to serve the old yard and transferring the other to serve the new one and to run on new tracks with necessary concrete foundation walls to support them. The old and new tracks are, of course, level throughout their length but the new yard and its tracks are 8 ft.  $4\frac{1}{4}$  in. higher than the old. Moreover, the alignment of the new tracks, while approximately parallel to the old, actually makes a small angle of 3 deg. 15 min. with them. Two possible ways of moving such a bridge present themselves; either dismantle the bridge and re-erect it in its new position, or move the bridge along the ground to its new place without dismantling. The second alternative was chosen as being cheaper and quicker, thus getting the bridge operating in the new yard with a minimum of interruption. It was important that the move be made between the middle of July and the end of August, as there is a comparative lull in coal handling at that time of year. A contract was accordingly given to the Dominion Bridge Company, Toronto, to move the bridge to its new location beginning in July and finishing in August, 1942. The method of moving was outlined in the agreement, namely, to jack both pier and shear legs at their bottoms, high enough to allow railroad trucks to be inserted under the legs to carry the load, these trucks to travel approximately at right angles to the ordinary operating travel and to rest on standard gauge tracks laid by the Algoma Steel Corporation on slag ballast and fill at a constant up grade to bring the bridge to the level of the higher new yard and at a constant but slight curvature to take care of the 3 deg. 15 min. difference in alignment of permanent yard tracks. When the bridge reached its final site it was to be jacked again, the trucks removed, and the bridge brought to rest on the permanent rails. This method is obvious enough but no similar structure has ever before been so transferred in Canada, and we know of no very close precedent in the United States or elsewhere.

The bridge was built some time ago by Messrs. Heyl and Paterson of Pittsburgh, Pa., and their detail drawings were available for reference. The total weight of the bridge including coal carried in the bucket was stated to be 475 tons, and an independent check of the weights from the shop drawings showed this given weight to be well on the

safe side. The pier leg is actually 5 ft. longer than the shear leg. Since the bridge bottom chord is level and the pier and shear legs are the same transverse width at the top and have the same batter, it follows that the pier leg is actually wider at the bottom than the shear leg. The difference in spread is 1 ft.  $9\frac{3}{4}$  in. or  $10\frac{7}{8}$  in. on each side of the centre line of the bridge. As it was desirable that the trucks under both shear and pier legs should run on the same temporary tracks, these tracks were laid at an average distance—41 ft.  $4\frac{7}{8}$  in.—apart centre to centre so that the centre of the bottom of the batter post that rested on the trucks was only  $5\frac{7}{16}$  in. off the centre line between standard gauge rails. Theoretically this would throw more load on one rail than on the other, but this was compensated for by the stiffness of the transverse bracing in the pier leg and special knee



Fig. 1—View of coal bridge ready for moving, looking at north or shear leg end.

braces that were inserted at the base of the shear leg. Two railroad trucks, each of four wheels, were used under each pier and shear corner. At each pier corner a standard 75-ton and a 50-ton truck were used and at each shear corner two 60-ton special trucks such as are used under locomotives when they are being repaired. The standard trucks had 33-in. wheels, while the wheels on the repair trucks were much smaller but very husky. The 75 and 50-ton tandem arrangement would take care of 125 tons reaction or 250 tons for the whole pier end. The stretchers distributing to these trucks were loaded at the  $\frac{3}{5}$  points so that the heavy truck would get  $\frac{3}{5}$  of the load, the light one  $\frac{2}{5}$ . The 60-ton repair trucks were much lower in height and had to be built up with heavy timbers as shown in Fig. 2. Between them they would take 120 tons, or 240 tons total for the whole shear leg end. The different sizes of trucks were used because they were the best available and capable of carrying the loads. The rails used for the temporary track were of 85 lbs. A.S.C.E. section. The trucks were spaced 11 ft. 3 in. apart longitudinally centre to centre at the pier end, and 9 ft. apart at the shear end. The stretchers to distribute the reaction from the leg to the trucks were two 24-in. beams of 79.9 lb. per ft. These stretchers supported the legs near where the permanent wheels had supported them.

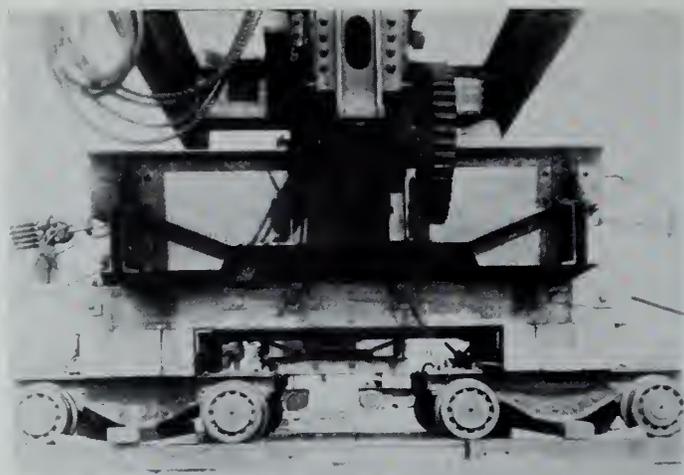


Fig. 2—Arrangement of 60-ton trucks and timbers at shear leg corner.

For jacking purposes, cribs of heavy wooden timbers were built up gradually as the bridge was raised. These cribs were just outside the temporary track width and carried four 50-ton Norton jacks at each corner. These jacks supported the four ends of two transverse 24-in. 104.5 lb. beams 20 ft. long into which were headed double 18-in. channels, at the centre of which angle ties were riveted to connect to the tops of the main gussets or box girders that formed the bases of the legs. Thus the whole load was carried through the tie angles to the cross channels, to the 24-in. beams, to the jacks, to the cribbing, to the ground. In the old yard the ground was well compacted and very little settlement under the jacks could be noted. In the new yard some ground was softer so concrete foundations were provided by the Algoma Steel Corporation at the jacking points.

The pier leg being at the south end of the bridge, this permanent track is 5 ft. lower than the one at the shear end which is to the north. This condition holds good also for the new yard, so that beginning at the most southerly point of travel the permanent rails for old and new yards are at successively higher elevations somewhat conforming to the ground surface, but not exactly so. Thus the movement of the bridge was accomplished by pulling uphill at the base of the shear leg. Needless to say the bridge as built was not intended to be pulled in any such manner and double temporary provision was made to take care of this pull and distribute it properly. The bottom of the shear leg was knee-braced to the second bottom chord joint of the bridge by means of two members about 75 ft. long as seen in Fig. 1. These temporary members were actually derrick booms from Dominion Bridge Company's stock,

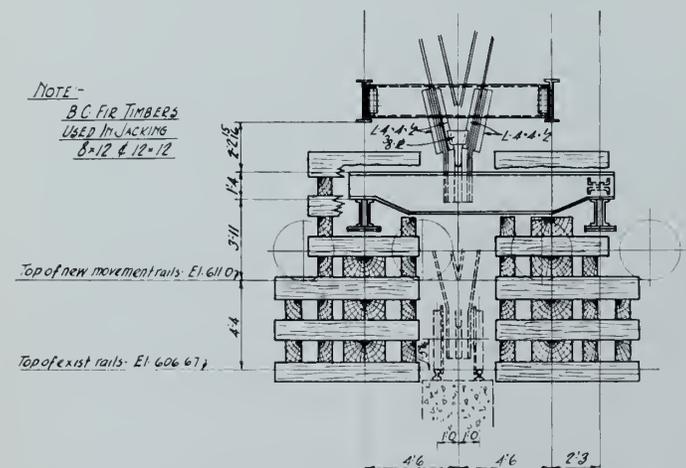


Fig. 3—Special framing for jacking at bottom of pier legs.

with their ends adapted to connect to the leg at the bottom, and to the bottom chord joint at their upper ends, and to take either tension or compression. As an added means of distributing the traction pull, 1½-in. threaded rods were inserted as horizontal ties between the bottoms of the shear and pier legs. These were in 30-ft. lengths connected together with home-made turnbuckles and suspended at several points by wire rope hangers from the truss above to prevent sag. One of these tie rods with its turnbuckle, and a towing tackle can be discerned in Fig. 2. During pauses in the movement several lengths of these tie rods could be readily removed if necessary to allow track or road traffic to pass under the bridge but in such cases the trucks were first wedged in position so that they could not move on the temporary tracks. It was assumed that there might possibly be as much as 15 tons pull required at each corner at the shear leg end in order to move the bridge along the tracks. No one was surprised, however, when a much smaller pull proved adequate. Ten parts of 5⁄8-in. plow steel rope were used at each corner to take the pull from the hoisting engine.

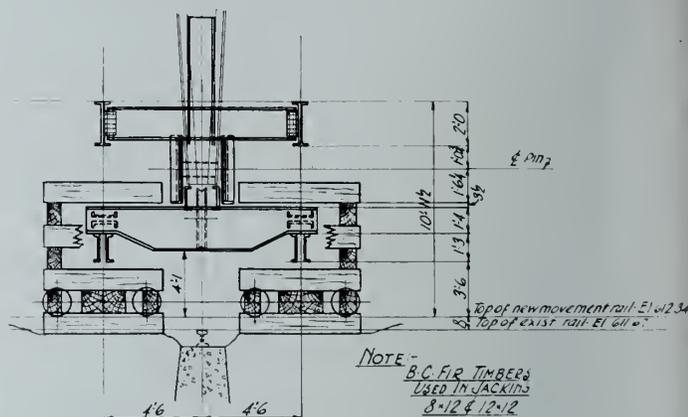


Fig. 4—Special framing for jacking at bottom of shear legs.

Figures 3 and 4 illustrate the special framing used at the bottoms of the pier and shear legs to take the load from the jacks into the legs and to deliver the load from the legs to the trucks and temporary rails after the jacks were removed.

Figure 5 shows the jacking crib at the shear leg end with the bridge jacked up high enough to allow the two specially timbered 60-ton repair trucks to be set in place under the leg. (See also Fig. 4).

The sequence of operations at the site was as follows:—

1. A suitable place was chosen near the east end of the yards where the bridge could be transferred from one runway to the other with a minimum of inconvenience to ordinary yard operations and shunting. At this place the actual distance that the bridge would have to be moved was about 860 ft.

2. The two standard gauge temporary railroad tracks were built by the Algoma Steel Corporation with slag ballast and gravel fill. These tracks were set on a uniform curve to include four points, viz., the centre lines of pier leg and shear leg in the existing yard and also at their new location in the new yard. A constant upgrade delivered the bridge to about its final elevation. Gaps were left in the concrete foundations under the permanent rails in the new yard to give clearance for the trucks and jacking down operations.

3. The path of the bridge crossed many existing tracks and a main road. On two of these tracks and on the road the traffic could be interrupted for only three or four hours, so it was necessary to arrange for the temporary tracks to be supported at these points on special timber framing that could be quickly placed and removed.

4. The bridge itself was prepared for its travel by connecting the 75-ft. knee braces at the shear end, inserting

the tie rods near ground level, removing certain platforms and machinery parts at the bottoms of the legs that interfered with jacking operations, and connecting the jacking girders with angle ties to the base gusset plates of the legs, and temporary braces at the bottom of the shear leg for lateral stability.

5. Using eight jacks, four at each corner of the pier leg, this end was raised about a foot and blocked in position using timbers. The jacks were then removed and taken to the shear leg end which was raised about two feet. This alternate process continued until the bridge was up some eight feet, that is, high enough for the trucks to be inserted at both ends and the bridge lowered to rest on them.

6. One hoisting engine was used to pull the bridge up-grade on the tracks at a speed of 8 ft. per minute. It had to be moved successively to new locations with the snatch block also connecting to new deadmen. The bridge was blocked and guyed when not in motion and it was not moved during high winds. During the rests in the moving, the busy tracks and the road were cleared of obstructions such as temporary track, rope haul, or horizontal tie rods.

7. When the pulling was completed the bridge was jacked to the proper level at each end, was set on rails that rested on temporary timbers in the gaps that had been left in the foundation walls, and was moved on these tracks until it rested over the permanent new foundation walls.

8. The tie rods and knee braces were then removed and the machinery parts and platforms that had been removed were replaced at the bottoms of the legs.

9. The temporary timbers were removed from the gaps in the foundation walls and these gaps were filled with concrete construction corresponding to the rest of the walls, and permanent rails were completed.

10. The temporary railroad tracks on which the bridge had been moved were taken away.

Actually some preparations for connecting jacking beams were begun on July 24th and jacking began about August



Fig. 5—Jacking crib at shear leg end showing 60-ton trucks being placed under leg.

first. The pulling of the bridge on its temporary tracks took place during the third week in August and the bridge was on its final permanent rails before the end of the month.

No hitch of any sort occurred in the moving operation. The structure was insured from the time the jacking commenced until set in its final position in the new yard. Much of the credit for the smoothness of the arrangements belongs to the Algoma Steel Corporation, and particularly to its chief engineer, Mr. Carl Stenbol, M.E.I.C. Good co-operation was also received from the Sault Structural Steel Company of which Mr. E. A. Kelly, M.E.I.C., is manager. The planning and execution was the responsibility of the Ontario Division of the Dominion Bridge Company, with Mr. A. Ross Robertson, M.E.I.C., as general manager, Mr. W. H. Butler, erection superintendent and Mr. Jack Erickson as erection foreman at Sault Ste. Marie.

## MUSIC AS AN AID TO WAR PRODUCTION

In an address delivered recently before the Metropolitan Section of The American Society of Mechanical Engineers, Professor Harold Burriss-Meyer, Director of Research in Sound at Stevens Institute of Technology revealed the results of what is claimed to be the first scientific, statistical investigation conducted in the United States for the purpose of evaluating the effects of music on employee morale and factory production.

Professor Burriss-Meyer and Mr. Richmond L. Cardiwell, also of Stevens, invaded a number of factories and war plants in the east to measure the most obvious thing—does music in the factory influence the production rate. The data showed that in 75 per cent of the investigations production was considerably higher where music was used than where it was not used. Increases in production rates, resulting from the introduction of music, ranged from 1.3 per cent to 11.1 per cent. Further studies indicated that the effect was not a transient one. The production increases are even more surprising when it is considered that many of the groups measured consisted of employees on piece work who already were producing at top speed. In addition to increasing the production rate, Monday morning absenteeism and early end-of-day departures were reduced phenomenally.

Having answered definitely the question of what music does to the production rate, the investigators next turned their attention to an appraisal of programmes. The curves indicate that a carefully selected and planned programme boosted production 6.8 per cent in a typical plant already employing music.

Said Professor Burriss-Meyer, "This would seem to bear

out a theory to which I have long subscribed, which is that, while music is better than no music, programming will not be satisfactory until it is undertaken on the basis of a careful analysis of the results it gets. We have to date only the showmanship and experience of the programmers. More statistical analysis of factory performance should teach us much. We believe that programming must ultimately be undertaken for the factory, if not for the specific operation. Fatigue curves vary in shape and amplitude and it is difficult to find one remedy for dips occurring at different times in different operations. We have, at least, established the fact that the remedy exists and the technique for employing it is in hand."

In closing, the speaker observed, "Little of the music used in the factory is germane to the endeavour it accompanies. The work song took not only its rhythm but its mood and lyric from the work operation. The transcription carried something composed for the concert hall, the stage or the night club. The leisure music is not in the idiom of the modern industrial plant and yet the industrial audience will at the present rate soon be the largest audience for the musician. No artist undertakes a composition or performance without the consciousness of his audience, and insofar as his art is valid he undertakes to exercise emotional control over that audience. When the composer starts to think of his work as being first and oftenest performed in a factory, before people who are working while they listen, we may well have a musical idiom which is something new on the face of the earth, and what industry can do for music may be as important when the record of this civilization is written, as anything music can do for industry."

# THE SUPERCHARGING OF TWO-STROKE DIESEL ENGINES

F. OEDERLIN

*Managing Director in charge of Engineering, Sulzer Brothers Limited, Winterthur, Switzerland*

Extracts from a paper describing development work in connection with the supercharging of two-stroke Diesel engines

**SUMMARY**—Starting with the Sulzer two-stroke Diesel engine with normal scavenging-air pressure, supercharged types of engines with exhaust-gas turbines are described, in which mean effective pressures of 12 to 18 kg. per CM<sup>2</sup> (170-255 lb. per sq. in.) have been reached not only on the testbed but also in industrial service. In addition, engines of special design are mentioned, whose working cylinders may also be used as power gas generators.

The supercharging of two-stroke Diesel engines has always been an important aim in the development of the Diesel engine, more particularly since the four-stroke engine has been supercharged successfully. In 1912 the Sulzer two-stroke engine was built with "extra-charging." The air charge in the cylinder at the beginning of the compression stroke was at a higher pressure than had hitherto been generally used. This extra-charging pressure was limited, in accordance with the scavenging-air pressure, to about 1.2 to 1.4 atm. (17-20 lb. per sq. in.) abs., this giving, as compared with engines without extra-charging, an increased output of 10 to 30 per cent. This extra-charging pressure has remained practically unchanged up to the present day and has been increased only in some special cases. The reason for this is that any further increase in the extra-charging pressure means an increase in the work absorbed by the scavenging pumps, and consequently the fuel consumption is increased unless the energy of the exhaust gases, which increases with the extra-charging pressure, can be utilized.

The adoption of higher supercharging pressures therefore requires, particularly with respect to fuel consumption, utilization of the exhaust energy, that is to say its conversion into useful mechanical energy. At present the best means for this is the exhaust-gas turbine.

The most evident solution would be to use the exhaust-gas turbine to drive a rotary compressor supplying scavenging and charging air, and in this way to eliminate the scavenging pump. Unfortunately it is not possible to realize this method of supercharging in practice, since only at high loads and high exhaust temperatures is the output of the exhaust-gas turbine sufficient for compressing the necessary amount of scavenging and charging air; at low loads the supply of air would be insufficient. The crux of the matter, however, is that the two-stroke engine supercharged in such a manner could not be started at all, since the exhaust-gas turbine driving the compressor comes too slowly up to speed after being started. Consequently, to supercharge the two-stroke engine, the energy which is lacking, particularly for the compressor when starting and at low load, must be supplied from outside.

It is possible for instance, according to the Sulzer-process here called "high supercharging," to adopt for this purpose a reciprocating scavenging-air pump, suitably strengthened and of such dimensions as to give the appropriate degree of supercharging, this pump being driven from the crankshaft and supplying the total quantity of air required. In order to be utilized, the turbine energy is transmitted to the crankshaft by gearing. The reciprocating scavenging-air pump may also be replaced by a rotary compressor which is driven direct or indirect from the exhaust-gas turbine coupled to the crankshaft through gearing. In both cases the compressor is already driven by the Diesel engine when starting and can therefore supply the necessary quantity of scavenging air. The supercharging pressure can, at least theoretically, be chosen as desired. The most efficacious supercharging pressure will vary, however, from time to time.

Investigations have shown that the indicated output of

the exhaust-gas turbine is greater than the indicated power absorbed by the compressor. A positive area of indicated work is therefore available for the charging set. However, because of the unavoidable losses in the exhaust-gas turbine and compressor, the output of the turbine is sufficient to cover the power required by the compressor only in the case of large installations and when the load on the plant is high. The surplus power of the supercharging set is then transmitted to the crankshaft through the gearing already mentioned. But even with engines of medium and small output the power required by the compressor will be supplied mostly by the exhaust-gas turbine. Under average conditions it can be presumed that the power required for the compressor and the output developed by the turbine will balance each other to a large extent.

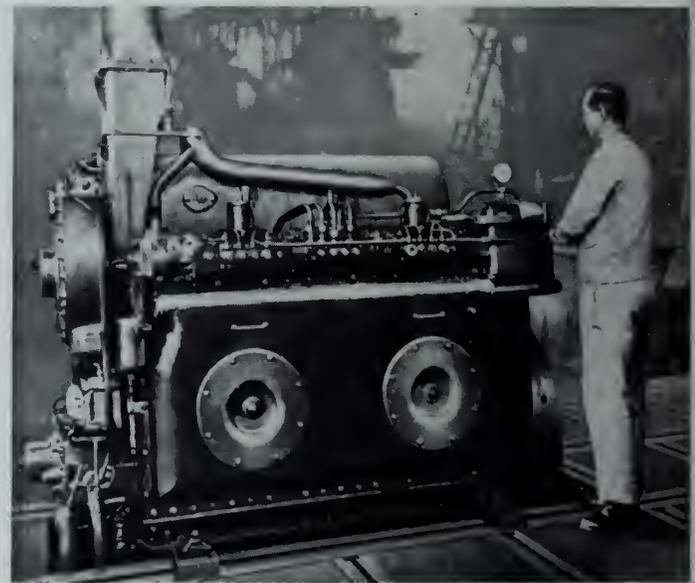


Fig. 1—First supercharged opposed-piston two-stroke Diesel engine with coupled exhaust turbines.

Based on these considerations, Sulzer Brothers several years ago took up the problem of two-stroke high supercharging. First of all a special experimental engine was built and submitted to thorough tests. These tests were at first confined to the Diesel engine alone. The effect of the exhaust-gas turbine was imitated by a throttle orifice. The air for scavenging and charging was taken from the compressed-air system in the works and heated up to the temperature corresponding to the polytropic compression of a normal compressor.

With this experimental engine supercharged to 2 atm. abs., a mean effective pressure of 12 kg. per cm<sup>2</sup> (170 lb. per sq. in.) was obtained with absolutely clear exhaust. This mean effective pressure could be maintained without any difficulty for a considerable length of time. During a later test on another engine with the same supercharging pressure, a mean effective pressure of as much as 13 kg. per cm<sup>2</sup> exponent (185 lb. per sq. in.) was maintained for 48 hours. In comparison with the non-supercharged two-stroke engine, the increase in mean effective pressure or in output was 100 per cent.

The same experimental engine was then worked with a supercharging pressure of 3 atm. abs., which allowed a mean effective pressure of 15 kg. per cm<sup>2</sup> (210 lb. per sq. in.) to

be reached, and this could also be maintained as long as desired with the exhaust perfectly clear.

After the clearance space had been suitably enlarged, the same experimental engine was run, the supercharging pressure being gradually increased to 6 atm.abs., and it was found that a mean effective pressure of 18 kg. per cm<sup>2</sup> (255 lb. per sq. in.) could be obtained. Under such conditions combustion takes place with a relatively large proportion of excess air and gives at all loads an absolutely smokeless exhaust gas, the purity of which shows it to be an excellent medium for working an exhaust-gas turbine.

Based on the excellent results obtained with the experimental engine mentioned, an engine supercharged to 2 atm.abs. was built. In order to obtain an engine with as high an output as possible, the opposed-piston type was adopted. The exhaust-gas turbine is connected overhung to the end of the exhaust manifold. Its output is transmitted to the crankshaft through toothed gearing. The scavenging and charging air is supplied by reciprocating compressors coupled to the crankshaft. This engine is shown in Figs. 1 and 2. Its principal data are:—

Number of cylinders.....	4
Bore.....	190 mm.
Stroke.....	2x300 mm.
Speed.....	750 r.p.m.
Piston speed.....	7.5 m/sec.
.....	1475 ft./min.
1-hour rating.....	1370 B.H.P.
Mean effective pressure at 1-hour rating, including turbine and compressor.	12 kg./cm <sup>2</sup> . 170 lb/sq.in.
Fuel consumption.....	158 grams/B.H.P.-hour. 0.35 lb/

During industrial service in the Sulzer works for more than 3,000 hours, it was found that the newly designed constructional elements comply in all respects with the stipulated conditions. The mechanical transmission of energy between exhaust turbine and crankshaft never gave rise to any trouble. Even during periods of severe cold the engine always started easily and quickly. This Sulzer engine represents the first practically usable realization of a supercharged two-stroke engine with built-on exhaust-gas turbine, with which such high mean effective pressures were attained.

In large installations the mechanical coupling between the turbine and the crankshaft can be replaced by an electro-magnetic or an hydraulic coupling. The transmission of energy may also be effected electrically, the supercharging set being driven by an electric motor receiving energy from the mains or from a separate generator.

In order to determine the suitability of high supercharging at higher speeds, an experimental engine was built having cylinders of 120 mm. bore and 2 by 150 mm. stroke,

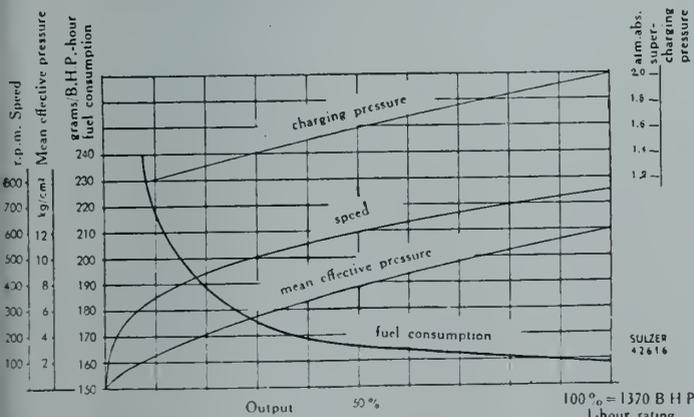


Fig. 2—Fuel consumption, speed, charging pressure and mean effective pressure of the supercharged opposed-piston two-stroke Diesel engine illustrated in Fig. 1, as a function of the load when working according to the propeller law.

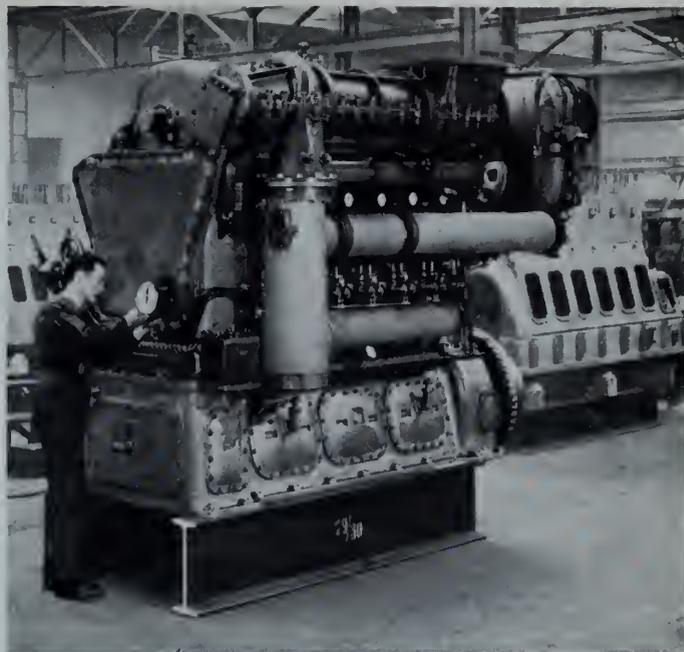


Fig. 3—Two-stroke two-shaft opposed-piston Diesel engine, supercharged to 2 atm. abs. and developing 1,560 B.H.P. at 850 r.p.m.

and intended at first to run at 1500 r.p.m. Also this new design easily reached the mean effective pressures of the former experimental engines, amounting to 12, 15 and 18 kg per cm<sup>2</sup> with supercharging to 2, 3 and 6 atm.abs., respectively. At 1500 r.p.m. the fuel consumption was 180-190 grams per B.H.P. per hour, if the output of the turbine and the power absorbed by the compressor are not considered, which, as mentioned, practically balance each other. Meanwhile the speed has been raised to 2400 r.p.m., corresponding to a piston speed of 12 m. per sec.

In addition, tests were made on a single-piston engine of 420 mm. bore, where the supercharging was at first limited to 2 atm.abs. Also these tests showed that the output increases up to this limit practically in direct proportion to the height of supercharging, thus confirming the results that had been obtained with engines of smaller bore in this field.

Based on these results, Sulzer Brothers have started gradually to adapt their single-piston engines of medium-sized and large bore to the requirements of two-stroke supercharging. Simultaneously they have developed a new type of engine (Fig. 3), allowing a far-reaching utilization of the possibilities offered by high supercharging. This engine, of the two-shaft opposed-piston type, has the following data:—

Number of cylinders.....	6
Bore.....	180 mm.
Stroke.....	2x225 mm.
Speed.....	850 r.p.m.
Piston speed.....	6.375 m/sec. 1250 ft./min.
Supercharging pressure.....	2 atm.abs. 28 lb/sq.in.
Output, 1-hour rating.....	1560 B.H.P.

This engine is built in such a way that it can also be supercharged experimentally at 6 atm.abs. thus raising its output to 2340 B.H.P. and further reducing its specific weight.

Supercharging to 5 or 6 atm. (70-85 lb. per sq. in.) abs. is peculiar, in that, within this range of supercharging, the power delivered by the Diesel engine and the power absorbed by the supercharging compressor become equal. The effective output of the whole plant thus corresponds essentially to the output of the exhaust-gas turbine. The turbine may therefore be uncoupled from the Diesel engine and from the compressor without disturbing the energy balance of the

whole set. The set, comprising Diesel engine and compressor, here designated "power gas generator," fulfils the same purpose as, for instance, a boiler in a steam power station. The whole effective output is given out by the power gas turbine which corresponds to the steam turbine of the steam power station. Accordingly several power gas generators can be arranged to work on one common power gas turbine.

This power generating process can also be performed by free-piston power gas generators. With power gas generators of this kind (shown diagrammatically in Fig. 4), each of the opposed pistons of the Diesel part works direct on a compressor piston which compresses the scavenging and charging air. No crankshaft is provided. The two pistons

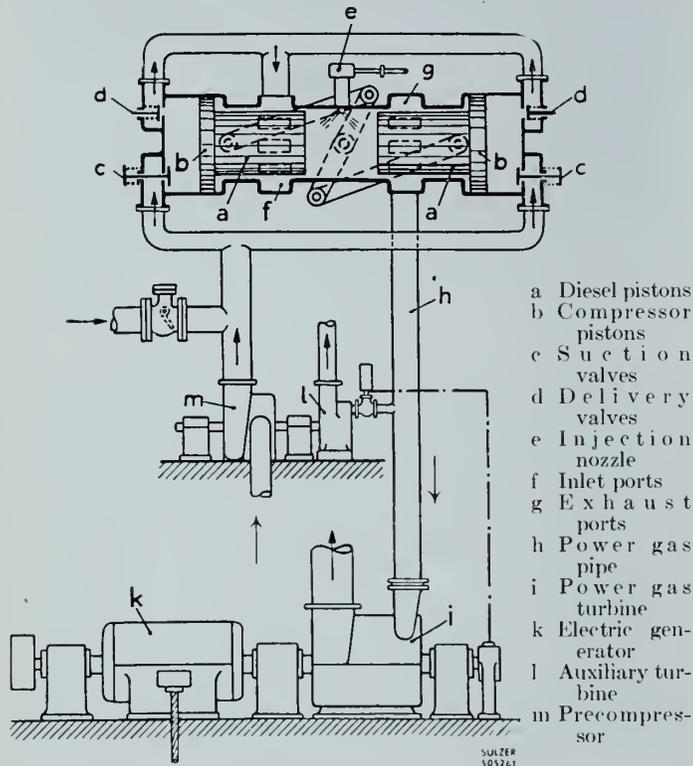


Fig. 4—Power gas process with free-piston power gas generator. The two Diesel pistons *a* with the built-on compressor pistons *b* are connected to each other by a synchronising device. The two Diesel pistons are pushed inwards by the expansion of the air remaining in the compressor cylinders, thereby compressing the air contained in the Diesel cylinder. The fuel injected through the nozzle *e* is burnt in the highly compressed air, after which the two Diesel pistons are forced outwards. Then the air drawn in by the compressor pistons during the previous stroke is compressed. The compressed air delivered by the arrangement serves for scavenging and charging the Diesel cylinder. The exhaust gases, here called power gases, drive the exhaust gas turbine *i* coupled to an electric generator *k*. The auxiliary turbine *l*, which is also connected to the power gas pipe *h*, drives the precompressor *m* which precompresses the air entering the compressors and thereby supercharges them.

are merely coupled to each other by a linkage which ensures their running symmetrically. The volume of the clearance space adjusts itself automatically to suit the supercharging pressure used at the moment.

The power gas process constitutes a practical realization of the "gas turbine." A remarkable feature is the high thermal efficiency of 35 to 40 per cent, without employing any recuperators or similar apparatus and at service temperatures of only 450 to 500 deg. C. (840-935 deg. F.). The power gas turbines are small and simple. The reliability in service of the whole plant is increased by the independence of the individual power gas generators. Critical speeds are not to be feared, since the separate power gas generators are coupled to each other only by a very flexible gas column. With the power gas process, outputs may be obtained

which lay hitherto beyond the range covered by the Diesel engine, and with specific weights corresponding to those of the lightest steam installations.

The supercharging pressure may be increased beyond 6 atm.abs. With the power gas process, however, the exhaust-gas turbine output must be drawn upon in this case for the compression work, since the power required by the compressor exceeds the power developed by the Diesel engine.

The supercharging set of the supercharged two-stroke engine may be regarded as a constant-pressure gas turbine, i.e., a gas turbine with continuous combustion whose combustion chamber is replaced by a supercharged Diesel engine. The supercharging set has, as in the case of the gas turbine, an indicated output of positive value. Whilst in the case of the gas turbine only the difference between the output of the turbine and the power absorbed by the compressor appears as effective output, this is increased, with high supercharging, by the output obtained from the Diesel engine. Its effect appears clearly in the thermal efficiency, which is of the order of about 40 per cent with high supercharging, whilst it amounts to about 18 per cent with the simple gas turbine.

Replacing the combustion chamber of the gas turbine by a Diesel engine is also justified with respect to the heat load, since it is in any case necessary to cool the hot gases from their initial temperature of 1500-2000 deg. C. to about 500-600 deg. C. before admitting them to the exhaust-gas turbine. Instead of effecting this cooling by admixture of excess air, as is the case in the gas turbine, this cooling takes place in the supercharged Diesel engine, mostly through adiabatic expansion of the gases in the Diesel cylinders, where they at the same time perform useful work.

When the supercharging pressure of the Diesel engine is further increased, the swept volume becomes smaller and smaller, the clearance remaining the same. In the limiting case the swept volume becomes zero, and the Diesel engine is then reduced to nothing but clearance space. This is then identical with the combustion chamber of the hypothetical high-pressure gas turbine, which because of its high working temperatures can at present not yet be realized. On the other hand, this working process can, as has been shown, be carried out with good efficiency in the supercharged Diesel engine or in the power gas plant.

From the constructional point of view it is logical to have the combustion process and the higher compression and expansion pressures in the Diesel cylinder, this being the most suitable structural element therefor. Since, however, the expensive swept volume of the Diesel engine is only poorly utilized in the lower part of the indicator diagram, it is again logical, as far as it is possible to do so, to confide this part of the compression and expansion work to radial or axial compressors and to turbines, which as is well known, are cheaper, lighter and smaller, and have proved especially well suited for handling large quantities of gases at low and medium pressures.

From these considerations and the results obtained, it can be concluded that there are important reasons in favour of this combination of the Diesel engine and the gas turbine. It offers an increase in thermal efficiency of more than 100% as compared with the gas turbine, and an increase in mean effective pressure of 100 to 200% as compared with the non-supercharged Diesel engine.

Nevertheless the gas turbine should acquire importance as well as the power gas process, especially in fields where units of great power are needed, provided that its efficiency, at full load and particularly at part load, can be considerably improved. However, the gas turbine will not be able to replace the Diesel engine, whether supercharged or not, since the Diesel engine can still today claim to have the highest thermal efficiency of any form of thermal prime mover, and it will maintain this superiority also in face of the gas turbine.

# WARTIME NATIONAL EFFICIENCY

G. A. GAHERTY, M.E.I.C.

President of the Montreal Engineering Company, Ltd.

Substance of an address given September 9, 1942, at a dinner meeting of the American Institute of Electrical Engineers' Pacific Coast convention, Vancouver, B.C.

**SUMMARY**—Recognizing that war causes a dislocation in a nation's economy which in turn tends to lower its efficiency, the author cites the necessity for expediting war production in Canada and suggests a national-efficiency programme applicable to any nation at war. He declares that to achieve victory there must be a judicious allocation of men and materials for the maximum output of the implements of war and for the curtailed output of essential civilian goods; that there must be a rigorous practice of conservation on the part of individuals, business, and government; and that there must be a forfeiture of personal convenience where the national welfare is concerned.

Canada now has been at war for three years and in that time has advanced far along the road to total war. It is timely to consider the war experiences of Canada, and the conclusions that can be drawn from them, since the war programme of the United States, as it unfolds, is likely to follow much the same pattern.

At the very outset Canada became a major and rapidly increasing source of supply for Britain of aluminum, copper, zinc, foodstuffs, and automotive equipment. The financing of these purchases, a billion dollars of which were assumed by the Canadian Government, was a heavy strain on Canadian economy, but thanks to the foresight of the Canadian Department of Finance, stringent control of foreign exchange was imposed and enforced from the outbreak of war. While this brought the war home to Canadians who wanted American funds, it enabled Canada to finance the British requirements and also to meet her own financial obligations to the United States.

With the co-operation of industry, prices on war goods in Canada were for a time held down to prewar levels, but the industrial activity resulted in so much more money in the hands of wage earners that prices soon began to rise at an alarming rate. Sensing the danger, the Canadian Government with commendable promptness stabilized wages more than a year ago on a cost-of-living basis and established maximum prices for goods and services. These "ceilings" have since been maintained with considerable success, notwithstanding the efforts of certain labour and agricultural pressure groups.

## ALLOCATE MEN AS WELL AS MATERIALS

Income and other taxes have been raised until those whose income is dependent upon the profits of corporations are taxed even more heavily than in Britain. The excess profits tax has been increased to 100 per cent, of which 20 per cent represents compulsory savings refundable after the war. Compulsory saving has been instituted for those on salaries and wages, and installment buying has been curbed. Gasoline, sugar, coffee, and tea have been rationed throughout Canada. The civilian use of rubber, copper, aluminum, and steel has been cut almost to nothing and even their military use is drastically restricted. The manufacture of many articles has been prohibited. Notwithstanding these measures, the shortage of labour has become so acute that vital war industries such as shipbuilding are now working at reduced capacity because of inability to get men. Selective service, which the Government has just introduced, is designed to make more men available for war work, but there is a definite limit to the Canadian manpower supply and the war effort can be further stepped up only through the more effective utilization of resources in man-power and materials, in other words, by wartime national efficiency.

With all due respect for the splendid progress to date, this is no time for complacency. We are facing a crafty

and unscrupulous enemy. He has cut us off from our main sources of three vital war materials: tin, tungsten, and rubber. He is taking a heavy toll of shipping and has played havoc with lines of communication, notably his severing of the Mediterranean route to Suez. Resources are being dissipated by the resulting necessity for convoying, for shipping via roundabout routes, for building ships to replace those he is sinking, and for constructing synthetic-rubber plants. His resources, at the same time, are increasing as he puts to work the enslaved peoples of Europe.

Make no mistake of it, victory can be achieved only by the complete mobilization of all our resources and their skillful employment in offensive operations; in other words, total war. *We must seek out and destroy the enemy.* It is not the total number of men in the army that counts, but the fire-power and the mobility of the armed force with which to strike across the English Channel and in the China Sea. The Canadian Navy, Army, Air Force and munitions industry must all be developed in proper balance so that an attack can be made with maximum effect.

## MILITARY VERSUS POLITICAL STRATEGY

The great weakness of democracies is that their resources too often are frittered away through the deciding of war policies on grounds of political expediency rather than of military strategy. In Canada, for example, in calling up men for military service, whether they are married or single is the criterion, and single men who are too old are taken in preference to married men better fitted for fighting. In matters of this kind motives of self-interest still dominate, unfortunately. Our problem is to better, by democratic means, what the National Socialists of Germany achieve by enslavement, espionage, and lying propaganda. The stepping-up of Canadian national efficiency for war involves not only the problem of allocating each individual to his proper sphere, but also the problem of recognizing and counteracting the various subversive forces and of building a morale conducive to the *maximum output per individual.*

A major war causes an upheaval in national economy that in itself tends to lower national efficiency. In peacetime we live largely by taking in each other's washing. We exchange goods and services, money serving as a convenient medium whereby transactions can be effected that are fundamentally barter. The real wages for our services are not the money we receive, but what that money will purchase in goods and services. Such goods and services can be made available in wartime only at the expense of war production, and herein lies the main difficulty of a wartime economy. For the *total war* in which we are involved, the very *minimum standard of living* for everyone is indispensable, as is also the *maximum war output per individual.* The problem is how to get everyone working to his utmost with the very minimum of immediate reward.

## LIVING STANDARDS VERSUS WAR PRODUCTION

A major war produces a tremendous dislocation of income, and consequently of purchasing power. On the one hand, many businesses such as the automobile business become war casualties; salaried people must work longer hours but for an income that is much reduced by taxation; those who have invested their savings in common stocks, the very foundation of our industrial progress, have their income taxed first in the hands of the corporation, and then again when it reaches the individual. On the other hand, wage earners in most cases are much better off. They are

fully employed and they work longer hours often at high overtime rates. Some of them, who ordinarily would be considered unemployable command good wages under the present acute labour shortage. It is not surprising to find them breaking out in a spending rash and buying those things which heretofore they have been unable to buy. Thus we find an increased demand for the very goods the production of which must be curtailed or cut off to wage a successful war. It is this increased demand with a diminished supply of such goods and services that starts the inflationary spiral.

How best to curb the purchasing power of the individual while the war lasts is the question facing us to-day. Taxation, rationing, and curtailment of production of non-essentials all have their place, but if carried too far promote discontent, and for maximum output it is indispensable that our workers be happy. We must do our utmost to induce the workers to postpone the enjoyment of the fruits of their labour until after the war; in other words, to save. It is of no great importance whether the savings are in war loans, or in bank deposits, or in paying off a mortgage, so long as the money is not spent on services or goods the production of which involves the use of man-power or of critical materials. It should be recognized, however, that a modicum of non-essentials, and even of luxuries is indispensable if the worker is to be kept happy, and we should concentrate on those that involve the least use of man-power and critical materials.

#### WHAT IS "ESSENTIAL" ?

The individual view as to what is "essential" depends largely on "whose ox is gored." There is the example of a labour deputation, in a Canadian province that prides itself on its patriotism, arguing that a local newsprint mill should not be shut down, but that instead "non-essential" industries should be discontinued. Needless to say, the deputation did not elaborate on what industries it considered "nonessential" and why. We in the light-and-power business, until recently at least, have considered electricity to be indispensable. True, it is essential for the mass production of munitions, but for the household it is only a convenience. Further, the use of electric power for the display advertising of goods, the sale of which should be restricted, is a positive detriment to the war effort.

Essentiality is also a question of degree. A four-page newspaper might be deemed essential, but not so a forty-page one. Wheat and flour are just as essential for our war effort as shells, but we do not need all the 400,000,000 bushels that the Canadian prairie produces. When production facilities exceed essential needs, efficiency generally can be achieved best by maintaining capacity operation in enough plants to produce only the required amount of goods, allowing these plants an adequate supply of labour and materials, and by closing down plants which produce goods in excess of exact needs. This already has been done in several Canadian industries, such as sugar refining.

Essentiality is a word that cannot be qualified. Either a thing is essential or it is not; but one cannot say that one thing is more essential than another, that tanks are more essential than guns. Both are needed in definite proportions, although one may be needed in advance of the other. Already the Englishman has been forced to recognize this and has done away with priorities almost entirely. To obtain the requisite materials, however, a "certificate of essentiality" is required, and by this means non-essentials are cut off and war work is limited to what existing facilities and resources can produce efficiently.

We must always remember that there is a definite limit to what we can produce, and if we attempt to push our production too far we end by actually producing less. The law of supply and demand works as far as labour is concerned, and if the demand exceeds the supply the loafer comes into his own and efficiency drops. It is therefore imperative that we cut our suit according to our cloth and

concentrate our attention on the more effective use of our existing resources—men as well as materials.

The curbing of nonessential spending by companies and by governments insofar as it involves the use of man-power and of critical materials is just as important as in the case of the individual. Expenditures for extensions and replacements should be avoided wherever possible, and old equipment made to last. Accounting, sales, and other departments should be streamlined to eliminate all unnecessary posts, current maintenance should be deferred to the very limit. For example, a Canadian power company is adopting a bi-monthly accounting period. It should be recognized, however, that company policy regarding replacements and maintenance is something that from its very nature is beyond the control of the government and that to secure the full co-operation of the companies, it is indispensable that labour and materials for maintenance and replacements be made available as necessary on a high priority. Otherwise the far-sighted plant manager is likely to stock up with spare parts and keep his plant in a high state of repair for fear of getting caught with a prolonged shutdown because of material or labour shortage.

#### GOVERNMENTS CAN ECONOMIZE TOO

For years civil government has been absorbing a greater and greater proportion of workers, but we have now reached a point where we must revert to the simpler life of earlier days. Our various government agencies now provide innumerable services ostensibly for the benefit of the public that could be dispensed with until after the war. Every civil servant that can be diverted to war work is just so much clear gain even if his full former salary is continued. Public-utility commissioners, judges, and so forth, have the experience needed to administer the various war controls, and already in Canada the services of such men are being utilized in war jobs.

Throughout the country the construction of public works such as roads is rapidly being tapered off and before long we expect to see it cease altogether, as more and more of our political leaders are realizing that such work is carried out only at the expense of our war effort. A much more difficult problem arises in connection with works having a wartime justification such as housing projects. Here it is a case of relative importance. We must always remember that every house we build is at the expense of our production of guns and tanks, and we must decide which we need more. Obviously it is better to be somewhat overcrowded than to have our country overrun by the enemy. Too much overcrowding however results in discontent among workmen and a lowering of the war output per man. The danger is that local pressure groups will force the building of housing projects, when in the national interest the man-power and the materials are more urgently required for other purposes. Such pressure groups usually are led by well-meaning citizens who think they are doing a public service, but their activities should be recognized in their true light as one of the most effective forms of sabotage.

In such questions the short-term view must be taken. It is the current expenditure of material and man-power that counts. Whether it be a barracks, a munitions factory, or a housing project, the use of temporary instead of permanent construction is fully justified wherever any saving can be made in man-power or critical materials, as this will mean that many more ships and guns can be turned out currently, and they are needed *now*.

Our armed forces constitute the chief drain on our total man-power and therefore it is the efficiency with which they are employed that is the main factor in our war effort. The total *number* of men in the army means nothing. It is the number that can *strike* in a theatre of war and their fire-power that counts. It is not the number of tanks and airplanes, but their fighting qualities that count. Too often in democratic countries sectional pressure leads to forces being immobilized to guard against possible hit-and-run

raids and other military diversions. Also, shore establishment in dockyards may be built up, although repair work might be done with less use of man-power by shipbuilding contractors. More men may be used to guard munition plants than would be required to restore any damage likely to arise from sabotage if the plants were left unprotected. These are questions that should be dealt with by the General Staff, but it is the duty of every citizen to see that the General Staff in making these decisions is unhampered by the sinister activities of pressure groups.

#### IF WE ARE TO STOP LOSING THIS WAR—

If we are to stop losing the war, further industries and businesses will have to be shut down. In some instances these necessary changes involve disturbing implications. South Africa, for example, is almost entirely dependent upon the gold-mining industry, but that industry is not essential to the war effort of the United Nations. It is only by the drastic curtailment of nonessential industries that sufficient labour can be made available to relieve the acute shortage in war industries. The 40-hour week and the various conditions of labour which require the employment of three men where two would do, jurisdictional limitations which prevent a man from handling

more than one job—these, too, are contrary to the national interest in wartime when all must produce the utmost.

We in the power business have had to slip into reverse. It is no easy matter to overcome the training of years and start saving electricity so that it will be available in sufficient quantity for essential war industries. That is to say, we must forego sales that are our bread and butter to take on business that is financially unattractive. At least one power company in Canada is already replacing copper conductors with iron wire on lightly loaded primary circuits so as to make more of this scarce metal available for war purposes.

Beware of the individual who looks upon the war as a golden opportunity to introduce his pet social theory, such as prohibition which was foisted on the country in the last war. Thumbs down on those who by spreading racial, sectional, religious, or class prejudice, would divide and rule.

Promote, particularly among those in the lower income brackets, a better understanding of the reasons for war hardships. Provide the necessary incentive so all will work to the utmost. Save both as individuals and in one's official capacity so that man-power and material can be conserved for war work. This is the way to step up our wartime national efficiency.

## SALVAGE AND SUBSTITUTES

On October 17th, fifteen hundred production men attended a conference of munitions manufacturers. It was held in Toronto, and was called by the Production Coordinator of the Department of Munitions, H. J. Carmichael. The topic was how to produce to capacity. Waste must go. Materials, machinery and man-power must be made to go farther, by substitutions, redesigning, and new methods. The Minister, C. D. Howe, sent a special message to the gathering. The staff of his department had arranged an impressive show of examples where savings have already been made. The changes they illustrated have already led to savings amounting to over one hundred and fifty million dollars annually, and to the release of valuable machine tools, rubber, copper, tin, and labour. Canadian industry is required to continue and intensify this effort. What has already been accomplished, said Mr. Carmichael, only scratches the surface.

The exhibits showed the astonishing effect of changes in details or small parts. For example, redesign of the rear catch of the Bren machine gun magazine, formerly welded but now stamped, saves 198,000 pounds of copper coated welding rod, \$39,000 worth of oxygen and acetylene, saves 515,592 man-hours and releases ten milling machines and 24 welding positions at the cost of six new machines, resulting in an estimated annual saving of \$339,112. Hundreds of other instances could be named. The substitution of Canadian-made wood pulp for the imported cotton linters formerly used in nitrocellulose manufacture for explosives, increases our nitrocellulose manufacturing capacity and shows a net annual saving, including exchange, of two million dollars.

The exhibition was in fact, an extraordinary pooling of trade secrets and methods. Production men were not only asked to save critical materials, machines and man-hours, they were shown how it was being done and how it could be done. They were assured by officials of Army, Navy and Air Force Inspection Boards that although there would still be insistence on high quality the programme would have the full co-operation of their inspection authorities.

Not only were the production men asked to turn their own engineering staffs on to the problems of conservation by redesign, simplification and substitution, they were asked to seek out and welcome suggestions from all their workers.

"Suggestion box" systems which have been successful in some of the larger plants were described and recommended as sources of new ideas.

Canadian production of munitions and supplies will reach its peak early in 1943, at an estimated total of \$3,700,000,000 a year. In face of a programme that is taxing our raw material supplies, plant capacity and man-power to the



A corner of the exhibit at the munitions manufacturers conference in Toronto on October 17th.

utmost, the time has now come for intensive development of every possible resource, not only in material and machines, but in human ingenuity as well. The Carmichael conference was not twenty-four hours old before immediate results were becoming manifest. A change in production method, inspired by the conference, was announced by a large munitions plant. The change will permit reallocation of 300 workers to other tasks. Investigation of material replacement possibilities was under way in many plants. A major munitions project announced its intention to adopt the government-endorsed "suggestion box" scheme immediately. A company which had applied for a building project cancelled the request. Canadian wartime industry is buckling down to the stern job of making the most of what we've got.

# MAN-POWER CONTROL IN CANADA

At the recent joint meeting of The Engineering Institute of Canada and the American Society of Civil Engineers at Niagara Falls, Ont., an address on this subject was given by the general secretary of the Institute; his remarks form the basis of the following article. As our members know, Mr. Wright's services are lent to the government, and he is now assistant director of National Selective Service at Ottawa. The director of the Wartime Bureau of Technical Personnel, H. W. Lea, M.E.I.C., was present at the meeting and added to the information presented by Mr. Wright.

Few Canadians yet realize the wide scope and real importance of the operations of the National Selective Service organization, or the active part which the Institute and kindred societies took in the early stages of its development. Obviously there must be proper control and utilization of all our man-power if our war effort is to be a total one. Thus the means by which this vital need is being supplied must be of primary interest to every Canadian and especially to engineers, because the first steps taken dealt with the availability of technically trained men.

Late in 1938—before war began—the Department of National Defence asked the three national technical institutes (the Canadian Institute of Chemistry, the Canadian Institute of Mining and Metallurgy, and The Engineering Institute of Canada), to circularize their membership in order to establish a roster of technical personnel giving the information necessary for the utilization of such persons in time of war. This is believed to have been Canada's first effort to survey any part of the man-power field for war purposes. The request was encouraging for it accepted the principle that members of a specialized group are the people best qualified to deal with that group.

A committee made up of the secretaries of the three institutes was established to carry out the work. Recognizing the national importance of such a registration, the committee recommended that registration should go beyond the membership of the three institutes, and include the provincial associations of professional engineers, and certain other organizations whose membership could be classified as technical.

A questionnaire devised and supplied by the Department of National Defence was circulated to a consolidated mailing list. From the completed forms the information was transferred to cards upon which the skills and competencies of each person were noted in the form of a coded index.

About this time Ottawa was being flooded by offers of citizens to serve in almost every or any capacity. To handle this there was set up by the Government an office known as the Voluntary Service Registration Bureau. Eventually all the records of the original questionnaire were transferred to that office thus installing the technical section of the Bureau. The valiant efforts of its small staff, however, could not cope with such a huge task, and as time went on the usefulness of the records became increasingly limited.

Late in 1940 the three institutes were approached again, this time by the Department of Labour. By now the war had progressed sufficiently that the shortage of technical personnel was apparent, and it became more than ever urgent that something be done about it.

The Department of Labour proposed that the three institutes should combine to take over the whole problem and work out their own solutions. The acceptance of this proposal in February 1941 resulted in the establishment by order-in-council of the Wartime Bureau of Technical Personnel. The three institutes recommended to the Minister the appointment of Elliott M. Little to the post of director of the Bureau, and late in February the Bureau opened its office in Ottawa.

The direction of the enterprise was left entirely in the hands of the voluntary bodies, while the costs were met by the Federal Government. It is pleasant to know that the

Government's confidence in this technical group has not been misplaced. The results of the work of the bureau are indeed gratifying.

In view of the desire to have the bureau act for the entire professional group, an advisory board was established, upon which representation was given to the three institutes, the universities, the professional associations and employers as represented by the Canadian Manufacturers' Association. Thanks are due for the assistance given in preliminary investigations by American friends, particularly the National Roster of Scientific and Technical Personnel in Washington and the employment office of the Founder Societies in New York.

The Bureau's record system has been kept very simple. The complete story of each person is kept on a large questionnaire filed alphabetically with smaller cards filed under classification code numbers to indicate competencies. In this way any person can be found by name and any type of person can be found under the classification code number.

After approximately one year of operation a very helpful order-in-council was passed. The principle features of Order-in-Council 638 are:

(a) That no technical person as described in the order can take a new position without having a permit from the Bureau.

(b) No employer can take into his employ any technical person without a permit.

(c) Every employer will have to maintain the seniority of any employee who leaves his services for more essential work at the request of the Bureau and reinstate him at the conclusion of that work.

The total number of registered persons is about 25,000 which is probably 80 per cent of all the technical personnel in Canada. The Bureau is now issuing about 400 permits a month.

The Bureau is also concerned with the availability of students following technical courses at the universities, and has been influential in the establishment of a control system which provides for the postponement of their call-up for compulsory military service during their college courses, provided that they enroll in the C.O.T.C. or some other unit. Students who fail to pass university examinations, however, may be called up immediately. Post graduate study is only permitted if it is considered to be in the national interest or in aid of the prosecution of the war. Permission is refused for a student to change his course. These and other requirements are covered by Order-in-Council 8343.

During the first two years of the war it became increasingly evident that peace time methods of obtaining workers and supervisory personnel were quite inadequate to fill the needs of our rapidly expanding wartime industries. Difficulties, interferences, and confusion developed in existing industries. The establishment of new plants and the growth of old ones led to shortage of men and excessive labour turn over. It became evident that a very extensive general scheme of man-power control must be put in force. The work of the Wartime Bureau of Technical Personnel was in fact an essential part, but only a part, of the task of man-power control, and it was no doubt a recognition of this fact which led to the selection of Elliott Little, the director of the Bureau, to direct the new and larger organization now found to be necessary.

Accordingly, legislation was passed putting in force, some six months ago, a comprehensive system of man-power control under the name of National Selective Service. Its original form was modified by certain changes made as recently as September 1st, when its scope and the powers of the board were extended, so as to make a reasonable amount of control eventually possible. It is realized that many

difficulties are ahead, however, and that it will take time to surmount them.

The following notes will help to indicate the principles on which National Selective Service is now working:

As part of the Selective Service authority, the Minister of Labour has power to call for the compulsory registration of any groups of people in Canada. This is being done and from these special registrations there is being built up a man-power inventory of everyone in the Dominion.

The field organization is using the existing local offices of the Unemployment Insurance Commission, some two hundred in number, and additional offices will be opened where needed.

The outstanding features of the Selective Service legislation are briefly as follows:

A schedule of priorities of industries has been established to be used as a guide by the employment offices in placing men.

With a few exceptions no person may leave his employment without giving at least seven days notice, and no employer may lay off or dismiss a worker without giving him seven days notice. The purpose of these important provisions is to stabilize the movement of labour. With a scarcity in every industry it was not reasonable to permit workers to wander from place to place as they saw fit without regard to the amount of time lost nor was it reasonable to permit employers to dismiss men without giving them some notice whereby they might arrange for their next employment.

As Selective Service is now responsible for the placement of all workers it is absolutely necessary that some advance notice be given of the requirements of employers and of all dismissals so that some planning can be done in advance. The notice also provides a cooling-off time for both employer and the employee in which a decision not to be separated might be made.

No employer may take into employment or discuss employment with any worker who does not carry with him a permit issued by a Selective Service officer whereby he is permitted to be interviewed and to be employed. These permits are obtained when the seven days notice of separation is brought to the Selective Service officer.

The permit is usually limited to the area in which the office functions, that is, a worker may not move back and forward across the country unless he has a permit authorizing him to do so. A great deal of the travelling done by

labour was induced by employers themselves who were constantly making their needs known in other parts of the country.

The permit may also limit the work to a single establishment or to a single industry or to a single occupation. In this way, absolute control is given over the direction of all unemployed labour.

A disturbing factor in the labour market has been a multiplicity of "help wanted" advertisements appearing in the daily papers. The new legislation now prohibits advertising unless the advertisement is approved by a Selective Service officer.

Any person who has been out of work for seven days may be placed in employment by an officer and he may not leave this employment without the permission of the same officer.

Any person who has been only partially employed for a period of fourteen days may be moved to other work of a high essentiality where he may work full time.

Provision has been made for certain supplementary allowances to compensate workers when they are transferred by a Selective Service officer. These allowances include travelling compensation and compensation when the earnings on the new position are less than those of the position from which he was transferred. Advances can also be made at the commencement of new employment to help a worker until his first pay is received.

Severe penalties are provided for infraction, fines up to \$500 may be assessed and imprisonment up to twelve months with hard labour or both fine and imprisonment.

This, in essence, covers the labour controls now in force in Canada. Some weaknesses have been found in the legislation but they are not serious and, on the whole, it is believed excellent results can be obtained from the present regulations.

It is evident that during a brief transition period there will be some confusion and even misunderstanding, but eventually the controls will work smoothly as their necessity becomes understood. Many employers have already reported greatly improved conditions, although there has not yet been time for the system to function to its full extent.

With the support of the public the job can be done. Engineers form an influential section of that public, and their assistance will be specially helpful.

---

## BROTHERS OF THE BRIDGE

A. L. CARRUTHERS, M.E.I.C.

*Bridge Engineer, Provincial Department of Public Works, Victoria, B.C.*

**From an address presented to the Victoria Branch of the Engineering Institute of Canada,  
on January 19, 1940**

*Abstracted by R. C. PURSER, M.E.I.C.*

When the Dark Ages descended upon Europe after the fall of the Roman Empire, progress in the arts and sciences received a shock that made its impress felt for a thousand years. Law and order were disrupted, trade and commerce almost ceased, and fear and suspicion prevailed everywhere. Barbarism terrorized the population for many years.

Included in the general disintegration was the art and science of transportation, developed by the Romans to a high point in their many conquests. Roads and bridges, so necessary to them in the subjugation of outlying countries, became a danger to those countries now that the imperial power had become dissipated. Such facilities were an invitation to the invader to loot, rob, pillage and destroy. For this reason they were largely neglected and sometimes even done away with, a course of action that was concurred in by the Church, which maintained that rivers, gorges and mountains were made by Providence to keep peoples apart.

The consequences to trade and to the whole political, social and commercial structure of Europe were tremendous.

After the first period of utter chaos was over, a system of society distinctive to the age was slowly evolved. Human beings, like every other animate creature, must eat to live. So back to mother earth they were forced. In time as they gradually attained a measure of abundance they felt the necessity of defending themselves and their possessions and of building up some semblance of law and order. Out of this necessity, through long centuries of darkness, they groped their way toward and into the feudal system, an economic, political and social system based simply and only upon fixed property—land and buildings.

It would take too much space here to trace the complete development of this system in western Europe throughout the mediaeval period, to describe its amazing virility and the reasons why some vestiges of it still persist in such a

democratic, highly industrialized country as England is to-day. Although it was a good system for the times, in that by fixing society to the soil it brought barbarism to a halt, it had many limitations, not the least of which was the fact that it steadily resisted the free movement of trade. For this reason feudalism saw no necessity for the extensive development of transportation facilities, and was disinclined toward any outstanding contribution that would tend to break down the generally held notion that geographic barriers were meant to keep people apart. But it could not stifle such development entirely.

An important feature of the times was the place of monasticism in social life. All monasteries were not started initially as religious institutions—they existed long before the Christian era—but those organized and supported by the Church naturally emphasized the religious side of life. To a large extent they were established and maintained by men who craved to be emancipated from the ennui that was eating their hearts out, those who found themselves unemployed, frustrated, disillusioned and generally “fed up.” There are records to show that they were, at times, started simply as unemployment camps to which flocked thousands of people from every class of society, simply to find an escape or asylum for themselves. Their ranks included the lazy, the active, intelligent, illiterate and educated, the saint, the sinner, the serf, freeman and knight, and even feudal lords.

The monasteries were feudal. The abbots of the monastery were feudal lords. Their overlord and source of property rights might be a baron, a prince or king, a bishop, or as evolved in later years the Pope at Rome. Fees or dues were paid in produce or later on in money, or both. To maintain their own health and sanity in these institutions the monks toiled and also impressed upon their members the duty and dignity of worthwhile work. They turned to practical pursuits, to studies, art, science, literature, farming and what is of interest to the modern engineer, in the course of time some of them turned to bridge building.

Among the privileges bestowed upon the monks by their feudal lords was that of collecting tolls on roads, bridges and ferries. These tolls they turned into the monastic treasury and from them the monks received their subsistence. This was in recognition of their commendable service in establishing hostels for the care and protection of transients and travellers. But it was a poor subsistence as trade and travel in those days was not extensive.

In time the monks established for themselves an enviable reputation. Their humble services were greatly appreciated all over Europe, and even barbarous tribes while making their raids seldom disturbed them. This esteem became fixed in codes of behaviour and law, and turned out to be a very important factor in their success.

As travel became more general the monks were requested to take on the maintenance of highways and collect dues therefor. More and more responsibility was assumed. Their overlords thought enough of their efforts to help in the good work. In the meantime more settled conditions obtained and their thoughts turned to replacing bridges that had been destroyed and to substituting bridges for ferries.

As a guide they had the remains of old Roman bridges, and there is evidence to show that they were quite familiar with the bridge work in Italy. They started to study and to draw plans. As most of their buildings were of brick and stone, good masons were available; and as some monastic estates were hewn out of the dense forests they had men trained in timber work.

At first their attempts were rather feeble and were much opposed by the religious prejudices against bridging gulfs of separation established by Providence. Other forces rendered their efforts difficult if not futile. Ultimately in 1154 so as more effectually to carry on, the bridge builders among the Benedictines, an important order in southern France to which they belonged, separated therefrom and organized at Maupas as *Fratres Pontifices*—a bridge-building brotherhood. Their leader was Bénézet, a monk of great courage,

marvellous personality and with a constructive mind that refused to be trammelled by the deadening absolutism of philosophic thought of the day.

Apparently the Brothers of the Bridge were loosely organized for the reason that they held little land and were dependent for funds upon the barons, bishops and overlords who were sufficiently concerned with improved facilities. They were students, workers and organizers, and inspired confidence and respect. The old tradition of “hands off” stood them in good stead. From place to place and country to country they sent their missionaries, establishing branches of the order wherever they found intelligent, enterprising and progressive groups who were willing to plan and work. Thriving municipalities sent for them to assist in designing and supervising their bridges.

In their organization, built up somewhat the same as other feudal orders, the abbot was Pontifex Maximus. One of these attained the position and dignity of Pope and ever since then one of the highest titles conferred upon His Holiness is that of Pontifex Maximus. Legend connects this with the Pope's power to bridge the gulf between earth and heaven, a natural deduction as priests in quite early times supervised bridge building and were always required to officiate at dedications.

One of their finest structures was that over the Rhône at St-Esprit, completed in 1309 A.D., and consisting of 26 stone arches, 86-foot to 114-foot spans, roadway 18 feet wide and a total length of 2,700 feet. For years it was the longest masonry bridge in existence. At Lyons, La Rochelle, Villeneuve and Saintes there were similar structures. But a complete list would be too lengthy here. We shall mention only two of them in detail.

One of the earlier bridges, constructed under the direction of Bénézet himself shortly after the formation of this order, was that over the Rhône at Avignon. It was a magnificent structure for the times consisting of 22 stone masonry arches on stone piers, a roadway 13 feet wide and at a level 46 feet above high water. A chapel to St-Nicholas, the guardian saint of river travellers, was built on the main central pier.

Legend has it that Bénézet came to the Rhône at Avignon in 1177 in response to divine command, spent his last farthing to be ferried across the river and then, according to an account in “*Mediaeval Towns*”:

“Bénézet entered the city and sought the bishop who was preaching to the people in the abbey and said, ‘Stay, an angel hath sent me to build a bridge over the Rhône.’ The bishop holding him a mocker threatened to lead him to the provost to be chastised and his feet and hands cut off as a vile knave. ‘But, I have been sent by a divine message to build the bridge,’ stated Bénézet. ‘Thou base varlet that hast naught,’ returned the bishop, ‘and yet pratest of building a bridge, when neither St-Peter, nor St-Paul, nor great Charles the Emperor hath been able to build it. But I will give thee a stone at my palace and if thou canst carry it away, I will believe thee.’

“So Bénézet, the bishop and a great crowd went to the palace. And Bénézet carried a stone that thirty men could not move as easily as if it were a pebble and laid it down for the foundation of the bridge. Then thanks were given and they all cast down all the pieces of silver they had for the bridge; and so the great bridge was begun.”

Thus the legend goes that is associated with the commencement of this bridge. Historical records, however, state that Bénézet was already prior of the Brothers of the Bridge at Maupas, where the order was first established, and they had been planning for years for such a project.

On completion of this bridge Bénézet was made a saint and the Friars Pontiff had privileges lavished upon them. Barons, bishops, kings and popes granted indulgences to those who contributed funds or labour to build and maintain bridges under their supervision. Bénézet established branches of the order at Avignon as well as at other important centres in France.

In those days quite a number of bridges were built by religious orders in England, but whether any of these orders were connected with the Brothers of the Bridge is not clear. The first bridge over the Thames was a timber trestle built in the tenth century by a religious order founded by the ferryman's daughter for the purpose. It was later destroyed by fire, rebuilt, and burned down again.

The celebrated Old London Bridge was started in 1176 by Peter of Colechurch, a Friar Pontiff. He laboured at it faithfully for years but died in 1205 before its completion and was buried in a crypt in the chapel. King John had been so impressed by the work of the Brothers in France that he sent for Isambert, a celebrated builder of the time. Isambert completed the bridge in 1209. Afterwards buildings were erected on top of the piers, along and over the roadway and sidewalks, some of them extending away out over the structure.

There were 20 arches in all, a single draw span and two defence towers. The piers were founded on piles with timber grillage. The total length was 940 feet.

Soon everything pertaining to the life of Old London centred around London Bridge. Meetings, riots, celebrations, executions, duels, courting, begging, suicides, murders, robbing, stargazing and shopping were accommodated by the old structure to such an extent that it is amazing how room was left for traffic.

From the time it was finished until it was removed six hundred years later it continued to fall down in parts. "London Bridge is Falling Down," the celebrated song and game sung and played all over the English-speaking world, had its origin in this circumstance. Every line of it has a historical significance.

Serious foundation defects developed in 1770. A Frenchman, Labele, the inventor of the modern caisson, was called in. He could have done something about foundations for a new pier, but for one already built, not at all. Smeaton, of lighthouse fame, was called in and deposited large blocks of stone riprap all around and saved it.

On several occasions houses split in two and toppled over into the river. Boats fouled the piers and sank. Five more or less disastrous fires occurred. During one of these, 3,000 people were burned to death or drowned. Finally the buildings and therefore the fire hazard were removed and it looked then as if the old veteran would last forever. It stood until 1830 when it was replaced by the present really fine stone arch structure built by the Rennies.

So with the few records available and a knowledge of the times in which they lived and worked, the remains of structures still existing, and a little imagination, we can arrive at a fair estimate of the work of these faithful Brothers. They started out in southern France by rendering a small but commendable service to harried travellers. They established themselves in the confidence and good will of all peoples. They recognized the dire need, they studied, planned, ventured, worked and accomplished great things in themselves, but what is quite as important, they revived and perpetuated and to some extent improved an art that would otherwise have languished.

Others, especially the Italians, did carry on notable bridge construction throughout the mediaeval period; but undoubtedly, the work of the Friars Pontiff and their lay brothers in France where their finest bridges were built had much to do with the rapid advance in bridge construction during and after the Renaissance.

## Abstracts of Current Literature

### TIMBER BRIDGE FLOATED DOWN TO DISMANTLING POINT

*From National Lumber Manufacturers Association, Washington, D.C.*

Floating a full-sized timber bridge down a river it once had spanned was a unique feat of engineering performed on the Kettle River in Washington when the waters began to pour into the 150-mile-wide reservoir of the new Grand Coulee Dam.

Back from the dam, 112 miles, the Great Northern Rail-

### Abstracts of articles appearing in the current technical periodicals

wasteful not to recover them in the process of removal.

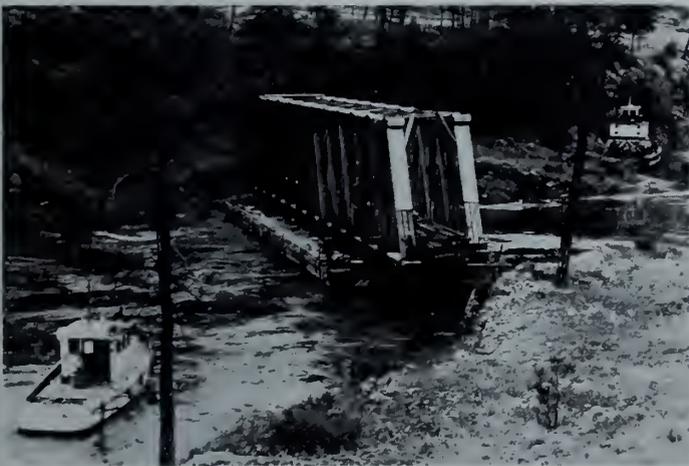
Rather than transport derrick and piling 150 miles overland to this remote spot, engineers decided, instead of dismantling the bridge at the site, to try an innovation. They would drop the two spans of the bridge down onto huge barges and float them down the river, then down the Columbia to the dam where they could be dismantled more economically and their timbers salvaged for further service.

But a difficulty was involved in this neat plan: the furious little river was not wide enough. However, as the reservoir waters would rise, they would back into the Kettle channel and widen it.

A delicate problem of timing then came into play. The water level in the Kettle gorge had to rise but not *too* high. A new bridge to carry the relocated tracks had been made ready a quarter-of-a-mile downstream and there was none too much clearance beneath it to allow for passage of the barge-borne timber spans. The operation, therefore, had to be calculated closely against the rate-of-rise of the water—and, once begun, completed in a hurry.

It took two days to bring the barges and the necessary tugboats from the dam, up the two rivers to the site of the bridge. The Kettle by now was widened and quieted by the waters which were steadily backing into it. In one day, a crew of 14 men freed the bridge from its moorings and swung it down on the waiting barges. In another two days, it was at the dam and; in four days more, it was dismantled. Its still-serviceable timbers were valued at \$15 per 1,000 board feet.

As a matter of engineering interest, the bridge consisted of two Howe-truss all-timber spans, one 68 ft. long, weighing 90 tons, and the other, 151 ft. long, weighing 210 tons. Its deck elevation was 1,288 ft. and it contained 100,000 board feet of lumber.



road had a 26-mile branch-line between Spokane and Republic. Where the tracks crossed the narrow and turbulent Kettle as it raced toward the Columbia, there was a timber bridge that had been doing duty since 1902.

Since the rising waters of the vast reservoir would inundate both tracks and bridge to a depth of two feet, the branch-line had to be moved. The bridge timbers were still sound, had good salvage value, and it would be

From *The Engineer* (LONDON), SEPT. 4, 1942

Reference has already been made in our columns to the formation of a new corps called the Royal Electrical and Mechanical Engineers. It is now announced that this new corps was formally inaugurated on October 1st. During the past week the War Office arranged a press visit to the new R.E.M.E. headquarters, with its workshops and training centres, to show the results of the reorganization which has been going on during the past few months. In the main the R.E.M.E. includes all the engineering side of the R.A.O.C. and the maintenance staff of the R.A.S.C., along with a portion of the mechanical maintenance staff of the Royal Engineers. Major-General E. B. Roweroft, a former officer of the R.A.S.C., has been appointed Director of Mechanical Maintenance. At the headquarters, officers and artificers are rapidly being trained in specialised courses, the former according to their engineering qualifications and the latter according to their different trades. The courses so far arranged include the repair and recovery of armoured fighting vehicles, mechanical transport repair and recovery, and armament inspection, along with a course for R.E.M.E. staff appointments in the field. Other important courses include, those in electrical work, in armour plate welding and general welding, along with a special course in compression-ignition engines. At separate establishments other courses are given in field artillery equipment, anti-aircraft artillery equipment, radio and wireless equipment, and fire control instruments. In all these courses intensive training is given under conditions which correspond as closely as possible to actual field work. This work, which includes rigorous infantry training, covers a very wide range. It includes that of light detachments for the front line of battle, mobile brigade workshops, and work at the base depôts and home bases, right up to the factories themselves. The repair and maintenance work of the R.E.M.E. embraces tanks, guns, motor-cycles, searchlights, binoculars, typewriters, and wrist watches. All tradesmen in the ranks will be given the new title of "craftsman." The new badge of the Royal Electrical and Mechanical Engineers is officially described as "a laurel wreath surmounted by a crown, four shields on the wreath bearing the letters R.E.M.E., and within the wreath a pair of calipers," these having been chosen as an indication of the accuracy which is demanded by the work of the new corps. We understand that the new motto for the R.E.M.E. will be chosen when the corps has started on its career.

### GROWTH OF MODERN TYPES OF SOVIET LOCOMOTIVES

From *Trade & Engineering* (LONDON), SEPTEMBER, 1942

Thirty-five years ago well over 50 per cent of all the steam locomotives in Russia were fired by oil, but the proportion now probably does not exceed ten per cent, for while the oil production of the U.S.S.R. has increased since the pre-1914 era the requirements of industry, aviation, agriculture, and the army have gone up to such an extent that railway needs have come to be regarded as of secondary importance in view of the new coalfields exploited. For the same reason the large-scale construction of Diesel locomotives inaugurated ten to twelve years ago has been stopped.

This change in fuel probably forms the greatest fundamental difference between Tsarist and Soviet locomotives. It is true that the number, power, and size have increased enormously, but that is merely the normal progress to be expected in any country. Another feature is the use of condensing tenders in arid districts. According to some reports over 1,000 of such equipments are in service, but possibly this figure should be regarded with reserve.

Some years after the last war, efforts were made to standardize a freight locomotive of the 0-10-0 type, and a few thousands were built in Germany, Sweden, and the U.S.S.R. They were designed specifically to suit as many lines as possible, and therefore the axle-load was severely restricted. They were the most powerful engines for freight traffic until 1931-32, when several heavy American-built locomotives of great capacity, with the 2-10-2 and 2-10-4 wheel arrangements, were set to work on routes—particularly in the Donbass—where track and bridges had been strengthened appreciably. A little later, a 4-8-2+2-8-4 Beyer-Garratt, the largest locomotive ever exported from England, was obtained, and about 1934 two 4-14-4 locomotives, weighing 300 tons with tender, were completed at Lugansk ostensibly for working 3,000-ton mineral trains over the then new Moscow-Donbass direct line. At the same time designs were prepared for standard freight and standard passenger engines for heavy work, to take advantage of the bridge strengthening and track relaying which were being carried out as part of the second Five-year Plan. The freight engine—a 2-10-2—was modelled largely on the United States engines of the same type delivered in 1931, and the passenger engine—a 2-8-4—had boilers and cylinders similar to those of the freight class.

The now very numerous 2-10-2 engines of the standard FD (Felix Dzerjinsky) class have two 26½ in. by 30¼ in. cylinders and 59 in. coupled wheels; their boiler pressure is 213 lb. per sq. in. and the evaporative heating surface 3,177 sq. ft. They have slab frames, wide fire-boxes with Belpaire tops, multi-element E-type superheaters, feed-water heaters, mechanical stokers, and boosters. It is believed that engines of this type work most of the mineral traffic on the Donbass, Donbass-Moscow, Kussbass-Ural, and other main lines, hauling trains up to 3,000 tons in weight and composed of 40-50-ton bogie cars.

Comprehensive tests with locomotives of this class, equipped with a plain circular blast nozzle, showed that at an hourly firing rate of about 120 lb. per sq. ft. of grate area the evaporation was equivalent to 13.5 lb. of steam per sq. ft. of evaporating heating surface, and that a tractive effort of 43,800 lb. could be maintained up to 17-18 m.p.h.: at 35-37 m.p.h. the tractive effort at the wheel rims was 25,000-24,000 lb. The minimum steam consumption was equivalent to 17.4 lb. per rail h.p. hour.

### STANDARD PASSENGER CLASS

To supersede old 4-6-2 and unsuccessful three-cylinder 4-8-0 engines the U.S.S.R. Commissariat of Transport in 1933 began to develop the JS (Josef Stalin) class of two-cylinder 2-8-4 express and heavy passenger locomotives, and these, with various detail modifications made in the last seven or eight years, work the principal passenger trains on the Moscow-Leningrad route and the other main lines radiating from Moscow. Streamlining has been applied to one or two of the class.

In these locomotives the 26½ in. by 30¼ in. cylinders drive 73 in. wheels, but the boiler proportions, rather limited maximum cut-off, and equipment are the same as those of the FD class; the differences are in the chassis—frame, wheels, trucks, boxes, and suspension. Theoretically, the boiler should have the same evaporative capacity, but in some of the long line tests conducted the plain circular blast nozzle used in the FD type was superseded by a special nozzle with separate exhausts from right and left hand cylinders, and having four circular openings with an aggregate area 32 per cent greater than that of the FD nozzle. This was largely responsible for increasing the evaporation by 16-17 per cent to about 15¾ lb. of steam per sq. ft. of evaporative heating surface. Other results of the improved draught arrangements are the reduced back pressure and consequent increased horse-power, and the reduction in steam consumption to a minimum of 15½ lb. per rail h.p. hour.

## DEVELOPMENT OF IMPACT-RESISTANT WINDSHIELDS

From *S.A.E. Journal* (NEW YORK), July 1942

At this time when the nation's air transportation system is important to the war effort, the maintenance of safe and reliable operation assumes added significance. Accordingly, the conduct of technical development looking to the minimization of causes of accidents not only is necessary as a safety measure but has become a defence urgency.

One of the most serious potential hazards to air-carrier operation involves the existing lack of means for adequately protecting windshields against collision with birds during flight. Such collisions usually result in the immediate and total decease of the birds. Unfortunately, however, they also can result in the destruction of the airplanes involved and in the death of their occupants.

Impact forces in such collisions are enormous. Even small birds such as ducks not only have penetrated the windshield, but one in particular continued through the bulkhead, travelled the length of the cabin, penetrated the rear cabin wall, and lodged finally in the baggage compartment. Fortunately in this case neither the passengers nor the crew were struck.

The possible destruction and loss of life resulting from such a collision with a duck is unpleasant to contemplate. However, the force of such an impact is multiplied several times when an airplane disputes the right of way with a swan. This has occurred. In fact the collision in question involved five swans. The pilot of that airplane reported as follows:

"Time 12.17 a.m.—Climbing at 8,000 feet—Air speed 150 m.p.h.—Hit flock of swans—One swan penetrated leading edge, left wing—Second swan almost tore off left vertical stabilizer—Rudders jammed—Third swan struck and dented engine cowl—Later, two swans went through propeller—Portion of swan taken from wing after landing, weighed 11½ lb."

NOTE: Wild swans weigh as much as 20 lb.

Accidents involving bird collision have become alarmingly numerous. A partial record, obtained by M. Gould Beard of American Airlines, includes 61 such collisions since 1939, two-thirds of which occurred at night and more than one-third of which resulted in the penetration and shattering of the windshield.

The development of means to protect aircraft windshields from such collisions appears to the Technical development Division of the Civil Aeronautics Administration to be a "must" project. This urgency further has been emphasized by numerous requests from the industry and from other bodies within the Administration that such development be undertaken. This now is in process.

The prospect of stopping a 20 lb. swan at a relative approaching velocity of 270 m.p.h. at first was somewhat disheartening, particularly since de-icing means and protection against visual and acoustical shock due to lightning necessarily are involved in any windshield development problem. Continued studies and investigations, however, have indicated that there is considerable promise of providing a large degree of protection, and that such protection need not involve excessive weight or complication.

Thus among other possibilities, the use of a retractable metal screen or similar arrangement was considered, although the mechanical difficulties involved made its practical realization somewhat doubtful. Recently, however, developments of transparent glass-plastic combinations have resulted in windshield panels of reasonable thickness that have proved highly resistant to impact, as indicated by numerous pressure and impact tests and by computations based upon those tests.

Those pressure and impact tests were carried out by the manufacturer of the glass-plastic panels, by Dr. F. W. Adams of the Mellon Institute of Industrial Research, by Dr. G. M. Klein of the National Bureau of Standards, and

by personnel of the Civil Aeronautics Administration. Pressure tests of the glass-plastic windshield panels indicate that static pressures of at least 35 lb. per sq. in. can be withstood by a 14 x 28 in. panel ⅝ in. thick, and that the panel will undergo large deflections of several inches magnitude before the plastic layer will rupture. Dr. Klein's tests on the recently developed glass-plastic windshield panels further indicate that at normal temperature those panels are far more resistant to penetration by a falling dart than is the conventional type of windshield.

The tests carried out by Dr. Adams to determine qualitatively the effect of variations in the consistency of a projectile striking a glass panel revealed secondary effects caused by the velocity of the projectile, and the effect of variations in angle of incidence during collision. It was indicated that a semi-liquid projectile, such as a bird carcass, has considerably less penetrating power than a tough rubber-like projectile, that at high velocities this effect becomes even more pronounced, and that the resistance of a windshield at 45 deg. incidence to the path of a projectile is much greater compared to resistance at normal impact than would be expected from geometric theory.

### RESULTS OF EARLY TESTS

A further series of tests was made by the Civil Aeronautics Administration in which a compressed-air gun with a 3½ in. diameter barrel and operated at 200 lb. per sq. in. pressure was utilized to project freshly killed chickens against a backstop. It was learned from such tests that the chicken carcass would be completely flattened and shredded by a 200 ft. per sec. impact, although still hanging together in one mass, and would cover an area of approximately 100 sq. in. on the backstop. It further was indicated by those tests that it is practical to utilize a freshly killed bird carcass for test purposes.

The degree of protection provided either by a retracting shield arrangement or by improved windshield materials appears doubtful until tests which simulate actual flight conditions can be conducted. The Technical Development Division, therefore, has considered that as a prerequisite to obtaining adequate windshield protection, it is essential that a satisfactory testing method be developed: for obtaining fundamental design data; for evaluating the degree of protection afforded by presently existing windshield materials; to provide a basis for indicating when adequate protection finally is obtained; and for determining the resistance of other portions of aircraft structures against such impacts. It has appeared evident in such connection that the testing method should utilize a catapult to project a simulated or actual bird carcass against the test structure at a velocity equal to the velocity at which the bird and airplane approach each other under flight conditions. It furthermore has been indicated through considerable investigation that the most practical type of test catapult is a compressed-air gun.

In order to obtain preliminary data for the design of such a gun and further to determine the practicability of its use as described before, a series of tests was made with a small gun available at the National Bureau of Standards from which freshly killed chickens were shot. As previously mentioned, it was concluded from those tests that a bird carcass can be propelled from such a gun without appreciable damage to its body and that the complete flattening and spreading which occurs upon impact would be difficult or impossible to simulate with anything but an actual bird carcass.

### LARGER GUN BEING DEVELOPED

As a result of those experiments it is considered desirable to attempt the development of a larger air gun which would be capable of projecting 16 lb. of de-winged swan carcass at a velocity of 270 m.p.h. Accordingly, arrangements are being made by the Civil Aeronautics Administration to negotiate a contract with the Westinghouse Electric and Mfg. Co., to provide a complete test setup at its East

Pittsburgh plant. This set-up will include a compressed-air gun using either of two 20 ft. barrels of 5 in. and 10 in. diameters, means for mounting the forward cabin or other portion of airplanes in front of the gun, and means for measuring the velocity of the bird carcasses as they are projected. In addition, it is planned to obtain high-speed motion pictures during the tests and to install strain gages and accelerometer pick-ups at various points on the structure in order to obtain impact forces, stresses, and other data on the windshields and supporting structures.

In addition to its use by the Civil Aeronautics Administration, it is planned to make the test set-up available to other designated organizations so that windshields, windshield protecting devices, or other portions of airplanes may be tested from time to time as may prove desirable. However, since a number of recently developed windshield panels now are available, it is felt that the first series of tests should involve the forward cabin portion of an air-carrier type airplane with various panels installed.

Attempts now are being made to obtain such a structure. The Pittsburgh Plate Glass Co., and the Libby-Owens Ford Glass Co., have indicated their desire to submit test panels. F. C. Lincoln of the Division of Wild Life Research of the Department of the Interior has been most helpful in supplying information concerning the weights and proportions of migrating birds and is aiding in our efforts to obtain bird carcasses for testing purposes. It is hoped that members of the industry and interested Government agencies will participate in this programme in every way possible.

*Excerpts from the paper of the same title by A. L. Morse, Civil Aeronautics Administration, presented at the National Aeronautic Meeting of the Society, New York, N.Y., March 12, 1942.*

## THERMIT AS USED IN INCENDIARY BOMBS

From *Chemical & Metallurgical Engineering* (NEW YORK), July 1942

It was a German, Goldschmidt, who, while he was attempting to reduce chromium and manganese, discovered how to ignite thermit safely. His countrymen later applied this knowledge of aluminothermics to the design of a magnesium-thermit incendiary bomb during the closing months of the first World War. Ludendorff, in his memoirs, reports that a number of incendiaries of this type were ready for use in 1918, but that the German High Command, knowing the conflict was nearing its end, did not order their use, fearing that thereby more severe peace terms might be imposed upon the German nation.

The modern magnesium-thermit incendiary used by Axis bombers on British and European cities has been described many times. The most common size weighs one kilogram or 2.2 pounds. It consists of a tube of magnesium alloy filled with a firmly packed thermit mixture, and fitted with tail-fins and a firing mechanism. Since it was manufactured by the Griesheim-Elektron company, it sometimes is known as the Elektron bomb.

The bomb ignites on impact, a pin being driven into a firing cap that sets fire to a starting charge which in turn ignites the thermit. The temperature of the thermit reaction is more than sufficient to ignite the magnesium alloy tube which constitutes the body of the bomb. The high temperature generated by the thermit reaction within the tube builds up considerable pressure so that bits of molten metal, flame, and smoke are forced out of the vent holes. But this reaction continues only for about three minutes, and thereafter the magnesium burns with less vigor at a temperature of about 2,300 deg. F. for fifteen minutes or more if undisturbed. A certain number of the bombs, called "discouragers," contain a light explosive charge that will go off during the thermit reaction.

Burning magnesium's ability to extract oxygen even from water is turned to advantage in disposing of bombs of this type. A spray of water directed on the bomb speeds up the rate of combustion so that the bomb will be consumed

in about two minutes. If a solid stream of water is applied to the bomb, however, it will cause such an ebullient action as to spread the fire.

Thermit is used also in the petroleum type of incendiary to provide ignition. Inexpensive grades of oil with high flash points can thus be used. To prevent the petroleum from being scattered on impact, it is mixed with soap to form a wax-like solid. Metallic sodium or potassium may be mixed with the petroleum when attacks are made on water-front objectives, because the vigorous reaction of these solids with water will ignite the oil. Petroleum bombs are generally of large size. Some of those dropped on London produced pillars of fire rising 30 feet in the air and 12 feet in diameter.

Thermit alone, in a steel bomb case fitted with tail fins and a firing mechanism, is reported to be a type of incendiary used by Japan. These are said to weigh 15 and 50 kilograms, and would have considerable penetration power. This type of bomb also ignites on impact and may contain an explosive charge. The thermit reaction, which transforms the metallic oxide and all the steel parts of the bomb into molten metal, is completed in about 30 seconds, and it is the great heat of this metal that carries the threat of fire.

The Chemical Warfare Service recommends, if there is a chance to minimize the incendiary effect of the molten metal, that a spray of water be directed onto it to cool it as quickly as possible below the ignition temperature of the combustible material with which it comes into contact.

There is a demonstration of the thermit reaction often made of late in training classes for civilian defence workers. A small quantity of a thermit mixture is placed in a paper cup and suspended above a container of water. A few inches below the level of the water a metal plate is suspended and at the bottom of the container is a layer of sand. The thermit is ignited with a starting mixture, and of course, it falls into the water and burns through the metal plate, dropping to the sand at the bottom of the container, where it glows briefly and causes the water to boil and bubble. This demonstration shows that thermit "even burns under water." The thermit reaction is practically completed when the residue of molten iron and slag burns through the metal plate, and what the spectator sees at the bottom of the container is the cooling metal.

The effect of thermit on ordinary carbonaceous material is not as positive as on steel. When burning on wood, for example, a layer of carbon forms under the molten iron, which serves to insulate the area below the hot iron against further burning. Thus, if a crucible is made on a 2-in. plank, and filled with thermit, the chances are that the thermit will not burn through the plank. But under the same circumstances, it would burn cleanly through a 1-in. steel plate.

## THE PRODUCTION OF HELIUM

From *Engineering* (LONDON), AUGUST 28, 1942

The properties and uses of helium are well known; it is a colourless, odourless, non-inflammable and exceedingly light gas, having a specific gravity of only 0.139 (air = 1.0). On account of its non-inflammability, it has been used for many years for filling airships and balloons, since it is only twice as heavy as hydrogen and possesses 92.6 per cent of the lifting power of that gas. Helium, however, has other applications; mixed with oxygen it is employed to prevent deep-sea divers from suffering from "bends" (a form of paralysis resulting from a rapid change of pressure) and to mitigate caisson disease. Helium-oxygen mixtures are also employed in medicine for the treatment of asthma and other respiratory affections. Helium occurs as a constituent of natural gas and is extracted in large quantities at an installation owned and worked by the United States Bureau of Mines, at Amarillo, Texas. The process employed, we understand, simply involves the separation, or isolation by low-

temperature fractionation, of the helium from the other gaseous constituents.

Since the establishment of the Amarillo plant in 1929, the Bureau has been responsible for the production of upwards of 100 million cu. ft. of the gas. The installation, however, had not been operated at its maximum capacity until last year when the course of world events brought increasing demands for helium. In order to supply these demands the plant at Amarillo has recently been considerably extended, and it is anticipated that the production this year will be several times larger than that for 1941. In addition, a new helium-producing plant, the exact location of which is not stated has been decided upon. This will draw its supplies of helium-bearing gas from an existing pipe line which conveys natural gas to a distant site where it is consumed as fuel. Arrangements have also been made for conducting systematic surveys of other fields which may become a source of helium in commercial quantities, and engineers and geologists on the staff of the Bureau of Mines are conducting this work. To meet the cost of all these developments the United States Congress recently voted a sum of four million dollars. It is satisfactory to find that the Bureau of Mines has made every endeavour to maintain the price of helium low and that this has steadily fallen during the three years 1938 to 1940. In this last year the cost per 1,000 cu. ft., exclusive of service charges, was \$11.17 to medical users, \$11.73 to scientific users, and \$13.14 to commercial firms.

### WORKS RELATIONS SCHEMES

From *The Engineer* (LONDON), Sept. 18, 1942

Some weeks ago we stressed the importance of suitable propaganda in the factory, and the opportunity was taken to suggest that the wholesale use of slogans had inherent defects. We notice with satisfaction that similar sentiments are finding their way into the American technical papers, one of which, bravely borrowing a weapon from the enemy, exclaims, "Don't slug 'em with slogans." We are not surprised to be informed that "any intelligent worker will and should resent" such sentiments plastered over the workshop walls as "Work Wins War," "Count Me in this War," "Shake a Leg, Mister," while "Do Your Duty" conveys the implication that the boss is doing his, but that you are not doing yours. Slogans may be an easy way of making an appeal, but it is a way far from the best. It is our desire to suggest the better way, which lies in a far greater development of what may be termed "Works Relations Schemes."

The Royal Ordnance Factories, with their Joint Productive Consultative and Advisory Committees, have taken the somewhat revolutionary line of enlisting the help of the worker in the efficient management of the workshop but the subject of works relations is a far broader one, in which the main idea is to make every single operator keen on his job, and able to take an intelligent interest in the production of even the simplest part. The Ministry of Supply con-

siders this question as of sufficient importance to warrant the setting up of a special Public Relations Branch, which maintains contact through the various production departments with a large number of factories working for the Ministry. The staff in this special branch is composed of men who have both factory and newspaper experience, and who are able to spread good ideas and readily sense special needs in relation to observed *morale*. The idea of compulsion is repugnant to the scheme, for co-operation and understanding make its keynote. Many methods have been suggested and explored. Perhaps the most important step is that of ensuring that the worker knows the purpose for which the article he or she is producing day in and day out is intended; it all seems so remote from the war effort as to be meaningless. If a picture is displayed clearly showing how the particular component fits into some article, and how that article in turn is assembled into something bigger, something that perchance figures in the daily press, then interest is awakened. That small piece becomes more vital when it is shown, let us say, set in the fuse, which fuse is then depicted in the shell destined to bring to destruction an enemy aircraft. It is still better when the bomber pilot, fresh back from some notable feat, calls at the filling factory and talks to the employees who are engaged on filling his bombs, when one of our paratroops has a talk with the people who make his equipment, or when the A.A. gunner tells the men in the gun factory something of his life and the behaviour of his weapon. These talks usually take place in the mid-day interval at the works canteen and the speaker is generally entertained to luncheon with the workers.

In the first six months of organizing these talks the Ministry of Supply has provided over five hundred speakers from the Services for different factories, and the results have been strikingly successful. The visits arranged to the proof butts for workers to see their products actually tested, for girls from filling factories to visit Bomber Command stations and talk to crews returning from action, for inter-factory visits so that persons working on sub-contracts may see how a job that is remote from the finished product will take its place in the final stages of production—all these have added a spur to production.

The general principle underlying efficient works relations schemes must always be information rather than exhortation, and to this end no tool will be despised, be it the educational film, be it the factory radio, with its great potentialities, or be it the use of the public press, in fact, anything that will encourage a better appreciation of the industrial front. To sum up the position, every effort is made to give workpeople a clearer perspective, enabling them to appreciate what happens as a result of their personal efforts. It has been abundantly proved that men and women in our factories are extraordinarily receptive of information, and welcome demonstrations, while mere exhortations leave them cold or even sullen. The more manufacturers realize the value of works relations schemes, the greater will be the effect on output. Much has been done, but much more still remains to be done.

## STRUCTURAL DEFENCE AGAINST BOMBING

A reference book on the engineering features of civil defence, published by The Engineering Institute of Canada in order to make available to Canadian engineers and architects a record of some of the experiences and practices of British authorities in regard to structural air raid precautions, so that in the event of emergency arising in this country the necessary action can be taken without loss of time and on the most efficient and economical lines.

It is a 56-page booklet, 8½ by 11 in., with heavy paper cover. It contains 79 illustrations and eight tables. Copies may be secured at \$1.00 each from

THE ENGINEERING INSTITUTE OF CANADA, 2050 MANSFIELD STREET,  
MONTREAL, QUE.

## THE WORK OF LOCAL RECONSTRUCTION COMMITTEES

At the October meeting of Council, the chairman of the Institute Committee on Post War Problems presented an interim report, pointing out that under the Department of Pensions and National Health, citizens' committees are being established in various localities throughout Canada to deal with problems of post-war reconstruction. Mr. Miller suggested that these local groups could make good use of the branches of the Institute. He believed that our branches would be pleased to nominate engineers to work on these citizens' committees if desired, and proposed to communicate with the various local committee chairmen accordingly. This course met with Council's approval.

The formation of these local citizens' committees is a very necessary step, for reasons which have been explained in a recent memorandum prepared by the Cabinet Committee on Reconstruction, usually referred to as the James Committee.<sup>1</sup> The memorandum indicates the various kinds of problems which will have to be considered by such committees and by local authorities; in connection with many of these it is plain that engineers nominated by our local branch could render valuable assistance.

The memorandum points out that there are many post-war problems which cannot be solved unless they are solved locally, because geographic and economic conditions vary so widely throughout Canada. It therefore mentions a number of topics of this kind, as starting points on the road to detailed study and planning.

These questions are grouped under five heads, as follows:

1. Town planning.—This would cover the provision of parks and other amenities, the construction of roads and public buildings, and housing developments.<sup>2</sup> For all these, master-plans must be available in each community, so that detailed specifications for each project can be ready when the war comes to an end. This is a task that must be done locally, though the interested agencies of the Dominion Government will be able to give useful assistance.

2. Employment opportunities and social security.—There is now in operation a Dominion-wide system of employment offices. Workers and business enterprises in each community should become familiar with the operation of the local office so as to make recommendations to render its working more efficient. This applies also to questions of public health, the assistance of workers who may be in distress, and retirement allowances for those who can no longer earn their living. These and other like matters should be studied now, and locally.

3. Education.—In Canada education is administered by provincial governments, under which local educational authorities operate. In many places war conditions have made it evident that serious weaknesses exist in our present system, and changes may be needed. Local committees may well study their local needs, notably in regard to the possible lack of facilities for technical training, not only for university or professional students but also for the multitudes who will become workers on farms, in factories or offices.

4. Conservation of natural resources.—A sub-committee of the James Committee is already studying the conservation and effective utilization of the Dominion's natural resources. But in many places there are local problems of forest development, flood control, irrigation or land utilization which can best be considered by those familiar with local conditions, in consultation with duly constituted local authorities.

5. Projects for the integration of industry and agriculture.—In some rural areas or small urban communities a proper

<sup>1</sup>Its chairman is Dr. F. Cyril James, Principal of McGill University.

<sup>2</sup>A subcommittee of the James Committee is studying construction projects. Its chairman is K. M. Cameron, M.E.I.C.

## News of the Institute and other Societies, Comments and Correspondence, Elections and Transfers

integration of industry and agriculture would provide increased employment opportunities and a more stable standard of living for those concerned. There are already many instances of successful schemes of this kind. In fruit growing areas, canning factories; in forest areas, woodworking industries giving employment when logging is dull; in seasonal agricultural regions, small factories for the production of consumer goods during the off seasons; all these have been found workable. Local committees may well make plans for such activities where suitable conditions exist.

In all these matters the initiative has to be taken locally, and there must be co-operation between local, provincial and federal authorities. It will be seen that the local citizens' committees, to whom the memorandum is primarily addressed, will have before them many questions on which the advice and opinion of trained engineers would be helpful if not essential. The Institute Council therefore hopes that the citizens' committees as well as our branches will see their way to act in accordance with Mr. Miller's suggestion.

### 1943 ANNUAL MEETING

All plans for the Annual Meeting of the Institute were suspended upon the announcement made a short time ago in the press by the Honourable C. D. Howe, HON. M. E. I. C., that the Government was requesting organizations to cancel their conventions in order to economize on transportation facilities.

At the meeting of Council held in Niagara Falls in October it was agreed that Vice-President K. M. Cameron and the General Secretary should consult Mr. Howe in Ottawa to see whether or not his request included such business and professional meetings as that held by the Institute.

At the first opportunity, Mr. Cameron and Mr. Wright called on Mr. Howe and received assurance that such meetings were not included. He thought organizations whose meetings could make a contribution to the war, should be continued, particularly where the amount of railroad travelling was not unreasonable.

As the 1943 meeting is to be held in Toronto, by far the largest percentage of those in attendance will come from the Toronto area, therefore, the meeting is not likely to result in any noticeable amount of railroad travel.

Pending this decision, some time has been lost in planning, but the machinery was all set in motion again as soon as Mr. Howe's decision was obtained, and it is expected that everything will be in full readiness in good time for the meeting.

### STRUCTURAL DEFENCE AGAINST BOMBING

A reference book on the engineering features of civil defence, published by The Engineering Institute of Canada in order to make available to Canadian engineers and architects a record of some of the experiences and practices of British authorities in regard to structural air raid precautions, so that in the event of emergency arising in this country the necessary action can be taken without loss of time and on the most efficient and economical lines.

It is a 56-page booklet, 8½ by 11 in., with heavy paper cover. It contains 79 illustrations and eight tables. Copies may be secured at \$1.00 each from

THE ENGINEERING INSTITUTE OF CANADA,  
2050 MANSFIELD STREET,  
MONTREAL, QUE.

## ACTIVITIES OF THE CIVIL DEFENCE COMMITTEE

The following notes have been extracted from the latest progress report of the committee on the Engineering Features of Civil Defence for the information of the general membership.

No report has as yet been received indicating that any of Dr. Manion's Provincial A.R.P. Committees had sought contact with or requested assistance from any of our Branch Committees. Some of the latter have not yet felt themselves to be in position to offer such assistance, but six of the 19 Branch Committees report that they have made contact with the appropriate Provincial A.R.P. Committee and have offered their assistance as desired. These six Branch Committees are: Border Cities, Montreal, Saguenay, Saskatchewan, Toronto, Winnipeg. It is expected that additional Branch Committees will report such contacts in the near future.

The Branch Committees have found it difficult to know just how to carry on effectively, because of lack of specific assignments from the main Committee. It is expected that this situation will be somewhat relieved now that "Structural Defence Against Bombing" has been issued and these Committees placed in a position to proceed along the lines intended. The situation should be still further relieved as other work of the main Committee progresses and it becomes possible to issue further information to the branch Committees with suggestions as to its use.

Mr. H. F. Bennett's sub-committee on the abridged Webster notes has completed its assignment in a manner well worthy of the appreciation of the Institute.

The secretary having assembled information in regard to the number of copies of this sub-committee's report to be struck off and the price per copy at which it should be sold, there being no meeting of Council in immediate prospect, and there being an urgent desire to have the report available before the middle of October, the Finance Committee decided on October 5th that,

- (1) For the first printing 1,000 copies would be struck off and the type would remain set for three months so that within that time additional copies could be struck off as required.
- (2) The report would be sold at \$1.00 per copy, with no discount on quantity orders and no copies distributed free.

The report was printed and issued on this basis as an E.I.C. publication, under the title "Structural Defence Against Bombing." It became available on October 14th and up to date of this progress report over 250 copies have been sold, without benefit of advertising or of public announcement other than those at the Niagara Falls closed session and at the Montreal Branch meeting on October 22nd.

"Structural Defence Against Bombing" has been called directly to the attention of the chairmen of all Branch Committees and certain others, with the suggestion that they call this publication to the attention of the members of their Branches and, through them or otherwise, to the attention of those companies or other organizations in their territories to whom it will prove of value and assistance. A wide distribution is desired in order to disseminate as rapidly as possible information, not now generally available, to that portion of the public which this publication is intended to serve.

Professor Legget's preliminary draft memorandum relative to organization for emergency repairs to works and buildings has been approved in principle by the governing bodies of The Engineering Institute of Canada, the Royal Architectural Institute of Canada and the Canadian Construction Association, and work is actively in hand by representatives of these three bodies in the preparation of a joint submission.

Through contacts made by Professor Legget, he received copy of a press release by the Office of Civilian Defence,

Washington, D.C., reporting the request by Director Landis of the O.C.D. for the formation of regional, state and local committees representing the technical and scientific professions and assigning to these committees three "urgent missions," as follows:

- (1) Organization and training in each city of a suitable number of technical intelligence units.
- (2) Check as to the adequacy and suitability of air raid shelters as now selected and designated.
- (3) Check as to the adequacy of provision for break-down service in the most essential public utilities, especially water supply, electric power and communications.

This press release states that the various U.S. national technical and professional societies have offered the services of their offices and members in developing technical committees for civilian defence throughout the United States.

Copies of this press release have been sent to the chairmen of Branch Committees and others as information, with the request that, until the assignment Professor Legget's Sub-committee has in hand has been completed, no corresponding action should be taken by them, but that in due course they may be asked to assist in work of a similar nature.

During the joint meeting of the American Society of Civil Engineers and the Institute in Niagara Falls, a symposium on Civilian Protection in Wartime was held on Wednesday afternoon, October 14th, as a closed session under the joint auspices of the E.I.C. Committee on Engineering Features of Civil Defence and the A.S.C.E. National Committee on Civilian Protection in Wartime. The Canadian speakers were:

- President C. R. Young—Introductory remarks on behalf of the Institute.
- Mr. H. F. Bennett —Structural aspects of civil defence work.
- Mr. G. McL. Pitts —Co-operation in Canada between architects and engineers.
- Prof. R. L. Legget —Review of the work of the Institute Committee on Engineering Features of Civil Defence.

About 200 were in attendance and the closed session was both interesting and instructive. The Institute publication "Structural Defence Against Bombing," was available for sale after the meeting.

Branch Committee reports indicate progress in perfecting their organization so as to be ready to handle any assignments that may be transmitted to them.

On the evening of October 22nd, Mr. D. C. Tennant, Engineer, Ontario Division, Dominion Bridge Company, Toronto, spoke at a meeting of the Montreal Branch, his subject being "Engineering Aspects of Air Bombing and Structural Defence."

## TO MEMBERS WITH RELATIVES IN THE SERVICES

In the September issue of the *Journal*, attention was called to a resolution, passed at the regional Council meeting held at Halifax in August, and suggesting that members might render valuable service by providing some measure of hospitality at their homes, for sons and daughters of members of the Institute from other parts of the country, stationed in their locality.

The introductions for such hospitality can best be arranged through the branch secretaries. Members who wish to establish contacts for a relative in a distant centre should refer to the third page of the *Journal*, where they can find every month the names and addresses of all branch secretaries. A word sent to any of them should bring quick action.

Headquarters has already received indications that the Institute Branch, at "An Eastern Canadian port," is anxious to take the initiative in this new endeavour.

# NIAGARA FALLS JOINT MEETING



(Left) The two presidents, Dean C. R. Young of the Institute and E. B. Black of the Society.



(Right) The incoming presidents, K. M. Cameron of the Institute and Ezra B. Whitman of the Society.



(Above) Officers of the Institute and the Society; Front row: T. H. Hogg, past-president of the Institute, C. R. Young, president of the Institute, C. M. Spofford, vice-president of the Society, E. B. Black, president of the Society, K. M. Cameron, president-elect of the Institute. Back row: L. Austin Wright, general secretary of the Institute, A. J. Grant, past-president of the Institute, C. H. Stevens, vice-president of the Society; C. J. Mackenzie, past-president of the Institute, C. B. Burdick, vice-president of the Society, and F. H. Fowler, past-president of the Society.



(Right) Local section delegates, officers and guests gather at the hotel entrance.



Prof. C. M. Spofford, M.Am.Soc.C.E., one of the Society's vice-presidents and Ezra B. Whitman, official nominee for president of the Society.



Major J. P. Carrière, R.C.E., of the Directorate of Military Training, Ottawa, discusses engineer training with Col. L. E. Robbe of the U.S. Engineer Corps.



(Upper left) President E. B. Black of the American Society.

(Above) E.P. Goodrich, director of the American Society and chairman of National Committee on Civilian Protection in War Time.

(Lower left) G. MacL. Pitts, M.E.I.C., president of the Royal Architectural Institute of Canada, advocates close co-operation between architects and engineers.

(Upper right) H. W. Lea, director of the Wartime Bureau of Technical Personnel, Ottawa

(Above) L. Austin Wright, general secretary of the Institute and assistant director of National Selective Service, discusses man-power while G. T. Seabury, secretary of the American Society, listens.

(Lower right) Prof. H. E. Wessman, M.Am.Soc.C.E. of New York University.



### THE JOINT MEETING AT NIAGARA FALLS

Eight years ago the American Society of Civil Engineers came to Vancouver to hold a regional meeting jointly with The Engineering Institute of Canada and the affair was a great success. Many of our members still have pleasant memories of that event, and have hoped that our friends would come to Canada again. This year they have done so crossing the border at Niagara Falls, Ontario, to hold joint sessions there with the Institute. The choice of locality proved to be wise. Some four hundred members of the Society and the Institute attended, and from October 13th to the 15th took part in a well-planned programme of technical sessions, business meetings and social events. The weather was favourable most of the time. The falls continued their regular hydraulic performance throughout the meetings and the General Brock Hotel did well as regards creature comforts and accommodation.

Activities really began on Monday, October 12th, when the Society's Board of Direction held sessions throughout the day. On Tuesday, the Institute Council had a well attended regional meeting, dealing largely with the work of the Institute committees on Post-War Problems and the Engineering Features of Civil Defence. Luncheon on this day and an informal dinner in the evening gave excellent opportunities for meeting old friends and making new ones.

The more formal proceedings began on Wednesday morning with an exchange of official greetings between officers of the two societies. This pleasant ceremony was followed by a discussion of man-power control as it is being developed in Canada and in the United States—a matter of pressing importance to both countries at the present time. L. Austin Wright, assistant director of National Selective Service, explained the regulations now effective in Canada and the general information that he gave was supplemented by H. W. Lea, director of the Wartime Bureau of Technical Personnel.

At luncheon President C. R. Young spoke on "The Place of the Engineer"; his address was welcomed as one of the outstanding features of the whole meeting<sup>1</sup>.

The afternoon session on Wednesday took the form of a symposium on civil defence in Canada and the United States.

<sup>1</sup>The President's address will appear in our next issue.

Much of the information presented was of a confidential nature, based on data obtained in England and in other places where war damage has been extensive. Recognizing the need for proper secrecy, admission to this closed session was by signed tickets only. Members willingly co-operated in this necessary precaution. Those present felt that real help had been given them by this discussion and exchange of views.

A formal dinner was held in the evening at which two hundred and fifty sat down. After toasts to the King and the President of the United States, Dr. H. J. Cody, president of the University of Toronto gave an inspiring address on the development of our present civilization, sounding an urgent call for the international co-operation which is necessary for its defence.

Thursday was fully taken up with meetings of the Technical Divisions of the A.S.C.E. in which many members of the Institute took part. At luncheon an interesting account of army engineer training in the United States was given by Brigadier-General E. H. Marks of the United States Army.

For the ladies there were trips, bridge parties and teas; they also had the pleasure of hearing Dr. Alice Vibert Douglas, dean of women in Queen's University, Kingston, who spoke on "Astronomy's Debt to the Engineer."

All the arrangements worked smoothly. Our American visitors appreciated the courtesy and help of the Immigration and Customs Officers who made transfer across the border at the Rainbow Bridge a simple affair.

The benefits of such a meeting are manifold. Not the least of them is the development of a feeling of mutual confidence and comradeship between the engineers of the two neighbouring countries.

### COMING MEETINGS

**Canadian Construction Association.**—Annual Convention, Log Chateau, Seigniory Club, Que. January 20-22, 1943. General Manager, J. Clark Reilly, Ottawa Building, Ottawa, Ont.

**The Engineering Institute of Canada.**—57th Annual General Professional Meeting, Royal York Hotel, Toronto, Ont., February 11-12, 1943. General Secretary, L. Austin Wright, 2050 Mansfield St., Montreal, Que.

AT THE INFORMAL DINNER FOR OFFICERS OF BOTH SOCIETIES



(Above) Left to right: Dean C. R. Young, president of the Institute, E. B. Black, president of the American Society, Mrs. Young and F. H. Fowler, past-president of the Society.

(Below) Past-president C. J. MacKenzie of the Institute, Mrs. F. H. Fowler, and Past-president T. H. Hogg of the Institute.



(Above) Mrs. T. H. Hogg and C. B. Burdick, vice-president of the Society.



(Left) President-elect of the Institute K. M. Cameron and Mrs. Cameron.

(Below) Mrs. W. N. Brown of Washington, Col. E. G. M. Cape, treasurer of the Institute, Secretary G. T. Seabury of the American Society and Mrs. Seabury. In the foreground, Mrs. Cape.



(Above) General Secretary L. Austin Wright chats with Dr. D. W. Mead, past-president and honorary member of the American Society, and Mrs. Mead.



Some of the Institute officers: Councillor H. R. Sills, Chairman H. F. Bennett of the Young Engineer Committee, Mrs. Bennett, Councillors J. G. Hall and Dr. A. E. Berry.

Councillor J. A. Vance discusses Institute activities with Miss M. McLaren from Headquarters while J. C. Hoyt of Washington proposes a toast to Miss E. Gibson also from Institute Headquarters.

When one views the wastage and devastation of modern war it would seem that the human race will be impoverished for years to come. But a more careful view indicates that the appalling expenditure of materials is being mitigated by the research and development which has been made necessary by the demands of modern warfare and by the increasing scarcity of raw materials. This is not immediately apparent as many of the most spectacular achievements of engineers, chemists and scientists are now being used for war purposes. Most of these developments are still military secrets. In many instances, their civilian potentialities have not yet been explored.

One example which comes to mind is the advancement in the field of radio communication. I heard an authority say recently that the principles involved in the radio locator, once they could be divulged and divorced from military necessity, would revolutionize communication. Less spectacular perhaps, but more tangible, are the possibilities inherent in micro-photography combined with world-wide aviation. Following the war, no one need be more than a few days separated from anyone anywhere in the world.

At present, the light metals are being monopolized for war purposes. The vast expansion in both the capacities and the techniques of the production of aluminum and magnesium may well revolutionize much of our way of living when these light metals are made available for civilian requirements.

The great synthetic rubber industry now being brought into production will produce a wide variety of rubbers capable of meeting all the normal requirements and many new requirements which hitherto could not be met by natural rubber at all.

As an offshoot of synthetic rubber, research techniques in polymerization and hydrogenization and the use of catalysts are finding interesting ramifications. It is now possible to produce high-test gasoline from a wide variety of agricultural products with comparatively simple plant and equipment. Hitherto inaccessible regions may eventually be equipped to produce their own gasoline. This may have an important bearing on both air transportation and mechanized agriculture.

There are some who will predicate a whole post-war programme of industrial expansion on the civilian application of plastics which are now being largely used for war purposes. Polyethylene and polythene, because of their amazing electrical properties, are being exclusively used in radar work and are hardly known to the public at all. New plastic tubes and pipes are now being made which can be welded like metals. Lucite and a host of other plastics will, after the war, take their place in civilian life.

The paint industry has engaged in research into the special requirements of camouflage, into infra-red resistant pigments and into special lacquers to take the place of tin and other metal coatings. This research will probably result in paints for civilian use far in advance of anything known before.

Food research is now perfecting dehydration techniques. New methods of packaging and preserving—methods of crystallizing foods with preservation of all their essential qualities—new methods of planting and rotation—will all have their effect.

We are also learning to use our critical materials more sparingly. Recent developments of electrolytic tinning have already cut requirements for tin in half. Close scrutiny regarding the use and specifications of nickel have reduced our requirements by 25 per cent. New steel specifications are having similar effects.

The necessity for maintaining large numbers of men in virgin territories is resulting in new methods of sanitary control and the development of highly mobile sanitary equipment. Such techniques may open up parts of the world hitherto considered to be inaccessible.

Allied to all the above, of course, is the fact that everywhere the search for new raw materials and new methods and new processes is being accelerated. At long last, the countries of the world are beginning to adopt a closer standardization of scientific measurements. The industrialization of the world is being disseminated more evenly throughout the various regions of the earth. Mass production methods and pools of skilled labour can now be found all over the world. Through recently negotiated patent agreements, scientific techniques and processes are now being made available to all the peoples of the United Nations.

Thus are engineers and scientists laying the foundations of an ampler world, in part atonement, at least, for making possible many of the horrors of modern war.

As the fate of Manchuria and Poland and Pearl Harbor forced upon the democratic countries of the world a progressive realization that war was inevitable, we began by imposing a war production programme on top of our normal civilian production. As we increased our war preparations, it became necessary to invent a way of curtailing civilian production. A priority system was set up whereby war requirements were given a prior claim over civilian needs on scarce materials. Very soon, priorities had to be extended to civilian requirements in order to distinguish between "essential" and "non-essential" civilian requirements. Finally, the point was reached when the sum of "essential civilian" and "total war" requirements exceeded total production capacity. At this point the priority system naturally broke down. This happened in England towards the end of the first year of the war. It is happening now in the United States. The alternative is a system of allocations in which an attempt is made to balance total production with total need. To the engineer this seems like as easy and obvious next step, but it involves profound and far reaching consequences. In economic parlance the transition from priorities to allocation might almost be regarded as a change from *laissez-faire* to a planned economy. Since we are fighting a global war and since the normal sources of so many raw materials are now in enemy hands and since the production of certain articles of war and certain synthetics must be centralized in one area or another, our allocation system must also be planned to operate on a global scale. The job of setting up bodies and of organizing the programmes for the production and consumption of the United Nations and of establishing the necessary authorities to carry them out on a world-wide scale is an herculean task. Short of production itself, it is the most important undertaking in the world at the moment. It is an undertaking so complicated and so vast and requiring such close detail that nothing short of a major crisis in the affairs of all mankind could have forced us to face it and carry it through. Those of us who are immersed in the immediate tasks of carrying into effect this programming scheme tend to see only the difficulties and the possibilities of strain and misunderstanding and international friction. Underlying it all is a great new step forward in world affairs. One of the most immediate effects is the fact that the division between civilian and war requirements is disappearing. All requirements are now becoming either direct or indirect war requirements. Anything which does not aid the war effort has no place. Thus it is being brought home to all that this is a people's war and that the peace must be a people's peace. It is a demonstration of the necessity of international solidarity and of the possibility of international co-operation. It is a "first" in history and there will be no going back. Humanity is being organized in a phalanx. Churchill, Roosevelt, Stalin, Chiang-Kai-shek; behind them the general staffs; behind them the joint international boards; behind them the various boards and organizations; and behind them the combined efforts of fifteen hundred million people, now for the first time treading the same road in a communal effort and setting their faces towards a common goal.

E. R. JACOBSEN, M.E.I.C.

## THE COMMITTEE ON THE YOUNG ENGINEER

At the Council meeting held at Niagara Falls last month, H. F. Bennett presented the following report concerning the recent activities of his committee:

I am reporting on the activities of the Engineering Institute of Canada Committee on the Training and Welfare of the Young Engineer since the Annual Meeting in February, 1942.

(1) About 13,000 copies of the brochure—"The Profession of Engineering in Canada"—have been published and about 9,000 copies have been distributed without charge to the engineering colleges and to the high schools throughout Canada.

(2) Student Guidance Committees have been set up in sixteen of the branches of the Institute to implement the guidance phase covered by the brochure. I have received frequent reports from several of these branches, indicating a considerable activity. It is to be hoped that the remaining branches will follow with the naming of their committees.

(3) The French language edition of the brochure is now in the hands of the printers. These will be distributed to the French speaking schools in the province of Quebec and in the French districts of the other provinces.

(4) The president and other members of the Institute have spoken on the subject of student guidance at a majority of the branches of the Institute.

(5) The several Branch Committees are now co-operating with local guidance committees, student counsellors, university alumni and high school principals.

(6) Single copies of the E.C.P.D. Manual for Student Counsellors have been distributed to the Branch Committee chairmen, and they are asking that a supply be obtained for their use. This request will be in my recommendation portion of this report.

(7) Since we reported to you on the need for greater publicity on the subject of Student and Junior prizes, we have had enquiries from the branches indicating a renewed interest in these competitions.

### RECOMMENDATIONS

(1) We would recommend to the councillors of each Branch that they encourage the activities of the Junior member committees and the Student guidance committees, and if these have not yet been formed in their individual branches, that they be urged to carry out this request so that there will be no loophole in our organization.

(2) We would recommend that 200 copies of the E.C.P.D. Manual for Committees of Engineers, and 200 copies of Appendix "A" of that Manual, be obtained from the E.C.P.D. at an estimated cost of \$15.00.

Respectfully submitted on behalf of the Committee.

(Signed) HARRY F. BENNETT, M.E.I.C.,  
Committee Chairman.

## ENGINEERS COUNCIL FOR PROFESSIONAL DEVELOPMENT

The 10th Annual Meeting of the Engineers Council for Professional Development was held in New York on Saturday and Sunday, October 17th and 18th under the general guidance of R. E. Doherty, Chairman of the Council, and President of the Carnegie Institute of Technology. The meetings were held in the board room of the American Society of Civil Engineers and the Engineer's Club.

The Institute was well represented by President C. R. Young, and past presidents J. B. Challies and Arthur Surveyer, and James Vance, the Institute's representative on the Committee of Professional Recognition, and the General Secretary.

Saturday's session was devoted to a meeting of the executive of the council and Sunday was a general meeting, concluding with a dinner at the Engineer's Club in the evening, at which Dr. Doherty was chairman and Colonel C. E. Davies was toastmaster.



From left to right, Harold V. Coes, president-elect of the American Society of Mechanical Engineers; Past-President Arthur Surveyer of The Engineering Institute of Canada; Dr. R. E. Doherty, president of Carnegie Institute of Technology and chairman of E.C.P.D.; Toastmaster Colonel C. E. Davies, secretary of A.S.M.E.; L. Anstin Wright, general secretary of E.I.C.; Dean R. L. Sackett of Pennsylvania State College, chairman of the Committee on Student Selection and Guidance; C. H. Stevens; Dr. A. R. Cullimore, president of Newark College of Engineering. Past-President J. B. Challies of the E.I.C. was sitting on the left just out of the camera range.

The evening was given over to discussion of the work already accomplished by the E.C.P.D. in the first ten years of its existence, and to its position in the future in relationship to the various war activities.

At the Sunday meeting, the reports from all committees were presented and approved. All or part of these reports will be printed in the *Engineering Journal* very shortly. They point out the value of the work being done in a field in which the Council is giving very definite leadership. No single agency is doing so much for the advancement of the professional interest of the engineers, as is the Engineers Council for Professional Development.

## PROFESSOR WEBSTER PURSUES HIS GOOD WORK

Those who had the privilege of attending Professor Webster's lectures or of meeting him personally will be interested in the following letter from the Chief Engineer of the British Ministry of Home Security, Sir A. M. Rouse.

Ministry of Home Security,  
Home Office Building, Whitehall.

7th September, 1942.

Assistant General Secretary,  
The Engineering Institute of Canada,  
Montreal, Que.

Dear Mr. Trudel,

Your letter of the 29th July, 1942, to Prof. F. Webster, enclosing Copy No. 1 of "Structural Defence against Bombing" has been received, and in his absence I have opened it.

Prof. Webster is absent in the East giving advice on the defence of an important installation, and I delayed acknowledging your letter in case he should return in time to do so himself.

I feel, however, that your letter must be answered lest you should feel that Prof. Webster is guilty of a discourtesy.

It is very gratifying to us, his colleagues, to know that his work in Canada was appreciated so widely.

Yours sincerely,

(Signed) A. M. ROUSE,  
Chief Engineer.

We wish Mr. Webster all success in his work which does so much to lessen the possible damage and loss of life from aerial bombing.

## CANADIAN ENGINEERS IN ENGLAND

About this time last year, a representative of the British Ministry of Aircraft Production, member of the Institute, came from England to enlist the services of a number of Canadian engineers on several important construction projects of the Ministry.

Before his arrival, Mr. W. O. Maclaren had communicated with the Institute, requesting that a number of possible candidates for the positions be assembled ready for his interviewing. The Institute Employment Service, in co-operation with the Wartime Bureau of Technical Personnel, did the necessary canvassing and, upon his arrival in Canada, Mr. Maclaren was able to interview several qualified persons in the principal centres. As a result, several engineers were engaged, by the Ministry, in a civilian capacity, and went over to England early this year.

The following letter received recently from Mr. Maclaren may be of interest to the relatives and friends of these engineers:

MINISTRY OF AIRCRAFT PRODUCTION,  
Thames House, Millbank, S.W.1.  
15th October, 1942.

The Secretary,  
The Engineering Institute of Canada,  
Montreal, P.Q.

Dear Sir,

I regret that owing to my activities in this country, I am not able to write nearly as often as I would like.

I do feel, however, that you will be interested to learn something of the activities of some of the Canadian engineers whom I brought over to this country to take up positions with the Ministry of Aircraft Production.

Mr. S. S. W. Cole has proved himself to be extremely useful in his capacity of resident engineer in charge of a very secret type of factory, the cost of which project is running into some three and a half million dollars. Mr. Cole is making extremely good efforts in this country and is handling his work with customary Canadian efficiency.

Mr. W. H. Ellis is my deputy (superintending engineer) on a contract for the Ministry, in value of over six million dollars, and is carrying out his duties conscientiously and with outstanding ability. He is extremely interested in his work and perfectly happy in his surroundings.

Mr. J. H. Brown is resident engineer and is distinguishing himself on a three million dollar project for the Ministry, and by his high degree of energy, activity and outstanding ability in administering this contract in a most able and satisfactory manner.

Mr. Kingston is engaged as civil engineer on one of the biggest undertakings in this country, running approximately ten million dollars and he has proved himself to be extremely satisfactory in every way.

Mr. J. A. Fisher is engaged as civil engineer on another very large contract in the north of England, and his tactful understanding, energy and conscientious application to his duties are assisting in no small measure in the early completion of a major contract being undertaken by this Ministry. Mr. Fisher is taking a particularly keen interest in local conditions in this country, and any spare moments he has (which are few) he is studying every building of any historical interest and appears to be getting a real kick out of it.

Mr. J. C. Loiselle, s.e.i.c., is mostly engaged on design work at the Ministry's headquarters, and his cheerfulness and willing application to his duties both ensure that his work is being undertaken in a most efficient manner and enable him to get along agreeably with people with whom he comes into contact. Mr. Loiselle should be acquiring by this time a very intimate knowledge of London and its environs.

Mr. C. M. Hare, m.e.i.c., is carrying out some very useful work for the Ministry, but as I have not come in contact with him for some months now, I have less detailed informa-

tion about him than of the other members of the party.

I must thank the Institute for its most gracious and helpful co-operation at the time of my recent visit to Canada, during which time these engineers were chosen, and since when they have arrived in this country. My visit would have been well worth while if I had only obtained one engineer out of the group noted above. As I am fortunate enough to obtain several extremely able engineers through the good offices of the Institute and the Wartime Bureau of Technical Personnel, the position is even more favourable.

In conclusion, I would like to convey my most sincere regards to Mr. L. Austin Wright, Miss McLaren, his secretary, and to Mr. H. W. Lea, now the director of the Wartime Bureau of Technical Personnel, for making my visit both profitable and interesting.

I will let you have such further information as may come into my possession at as frequent intervals as conditions permit.

Yours faithfully,

(Signed) W. O. MACLAREN, m.e.i.c.,  
Superintending Engineer—M.A.P.,  
Assistant Director of Aircraft Production Factories.

## CORRESPONDENCE

THE KING VS. PARADIS AND FARLEY INC.

Montreal, October 20th, 1942.

The Editor,  
The Engineering Journal, Montreal, Que.

Dear Sir,

I would like to submit to the attention of your readers the following thoughts in connection with the case recently decided by the Supreme Court of Canada and summarized in the September issue of the *Journal*, *The King vs. Paradis & Farley, Inc.*

The learned judges say that the contractor was obligated to drive piles in a specified location, not in a specified material. Suppose the test borings, which were probably not closer than 100 ft., by chance did not in any way represent the material, and it developed that piles could not be driven at all instead of at some additional cost. The design of necessity would then have been changed, and either the contract cancelled, or the contractor compensated at agreed prices for the changed conditions. The owner and the owner's engineers generally have ample time and facilities for securing information. Accurate information as to the foundation material is a prerequisite for the design. By publishing information, I contend that the owner tacitly admits influencing the contractor, who generally has neither the time nor means to verify the information, and regardless of the fact that the owner states he is not to be held responsible for such information, he undoubtedly should be responsible if he issues information at all. Partial change from the conditions anticipated by the published information, warrants adjustment of compensation to the contractor, just as a complete change in design warrants adjustment.

Why should a clause be allowed in a contract, or a whole contract be written permitting an owner to benefit at the expense of a contractor, because of the deficiencies or professional irresponsibility of the owner's engineers, or to put it more gently, because of the owner's lack of confidence in his engineer, or again because the owner desires to take unfair advantage of the cupidity of many contractors.

Bidding, of course, is voluntary, and a contractor does not have to put his head in a noose. Lotteries are not allowed in this country however. Government departments and others should not be allowed to call for tenders on work under such conditions.

Regardless of what may be done, the old principle of *Caveat emptor* will prevail. As I see it, the contractor "buys" every job for which he signs a contract. However, His Majesty, and those acting for him, are supposedly beyond

reproach. That His Majesty or any owner should retain or employ engineers, and then by outrageously one-sided contractual obligations attempt to safeguard the owners from all possible errors, omissions or misjudgements of the engineers, appears to me grossly unjust to the contractor, apart from being a very terrible reflection on the integrity and capabilities of the engineers.

In my opinion, all information available pertinent to proper pricing by the contractor, should be given always. When there is doubt as to the reliability of the information, or when the owner arbitrarily will not assume responsibility for it, then a fee type of contract should be mandatory.

If unit prices or a stipulated sum are required, the information should without any doubt be guaranteed.

If the actual conditions result in additional cost over the guaranteed conditions, the contractor will be entitled to compensation and the owner will be required to pay. The owner would have to pay in any case if the true conditions were known when the tender was made. If the conditions are uncertain and are not guaranteed—but turn out much better than anticipated, then the owner under a fee contract pays the actual cost only.

I have been misled by improper information. The most glaring occurrence was in 1932 arising out of my contract for the construction of the Paris high level bridge for the Ontario Department of Highways. The Department exhibited borings on the drawings, and at the same time disclaimed all responsibility for them. There were a number of river piers and a large east abutment. The footing for this abutment was about 45 ft. below the existing ground at the bottom of the east bank of the Grand River valley. The roadway was about 45 ft. above, i.e., a total height of about 90 ft.

The borings showed shale to rock at 45 ft. below the existing ground. The shale in the vicinity was such that it could be dug with a clam mostly without shooting. The overbreak would not be excessive and sheeting and bracing would not be required. So the job was bid and "bought."

There was clay but no shale for the whole 45 ft. The overbreak was very great, and disaster due to the hill sliding was just avoided, serious cracks having developed in the old road 60 ft. above the existing ground one hundred feet above the bottom of the hole. I had inspected the cores previous to bidding. These must have been allowed to dry out before being recorded.

Some adjustment was made after over a year's delay, but the Department disclaimed all responsibility.

E. P. MUNTZ, M.E.I.C.,

*Past President, National Construction Council.*

## MEETING OF COUNCIL

A regional meeting of the Council of the Institute was held at the General Brock Hotel, Niagara Falls, Ontario, on Tuesday, October 13th, 1942, at two o'clock p.m.

Present: President C. R. Young (Toronto) in the chair; Past-Presidents T. H. Hogg (Toronto) and C. J. Mackenzie (Ottawa); Vice-President K. M. Cameron (Ottawa); Councillors A. E. Berry (Toronto), J. G. Hall (Montreal), R. E. Hertz (Montreal), A. W. F. McQueen (Niagara Peninsula), G. M. Pitts (Montreal), W. J. W. Reid (Hamilton), H. R. Sills (Peterborough), and J. A. Vance (London); Treasurer E. G. M. Cape (Montreal); General Secretary L. Austin Wright and Assistant General Secretary Louis Trudel. There were also present by invitation—Past-President A. J. Grant (St. Catharines); Past-Vice-President E. P. Muntz (Montreal); Past-Councillors M. B. Atkinson, W. R. Manock and W. Jackson of the Niagara Peninsula Branch; D. J. Emery, chairman, Peterborough Branch; C. G. Cline, chairman, C. G. Moon, past-chairman, J. H. Ings, secretary-treasurer, W. D. Bracken and J. W. Brooks, members of executive, Niagara Peninsula Branch; W. C. Miller, Presi-

dent, Association of Professional Engineers of Ontario and chairman of the Institute's Committee on Post-war Problems; H. F. Bennett, chairman of the Committee on the Training and Welfare of the Young Engineer; Major M. B. Watson, Registrar of the Association of Professional Engineers of Ontario and Secretary of the Dominion Council of Professional Engineers.

In welcoming the councillors and guests President Young expressed his pleasure at seeing so many past officers. Their advice and participation in the discussions would be of great assistance to Council. Following the usual custom, he asked each person present to stand and give his name, place of residence, and Institute affiliation.

The question had been raised as to whether or not the Institute would be justified, under present conditions, in proceeding with the preparation of dies for the two new medals recently established by Council. Enquiries had been made and although no reply had as yet been received from Mr. H. E. Ewart, the Master of the Royal Canadian Mint, Henry Birks and Sons advised that they could accept an order for the dies, but the medals could only be made in gold or silver. It was decided to await a reply from Mr. Ewart before reaching any decision.

Attention was drawn to a recent announcement in the press whereby in order to conserve transportation, the Honourable C. D. Howe made an appeal for the curtailment of all unnecessary travel, including the postponing of conventions and similar gatherings.

The general secretary read a letter which the President had addressed to Mr. Howe, asking whether his appeal would go so far as to make it desirable for the Institute to abandon the idea of its annual professional meeting in February, 1943. In Mr. Howe's absence in England a reply had been received from Mr. W. J. Bennett, executive assistant to Mr. Howe, which indicated that, in his opinion, Mr. Howe would likely suggest that the meeting be postponed as the appeal to be effective should apply without favour to any particular group.

President Young pointed out that at the regional meeting of Council held in Halifax in August, before any appeal had been made for the conservation of transportation facilities, it had been unanimously decided to hold the annual meeting in its usual form.

Dean Mackenzie who had attended the Halifax meeting, felt that the meeting in Toronto would not be a very great strain on the transportation systems as a large proportion of the members attending would come from Toronto and nearby territory. In view of the important part which engineers are taking in the war effort, he would not like to see the meeting postponed.

Colonel Cape felt that the Institute meeting would be a purely professional gathering, mostly taken up with matters of vital interest to the war effort, and would not be in the same class as other conventions which Mr. Howe had in mind.

Following discussion it was unanimously decided to ask Vice-President Cameron and the general secretary to wait upon Mr. Howe as soon as possible after his return from England, and discuss the matter with him.

Dr. Berry reported that the Toronto Branch Annual Meeting Committee was making good progress. Arrangements had been completed with the hotel, and the Papers Committee was at work. However, plans would be held in abeyance until a decision had been reached as to whether or not the meeting would be held. It was very desirable that the Papers Committee should be informed of the decision as soon as possible.

A letter was read from Mr. Wills MacLachlan, chairman of the Committee on Industrial Relations, who had expected to be present, although he had no special report to make at this time. The next meeting of his committee would be held on October 16th, following which a further report would be available.

Mr. W. C. Miller, chairman of the Committee on Post War Problems, read a letter describing the work accomplished by his committee and referring to the possible co-operation with the various citizens' committees now being established under the guidance of the Department of Pensions and National Health and dealing with the problems to be met in the rehabilitation of returned soldiers.

President Young felt that in contacting the various citizen committees now being established under the guidance of the Department of Pensions and National Health, Mr. Miller's committee had undertaken a very useful activity.

Mr. Cameron stated that his sub-committee on post-war construction was looking forward with much interest to receiving the report from Mr. Miller's committee on the draft questionnaire entitled "Considerations for the Evaluation of Post-War Construction Projects." Mr. Cameron was interested to note that his suggestion regarding the possibility of members of the Institute supporting the various citizens committees, had been acted upon. He felt that this offered a splendid opportunity for engineers to obtain some recognition, and also to show that they are really public spirited citizens. Engineers are taking a leading part in the war effort, and while post-war reconstruction problems must necessarily take second place to the actual prosecution of the war, Mr. Cameron felt that engineers, both individually and as a body, would be able to render a real service in post-war planning.

In Mr. Pitts' opinion, too many committees on post-war construction were being formed. A greater co-ordination of effort would be more likely to produce results.

Following further discussion, Mr. Miller's letter was accepted as a progress report.

In the absence of Chairman J. E. Armstrong, the assistant general secretary read progress report No. 3 of the Committee on the Engineering Features of Civil Defence, dated September 5th, 1942. This report is published in the October number of the *Journal* for the information of all members.

As chairman of the sub-committee on the abridged edition of the Webster lectures, Mr. Bennett reported that his committee had completed its task which had been rather difficult owing to the fact that the committee members were somewhat scattered. Special thanks were due to Mr. S. R. Banks for the way in which he had centralized the work of the committee. It was announced that the books would be available for distribution at this meeting.

Mr. Pitts reported that his sub-committee on Protection Against Bombing, etc., was making progress. The committee was gathering information but had nothing definite to report at the present time.

Regarding Mr. Legget's sub-committee on the Repairing of Damaged Structures, Mr. Pitts had received authority from the Royal Architectural Institute of Canada to co-operate with the Institute and the Canadian Construction Association in completing the report which is being prepared for submission to the federal government by the three bodies.

Following presentation by Mr. Bennett of his report on the Committee for the Welfare and Training of the Young Engineer printed elsewhere in this issue, Mr. Pitts drew attention to the financial aid which is now being given by the federal and provincial governments to enable students to complete their engineering and science courses. He wondered if it would be possible for such financial aid to be continued as part of the reconstruction programme after the war. He believed that if the Institute—possibly through Mr. Bennett's committee—would associate itself with such a proposition, the government would be very willing to co-operate. Mr. Bennett's sub-committees on student guidance would be in a good position to advise the government on prospective candidates for this financial aid.

Mr. Bennett stated that he had been rather surprised that his committee had not been consulted in connection with this question. He believed that this aid to students would be continued after the war, and his student guidance committees would be in an excellent position to render

valuable assistance in the matter of selection of prospective candidates. Individual members of his committee had already been consulted, although the committee as a whole had not been approached. Mr. McQueen, a member of Mr. Bennett's committee who had been approached unofficially, thought it would be of great assistance both to students thinking of entering the university and to the student guidance committees if the contact with the government could be made more or less official. In President Young's opinion this would be a very useful service for the Institute's committee to undertake.

Dean Mackenzie pointed out that as education is a provincial matter, the whole subject would require careful consideration. He felt that post-war scholarships should not be confused with those now being given by the government on a war basis. He doubted whether it would be wise for the Institute to make any recommendations along this line at the present time, although he was in favour of studying the matter.

Following further discussion, it was unanimously resolved that Mr. Bennett's committee be asked to give this whole matter some preliminary consideration and make recommendations to Council regarding any action that might be taken by the Institute.

Mr. Muntz, chairman of the Nominating Committee, reported that the unanimous selection of his committee for the presidential nominee for 1943 was Vice-President K. M. Cameron.

President Young expressed his own particular pleasure in having Vice-President Cameron nominated as his successor. He testified most heartily to Mr. Cameron's devotion to the cause of the Institute. He had been a tower of strength to him during his term of office. The Institute would be most fortunate in having him as president.

Mr. Cameron expressed his appreciation of the great honour conferred upon him. His two years as vice-president had given him a great deal of pleasure and satisfaction. He had enjoyed particularly the privilege of accompanying Dean Young and Dean Mackenzie on their presidential visits to the branches. If elected president, he would do all he could for the engineers of Canada.

A letter was presented from Past-President McKiel reporting that when in Newfoundland recently he had discussed with members of the Institute the possibility of establishing a branch in St. John's. As a great many of the members now in Newfoundland are there temporarily as a result of the war, it was the general feeling that it would not be wise to attempt the formation of such a branch at the present time. This report was noted.

The death of Past Councillor H. S. Johnston, of Halifax, who had attended the regional meeting of Council held in Halifax in August last, was noted with sincere regret. It was also noted that Professor H. R. Webb, of Edmonton, a past councillor of the Institute and registrar of the Association of Professional Engineers of Alberta, had been killed in a mountain-climbing accident while surveying for the Calgary Power Company. The general secretary was directed to convey to the families of these two former members of Council, the sincere sympathy of the President and Council of the Institute.

A number of applications were considered and the the following elections and transfers were affected:

ADMISSIONS	
Members.....	11
Students.....	9
TRANSFERS	
Junior to Member.....	13
Student to Member.....	2
Student to Junior.....	7

Several applications for admission as Affiliate were presented, together with a memorandum regarding this classification from Councillor H. N. Macpherson, and a letter

from the Montreal Branch asking for Council's opinion on two particular cases in order that the branch might have a clear interpretation of Council's policy regarding the admission of Affiliates.

A prolonged discussion took place as to the type of person to be admitted under the provisions of Section II of the By-laws. It was noted that recently Affiliate Membership has been offered to candidates who have had a great deal of engineering experience but who have not the required educational qualifications for the class of Member, and who may not at the present time be in a position to sit for the Institute's examination. This did not seem to be the correct classification for such persons. It was felt that this classification was intended more properly for persons with high educational qualifications but who are not necessarily engineers.

There appears to be a great difference of opinion as to the type of person who should be admitted to this classification. The interpretation of the by-law itself by members of Council was far from unanimous. Dean Mackenzie did not agree with the suggestion that any person who complied with the requirements of Section II should be admitted as an Affiliate. In his opinion, it might even be necessary to amend that section of the by-laws. Mr. Hall pointed out that the Institute Membership Committee had had this classification under consideration for some time, and the matter had been thoroughly discussed at several Council meetings. The present discussion had brought out more clearly than ever the fact that there is no unanimity of opinion as to what is meant in the by-law. His recommendation would be that for the time being, the present by-law should be clarified so that everyone would have the same interpretation. After investigation it might be found desirable to revise Section II of the by-laws.

Mr. Bennett suggested that a good idea of the type of man that this classification was intended to cover might be obtained if the records of Affiliates of twenty years ago were examined.

Following further discussion, it was decided to defer action on all applications for admission as Affiliate, and to ask the Institute's Membership Committee to investigate the situation thoroughly, to look up the records of early Affiliates, and endeavour to establish a normal interpretation of Section II of the By-laws. Such an interpretation, if approved by Council, could be circulated to all branches for their guidance, and would obviate the necessity of changing the by-law at the present time.

Dr. Hogg expressed appreciation of the presence at this meeting of an esteemed past-president, Mr. A. J. Grant, of St. Catharines, Ontario.

It was decided that the next meeting of Council would be held in Montreal on Saturday, November 21st, 1942.

There being no further business, the Council rose at four-thirty p.m.

## ELECTIONS AND TRANSFERS

At the meeting of Council held on October 13th, 1942, the following elections and transfers were effected.

### Members

- Dell**, Charles Adin Orin, elec. designing dftsman., H. G. Acres & Co., Niagara Falls, Ont.
- Easton**, Wallace Moffat, B.Sc. (Mech.), Hon.M.E., (Clarkson Coll. of Technology), asst. divn. engr., Consolidated Paper Corp'n. Ltd., Shawinigan Falls, Ont.
- Fortin**, René, B.A.Sc., C.E. (Ecole Polytechnique), designing engr., B. R. Perry, M.E.I.C., constg. engr., Montreal, Que.
- Lapeyre**, Jean, ingénieur diplômé de l'Ecole Polytechnique et de l'Ecole Supérieure d'Electricité de Paris, tool engr., Engineering Products of Canada, Ltd., Montreal, Que.
- Miard**, Henry Thomas, B.A.Sc. (Civil), (Univ. of B.C.), senior asst. engr., Civil Aviation Division, Dept. of Transport, Lethbridge, Alta.
- Mills**, Cecil Gordon, B.Sc. (Elec.), (McGill Univ.), elec. engr., West Kootenay Power & Light Co., Trail, B.C.
- McIntyre**, Jacob Spence, B.A.Sc. (Univ. of Toronto) chief mech. engr., Armstrong, Wood & Co., Toronto, Ont.

**Patterson**, Wilfred Ernest, B.Sc. (Chem. & Met.), (Queen's Univ.), technical director, Merck & Co. Ltd., Montreal, Que.

**Pouliot**, Adrien, B.A.Sc., C.E. (Ecole Polytechnique), L.Sc. (Maths.), (Sorbonne, Paris), M.Sc. (Laval Univ.), Dean, The Faculty of Science, Laval University, Quebec, Que.

**Ransom**, Rosmore Howard, B.Eng. (McGill Univ.), Officers' Training Course, R.C.A.F., Montreal, Que.

**Sarault**, Gilles Edouard, B.Eng. (Elec.), (McGill Univ.), lecturer, Dept. of Electrical Engineering, Laval University, Quebec, Que.

### Transferred from the class of Junior to that of Member

**Baxter**, Gordon Bruce, B.Sc. (Elec.), (McGill Univ.), asst. elect. supt., Canadian International Paper Co., Three Rivers, Que.

**Benoit**, Jacques Emmanuel, B.A.Sc., C.E. (Ecole Polytechnique), dist. sales mgr., Wallace & Tiernan, Ltd., Montreal, Que.

**Colpitts**, Cecil Ashton, B.Sc. (Civil), (Univ. of Manitoba), divn. engr., C.P.R., Saskatoon, Sask.

**Denton**, Allan Leslie, B.Sc. (Elec.), (Univ. of N.B.), Navigation Instructor, (Pilot Officer), R.C.A.F., Chatham, N.B.

**Dickson**, William Leslie, B.Sc. (Elec.), (N.S.Tech. Coll.), B.Eng. (Mech.), (McGill Univ.), asst. chief engr., Deloro Smelting & Refining Co. Ltd., Deloro, Ont.

**Doddridge**, Paul William, B.Sc. (Elec.), (Univ. of N.B.), asst. switch-gear engr., apparatus sales dept., Can. Gen. Elec. Co. Ltd., Toronto, Ont.

**Eagles**, Norman Borden, B.Sc. (Elec.), (Univ. of N.B.), Engineering Instructor, No. 21 E.F.T.S., Chatham, N.B.

**Fisher**, Sidney Thomson, B.A.Sc. (Univ. of Toronto), development engr. & sales engr., Special Products Division, Northern Elec. Co., Montreal, Que.

**Laird**, David William, B.Sc. (Civil), (Univ. of Man.), designing engr., C. D. Howe Co. Ltd., Port Arthur, Ont.

**Powell**, John Giles, B.A.Sc. (Civil), (Univ. of Toronto), asst. engr., Gore & Storrie, constg. engrs., Toronto, Ont.

**Stewart**, Leslie Baxter, B.Sc. (Elec.), (McGill Univ.), powerhouse supt., Shawinigan Water & Power Co., Rapide Blane, Que.

**Sudden**, Edwin Alexander, B.A.Sc. (Univ. of Toronto), design engr., hydraulic dept., H.E.P.C. of Ontario, Toronto, Ont.

**Young**, William Hugh, B.Sc. (Mech.), (Queen's Univ.), mill engr., Brompton Pulp & Paper Co. Ltd., East Angus, Que.

### Transferred from the class of Student to that of Member

**Filion**, Paul, B.Eng. (Chem.), (McGill Univ.), engr., fire prevention dept., [Reed, Shaw & McNaught, Ltd., Montreal, Que.

**Smith**, Arthur James Edwin, B.A.Sc. (Civil), (Univ. of Toronto), Capt., R.C.E., Works Officer, M.D. No. 10, Fort Osborne Barracks, Winnipeg, Man.

### Transferred from the class of Student to that of Junior

**Auclair**, Charles A., B.A.Sc., C.E. (Ecole Polytechnique), gen'l. engr., Arthur Surveyer & Co., Montreal, Que.

**Campbell**, Gerald Arthur, B.Sc. (Civil), (Univ. of N.B.), c/o Mrs. Helen S. Hubbard, Beaverbrook Residence, Fredericton, N.B.

**Conklin**, Maurice, B.Eng. (Mech.), (Univ. of Sask.), tool designer, Canadian Propellers, Ltd., Montreal, Que.

**Hilbard**, Ashley Gardner, B.Eng. (Civil), (McGill Univ.), dftsman., bridge engr. dept., C.P.R., Montreal, Que.

**McBride**, James Wallace, B.Sc. (Elec.), (Univ. of Man.), S.M. (Aero), (M.I.T.), research associate, divn. of industrial co-operation, Mass. Institute of Technology, Cambridge, Mass.

**Stanley**, James Paul, B.Eng. (Mech.), (McGill Univ.), Flying Officer, engrg. divn., R.C.A.F. Headquarters, Montreal, Que.

### Students Admitted

**Bailey**, John Calvin, B.Sc. (E.E.), (Purdue Univ.), student engr., Can. Gen. Elec. Co. Ltd., Peterborough, Ont.

**Belyea**, James Louis, (Univ. of N.B.), Beaverbrook Residence, Fredericton, N.B.

**Goodfellow**, J. Bruce G., (McGill Univ.), 134 Cornwall Ave., Town of Mount Royal, Que.

**James**, Lourimer, (Mount Allison Univ.), 108 Pacific Ave., Moncton, N.B.

**Nachfolger**, Nathan, (McGill Univ.), 4359 Esplanade Ave., Montreal, Que.

**Macnab**, Edward Nelson, (Univ. of N.B.), Beaverbrook Residence, Fredericton, N.B.

**Roche**, Maurie John, (McGill Univ.), 3426 McTavish St., Montreal, Que.

**Smith**, Robert Rudolph, (Univ. of N.B.), 10 Paddock St., Saint John, N.B.

**Stone**, Daniel, (Univ. of Toronto), 46 Burnside Drive, Toronto, Ont.

## News of the Personal Activities of members of the Institute, and visitors to Headquarters

**R. deB. Corriveau**, M.E.I.C., assistant chief engineer of the Department of Public Works of Canada, was honoured recently at a presentation made to him upon his retirement effective September 1st, 1942, after 42 years of continuous service in the department. The presentation of a sterling silver tray was made by the Honourable J. E. Michaud, Minister of Public Works, before the assembled staff of the chief engineer's office. In addition to the address of the minister, Mr. Corriveau was also complimented by K. M. Cameron, M.E.I.C., chief engineer of the Department of Public Works and W. P. Harrell, acting deputy minister.



R. deB. Corriveau, M.E.I.C.



E. P. Murphy, M.E.I.C.

**E. P. Murphy**, M.E.I.C., has been appointed Deputy Minister of Public Works of Canada succeeding the late James B. Hunter. Mr. Murphy graduated from Queen's University and joined the Department of Railways and Canals in 1907 as engineer on the Trent Canal. From 1914 to 1918 he was engineer on the St. Peter's Canal, Cape Breton. Later he worked on the Cornwall Canal and on the Severn division

Born at West Hoboken, N.J., Mr. Corriveau was educated at McGill University, Montreal, where he received the degree of Bachelor of Science in 1900. During the summers of his university course he was engaged on railway location and harbour surveys. Following graduation, he entered the federal service in the Public Works Department and was first associated with the late chief engineer of the department, Arthur St. Laurent, past president of the Institute, on the construction of the Laurier Avenue bridge over the Rideau Canal at Ottawa. From that time until the death of J. H. Fraser, M. Can. Soc. of C.E., he was principal assistant to Mr. Fraser whom he succeeded as district engineer of the department, with headquarters at Ottawa. In 1923, when Mr. St. Laurent died, Mr. K. M. Cameron succeeded him as chief engineer of the department and Mr. Corriveau was appointed assistant chief engineer succeeding Mr. Cameron.

In his capacity as assistant chief engineer Mr. Corriveau has been associated for the past forty-two years with all the important projects carried out by the department on river and harbour work. In addition he did special development work on the St. Hubert airport from 1928 to 1930 and pursued intensive hydraulic studies in connection with the regulation of international waters.

The many friends of Mr. Corriveau in the engineering profession throughout Canada wish him every happiness and a long period of well-earned retirement.

**P. E. Doncaster**, M.E.I.C., district engineer for the Department of Public Works of Canada at Fort William, Ont., is at present with the engineering services of Polymer Corporation Limited, Sarnia, Ont.

**D. J. Emery**, M.E.I.C., chairman of the Peterborough Branch of the Institute, spent two weeks in Montreal last month attending a special course on chemical warfare given at McGill University under the auspices of the Directorate of Civil Air Raid Precautions. Mr. Emery was delegated by the Peterborough A.R.P. organization.

of the Trent Canal. From 1921 to 1930 he was division engineer on the construction of the Welland Ship Canal at Thorold, Welland and Port Colborne. From 1930 to 1934 he was superintendent of operations on the southern division of the Welland Canal and from 1934 to 1937 he was construction engineer. In 1937 he became engineer in the Department of Transport and at the outbreak of war in 1939 he was appointed construction engineer of the War Supply Board. Before his recent appointment Mr. Murphy was director of the Defence Projects Construction Branch in the Department of Munitions and Supplies at Ottawa.

**J. A. Lalonde**, M.E.I.C., chairman of the Montreal Branch of the Institute, has recently accepted a position as production manager with Marine Industries Limited at Sorel, Que.

**J. M. M. Lamb**, M.E.I.C., was reported in the last number of the *Journal* as having been appointed district engineer of the Department of Transport at Saint John, N.B. Mr. Lamb has been district engineer since 1940 and last July he was promoted to the position of agent of the Department of Transport, succeeding Colonel H. F. Morrisey, M.E.I.C., who died last summer.

**A. M. Reid**, M.E.I.C., of the Bell Telephone Company of Canada has been transferred recently from Toronto to Montreal as general employment supervisor. Mr. Reid is the secretary of the Institute Committee on Industrial Relations.

**Major J. P. Carrière**, M.E.I.C., has been appointed recently to the staff of the Directorate of Military Training at National Defence Headquarters and is in charge of engineer training and chemical warfare training. Major Carrière returned from overseas last spring to attend the Staff College at Kingston, Ont.

**C. O. P. Klotz**, M.E.I.C., is now employed as resident engineer with the Aluminum Company of Canada Limited at Kingston, Ont. He was previously located at Arvida, Que., with the same company.

**Dr. Paul E. Gagnon**, M.E.I.C., director of the Department of Chemistry at Laval University, Quebec, has been awarded the first prize of the scientific section in the 1942 Quebec provincial government's contests, commonly known as the David competitions. Dr. Gagnon was educated at Laval



**Dr. Paul E. Gagnon, M.E.I.C.**

University. He did post-graduate work in Paris during three years and spent 18 months at the University of London, England, as well as six months at the Massachusetts Institute of Technology, Cambridge, Mass. He joined the staff of the university as a lecturer in 1931 and became an assistant professor in 1932. He was appointed professor in the Faculty of Science in 1935 and he received his present appointment of director of the Department of Chemistry in 1938. Dr. Gagnon is also president of the Graduate School at Laval University.

**J. Frank Roberts**, M.E.I.C., has accepted a position as manager of the hydraulic department of Allis-Chalmers Manufacturing Company at Milwaukee, Wis. For the past six years he was connected with the Tennessee Valley Authority as senior mechanical engineer at Knoxville, Tenn., U.S.A. Mr. Roberts graduated from the University of Wisconsin in 1918 with the degree of Bachelor of Science and from 1919 until 1922 was testing engineer with the Allis-Chalmers Manufacturing Company. In 1922 he became sales engineer with the hydraulic department of the same company, and in 1924-1926 he was sales engineer in charge of the company's Canadian work for the hydraulic department. In 1927 he came to Canada as hydraulic engineer with the Power Corporation of Canada, Limited, at Montreal.

**H. J. McLean**, M.E.I.C., was offered a complimentary dinner last month by the Calgary Branch of the Institute jointly with the Rocky Mountain Branch of the Canadian Institute of Mining and Metallurgy and the Calgary district of the Association of Professional Engineers of Alberta, on the occasion of his transfer to Montreal as superintendent of construction with Montreal Engineering Company. Mr. McLean has been connected with the Calgary Power Company Limited since 1926. He was responsible for the construction of the Ghost Power Development of the company, and, as hydraulic engineer, he developed means of improving the hydraulic efficiency of the various stations of the company. He carried out investigations in connection with several storage projects. For the past two years he was actively engaged in the construction of the Cascade plant of the company.

Mr. McLean took a special interest in the activities of the engineering societies in Calgary and he was councillor of the Institute and chairman of the Calgary Branch. In 1940 he was president of the Association of Professional Engineers of Alberta and he was instrumental in bringing about the agreement between the Institute and the Association.

**Aimé Cousineau**, M.E.I.C., sanitary engineer of the Department of Health of the city of Montreal, has been appointed



**Aimé Cousineau, M.E.I.C.**

assistant director of the department in addition to his normal duties.

**R. J. Askin**, M.E.I.C., has been transferred recently from the position of mill manager of the Thunder Bay Paper Company Limited, at Toronto, to the position of assistant manager of mills with Abitibi Power and Paper Company Limited, at Toronto, Ont. Since his graduation from Queen's University in 1923 he has been connected with the Fort William Paper Company and later with the Abitibi Power and Paper Company.

**A. C. Abbott**, M.E.I.C., of The Shawinigan Water and Power Company has been transferred recently from Trois-Rivières to Montreal. Mr. Abbott has been with the company ever since his graduation from McGill University in 1926.

**Pilot Officer E. S. Braddell**, M.E.I.C., has been appointed technical adjutant of the maintenance squadron at No. 2 Flying Instructor's School, R.C.A.F., Vulcan, Alta. Previous to his enlistment in the Air Force, Mr. Braddell was with the Northern Electric Company Limited at Winnipeg, Man.

**Jean Bouchard**, M.E.I.C., is now located at Mackenzie, British Guiana, with Demerara Bauxite Company. For the past few years he had been employed with A. Janin and Company at Gaspé, Que.

**F. S. Small**, M.E.I.C., left the employ of the Hudson Bay Company, Flin Flon, Man., a few months ago, and is now with Fraser Brace Limited at La Tuque, Que.

**J. E. Neilson**, M.E.I.C., of Foster Wheeler Limited, has been transferred recently from Montreal to St. Catharines, Ont. He has been in the employ of the company since 1934. Upon his graduation from Queen's University in 1928 he went with the Riley Engineering and Supply Company Limited in Toronto, Ont., and remained in their employ until he joined Foster Wheeler.

**R. H. Riva**, M.E.I.C., is now superintendent with McGraw Construction Company, Inc., at Middletown, Ohio, U.S.A. Lately he had been with the Gary Armor Plate Plant, Gary, Indiana.

**W. C. Tatham**, M.E.I.C., was appointed works engineer of the nylon division of Canadian Industries Limited last

March and has been located in Kingston, Ont., since then. Previous to joining Canadian Industries Limited Mr. Tatham was assistant chief engineer with Courtaulds (Canada) Limited at Cornwall, Ont.

**Lieut. J. P. Leroux**, M.E.I.C., graduated last month from the Officer's Training Centre at Brockville, Ont. Before joining up he was resident engineer with the Mont-Joli Airport, Mont-Joli, Que. He graduated from the Ecole Polytechnique in 1939.

**Colonel M. P. Jolley**, Jr.E.I.C., who was with the Department of National Defence Headquarters at Ottawa is now president and general manager of Small Arms Limited, Long Branch, Ont.

After his graduation with honours in mechanical engineering from McGill University in 1933, he studied at the Military College of Science, Woolwich, Eng., and qualified as an ordnance mechanical engineer. During the years 1935 and 1936 he made a survey of small arms production in England. He returned to Canada in 1936 and became assistant to the director of artillery and mechanization at National Defence Headquarters, Ottawa.

**Lieut. René Leduc**, Jr.E.I.C., graduated last month from the Officer's Training Centre at Brockville, Ont. Before he enlisted, Lieut. Leduc was employed with Consolidated Paper Corporation Limited at Montreal.

**H. E. Hewitt**, M.E.I.C., is now employed at the International Coal and Coke Company Limited at Coleman, Alta., as assistant engineer.

**Major A. P. Boutilier**, R.C.E., Jr.E.I.C., is chief works officer with the Department of National Defence, engineer services at Sydney, N.S. Previous to his enlistment he was with the Dominion Steel and Coal Corporation at Sydney.

**F. Allan Davis**, Jr.E.I.C., of British American Oil Company Limited has been transferred recently to the head office of the company in Toronto, Ont. He was previously refinery engineer at Montreal East.

**2nd Lieut. Raymond LeBel**, Jr.E.I.C., graduated this month from the Officer's Training Centre, Brockville, Ont., and is now stationed at Petawawa, Ont. Mr. LeBel left the employ of J. M. E. Guay, Incorporated, consulting engineers, Montreal, last August to join the Royal Canadian Engineers.

**René Dupuy**, Jr.E.I.C., of the British Air Commission has been posted at Canadian Car and Foundry Company Limited, Fort William, Ont. He was previously inspector in charge at Canadian Vickers Limited, Montreal.

**F. C. Read**, Jr.E.I.C., of Dominion Tar and Chemical Company, Limited, has been transferred from Montreal to the Toronto plant of the company.

**Harold T. Kummen**, S.E.I.C., has joined the Navy and is now stationed as a Probationary Sub-Lieutenant at Halifax, N.S. Since his graduation from the University of Manitoba in 1941 he had been with the Aluminum Company of Canada Limited at Arvida, Que.

**Richard Scott**, S.E.I.C., has joined the staff of the Department of Electrical Engineering of the University of Toronto. He was previously with Canadian General Electric Company Limited at Peterborough, Ont.

**J. E. Poole**, S.E.I.C., is now working in the engineering department of Defence Industries Limited, Montreal, having been transferred from the nylon division of Canadian Industries Limited, Kingston, Ont.

**V. G. Kosnar**, S.E.I.C., who was previously located in Trinidad, B.W.I., with Trinidad Leaseholds Limited, is now employed in the Naval Service of the Department of National Defence at Ottawa.

**W. R. Staples**, S.E.I.C., is now instructor in mechanical engineering with the University of Saskatchewan at Saskatoon, Sask. Mr. Staples graduated from the university in 1942 and lately had been located in Montreal, with Dominion Engineering Works.

**Irving I. Zweig**, S.E.I.C., has recently received an appointment as senior research assistant in the division of physics and electrical engineering, National Research Council, Ottawa.

**P. G. Wolstenholme**, Affil. E.I.C., has been transferred from the Montreal office of the Aluminum Company of Canada Limited to the company's plant at La Tuque, Que.

## VISITORS TO HEADQUARTERS

**Jean Morency**, Jr.E.I.C., Bureau of Mines, Quebec, on September 3rd.

**Gilbert Padley**, Jr.E.I.C., from Trinidad, B.W.I., on October 8th.

**Viggo Jepsen**, M.E.I.C., chief draftsman, Consolidated Paper Corporation Limited, Grand'Mère, Que., on October 10th.

**J. Phileas Villemure**, Jr.E.I.C., superintendent of city works, Grand'Mère, Que., on October 10th.

**Rosaire Saintonge**, S.E.I.C., Consolidated Paper Corporation Limited, Port Alfred, Que., on October 10th.

**John E. Cade**, M.E.I.C., assistant chief engineer, Fraser Companies Limited, Edmundston, N.B., on October 15th.

**D. J. Emery**, M.E.I.C., designing engineer, Canadian General Electric Company Limited, and chairman of the Peterborough Branch of the Institute, Peterborough, Ont., on October 20th.

**D. C. Tennant**, M.E.I.C., engineer, Ontario Division, Dominion Bridge Company Limited, Toronto, Ont., on October 22nd.

**S. D. Levine**, S.E.I.C., Crucible Steel Company, Newark, N.J., on October 22nd.

**H. T. Kummen**, S.E.I.C., from Arvida, Que., on October 22nd.

## Obituaries

*The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.*

**Harold Stanley Johnston**, M.E.I.C., chief engineer of the Nova Scotia Power Commission died at his home in Halifax on Tuesday, October 6th, 1942. He had been in ill health for the past year and confined to his home for a month. Born at Gananoque, Ont., on February 21, 1885, he graduated from McGill University in civil engineering in 1911 with honours in railway engineering after working some years with the Canadian Pacific Railway on construction jobs.

He was for some time assistant hydro-electric engineer with Smith, Kerry and Chase, engineers, in Nipissing, Ont., and later engineer in charge of construction with the Calgary Power Company at Horseshoe Falls, Alta. After 18 months in the armed forces he served in the engineering branch of the Department of Soldiers Civil Reestablishment at Calgary.

Mr. Johnston came to Nova Scotia in 1920 to join the staff of the Nova Scotia Power Commission and in a few years was promoted to chief engineer, the post he held until the time of his death. Keenly interested in the affairs of the community, he was an active member of All Saints Cathedral, former member of the executive of the Halifax Y.M.C.A. and until a year ago chairman of the Y.M.C.A. Service Men's Hostel, a member of the Halifax Club and the Commercial Club.



Harold Stanley Johnston, M.E.I.C.

Mr. Johnston joined the Institute as a Student in 1907. He was transferred to Associate Member in 1911 and he became a Member in 1922. He was a member of the Association of Professional Engineers of Nova Scotia since 1920, had served on its Council and was very active and instrumental in the drafting of the agreement now existing between the Institute and the Association of Professional Engineers of Nova Scotia.

**Lyall Radcliffe McCurdy**, M.E.I.C., died in the hospital in Montreal on October 9th, 1942, after a brief illness.

He was born at New Glasgow, N.S., on July 16th, 1897. He was educated at Dalhousie University, Halifax, and at McGill University in Montreal where he received the degree of Bachelor of Science in mechanical engineering, in 1921. He was granted the Master of Science degree in machine design from McGill in 1927, after writing a thesis on research work he had carried out concurrently with teaching. From

1922 to 1927 he was sessional lecturer and demonstrator in the Department of Mechanical Engineering at McGill and in 1927 was appointed lecturer in the same department. In 1936 he became assistant professor of mechanical engineering, a position which he occupied until the time of his death. Professor McCurdy had made a special study of journal bearing friction and he had conducted a special investigation on the efficiency and operating costs of towing equipment on the upper Ottawa River.

Mr. McCurdy joined the Institute as a Student in 1919, transferred to Junior in 1926, and became an Associate Member in 1929. In 1940 he became a Member.

**Lt.-Colonel Charles Rowlatt Townsend**, M.E.I.C., died on board ship and was buried at sea on October 11th, 1942. He had suddenly taken ill in Scotland and was returning to Canada.

Born at Victoria, B.C., on February 9th, 1891, he received his engineering education at the University of New Brunswick where he graduated with the degree of Bachelor of Science in 1920. Two years later he received his degree of Master of Science from the same university. He served in the Canadian Field Artillery in the last war and won the Military Medal.

Upon his graduation in 1920 he joined the air service division of the Laurentide Company Limited at Grand-Mère, Que., and was engaged during the next three years in aerial photography. In 1923 he was transferred to the logging division. In 1930 he became chief forester of the Canada Power and Paper Corporation and a few months later he was appointed manager of the Anticosti Island for the Consolidated Paper Corporation. In 1936 he came to Montreal as consulting forest engineer. Two years ago he went overseas with the Transport Section of the Canadian Forestry Corps.

Colonel Townsend joined the Institute as an Affiliate in 1927, transferring to Associate Member in 1934 and becoming a Member in 1940.

## News of the Branches

### BORDER CITIES BRANCH

J. B. DOWLER, M.E.I.C. - *Secretary Treasurer*  
W. R. STICKNEY, M.E.I.C. - *Branch News Editor*

On Friday, October 16, the president, Dean C. R. Young visited the Border Cities Branch, accompanied by Assistant General Secretary Louis Trudel. Along with several members of the Branch executive, they were taken on an inspection tour of the Ford Motor Company of Canada, then had luncheon in Detroit at the new Rackham Memorial Building with executive members of the American Society of Mechanical Engineers.

At the evening dinner meeting in the Prince Edward Hotel, by special arrangement in honour of the president's visit, the Border Cities Branch was host to the members of the Detroit Section of the American Society of Mechanical Engineers and several distinguished American engineers. H. L. Johnston, branch chairman, acted as chairman and toastmaster and after introducing the members and distinguished guests at the head table, called on Mr. C. M. Goodrich, consulting engineer of the Canadian Bridge Company, who proposed a toast to the American Society of Mechanical Engineers. In responding to the toast, Dr. J. W. Parker, president of the American Society of Mechanical Engineers, paid tribute to the co-operative work being done by engineers in Canada and the United States in our war effort. He also spoke of attending the annual meeting of The Engineering Institute of Canada in Montreal, and how much he was moved by the tremendous affection demonstrated at that time for their scientist and military leader, Lieutenant-General A. G. L. McNaughton.

### Activities of the Twenty-five Branches of the Institute and abstracts of papers presented



From left to right: J. W. Armour, Dr. James W. Parker, Dean C. R. Young and Chairman H. L. Johnston.

Mr. Armour, chairman of the Detroit Section of the American Society of Mechanical Engineers, introduced Dean C. R. Young who spoke on **The Engineer and the Technologist**. He described a technician as a person skilled in mechanical art or trade but with no knowledge of the science underlying that art or trade; a technologist as a person who possesses unusual knowledge of one branch of a science or scientific process but without the ability to

## HALIFAX BRANCH

S. W. GRAY, M.E.I.C. - *Secretary-Treasurer*  
G. V. ROSS, M.E.I.C. - *Branch News Editor*

The first fall meeting of the Halifax Branch was held at the Halifax Hotel on October 22, with Mr. J. R. Sutherland as the guest speaker.

Mr. Sutherland is the editor of the *New Glasgow Evening News* and has just returned from a six weeks visit to the British Isles as a guest of the Canadian Government. He spoke of many interesting phases of life in Britain, and particularly of the work he saw being done by engineers in the Canadian Army.

Mr. Sutherland stated that General McNaughton "is extremely well thought of in England, particularly by the Americans, who told me if they had their choice, General McNaughton would be put in charge of all the Allied Nations technicians."

The scroll of the Engineering Institute prize was presented to William Henry Bowes, student at the Nova Scotia Technical College, by J. R. Kaye.

About 70 persons were present including several senior students of the Technical College. For some years, the Branch has endeavoured to have all the senior engineering students attend one of the dinner meetings as guest of the Branch.

P. A. Lovett was chairman of the meeting.

## HAMILTON BRANCH

A. R. HANNAFORD, M.E.I.C. - *Secretary-Treasurer*  
W. E. BROWN, Jr., E.I.C. - *Branch News Editor*

In the Westinghouse auditorium on October 6th, John A. M. Galilee and L. A. Shaver, both members of the Canadian Westinghouse Company, spoke on the subject entitled **P.C.C. Street Railway Cars.**

The occasion was a joint meeting of the Hamilton Group of the American Institute of Electrical Engineers and the Hamilton Branch of the Institute. J. T. Thwaite, chairman of the former group, occupied the chair assisted by Stanley Shupe, chairman of the Hamilton branch of the Institute.

Mr. Galilee introduced the subject of the P.C.C. cars which are now in use by the Toronto Transportation Commission and also in other cities on this continent. In view of the serious situation regarding automobiles, the public transit industry has assumed great importance at this time. Only a few years ago it was generally considered that street cars were going out and yet today Toronto has 140 new P.C.C. cars in operation and has more on order.

In the 1920's the street car business flourished but in the 1930's the automobile caused a decline of revenue. The following figures are very interesting and are indicative of the trends. The population of Toronto is 875,000 and the number of passengers carried per year is: 1922—187,000,000; 1923—189,000,000; 1929—206,000,000; then comes the lowest year, 1930—148,000,000; 1940—168,000,000; 1942—238,000,000 (forecast). The declining revenue in the 1930's worried the public transit ownership and the association of the various transit companies on the continent realized that a better street car was imperative. As the representatives of these companies were principally presidents, the 1932 gathering was called the Presidents Conference Committee, hence the name P.C.C. cars. The committee invited the co-operation of the transit companies and the manufacturers of every part that goes into a car, and funds were raised to build a car that would compete with the automobile. The first P.C.C. car was built in 1935, its object was to regain public favour and its improvements were many: smooth rapid acceleration of 4.7 m.p.h. per sec. with retardation at the same rate and with a maximum rate of speed of 45 m.p.h. on level track; good lighting for reading; streamline appearance; windows comparable to an automobile; clean hand rails; modern heating and ventilation; rubber springs and also magnetic hand brake. Lantern slides illustrated the historical background of the street car from the time of

co-ordinate many phases of scientific study. The engineer is the utilizor of many arts and sciences, not necessarily proficient in any one of them, but with judgment and discernment he can employ and direct the labours of other men and act as general co-ordinator.

In these days it is appropriate to develop technologists, since we cannot afford time to get men wholly trained for work which must be done. Such men are much in demand now, but difficulties will arise in placing these wartime specialists in the post-war world where their efforts will be most profitable.

There is a distinct attraction in the study of technology, and young men often make the mistake of ignoring the broad view of engineering. The point of view of the engineer is of far greater importance than the limited viewpoint of the pure technologist. During depression years, many charges were laid against engineers for supposed failure to recognize human values and needs. That danger does exist but it must be overcome. Engineers should know and appreciate what constitutes a profession, and should get away from the idea that engineering is a technological study. They must not spend all their time in the fascinating study of a particular science, but realize they have a duty to society and a trusteeship imposed on them as professional men similar to other professional men. Properly regarded, engineering is a very learned profession involving the solution of many problems having both scientific and human backgrounds.

Mr. J. Clark Keith, past vice-president of the Institute, moved a vote of thanks to Dr. J. W. Parker, and Mr. A. M. Selvey, past chairman of the Detroit section of the American Society of Mechanical Engineers, moved a vote of thanks to Dean Young. Motion for adjournment was made by Councillor E. M. Krebsler.

## CALGARY BRANCH

K. W. MITCHELL, M.E.I.C. - *Secretary-Treasurer*  
J. N. FORD, Jr., E.I.C. - *Branch News Editor*

Mr. C. A. Price of Hamilton, chief engineer of the Canadian Westinghouse Co., was the guest speaker at a special meeting held by the Calgary Branch on September 25th in the Palliser Hotel.

The subject of the speaker's address was **Recent Electrical Developments.** Mr. Price pointed out that due to present day shortages in certain materials such as cork, rubber, tin solder and babbitt, much effort has been directed to the discovery of substitutes for these materials which are so vital in the manufacture of electrical apparatus. Great strides have been made in this direction with compounds of lead, copper and silver playing their part in the making of these substitutes. Friction and ball bearings have also given way to sleeve bearings which are more easily repaired.

One of the most recent developments in the electrical field is the use of the mercury arc rectifier as a frequency changer. The efficiency of this rectifier is six per cent higher than any type of frequency changer in present day use. The speaker also stated that carrier current relaying has been developed to a point where it will perform any relay operation needed.

"Present day requirements call for closer design and higher speeds in electrical apparatus with the result that the use of synchronous condensers and the flywheel effect has been increased considerably," stated Mr. Price.

At the conclusion of the speaker's address Mr. McEwen expressed the appreciation of the meeting, for an interesting account of present day developments.

The second part of the evening's programme was sponsored by the Canadian General Electric Co. with some very interesting moving pictures in technicolour on "Welding." These pictures showed remarkable photography and stressed the four important points in welding, namely, speed of travel, length of arc, angle of electrode and current setting.

the horse drawn cars. A movie of the P.C.C. car in motion was shown.

Mr. Shaver, control engineer, showed that the design had two objects, better riding comfort for the passengers and a saving of weight. The P.C.C. car is driven by four 55 hp. motors, each weighing 4,000 lb. as compared to the previous latest car having four 40 hp. motors each weighing 7,000 lb. The speaker explained that the operation is entirely automatic and he gave a very lucid description of the control which allows such rapid acceleration and retardation with a maximum of safety for the public.

W. Hollingworth, moved a vote of thanks to the speakers for this very able and instructive lecture and he also expressed the thanks of the Hamilton Branch to the Canadian Westinghouse Company for the use of the auditorium. The attendance was 150.

### MONTREAL BRANCH

L. A. DUCHASTEL, M.E.I.C. - *Secretary-Treasurer*  
WILLIS P. MALONE, M.E.I.C. - *Branch News Editor*

The first meeting of the 1942-43 season opened on October 8th with a lecture on **Aquifers and Water Wells** by J. W. Simard.

Water has always been one of the prime needs of man and his migrations have always taken him where there were adequate supplies of surface water. More recently he has been turning to ground water as a source of supply.

The source of all water supply is rainfall. When rain falls on impervious ground it finds its way to small streams, rivers, lakes, and finally the oceans. Falling on pervious ground, it seeps through to form a reservoir deep in the subsoil, ready to be tapped and used. Deep wells are sunk down to the reservoir and the water pumped up. These wells should not be confused with artesian wells where the water issues under pressure from a fissure in rock.

A typical deep well is the gravel wall well. It consists of an outer casing, an inner casing, and a screen which is attached to the inner casing. The pump is located in the inner casing near the bottom and is operated through a shaft by motive power above the ground. The outer casing is first put in position, followed by the inner casing with the screen on the end. The annular space between the casings is filled with gravel. Water is pumped up through the inner casing, and with the water come fine particles of sand and clay. As the fine particles are removed the screen and inner casing are gradually lowered until the end of the inner casing is on a level with the end of the outer casing, the screen being below this level. The gravel in the annular ring moves down around the screen to form a filter bed. This gravel keeps fine particles out of the water being pumped and minimizes wear in the pump.

A typical installation with a 12 in. diameter inner casing will deliver 1,000 gallons per minute with a pump efficiency of 80 per cent. A well supplying 2,000,000 gallons per day is considered a large well.

In the United States today 50,000,000 people use ground water. Of these 20,000,000 are supplied through public works. This gives some idea of the extent to which this system of water supply has been developed.

Following the lecture refreshments were served in the reading room.

\* \* \*

On October 15th Mr. Z. Krzywoblocki gave a lecture on **Air Power Theories and Aviation Progress in Reality**, outlining the various theories that have been expounded on the use of air power in warfare, and the development of the airplane since the last war.

The use of air power in the last war was based on the theory of collaboration with the ground forces.

About 1921-23 Italy was responsible for the theory that with command of the air the enemy could eventually be made to capitulate.

Then followed about 1933-35 the French theory that air power should be flexible—that flyers should be trained to

operate in either small units or large units, or even singly, as occasion demands. Hence they introduced the all-purpose plane.

The Douhet theory, as exemplified by the German Luftwaffe had its first trial in Spain. Since that time it has had many trials with varying successes and failures. The successes include Poland, where in three days the Germans gained control with their 8,000 planes against Poland's 1,000; Finland, where Russia used 400 bombers at Helsinki; Norway, where air power was victorious over sea power; France, where the old type French planes were no match for those of the Luftwaffe. It has failed in Great Britain; and Crete cannot be counted a success, as the loss of planes was so great and first honours went to the air-borne infantry.

The success of the Douhet theory depends on a huge quantity of bombers. These are costly and short-lived, and mass production of them demands standardization of all industry, with specialists and skilled workmen in the plants. Ten trained men are required on the ground for every man in the air. Fuel is required in enormous quantities.

Great progress has been made in the development of the airplane since the last war. The experience of the last war pointed the way for this progress in the matters of design and armaments. The monoplane became the basic type and metal the basic material, although wood has come into fairly wide use in the past ten years. With increase in speeds, instruments have become more important and great improvements have been made.

This war has seen no structural changes, no material changes, no startling developments in bombs, no new records in speed or altitude. Progress has been made in the speeds of normal planes—these tend to approach record speeds—in navigation and radio, in high altitude and ocean flying, in armaments. The major effort has been expended in increasing production rather than in development of quality.

\* \* \*

**Air Bombing and Structural Defence** was the subject of the lecture given on October 22nd by D. C. Tennant. Mr. Tennant described various types of bombs, their effects, and the defence means that have been developed.

The main types of bombs in use are fragmentation bombs, demolition bombs, and incendiary bombs. The fragmentation bombs are designed to explode on contact, expelling the fragments at a velocity of about 7,000 ft. per second. They have more effect on people in the vicinity than on buildings. Demolition bombs have delayed action fuzes and penetrate the ground or buildings before exploding. Bombs vary in weight from 20 pounds to 2 tons.

The explosion of a bomb radiates a pressure wave which is followed almost instantaneously by a suction wave. The latter causes the walls of buildings to fall outwards, and in the case of wall-bearing structure, the building or part of it collapses. Reinforced concrete structures withstand bomb explosions best. One reason that so much damage has been done to buildings in Great Britain is that most of the buildings are wall-bearing, and reinforced concrete construction is rare.

Important buildings are camouflaged to look like fields or orchards, while in a field perhaps half a mile distant, a dummy skeleton of the factory is built.

Shelters of various types and sizes have been built in Britain. The most popular is the Anderson shelter designed for family use. It is made of corrugated steel and partly sunk in the ground. This shelter will suffer considerable distortion but cases of total collapse are rare. Communal shelters are made of reinforced concrete, and to withstand a direct hit the roof is made ten feet thick. Tunnels make effective shelters and are used where they are available. In Chunking 400,000 people are accommodated in tunnels.

In this country the need of air shelters, in the event of air raids, would not be nearly so great as in Great Britain because our multi-storied buildings of reinforced concrete would offer a high degree of protection.

## OTTAWA BRANCH

A. A. SWINNERTON, M.E.I.C. - *Secretary Treasurer*  
R. C. PURSER, M.E.I.C. - *Branch News Editor*

A joint evening meeting with the Ottawa branch of the Canadian Institute of Mining and Metallurgy was held at the National Research Council auditorium on October 22. O. W. Titus, B.A.Sc., chief engineer of the Canada Wire and Cable Company Limited, Toronto, spoke on **Copper Mining in Arizona**, his address being accompanied by a motion picture relating to the subject.

Copper, as one of the earliest metals known to man, was used for making weapons of war and played an important part in the rise and fall of early empires. The speaker paid tribute to the sagacity of the earliest copper miners. "Modern prospectors," he said, "could teach the early Roman prospectors nothing."

Methods used in extracting copper in Arizona were shown in the film, as well as the course for the open pits and deep shafts to the smelters. Modern machinery as used in copper production and means of maintaining a high standard of safety were also depicted.

N. B. MacRostie, chairman of the Ottawa Branch of the Institute, introduced the speaker. He was thanked by Ralph Bartlett, vice-chairman of the local branch of the Canadian Institute of Mining and Metallurgy.

A joint evening meeting with the Ottawa section of the Society of Chemical Industry was held at the National Research Council auditorium on September 25. Dr. I. M. Rabinowitch, M.D., M.Sc., of McGill University addressed the meeting on the subject of **Chemical Warfare**, with particular reference to the use of poisonous substances in air attacks and methods of decontamination of persons and property. He had spent considerable time in England studying this subject under "blitz" conditions.

Dr. Rabinowitch said that of all the thousands of chemical substances with poisonous qualities, only a dozen or so have practical military application, the two general classes being: non-persistent, such as tear gas, and persistent blister gases of the "mustard" class, which included arsenicals. "The worst part of the blister gases," he said, "is their insidious approach. A person might be beyond medical aid before he realized he had been contaminated." Such gases seeped through clothing and boots and caused total blindness if even one drop got in the eye, and serious blisters if on the skin. They could last weeks or months, could get into shelters ordinarily safe against bullets or bombs, and were much more economical than explosives.

"If the Germans should attack Canada," he said, "they would probably use the mustard gases with high explosives." The presence of the gas greatly complicated first aid, repairs and cleaning up after raids. The speaker advised his listeners never to look up in the air during a gas raid "since you would likely get enough gas to cause blindness."

## SASKATCHEWAN BRANCH

STEWART YOUNG, M.E.I.C. - *Secretary Treasurer*

The Saskatchewan Branch met jointly with the Association of Professional Engineers in the Kitchener Hotel, Regina, on Wednesday evening, October 21, 1941. After dinner, at which the attendance was 45, adjournment was made to the Crime Detection Laboratory, R.C.M.P. Barracks where Surgeon (Dr.) Maurice Powers, Director of Criminal Investigation for Canada, explained the organization of the laboratory, afterwards showing a film depicting the "Hit and Run Driver." Following this, those in attendance were shown by Sgt. J. I. Mallow, B.Sc. (Eng.) and Corp. J. Robinson through the laboratory and given explanations of the various microscopes, photographic and chemical equipment, spectroscope and the museum of criminal investigation display. The latter included samples of forged documents, counterfeit notes and coins, fingerprints, masks and weapons of various description.

## ST. MAURICE VALLEY BRANCH

VIGGO JEPSEN, M.E.I.C., *Chairman*

The St. Maurice Valley Branch held a meeting in Shawinigan Falls on Thursday, October 22, 1942, at the Cascade Inn. The attendance was approximately one hundred.

The speaker was Mr. A. W. Whitaker, Jr., general manager of the Aluminum Company of Canada, Limited.

In his address Mr. Whitaker dealt with the history of his company at Shawinigan Falls and the progress it has made since its inception. He also referred to the early history of Shawinigan itself and how the Aluminum Company of Canada had come into the picture through the development of power by the Shawinigan Water and Power Co., in 1899.

Mr. Whitaker explained how the development of hydro-electric power had been the means of establishing the aluminum industry in Canada, and at Shawinigan Falls, the first plant to be erected, contemporaneous with the installation of the first power units thirty years ago, was that of the Northern Aluminum Company, which commenced operations in 1901. He told of the utility and value of the plant at Shawinigan and how it had contributed to the industrial progress of the Dominion.

In referring to the history of the plant at Shawinigan, Mr. Whitaker mentioned that since 1901, the output has increased enormously, especially since the beginning of the present war. The first power contract, he said, was signed in 1899.

The Shawinigan plant has had its difficulties, but today, the plant is working at full capacity on the production of war materials. Mr. Whitaker also related the story of the company's activities at Arvida and of the giant new plant that was built there, as well as the new power development at Shipshaw. He spoke of the various developments of the company since then and every increasing expansion of the industry. He told of how it had progressed from comparatively small beginnings to a great enterprise. The story of the Aluminum Company of Canada is an interesting one, a story which tells of the rapid progress and enormous expansion that has taken place. The company has been expanding in a number of places and its production has increased enormously. The terrific rate of expansion which it has had to deal with has presented problems of great importance. Additional equipment and man-power were necessary. More and more aluminum had to be made for war purposes. The company has had to build new plants and borrow money in order to make aluminum more quickly. Its record of achievement has been remarkable and Mr. Whitaker made the story very interesting to an appreciative audience.

The speech was illustrated with many lantern slides.

The speaker was introduced by Mr. P. Radley and thanked by Mr. H. G. Timmis. The Branch chairman, Viggo Jepsen, presided over the meeting.

## VANCOUVER BRANCH

P. B. STROYAN, M.E.I.C. - *Secretary-Treasurer*  
A. PEEBLES, M.E.I.C. - *Branch News Editor*

**The Design and Construction of the Scanlon Dam**, was the subject of a paper given before the Vancouver Branch on October 22nd in the Medical-Dental Building. The speaker was William Jamieson, field engineer for the Powell River Co. Ltd., Powell River, B.C.

The pulp and paper plant of the Powell River Co. Ltd. is situated on the B.C. coast, about 70 miles north of Vancouver. Additions to this plant completed in 1926 included development of the hydro-electric system to its full economic capacity. When further expansion was undertaken in 1929, a new source of power had to be found, and a site was chosen near Stillwater, 17 miles south of Powell River. Here, the Lois river forms the outlet from Gordon Pasha lakes, and several smaller lakes in the same drainage basin of some 480 square miles.

Temporary development was carried out at this site to provide for immediate requirements, but plans included additional work when future increase in capacity should be required. The power house was completed but only one 18,000 Kva. generator was installed. Extensive borings were made and a geological survey carried out to determine the best site for a future permanent dam. Above this point a temporary log crib structure was built, providing storage and a 350 ft. head above the power house.

From this dam a 12 ft. diam. wood penstock carried the water to a point below the permanent dam site, where it joined a section of reinforced concrete pipe. A tunnel was bored, approximately a mile long and 12 ft. in diam. from which a steel penstock continued down to the power house at tide-water. A feature of this penstock is its surge tank which is a well known landmark for travellers along the coast. All this work, with the exception of the log dam, head-works, and wood penstock, was part of the ultimate development.

It was believed that after four or five years, the permanent dam would be required, but business conditions did not warrant further capital outlays and the work was delayed. However, nature intervened and after nine years, serious deterioration had taken place in the log crib dam and its head-works, and expensive repairs were indicated. An expert survey indicated that rot and termites had found favourable conditions in the structure and had attacked it rapidly. The logs were not peeled or treated, a fact which hastened their decay.

It was decided to proceed with the permanent dam, rather than spend money on repairs. The structure recently built is of the variable radius arch type, 980 ft. long at the base and 780 ft. long on the crest, 8 ft. thick at the top and 37 ft. at the bottom. The height is 205 ft. though the dam has not been carried to its final height except at the intake structure. The spillway, at one end, is still a rock excavation only. At some future time it will be concreted, and provided with four taintor gates 20 ft. wide, and one 10 ft. wide.

Focal points were established for the radii at each construction joint and carefully referenced. As all the foundation excavation was in rock, the area was contoured very carefully, and the grid maintained by painting lines of various colours on the rock as drilling and removal proceeded. Bedrock was 50 ft. below the river bed, and timber shafts were employed during excavation. The temporary wood stave penstock crossing the site had to be kept in service; so it was supported by timber trusses resting on un-excavated ground at the limits of the foundation area. Settlement started at one end of these, and a square pier of reinforced concrete had to be built from the bottom of a shaft sunk to bedrock, to carry one end of the trusses. This was later incorporated into the dam. The area was kept dry by several pumps and a series of wellpoints. A 6 ft. diam. concrete culvert was used to pass the river flow during construction, being later sealed with concrete. Water stops of steel, 16 in. wide, with copper seals, were placed in each construction joint. Concrete was placed in blocks and no artificial cooling was provided for.

Maximum design stress in the concrete was 780 lb. per sq. in. The mix contained 376 lb. of cement per cu. yd. and included three sizes of gravel and sand. Maximum aggregate size was 4 in. All concrete was vibrated after being deposited from swinging derricks or buggies. Before placing the first concrete, holes from 24 to 27 ft. in depth were drilled in the foundation and grouted to fill up any seams in the rock and minimize seepage.

The contract was for a lump sum, and quantities included 50,000 cu. yd. of rock excavation and 61,000 cu. yd. of concrete. Mr. B. C. Condit was consulting engineer and contractors were Stuart Cameron and Co. Ltd. The total sum involved was \$1,100,000.

Following his address, Mr. Jamieson displayed many interesting photographs and plans of the work. The chairman of the branch, W. O. Scott, presided, and 30 members were present.

## Library Notes

### ADDITIONS TO THE LIBRARY

#### U.S. Bureau of Mines—Miners' Circular:

No. 43—Some haulage safety devices for use on grades, slopes and inclined shafts.

#### U.S. Geological Survey—Water Supply Papers:

No. 887—Methods for determining permeability of water-bearing materials. 897—Surface water supply of the U.S.A. 1940: pt. 7, Lower Mississippi River basin. 899—Surface water supply of the U.S.A. 1940: pt. 9, Colorado River basin. 906—Water levels and artesian pressure in observation wells in the U.S.A. in 1940: pt. 1, Northwestern States. 907—Water levels and artesian pressure in observation wells in the U.S.A. in 1940: pt. 2, Southeastern States. 909—Water levels and artesian pressure in observation wells in the U.S.A. in 1940: pt. 4, South Central States.

#### U.S. Geological Survey—Professional Papers:

No. 197A—Alkalic rocks of Iron Hill, Gunnison County, Colorado. 197B—Oligocene foraminifera near Miltry, Alabama.

### AIR RAID PRECAUTIONS

#### Canadian Engineering Standards Association—ARP Specifications:

No. 501—Strengthening of cellars in houses. June, 1942.  
No. 502—Blackout illumination. June, 1942.

### Book notes, Additions to the Library of the Engineering Institute, Reviews of New Books and Publications

No. 503—Specification for street lighting during blackouts. July, 1942.

No. 504—Specification for blackout of buildings. July, 1942.

#### TECHNICAL BOOKS

##### Principles of Heat Engineering:

Neil P. Bailey. N.Y., John Wiley and Sons, Inc., 1942. 6 x 9 1/4 in. \$2.75.

##### Oil Property Valuation:

Paul Paine. N.Y., John Wiley and Sons, Inc., 1942. 6 x 9 1/4 in. \$2.75.

##### Fundamentals of Electric Waves:

Hugh Hildreth Skilling. N.Y., John Wiley and Sons, Inc., 1942. 6 x 9 in. \$2.75.

##### Natural Trigonometric Functions:

To seven decimal places for every ten seconds of arc together with miscellaneous tables. 2nd ed. Howard Chapin Ives. 7 x 10 in. \$9.00.

#### PROCEEDINGS, TRANSACTIONS

##### Society for the Promotion of Engineering Education:

Proceedings of the forty-ninth annual meeting held at the University of Michigan, June 23-27, 1941. Pittsburgh, Office of the Secretary, 1942.

#### Smithsonian Institution:

Annual report of the Board of Regents for the year ended June 30, 1941.

#### Canadian Electrical Association:

Proceedings of the fifty-second annual convention, 1942.

#### REPORTS

##### The Asphalt Institute

Specification for the sand-asphalt road mix course on natural sand subgrade. No. RM-3—July 31, 1942.

##### Edison Electric Institute:

Specifications for single tube seamless copper splicing sleeves. TD-9, 1942.

##### American Institute of Electrical Engineers Standards:

No. 3—Proposed standard for guiding principles for the selection of reference values for electrical standards. June, 1942. No. 21—Standards for apparatus bushings and test code for apparatus bushings. June, 1942. No. 22—Standard for air switches and bus supports. June, 1942. No. 27—Standards for switchgear assemblies. August, 1942. No. 32—Neutral grounding devices. June, 1942.

## U.S. Bureau of Standards—Building Materials and Structures Reports:

Dimensional changes of floor coverings with changes in relative humidity and temperature, BMS85—Structural, heat-transfer and water-permeability properties of "Speedbrik" wall construction sponsored by the General Shale Products Corporation, BMS86—A method for developing specifications for building construction, BMS87—Structural properties of "Precision-Built, Jr." prefabricated wood-frame wall construction sponsored by the Homasote Co., BMS89—Structural properties of "PHC" prefabricated wood-frame constructions for walls, floors and roofs sponsored by the PHC Housing Corporation, BMS90.

## Cornell University—Engineering Experiment Station:

Some factors influencing the heat output of radiators. Bulletin No. 29, April, 1942.

## Edison Electric Company:

Cable operation 1940. A joint report of Committee on Power Distribution, Association of Edison Illuminating Companies and Transmission and Distribution Committee, Edison Electric Institute. Publication No. J3—August, 1942.

## War Production Board:

National emergency specifications for the design, fabrication and erection of structural steel for buildings. N.Y., The American Institute of Steel Construction, September, 1942.

## Illinois—State Water Survey:

Sandstone water supplies of the Joliet area. Bulletin No. 34, 1941.

## U.S. Department of Agriculture—Consumers' Counsel Division:

Inspection and control of weights and measures in the U.S.A. Publication No. 7.

## Canada—National Research Council:

The theory of some A-C commutator motors with series characteristics. Reprinted from The Canadian Journal of Research, vol. 20, May, 1942.

## American Institute of Steel Construction, Inc.:

Annual report for the year ending September, 1942.

## Quebec—Streams Commission:

Twenty-sixth report for the year 1937.

## American Telegraph and Telephone Company and the Edison Electric Company:

Wave shape of multi-phase rectifiers. Engineering report No. 49, April, 1942.

## The Electrochemical Society—Preprints:

No. 81-33—The electrolytic decomposition of aqueous ammonium chloride solutions. 82-7—The electric resistance and anisotropy of artificial graphite between 290° K and 12° K. 82-8—The specific heat equations for carbon dioxide, carbon monoxide, steam, hydrogen and oxygen and the free energy equation for the water-gas reaction. 82-9—An electrolytic study of linear diffusion of silver salts. 82-10—Absorption potentials at gas-solid interfaces. 82-11—Cathode films in tungstate-containing plating baths. 82-12—The effect of temperature on the rate of self discharge of lead acid storage batteries. 82-13—Reaction rates in ionic solutions. 82-14—The corrosion resistance afforded by bright dipped cadmium coatings. 82-15—Diffusion theory of the codeposition of gold and copper. 82-16—Ion-solvent interaction and individual properties of electrolytes. 82-18—Anodic treatment of plain carbon steels. 82-19—Some observations on the formation and stability of oxide films. 82-20 The adherence of thick silver plate on steel. 82-21—The structure of brush-plated silver.

82-22—An interpretation of the mechanism of bright electroplating. 82-23—The electrolysis of grignard reagents: short-lived free radicals in ethyl ether. 82-24—Tin plating from potassium stannate bath. 82-25—Studies on over-voltage xiii decay of cathodes potential in still and stirred solutions with hydrogen or with nitrogen.

## Bell Telephone System—Technical Publications:

The rate of oxidation of copper—The crystallinity of cellulose esters—Greensalt wood preservative—Electron diffraction studies on thin films—A secondary frequency standard—Inspection in a manufacturing plant—The future of transoceanic telephony—Monographs No. 1340-1346.

## U.S. Geological Survey—Bulletins:

No. 917D—Tertiary deposits of the eagle-circle district Alaska. 926B—Geology of the Gerstle river district, Alaska. 931C—Tin deposit at Majuba Hill, Pershing County, Nevada. 931E—Tungsten deposits in the Sierra Nevada near Bishop, California. 931F—Nickel deposits of Bohemia Basin and vicinity Yakohi Island, Alaska. 931G—Chromite deposits of Kenai Peninsula, Alaska. 931I—Nickel deposit near Riddle Douglas County, Oregon. 931J—Quick silver deposits in the Steens and Pueblo Mountains, Southern Oregon. 931L—Tin deposits of northern Lander County, Nevada. 931M—Manganese deposits in the Nevada district, White Pine County, Nevada. 931N—Quicksilver deposits of the opalite district Malheur County, Oregon, and Humboldt County, Nevada. 931O—Nickel deposit near Gold Hill Boulder County, Colorado. 931P—Mica-bearing pegmatites of New Hampshire. 931Q—Quicksilver and antimony deposits of the Stayton district, California. 932B—Geophysical abstracts 105, April, June, 1941. 932C—Geophysical abstracts 106, July, September, 1941. 933A—Mineral industry of Alaska in 1940.

## U.S. Bureau of Mines—Bulletins:

No. 425—Magnetic separation of ores. 445—Plastic and swelling properties of bituminous coking coals. 446—Typical analyses of coals of the U.S.A. 447—Quarry accidents in the U.S.A. during 1940. 448—Coal accidents in the U.S.A., 1940.

## U.S. Bureau of Mines—Technical Papers:

No. 626—Analyses of West Virginia coals. 634—Carbonizing properties and petrographic composition of lower lignite-bed coal from the Atlas mine, Middlesboro, Bell County, Ky., and the effect of blending this coal with Pocahontas No. 3 and No. 4 bed coals. 638—Photomicroscopy of salt in petroleum. 639—Bibliography of Bureau of Mines investigations of coal and its products 1935 to 1940. 643—Theoretical calculations for explosives.

## BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet the books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

## AIRCRAFT ENGINE MAINTENANCE

By J. H. Suddeth. John Wiley & Sons, New York: Chapman & Hall, London, 1942. 374 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$2.75.

In addition to covering thoroughly proper methods of inspection, servicing and repair, this work goes extensively into construction and operating principles, as a background for practical work. Engine components, fuels, fuel systems, carburation, lubrication, ignition, instruments, accessories and propellers are described in detail.

## AIRPLANE STRUCTURAL ANALYSIS AND DESIGN (Galcit Aeronautical Series)

By E. E. Sechler and L. G. Dunn. John Wiley & Sons, New York: Chapman & Hall, London, 1942. 412 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, \$4.00.

The material in this book is divided into three major parts: preliminary considerations in design; methods of structural analysis; and applied stress analysis. The treatment of the standard structural problems has been held to a minimum. Emphasis is placed on the presentation of most of the recognized design criteria, with experimental evidence, when available, as to their exactness. Literature references accompany each chapter.

## AMERICAN HIGHWAY PRACTICE, Vol. 2

By L. I. Hewes. John Wiley & Sons, New York: Chapman & Hall, London, 1942. 492 pp., illus., diagrs., charts, tables 9½ x 6 in., cloth, \$6.00.

The second volume of this treatise is devoted to pavements of asphalt, concrete and brick. Penetration macadam, sheet asphalt, asphaltic concrete, cement concrete and brick roads are treated comprehensively, with some attention to their origins and historical development, and full information on current American practice. The design of cement-concrete pavement mixtures and concrete road slabs is given special attention, and a chapter is devoted to small bridges, culverts, guard rails, etc., Each chapter has a bibliography.

## AMERICA'S FUTURE PATTERN

By E. S. Cornell, Jr., author and publisher, Larchmont, New York, 1942. 214 pp., diagrs., charts, tables, 8 x 5 in., cardboard, \$1.50

The author presents a picture of our present economic situation, explains what brought it about and indicates the correctives which he feels are necessary. Chapters upon politics, religion, education and law are included as belonging to the complete picture.

## AMERICAN ELECTRICIANS' HANDBOOK

By T. Croft, revised by C. C. Carr. 5th ed. McGraw-Hill Book Co., New York and London, 1942. 1,634 pp., illus., diagrs., charts, tables, 8 x 5 in., lea., \$5.00.

The new edition of this well-known reference book has been thoroughly revised and considerably expanded, new sections on the properties and splicing of conductors and on general electrical equipment and batteries have been added, and others have been rearranged. The book aims to meet the needs of those having little technical training by providing accurate information, based on correct engineering principles, in simple language.

## BLUEPRINT READING FOR THE METAL TRADES

By W. A. De Vette and D. E. Kellogg. Bruce Publishing Co., Milwaukee, Wis., 1942. 132 pp., blueprints, diagrs., charts, tables, 11 x 8½ in., cloth, \$2.50.

Practical instructions are given for the interpretation of blueprints of machine parts. The text is illustrated by numerous actual blueprints for explanation or for practice work. The material is presented in such a way as to be of assistance to the mechanic who must make sketches himself, and a large group of miscellaneous problems and check sheets is included.

**CODE OF MINIMUM REQUIREMENTS FOR INSTRUCTION OF WELDING OPERATORS Part A—Arc Welding of Steel 3/16 to 3/4 in. thick (tentative).** American Welding Society, 19 West 39th St., New York, 1942. 68 pp., illus., diagrs., charts, tables, 9 x 6 in., paper, 50c.

This publication is a revision of the "proposed" code issued by the American Welding Society in 1941, which was adopted by the

War Production Board for use in defining an "accredited school." The revision has expanded the code considerably, especially the suggestions to persons organizing courses in metal arc welding. Requirements regarding school equipment, qualifications and duties of instructors, instruction in welding practice and theory and final testing are given.

#### CONTROLLED ATMOSPHERES

*Symposium presented before the Twenty-Third Annual Convention of the American Society for Metals held in Philadelphia, Pa., October 20 to 24, 1941. American Society for Metals, Cleveland, Ohio, 1942. 232 pp., illus., charts, tables, 9½ x 6 in., cloth, \$4.00.*

This volume contains the papers presented at a symposium held in 1941 by the American Society for Metals. The ten papers presented discuss various aspects of the control of furnace atmospheres in the heat treatment of steel, copper, aluminum and magnesium, including the question of cost.

#### ECONOMICS OF AMERICAN INDUSTRY

*By E. B. Alderfer and H. E. Michl. McGraw-Hill Book Co., New York and London, 1942. 566 pp., illus., diagrs., charts, maps, tables, 9½ x 6 in., cloth, \$4.00.*

This is an introductory survey of the principal manufacturing industries of the United States, intended as a textbook for students of industrial management and industrial relations, and of economics. The predominant economic characteristics of the industries are set forth, and the basic character of each industry and its significant developments are interpreted.

#### ENGINEERING MECHANICS

*By F. L. Brown. 2 ed. John Wiley & Sons, New York; Chapman & Hall, London, 1942. 503 pp., diagrs., 9½ x 6 in., cloth, \$4.00.*

A textbook in mechanics for students of engineering which is characterized by emphasis on methods of solution in which reference is made to relationships set forth verbally, as principles, rather than symbolically, as formulas. The new edition has many more problems than the first one, has new cuts and has been completely reset.

#### ENGINEERING QUESTIONS AND ANSWERS, Vol. 3

*Emmott & Co., Ltd., London and Manchester, England, 1942. 176 pp., illus., diagrs., charts, tables, 10 x 7½ in., cardboard, 6s.*

These questions have been selected from those submitted by readers of the "Mechanical World and Engineering Record," and are here re-published with the answers prepared by the editors. A wide variety of practical shop problems is covered.

#### Great Britain. Dept. of Scientific and Industrial Research

#### FUEL RESEARCH, Physical and Chemical Survey of the National Coal Resources No. 54

#### THE LEICESTERSHIRE AND SOUTH DERBYSHIRE AND SOUTH DERBYSHIRE COALFIELD. SOUTH DERBYSHIRE AREA, THE EUREKA SEAM

*His Majesty's Stationery Office, London, 1942. 42 pp., illus., diagrs., tables, 9½ x 6 in., paper, (obtainable from British Library of Information, 30 Rockefeller Plaza, New York, 90c.).*

This report, one of a series forming a survey of the coal seams of Great Britain, gives a comprehensive and detailed account of the physical and chemical properties of the coal of the Eureka seam in South Derbyshire.

#### Great Britain. Department of Scientific and Industrial Research

#### BUILDING RESEARCH, WARTIME BUILDING BULLETIN No. 21. Notes on the Repair of Bomb-Damaged Houses

*His Majesty's Stationery Office, London, 1942. 21 pp., illus., diagrs., tables, 11 x 8½ in., paper, 1 s. (obtainable from British Library of Information, 30 Rockefeller Plaza, New York, 30c.).*

This bulletin is designed to assist the expert to decide what to do to a damaged building. It gives data on the strength of damaged walls and general suggestions on various repair problems, including the treatment of dry rot and the interior finishing of repaired structures.

#### Great Britain. Ministry of Labour and National Service

#### HOW FACTORY ACCIDENTS HAPPEN. Descriptions of Certain INDUSTRIAL ACCIDENTS, Notified to H.M. Inspectors of Factories, Vol. 25, 1st November, 1941

*His Majesty's Stationery Office, London, 1941. 33 pp., diagrs., 9½ x 6 in., paper, (obtainable from British Library of Information, 30 Rockefeller Plaza, New York, 15c.).*

The accidents described are classified in various groups: power and transmission, process machinery, lifting machinery, electrical plant, explosions and fires, gassing and poisoning, buildings and structural work, miscellaneous, and the worker. The types of accidents that are most common in war time are given special attention.

#### HOW TO REMODEL A HOUSE

*By J. R. Dalzell and G. Townsend. American Technical Society, Chicago, 1942. 528 pp., illus., diagrs., charts, tables, 9 x 5½ in., cloth, \$4.75.*

The steps involved in remodeling a dwelling or modernizing individual rooms are explained in full detail in this volume, which should prove useful to home owners and others interested. An illustrative example is carried through step by step. Numerous illustrations add to the value of the text.

#### INDUSTRIAL CHEMISTRY

*By E. R. Riegel. 4 ed. Reinhold Publishing Corp., New York, 1942. 861 pp., illus., diagrs., charts, tabl s., 9½ x 6 in., lea., \$5.50.*

After five years, this popular text has been again revised and somewhat enlarged. New chapters on Paper and pulp and on Synthetic textile fibers have been added. Statistics have been brought closer to date. Throughout, changes have been made to cover new developments. A vast amount of information on the chemical industries is brought together in a single volume.

#### INTRODUCTION TO HIGHWAY ENGINEERING

*By J. H. Bateman. 4th ed. John Wiley & Sons, New York; Chapman & Hall, London, 1942. 459 pp., illus., diagrs., charts, tabl s., 9½ x 6 in., cloth, \$4.00.*

A textbook for students of civil engineering in which emphasis is on fundamental principles and processes. In addition, current practice is described in some detail. This edition has been revised and rearranged. The chapters on roadside improvement, properties of bituminous materials, subgrade stabilization and the structural design of pavements have been expanded.

#### ISOMERIZATION OF PURE HYDROCARBONS (American Chemical Society Monograph Series No. 88)

*By G. Egloff, G. Hulla and V. I. Komarevsky. Reinhold Publishing Corp., New York, 1942. 499 pp., diagrs., charts, tables, 9½ x 6 in., cloth, \$9.00.*

This useful monograph reviews the literature upon isomerization of hydrocarbons of the aliphatic, alicyclic and aromatic series, a process responsible for many important com-

mercial products, such as high-grade gasoline, viscous oils, synthetic rubber, etc. Isomerization is discussed for individual members of the various groups of hydrocarbons and typical reactions are analyzed. The data contained in over seven hundred reports have been calculated to a uniform basis and tabulated. There is a digest of patents and an extensive bibliography.

#### LEARNING THE RADIOTELEGRAPH CODE

*By J. Huntoon. American Radio Relay League, West Hartford, Conn., 1942. 34 pp., illus., diagrs., charts, tables, 9½ x 6½ in., paper, 25c.*

This pamphlet is issued in view of the present widespread interest in learning the international Morse code, and is intended to supply a method suitable for either class use or individual study.

#### MANUAL OF AIRCRAFT HYDRAULICS, Theory, Maintenance, Design

*By J. E. Thompson and R. B. Campbell. Aviation Press, San Francisco, Calif., 1942. 202 pp., illus., diagrs., charts, tables, 10 x 7½ in., paper, \$4.00.*

The design, operation and maintenance of hydraulic systems and equipment as used in aircraft are presented in this text. Many typical units of hydraulic systems used by American manufacturers are described. The illustrations add to the text.

#### MARINE ENGINEERING, Vol. 1, By H. L. Seward

*Society of Naval Architects and Marine Engineers, New York, 1942. 353 pp., illus., diagrs., charts, tables, 11 x 8½ in., cloth, \$6.00.*

This volume is the first of two which have been sponsored by the Society of Naval Architects and Marine Engineers as a companion to the "Principles of Naval Architecture" issued by it recently. Prepared by various authorities it is intended to provide a comprehensive treatise on up-to-date practice in merchant ships. Volume I deals with propelling machinery, power and revolutions, general design procedure, boilers, steam and Diesel engines, reduction gears, propellers and shafting, and materials and metallurgy.

#### MATERIALS TESTING AND HEAT TREATING (Rochester Technical Series)

*By W. A. Clark and B. Plehn. Harper and Brothers, New York and London, 1942. 132 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$1.75.*

This manual offers a series of laboratory exercises that suggest many commercial acceptance tests, but which have been adapted to ordinary school or college laboratory equipment. The tests have been chosen for their educational value in illustrating fundamental principles as well as for their relation to commercial tests.

#### MATHEMATICS OF MODERN ENGINEERING, Vol. 2 (Mathematical Engineering)

*By E. G. Keller. John Wiley & Sons, New York; Chapman & Hall, London, 1942. 309 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$4.00.*

The three-volume work of which this is the second volume aims to present those aspects of mathematics which the experience of a large manufacturing organization, in dealing with mechanical and electrical investigations, has found to be of most value to engineers. This volume contains an explanation and elaboration of the fundamental method of mathematical engineering which includes the reduction of physical phenomena to a mathematical system and the solution of that system.

(Continued on page 656)

# PRELIMINARY NOTICE

## of Applications for Admission and for Transfer

October 31st, 1942.

The By-laws provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.\*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

**Communications relating to applicants are considered by the Council as strictly confidential.**

The Council will consider the applications herein described at the December meeting.

L. AUSTIN WRIGHT, General Secretary.

\*The professional requirements are as follows:—

**A Member** shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupillage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science or engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

**A Junior** shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

**A Student** shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

**An Affiliate** shall be one who is not an engineer by profession but whose pursuits, scientific attainment or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

## FOR ADMISSION

**BEAUDOIN**—JOSEPH ARTHUR ALFRED, of 37-a Price Street, Kenogami, Que. Born at St. Hilaire, Que., July 17th, 1893; Educ.: I.C.S. Elec. Engrg. course; 1914-18, mtce. work, elec. dept., Brompton Pulp & Paper Co. Ltd., East Angus, Que.; 1919 to date, asst. to elec. supt., Price Bros. & Co. Ltd., Kenogami.

References: C. A. Hellstrom, J. W. Gathercole, J. Vinet.

**BRUNSKILL**—HARRY TALMADGE, of 911 Ouellette Ave., Windsor, Ont. Born at Saskatoon, Sask., Jan. 28th, 1916; Educ.: B.Sc. (Mech.), Univ. of Sask., 1940; 1940-41, dftsman., McKinnon Industries Ltd., St. Catharines, Ont.; 1941-42, engr., English Electric Co. of Canada, St. Catharines; at present, engr., plant engr. dept., Ford Motor Co. of Canada, Windsor, Ont.

References: V. W. MacIsaac, W. W. Brumby, I. M. Fraser.

**CRANSWICK**—JACK EDWIN BOYD, of Edmonton, Alta. Born at Moore Park, Man., Oct. 28th, 1905; Educ.: B.Sc. (E.E.), Univ. of Man., 1929; 1927-29 (summers), chairman, Manitoba Power Comm., J. J. Joubert Ltée., Montreal; 1929-30, chem. engr. (in charge), Mount Royal Dairies Ltd., Montreal; 1930-33, asst. engr., tech. dept., City of Montreal; 1933-36, heating & ventilation engr., Paul de Guise; 1936-42, heating, ventilation & elec. engr., de Guise & Duquette, and at present, consltg. engr., heating, ventilation & elec. engr., de Guise & Desaulniers, Montreal.

References: H. J. McEwen, D. A. Hansen, W. I. McFarland, R. M. Hardy, C. W. Carry.

**de GUISE**—PAUL ERNEST, of 4598 Decarie Blvd., Montreal, Que. Born at Montreal, Dec. 7th, 1897; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1923; R.P.E. of Que.; 1923-29, asst. chem. engr., J. J. Joubert Ltée., Montreal; 1929-30, chem. engr. (in charge), Mount Royal Dairies Ltd., Montreal; 1930-33, asst. engr., tech. dept., City of Montreal; 1933-36, heating & ventilation engr., Paul de Guise; 1936-42, heating, ventilation & elec. engr., de Guise & Duquette, and at present, consltg. engr., heating, ventilation & elec. engr., de Guise & Desaulniers, Montreal.

References: E. Gohier, J. A. Lalonde, L. Trudel, A. C. Fleischmann, H. Massue.

**GRAYDON**—EDGAR ROSS, of 82 Hillcrest Drive, Toronto, Ont. Born at Toronto, May 16th, 1914; Educ.: B.A.Sc., Univ. of Toronto, 1935; 1935-37 designing, detailing, etc., Toronto Iron Works Ltd.; 1937 to date, with the Dominion Bridge Co. Ltd., Toronto, as follows: 1938-39, field engr., 1939-42, checking struct. steel diagrams, drawings, and at present, struct. engr., designing struct. steel.

References: H. S. Irwin, M. W. Huggins, W. H. M. Laughlin, A. R. Robertson, G. J. Price.

**HEYLAND**—KENNETH VAUGHAN, of 4849 Wilson Ave., Montreal, Que. Born at Toronto, May 9th, 1902; Educ.: B.A.Sc., Univ. of Toronto, 1924; 1920-23 (summers), instr. man., O.L.S. and Toronto-Hamilton Highway Comm.; 1924-25, junior engr., Abitibi Power & Paper Co., Iroquois Falls, Ont.; 1927-41, sales representative, Kent-McClain Ltd., Toronto; 1941 to date, asst. mgr., Construction Equipment Company, Montreal, Que.

References: L. A. Wright, A. R. Chadwick, H. C. Seeley, F. G. Rutley, W. Griesbach.

**HOWARD**—ERNEST E., of Kansas City, Miss. Born at Toronto, Ont., Feb. 23rd, 1890; Educ.: C.E. and B.S., Univ. of Texas, 1900; D.Eng., Univ. of Nebraska, 1937; R.P.E. of N.Y., Miss., Iowa, Neb., Kansas, etc.; Member, A.S.C.E., 1900-01, instructor in engrg., Univ. of Texas; 1901-07, dftsman., designer, inspr., res. engr. on constr., 1907-14, junior partner, Waddell & Harrington; 1914-28, partner, Harrington, Howard & Ash; 1928 to date, partner, Ash, Howard, Needles & Tammer, and at present, senior partner, Howard, Needles, Tammer & Berquedoff, New York, N.Y. All of above firms have devoted their attention to design & supervision of constr. of bridges & similar structures.

References: M. B. Atkinson, F. E. Sterns, L. A. Wright, L. Trudel.

**JONES**—LORNE ALLAN, of 760 Gladstone Ave., Ottawa, Ont. Born at South Burgess, Ont., March 2nd, 1911; Educ.: Junior Matric.; 1933-35, timekeeper, roadman, transitman, road and bridge location work, with Lanark County Engineer; 1936-38, exploration branch, McIntyre Mines Ltd., Schumacher, Ont., as asst. to engr. on various properties and in exploration office; July, 1941, to date, junior engr., Directorate of Works & Bldgs., Rockcliffe Airport, Dept. of National Defence for Air.

References: V. R. Currie, P. W. Wallace, N. A. Thompson.

**LINDSAY**—DONALD LORNE, of Westmount, Que. Born at Quebec, Que., March 23rd, 1918; Educ.: B.Eng. (Mech.), McGill Univ., 1941; 1938 (summer), Anglin Norcross Ltd.; 1940 (summer), radio dept., Northern Electric Co. Ltd.; Since graduation—Sub-Lieut. (E) R.C.N.V.R., c/o Fleet Mail Office, Halifax, N.S.

References: G. L. Wiggs, D. G. Anglin, C. M. McKergow, E. Brown, W. J. Armstrong, F. M. Wood, G. J. Dodd.

**LOVELL**—JOHN, of 45 Third Ave. West, The Mountain, Hamilton, Ont. Born at Leeds, Yorks., England, July 25th, 1875; Educ.: Plymouth Technical College and private study; 1890-96, ap'tice to mech. engrg.; 1896-1901, various engr. shops; 1901-10, H.M. Dockyard, Devonport, on erection and install. of ship machy., steam trials, indicating powers, etc.; 1910-21, chief dftsman. and technical adviser, Messrs. Willoughby Ltd., shipbldrs. and marine engrs., iron and brass foundrs., struct. and elec. engrg.; 1921-24, general manager for same company; 1924-30, private practice as consltg. engr. Also part-time lecturer at Plymouth Technical College on "The Economics of Engrg. and the Principles of Works Management"; at present, engr. Hamilton Bridge Co. Ltd., Hamilton, Ont.

References: A. Love, L. S. MacDonald, G. A. Colhoun, A. R. Hannaford, W. S. Macnamara.

**LUNDY**—HOMER SHANNON, of Niagara Falls, Ont. Born at Niagara Falls, Oct. 29th, 1908; Educ.: Tech. Schools and private study. R.P.E. of Ont.; With H. G. Acres & Company as follows: 1929, junior dftsman., 1929-30, asst. to res. engr., 1930-33, dftng. and minor design on various jobs, 1934-38, design and detail on various projects, 1938, survey, design and supervision in the field of repairs to Parry Sound power house, 1938-39, engr. for contractors on Quinze River Dam, 1939, supervision of concrete work, 1939-41, design on various projects, 1941 to date, design and supervision of design and structural concrete for power house and head-block for Shipshaw power development, Aluminum Laboratories Ltd., Arvida, Que.

References: H. G. Acres, A. W. F. McQueen, H. E. Barnett, J. H. Ings, R. L. Hearn.

**ROUNTHWAITE**—CYRIL FREDERIC THOMAS, of 69 Howland Ave., Toronto, Ont. Born at Sault Ste. Marie, Ont., May 16th, 1917; Educ.: Bach. of Arch., Univ. of Toronto, 1942; Lieut., R.C.E. (Candn. Army Res.); 1929-33 (summers), misc. surveys, field work, etc.; 1939-40 (summers), mech. supt's. clerk, asst. field engr., Algoma Steel Corp.; 1941, struct. designer, Nelson Barracks, Halifax, office and lab., British American Oil Company, Sarnia; 1941, struct. designer, phthalic anhydride plant, Dominion Tar & Chemical Co.; 1941, designer, Candn. Officers' Training Corps Hdqrs. extension; 1942, struct. designer, C. F. Morrison, M.E.I.C., consltg. engr., Toronto (awaiting appointment in R.C.E.).

References: C. F. Morrison, A. D. LePan, J. L. Lang, C. Stenbol, W. H. M. Laughlin, A. M. Wilson.

**SCRIVENER**—ROBERT MASSEY, of 35 Whitehall Road, Toronto, Ont. Born at Ryde, New South Wales, Australia, May, 1886; Educ.: B.Sc., McGill Univ., 1911; R.P.E. of Ont.; 1911-13, engrg. dept., 1913-15, asst. field engr., and 1915-22, field engr., Eastern Canada Power & Mining Machy. Corp., Milwaukee; 1922-26, mining machy. engr., China and Japan Trading Co., Shanghai; 1926-28, field engr., Wagner Elec. Corp., St. Louis, Export Dept., London; 1928-42, consltg. engr. for various companies—consultant on design of plants and bldgs., design of constr. equipment, etc.; at present, general manager, Toronto Shipbuilding Co. Ltd., Toronto, Ont.

References: W. E. Bonn, C. Johnston, A. O. Wolff, E. L. Cousins, S. R. Frost, A. R. Robertson, J. B. Stirling, C. C. Cariss.

TURNER—GEORGE WEBBER, of 42 Chapel St., Thorold, Ont. Born at Thorold, June 3rd, 1908; 1927-31, rodman, 1932-35, engr. office and dftng. room, Welland Ship Canal; 1937 to date, dftng., detailing, and layout work for H. G. Acres & Company, Niagara Falls, Ont., incl. 2½ years chief instr'man and asst. to res. engr. on Grand River Conservation Dam, Fergus, Ont.

References: H. G. Acres, A. W. F. McQueen, J. H. Ings, C. W. West, H. E. Barnett.

WEAVER—HOWARD LEWIS, of 103 Dorothy St., Welland, Ont. Born at Port Colborne, Ont., July 25th, 1896; Educ.: completed course in Structl. Steel Design, Wilson Eng. Corp., Cambridge, Mass., 1928; 1913-15, apticeship, mech. dftng., M. Beatty & Sons, Welland; 1915-19, dftsmen. on plant layout and design. Electro-Metallurgical Co. of Canada, Welland; 1920, dftsmen., Buffalo Structural Steel Co.; 1920-21, dftsmen., Canadian Mead-Morrison Co., Welland; 1922-29, structl. steel dftsmen., checker and acting chief dftsmen., Standard Steel Constrn. Co., Welland; 1929-32, checker, Hamilton Bridge Company, Hamilton; 1932-33, designing buildings and layout equipment, Canadian Cannery Ltd., Hamilton; 1933-38, checking drawings, Hamilton Bridge Company; 1938 to date, chief dftsmen., Standard Steel Constrn. Co., Welland, Ont.

References: D. S. Scrymgeour, R. W. Willis, M. H. Jones, J. H. Ings, A. M. Fennis.

WEIGHTMAN—LEONARD, of 3811 Prudhomme Ave., Montreal, Que. Born at Nottingham, England, July 9th, 1904; Educ.: Comm. and Tech. High Schools; I.C.S.; prior to 1934, dftsmen. with Northern Electric Co. Ltd., B. J. Coghlin Co., Williams & Wilson, also engr. specialties salesman with the latter company; 1934-41, asst. plant supt. and mtce. engr., and asst. to designing engr. and chief dftsmen.; 1941 to date, engr. dept., mech. and elec. engrg., Steel Company of Canada, Montreal, Que.

References: L. A. Duchastel, H. J. Ward, P. E. Poitras, H. M. Jaquays, E. C. Kirkpatrick, I. S. Patterson.

#### FOR TRANSFER FROM JUNIOR

ALLAIRE—LUCIEN, of Metabetchouan, Que. Born at Montreal, Que., Feb. 16th, 1909; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1935; R.P.E., Quebec. During summers as follows: 1928-29, Eastern Steel Products, Preston, Ont.; 1932-33, Les Ingenieurs Associés; 1934, Quebec Streams Commission; 1935 (2 mos.), Sullivan Cons. Gold Mines, design engr.; 1936 (3 mos.), asst. surveyor, Siscoe Gold Mines; 1936-37, underground engr., Tetreault Mine; 1937 (2 mos.), asst. surveyor, E. Gohier; 1937-38, surveyor, Dept. of Agriculture; 1938, sales, St. Hyacinthe Engrg.; 1938 (8 mos.), Town Engineer, Val d'Or, P.Q.; 1939, res. engr., Quebec Streams Commission; 1939 to date, asst. divn. engr., Highways Dept. of Quebec, Metabetchouan. (St., 1936; Jr., 1938.)

References: A. Frigon, L. Trudel, O. O. Lefebvre, T. J. Lafrenière, A. Circe.

BACKLER—IRVING SAUL, of Montreal, Que. Born at Manchester, England, Dec. 14th, 1907; Educ.: B.Eng., McGill Univ., 1932; R.P.E. of Quebec; 1929-31 (summers), Northern Electric Co., Noranda Mines Co., and L. Backler Constrn. Co., Montreal; 1932 (summer), designing engr., Allied Engineers, Montreal; 1932-35, designing engr., Backler & Gersovitz, Montreal; 1935 to date, private practice as consulting engineer. (St., 1930; Jr., 1937.)

References: E. Roy, L. B. McCurdy, L. Berenstein.

BERRY—MELVILLE DOUGLAS, of 160 Palmer Street, Guelph, Ont. Born at Rush Lake, Sask., June 7th, 1908; Educ.: B.Sc. (E.E.), Univ. of Man., 1931; R.P.E. of Ontario; 1929 (summer), General Engr. Co., Hudson's Bay Mining & Smelting; 1930-33, genl. dftng., switchboard engr., test office, Canadian Westinghouse Co.; 1935-38, design engr., 1938 to date, chief engr., Leland Electric Can. Ltd., Guelph, Ont. (St., 1928; Jr., 1936.)

References: A. L. Dickieson, G. W. Arnold, J. T. Thwaites.

BRADFORD—GEORGE ALLEN McCLEAN, of Niagara Falls, Ont. Born at Brockville, Ont., May 29th, 1908; Educ.: B.Sc., Univ. of Sask., 1932; 1926-30 (summers), Geodetic Survey of Canada; 1933-38, designing dftsmen., 1938-41, development engr., Imperial Oil Ltd., Sarnia; 1941-42, mech. engr., Welland Chemical Works, Niagara Falls; at present, mech. designer with H. G. Acres & Co., Niagara Falls. (Jr., 1937.)

References: T. Montgomery, G. L. Macpherson.

CRAIG—JAMES WILLIAM, of Montreal, Que. Born at Halifax, N.S., Feb. 12th, 1906; Educ.: B.E. (Ceramic Engrg.), 1925, B.Sc. (Chemistry), 1927, Univ. of Sask.; 1925-27 (winters), demonstrator in chemistry, Univ. of Sask.; 1926 (summer), Geo. Survey of Can., Alta.; 1927 (summer), Prov. Sask. Surveys; 1929 (winter), Dept. of Mines (Ottawa), surveys, Turner Valley; 1927-35, research engr., National Research Council, Ottawa; 1935 to date, mgr., development and research, Canadian Refractories Ltd., Montreal. (St., 1928; Jr., 1930.)

References: W. G. Worcester, C. J. Mackenzie, G. M. Carrie, A. E. MacRae, J. J. White, W. E. Lovell, G. M. Williams, E. J. Carlyle, G. G. Ommanney.

DYER—JOHN HENRY, of St. Catharines, Ont. Born at Halifax, Dec. 7th, 1906; Educ.: B.Sc. (Elec.), N.S. Tech. Coll., 1928; 1928 (summer), asst. engr., Foundation Co. of Canada, Halifax; 1928-30, student apprentice course, 1930-33, junior switchboard engr., Canadian Westinghouse Co.; 1933-34, testing lab., Imperial Oil Refinery, Dartmouth, N.S.; 1935 (summer), Milton Hersey Co., Dartmouth, N.S., asphalt insp.; 1935-36, 1936-37 (winters), asst. prof. of engrg., St. Mary's College, Halifax; 1936 (summer), road insp., Milton Hersey Co., Sydney and Truro, N.S.; 1937 to date, switchgear design and dftng., English Electric Co., St. Catharines, Ont. (St., 1928; Jr., 1937.)

References: P. A. Lovett, J. R. Kaye, M. W. Brumby, R. L. Dunsmoore, J. R. Dunbar.

ELFORD—WESLEY FRED, of Toronto, Ont. Born at Cogswell, North Dakota, U.S.A., July 28th, 1909; Educ.: B.Sc. (Elec.), Univ. of Alta., 1937; 1937-38, factory course, 1938-40, asst. chief insp., 1940-41, foreman of machine shop, Massey Harris Co., Toronto; 1941-42, insp., Dept. of National Defence, Naval Equipment, Ottawa; 1942, asst. engr., Teleflex Ltd., Toronto. (St., 1937; Jr., 1940.)

References: C. A. Robb, W. E. Cornish, R. S. L. Wilson, J. S. Campbell.

GISLASON—STEFAN INGVAR, of Cartierville, Que. Born at Winnipeg, Man., Nov. 11th, 1908; Educ.: B.Sc. (C.E.), Univ. of Man., 1931; R.P.E., Ontario; 1931-35, dftsmen., Dept. of Northern Development, Ontario; 1935-42, dftsmen. and engr., Dept. of Highways, Ontario; at present, asst. design engr., Defence Industries Ltd., Jean Brillant, Que. (Jr., 1938.)

References: E. A. Kelly, A. H. Rabb, R. F. Petursson, C. F. Davison, J. G. Welsh.

HINTON—ERIC, of Deer Lake, Nfld. Born at Warwick, England, Jan. 29th, 1901; Educ.: Civil Engrg. Diploma, I.C.S., 1923. Passed E.I.C. Exams for Junior, 1932; 1918-23, article pupil to Frank Latham, M.I.C.E., Borough Engr., Penzance, England; 1924-25, asst. engr. for 9 miles division of Nfld. rly., incl. all incidental constrn. of steel bridges, timber pile treaties, earthworks, etc., for Sir W. G. Armstrong Whitworth Ltd.; 1926-28, asst. engr. i/c mtce. and improvements to all hydraulic structures, snow surveys and spring flood forecasts, Newfoundland Power & Paper Co. Ltd.; 1929-36, engr. with International Power & Paper Co. of Newfoundland Ltd., in charge of all hydraulic structures and equipment of Deer Lake hydro-electric plant, survey and design of 110 kv. trans. line, frazil ice troubles, power supply problems and prelim. studies of small potential hydro-electric developments, design and constrn. of earthworks and reinforced concrete structures for flood protection, various structural alterations to above power house, etc.; 1937-42, engr. in charge of all plant structures and hydraulic equipment at Deer Lake, water hammer investigations, structural reinforcement of two 21,000 kva. generators, investigation of defective concrete by diamond drilling, rehabilitation of Ambursen dam bulkhead section, redesign and reconstrn. of woodstave penstock, design and constrn. of timber pile wharf and dock for 10,000-ton ships, power and paper plant valuation,

and at present, hydro-electric engr. and asst. manager, hydro-electric dept., Bowater's Newfoundland Pulp & Paper Mills, Ltd., Deer Lake, Nfld. (Jr., 1932.)

References: C. M. Bang, K. O. Elderkin, R. L. Weldon, A. B. McEwen, A. H. Chisholm, H. C. Brown.

LYONS—GERALD S., of Montreal, Que. Born at Montreal, Aug. 9th, 1899; Educ.: B.Sc. (Elec.), Queen's Univ., 1924; 1924-42, engr., design and layout of outside plant for Bell Telephone Co. of Canada. (St., 1922; Jr., 1930.)

References: L. E. Ennis, W. J. S. Dormer, D. Rhodes, E. Baty, F. M. Corneil.

MARCOTTE—ROLAND, of Isle Maligne, Que. Born at Roberval, Que., Jan. 19th, 1906; Educ.: B.Sc., Sch. of Engineering, Milwaukee, Wisconsin, 1933; With Saguway Power Co. Ltd., as follows: 1934-36, dftng., 1936-38, asst. power distribution engr., 1938-40, plant engr., 1940-41, general engrg., 1941 to date, operating engr., Isle Maligne, Que. (Jr., 1938.)

References: F. L. Lawton, J. R. Hango, J. E. Thicke, C. Miller, W. E. Cooper.

NICHOLS—JUDSON TIMMIS, of Arvida, Que. Born at Montreal, Feb. 8th, 1909; Educ.: B.Eng. (Mech.), McGill Univ., 1934; 1934-41, mech. engr., Hudson's Bay Mining & Smelting Co., Flin Flon, Man.; 1941 to date, mtce. engr., Aluminum Co. of Canada, Arvida. (St., 1931; Jr., 1936.)

References: N. M. Hall, M. K. T. Reikie, B. E. Bauman, M. G. Saunders, A. Laurie.

REINHARDT—GERARD VICTOR, of Arvida, Que. Born at LaHave, N.S., March 20th, 1908; Educ.: B.Sc. (Mech.), N.S. Tech. Coll., 1934; 1936-39, asst. mech. engr., Dominion Bridge Co. Ltd., Lachine, Que.; 1939 to date, engr. office as dftsmen., Aluminum Co. of Canada, Arvida, Que. (St., 1932; Jr., 1937.)

References: M. G. Saunders, C. B. Moxon, G. Deneau, F. T. Boutillier, R. E. McMillan.

SMITH—MAURICE HOWIE, of Peterborough, Ont. Born at Edholm, Nebraska, U.S.A., Dec. 20th, 1901; Educ.: B.Sc. (E.E.), Univ. of Man., 1935; 1936 (7 mos.), elect. instln., sampler, office records, Argosy Gold Mines, Cassamutt Lake, Ont.; 1937-40, student course, research dept., Massey Harris Co., Toronto; 1940 (4 mos.), Dept. of Natl. Defence, insp., at Peterborough, Ont.; Nov., 1940, to date, insp. officer, Inspection Board of United Kingdom and Canada, i/c electl. inspection for Peterborough district. (Jr., 1939.)

References: I. F. McRea, C. R. Langley, D. V. Canning, V. S. Foster, W. T. Fanjoy, H. R. Sills, J. S. Campbell, E. P. Fetherstonhaugh.

TIMM—CHARLES RITCHIE, of Montreal West, Que. Born at Westmount, Que., Mar. 19th, 1908; Educ.: B.Sc. (Elec.), McGill Univ., 1930; 1927 (summer), instr'man., Fraser Brace Engrg. Co., Paugan Falls, Que.; 1928-29 (summers), dftsmen., Power Engrg. Co., Montreal; 1930-31, shop test course, General Electric Co., Schenectady, N.Y.; 1934-36, dftsmen., Dominion Engrg. Works, Lachine, Que.; 1936-40, estimator and sales engr., Bepec Canada, Ltd., Montreal; 1940 to date, electrical engr., central engrg. dept., Dominion Rubber Co. Ltd., Montreal (St., 1928; Jr., 1936.)

References: R. Ford, R. A. Yapp, K. O. Whyte, J. D. Chisholm.

WATIER—ARTHUR H., of Shawinigan Falls, Que. Born at Chicago, Ill., Aug. 18, 1907; Educ.: B.Eng., McGill Univ., 1932; 1929-30 (summers), dftng., cable testing, Northern Electric Co.; 1931 (summer) meter shop, Shawinigan Water & Power Co.; 1933-34, Canada Light & Power Co.; 1934-37, power house operator, 1937-39, asst. to line supt., and 1939 to date, asst. to supt. of generating stations, mtce. design and engrg., Shawinigan Water & Power Co. (St. 1931, Jr. 1936.)

References: C. R. Reid, C. Luscombe, H. J. Ward, H. K. Wyman, J. M. Crawford.

WESELAKE—EDWARD JOSEPH, of 503½ Selkirk Ave., Winnipeg, Man. Born at Winnipeg, June 21st, 1907; Educ.: B.Sc. (E.E.), Univ. of Man., 1930; 1928-29 and 1931 (summers), instr'man., Fraser Brace Engrg. Co., insp., rock ballasting, C.P.R., dftsmen., Northern Public Service Corp., Winnipeg; 1931-38, dftng. work on assignment for local bldg. contractors; 1938-39, meter service work, City of Winnipeg Hydro Electric System; 1939-40, dftsmen., Public Works of Canada, Winnipeg; 1940-41, reinforced concrete designer, Cowin & Co., Winnipeg; 1941, junior engr., Works and Bldg. Divn., R.C.A.F., Dept. of National Defence; April 1941 to date, reinforced concrete design, Cowin & Company, Winnipeg, Man. (St. 1927, Jr. 1937.)

References: H. B. Henderson, C. V. Antenbring, E. S. Kent, A. J. Taunton.

WILLIS—RALPH RICHARD, of Montreal, Que. Born at Youghall, N.B., June 28th, 1908; Educ.: B.Sc. (Civil), Univ. of N.B., 1931. N.B.L.S., R.P.E. of Que.; 1929 (summer), compassman and timber cruiser; 1930-32 (summer), student asst., topog. divn., Geological Survey; 1933-34, asst. engr. on constrn. of pipe line and filter plant; 1934-35, land surveyor for private parties and Dept. of Lands & Mines, N.B.; 1935 (summer), asst., Geol. Survey of Canada; 1935-36, land surveyor; 1936, asst. to plant engr., Bathurst Power & Paper Co. Ltd.; Aug. 1936 to date, engr. on layout, design and installn. of heating, ventilating equipment for paper mills, at present chief engr., Ross Engineering Co. of Canada Ltd., Montreal, Que. (St. 1931, Jr. 1936.)

References: J. Stephens, D. Hutchison, B. R. Perry, E. O. Turner, F. A. Patriquen.

WILLOWS—FRED, of Beauharnois, Que. Born at Toronto, Ont., Dec. 20th, 1908; Educ.: B.Sc. (C.E.), Univ. of Man., 1929; R.P.E. of Que.; 1927-29 (summers), dftsmen. and clerk, C.P.R., lab. checker, municipal asphalt plant, City of Winnipeg, field engr. on grain elevator constrn., C. D. Howe & Co.; 1930, checking engr. on constrn. of copper refinery, Ontario Refining Co. Ltd. for Fraser Brace Engrg. Co. Ltd.; 1929-30, instructor, civil engr. dept., Univ. of Man.; 1931-32, instr'man., Dept. of Nor. Development Ontario; 1934 (summer), instr'man., Canadian Mining Projects Ltd., Winnipeg; 1934-36 (intermittently), dept. of surveys, Prov. of Manitoba; 1935 (summer), geologist (Grade IV), Bureau of Economic Geology; 1936 (summer), inspection and detailed reports on various mining properties in Northern Ontario for George Glendinning, mining promoter; 1936-37, chief of field party in Nor. Ontario for Shirley King, O.L.S., Toronto; 1938-40, field office engr., Highway Paving Co. Ltd., Montreal; 1940 to date, field engr., Beauharnois Light Heat & Power Co. Ltd. (St. 1929, Jr. 1936.)

References: C. G. Kingsmill, B. K. Boulton, C. H. Pigot, D. M. Stephens, E. S. Braddell, J. B. Striowski.

#### FOR TRANSFER FROM STUDENT

BOURGOIS—CLAUDE, of Three Rivers, Que. Born at Three Rivers, Dec. 11, 1914; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1940; 1937-38 (summers), asst. to Dr. L. M. Pidgeon, National Research Council; 1941-42, partner, Gohier, Dorais & Bourgeois; 1942 to date, asst. engr., Plessisville Foundry, Plessisville, Que. St. 1939.)

References: A. Circe, A. Cousineau.

CAREY—LESLIE CLEMENT, of Toronto, Ont. Born at Sackville, N.B., July 13, 1915; Educ.: B.E. (Civil), N.S. Tech. Coll., 1939; 1936 (3 mos.), mapping and street surveys for paving, for Lt. Col. F. L. West, town engr., Sackville, N.B.; 1936 (1 mon.), air conditioning design, dftng., E. & H. Prod. Ltd., Sackville; 1938 (summer), instructor in surveying, summer camp, Truro; 1939 (3 mos.) insp. and testing engr., Canadian Inspection & Testing Co., Toronto; 1939-40, transmission line surveys and dftng., and at present junior engr., H.E.P.C. of Ontario. (St. 1939.)

References: J. R. Montague, A. E. Nourse, S. W. B. Black, E. B. Hubbard, O. Holden.

CLARK—ALVIN IRA, of Arvida, Quebec. Born at Ardat, Sask., May 24, 1914; Educ.: B.Sc., Univ. of Sask., 1940; 1940 (7 mos.), machine shop clerk, 1940-41, asst. engr., munitions production, Sawyer Massey Ltd., Hamilton; 1941-42, mech. engr., (efficiency work), and March 1942 to date, mech. engr. (machine shop), Aluminum Co. of Canada, Arvida. (St. 1940.)

References: I. M. Fraser, N. B. Hutcheson, M. G. Saunders, W. E. Lovell, R. A. Spencer.

COUSINEAU—EMILE, of 1490 Bernard Ave. W., Outremont, Que. Born at Chute a Blondeau, Ont., Aug. 13, 1910; Educ.: B.A.Sc., Ecole Polytechnique, 1941; 1941-42, surveying and drawing, Quebec Streams Commission, Montreal. (St. 1939).

References: C. R. Lindsey, O. O. Lefebvre, A. Circe, S. F. Rutherford, J. E. Gill.

DECARIE—YVES STANLEY, of Montreal, Que. Born at Montreal, June 15, 1915; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1939; 1937 (summer), asst. to town engr., Val d'Or, and underground labour, Sigma Mines; 1938 (summer) investigator, Prov. Dept. of Industrial Hygiene; 1939-41, asst. supt., Sorel Steel Foundries, Ltd.; 1941 to date, estimates, costs, production, Longue Pointe Works, Canadian Car & Foundry Ltd. (St. 1937).

References: A. Circe, J. A. Lalonde, E. Gohier, L. A. Duchastel, L. Trudel, E. F. Viberg.

DE TONNANCOUR—L. CHARLES G., of 94a 4th St., Shawinigan Falls, Que. Born at Montreal, May 8th, 1913; Educ.: B. Eng. (Chem.), McGill Univ., 1940; 1937-39 (summers), control dept., Belgo Divn., Consolidated Paper Corp., carb. de divn., plant research, Shawinigan Chemicals Ltd. control chemist, Mallinckrodt Chemical Works; with Shawinigan Chemicals Limited as follows: 1940 (June-Dec.), chem. engr., plant research dept., 1941 (May-Aug.), shift boss, same dept., Dec. 1940 to May 1941, and Aug. 1941 to date, asst. to development engr., engr. dept., on design and layout of various plants. (St. 1940).

References: H. K. Wyman, A. H. Heatley, V. Jepsen, R. DeL. French, C. H. Champion, M. Eaton.

DUNLOP—ROBERT JOHN FORREST, of Montreal, Que. Born at Huntingdon, Que., Apr. 16, 1910; Educ.: B. Eng., McGill Univ., 1932; 1928-30 (summers), electrician's helper, 1931 (summer), and 1933-34, electrician, Shawinigan Engr. Co.; with Belding-Corticelli Ltd. as follows: 1934-42, time study, cost accounting, Montreal; at present, time study supervisor, St. Johns, Coaticook, Montreal. (St. 1930).

References: H. K. Wyman, F. S. Keith, G. D. Hulme, J. S. Cameron, E. G. Gagnon.

FOREST—CLEMENT, of St. Honore, Que. Born at Ste. Marie Salome, Que., Jan. 16, 1915; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1941; R.P.E. of Quebec; 1937-38 (summers), chairman, 1939-40 (summers), instrumentman, Quebec Highways Dept.; May 1941 to date, instr'man and inspr., Dept. of Transport, Civil Aviation Divn., Montreal. (St. 1939).

References: A. Circe, A. Gratton, F. J. Leduc, R. Boucher.

GROUT—RAYMOND EDWARD, of Montreal, Que. Born at Edmonton, Alta., April 4, 1914; Educ.: B.Sc. (E.E.), Univ. of Alta., 1936; 1937 to date, elect. dftsmn. and designing engr., Shawinigan Engr. Co. Ltd.; 1941 on loan for a period of six months to Arthur Surveyer & Co., Montreal, as elect. designing engr. (St. 1936).

References: J. A. McCrory, R. E. Hertz, E. V. Leipoldt, A. L. Patterson, A. Surveyer.

HAYES—RONALD ABRAM HUGHSON, of Montreal, Que. Born at Bloomfield Stn., N.B., April 4th, 1903; Educ.: B.Sc., McGill Univ., 1938; 1922-26 (summers), trans. line constr., house wiring, elec. constr. and relay installn., Shawinigan Engineering Co.; 1927-29, elec. design and constr., H. G. Acres & Co., Niagara Falls; 1929-33, power cable engr. and sales, 1933-38, gen. elec. installn. work, and rural distribution line constr., Northern Electric Co. Ltd.; 1938-40, trans. line calculations, etc., Aluminum Laboratories Ltd.; 1940, Aluminum Co. of Canada Ltd., expediting work on plant extension; 1940, elec. engr. i/c design and elec. layouts for foreign plants, and at present, asst. chief engr. on design and constr. of 1,000,000 h.p. hydro-electric plant, etc., Aluminum Laboratories, Limited, Montreal, Que. (St. 1922).

References: A. W. Whitaker, A. D. Ross, E. E. Orlando, H. G. Acres, N. C. Hand.

HOBAS—JOSEPH G., of Windsor, Ont. Born at Thorold South, Ont., Feb. 2, 1915; Educ.: B.Sc., Queen's Univ., 1940; 1935-36, mtce. dept., Beaver Wood & Fibre, Thorold; 1936 (summer), surveyor's helper, and 1939 (summer), rigger's helper, Welland Ship Canal; 1940-41, field constr. engr., Brunner Mond Ltd., Amherstburg; with Kelsey Wheel Co., Windsor, as follows: June, 1941, plant engr., time study and routing, plant layout; May-August, 1942, foreman in charge of machine dept., and at present, asst. engr., aircraft divn., i/c purchasing, follow-up and dept. prodn. (St. 1938).

References: W. M. Mitchell, L. T. Rutledge, E. M. Krebsner, H. L. Johnston, W. J. Fletcher.

HORWOOD—WILLIAM OSMUND, of Montreal, Que. Born at Montreal, Aug. 10, 1914; Educ.: B. Eng., McGill Univ., 1937; 1937-38, Crane Co., Chicago; 1938-40, Crane Ltd., Montreal; 1940 to date, i/c of pipefitters and welders as one of aides to asst. mech. supt., and at present, design and dftng., genl. engr. dept., Aluminum Co. of Canada, Arvida. (St. 1937).

References: M. G. Saunders, P. Poitras, D. G. Elliot, J. W. Ward, M. E. Hornback.

HUGILL—JOHN TEMPLETON, of Suffield, Alta. Born at Calgary, Alta., June 15, 1915; Educ.: B.Sc. (Chem.) 1939, M.Sc. (Phys. Chem.) 1940, Univ. of Alta.; 1938 (summer) surveyor, Bennett & White Constr. Co.; 1939-40, research asst. National Research Council Lab., Edmonton; 1941 (May-Oct.) Liaison Officer at Canadian Military Hydrgs., London, Eng., for the Director of Technical Research; Nov. 1941 to date, chief experimental officer (Capt.), Experimental Station, Dept. National Defence, Suffield, Alta. (St. 1940).

References: F. S. Keith, C. A. Robb, L. F. Grant, G. G. M. Carr-Harris, J. W. Young.

HUNTER—LAWRENCE McLEAN, of Toronto, Ont. Born at Ottawa, Ont., May 9, 1913; Educ.: B.Sc., Queen's Univ., 1936; 1932-33 (summers), with N. B. MacRostie, consltg. engr. and land surveyor; 1934-35 (summers), with Geo. S. Grant Constr. Co., municipal road paving; 1936-37, installn. of refractory settings for steam power plants in U.S.A., and installn. of oil reclaiming equipment in Canada, with General Supply Co. of Canada; 1937-40, engr. in production dept., 1940-42, asst. mgr., production dept., and 1942 to date, mgr. production dept., Coca Cola Co. of Canada, Ltd., Toronto. (St. 1936).

References: F. C. Askwith, C. D. Wight, G. F. Taylor, D. S. Ellis, N. B. MacRostie.

KIRKPATRICK—Capt. ROBERT EVANS, of Hull, Quebec. Born at Montreal West, May 4, 1914; Educ.: B. Eng., McGill Univ., 1937; 1934 (summer), moulder Peacock Bros. Foundry; 1935-36 (summers), scheduling in machine shop and foundry, and 1937-39, scheduling, estimating, etc., in shops, Dominion Engineering Co.; 1939-40, designing and mtce., B. S. Coghlin Co.; 1940, overseas with R.C.A., and seconded to chief inspr. of armaments in Woolwich Arsenal, with rank of Captain, recalled to Canada, and now attached to Inspection Board of United Kingdom and Canada, as inspection engr. (St. 1937).

References: R. deL. French, J. G. Notman, C. M. McKergow, R. E. Jamieson.

LAGUERRE—MAURICE L., of Montreal, Que. Born at Montreal, July 15, 1915; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1924; 1938 (summer), surveying on road constr., Prov. of Quebec; 1939-40 (summers), floorman in powerhouse, Southern Canada Power Co.; 1941 (summer), machinist marker and helper, Angus Shops, C.P.R., and at present field engr., Angus Robertson Ltd., Villeray plant. (St. 1942).

References: A. Circe, A. Lalonde, S. A. Baulne, T. J. Lafreniere, R. Boucher.

LAROSE—GERARD, of Verdun, Que. Born at L'Assomption, Que. Sept. 5, 1914; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1941; R.P.E., Quebec; 1937-40 (summers), instr'man., supervisor, and res. engr., Quebec Roads Dept.; 1941 to date, production service, Northern Electric Co., Montreal. (St. 1939).

References: J. J. H. Miller, P. P. Vinet, A. Circe, J. A. Lalonde, C. A. Peachey.

LAWRENCE—EDWARD ARTHUR, of Nanaimo, B.C. Born at London, England, July 5th, 1909; Educ.: Corres. Courses—elem. struct. engr., Wilson Engr. Corp., U.S.A., and British Inst. Technology (not completed due to war); 1927-29, rodman, 1929-34, instr'man. and asst. hydrographer, 1934-39, hydrographer and engr. i/c field surveys, 1939-41, watermaster, C.P.R., Dept. of Natural Resources, Irrigation Branch; May 1941 to date, with the R.C.A., C.A. (A), at present, Capt., 39th Field Battery, 21st Field Regiment. (St. 1932).

References: G. S. Brown, A. Griffin, C. S. Donaldson, J. T. Watson, C. S. Clendening.

MADILL—FLOYD ALEXANDER, of Edmonton, Alta. Born at Edmonton, Oct. 12th, 1914; Educ.: B.Sc. (Civil), Univ. of Alta., 1940; 1935-39 (summers), rodman, instr'man., Dominion survey parties; 1940 to date, engr., operator, computer, and at present, asst. party chief on gravity meter surveys, Imperial Oil Producing Department, Calgary, Alta. (St. 1940).

References: I. F. Morrison, R. M. Hardy, C. A. Robb, R. S. L. Wilson,

OATWAY—HAROLD CALLAGHAN, of Ottawa, Ont. Born at Stony Plain, Alta., July 23rd, 1914; Educ.: B. Eng., McGill Univ., 1929. Diploma (Aero. Engrg.), Imperial College of Science, London, England, 1940; 1940-41, demonstrator, McGill Univ.; 1941 to date, aeronautical engr.—Aircraft Development Officer (Design and Production), F/Lt., R.C.A.F., A.M.A.E. Divn., Air Force Headquarters, Ottawa, Ont. (St. 1937).

References: A. Ferrier, C. M. McKergow, C. W. Crossland, C. A. Robb, A. R. Roberts.

PAPINEAU—MARCEL L., of Trenton, Ont. Born at Outremont, Que., Aug. 15, 1911; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1940; 1937-39 (summers), and 1940-41, Noranda Mines Ltd.; 1941-42, technical adjutant for six months in air frame repair section of No. 6 Repair Depot; June 1942 to date, engr. officer commanding the sheet metal shop, welding, plating, radiator and tank shops of No. 6 Repair Depot, Trenton, Ont. Flying Officer. (St. 1939).

References: R. Boucher, L. Trudel, A. Frigon, A. Circe.

PEARCE—ELDRIDGE BURTON, of Amherst, N.S. Born at Sprucedale, Ont., July 13, 1915; Educ.: B.Sc., Queen's Univ., 1940; 1937-39 (summers), grinding and heat treatment, machinist's helper, Lake Shore Gold Mine, 1940-41, plate structures dftsmn., Horton Steel Works; 1941-42, dftsmn on tool design, Canadian Car & Foundry. (St. 1940).

References: A. Jackson, L. M. Arkley, L. T. Rutledge, N. B. MacRostie, R. P. Carey, C. S. Boyd.

PETERS—HENRY F., of Brandon, Man. Born at Winkler, Man., Sept. 13, 1903; Educ.: B.Sc., Univ. of Man., 1930; 1929, dftsmn., City of Winnipeg; 1930-31, field dftsmn. on constr., Slave Falls, City of Winnipeg Hydro-Electric System; 1931-32, instrman. on location and constr. Trans-Canada Highway, Dept. of Northern Development, Kenora, Ont.; 1935-37, res. engr., on highway constr., Manitoba Govt.; 1938-40, instrman on surveys of water storage projects, Dom. Dept. of Agriculture, res. engr. on dam constr.; 1940 to date, engr. i/c constr. and mtce., Works Officer (Fl./L.), No. 12 S.F.T.S., R.C.A.F., Brandon, Man. (St. 1930).

References: G. H. Herriot, A. J. Taunton, C. H. Attwood, B. B. Hogarth.

PEMISTER—WILLIAM IAN, of Niagara Falls, Ont. Born at Niagara Falls, Jan. 16, 1915; Educ.: B.Sc. (Mech.) Queen's Univ., 1941; 1936-40 (summers), apprentice engr., H.E.P.C. of Ontario; 1940-41, loft layout dftsmn. and tool designer, Fleet Aircraft, Fort Erie, Ont.; 1941 to date, engr. supervisor i/c Martin Photo-Loft, etc., National Steel Car Corp. Ltd., Malton, Ont. (St. 1938).

References: W. D. Bracken, D. S. Ellis, T. H. Hogg, L. T. Rutledge, W. U. Shaw.

RAWLAND—ARTHUR GORDON, of Quebec, Que. Born at Quebec City, Aug. 27, 1914; Educ.: B.Sc., Univ. of N.B., 1937; 1937-40, dept. of records, Price Bros. & Co. Ltd., Kenogami, at present, F/Lt., R.C.A.F., senior navigation officer, No. 6 I.T.S., Toronto, Ont. (St. 1937).

References: E. O. Turner, H. Cimon, J. Shanly, K. A. Booth.

SHISKO—NICHOLAS, of Gananogue, Ont. Born at Hearst, Ont., Jan. 12, 1915; Educ.: B.Sc., Queen's Univ., 1940; 1938 (summer) junior dftsmn., Abitibi Power & Paper Co.; 1939-40 (summers) dftsmn., Kirkland Lake Gold Mining Co., Chaput-Hughes, Ont.; 1940-41 (winter) lecturer in dftng., Queen's Univ.; 1941, asst. plant engr., general plant mtce., design of auxiliary equipment, Canadian Locomotive Co., Kingston; 1942 (Jan.-June), junior works engr., Small Arms Ltd., Long Branch, Ont.; at present, plant engr., Steel Co. of Canada, Gananogue. (St. 1938).

References: A. Jackson, D. S. Ellis, J. B. Baty, L. M. Arkley.

SMITH—ALLAN GARFIELD, of Toronto, Ont. Born at Ste. Agathe des Monts, Que., Jan. 6, 1914; Educ.: B. Eng., McGill Univ., 1937; 1936 (summer) student Shawinigan Water & Power Co.; 1937-40, illumination divn., Head Office, Montreal, and 1940 to date, sales engr., Northern Electric Co., Toronto. (St. 1937).

References: C. V. Christie, A. V. Armstrong, W. H. Hooper, C. A. Morrison, L. A. Duchastel.

TAYLOR—DUDLEY ROBERT, of Winnipeg, Man. Born at Montreal, Que., Sept. 21, 1914; Educ.: B. Eng., McGill Univ., 1937; 1937-38, radio engr., Canadian International Paper Co., Maniwaki, Que.; 1938 (3 mos.), studio operator, Canadian Broadcasting Corp.; 1938-40, radio technician, and 1940 to date, radio engr., Trans-Canada Airlines, Winnipeg. (St. 1936).

References: J. T. Dymont, C. A. Proudfoot.

## STRUCTURAL DEFENCE AGAINST BOMBING

A reference book on the engineering features of civil defence, published by The Engineering Institute of Canada in order to make available to Canadian engineers and architects a record of some of the experiences and practices of British authorities in regard to structural air raid precautions, so that in the event of emergency arising in this country the necessary action can be taken without loss of time and on the most efficient and economical lines.

It is a 56-page booklet, 8½ by 11 in., with heavy paper cover. It contains 79 illustrations and eight tables. Copies may be secured at \$1.00 each from

THE ENGINEERING INSTITUTE OF CANADA, 2050 MANSFIELD STREET, MONTREAL, QUE.

# Employment Service Bureau

## SITUATIONS VACANT

PERMANENT POSITION in Toronto or Montreal areas with a large industrial fire insurance organization. Previous experience in this work is not necessary. Applicant must be a technical graduate with manufacturing or engineering experience and possess a good personality. Several months training with full pay will be given. Please send photograph with letter. Apply to Box No. 2588-V.

GRADUATE MECHANICAL ENGINEER, preferably a man with paper mill experience to specialize in sale and installation of material handling equipment. Apply to Box No. 2590-V.

CHEMICAL OR METALLURGICAL ENGINEER with flotation experience for work in fluoride department at Arvida, Que. Apply to Box No. 2592-V.

CHEMICAL ENGINEERS for work at La Tuque, Que. Apply to Box No. 2594-V.

CIVIL ENGINEER with some pile driving experience for work at Mackenzie, British Guiana. Apply to Box No. 2595-V.

ELECTRICAL ENGINEER for plant and townsite electrical maintenance work at Mackenzie, British Guiana. Apply to Box No. 2596-V.

CONCRETE DETAILER for Arvida, Quebec. Apply to Box 2597-V.

DEVELOPMENT SUPERVISOR, technical graduate to take charge of small groups of younger engineers doing experimental and development work at Arvida, Quebec. Apply to Box 2598-V.

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.

MINING METALLURGICAL OR CHEMICAL ENGINEER for aluminum plant at Arvida. Industrial smelting or mining experience for experimental and technical work and supervision in remelt and shipping departments. Apply to Box 2599-V.

MECHANICAL DRAUGHTSMAN, general engineering department, Arvida, Que. Industrial plant piping, layouts and detailing experience. Apply to Box No. 2600-V.

CHEMICAL OR METALLURGICAL ENGINEER with flotation experience for work in cryolite plant at Arvida, Que. Apply to Box No. 2601-V.

CHEMIST, general technical department, Arvida, Que. Trained in experimenting in technical work with good prospects for work on investigational problems if satisfactory. Apply to Box No. 2602-V.

METALLURGICAL ENGINEER with physical metallurgy experience. Kingston Works, Aluminum Company of Canada, Ltd. Apply to Box No. 2603-V.

DESIGNING ENGINEER WANTED for a permanent position as chief engineer with a machinery manufacturing concern in Eastern Canada. State age, salary expected and give details of past experience. Apply to Box No. 2604-V.

## SITUATIONS WANTED

ENGINEER available, graduate, twenty years experience including apprenticeship, university and field, covering design, construction and maintenance. For full particulars, apply to Box No. 704-W.

INDUSTRIAL ENGINEER, M.E.I.C., Age 40, Canadian, Married, desires position as production manager or other executive capacity. Presently employed but desires change to plant on war work. Understands layout thoroughly. Location Toronto area. Salary dependent on responsibility, minimum \$3,600. Apply to Box No. 717-W.

## LIBRARY NOTES

(Continued from page 652)

### MODERN ELECTROPLATING (Special Volume)

*Electrochemical Society, Columbia University, New York, 1942. 399 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$5.50.*

This volume is an important addition to the treatise on electroplating, for it provides a comprehensive survey of modern practice, prepared by various experts and provided with copious references to the literature. The opening paper describes general principles and methods. Succeeding chapters deal severally with the various metals.

### MODERN SHIPFITTER'S HANDBOOK

*By W. E. Swanson. 2 ed. rev. and enl. Cornell Maritime Press, New York, 1941. 309 pp., illus., diags., charts, tables, 7½ x 5 in., cloth, \$2.50.*

This handbook supplies, in plain language, an account of the fundamental principles and working problems encountered in building a ship. Blueprint reading, mold loft and structural shop work, anglesmithing, assembly of sections, erection and launching are explained. Special attention is given to welded construction.

### MODERN WIRE ROPE DIGEST

*American Chain & Cable Co., Wilkes Barre, Pa., 1941. 253 pp., illus., diags., charts, tables, 7½ x 4½ in., cardboard, \$2.50.*

*Wire Rope Recommendations, Supplement to the Modern Wire Rope Digest, 1942 ed. American Chain & Cable Co., Bridgeport, Conn., 83 pp., illus., diags., 6½ x 4 in., paper, no extra price.*

This little handbook contains much practical information on the manufacture of wire rope, the types in use, the selection of rope for various purposes and its maintenance. It is intended as a guide to users.

### NATIONAL BUILDING CODE

*Prepared under the joint sponsorship of the National Housing Administration, Department of Finance, and the Codes and Specifications Section, National Research Council of Canada, Ottawa, Canada, 1941. 422 pp., diags., charts, tables, 9 x 6 in., linen, \$1.00.*

This code has been prepared under the sponsorship of the National Housing Administration and the National Research Council of

Canada by representatives of many professional and trade associations. Structural requirements, protection from fire, and health and sanitary requirements are covered. The code is recommended to municipalities as a model.

### NATURAL AND SYNTHETIC HIGH POLYMERS, a Textbook and Reference Book for Chemists and Biologists. (High Polymers, Vol. 4)

*By K. H. Meyer, translated by L. E. R. Picken. Interscience Publishers, New York, 1942. 690 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, \$11.00.*

This treatise is a translation of volume two of the second edition of Meyer and Mark's "Der Aufbau der hochpolymeren organischen Naturstoffe." It aims to provide a thorough description of the different high polymeric substances from the point of view of their preparation, purification, structure and properties. Natural and synthetic polymers, both organic and inorganic, are considered. The book is a substantial contribution, of great importance to chemists, technologists and biologists, as it provides a systematic account of our knowledge in this field.

### NEW TECHNICAL AND COMMERCIAL DICTIONARY

Part I—Spanish—English  
Part II—English—Spanish  
Part III—Conversion Tables of Weights, Measures and Monetary Units

*Compiled by A. P. Guerreto. Editorial Técnica Unida and Chemical Publishing Co., Brooklyn, N.Y., 1942. 600 pp., tables, 9½ x 6 in., fabrikoid, \$10.00.*

This dictionary contains more than 50,000 words used in electrical, mechanical, chemical and marine engineering, radio, mining, textile and other industries. It includes modern words referring to mechanized and motorized warfare, aviation, meteorology, etc., There is also a separate section giving conversion tables of weights, measures and monetary units.

### POISSON'S EXPONENTIAL BINOMIAL LIMIT

Table I—Individual Terms  
Table II—Cumulated Terms  
*By E. C. Molina. D. Van Nostrand Co., New York, 1942. 47 pp., tables, 11 x 8 in., paper, \$2.75.*

These tables give the numerical limiting values of the individual and cumulative terms for value of the parameter from .001 to 100.

Originally prepared by the Bell Telephone System for use in solving switching and traffic problems, they are also very useful in handling inspection data and for solving problems of sampling.

### PRINCIPLES OF IGNITION

*By J. D. Morgan, Sir Isaac Pitman & Sons, London, (Pitman Publishing Corp., New York, will not have this book in stock), 1942. 133 pp., diags., charts, tables, 9 x 5½ in., cloth, 12s. 6d.*

The purpose of this book is to describe simply and briefly the principal facts relating to the ignition of inflammable gas mixtures by sparks, flames, incandescent solid particles and other localized sources. Certain theories which have been put forward to co-ordinate or explain the action of these sources are also described. The book is intended primarily for engineers concerned with internal-combustion engines and with the prevention of explosions in mines and factories.

### PROCEDURE HANDBOOK OF ARC WELDING DESIGN AND PRACTICE 7th ed.

*Lincoln Electric Company, Cleveland, Ohio, 1942. 1,267 pp., illus., diags., charts, tables, 9 x 6 in., fabrikoid (\$1.50 in U.S.A.; \$2.00 foreign).*

This well-known reference book offers a comprehensive, authoritative description of the arc welding process. Methods and equipment, welding technique, procedures, speeds, costs, test methods, design of welded machines and structures, and typical applications of welding are considered. The new edition has been revised and enlarged.

### TABLES OF PROBABILITY FUNCTIONS Vol. 2

*Prepared by the Federal Works Agency, Work Projects Administration for the City of New York, conducted under the sponsorship of and for sale by the National Bureau of Standards, Washington, D.C., 1942. 344 pp., tables, 11 x 8 in., cloth, \$2.00.*

The two functions tabulated here are frequently called the ordinate and area respectively of the normal frequency curve, and are of fundamental importance in statistics, especially in testing the significance of a deviation in a normally distributed variate and in fitting normal distribution to observations. The tables extend to fifteen decimal places, at intervals of 0.0001 for x ranging from 0 to 1, and at intervals of 0.001 for x ranging from 1 to 7.8.

### BUILDING CODE

A National Building Code has just been published by the National Research Council, Ottawa, Ont., containing 422 pages and is priced at \$1.00 per copy. The code represents the work of some sixty active committee members chosen for their individual knowledge in specialized fields, together with an advisory committee comprising representatives of about sixty professional and trade associations and government agencies throughout Canada. It is, therefore, an authoritative document representing the considered views of a large group of competent advisers. Wide distribution of the National Building Code throughout Canada will, it is hoped, prove very useful as a means of improving regulations governing construction in Canadian municipalities.

### CAULKING COMPOUND

A 4-page bulletin is being distributed by The Conant Company, Limited, Montreal, Que., featuring the saving of fuel by the effective use of "Conant" caulking compound for glazing, pointing, caulking and embedding. This bulletin contains illustrations of various types of application, accompanied by full descriptions of the product, its application and action, and directions for its use. The compound is available in fifteen colours.

### CLEANING SPONGES

Evans & Company, Limited, Montreal, Que., have for distribution a 2-page folder describing the "Handy Maid" genuine natural sponges available for general cleaning purposes. These sponges are made of pieces of natural sponge, shredded for uniform texture and encased in self-absorbent cloth or white knitted cord covers. They are available in various sizes from 5 ins. by 6½ ins. to 7½ ins. by 10 inches.

### ELECTRICAL CONNECTORS

A 48-page pocket catalogue issued by Canadian Line Materials Limited, Toronto, Ont., contains descriptions, illustrations, dimensional drawings and specification tables covering a portion of the extensive line of "Burndy" electrical connectors. The complete line includes connectors for every wire, cable and bus application.

### ELECTRIC HEATING UNITS

The "Chromalox" line of heating units and equipment is comprehensively covered in a 64-page catalogue just published by Canadian Chromalox Company, Limited, Toronto, Ont. The catalogue contains illustrations and descriptions of each item, and in addition, tables of dimensions, capacities, etc., are included. The "Chromalox" line embraces a wide range of units for every purpose and this is illustrated on the first and last pages where typical standard units and special units are included. Ten pages of technical data are included.

### ELEVATOR-CONVEYOR

Link-Belt Limited, Toronto, Ont., have just issued a catalogue and data book, No. 2075, containing 32 pages. Two new sizes of Link-Belt "Bulk-Flo" elevator-conveyors are included, as compared with the catalogue that the company issued when it first announced this new bulk conveying system last year. Power formulae and other engineering data have also been added. The book contains diagrams showing paths of operation, gives a long list of materials that can be handled, and contains illustrated case studies, with tables of sizes, capacities, dimensions, etc. "Bulk-Flo" was announced as "a distinctly new and different power-operated conveyor system for the positive and continuous conveying of flowable granular, crushed, ground or pulverized materials of a non-corrosive nature."

## NOVA SCOTIA

### THE MINERAL PROVINCE OF EASTERN CANADA

Fully alive to the mining industry's vital importance to the war effort, the Nova Scotia Department of Mines in close co-operation with the Dominion Government has been very active in investigating the occurrences of the strategic minerals of manganese, tungsten and oil. By the end of this season at least \$150,000 will have been spent in the search for and the production of these minerals.

### THE DEPARTMENT OF MINES

HALIFAX

L. D. CURRIE  
Minister

A. E. CAMERON  
Deputy Minister

### MR. JOHN E. HESS, DECEASED

Mr. John E. Hess of the English Electric Company of Canada Limited, St. Catharines, Ont., died on October 4th at the age of forty-seven.

For the past eight years Mr. Hess has been Transformer Engineer of the English Electric Company of Canada Limited. He was a graduate in electrical engineering of the University of Toronto, and prior to coming to St. Catharines had been a member of the engineering department of the Canadian General Electric Company Limited of Toronto.

Mr. Hess was a member of the American Institute of Electrical Engineering, and of the Society of Professional Engineers of the Province of Ontario. He was widely known as one of the ablest engineers in his field, having an exceptional grasp of the practical as well as the technical aspects of electrical design, and was highly respected by his associates and members of the profession throughout Canada. During his career he designed many large, high-voltage power transformers operating in Canada at the present time.



Mr. John E. Hess.

### FLEXIBLE SHAFT MACHINES

Canadian Fairbanks-Morse Company, Limited, Montreal, Que., have prepared a 4-page bulletin, No. 401, describing the "Stow" line of flexible shafting and flexible shaft machines for grinding, sanding, wire-brushing, drilling, buffing, polishing and filing. In addition to illustrations and descriptive details of various models, a table is included giving specifications for both the direct connected machines and the multi-speed machines.

### FLOOR REPAIRING AND RESURFACING

A 4-page bulletin issued by Flexrock Company, Toronto, Ont., deals with factory flooring and tells how to cover rough concrete or wood floors, platforms, aiseways, ramps, and steps, to produce tough, durable, smooth surfaces. It describes and illustrates each operation in the making of feather-edge patches without chipping out old concrete or ripping up splintery wood, featuring the fact that any handy man can make permanent repairs with the least possible effort.

### GRINDING AND GRINDING WHEELS

"Grits & Grinds," No. 33, No. 8, published by Norton Company of Canada Limited, Hamilton, Ont., contains a story "The ABC of O.D. Grinding," based on the Company's booklet of the same name, which provides useful information and directions for the grinding of cylindrical shaped pieces and parts. This is combined with a section on the selection of grinding wheels for both cylindrical and centerless grinding.

### GUNITE CONSTRUCTION

A 66-page book just issued by Gunitite & Waterproofing Limited, Montreal, Que., contains technical data and general information regarding "Gunitite" and its use in construction. Following a tabulation of facts about "Gunitite," a series of seven chapters present the following information about "Gunitite": Its composition, properties and characteristics; in building construction; in engineering construction; in hydraulic structures; in the construction and restoration of tunnels and sewers; in mines; and in the protection and fireproofing of steel structures. A great number of photographs are used in each chapter to illustrate the application of "Gunitite" to the particular work described.

### HARD-FACING WELDING ELECTRODES

"Hard-Facing, Industry's Weapon Against Wear" is the title of a booklet being distributed by G. D. Peters & Company of Canada Limited, Montreal, Que. This booklet includes a brief description of the various "Stoody" electrodes and a condensed summary of the benefits of hard-facing. Considerable space is devoted to illustrated applications of hard-facing electrodes in various industries such as, mining, coke and gas, agriculture, dredging, lumber and paper, petroleum, contracting, etc. Finally, 140 odd parts which are subject to wear, impact and abrasion are listed in conjunction with the recommended electrode and method of application for their repair.

### HEAT ENGINEERING

In Volume XVII, No. 6, of "Heat Engineering" published by Foster Wheeler Limited, St. Catharines, Ont., the combination primary and secondary air preheater which features the new steam generator of the Bryce E. Morrow Station of the Consumers Power Company, near Kalamazoo, Mich., is described and illustrated. Other articles are entitled "Improved Coal Pulverizer Performance", "Liberty Ships" and "Chemical-Petroleum Equipment", each accompanied by illustrations.

### LIFT TRUCKS

Towmotor Company, Cleveland, Ohio, have published a 40-page manual, Form No. 37, entitled "The Inside Story of Towmotor," which explains what a lift truck really is, tells what performance can be expected of it, and sets up logical yardsticks of comparison enabling purchasers to determine whether the equipment they are considering is most suitable for their particular handling problem. Written simply, and well illustrated with diagrams and photographs, the manual translates basic engineering principles of functional lift-truck construction into terms readily grasped by even those now completely unfamiliar with this type of materials handling equipment. It is divided into six complete chapters, covering design, frame construction, lifting and stacking mechanism, power plant and travel mechanism, operating and control mechanism and servicing and maintenance features.

### LIGHTNING ARRESTER INSPECTION

A 16-page booklet, entitled "About the ET (Eye Test) Inspection of Lightning Arresters," has been issued by Canadian Line Materials Limited, Toronto, Ont. This booklet deals with the C-L-M arresters and the fully transparent glass body of these arresters which provides a means for reliable, easy, quick and conclusive field inspection, eliminates the necessity of expensive testing equipment, and assures constant, positive protection against lightning hazards.

### LUBRICATION EQUIPMENT

Stewart-Warner-Alemite Corporation of Canada Limited, Belleville, Ont., have issued a 34-page catalogue, Form No. C-22-23, which presents the "Alemite" line of power lubrication equipment designed to meet the needs of any branch of industry. Complete data, illustrations and specifications are given for each unit. In addition to the wide variety of power lubrication devices shown, the company has a separate catalogue covering "Alemite" hand guns and fittings.

### MANAGEMENT-EMPLOYEE CO-OPERATIONS

Under the title "More Production—Better Morale," The Chas. E. Bedaux Company of Canada, Limited, Toronto, Ont., has presented in a 16-page booklet some of its ideas on the prerequisites of efficient production based on the principle that skill, knowledge and experience of workers, supervisors and engineers must be pooled for the common objective to achieve maximum production.

### THE PRIME MINISTER VISITS JOHN INGLIS PLANT

Prime Minister W. L. M. King, accompanied by Mr. A. L. Ainsworth, Vice-President of John Inglis Company, Limited, visited the Inglis plant in Toronto where he inspected the work being done and chatted with many of the workers.

Starting at the front office on Strachan Avenue, the official party went completely through the plant to wind up at the Hanna Avenue gate. They saw everything that was to be seen and did not miss any of the departments.

Picture shows the Premier chatting with Miss Gladys Morton, who told the Prime Minister that "we are only doing our share" when he stopped to thank her and her many thousands of fellow workers employed at the Inglis plant, for the work they are doing.



Major James E. Hahn, D.S.O., M.C.

### APPOINTED DIRECTOR-GENERAL OF ARMY TECHNICAL DEVELOPMENT BOARD

Major James E. Hahn, D.S.O., M.C., of Toronto, has been appointed Director-General of the Army Technical Development Board, which was set up for the development of improvements and of new designs in weapons. Major Hahn has an impressive war record. Serving with the Canadian Expeditionary Force from 1914 to 1918 he was awarded the Distinguished Service Order and the Military Cross for gallantry in the Field. He was mentioned in dispatches three times, and was wounded twice.

Born in New York in 1892, Major Hahn came to Canada when he was six years of age. He was first commissioned in 1908 and later transferred to the 27th Battalion. He went overseas with the 1st Canadian Infantry

Battalion and was later appointed Staff Captain with the Eighth Infantry Brigade. During convalescence, after being severely wounded in France in 1916, he was attached to the staff of the Director of Organization, Canadian Military Headquarters, London, England.

He again returned to France and served on the General Staff of the Third and Fourth Canadian Division. Major Hahn's twin sons are now in the Queen's Own Rifles, Reserve Army.

### ANTI-RUST COMPOUND PROTECTS WAR SUPPLIES

A new anti-rust compound, designed especially to resist the effects of widely varying temperatures and salt spray encountered on long sea voyages, has saved thousands of automotive parts from the junk pile after arrival in war theatres.

Speaking on new packing and rust-proofing methods at the meeting of the S.A.E., in Toronto, on October 21st, Jack E. Harper of the Ford Motor Company of Canada, and Ralph Shelley of the Chrysler Corporation, explained that due to the greatly increased shipping time under war conditions, the packing of equipment for shipment during peacetime is not suitable at this time and extra precautions are necessary.

Previously, they said, many automobile parts sent from Canada had been arriving in such theatres as the Middle East in useless condition. Movies were used to show the waste caused by inefficient packing methods.

Working together, the meeting was told, Ford and Chrysler have perfected a new salt-resistant material which can withstand salt spray for 500 hours. New methods are being evolved every day, including the use of wax and cellophane.

Chairman of the meeting for the evening was J. H. Hickey, general manager of the service division, Chrysler Corporation.

### WATERPROOF PLASTIC RESIN GLUE

Le Page's Inc., Montreal, Que., are distributing a pocket-size folder describing their new waterproof plastic resin glue, which is available in powder form and is prepared for use by adding one pound of cold water to two pounds powder. Immediately after mixing, the glue is ready for use. It takes the form of an easy spreading, smooth, liquid glue which is waterproof after setting. It is packed in 50- and 140-lb. containers as well as in domestic sizes from 1½ ozs. to 16 ozs.

### WELDING

"The Stabilizer," Vol. No. 3, issued by The Lincoln Electric Company of Canada Limited, Leaside, Ont., features short contributed stories of actual problems and how they were solved by men engaged in welding work in the United States and Canada. A very wide variety of experiences and types of welding work is covered by these illustrated and signed contributions which occupy three columns of some fifteen pages.



The Prime Minister visits Inglis Plant.

# THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 25

MONTREAL, DECEMBER 1942

NUMBER 12



PUBLISHED MONTHLY BY  
THE ENGINEERING INSTITUTE  
OF CANADA

2050 MANSFIELD STREET - MONTREAL

L. AUSTIN WRIGHT, M.E.I.C.  
*Editor*

LOUIS TRUDEL, M.E.I.C.  
*Assistant Editor*

N. E. D. SHEPPARD, M.E.I.C.  
*Advertising Manager*

#### PUBLICATION COMMITTEE

C. K. McLEOD, M.E.I.C., *Chairman*  
R. DeL. FRENCH, M.E.I.C., *Vice-Chairman*  
A. C. D. BLANCHARD, M.E.I.C.  
H. F. FINNEMORE, M.E.I.C.  
T. J. LAFRENIÈRE, M.E.I.C.

"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

★ ★ ★

## CONTENTS

FOOD FOR WAR . . . . .	Cover
<i>(Photo Public Information)</i>	
AS THE YEAR ENDS . . . . .	661
<i>Dean C. R. Young, M.E.I.C.</i>	
THE CONSERVATION OF NATURAL RESOURCES WITH SOME REFERENCE TO POST-WAR PLANNING:	
INTRODUCTION . . . . .	663
<i>Robert F. Legget, M.E.I.C.</i>	
FOREST AND DRAINAGE AREAS OF ONTARIO . . . . .	663
<i>F. A. MacDougall, M.E.I.C.</i>	
THE WATER SITUATION IN SOUTHERN ONTARIO . . . . .	664
<i>Professor A. F. Coventry, B.A.</i>	
PUBLIC HEALTH AND CONSERVATION . . . . .	667
<i>A. E. Berry, M.E.I.C.</i>	
DEVELOPMENT OF GROUND WATER SUPPLY . . . . .	669
<i>J. W. Simard, M.E.I.C.</i>	
ENGINEERING ASPECTS OF AIR BOMBING . . . . .	674
<i>D. C. Tennant, M.E.I.C.</i>	
THE PLACE OF THE ENGINEER . . . . .	684
<i>C. R. Young, M.E.I.C.</i>	
WE ARE IN IT TOGETHER IN THE DEFENCE OF CIVILIZATION . . . . .	686
<i>H. J. Cody</i>	
TENTH ANNUAL MEETING OF E.C.P.D. . . . .	689
ABSTRACTS OF CURRENT LITERATURE . . . . .	694
FROM MONTH TO MONTH . . . . .	698
PERSONALS . . . . .	709
Visitors to Headquarters . . . . .	710
Obituaries . . . . .	711
NEWS OF THE BRANCHES . . . . .	713
NEWS OF OTHER SOCIETIES . . . . .	718
LIBRARY NOTES . . . . .	720
PRELIMINARY NOTICE . . . . .	723
EMPLOYMENT SERVICE . . . . .	725
INDUSTRIAL NEWS . . . . .	726
INDEX TO VOLUME XXV . . . . .	I

Price 50 cents a copy, \$3.00 a year: in Canada, British Possessions, United States and Mexico. \$4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, \$2.00 a year. —Entered at the Post Office, Montreal, as Second Class Matter.

THE INSTITUTE as a body is not responsible either for the statements made or for the opinions expressed in the following pages.

# THE ENGINEERING INSTITUTE OF CANADA

## MEMBERS OF COUNCIL - 1942

### PRESIDENT

C. R. YOUNG, Toronto, Ont.

### VICE-PRESIDENTS

\*A. L. CARRUTHERS, Victoria, B.C.  
†H. CIMON, Quebec, Que.

### PAST-PRESIDENTS

†T. H. HOGG, Toronto, Ont.

### COUNCILLORS

†E. D. GRAY-DONALD, Quebec, Que.  
†J. HAIMES, Lethbridge, Alta.  
\*J. G. HALL, Montreal, Que.  
†R. E. HEARTZ, Montreal, Que.  
†W. G. HUNT, Montreal, Que.  
†E. W. IZARD, Victoria, B.C.  
†J. R. KAYE, Halifax, N.S.  
\*E. M. KREBSER, Walkerville, Ont.  
†N. MacNICOL, Toronto, Ont.  
\*H. N. MACPHERSON, Vancouver, B.C.  
\*W. H. MUNRO, Ottawa, Ont.

### TREASURER

E. G. M. CAPE, Montreal, Que.

### GENERAL SECRETARY

L. AUSTIN WRIGHT, Montreal, Que.

†J. L. LANG, Sault Ste. Marie, Ont.  
†G. G. MURDOCH, Saint John, N.B.

†C. J. MACKENZIE, Ottawa, Ont.

†T. A. McELHANNEY, Ottawa, Ont.  
\*C. K. McLEOD, Montreal, Que.  
†A. W. F. McQUEEN, Niagara Falls, Ont.  
†A. E. PICKERING, Sault Ste. Marie, Ont.  
†G. McL. PITTS, Montreal, Que.  
†W. J. W. REID, Hamilton, Ont.  
†J. W. SANGER, Winnipeg, Man.  
\*M. G. SAUNDERS, Arvida, Que.  
†H. R. SILLS, Peterborough, Ont.  
\*J. A. VANCE, Woodstock, Ont.  
\*A. O. WOLFF, Saint John, N.B.  
\*For 1942 †For 1942-43 †For 1942-43-44

\*H. W. McKIEL, Sackville, N.B.

†J. E. ARMSTRONG, Montreal, Que.  
\*A. E. BERRY, Toronto, Ont.  
†S. G. COULTIS, Calgary, Alta.  
†G. L. DICKSON, Moncton, N.B.  
\*D. S. ELLIS, Kingston, Ont.  
\*J. M. FLEMING, Port Arthur, Ont.  
\*I. M. FRASER, Saskatoon, Sask.  
\*J. H. FREGEAU, Three Rivers, Que.  
\*J. GARRETT, Edmonton, Alta.  
†F. W. GRAY, Sydney, N.S.  
\*S. W. GRAY, Halifax, N.S.

### SECRETARY-EMERITUS

R. J. DURLEY, Montreal, Que.

### ASSISTANT GENERAL SECRETARY

LOUIS TRUDEL, Montreal, Que.

## STANDING COMMITTEES

### FINANCE

DEG. BEAUBIEN, *Chairman*  
J. E. ARMSTRONG  
E. G. M. CAPE  
G. A. GAHERTY  
J. A. McCRORY  
F. NEWELL

### LIBRARY AND HOUSE

W. G. HUNT, *Chairman*  
A. T. BONE  
J. S. HEWSON  
M. S. NELSON  
G. V. RONEY

### LEGISLATION

J. L. LANG, *Chairman*  
R. L. DOBBIN  
R. J. DURLEY

### PUBLICATION

C. K. McLEOD, *Chairman*  
R. DeL. FRENCH, *Vice-Chairman*  
A. C. D. BLANCHARD  
H. F. FINNEMORE  
T. J. LAFRENIERE

### PAPERS

J. A. VANCE, *Chairman*  
DEG. BEAUBIEN  
K. M. CAMERON  
A. L. CARRUTHERS  
H. CIMON  
J. L. LANG  
G. G. MURDOCH

## SPECIAL COMMITTEES

### BOARD OF EXAMINERS AND EDUCATION

R. A. SPENCER, *Chairman*  
I. M. FRASER  
W. E. LOVELL  
A. P. LINTON  
H. R. MacKENZIE  
E. K. PHILLIPS

### GZOWSKI MEDAL

H. V. ANDERSON, *Chairman*  
A. C. D. BLANCHARD  
T. H. JENKINS  
V. A. McKILLOP  
W. H. POWELL

### DUGGAN MEDAL AND PRIZE

J. T. FARMER, *Chairman*  
J. M. FLEMING  
R. C. FLITTON

### PLUMMER MEDAL

C. R. WHITTEMORE, *Chairman*  
J. CAMERON  
R. L. DOBBIN  
O. W. ELLIS  
R. E. GILMORE

### LEONARD MEDAL

JOHN McLEISH, *Chairman*  
A. E. CAMERON  
A. O. DUFRESNE  
J. B. DeHART  
A. E. MacRAE

### JULIAN C. SMITH MEDAL

C. R. YOUNG, *Chairman*  
T. H. HOGG  
C. J. MACKENZIE

### PROFESSIONAL INTERESTS

J. B. CHALLIES, *Chairman*  
J. E. ARMSTRONG  
G. A. GAHERTY  
O. O. LEFEBVRE  
H. W. McKIEL  
J. A. VANCE

### THE YOUNG ENGINEER

H. F. BENNETT, *Chairman*  
J. BENOIT  
D. S. ELLIS  
J. N. FINLAYSON  
R. DeL. FRENCH  
R. F. LEGGET  
A. E. MACDONALD  
H. W. McKIEL

### MEMBERSHIP

J. G. HALL, *Chairman*  
S. R. FROST

### STUDENTS' AND JUNIORS' PRIZES

**Zone A (Western Provinces)**  
H. N. Ruttan Prize  
A. L. CARRUTHERS, *Chairman*  
E. W. IZARD  
H. N. MACPHERSON  
**Zone B (Province of Ontario)**  
John Galbraith Prize  
J. L. LANG, *Chairman*  
A. E. PICKERING  
J. A. VANCE

**Zone C (Province of Quebec)**  
Phelps Johnson Prize (English)  
DEGASPE BEAUBIEN, *Chairman*  
J. E. ARMSTRONG  
R. E. HEARTZ

**Ernest Marceau Prize (French)**  
H. CIMON, *Chairman*  
J. H. FREGEAU  
E. D. GRAY-DONALD

**Zone D (Maritime Provinces)**  
Martin Murphy Prize  
G. G. MURDOCH, *Chairman*  
G. L. DICKSON  
S. W. GRAY

### INTERNATIONAL RELATIONS

R. W. ANGUS, *Chairman*  
J. B. CHALLIES, *Vice-Chairman*  
E. A. ALLCUT  
C. CAMSELL  
J. M. R. FAIRBAIRN  
O. O. LEFEBVRE  
M. J. McHENRY  
H. H. VAUGHAN  
C. R. YOUNG

### DETERIORATION OF CONCRETE STRUCTURES

R. B. YOUNG, *Chairman*  
E. VIENS, *Vice-Chairman*  
G. P. F. BOESE  
A. G. FLEMING  
W. G. GLIDDON  
O. O. LEFEBVRE  
J. A. McCRORY  
C. J. MACKENZIE  
J. H. McKINNEY  
R. M. SMITH

### WESTERN WATER PROBLEMS

G. A. GAHERTY, *Chairman*  
C. H. ATTWOOD  
L. C. CHARLESWORTH  
A. GRIFFIN  
D. W. HAYS  
G. N. HOUSTON  
T. H. HOGG  
O. O. LEFEBVRE  
C. J. MACKENZIE  
H. J. McLEAN  
F. H. PETERS  
S. G. PORTER  
P. M. SAUDER  
J. M. WARDLE

### ENGINEERING FEATURES OF CIVIL DEFENCE

J. E. ARMSTRONG, *Chairman*  
P. E. ADAMS  
J. N. ANDERSON  
S. R. BANKS  
H. F. BENNETT  
W. D. BRACKEN  
W. P. BRERETON  
R. S. EADIE  
E. V. GAGE  
G. A. GAHERTY  
R. J. GIBB  
A. GRAY  
J. GRIEVE  
J. L. LANG  
R. F. LEGGET  
I. P. MACNAB  
J. A. McCRORY  
H. J. McEWEN  
W. L. McFAUL  
C. B. MUIR  
W. H. MUNRO  
G. McL. PITTS  
M. G. SAUNDERS  
W. O. SCOTT  
T. G. TYRER  
H. K. WYMAN

### INDUSTRIAL RELATIONS

WILLS MACLACHLAN, *Chairman*  
E. A. ALLCUT  
J. C. CAMERON  
E. R. COMPLIN  
J. A. COOTE  
W. O. CUDWORTH  
F. W. GRAY  
E. G. HEWSON  
A. M. REID  
W. J. W. REID

### POST-WAR PROBLEMS

W. C. MILLER, *Chairman*  
F. ALPORT  
J. S. BATES  
DEGASPE BEAUBIEN  
A. L. CARRUTHERS  
J. M. FLEMING  
E. R. JACOBSEN  
G. R. LANGLEY  
H. MASSUE  
G. L. MACKENZIE  
D. A. R. McCANNEL  
A. W. F. McQUEEN  
G. McL. PITTS  
D. C. TENNANT

---

"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

---

## AS THE YEAR ENDS

IT IS WELL, and never more so than now, that periodic relaxations should punctuate the long-continued and intense activities of men. Even for the furtherance of the immediate objective, interruption is not only salutary but necessary.

Of the virtue of intermittency as a principle it is scarcely necessary to speak. Every soldier knows what it means to march discipline. The student toiling for the impending examination cannot ignore it. A great Chief of State has publicly declared that from time to time he must seek days of quiet reflection. Out of them, more than out of executive tumult, come decisions and pronouncements of far-reaching import.

Nor does the association of pause with the quality of performance rest merely upon the need for relieving fatigue. Thought itself is intermittent. It comes in jets of intuition, not as a steady, uniform, long-sustained flow. Indeed, as Dimnet has pointed out, the most significant advances in a field of thought are often made when one has deliberately turned to another, and perhaps momentarily a more attractive, subject.

And so it is that reflection and reinvigoration are essential to human progress. They may be foregone only at the risk of personal impoverishment of effort and ultimate loss to the community. The injunction to keep the Sabbath rests not only upon religious authority, but also upon sound physiological and psychological principles.

In Christian countries the festival of Christmas has come to be the great moment in all the year when men and women re-examine their position and re-dedicate themselves to high endeavour. Sham and selfishness have no place here. It is a time when generous impulses well to the surface unbidden and unrestrained. With them come perspective, calmness, judgment. With them, there breaks in upon us the realization of the futility of a life devoted only to personal advancement divorced from thought of wider responsibilities. The giving of some added momentum to the slow but sure onward movement of the human race becomes a source of deep satisfaction.

For engineers, the turning of the year has profound significance. In this cataclysm of war they have laboured long and hard and to great purpose. Their prestige stands higher than ever before in the history of the world. But what of the future? There can be no doubt that re-oriented and refreshed by the reflections and wholesome atmosphere of the Christmas season they will go forward on both the combat and the industrial fronts with renewed energy, clearness of purpose, and devotion to the grim task of carrying the war to a successful conclusion.

But there is need for doing more. In the inevitable setting of preoccupation and strain that will continue for we know not how long there should be a periodic bringing forward of the inspirations and outreachings of the generous season now upon us. Innumerable new tasks face the engineering profession when peace has come, tasks that will demand qualities of high citizenship as well as technical competency. Let us do our share to see that it meets the test with resolution and devotion.



President.

# THE ENGINEERING INSTITUTE OF CANADA

## OFFICERS OF BRANCHES

### BORDER CITIES

*Chairman*, H. L. JOHNSTON  
*Vice-Chair.*, G. G. HENDERSON  
*Executive*, W. P. AUGUSTINE  
 J. F. G. BLOWEY  
 W. R. STICKNEY  
 (Ex-Officio), E. M. KREBSER  
 G. E. MEDLAR  
*Sec.-Treas.*, J. B. DOWLER,  
 754 Chilver Road,  
 Walkerville, Ont.

### CALGARY

*Chairman*, H. J. McEWEN  
*Vice-Chair.*, J. G. MacGREGOR  
*Executive*, J. N. FORD  
 A. GRIFFIN  
 H. B. SHERMAN  
 (Ex-Officio), G. P. F. BOESE  
 S. G. COULTIS  
 J. B. DEHART  
 P. F. PEELE  
*Sec.-Treas.*, K. W. MITCHELL,  
 803—17th Ave. N.W.,  
 Calgary, Alta.

### CAPE BRETON

*Chairman*, J. A. MacLEOD  
*Executive*, J. A. RUSSELL M. F. COSSITT  
 (Ex-Officio), F. W. GRAY  
*Sec.-Treas.*, S. C. MIFFLEN,  
 60 Whitney Ave., Sydney, N.S.

### EDMONTON

*Chairman*, D. HUTCHISON  
*Vice-Chair.*, C. W. CARRY  
*Executive*, B. W. PITFIELD  
 E. R. T. SKARIN  
 J. A. ALLAN  
 E. ROBERTSON  
 J. W. JUDGE  
 (Ex-Officio), J. GARRETT  
 R. M. HARDY  
*Sec.-Treas.*, F. R. BURFIELD,  
 Water Resources Office,  
 Provincial Government,  
 Edmonton, Alta.

### HALIFAX

*Chairman*, P. A. LOVETT  
*Executive*, A. E. CAMERON  
 G. T. CLARKE G. J. CURRIE  
 A. E. FLYNN J. D. FRASER  
 D. G. DUNBAR J. A. MacKAY  
 J. F. F. MacKENZIE  
 J. W. MacDONALD  
 G. T. MEDFORTH  
 (Ex-Officio), S. L. FULTZ J. R. KAYE  
*Sec.-Treas.*, S. W. GRAY,  
 The Nova Scotia Power  
 Commission,  
 Halifax, N.S.

### HAMILTON

*Chairman*, STANLEY SHUPE  
*Vice-Chair.*, T. S. GLOVER  
*Executive*, H. A. COOCH  
 NORMAN EAGER  
 A. C. MACNAB  
 A. H. WINGFIELD  
 (Ex-Officio), W. J. W. REID  
 W. A. T. GILMOUR  
*Sec.-Treas.*, A. R. HANNAFORD,  
 354 Herkimer Street,  
 Hamilton, Ont.

### KINGSTON

*Chairman*, T. A. McGINNIS  
*Vice-Chair.*, P. ROY  
*Executive*, V. R. DAVIES  
 K. H. McKIBBIN  
 K. M. WINSLOW  
 (Ex-Officio), A. H. MUNRO  
 G. G. M. GARR-HARRIS  
 D. S. ELLIS  
*Sec.-Treas.*, R. A. LOW,  
 Queen's University,  
 Kingston, Ont.

### LAKEHEAD

*Chairman*, MISS E. M. G. MacGILL  
*Vice-Chair.*, E. J. DAVIES  
*Executive*, J. I. CARMICHAEL  
 R. B. CHANDLER  
 S. E. FLOOK  
 O. J. KOREAN  
 S. T. McCAVOUR  
 W. H. SMALL  
 E. A. KELLY  
 J. S. WILSON  
 (Ex-Officio), B. A. CULPEPER  
 J. M. FLEMING  
*Sec. Treas.*, W. C. BYERS,  
 c/o C. D. Howe Co. Ltd.,  
 Port Arthur, Ont.

### LETHBRIDGE

*Chairman*, J. M. DAVIDSON  
*Vice-Chair.*, C. S. DONALDSON  
*Executive*, A. G. DONALDSON G. S. BROWN  
 N. H. BRADLEY  
 (Ex-Officio), J. HAIMES  
*Sec.-Treas.*, R. B. McKENZIE,  
 McKenzie Electric Ltd.,  
 706, 3rd Ave. S., Lethbridge, Alta.

### LONDON

*Chairman*, F. T. JULIAN  
*Vice-Chair.*, T. L. McMANAMNA  
*Executive*, F. C. BALL  
 V. A. McKILLOP  
 H. F. BENNETT  
 A. L. FURANNA  
 R. S. CHARLES  
 (Ex-Officio), R. W. GARRETT  
 J. A. VANCE  
*Sec.-Treas.*, H. G. STEAD,  
 60 Alexandra Street,  
 London, Ont.

### MONCTON

*Chairman*, H. J. CRUDGE  
*Vice-Chair.*, J. A. GODFREY  
*Executive*, A. S. DONALD  
 E. R. EVANS E. B. MARTIN  
 H. W. HOLE G. C. TORRENS  
 (Ex-Officio), F. O. CONDON  
 G. L. DICKSON H. W. McKIEL  
*Sec. Treas.*, V. C. BLACKETT,  
 Engrg. Dept., C.N.R.,  
 Moncton, N.B.

### MONTREAL

*Chairman*, J. A. LALONDE  
*Vice-Chair.*, R. S. EADIE  
*Executive*, R. E. HEARTZ  
 J. B. STIRLING  
 J. M. CRAWFORD  
 J. COMEAU  
 H. F. FINNEMORE  
 R. C. FLITTON  
 G. D. HULME  
 (Ex-Officio), DE G. BEAUBIEN  
 J. E. ARMSTRONG  
 J. G. HALL  
 W. G. HUNT  
 C. K. McLEOD  
 G. McL. PITTS  
*Sec.-Treas.*, L. A. DUCHASTEL,  
 40 Kelvin Avenue,  
 Outremont, Que.

### NIAGARA PENINSULA

*Chairman*, C. G. CLINE  
*Vice-Chair.*, G. E. GRIFFITHS  
*Executive*, A. G. HERR  
 R. T. SAWLE  
 G. F. VOLLMER  
 W. D. BRACKEN  
 J. W. BROOKS  
 J. H. TUCK  
 D. S. SCRYMGEOUR  
 (Ex-Officio), A. L. McPHAIL  
*Sec.-Treas.*, A. W. F. McQUEEN  
 J. H. INGS  
 1870 Ferry Street,  
 Niagara Falls, Ont.

### OTTAWA

*Chairman*, N. B. MacROSTIE  
*Executive*, W. G. C. GLIDDON  
 R. M. PRENDERGAST  
 W. H. G. FLAY  
 G. A. LINDSAY R. YUILL  
 (Ex-Officio), K. M. CAMERON  
 C. J. MacKENZIE  
 W. H. MUNRO  
 T. A. McELHANNEY  
 R. K. ODELL  
*Sec.-Treas.*, A. A. SWINNERTON,  
 Dept. of Mines and Resources,  
 Ottawa, Ont.

### PETERBOROUGH

*Chairman*, D. J. EMERY  
*Executive*, C. R. WHITTEMORE F. R. POPE  
 I. F. McRAE R. L. DOBBIN  
 (Ex-Officio), A. J. GIRDWOOD  
 J. CAMERON  
 H. R. SILLS  
*Sec.-Treas.*, A. R. JONES,  
 5, Anne Street,  
 Peterborough, Ont.

### QUEBEC

*Life Hon.-*  
*Chairman*, A. R. DECARY  
*Chairman*, L. C. DUPUIS  
*Vice-Chair.*, RENE DUPUIS  
*Executive*, O. DESJARDINS  
 R. SAUVAGE G. ST-JACQUES  
 S. PICARD L. GAGNON  
 G. W. WADDINGTON  
 (Ex-Officio), E. D. GRAY-DONALD  
 R. B. McDUNNOUGH P. MÉTHÉ  
 H. CIMON  
*Sec.-Treas.*, PAUL VINCENT,  
 Colonization Department,  
 Room 333-A, Parliament Bldgs.,  
 Quebec, Que.

### SAGUENAY

*Chairman*, R. H. RIMMER  
*Vice-Chair.*, C. MILLER  
*Executive*, W. E. COOPER  
 J. FRISCH  
 B. BAUMAN  
 G. B. MOXON  
 (Ex-Officio), M. G. SAUNDERS  
 N. F. McCAGHEY  
 J. W. WARD  
*Sec.-Treas.*, ALEX. T. CAIRNCROSS,  
 P.O. Box 33,  
 Arvida, Que.

### SAINT JOHN

*Chairman*, D. R. SMITH  
*Vice-Chair.*, A. O. WOLFF  
*Executive*, H. P. LINGLEY  
 C. D. McALLISTER  
 C. C. KIRBY  
 (Ex-Officio), F. A. PATRIQUEN  
 V. S. CHESNUT  
 G. G. MURDOCH  
*Sec.-Treas.*, G. W. GRIFFIN,  
 P.O. Box 220,  
 Saint John, N.B.

### ST. MAURICE VALLEY

*Chairman*, VIGGO JEPSEN  
*Vice-Chair.*, J. H. FREGEAU  
*Executive*, E. BUTLER R. D. PACKARD  
 A. C. ABBOTT  
 R. DORION  
 H. J. WARD  
 E. T. BUCHANAN  
 J. JOYAL  
 H. G. TIMMIS  
 (Ex-Officio), A. H. HEATLEY  
*Sec.-Treas.*, E. E. WHEATLEY  
 Consolidated Paper Corporation,  
 Grand'Mère, Que.

### SASKATCHEWAN

*Chairman*, A. P. LINTON  
*Vice-Chair.*, A. M. MacGILLIVRAY  
*Executive*, F. C. DEMPSEY  
 N. B. HUTCHEON  
 J. G. SCHAEFFER  
 R. W. JACKLING  
 H. R. MacKENZIE  
 B. RUSSELL  
 (Ex-Officio), I. M. FRASER  
*Sec.-Treas.*, STEWART YOUNG  
 P. O. Box 101,  
 Regina, Sask.

### SAULT STE. MARIE

*Chairman*, L. R. BROWN  
*Vice-Chair.*, R. A. CAMPBELL  
*Executive*, N. C. COWIE  
 C. O. MADDOCK  
 C. R. MURDOCK K. G. ROSS  
 (Ex-Officio), J. L. LANG  
 E. M. MacQUARRIE  
 A. E. PICKERING  
*Sec.-Treas.*, O. A. EVANS,  
 159 Upton Road,  
 Sault Ste. Marie, Ont.

### TORONTO

*Chairman*, W. S. WILSON  
*Vice-Chair.*, W. H. M. LAUGHLIN  
*Executive*, D. FORGAN  
 R. F. LEGGET  
 S. R. FROST  
 F. J. BLAIR  
 E. G. HEWSON  
 C. F. MORRISON  
 (Ex-Officio), C. R. YOUNG T. H. HOGG  
 A. E. BERRY N. MacNICOL  
 H. E. BRANDON J. J. SPENCE  
*Sec.-Treas.*, S. H. deJONG  
 Dept. of Civil Engineering,  
 University of Toronto,  
 Toronto, Ont.

### VANCOUVER

*Chairman*, W. O. SCOTT  
*Vice-Chair.*, W. N. KELLY  
*Executive*, H. P. ARCHIBALD  
 I. C. BARLTROP  
 H. C. FITZ-JAMES  
 H. J. MacLEOD  
 R. E. POTTER  
 (Ex-Officio), J. N. FINLAYSON  
 T. V. BERRY  
 H. N. MacPHERSON  
*Sec.-Treas.*, P. B. STROYAN,  
 2099 Beach Avenue,  
 Vancouver, B.C.

### VICTORIA

*Chairman*, A. S. G. MUSGRAVE  
*Vice-Chair.*, KENNETH REID  
*Executive*, A. L. FORD  
 B. T. O'GRADY  
 J. B. PARHAM  
 R. BOWERING  
 (Ex-Officio), A. L. CARRUTHERS  
 G. M. IRWIN  
 E. W. IZARD  
*Sec.-Treas.*, J. H. BLAKL,  
 605 Victoria Avenue,  
 Victoria, B.C.

### WINNIPEG

*Chairman*, D. M. STEPHENS  
*Vice-Chair.*, J. T. DYMENT  
*Executive*, C. V. ANTENBRING  
 N. M. HALL  
 T. H. KIRBY  
 E. W. R. BUTLER  
 H. B. BREHAUT  
 (Ex-Officio), J. W. SANGER  
 V. MICHIE  
 C. P. HALTALIN  
*Sec.-Treas.*, THOMAS E. STOREY,  
 55 Princess Street,  
 Winnipeg, Man.

# THE CONSERVATION OF NATURAL RESOURCES WITH SOME REFERENCE TO POST-WAR PLANNING

A summary of the proceedings at a special open meeting of the Toronto Branch of The Engineering Institute of Canada, held on Thursday, 4th December, 1941.

## INTRODUCTION

By ROBERT F. LEGGET, M.E.I.C.

*Assistant Professor of Civil Engineering, The University of Toronto.*

The conservation of natural resources is a matter in which there has recently been a renewal of public interest in Canada. In the public press, frequent references to conservation may now be found. Organizations whose functions have any relation to natural resources—such as those of naturalists, hunters and anglers—have intensified their studies of special aspects of conservation, often in co-operative efforts. As a direct outcome of such work there was inaugurated in 1940 the Canadian Conservation Association, designed to correlate previously separated activities. And the conservational work of Ducks (Canada) Unlimited in the west of Canada, under the able direction of T. C. Main, M.E.I.C., has attracted international attention.

Mention of such bodies as hunters' and anglers' associations may seem to support the popular misconception that conservation is a matter to be studied only by those interested in wild life. That this view is a misconception is well known to all who have even started to investigate the present state of Canada's natural resources, or who have even glanced over any of the better informed literature on the subject. Any such introduction to the real meaning of conservation will show that no approach to the proper husbanding of resources can be made without some consideration of water. Depletion of forests interferes with run-off conditions; soil erosion is usually the effect of uncontrolled water flow. A natural consequence of both is the alteration of normal river flow—spring floods are increased, dry weather flow is reduced, reservoirs are filled by silt. With all such matters, the engineer is vitally concerned; he is inevitably one of the group of interested people by the concerted efforts of whom alone can the problems of conservation be faced and be solved.

Consider, as only one example, the work of the Grand River Conservation Commission. Little over one hundred years ago, the Grand River flowed through the well-wooded virgin brush country that was then south-western Ontario. In the course of a century, its valley has been largely denuded of trees, its banks plowed up with furrows often

running straight downhill to the river, and the great marsh provided by Nature as the source of its summer flow has been partially drained. And the result? Spring floods that have done incalculable damage to the cities and towns along its banks, and summer flows so low as to be a menace to public health. Of necessity the Conservation Commission was set up; the Shand Dam has been built to increase low summer flows, and correspondingly to reduce spring flooding; it is planned to fill up again the Luther Marsh! Thus has a start been made at the engineering features of conservation in one of eastern Canada's most fertile valleys, typical of what must be done elsewhere, in addition to agricultural and forestry conservation measures, if this land is to remain the pleasant and fertile country that so many imagine it still to be.

Conservation measures can only be undertaken on an appropriate scale if motivated by an awakened and informed public opinion. Since conservation measures appear to be particularly well suited for consideration in planning for the immediate post-war world, requiring in general much labour but relatively little capital expenditure, the mobilization of public opinion regarding conservation is today of even greater importance than usual. In an attempt to make some contribution to the desirable awakening of the public's appreciation of what conservation really means, the Toronto Branch of The Engineering Institute of Canada organized a special open meeting on 4th December, 1941. It was held in the theatre of the Royal Ontario Museum and was attended by about 400 people, including members of several interested societies and associations, present as guests.

Three short papers were presented, suitably linked together by appropriate introductory remarks. The Branch was signally honoured in that the (then) newly-appointed Deputy Minister of Lands and Forests of Ontario agreed to present a brief review of Ontario's forests. Against this background, Professor A. F. Coventry—a noted student of conservation who has made special studies of the water situation in southern Ontario—presented a vivid picture of soil erosion and water depletion. Finally, Dr. A. E. Berry, a member of the Branch and councillor of the Institute, discussed the relation of conservation and public health. Short summaries of these three papers follow.

## FOREST AND DRAINAGE AREAS OF ONTARIO

F. A. MACDOUGALL, B.Sc.F.

*Deputy Minister of Lands and Forests of the Province of Ontario.*

The forests of Ontario are extensive and varied. They vary from the southern hardwoods to the Arctic muskeg types. The formation is closely related to the geology of the area. A comparison of this geology with the forest regions shows this relationship.

The greater part of Ontario lies on the worn down mountain range known as the Laurentian Shield. Around Hudson's Bay it merges into the Coastal Plain. True agricultural regions are found south of this shield and in the glacial lake bottom known as the Clay Belt. Apart from small pockets of fertile soil, the Laurentian Shield is an area of forest covered sand and rock.

The forests in this area vary from the southern hardwoods in the agricultural lands to temperate hardwood and pine, north to the Arctic drainage; spruce forests north to the Coastal Plain and, finally, the sparse muskeg type and shoreline forest north to the Arctic.

One would be very unwise, confronted by existing evidence, to generalize as to the relationship of forest to water

in all the province. In the southern section water shortages may, through excessive drainage, become acute; in the extreme north there is water stagnation in the muskeg areas. The water problem and its forest relationship must be more clearly defined and related to definite areas.

Consider the forest on the Laurentian Shield. Clouds passing over this area precipitate their moisture over the dense forest. Under shelter, it lies as a deep mantle of snow protected from evaporation. The dense forest acts as a sponge to hold the moisture, but even a sponge becomes saturated and so it passes into the little streams, into the large rivers and on to the ocean.

The function of this forest is one of preventing evaporation by sheltering the area, encouraging precipitation and acting as a filter to let the water seep out gradually. The forest delays the time of run off in this region. Whether this delay is an advantage or disadvantage on the Laurentian Shield is tied up with watershed runoff and storage studies, and is a problem for waterpower engineers.



Fig. 1—Mouth of the Michipicoten river, Lake Superior. Typical Laurentian forests and lake view.

The rivers of this region passing through and over rock and gravel do not present the problems of erosion so common to agricultural land.

On the Laurentian Shield the problems of water use and study are therefore six in number:

1. The water serves to maintain the natural forest, and the forest reacts on water;
2. The great forest area affects the climate of all the region by holding back snow melting in the spring and keeping the air above it cool in the hot summer.
3. The water stored is used for power purposes and for logging;
4. The waters of the streams, their associated springs protected by forest growth, make a cool habitat for fish life;
5. The waters and this forest are necessary to maintain and shelter animal life;
6. The combination of this well forested and well watered country makes it a great resort for health.

The planning and management of all these water uses are briefly:

1. The protection of this natural forest as it stands, from fire, insects and disease.

## THE WATER SITUATION IN SOUTHERN ONTARIO

PROFESSOR A. F. COVENTRY, B.A.  
*Department of Zoology, University of Toronto.*

During recent years, indications have been accumulating that all is not well with the water supply of southern, agricultural Ontario. Many folks living in the country have endured failure of wells, drying up of ponds, diminution and often complete cessation of flow in streams, and all these have raised doubts. Several recent critical investigations have confirmed the doubts and given point to fears for the stability of the water supply of southern Ontario.

The first of these researches was conducted by K. M. Mayall in 1937 in King Township, under the auspices of Mr. Aubrey Davis of Newmarket. Mayall's findings on the water situation can be summarized briefly. The township, about 130 square miles in extent, has some 200 miles of watercourses leading north and south from a central ridge. A hundred years ago all these watercourses carried permanent streams; now, only some 25 or 30 miles continue in flow throughout a normal summer, the rest—80 to 85 per cent of them—becoming waterless. At the same time wells are failing and springs and ponds are drying up. Originally 80 per cent of the township was covered with mixed forest, but at the present time not more than 11

2. This natural forest must be brought under control. To control it requires permanency in management and cropping.

To attain this permanency there will be much work for the engineer in post-war days. Permanent forest roads in a logging area make possible the systematic cropping of a large area. Permanent waterpower structures to replace thousands of temporary lumber dams will make possible planned use of water.

To summarize the relation of Ontario's forests to water conservation there are three phases to the problem:



Fig. 2—Brulé Rock, Lake Superior. Sparse Laurentian forest cover.

(a) The water in the Laurentian Shield whereon erosion is absent;

(b) Agricultural Ontario where excessive drainage may make water scarcity.

(c) The northern Coastal Plain where excessive water is a problem.

In considering the relationship of post-war man-power problems with the control of water and its conservation in the forests of Ontario, The Engineering Institute is moving wisely and surely.

per cent of the land is wooded, and half of that 11 per cent is grazed and is thus inefficient.

The discovery of so disturbing a condition naturally and properly raised the question whether King Township is, as it was intended to be, a fair sample of conditions in southern Ontario; various pieces of evidence lead to the conclusion that it is representative.

N. Douglas, of Owen Sound, has reported that all the 15 townships of Grey County suffer from seasonal shortage of water, acute in all but two, and that 75 per cent of the streams have ceased to flow from ground springs and are therefore very uncertain.

R. S. Carman, of the Ontario Forestry Branch, has reported that the headwaters of Wilmot Creek, north of Orono, in Durham County, have shortened considerably within the memory of living men, that the springs from which they flow are now further down the hillsides, that the total flow in Wilmot Creek is now much less than formerly, and that wells have needed deepening in recent years. The reasonable inference seems to be that the underground water reservoir stands now at a lower level than in earlier days.

A survey by A. F. Coventry of the streams of the Peel Plain region, west of Toronto, reveals conditions closely comparable with those of King Township, and over a much larger area of land more completely devoted to agriculture, about 1,300 square miles in all. Figure 3 is a map of the watercourses of this area, totalling some 1,500 miles; those shown by solid lines are permanent, the rest, in broken lines, cease to flow for some part of a normal summer. The sinuous, stippled line indicates approximately the position

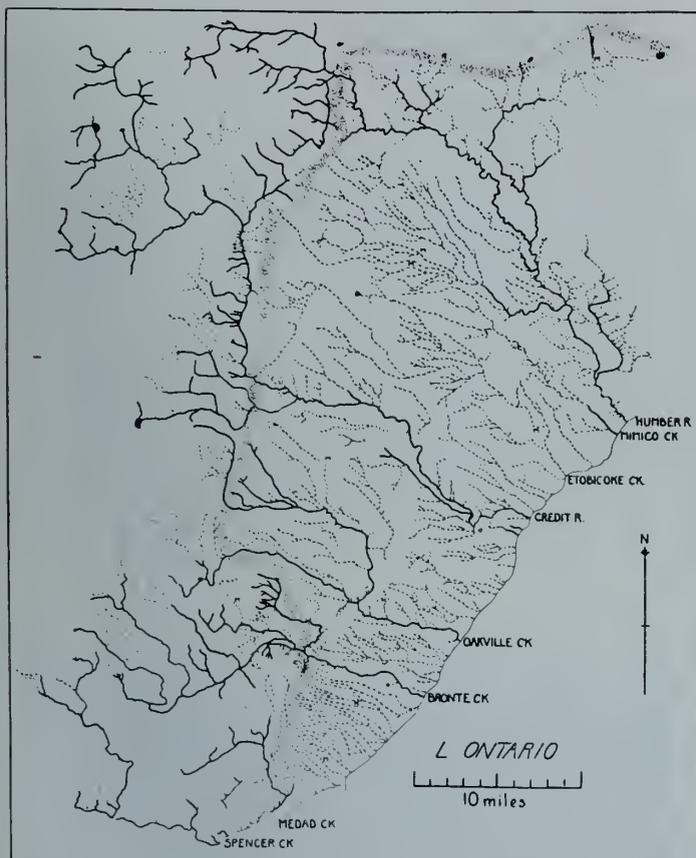


Fig. 3—Plan of the watercourses of Peel Plain and adjacent areas.

of the limestone escarpment on the west and the interlobate moraine on the north; it separates the highly developed agricultural plain to the southeast from the rougher, less fully cleared highlands on the north and west. About 500 miles of watercourse are on the rougher highland, the remaining 1,000 miles on the lowland.

In the area considered as a whole, 67 per cent of the streams are temporary; that is bad enough, but the situation becomes worse on further analysis. In the upland rougher region with more marshes and more cover, 31 per cent of the streams fail; in the lowland, 82 per cent. This is not the full tale; with one very small exception all the permanently flowing streams of the lowland owe their permanence to waters they receive from the highlands; the agricultural plain is now for practical purposes unable to maintain a permanent stream, where a hundred years ago, or less, were streams that drove mills. The average forest cover on the plain is some  $3\frac{1}{2}$  per cent.

These figures, striking in themselves, can perhaps be emphasized by a few pictures; they are chosen out of a considerable collection, for it is, in summer, easier to find dry stream beds than flowing streams. Figures 4 and 5 show the Etobicoke Creek near Summerville, on Dundas Street, at different seasons. The first is in summer. The stream bed is devoid of flowing water, the few puddles being the product of twenty hours' rain just before the photograph was made. The second picture, Figure 5, shows the same place during spring flood, though not at its greatest height. The flow is of the order of 200 cu. ft. per sec. and

it is rapidly removing from some 90 square miles of drainage basin the meltwater from the winter's accumulation of snow. In other words, a large part of the summer's water supply is going fast and uselessly to the lake a few miles away, instead of soaking into the ground as a reserve. About sixty years ago there was a mill at this point.

Figure 6 shows a stream bed in Halton County; it is now usually dry in May, although twenty-five or thirty years ago it was a trout stream. In its neighbourhood springs have failed for the first time during the last few years.

In many places streams that go dry for some part of the summer have cut their beds through the glacial till to bed-rock; not even this low level ensures a water supply, and what this implies in terms of underground reservoir is only too alarmingly easy to imagine.

The dominant features of the existing water situation in southern Ontario are floods in the time of spring thaw; dry stream beds in summer; failing wells in fall and winter.

All these are assignable to the same cause—removal of too much of the original cover, mainly forests, in the shelter of which the stream system developed through some 30,000 years. This slowly established water balance has been wrecked in about 100 years. In the absence of cover, snow is more exposed to evaporation by wind and sun, so that the amount that accumulates during winter is less than it used to be; what does remain lying on the open ground melts fast in the first warm days of spring and runs rapidly off as floods, often destructive and always wasteful, instead of melting slowly and soaking into the ground to swell the vast underground reservoir which is a vital part of the natural economy of water. In comparable fashion the water thrown down by summer storms lacks in some degree



Fig. 4—Etobicoke Creek near Summerville, Peel County, in summer.



Fig. 5—Etobicoke Creek near Summerville, Peel County, during spring run-off.



Fig. 6—Limestone Creek, Rattlesnake Point, Halton County, in fall.

the natural control which would allow the fullest use to be made of it.

These floods and the droughts correlated with them, bad as they are, are not the only evil of the unbalanced water system. Coupled with them is soil erosion—the removal of the fertile surface material on which the productivity of the land depends. This aspect of the loss of natural resources is well known in the United States and in our own West; perhaps there is less full realization that it has reached serious proportions in southern Ontario.

Erosion and water cannot be discussed apart to any profit, for they are aspects of the same problem. Wherever water runs over exposed soil it carries with it some of that soil, and the amount thus transported becomes tremendously greater with every small increase of the speed of the flow. This leads to several kinds of erosion, not sharply demarked from each other.

Under natural conditions erosion occurs seldom, at any rate under conditions like those of southern Ontario before the coming of the white man. When, however, its natural cover is removed from the soil, this single process upsets the water balance and makes water, according to the season, either too abundant or too scarce, and at the same time lays the soil bare to the action of moving water or wind.

Sheet erosion is the most widespread form, and it is probably the most dangerous, since it is less obvious than other types. It is the general removal of surface soil over large areas and it has affected nearly all parts of agricultural Ontario. The damage is of course greater on sloping lands, but even on practically level lands the surface may, in time, be removed to a destructive extent. This may not be easily observable from the ground, but it is a very conspicuous feature of a large proportion of air photographs of southern Ontario, and it is an important indication of loss of fertility.

It has been said that if the streams of a country are dirty after rain, the agricultural doom of that country is sealed; most of the streams of southern Ontario are dirty after rain.

When suitable conditions exist, sheet erosion can easily pass into much more dramatic forms: rills may enlarge into small gullies, and these may combine and extend on the grand scale. Figure 7 shows a small part of one such resulting area on red clay in Wentworth County. The gully shown is about 45 ft. deep.

Gullying may also be very destructive in light sandy and gravelly soil, as can be abundantly seen on the interlobate moraine and along the shore of Lake Erie.

Wind erosion is most damaging on sandy soils, of which there are many thousand acres in agricultural Ontario. Removal of the original forest cover deprived them of their protection; desiccation altered their physical condition; and the combined effect was to leave them open to destruction by wind. The surface is gradually blown away, sometimes

to a depth of three or four feet, and the transported material may easily impair the utility of adjacent lands. Figure 8 shows an area which has suffered this fate about 25 miles from Toronto.

Land in this condition is of course entirely useless for production; it is, in addition, an active menace through its tendency constantly to spread; and its value as a water-collecting area is reduced. This last is often a matter of special importance, since much of the land of this nature is along highlands which control the streams of neighbouring lowland, more purely agricultural regions.

Summing up, there has been no significant diminution in the annual fall of rain and snow on southern Ontario, and the amount that falls was, in the past, sufficient to develop a rich forest cover, abundant streams, and a soil eminently capable of supporting agricultural procedures. Now the streams are disappearing, largely in one annual, spectacular splurge at the time of spring floods, and the soil is losing its fertility, sometimes obviously, more often insidiously but none the less surely. The two processes are closely interlocked and cannot be separated in consideration or treatment. The conditions of the present will not cure themselves; they will almost certainly get worse as more and more cover is removed from the land, and more and more land is left open to the attacks of wind and water.

Ontario is faced with a grave problem, which, left unsolved, threatens her future, both social and economic. The solution will need comprehensive organization. First, careful and complete surveys are needed of existing conditions, about which far too little is known in sufficient detail for



Fig. 7—Gully in red clay near Waterdown, Wentworth County.



Fig. 8—Wind erosion near Aurora, York County.

the preparation of large-scale remedial measures; then, these surveys will be the basis for working out plans for reconstruction. In both phases the skilled knowledge of a wide range of technical experts will be demanded.

The execution of the plans, actual reconstruction, will require the toil of many men and so will be a proper subject for post-war re-establishment; but in order that this work may be available in the period of transition to a peace footing, the plans must be fully prepared beforehand during the war.

Further, it must not be supposed that reconstruction once effected can be left to look after itself; on the contrary, maintaining the countryside in its most efficient state, from every aspect, will be a continuing job, employing permanently a far greater number of trained men than has so far been at all contemplated.

Reconstruction on the lines just suggested is one of the basic problems confronting Ontario, and the treatment given it will play a large part in determining the future of the province.

## PUBLIC HEALTH AND CONSERVATION

A. E. BERRY, M.E.I.C.

*Director, Sanitary Engineering Division, Ontario Department of Health.*

Conservation includes not just a storing up of resources and physical assets but rather intelligent utilization of these facilities. Minimum impairment of capital assets by conservation is in contrast to waste and abuse. Consideration of future needs is important in any programme of conservation.

The objective in conservation is prosperity and welfare of the citizens of the country. Resources are of use only when the people are able to make use of them.

Conservation of man-power is essential for the welfare of a country, alike in peace and in war emergencies. Maximum use of man-power can result only when human welfare reaches the highest in health, morale, comfort and happiness. Thus a close association must exist between health and conservation programmes. Health protection is conservation of the most important kind. If a nation cannot be assured of health, the natural resources will be of little avail.

National wealth is measurable. In all Canada the average is about \$2,500 per capita—mostly made up of urban property and agriculture. In contrast to this who can measure the potentialities of the human population, when health and welfare are conserved.

### PROBLEMS OF PUBLIC HEALTH

Efforts in conservation of health have been going on for years. Great improvements have been made, but much yet remains to be done. The Honourable Ian McKenzie, Minister of Pensions and National Health, has stated that "sickness costs Canadians more than \$250,000,000 a year." This is more than the cost of the air training plan, in addition to loss in wages and productive capacity. It is also estimated that 50,000 wage earners are idle every day through sickness. This loss to industry is ten times as great as that from industrial accidents. Sickness may account for 10 days loss per worker per year or a loss to industry of \$100 per year per wage earner.

### ACTIVITIES OF HEALTH BODIES

Health agencies have been organized on a large scale with the objective of protecting humans against the ravages of disease, as well as making the environment more conducive to human welfare. These activities are carried on by the Dominion, the provinces, the municipalities and by voluntary agencies. Each has its task to perform.

There is in this programme a division of responsibility between the state and the individual. The state can do much to control the environment and prevent the spread of infection. The individual must also assume an important share in this work. He cannot depend entirely on the state for health protection.

### PRESENT STATUS IN DISEASE CONTROL

What is the situation to-day in the control of communicable diseases in this country? These have been reduced greatly. Lifetime has been extended, but certain diseases are still not under control. Heart diseases are at the top

in the list of causes of death. Cancer also is high. Both of these maladies depend much on the action of the individual.

In the case of tuberculosis there has been an energetic action taken by the state to control this. A steady decline has resulted. The death rate now in Ontario is 26.7 per 100,000 population. The province spends about 2½ million dollars annually on treatment and prevention; 61,000 examinations were made last year in chest clinics. Early diagnosis and prevention does much to conserve the nation's man-power.

The infant death rate in the province has dropped in the last 10 years from 73.7 to 43.2 per cent, and the percentage of deaths in this period caused by diseases of the digestive tract has dropped from 19 to 6.

Diphtheria has been declining steadily, and now very few if any cases are found in large cities.

In the diseases associated with environmental sanitation much improvement has been made. Typhoid fever is the lowest on record, and has been declining steadily. Undulant fever, paratyphoid fever and others in this group have reacted similarly. To do this it is essential to control the environment. Continual vigilance is needed. These diseases, where the state can exercise supervision, have shown promising results. The same does not apply to all those diseases which depend more on the individual's action.

### WHAT IS THE CAUSE OF UNCONTROLLED DISEASES?

Some diseases are more easily prevented than others. In some the state can adopt effective measures. It is necessary to enforce prevention and to adopt compulsory measures such as in the treatment of water, the pasteurization of milk, quarantine, etc. Prevention is seldom popular or dramatic except in cases of actual emergency. Public support is necessary in disease control. Education is desirable, but is seldom as rapid as compulsion.

### THE ENVIRONMENT AND DISEASE

To what extent does environment affect the health of the citizen, and how is conservation of resources linked with this? Some diseases are linked closely to the environment, and in general a prosperous country tends to good health. Soil erosion has a devastating effect on nutrition and general welfare.

### WATER SUPPLIES

Environmental problems include water supplies, stream pollution, sewage and waste disposal, flood control and droughts, recreational facilities, etc. All are specific problems for the conservationists in any country.

Municipalities must be assured of water supplies adequate in quantity and satisfactory in quality. It is required for domestic use, for fish life and for recreational purposes.

Ontario is fortunate, in general, in having an adequate supply of water for domestic purposes, except in small streams and shallow wells. Underground, deep wells have not been affected to any noticeable extent here, but elsewhere the levels have receded as much as 200 ft. Efforts

are made to replenish this supply by diverting used water into the underground again.

In surface waters, particularly in streams, floods and droughts are the opposite extremes of a single condition. Floods are not so serious to health, but they do constitute a real menace to property and to life. In 1941 the United States Government had an appropriation of \$69,000,000 for four major river control projects. Losses in Canada are periodically serious.

Droughts offer a very real health menace. Objectionable tastes are created, higher pollution occurs and illness is contracted. To avoid this, reforestation has been carried out at a number of places. The results are satisfactory.

#### POLLUTION OF STREAMS

The pollution of streams is a major problem in built up communities. This pollution is both domestic and industrial. Many examples of this are found in Ontario. They give rise to odour complaints, destruction of fish, problems in water treatment, algae decomposition, etc. Streams and surface waters should be utilized, but undue pollution should be avoided.

#### TREATMENT OF WATER AND SEWAGE

Modern methods are effective, but within limitations. High expenditures are involved for correction of pollution. Only a small part of the sewage from urban centres is adequately treated. The problem is not how to do this, but rather how to secure public support for the expenditures that are involved.

#### FOOD SUPPLIES

Food supplies and adequate nutrition are important in the health and welfare of a nation. Soil conservation plays a major role. Erosion may result in loss of essential minerals.

These foods must be carefully protected in the course from production to consumer. Milk supply is an example of this. Pasteurization, made compulsory in Ontario has achieved effective results in disease control.

The present situation in conservation leaves much to be desired. It is essential that interest be stimulated in these activities, and that funds will be forthcoming to meet the costs involved.

#### CONCLUDING NOTE

Following the presentation of the foregoing papers, there was exhibited—by special permission of the U.S. Department of Agriculture—one of the most remarkable of all documentary sound films, "The River". The film deals with the Mississippi River, what it has done and what man has done to it. It depicts vividly the vital part that this river has played in the development of the United States and shows how man, by abusing natural conditions has, in many cases, turned the river from a natural blessing into an uncontrollable menace. It goes one step further and points out how through agricultural practices and engineering projects, which in themselves are beneficial to the country as a whole, control of the river can be regained. It is a conscious attempt to present a fundamental problem so factually and so dramatically that those who see the picture will be moved to action. (Copies of this film are now available for loan in Canada; enquiry should be made of the National Film Board, Ottawa).

The film has great emotional appeal and formed a fitting climax to the preceding speeches. But, of set purpose, the meeting was continued so that the message of the film could be correlated with Canadian conditions. This was done by Professor Coventry in a brief but moving appeal, based on the situation in southern Ontario which he had previously described—a situation which demanded attention, he said, and that promptly. With this challenge, the meeting ended.

# DEVELOPMENT OF GROUND WATER SUPPLY

J. W. SIMARD, M.E.I.C.

*International Water Supply Limited, Montreal, Que.*

Paper presented before the Montreal Branch of The Engineering Institute of Canada, on October 8th, 1942

So long as primitive peoples were satisfied to live on the shores of streams, their water problems were easy to solve. Our early ancestors and their herds quenched their thirst from brooks and rivers.

Old Bible texts very often mention facts showing the scarcity of surface water, and the necessity of resorting to underground strata. They tell us about Abraham and his son, Isaac, sinking wells after their arrival in Palestine. They also describe the seven years of drought in Egypt, under the Pharaohs, as well as the journey across the desert by Moses and his people, when he had to strike the rock in order to save them from death by thirst. All these facts prove clearly that, even in the old days, surface water was sometimes scarce.

But when surface water was lacking, underground water had to be found, and this is how the art of well digging started.

Ancient wells generally gave little water, just enough for the domestic requirements of the people, and their live stock. Occasionally large flowing underground strata were encountered by chance, and their water used for irrigation purposes, but with these exceptions it can be said that before the industrial era, underground water was not exploited extensively.

With the growth of industry and the increase of population in various regions, many surface waters have become contaminated. In some areas, the flow of streams is not large enough to supply the requirements of constantly increasing cities and towns. Similarly, industrial developments also require water, sometimes in large quantity, and it must be always available, during drought as well as during rainy seasons. And so, we have been brought to the scientific search for ground water, and to the technique of well development.

The following notes give a résumé of some of the methods of locating water-bearing underground strata, and utilising their supplies.

## ORIGIN OF UNDERGROUND WATER

Unless its origin is magmatic or volcanic, water can only reach the subsoil by infiltration from the surface through pervious formations, or through rock fissures. If the ground is impervious, and if the rock formation is solid, and not porous, no underground water is to be found, whatever the depth.

The great source of ground water is rain. Rain water, after it has reached the surface of the earth, will run off on impervious soil like clay or solid rock, and will flow down to brooks, streams, rivers and lakes, finally reaching the sea. During its course, and depending on atmospheric conditions, it will lose part of its volume by evaporation, and vegetation will also absorb the quantity necessary for its life.

But rain falling on pervious ground percolates through it. This water seepage feeds the ground water-bearing strata, often called "aquifers".

However, there are exceptions to this rule, and water can penetrate underground through fissures in impervious rock. In this case water, following the laws of gravity, may be carried to great depth by these natural channels. Sometimes hot water springs and geysers originate in this manner. The water coming down from the surface is gradually heated at the approximate rate of one degree Fahrenheit per sixty feet of depth; in its course, it dissolves some of the mineral matters in contact with it, and at its outlet, it is frequently used for therapeutic purposes.

Experience has shown that the chances of reaching underground water by boring through fissured rock are sometimes remote, unless some effective geophysical methods are used to detect with such precision as is possible, the depth of the fissures.

In some pervious rocks like porous sandstone or limestone, the chances of securing water are much better, and in certain cases large quantities of water can be obtained when these rocks are in contact with a pervious stratum. Such geological conditions exist in northern France, around the industrial region of Flanders, where much fissured limestone lies at a shallow depth. This limestone, lying directly under sandy formations, is entirely submerged, and many wells have been bored in it to supply large plants with industrial water. It has been stated that the Maginot line was not extended to the Channel, on account of the practical impossibility of handling the ground water which would have been met with during construction.

Under normal conditions, water is in the subsoil, provided a pervious stratum permits its percolation. For this reason, it is not advisable to drill a well without a preliminary examination to find out if such a stratum exists.

## PRELIMINARY STUDY

There are many ways to secure this information: first, the study of geological maps will show what the ground outcrops are in the surrounding country; this will give a general idea of the formations; then an investigation trip on the ground will confirm the findings, and give the opportunity to check the drainage area. It will also be useful to see the wells of the region, if there are any; also to visit any trenches, quarries, or excavations which may exist. A careful study of the data so secured will indicate the existence or absence of an underground stratum, and if the conclusion is favourable, a rough estimate of its capacity may be made.

There exist many large ground water developments. In the United States, in the states of New York, Minnesota, Texas, Utah and California, and in Florida and Georgia, also in France and England, as well as in North Africa, in Algeria and Tunisia, there are many sources of this kind, tapped by hundreds of wells, supplying ground water in large quantities to public services, and to industry.

Thus it is often necessary to obtain very large supplies of water from underground sources; in such cases it is important to estimate the capacity of the water-bearing formations.

The capacity of a water-bearing stratum is limited to the amount of surface water percolating to it, and to the velocity of the underground flow. It is therefore necessary to estimate the catchment area, and to secure rainfall data on the surrounding country in order to calculate approximately the volume of water that may be drawn under favourable conditions.

## QUALITY OF GROUND WATER

All ground waters cannot be used. Some are not potable; some contain too much salt and magnesium, others contain carbonates and sulphates, and must be softened before distribution; the iron contents of others are too high for domestic purposes, or for their use by some industries. Therefore, it is important, before going to the expense of a permanent well, and of its equipment, to secure water samples for analysis. In order to get these, a small diameter test hole is drilled into the aquifer, and this is pumped until the water becomes clear. First samples will only be

taken after some hours of pumping, so that the water is not saturated with the soluble matters in the formation; the samples thus secured would represent the water to be obtained under future pumping conditions.

Ground water has many advantages, when compared to surface water. Its quality never varies; its mineral content is the same at all seasons; it is free from bacteria; its clearness and temperature are constant, and the cost of its treatment, when necessary, is low. Moreover, underground strata constitute an ideal reserve of water, economically stored, available whenever required.

The initial test hole will have given some information on the conditions underground, and as to the lengths and diameters of casings needed for the permanent well.

### VELOCITY OF UNDERGROUND FLOW

It remains to find what will be the probable flow from the proposed well. This is a more complicated question, for the following reasons: the underground water exists in pervious ground; these strata are generally formed by alluvial deposits, or consist of sedimentary formations. Alluvial deposits are found in the valleys of old and modern streams. Often, as it is the case in the Laurentian country, they have been washed down by glacier streams, or deposited during the moraine period, by the displacement of glaciers, which have eroded the secondary and tertiary formations of our region, under their tremendous weight. These deposits, sometimes called drift or overburden, are not evenly distributed; they contain clay, sand and gravel in variable quantities. Ground water will flow more freely if the sands are coarse, and if they contain little clay; on the other hand, the water circulation will be slower in fine sands, especially if they are mixed with clay.

The loss of velocity due to friction through coarse sand will therefore be less than the one through fine sand with clay. And this explains why the conditions of underground flow can vary in the same stratum, within a few hundred feet, and why the capacity of a proposed well can only be estimated by a test, to find out the conditions of the subsoil, on the site of the work itself.

Such tests are made in the following manner: a small diameter test well is drilled into the aquifer, and a temporary screen is set in the water-bearing stratum. The static level of the water in the well is then measured, and the well is pumped until the water is clear, and the pumping level stabilized. Note is taken of the volume of water pumped, and of the drawdown of the water in the well during pumping, the drawdown being the difference of depth of the water in the well, between static and pumping levels. After pumping, the time of recovery to the original level is also noted. Taking into account the time of pumping, the yield of the well per foot drawdown can now be established, and this is called the specific capacity of the well. Knowing the thickness of the stratum by boring, the specific capacity, and the possible drawdown, the volume of water that may be expected from the permanent well can now be estimated.

However, this figuring must be done with some care, because it is clear that by applying strictly the formula in thick layers of fine clayish sands, impossible yields would be figured. This is where experience counts. Even in a stratum composed of coarse elements, one must not forget that the maximum capacity of a well is limited to the velocity of water at the outside of the metallic screen set in the aquifer, and to the velocity of the water flow in the stratum itself. The well will only deliver the smaller quantity of water produced by either of those two factors. After the geological study and the two tests, necessary information to plan a well producing a known minimum quantity of water will be available.

There are many methods of measuring ground water flow. Dyes like fluorescin and eosin, highly coloured matters, are frequently used. Powdered fluorescin can be seen in a solution of one part in 40 million, and it can also be

detected by experiment in a solution of one to ten billion. The powder is deposited at a certain spot in the stratum, and then note is taken of the time when colour appears at a point downstream.

Many specialists in hydrology have given formulae on underground flow. Unfortunately, Mother Nature does not always take laboratory data into account, and the proportions of sand, gravel and clay may vary in different parts of the same stratum. For these reasons, it is wise to decide only after actual testing has been done.

In certain countries, sedimentary formations of the Lower Tertiary, and of the Cretaceous have been deposited

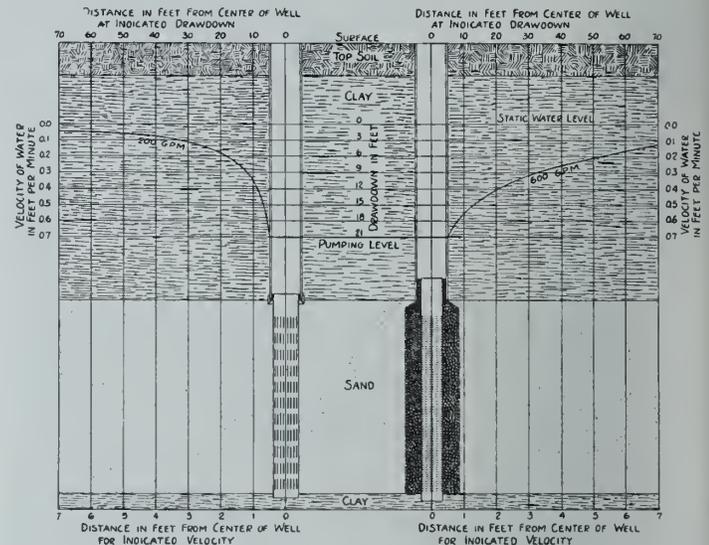


Fig. 1—Comparative yields of an ordinary tubular well (left), with a gravel wall well (right).

by the old seas. Important pervious deposits have thus been formed; they are spread on large areas, and are evenly distributed; their outcrops are also well located. Where many wells have been long in operation in such places, they have given valuable information on the water-bearing deposits, and it is therefore possible to estimate without testing, the minimum yield of a well, or of a series of wells.

The author has had some years' experience with deposits of this kind in Europe and Africa; more specially in France, near Paris, within the limits of the great depression of the Parisian basin. Many wells were sunk down to the Sparnacian formation of the Lower Eocene, as well as to the Albian and Aptian formations, of the Cretaceous; these wells were drilled without preliminary testing, on a water guarantee basis averaging 800 gallons per minute. It was possible to bore these wells without previous experimenting, because the strata tapped were well known, and a mass of data on the formations was available. But discretion must be used in this kind of estimation, and the safety factor must be applied, if one wishes to avoid numerous disappointments.

It may be added that in practice, the two tests to determine the quality and quantity of ground water, are made in the same test boring.

### CONSTRUCTION AND DEVELOPMENT OF A WELL

A modern well constructed in unconsolidated material generally consists of three main parts: the outer casing, the inner casing, and the screen.

The outer casing is a tube which extends from the ground level down to within a few feet of the top of the water-bearing formation. The lower end of the outer casing lies therefore a few feet above the top of the screen. Due to local conditions, it is sometimes necessary to set more than one outer casing.

Inside the outer casing, and concentric with it, is the inner casing, of a smaller diameter. It is set down to the water-bearing layer, and is directly connected to the screen.

The screen, usually of the same diameter as the inner casing, and connected to it, is set in the stratum at the most favourable level to secure the best underground flow. Various metals are used to resist corrosion, Armco iron, silicon or manganese bronze, copper, wrought iron or even stainless steel. The best types of screens are perforated with horizontal or vertical openings called shutters. It is through these openings that the water percolates into the well. The size of the openings of the screen depends upon the kind of formation. In short, the screen is a cylindrical metallic filter at the base of the well.

Two methods of drilling are most frequently used for water wells—the rotary and the cable-tool methods.

The rotary method, with its clay seal, has a great advantage in deep wells where many water-bearing formations exist, each containing different types of water of more or less good quality. By using this clay seal, good water formations can be developed, without being contaminated by undesirable water from others. An interesting case in the author's experience is one of a well passing through four water-bearing layers, the first and third being discarded, and the second and fourth being developed.

On the other hand, the cable-tool method is quicker for shallow wells, especially where hard formations are encountered. This method also gives better information on the ground structure, unless expensive coring is done with the rotary system.

But let us suppose that by using either system the hole has been completed, and that casings and screen of proper diameters have been set, the screen resting well in the stratum, so that water can seep into the well under the best conditions.

For most drillers the work is then completed, and it is now up to the customer to buy a pump, if the well is not flowing. Often, after this pump is set, it will be noticed that the yield has decreased, and that the quantity of water pumped is not up to expectation. If an investigation is made, it will tend to show that generally, the decrease of flow is due to the finer particles of the water-bearing layer which have been sucked into the lower part of the screen, and are partially blocking the shutters. If pumping is continued under these conditions, pump parts such as shafts, impellers and wear rings may soon be badly worn and the yield of the well will keep on decreasing until it will practically become useless. Sometimes the production of water will suddenly cease without warning. What is the probable cause of the trouble in such an emergency?

It is most likely that fine particles of sand and clay have been deposited in the bottom of the well, partially blocking the screen, and reducing its percolating area. Some of this sand may have gone through the pump, and caused the untimely wear. Or the displacement of these fine sands may have left cavities around the well, and after a while the formation has caved in along the walls of the casing and screen, and this latter may be entirely blocked. In this case, most frequently, the well is a total loss.

It is therefore important that the well when in operation should not yield water which is cloudy or contains sand or clay. If it does, the rate of pumping should be reduced until the water is clear again.

Experience has shown that the sinking of a well, and the setting of screen and casings, is only part of the enterprise, and often the easiest. What remains to be done is even more important: the development of the well to bring it up to a minimum water production, and its permanent stabilization to that production. This is the purpose of the so-called "gravel wall well." (See Fig. 1).

The object of this development is to increase the filtering area through which the water penetrates into the well. This is accomplished by setting around the screen clean gravel of such a size that it will not pass through its shut-

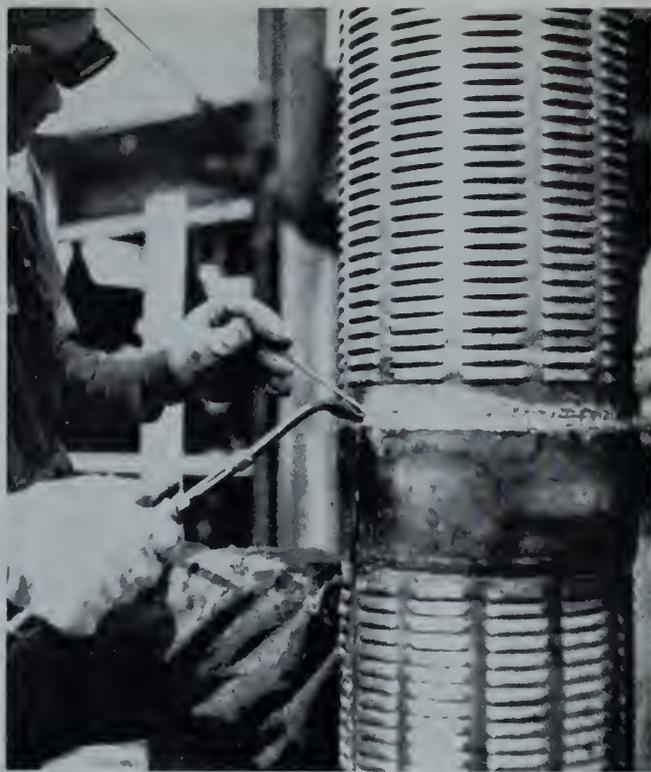


Fig. 2—Field welding joints of 12-in. bronze shutter screen as it is being installed in well.

ters, but will build up outside its metallic walls. The gravel is first put into the annular space between the outer and the inner casing, and then forced down by agitating and pumping. In the course of these operations, the finer constituents of the aquifer in the immediate vicinity of the well are purposely forced inside the screen, and simultaneously replaced by calibrated gravel. After many operations of this kind, a mass of gravel is formed around the screen, and the bottom of the well has become a regular gravel filter with a metallic core. The filtering area of the well was originally only that of the metallic screen itself, but it has been increased, and is now measured by the outside surface of the gravel filter. If more gravel is forced down, the size of the filter will increase, and so will the area through which the water can penetrate into the well. It follows that for the same flow of water, the larger this area, the slower is the velocity of the incoming water. If for a given capacity, the water velocity can be decreased to such a point that no fine matters are washed into the screen, then the water will be clear, and the well stabilized. After these operations, all fine matters having been forcibly removed around the screen, the well has been cleared of everything that could destroy its equilibrium in the course of future pumping.

It is important, during the developing process, to provide that gravel spreads as evenly as possible around the screen. Voids, caused by gravel bridging, would produce points of high velocity, through which more fine material would soon wash in to block the screen, and the whole undertaking would have to be started all over again.

During such development, it will be noted that the yield of the well increases at the same pumping level, and that water clears up more rapidly at the increased rate of pumping. This is because the well is stabilizing properly, and in some cases yields of from ten to twenty times the original output are finally secured.

After the required flow is obtained it is necessary to continue operation, so as to make sure that the water remains clear, and that the pumping level stabilizes. When these conditions have prevailed for many consecutive hours, it shows that the well has been developed to its permanent

yield, and that there is no more danger of future sanding up or cave in.

The quantity of gravel absorbed by a well in the course of its development varies a great deal. It is the flow of the



Fig. 3—Setting a 16-in. shutter screen in the 42-in. outer casing of a Layne gravel wall well.

water required, and the kind of material in the stratum around the well, that will govern the size of the gravel filter. However, in order to give some approximate figures, it may be said that frequently a gravel wall well will absorb from 10 to 15 tons of gravel. The author knows of a well in which 120 tons were required to stabilize a formation composed of fine material, where a rather high yield was wanted. Thus it is not surprising to learn that it often takes more time to develop a well than to sink it.

However, there is a limit to development, and the filter must not exceed certain dimensions. If its size would become such that the loss of head through it should be greater than the loss of head through the stratum itself, it is clear that further development would only be negative.

#### PUMPING UNITS

The well is now completed. If it is not flowing, some pumping unit must be installed. The choice of this machinery must be made with care. In recent years, manufacturers of vertical turbine pumps have greatly improved their device. Today we can obtain a pump, to be set in a twelve-inch casing, that will deliver more than 1,000 gallons per minute with 80 per cent efficiency.

In order to get the best and quickest results, it is desirable that the same specialist should supply the complete installation, both well and pumping equipment. At first sight the drilling of a well and the supply and installation of a pump do not seem to have anything in common, but experience has shown that these operations are closely related for the following reasons.

After much work, a competent specialist has finally succeeded in completing a high yield well. But unless the well is a flowing one, the customer as yet has no water, and he will not have any until a proper pumping outfit is installed. If the furnishing and installation of this unit is given to somebody who is not interested in the well, it may, and often does happen, that during the setting of the pump some tool or part of machinery is dropped into the well; this may partially block the screen, and therefore decrease the yield of the well. Even if the pump is installed without mishap, it will be necessary to make tests and this may result in a lot of trouble if done by some one not familiar with the technique of gravel wall well construction. For example, if starting and stopping of the pump is too frequent, and not

watched closely, or if the capacity of the pump is such that the volume of water coming out of the well is larger than the capacity to which it has been developed, the agitation caused by too frequent starts and stops, or by over-pumping, may destroy the equilibrium of the formation, and the fine sands and silt will then move in again with the consequences which have already been mentioned.

The customer will not be satisfied, because he will have no water, and he will have to deal with two contractors, each of whom may in good faith blame the other for the failure of the enterprise.

How natural it would be for the builder of the well to claim in his favour the results of his preliminary pumping, duly demonstrated by tests. On the other hand, the manufacturer might say that his pump is according to specifications, and offer to prove its features by laboratory tests. He would therefore claim that if the well does not give more water it is because it has been badly constructed. In the meantime, the customer will be without water, and this might cause considerable damage to his industry, or to the public service he is directing.

In order to avoid useless trouble and discussions, and to obtain quick practical results, it is therefore advisable to give to the same party the whole water production undertaking. If this party knows his business, after having made the necessary tests he should be in a position to give a water guarantee, as to quantity, quality and pressure. Thus the customer will get satisfactory results, and if he is not satisfied, he will know whom to blame.

#### WATER GUARANTEE

Such a water guarantee should cover the water production of the well, and also the material and equipment. It should extend for a period of one year from the time of the final installation of the pumping unit. This will give enough time to find out if the water stratum can stand the pumping during the four seasons of the year, including the dry ones, and to observe if pump and motor are working up to specifications.

If something were to go wrong in the water-bearing stratum, either on account of overpumping, or of improper construction or development, an abnormal drawdown of the pumping level in the well would immediately occur, or the volume of water pumped would decrease materially, or both these events would happen at the same time; the water would become cloudy, or even full of dirt, and sand deposits would be observed. If, however, during the few weeks following the beginning of operation everything remains normal, it is because the well has been properly developed and because the source of water can stand the pumping without failing.

For the reasons already mentioned, it will be understood that a water guarantee cannot be given in a rock well. It is very difficult to locate a water-bearing fissure; moreover, no well can be expanded against rock walls; it is necessary therefore to be satisfied with the initial quantity of water contained in the fissure itself.

#### BATTERIES OF WELLS

As already mentioned, many important water-bearing strata have been tapped to feed large cities, which thus depend entirely on wells for their water supply. Mr. O. E. Meinzer, geologist in charge, Division of Ground Water, United States Geological Survey, estimated some years ago that in the United States alone more than fifty million people were supplied by wells, and that of these, twenty million were getting their supply through public services. In the United States about half of the cities with populations from 5,000 to 25,000 people are using surface water, the others are getting ground water; more than 8,000 small cities and villages of less than 5,000 population are also depending on ground water.

Amongst the large centres using well water, are those of the western section of Long Island, being part of Greater

New York; the cities of Houston, Memphis, Salt Lake City, etc. If ground water should fail them, very grave conditions would result.

When it is realized that for Long Island alone more than 200 million gallons of water are daily extracted from the ground and distributed, one can understand how necessary it is to study carefully the possible variations of the underground water strata.

It will be of interest to consider what has to be done when a large centre is to be supplied with ground water, and consequently many wells must be sunk in the same formation.

After having figured the capacity of the water-bearing stratum, by studying the geological formations, the physical contours, and the local precipitation data, tests are made to determine the quality of the ground water, and then steps are taken to estimate the possible capacity of the aquifer.

If the project is large, a number of wells may have to be constructed and, in that case, the distance between the wells must be determined so as to give the best performance.

Let us examine what happens in a non-flowing well, when idle, and when in operation. Although the same natural laws prevail for underground as for surface waters, they are subject to a different regime. This is due to the difficulty of circulation of water through the formation.

When a well is not pumped, the water comes up to the natural level of the water table, at what is called its static level. If this static level is higher than the ground, a flowing well will result.

As soon as pumping begins, the suction of water in the well will reduce the pressure, and this will gradually bring water down to the pumping level. After a certain time, if the well has been properly made and developed, and if the supply is not overpumped, we know that the pumping level will stabilize itself for the same volume of water. If then gauge holes are sunk from place to place around the well, and observations made of the water level in them, they will make it possible to study the effects of pumping on the ground water table near the well which is being pumped. If a cross section curve is drawn, it will show that the water table has taken the form of an inverted cone, the apex of which is in the well at the pumping level, the irregular edges being more or less distant according to the perviousness of the formation.

The ratio of the depth of the cone to the average diameter of its base is in direct proportion to the loss of head through the water-bearing stratum; the finer the sands, the steeper will be the sides of the cone, and the smaller its base. Inversely, for the same yield, in a deposit of coarse sands and gravel, there will be a lesser depression of the water table, extending within a greater radius from the well. The zone of this depression represents the area of interference around the well. In certain cases this interference extends to some distance, and it is quite important to find the limits of this zone, when a battery of wells have to be made and pumped simultaneously in the same area.

For if wells are too close they will interfere with one another, and their pumping levels will show an abnormal drawdown; in an extreme case the total capacity of two wells sunk too close together, might not be more than the capacity of one of the wells. It is therefore necessary to locate the wells so that there is the least interference.

But on the other hand, for certain reasons of economy, one may be forced to locate the wells within their zone of interference, and still gain by doing so; but in such a case it is necessary to make sure that an increased flow is ob-

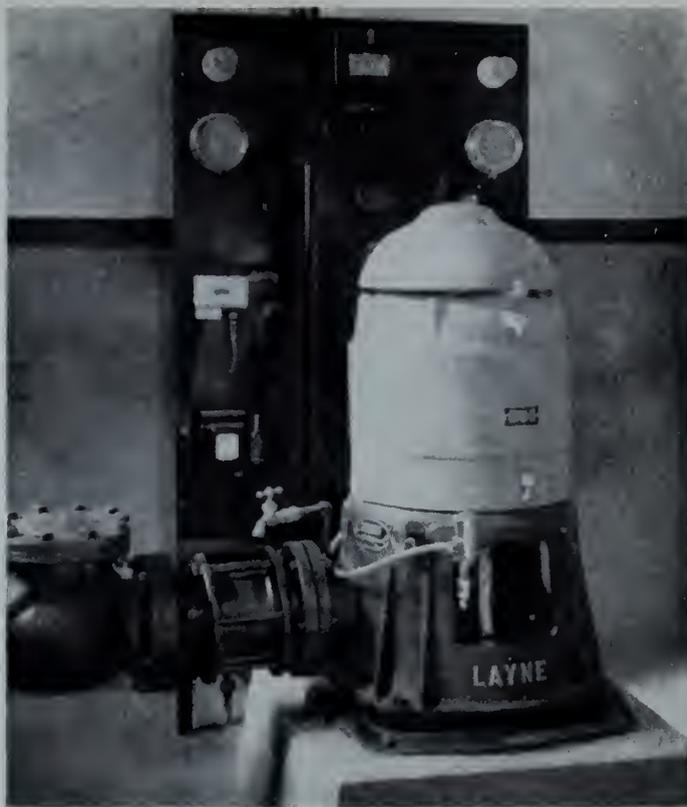


Fig. 4—Layne gravel wall well and vertical turbine pump installation for the municipality of Chesley, Ont.

tained, and that the pumping levels are definitely stabilized. Therefore, it is advisable to watch closely the interference of the wells amongst themselves. One method is to stop the pumping of one or of a series of wells, and to observe the effects of stopping and starting on observation wells.

Sometimes the problem is the construction of new wells sunk to a stratum already supplying large quantities of water. It is then advisable to watch closely the effects of the new pumping, and if it produces too great a depression on the water table, immediate precautions should be taken not to deplete the water-bearing stratum. In other words, when a battery of wells have to be sunk in a stratum, it is necessary to make sure that the total amount of water to be extracted is not greater than the recharge possibility of the stratum itself.

By taking adequate measures which cannot be detailed here, it has been possible to restore important water strata that had previously been overpumped and, by so doing, avoid disastrous conditions for populations that depended exclusively on wells for their water supply.

The object of these notes has been to show that water supplies from aquifers have rendered, and can still render, great services to the community. It is, however, important that those in charge of the work should be familiar with modern technique, and should understand that the time is gone for wells made in haphazard fashion.

The construction of a large-yield well, or of a system of wells, must be preceded by a serious study, and must be carried out by scientific and technical methods. In this way the development of ground water strata will aid more effectively the industrial and economical development of our country.

# ENGINEERING ASPECTS OF AIR BOMBING AND STRUCTURAL DEFENCE

D. C. TENNANT, M.E.I.C.

Engineer, Ontario Division, Dominion Bridge Company Limited, Toronto, Ont.

Paper presented before the Montreal Branch of The Engineering Institute of Canada, October 22nd, 1942, and before the Hamilton Branch, on November 18th, 1942.

Shortly after the outbreak of this war, we in Canada and the United States began to learn—though not at first hand—of the devastating effects of air raids, and possible defences against them. For a while definite information was hard to get, but as months and even years have gone by much has been spoken, written, and published regarding experiences in Britain, Europe, Africa, China and the Far East, so that now it is not easy to choose from the available information, concise and salient data, adequate for a clear picture, but lacking details that might be of use to the enemy.

Broadly speaking the title of this paper might be taken to include both military and civil activities, for air bombing is directed at naval, military and civilian targets, but it is assumed that The Engineering Institute is more particularly interested in the civilian side of the subject and the author does not feel qualified to suggest anything in connection with the military aspect.

Table I outlines a typical organization for civilian defence that applies to the Dominion itself and also to provinces and municipalities. It will be noted that the five main subdivisions of this organization deal with police, fire, health, structures and transport. The sub-headings shown under these five departments indicate that practically all the engineering considerations group themselves under structures and transport. Transport is important and local preparations have in some cases been made for it. It is, however, a specialized engineering activity and one that is difficult to discuss until actual needs emerge. This paper will, therefore, limit itself to a consideration of the engineering items listed in Table I under structures.

## (A) AIR BOMBS

### 1. INCENDIARY BOMBS

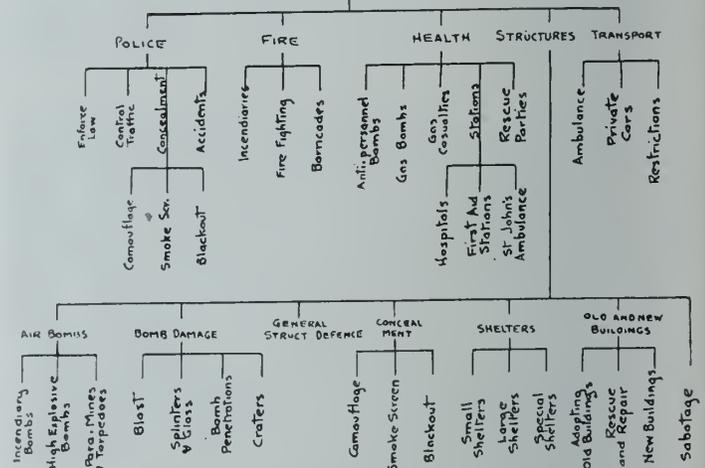
Fire has historically been one of the most powerful and most feared agencies of destruction in war. Incendiary bombs are especially intended to cause fires, but it may be fairly stated that over fifty per cent of the damage done to buildings from all sorts of air bombs is due to the fires that are kindled. German incendiary bombs used in the first world war were of a somewhat squat shape approaching the spherical and contained phosphorus, thermite, tarred cotton waste, and were wound round with tarred rope. Those used in this war are mostly of metallic magnesium, long and cylindrical and fitted with a fuse near the nose and with metal vanes at the rear. They weigh one kilogramme or slightly more than two pounds. The magnesium itself burns and is very difficult to extinguish with water as this tends to spread the fire. The bomb may be smothered with sand. A two pound incendiary bomb will perforate most roof materials except concrete, as it usually has a striking velocity of about four hundred feet per second. When air raids are expected it is, therefore, necessary to keep guards posted on roofs and upper storeys for the prompt removal of incendiary bombs. A typical present day German incendiary bomb is shown in Fig. 1. A great deal more might be said about incendiary bombs as fire is really an engineering subject, but fire protection has become the special care of our fire departments and this paper will treat more particularly of other forms of bombing.

### 2. HIGH EXPLOSIVE BOMBS

As a background it is well to remember that although modern bombing is new, yet history includes experience in

the hurling of missiles against fortifications in time of war considerable study of earthquake resistant buildings, and fires and fire fighting. This knowledge helps in a consideration of the impact, shake, and fires caused by high explosive bombs. An aircraft bomb consists of a "case" holding high explosive or incendiary mixture or gas, with means of exploding, igniting or discharging the contents as the case may be. The bombs are in a carrier on the bottom of the aircraft so that when released their speed and direction are the same as those of the airplane itself. Bombs were formerly spherical but now they are cylindrical or barrel

TABLE I  
ORGANIZATION CHART  
CIVILIAN DEFENCE COMMITTEE



shaped so that the guide vanes at the rear help them to retain their direction and the smaller cross sectional area offers less air resistance, resulting in greater speeds. A bomb released from a plane travelling horizontally will have a trajectory in the form of a parabola with a vertical axis and an ever increasing steepness as it approaches the earth. The air resistance modifies the parabolic path and considerably slows the velocity. Actually the high explosive bombs that have been dropped in Great Britain seldom have a striking velocity of more than 1,000 ft. per sec. even if dropped from great heights such as 15,000 feet. This is due to air resistance. The angle that the trajectory makes with the vertical at the point of impact is known as the "angle of impact."

Table II shows the height of release, angle of impact and striking velocity for bombs released from a plane travelling horizontally at 200 miles per hour.

A low explosive such as gunpowder burns with a rapid combustion. A high explosive such as gun cotton or trinitrotoluene—T.N.T.—explodes so much faster that the action is referred to as detonation. Table III shows the speed of detonation of several high explosives and their explosive factor which indicates their power as compared with black gunpowder.

The speed is the outstanding difference. A pound of a low explosive such as gunpowder, scientifically packed alongside a railroad rail and exploded, will shift the whole track perhaps thirty feet or more. But a pound of the high explosive gun cotton properly packed will create so much

heat and impact so rapidly that it will shatter a portion of the rail by fusing it. Gunpowder or cordite will expel a bullet from a rifle, but gun cotton would shatter the rifle chamber or breech before the bullet had time to be expelled from the barrel.

TABLE II

Height of release Feet	Angle of impact Degrees	Striking velocity Feet per Sec.
1,000	46	390
3,000	33	520
5,000	26	610
7,500	22	710
10,000	19	800
12,500	17.5	880
15,000	16	950

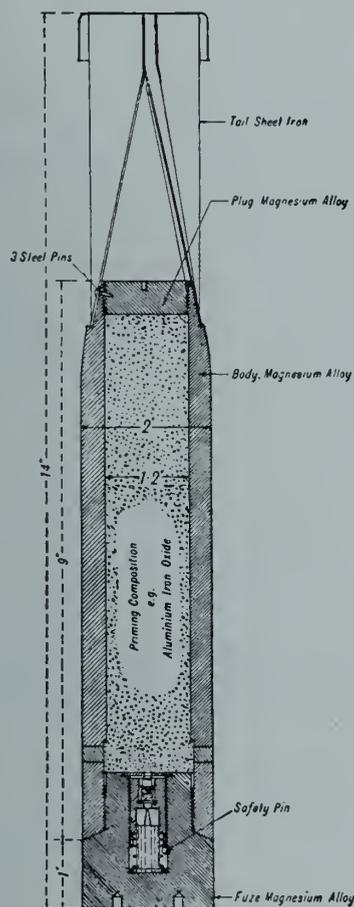


Fig. 1—Typical German incendiary bomb.

TABLE III

Explosive	Vel. of detona- tion Metres per sec.	Explosive Factor
Gun-cotton (dry).....	7300	2.8
Trinitrotoluene (T.N.T.) .....	6950 to 6483	3
Dynamite No. 1.....	6800	2.8
Amatol 80/20.....	5080	2.4

High explosive bombs differ, of course, in size from say— an anti-personnel bomb of 2 lb. or less to a large bomb weighing two tons as used at the beginning of the war, or four tons as recorded recently in our Canadian newspapers. They differ also in two other important respects, namely the relative weight of the case itself and the kind of fuse. So we have armour piercing, heavy case, medium case and light case bombs. The heavier the case, the greater the

penetrating power of the bomb. Obviously in two bombs of equal size and weight the one with the heavier case will contain a lesser weight percentage of explosive. Fuses are of two main kinds, the instantaneous fuse designed to cause explosion at the moment of impact and usually attached to the nose of the bomb, and the delay or time fuse having mechanical, electrical or chemical means to explode the bomb some time after impact; this period may be a fraction of a second or even several hours, as desired. Time fuses are ordinarily attached to the rear of the bomb where the impact when the bomb strikes the target is not so likely to smash the fuse mechanism and put it out of business. Tables IV and V show types and sample dimensions of H.E. bombs. It is not possible to give complete data on air bombs because in this war new and heavier varieties are appearing so frequently.

TABLE IV

Type of bomb	Charge/weight Per cent	Gross weight
Anti-personnel.....	15 to 20	20 lb.
Light-case.....	50 to 60	50 to 4000 lb.
Medium-case.....	25 to 40	
Heavy-case.....	small	

TABLE V

TYPICAL DIMENSIONS OF AIRCRAFT BOMBS

Bomb	Length	Diam.	Sectional Density
2,000 lb. light-case.....	14 (9) ft.	24 ins.	4.4 lb./in. <sup>2</sup>
1,100 lb. heavy-case.....	6 (4) ft.	12 ins.	9.7 "
550 lb. medium-case....	5 (4) ft.	15 ins.	3.1 "
220 lb. medium-case....	4½ (2) ft.	10 ins.	2.8 "
100 lb. medium-case....	4 (2) ft.	9 ins.	1.6 "
20 lb. Anti-personnel...	2 (1) ft.	5 ins.	1.0 "

Figures in brackets in Col. 2 give length of bomb-carcase not including tail.

$$\text{Sectional density equals } \frac{\text{Mass}}{\text{Max. Cross Sectional Area}}$$

Armour-piercing bombs are generally used against military or naval rather than civilian targets. They have very heavy cases and great penetrating power. The advantage of a heavy case and a time fuse is that the bomb enters and lodges in the target before the explosion takes place, and an explosion in a confined space does more damage to the target than does a surface explosion. On the other hand a light case bomb with instantaneous fuse will explode on the surface of a street and its greater percentage of explosive will cause greater air impact and a greater number of splinters, doing more damage to persons and shattering more glass at great distances from the explosion centre.

### 3. PARACHUTE MINES AND AERIAL TORPEDOES

These two varieties of explosive missiles dropped by aeroplanes have no resemblance to each other but may be mentioned because we have recently heard of their use. The parachute mine contains a very high percentage of explosive. Its protective casing is light and has little resistance to impact, so that the speed of descent has to be moderated by attaching it to a parachute. When it reaches the ground it is most dangerous from an incendiary and explosive point of view. Much of the more recent damage by the Germans in congested areas has been due to parachute mines.

The aerial torpedo is used by aeroplanes operating with the navy. It resembles an ordinary naval self propelling torpedo and is used against enemy ships, but is released from a low-flying plane and attacks the target in the same

way as any other torpedo. Because it is carried by an aeroplane it is likely to be smaller than most other torpedos.

## (B) BOMB DAMAGE

### 1. BLAST

Let us assume that a high-explosive bomb contains one cubic foot of solid or liquid explosive. Detonation converts this into a gas which would have a volume of say 1,000 cu. ft. at ordinary temperature and pressure. But at the very high temperature of detonation this volume may be 10,000 or 12,000 cu. ft. at the instant of explosion. The case expands, mostly at its centre, to about one and a half times its usual size and then bursts, releasing explosive gas and shooting out fragments or splinters in all directions at about twice the speed of a rifle bullet, which is 2,500 to 3,000 ft. per sec. All this happens in about one five thousandth of a second. The results are a sudden enormous air pressure, fragmentation, disruption, penetration, craters and other damage. These may best be studied separately.

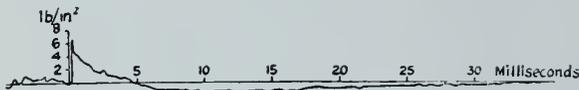


Fig. 2—Oscillograph record of typical blast wave.

Experiments show that in the immediate vicinity of the blast the air pressure increases greatly and suddenly and then subsides to a subnormal pressure or suction that lasts much longer than the initial high pressure and often causes more damage to structures. Figure 2 shows an actual experimental curve of pressure taken at 50 feet from the explosion of a 500 lb. bomb.

Table VI gives pressures and suctions at different distances from the explosion centre. This successive pressure and suction radiates in air waves, the duration of each wave as shown in Fig. 2 being about 30 milli-seconds, which is about one thirty-third of a second.

TABLE VI  
INITIAL PHASES—500 LB. MEDIUM-CASE BOMB

Distance from Bomb Feet	Maximum Positive Pressure Lb. per sq. in.	Maximum Suction Lb. per sq. in.
30	24	—
50	6	1.4
100	2.3	0.8
200	0.4	0.2

Some rather strange examples can be cited to prove that this suction actually exists as a destructive part of the shock wave in the air. Fig. 2 might give the casual impression that the maximum positive pressure in the air wave is not excessive, but it will be noted that it represents pressures at 50 feet from the centre of explosion, and according to Table VI the pressures are vastly greater closer to the explosion, so much so that life cannot withstand the air shock at close quarters, to say nothing of fragments and splinters travelling at high speeds in all directions.

### 2. SPLINTERS AND GLASS

Splinters or bomb fragments travel outwards from the explosion centre as already stated at initial speeds up to 7,000 feet per sec. These penetrate or perforate any targets presented, depending on the character of the target and the speed and weight of the splinters. Table VII shows penetration into Douglas fir.

Table VIII indicates the number of perforations in steel plates of varying thicknesses and at different distances from the explosion.

Flying glass is very dangerous, particularly to persons. In the first world war the Halifax explosion smashed the glass in a front door and carried the splinters the full 50-ft.

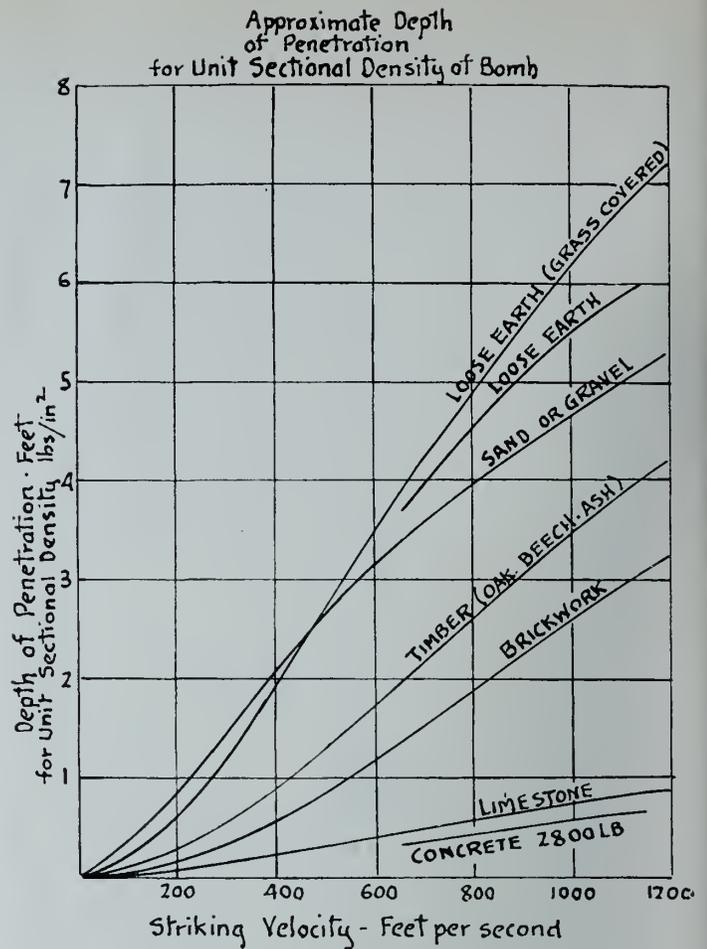


Fig. 3—Diagram showing depth of penetration of different materials by typical bombs.

length of a corridor, embedding them in a wooden door at the far end, and the splinters did not fall perceptibly in transit.

The fragments from anti-aircraft shells dropping to earth after the explosion, cause damage similar to that of the splinters from a bomb blast. Their speed is the result of the force of gravity.

### 3. BOMB PENETRATIONS

Perforation means that the bomb or fragment passes through the target. Penetration includes any entering of

TABLE VII  
PENETRATION BY FRAGMENTS INTO DOUGLAS FIR

Fragment Wt. Ounces	Striking Velocity Feet per Sec.	Mean Penetration Inches
1/2	2,000	5.05
	1,000	2.5
1/4	1,000	1.4
	4,000	3.55
1/25	2,000	2.1
	2,000	1.2
1/50	2,000	1.2
	4,000	1.6
1/200	3,000	1.3
	2,000	0.8

the target short of perforation. In the case of bombs, penetration is not an end in itself as is the case with rifle bullets, shrapnel or splinters, but it is rather a means to an end, the end being destruction by explosion or fire, or the distribution of war gas. Table IX shows penetrations of different targets by typical bombs of varying case thickness, size and speed.

TABLE VIII

PERFORATIONS PER 100 SQ. FT. IN STEEL PLATE FROM HEAVY BOMB

Plate thickness	30 ft. dist.	50 ft.	100 ft. dist.
1/2 in.	—	72	—
1 in.	42	24	4.5
1 1/2 in.	26	15	3
2 in. (2-1")	11	5	—

Figure 3 gives similar information regarding various targets. It may be noted that if we have two bombs of similar shape, one of which has just twice the linear dimensions of the other, then the larger will have eight times the volume or mass of the smaller, but only four times the cross sectional area. The gravity pull on the larger will be eight times that on the smaller bomb, whereas the air resistance—which depends on the sectional area—will be only four times as great. Thus with similar shape and density and a similar height of release the larger bomb will reach the earth surface at a higher speed than the smaller one. Sectional density is the weight of the bomb per square inch of cross sectional area. The greater the sectional density, the greater the speed of the bomb, other factors being equal.

TABLE IX  
BOMB PENETRATIONS

Bomb lb.	50	110	220	550	1100	2200	4000
Shell case	Med.	Heavy	Med.	M.H.	Heavy	Med.	Med.
Dia. in.	5	7	10	12	12	21.5	25.5
Wt. per sq. in.							
Section.	2.5	2.9	2.8	4.9	9.7	6.1	7.8
Velocity ft. per sec.	500	600	700	800	1000	1200	1500
Penetration in feet							
Soft Clay	11	16	20	37	92	72	95
Earth	7	10	12	24	59	44	62
Sandy Soil	6.5	9	10	20	50	32	47
Firm Gravel	4	6	7	14	35	26	37
Oak Beech							
Timber	3	5	6	12	33	25	47
Bricks	3.5	4	4.5	9	25	20	32
Limestone	1	1.5	2	3	8	5.5	8.5
Rein. Concrete, 2,800 lb.	0.8	1	1	1.5	6	4.5	7.5
Rein. Concrete 3,200 lb.	0.7	0.7	0.8	0.9	4	3	5
Rein-Concrete, 5,700 lb.	0.5	0.5	0.6	0.7	3	2	3.5

Referring to Shell Case—M.H. denotes Medium Heavy.

4. CRATERS

If a heavy-case bomb with time fuse hits the concrete roof of a multi-storey building with concrete floors, it is quite likely to perforate the roof and several floors before coming to rest and exploding. Figure 4 illustrates the action on a concrete slab, showing how the impact causes a compression in the upper portion of the slab, which in turn creates a tension in the lower portion, dislodging an irregular plug-shaped portion and allowing the bomb to come through. This is known as the scabbing of concrete and it occurs successively on the upper floor slabs, with lessened force each time until the bomb is brought to rest.

If the bomb does not perforate the target but merely penetrates it to some depth as indicated in Table IX, the resulting depression in the surface is known as a crater. Most bombs are dropped from great heights coming to the ground with great velocity but seldom more than 1,000 ft. per sec. Even in a city like London, only about 15 per cent of the ground surface is covered by buildings, therefore, the chances are about six to one that the bomb will not hit a building but will land in a park, street, lane or backyard. More accurate aim can, of course, be attained with low flying planes or dive bombers. The crater left in the earth surface after the explosion of a heavy-case bomb deserves

study. Figure 5 is a diagrammatic representation of a crater in ordinary earth. The circle O shows where the bomb bursts and it will be noted that the depth of this burst below the normal earth surface is about equal to the radius AB of the final crater. The ratio AB over AO is known as the index of the mine, which in this particular case is equal to one. With this index the crater is known as a common mine. If, due to less penetration, or greater explosive power, the index—usually referred to as *n*—is greater than unity, then we have an overcharged mine. If the index is less than unity it means that the penetration is deeper or the explosive force relatively less and the radius of the crater is less than the depth of burst, resulting in an undercharged mine. It is also possible for the burst to be at such a depth that the explosion does not affect the ground surface. This is known in military language as a camouflet. The opposite extreme is the surface explosion—perhaps from a light-case instantaneous bomb—bursting on the fairly hard paved

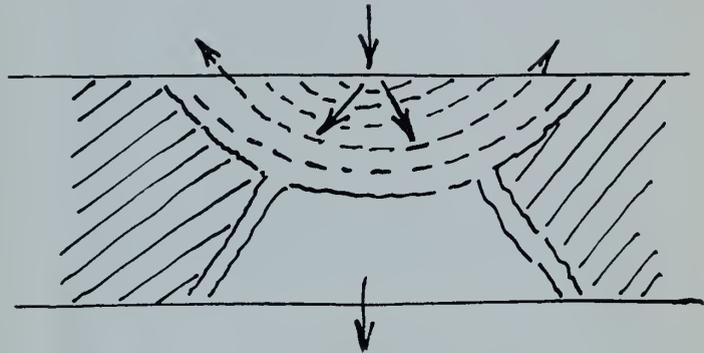


Fig. 4—Diagram showing "scabbing" of concrete.

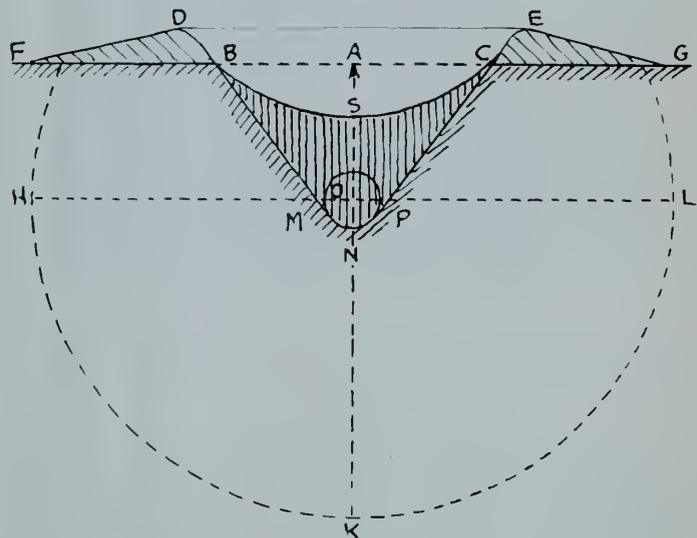


Fig. 5—Diagrammatic representation of a crater in ordinary earth.

street or on frozen ground and making only a very shallow crater or none at all. Figure 6 shows the relation between depth of burst and diameter and depth of crater for various bombs and different values of *n*.

Near London a test was made on a plot of ground forty feet square. A brick sewer was laid 8 ft. 6 in. below the surface. Water and gas mains, power, light and telephone cables were laid below the surface in loamy soil and in two layers at right angles to each other. Four-inch wood block pavement was laid on the surface resting on 11-inch reinforced concrete on ash and hard ballast. A large medium-case bomb was inserted 2 ft. 6 in. deep at the centre of the plot. When exploded it formed a hole in the pavement 8 ft. in diameter and a cavern below the pavement 20 ft. in diameter and 4 ft. 3 in. deep. Fragments of concrete were thrown 100 yards. Both layers of service mains were made almost useless but the sewer while damaged was still

capable of functioning. The photograph in Fig. 7 shows a bomb crater in one of London's streets and it will be observed that service conduits, water mains and sewer have been badly disrupted.

Variation of Diam. and Depth of Crater with Depth of Burst in Earth ( $S=1.4$ ). Light Case Bombs.  $C$ =Weight of Charge.

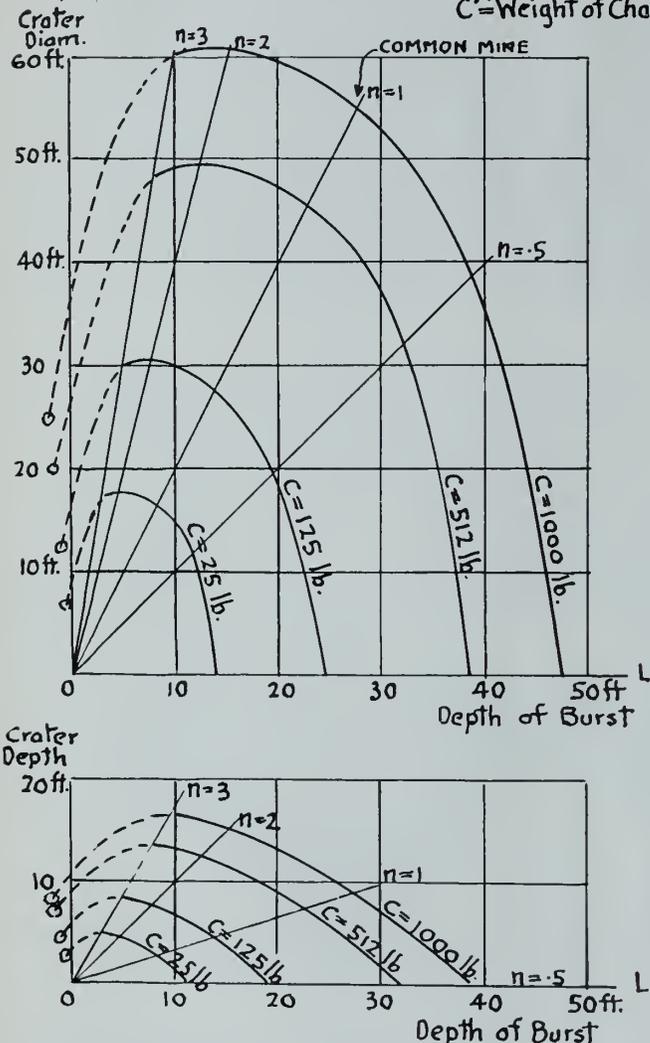


Fig. 6—Diagram showing relation between depth of burst and diameter and depth of crater for various bombs, for different values of  $n$ .

(C) STRUCTURAL DEFENCE

In connection with the foregoing, it should be understood that the sizes of bombs, craters, etc., are merely typical. Even if it were possible to make an exhaustive list for the kinds of bombs used to date, it must be remembered that greater and more powerful bombs are continually being designed and the end is not yet.

Thus in designing structures a combination of common sense and foresight will produce varying degrees of bomb resistance, but an absolutely bomb proof structure can exist only in the imagination of an optimist. One must know the unknowable future before deciding that anything is bomb proof.

Structural defence enhances the safety of persons, and also that of buildings and plant. If these latter are demolished the country's industrial and war effort will be paralysed. To help in consideration of this subject it will be well to take it under three main headings, viz. concealment, shelters and buildings, old and new.

(D) CONCEALMENT

1. CAMOUFLAGE

Camouflage is a broad subject—almost anything may be camouflaged to blend with the colour of its surroundings



Fig. 7—Photograph of bomb crater in one of London's streets.

and so be less noticeable. So far as air attack is concerned, camouflage should be designed to deceive the attacking pilots and their observers at the place and at the height where bombs might be released. Such camouflage should be backed up by the use of fighting planes and anti-aircraft artillery, because if the attacking planes reach low altitudes for any length of time the camouflage is likely to be solved by the enemy. It is quite possible with wire mesh and various sorts and colours of canvas, along with light temporary framing, to so change the contour and even the colour of a limited portion of the landscape as to make it appear that some vulnerable target, such as a building or a bridge is, say, half or three quarters of a mile away from its real site. Some light dummy construction is used to simulate the structure itself. Almost the best possible camouflage is natural protection by trees. To simulate trees by camouflage requires elaborate and expensive work. But if in building new roads or factories the trees can be left in place to some appreciable extent, instead of being entirely destroyed as is usually the case, then camouflage will be greatly simplified and at the same time we shall earn the lasting goodwill of our friends, the landscape architects.

Inflated balloons with suspended nets are sometimes used to prevent the too near approach of enemy planes, even where camouflage is not in use. Camouflage and balloons are usually arranged for by military authorities.

2. SMOKE SCREENS

A smoke screen is readily created in industrial areas by merely interrupting the observance of the usual laws enforcing smoke suppression. The effectiveness of the screen depends on the number and size and strategic position of the local chimneys and on the character of the fuel used; and the duration of the effectiveness depends on air, weather and winds. Usually these smoke screens cannot be depended on to last as long as they are wanted and where they are wanted.

3. BLACKOUT

Lights are of great advantage to the attacking bomber at night, particularly in or near large cities. So it is generally

conceded that a blackout is the best night defence. They have been very effective in Great Britain and in Europe. Many parts of Canada and the United States, especially the coastal cities and towns, are well organized and have had blackout rehearsals. In private houses and most buildings where work is not being done at night the blackout arrangements are simple and all lights are dimmed or put out. Special cases include schools conducting night classes, war factories on night shifts, hospitals, railway stations and railroad trains. It is desirable that all such institutions carry on with a minimum of interruption. Even with the best of care there must be many more alarms than actual raids. Use is made of a fabric known as hessian bitumen for blacking window panes. Heavy black curtains that can be drawn across the inside of windows are also used, and opaque wooden shutters are used outside the windows. At railroad stations and hospital entrances and on emergency automobiles dim lights may be permitted. Nurses are often allowed dim flash lights. In war factories arrangements are made for the workers to have safety refuges near their benches or machines, thus reducing the interruption by the air raid to a few minutes. Nearly all municipalities in Canada and the United States have air wardens organized for handling blackout problems and accidents. These organizations are modelled after those that have been successful in Great Britain.

Recently, night defence by excessive glare of lights, enough to dazzle the attacking planes, has been advocated in the United States and actually tried as a defence by the Germans against a recent air raid by the R.A.F. The casualties among the attackers were decidedly greater than usual, but it is possible that the damage by bombing on more obvious targets may have been much more severe also.

#### (E) AIR RAID SHELTERS

##### 1. SMALL SHELTERS

Many small shelters were built in the back yards of houses in Great Britain almost as soon as war broke out. None of them will withstand a direct hit by a bomb, but all are resistant to flying bomb splinters, incendiary two-pound bombs, and falling fragments from anti-aircraft shells. Three sorts may be mentioned.

##### Trench Shelters

These are buried or half buried in the ground and generally accommodate from four to twelve persons. They are covered or arched over with wood or other framing and the roof is covered with about 18 inches of turf or sandbags. At one end there is a door opening and sometimes a special door covering. The opening should if possible be not more than six feet away from and facing a good permanent wall so that splinters cannot very well enter unless they deflect from the wall, which is unlikely. The shelter should be floored and lined and properly drained and seats or bunks should be provided.

##### Surface Shelters

These are like the trench shelters, except that they are entirely above ground and there is no drainage problem. The walls are of brick or stone or reinforced concrete about 13 inches thick. This thickness of wall or the 18 inches of turf on the roof will keep most splinters out.

##### Anderson Shelters

The Anderson shelter resembles the trench shelter and is often half buried in the ground. The sides and roof are lined with corrugated iron vertical side pieces—curved to arch shape at the roof and overlapping at the crown—and the roof and sides are covered with at least 18 inches of turf. These have been derided in North America as tin cans but photographs show them still holding together even when distorted by blast, when everything else around was demolished. They have actually saved more lives than any

other class of shelter and have been very widely used. Figure 8 shows a typical Anderson shelter.



Fig. 8—Photographs showing method of erection of Anderson shelter and final appearance.

##### 2. LARGE SHELTERS

After many serious results from high explosive bombs exploding at or near small private shelters, the municipalities in Britain themselves began to assume responsibility for larger, safer shelters, and they called on the Institution of Civil Engineers for recommendations. The Institution set up a special committee for the purpose and they enunciated the important principle that shelter design is dependent on more or less definite assumption as to what is to be resisted whether blast and splinters only, hits by smaller bombs up to 500 lb., or direct hits by larger bombs. Table X shows the three types of protection as suggested by the Institution's Committee and also the thickness of earth, sand, ballast, brick or concrete that should resist a bomb explosion either through the roof, floor, or sides of the shelter above or below ground. It is possible for a bomb to penetrate the ground alongside the shelter with a resulting explosion adjacent to the side walls or even under the floor. Figures 9 and 10 show circular and rectangular, partially underground, shelters in accordance with the Institution's suggestions. The maximum concrete roof thickness of 7 ft. 6 in. suggested in Table X has since been increased to 10 ft. to take care of more severe bomb bursts. Other dimensions have been similarly increased.

The following suggestions apply to shelters in general and especially public underground shelters:

(a) Limiting capacities are usually assumed at 400 persons for shelter against lighter bombs and 1,200 persons where heavier bombs are likely.

(b) There should be two entrances, so that if one is blocked by debris the other will be available. Entrances in public shelters should be capable of admitting stretcher cases and wide enough to permit quick access or emptying.

(c) Division walls help to support and strengthen the roof and it is advisable to divide the shelter into compartments each for about 50 persons. This localizes damage by bombs and prevents to some extent the spread of panic.

TABLE X

Type of Protection	Overhead Protection	Lateral above Ground	Lateral below Ground	Base Protection
FIRST Blast and Splinters, 50 feet away	1' 6" Earth, Sand, or Ballast, or 6" Concrete or 5" Reinf. Concrete.	2' 6" Sand or Earth, or 13 1/2" Good Brick or Stone Wall.		
SECOND Hit by 500 lb. Medium Case Bomb	Special Quality Reinf. Concrete 5' thick.	Special Quality Reinf. Concrete 3' 3" thick.	Special Reinf. Concrete 6' 6" thick.	Reinf. Concrete 5" thick.
THIRD Hit by Heavy-Case Bomb.	Special Quality Reinforced Concrete 7' 6" thick.	Same as above	Same as above	Same as above

N.B.—Thickness of walls below ground may be reduced to 5' 6" for Round Shelters not more than 30 ft. inside dia., or on straight walls with Buttresses not more than 10 ft. apart.

Below 25 ft. in Sand or Gravel or 40 ft. in Clay, wall and base thicknesses may be reduced 4 in. for every additional foot of depth to a minimum thickness of 2' 6".

(d) If shelters are open to outside air, gas masks must be available. If shelters are sealed in some effective way, gas

masks are unnecessary. Sealed shelters may be air conditioned.

(e) Preventive low earth dams can be built around the entrances to underground shelters to prevent surface water entering the shelter.

(f) Chemical closets will provide the necessary sanitary facilities.

(g) Emergency supply of drinking water in bottles is useful if the regular water pipes are damaged.

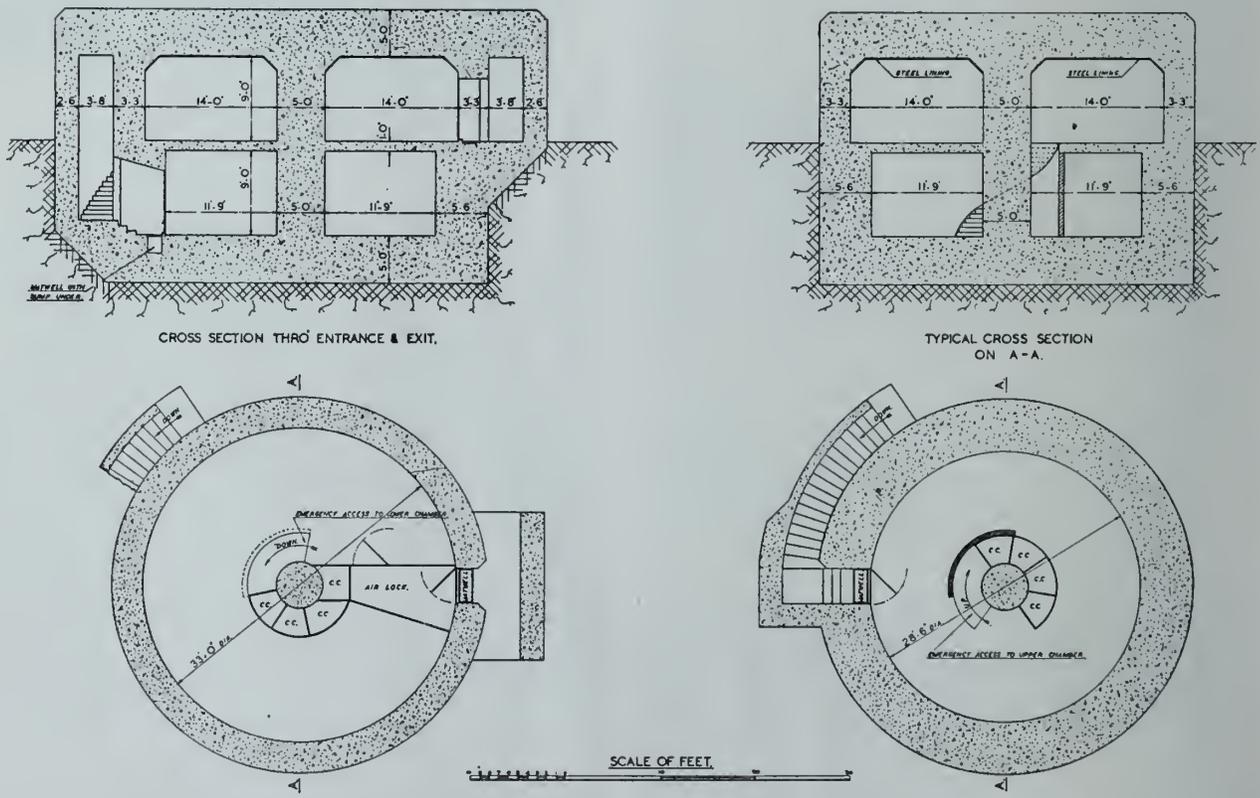
(h) Similarly, candles are advisable in case the regular lighting system is out of order.

(i) Spades and picks in the shelter will come in handy if it is necessary that occupants dig themselves out.

While most of the larger shelters are built by municipalities, some of the best have also been erected by telephone and power companies and by schools.

Some general observations on shelters may be made here. A shelter has really done its job if it prevents serious damage or death of the occupants, even if it comes out of the bombing in a bent and battered condition. There will often be an opportunity to repair and strengthen it before the second onslaught occurs or it may survive several bombings with only increased distortion while still offering a good deal of protection. Therefore it is wrong to use ordinary working stresses as stipulated by peace time codes in designing shelters. Allowable stresses should be considerably increased, to at least the elastic limit of the material and full advantage should be taken of redundancy. In fact redundancy is of very great advantage in case part of the shelter or some members are removed or displaced by the explosion.

Elaborate and fairly comfortable shelters tend to induce some persons to resort to them more than is necessary and to stay there unduly perhaps in a spot that they may come to look on as reserved for themselves. These persons are certainly not making a maximum war effort when they are in the shelters unnecessarily. On the other hand, there are many people who can scarcely be induced to go to the shelters when they really should.



CIRCULAR SHELTER FOR 200 PERSONS  
Fig. 9—Circular shelter for 200 persons.

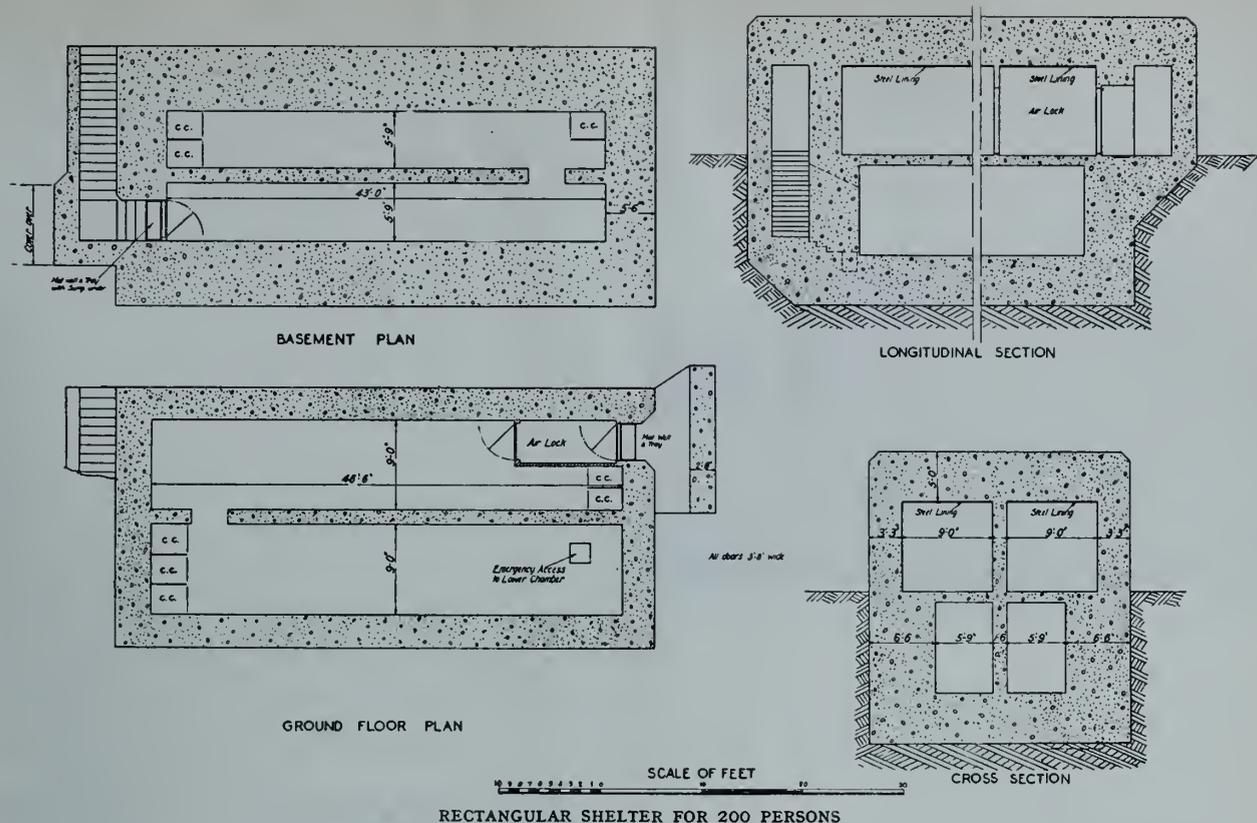


Fig. 10—Rectangular shelter for 200 persons.

Justification for expensive shelters is a matter of judgment. In Great Britain heavy bombing has been at times very frequent and important cities, such as London and the industrial centres require shelters of great capacity if their life and work is to continue and be productive. Permanently built refuges such as underground shelters of great capacity and portions of transportation tunnels have been provided. Schools have in many cases built shelters large in capacity but not so sturdily constructed. North America has not yet suffered from air bombing, but precautions such as blackouts, captive balloons and air raid precaution training have been organized and rehearsed and put into effect in coastal areas and some other strategic points farther inland. The taking of such measures is an insurance against disaster. The amount spent in this manner should depend on two things, the likelihood of attack and the importance of the buildings or plant in the war economy.

### 3. SPECIAL SHELTERS

Among the more specialized shelters may be noted the sheet steel cone-shaped shelter of sufficient size to hold only one or two persons. It has a tight fitting stiffened side door, curved to conform to the shape of the cone. Figure 11 shows such a shelter. It is intended to give some protection to the very limited number of key men—such as air wardens—who must stay at times in dangerous places.

There is also the corridor-like pre-cast reinforced concrete shelter consisting of portable concrete frames a foot or two long clamped together by long tie rods passing through holes in the frames like the sections of an ordinary heating radiator. These can be made as long as advisable and can be taken apart and easily moved. They are used just outside of war factories and their nearness to the factory minimizes the time that the worker loses during an air raid alarm.

In Ramsgate, and also in Chungking, China, and in many other places, underground tunnels of enormous capacity have been dug in somewhat chalky soil. Finsbury—one of the London boroughs—has projected underground spiral garages of large size to serve as municipal shelters during

the war and as regular garages afterwards. Figure 12 shows such tunnels and the spiral garage.

## (F) OLD AND NEW BUILDINGS

### 1. ADAPTING OLD BUILDINGS

When a bomb explodes above ground, air shock is of importance as it will shatter glass and light partitions and curtain walls even at some distance. When the explosion is below ground, earth shock assumes primary importance, the vertical and horizontal components of this shock causing the collapse of walls and floors, especially when these are not well bonded together.



Fig. 11—Cone-shaped shelter.

Fabrics such as the hessian bitumen mentioned under blackout tend to prevent shattering and flying of glass. Wired glass is much better than plain glass, and wire mesh can be secured just inside the panes with a good effect.

Wire "trussing" of panes and the pasting of brown paper on the glass are not very effective. Large windows may be strongly boarded outside or partially or entirely walled up by temporary brick walls. If these walls do not reach the top of the window it will be well during an air raid to open

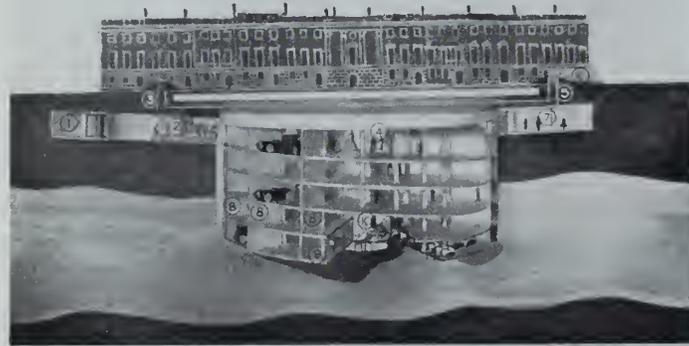


Fig. 12—Underground spiral garages to serve as municipal shelter, during war, projected for the borough of Finsbury.

that portion of the window that is not walled, thus preventing glass breakage.

The collapsing of walls, roofs, and floors in the upper part of a building is almost sure to throw a heavy debris load on some of the lower floors. It is well therefore to choose a suitable lower floor and insert extra props of wood or other material to help that floor to withstand this debris load. Such props and other reinforcing can be designed with a much smaller factor of safety than used in ordinary construction because deflections and distortions do not make much difference as long as actual collapse is prevented.

If part of an existing building is to be used as a shelter it is well to choose a portion where bombs would have to perforate several floors or walls before reaching the shelter.

In buildings of only a few storeys this location will usually be the basement or some of the lower floors and somewhere near the centre of the site. The walls and ceiling of the chosen room can have extra reinforcing and shoring. If above ground, the shelter room is better a storey or two up, because splinters from bombs in the streets do most damage on the ground and first floors.

In certain special buildings such as power and transformer stations it may be advisable to enclose important equipment and the machines by heavy reinforced concrete or brick construction of a strength comparable to that used in large public shelters.

In some dwelling houses, sleeping mattresses are placed under heavy tables and these tables are made strong enough to carry a heavy debris load of collapsed floors, plaster, etc. The space from floor to table is screened with heavy wire mesh to exclude large fragments. The so-called Morrison shelter is of this type. It is built with either a steel or wood frame and top cover, well braced together.

In all buildings there are certain measures that may be taken to minimize damage from air raids.

(a) Heavy objects should be moved from upper to lower levels.

(b) Needless high brick parapets or chimneys can be made lower so as to lessen the danger if they should fall.

(c) Flammable objects should be taken out of buildings and should not be allowed outdoors within 10 feet of the building. This applies generally to automobiles also.

(d) Ready access should be provided to the roof so that it can be patrolled for the removal or extinguishing of incendiary bombs.

(e) Important plumbing may be encased in concrete walls giving sufficient room for emergency access.

## 2. RESCUE AND REPAIR PARTIES

Parties are organized in London for rescue and repair after bombings thus illustrating the necessity of co-operation between different branches of the Defence Committee's work. Table XI shows the equipment provided for heavy rescue parties and for light rescue parties. The first two-thirds of the list includes equipment that an ordinary householder would be unlikely to have available. The latter third of the list contains more common tools. The first duty of rescue parties is to save life and minimize injuries to persons pinned beneath wreckage. The second is the making of temporary repairs and the prompt reporting of unsafe conditions in walls, chimneys, etc. The rescue and repair parties are followed by demolition squads and more permanent repair and reconstruction gangs.

## 3. NEW BUILDINGS

The design of new buildings should take cognizance of the lessons learned from air raids.

Fire is on the whole the most destructive force in such raids. Fireproof construction is therefore indicated. If wood must be used it can be impregnated with chemical salts forced into the wood itself, or covered with certain protective paints, which are not nearly so effective as the salts.

Experience shows that buildings with a complete steel or reinforced concrete frame supporting the various floors, walls and roof are more resistant to shocks from either earthquakes or bombs than any other type of multi-storey building.

Buildings with load-carrying walls should have frequent cross walls or ties to prevent the main walls spreading and allowing the floors to collapse.

Steel or concrete frames for buildings of either one or more storeys can be designed with stiff or continuous joints so that even if one important member is removed or ruined the building may still stand and the damage can be repaired without any great delay or interruption in the use of the building. Some buildings still stand in place after one column or column foundation has been destroyed by blast.

A bomb blast may loosen light weight partitions or doors from their fastenings and hurl them as missiles causing much damage. These can be arranged so that they are not

TABLE XI

For Heavy Party	TOOLS FOR RESCUE PARTIES	For Light Party
3, 12 ft.	Iron Shod Levers	2, 10 ft.
1, 3 ton	Lifting Tackle	1, 1½ ton
3	6 ft. chains (3 ton Cap.)	1
1	Set of Rope Tackle, 3 sheave, 2 sheave	1
1	Single Sheave Snatch Block	1
2	10 to 15 ton Jacks (preferably ratchet)	2
1	20 ton Jack (preferably ratchet)	—
1	35 ft. Extension Ladder	1
1	Acetylene Cutting Outfit (certain areas)	—
2	Small Acetylene Flares	2
1	Large Acetylene Flares	—
2	Heavy Axes	1
2	Firemen's Axes	2
2	Two-handed Cross-cut Saws	1
3	40 ft. lgths. 1½ in. Manilla Ropes	3
1	100 ft. lgth. 3 in. Manilla Rope	1
1	100 ft. lgth. 4 in. Manilla Rope	—
6	15 ft. lgths. 5/8 in. Wire Rope	6
4	Light Picks (about 4 lb.)	3
4	Crow Bars	3
4	Shovels	3
2	Sledge Hammers	1
2	Hand Saws	2
2	Iron Wheelbarrows	1
3	3 in. x 9 in. Planks, 12 ft. lg.	3
6	Hurricane Lamps	4

Heavy Tarpaulins or Canvas Sheets or Corr. Iron Sheets to protect from falling debris.

Fire baskets for warmth in winter.

Miscell. Tools, spikes, blocks.

Use small trucks for transport.

easily moved in the direction of the probable blast, or, they may be omitted altogether.

Roofs of war factories—which are usually of one storey—may be of wood, corrugated iron or concrete slab. The slab gives protection against the entrance of incendiary bombs, bomb splinters, or fragments of anti-aircraft shells, but with a direct hit on the concrete roof much greater damage will occur inside the building than with the lighter roofs, because a collapsed concrete slab is more destructive to equipment beneath it than are lighter roof coverings. Saw tooth roofs or any other sort of roof windows should be avoided or protected by louvres that can be closed in emergency, because the flying glass resulting from a blast is most dangerous and nullifies for sometime any heating or ventilation control in the building. Figure 13 shows buildings completely framed to carry all dead and live loads including the walls. It will be noted that even after a severe bombing the main frame still stands and the repairs will therefore be accomplished without much trouble and in a comparatively short time.

The war has emphasized the essential place in our economy occupied by various materials, especially steel. It seems likely therefore that the increased allowable unit stresses now advocated for the duration of the war only, will to some extent survive the coming of peace. At any rate it is frequently worth while, in designing steelwork, to take into account continuity of beam action and stiffness of joints, thus reducing cross sectional area while benefitting from the resultant rigidity and indeterminacy.



Fig. 13—Photograph of completely framed buildings still standing after severe bombing.

#### (G) SABOTAGE

Perhaps what has been said about air bombs, bomb damage, structural defence, and shelters seems somewhat

remote from our comparatively peaceful existence in the central portion of America. Not so as to sabotage. During the last war it is certain that enemy agents spent many millions of dollars in deliberately trying to destroy war factories and dislocate industries. It is known definitely that similar agencies are at work here to-day but obviously the publication of details would be unwise.

Sabotage differs from air bombing in that explosives or incendiary packages can be carefully concealed at the most vulnerable locations. Often it is difficult for the saboteur to carry on his work and he therefore cannot handle the enormous quantities of explosives, etc., that would be used in an air raid. But he makes up for this by skill and cunning in the placing of his mines.

Last July, in Minneapolis, the American Society of Civil Engineers held a symposium on sabotage. This symposium indicated that the attacks were likely to centre around water supply, power, and war industries. One of the most common destructive agencies is fire, and water and power are essential in fighting fires. Transportation systems such as railroads, and communication agencies such as telephones may also be attacked but these services are well equipped to fight storms and other services may be temporarily substituted. It is difficult to entirely disorganize sewer systems and a small damage does not usually cause an immediate crisis. It is well, however, to provide as far as possible, duplicate systems for water, power, light and sewerage. Generally speaking measures taken to combat sabotage are also useful in cases of an air raid.

#### ACKNOWLEDGMENT

In compiling these notes the writer owes much to Handbooks 5 and 5-A, published by the British Government on air bombs and structural defence; to publications of the American Society of Civil Engineers; to several good friends who have given him pictures and hints; and also to several engineers both from Canada and from Great Britain who have been eye witnesses of some of those calamities against whose perpetrators our war is being waged.

**Editor's Note**—A reference book on "Structural Defence Against Bombing" has recently been published by The Engineering Institute of Canada in order to make available to Canadian engineers and architects a record of some of the experiences and practices of British authorities in regard to structural air raid precautions, so that in the event of emergency arising in this country the necessary action can be taken without loss of time and on the most efficient and economical lines.

This book was carefully edited by a sub-committee of the Institute Committee on Engineering Features of Civil Defence. It contains 56 pages, 79 illustrations, 8 tables and an extensive bibliography. It may be secured at Institute Headquarters at \$1.00 per copy.

# THE PLACE OF THE ENGINEER

C. R. YOUNG, M.E.I.C.

*Dean of the Faculty of Applied Science and Engineering, University of Toronto and President of The Engineering Institute of Canada.*

**From a luncheon address presented at the joint meeting of The Engineering Institute of Canada and the American Society of Civil Engineers, Niagara Falls, Ont., October 14th, 1942.**

In the scant two centuries that have elapsed since the engineer first had applied to him the designation that he now bears, he has risen high in the professional scale. At no time has he stood higher than now. Not only does he head up the technological phases of both wartime industry and the maintenance of the public services, but at the same time he has entered the armed forces to a far greater extent than would be called for by a mere consideration of occupational statistics.

There are reasons for the rise of the engineer and there are reasons, too, for his progress being less rapid than the circumstances of his scientific and technical attainments would appear to warrant.

## EARLY BARRIERS TO ADVANCEMENT

Professional engineering grew out of the practical achievements of clear-headed, resourceful artisans and skilled manual workers. James Brindley, the creator of the canal system of Britain was a millwright, ill-educated, ingenious, and human. After many disappointments in attempting to improve the Newcomen engine, he frankly records in that revealing account book of his the entry "To running about a drinking, 1 6." Things were cheaper in those days. John Rennie, the founder of a noted family of engineers, was another millwright. Thomas Telford, who remade the highway system of Scotland, began as a stone mason. George Stephenson, who made the locomotive a practicable mechanism for transport, was a pumping engine fireman and could neither read nor write till he was nineteen years of age.

The attitude of the literary and classical groups was hostile to these workers in a new and practical sphere. Seneca, after recording that there had been inventions such as transparent windows and tubes for diffusing warmth equally through all parts of a building, observed that

"The inventing of such things is drudgery for the lowest slaves. Philosophy lies deeper. It is not her office to teach men how to use their hands. The object of her lessons is to form the soul."

Dr. Samuel Johnson, in his famous dictionary, defined mechanical as "mean or servile."

Dean Swift spoke in scorn of "that fellow Newton (Sir Isaac) over the way—a glass grinder and a maker of spectacles."

John Smeaton, to whom the designation of "civil engineer" was first applied, and one of the most profound philosophers of the profession, was taken to task by his fellow members of the Royal Society for having undertaken the "navvy" work of building a road across the valley of the Trent.

In fact, the educated classes of the eighteenth century regarded mechanical subjects with contempt and pursuits involving them as neither honourable nor remunerative.

The situation improved but slowly. Training for the practice of engineering was still largely a matter of pupillage or apprenticeship in the offices of practising engineers or manufacturers. So much stress was laid on the practical that John Rennie held that a young man was, after three or four years at Oxford or Cambridge, in a sense, unfitted for the practical work of engineering.

While Rensselaer Polytechnic Institute, at Troy, N.Y., was founded in 1824, the influence of the universities and engineering colleges was slow in making itself felt. As late as 1840, when a professorship of civil engineering and mechanics was founded in Glasgow University, a vigorous

campaign was carried on by the traditionalists to have it suppressed.

And so the calling of the engineer was held much too close to specific technological tasks, without any notable concern for the long-range interests of the client or the country. In his presidential address to the Western Society of Engineers, in 1891, L. E. Cooley asserted that

"The early engineer of this country was a species of scientific or skilled tramp with a precarious tenure of position measured by the work in progress. He furnished his employer with the skill of his trade without questioning public policy or the best solution."

It is not strange, therefore, that public recognition has lagged behind the warrant for it. Around the turn of the century, a member of the Canadian Society of Civil Engineers reported that his parents had left him a sum of money to study a profession, and when he chose engineering, certain interested persons tried to bar his claim on the ground that engineering was not a profession at all. When he succeeded, after great expense, in establishing the validity of his choice in the courts, the decision was the occasion of widespread surprise.

## THE TURN OF THE TIDE

As the universities and engineering colleges more and more took over the educational aspects of the training of the engineer, the attitude of the public to the profession of engineering became more cordial. Some of the breadth of outlook that derives from the mingling of young men of widely different interests on the campuses of the world soon made its effect apparent. Educationally, engineers were henceforth to be classed with the members of other learned professions.

For half a century there has persisted on this continent a reaching out for improved professional status for engineers. To many, the most direct route to the objective appeared to be legislation and restriction. It was all very simple. Secure a licence to practise and you are set up for life.

It is not remarkable that this simple mechanism failed to solve the problem of status. Except for a few who were excluded by reason of unsatisfactory qualifications, the relative position of engineers remained the same. One does not need to seek for the reason: licensure carries with it nothing more than an assurance of good character and minimum technical competency. Of itself, it does not reveal those who excel, either in their technical equipment or in the intangible qualities of a leader of the profession. As Colonel Willard Chevalier has said:

"There is something bigger, more vital and more fundamental in the professional relationship than anything you can write into a statute."

The truth of this is becoming increasingly apparent. Perhaps the most significant of the objectives of the Engineers Council for Professional Development, and one on which emphasis ought to be placed, is the early seating of the young, newly-graduated engineer comfortably in the professional saddle. True, technical competency must remain the solid foundation on which the lower lifts of the young man's professional life have to be built, but he will not go far nor fare well if he contents himself with it alone. He must develop an interest in the long-range welfare of his employer and a sympathetic understanding of the currents of national and community life. He must be able to take his place comfortably amongst the leaders of other professions

and be able to represent with credit any institution or any just cause.

### THE PROFESSIONAL GOAL

It is taken for granted, of course, that the place that the engineer seeks is within the professional orbit. Whether he receives his compensation in the form of fees or in the form of salary makes no essential difference. The demands of the professional life are the same.

It is axiomatic that valid membership in a profession connotes a sound and broad education. There are no unlearned professions. As Abraham Flexner has pointed out, a profession has its roots deep in cultural and idealistic soil. It represents the application of free, unhampered, resourceful intelligence to the comprehension and solution of problems.

Of course, whoever would maintain his place in a profession must possess technical competency. It is the solid and prerequisite foundation on which service to the client, the employer, and the public must be built.

The most significant element in the professional relationship, however, without which all apparent service is vain, is the principle of trusteeship. The engineer cannot afford to avail himself of the doctrine of *caveat emptor*. In common with the conscientious physician or lawyer, he seeks to procure for the employer that which is ultimately best for the employer himself and not that which will most benefit the adviser or give him the least personal trouble.

When Sir John Fowler was retained by a corporation he gave to it the maximum of his energy and attention, so that he came to be spoken of as the shareholders' engineer.

It would have been much easier for Alfred Noble to sign the majority report of the International Commission of Engineers and to throw his great weight on the side of those who urged an attempt at the construction of a sea-level canal at Panama. Conscious of a duty to safeguard the United States against what he thought to be a hazardous enterprise, he wrote the minority report, which was finally adopted. In that act he conformed to the doctrine of trusteeship.

Not all of the effort of which a professional man is capable is properly applicable to the advancement of his personal fortunes. The profession of itself has some claims on him. John Smeaton deliberately limited his undertakings as an engineer in order to broaden his horizon and carry on scientific investigation. He held that "the abilities of the individual are a debt due to the common stock of public well-being." Over three hundred years ago, Francis Bacon had laid this obligation squarely upon shoulders meant for it:

"I hold every man a debtor to his profession; from which as men of course do seek to receive countenance and profit, so ought they of duty to endeavour themselves by way of amends to be a help and ornament thereto."

### THE ENGINEER IN THE FUTURE

Despite the inevitable dislocations that will occur when war gives way to peace, there is no ground for fearing long or widespread technological employment. An immense backlog of unsatisfied demand for the goods of peace is being built up, and the standards and patterns of 1939 will not satisfy a world that has seen invention break into new

territory on innumerable fronts. Dr. Charles M. A. Stine has said that the inconceivables of two years ago are today's realities. Under the stress of war, chemists have discovered new continents of matter and the world of 1940 is already an antiquity. In such a setting the technically competent will find ample scope for their abilities and energies.

It would be comforting if we could be equally sure that the engineer of the post-war years could be depended upon to do his full share in bringing about that lessening of the impact of technological advance on society of which President Roosevelt spoke so earnestly in 1936. It is no imaginary menace. So thoughtful and realistic an observer as President R. E. Doherty, of the Carnegie Institute of Technology, has this to say of it:

"The engineering profession—has added fuel to the technological flame that has illuminated and warmed the whole social community with physical comfort and convenience, but apparently it has not occurred to the profession that the flame, though beautiful and interesting, may yet consume us."

The place that the engineer is to occupy in the future will very largely depend on how well he adjusts himself and his technology to the whole inexorable forward movement of humanity. From that place which he hopes to attain, it is expected that he will look out with sympathy and understanding on the long upward struggle of mankind in which he must, through his technical attainments, play a vital part.

The engineer should realize fully that not all of the problems of the world can be solved by a technological approach. Much consideration must be given to those sentimental and often perverse intangibles that determine the attitude of human beings to the great issues of life. It is idle to expect laymen to subscribe to the pious wish that everyone should try to look at things in the way that engineers look at them.

The plain truth is that the solution of many of our problems does not lie in the direction that engineers think it does. Professor Lorenzo G. Straub has effectively pointed out the futility of the one-track approach:

"I cannot agree that our much glorified 'engineering approach to a problem' is the panacea which the world has been awaiting. In fact, the technical procedures of the engineer, where not tempered by perspective gained in studies in the humanities, definitely handicap him in his efforts to unravel social problems. He fails to recognize that the structure of our social-economic order is dynamic and constantly changing—fundamentally different from technology. The ever-changing problems of human affairs do not lend themselves to fixed formulas as technology does, encompassed as it is by the rigid laws of the physical sciences."

And so the place of the engineer in the future is largely conditional upon the breadth of his outlook, his interests, and his activities. For one who buttresses his technical competency with a wholesome regard for the interests of his fellows and with constructive labours on their behalf, it is secure. That security is not augmented by any straining after status. More than upon anything else it rests upon the individual stature of the engineer himself.

# WE ARE IN IT TOGETHER IN THE DEFENCE OF CIVILIZATION

H. J. CODY

*President, University of Toronto, Toronto, Ont.*

Substance of an address delivered at a joint meeting of the American Society of Civil Engineers and The Engineering Institute of Canada at Niagara Falls, Ont., on October 11th, 1942.

I thank you very much for your very hearty welcome.

It is a pleasure to have here this evening, as the president of The Engineering Institute of Canada, one who has already addressed you on the place of the engineer in society and in the whole constructive problem of the race. We are very proud of Dean C. R. Young, proud of the Institute and the faculty of engineering over which he so ably presides.

He has come from the performance of a very difficult task. Our Government, like the Government in the United States, has called for more engineers. The Navy, the Army, the Air Force and industry are all calling for engineers. Our engineering schools cannot meet the demand immediately but that demand has led to a great influx of students into the faculties of engineering on this continent.

Dean Young presides over a group of students now numbering 1,428. The first year students actually numbered 606. You will naturally understand how a dean and his faculty are perplexed in solving the problem. But one thing I am very sure of, and that is that they will not lower the standards of instruction. They will give of their best, so that after the war there will be no half-baked or half-trained engineers going forth with their degrees from the University of Toronto.

What is true of that university will be true of all the universities in this continent, I believe.

We have all been trying to accelerate programmes of instruction. I am inclined to think, if I may venture so to say, that on the other side of the international boundary there has been a tendency to accelerate too much and in too many faculties. It is especially difficult to accelerate in engineering, because the course is a blend of theory and of the application of theory, and if you try to accelerate too much you add period to period of theory without giving adequate opportunity for the practice of its application.

And so, we have decided in the University of Toronto to make our contribution to the supply of additional engineers by putting on extra courses at night or in some cases in the daytime, to fit groups of students for special purposes. We have just begun in our university a new course for 160 young men, aged about nineteen. They have come from all parts of the Dominion, and they are taking a one-year intensive combined course in mathematics, physics, and selected engineering subjects. These men will be fitted at any rate to be well-trained technical men in industry, if not in the armed forces.

Dean Young, fully appreciating the high calling of an engineer, is determined that there shall be no lowering of standard, and he is also determined—may I emphasize his determination—to inject into the strict engineering course as much of the humanities as possible. I think one of the defects of our professional education in these days is the neglect of the humanities.

As far as I can foresee, for some years to come there will be a great tendency in all our educational work toward what are called the practical subjects. The study of these subjects alone will not, I am sure, make a man as well educated all around as will the professional course or the practical course, if those courses are inspired somewhat by the divine afflatus that comes from study of the humanities. Let us not put the practical subjects and the humanities in stark antagonism. They ought to go together. And what I am sure in the Divine Purpose is meant to be joined together let us not permanently put asunder.

While it is true that I am not a technical engineer, I do know by observation and intercourse a little about the curriculum of engineering and certainly about the characteristics of many of the instructors and something of the strength and educational foibles of the engineering student.

I shall not attempt to discuss the wide field of engineering, but it is a wonderful art, the art of organizing and training and directing the energies and the brains of men and the control of the forces and materials of nature for the benefit of mankind. Can there be a nobler calling?

When you engineers realize the length and breadth and height of those ideals, you may well be proud of being the material builders of every nation on the face of the earth.

But there is, of course, over and above those material aims certain great moral or spiritual ideals which you are building into materials you control and combine. On your American defence stamps, you remember, there is a hand holding a torch, the Torch of Liberty, doubtless. But a torch burns out while it gives its light, and liberty is only the sure possession of those who are willing to make sacrifices to maintain it and to diffuse it.

Above the Torch of Liberty there are four great words: "Security, Education, Conservation, Health," four great ideals that every living and progressive and sound nation is seeking to realize.

The first of those is that which confronts us at the moment, the great ideal of security. We cannot carry on our educational programme or a programme of conservation or well establish a great programme of national health unless we are reasonably secure in our action and in our planning. Security is the problem that challenges us on every side. The war is the background, in other words, and the foreground of all our thought and planning and action. In war time nothing can be as usual. Business cannot be as usual. Social life cannot be as usual. Our educational programmes cannot be as usual. Even our religious worship cannot be as usual, while we are confronted with this great struggle for security, aye, and for more than security, for the victory that will make peace, righteous peace, secure through the generations that are to come.

Now we are engaged today in a war that on the one hand is dominated by science, pure and applied, as no other war has been, and at the same time is being waged for the most ideal of objects. Never did the scientist and the engineer play a greater part in any human struggle than they are playing today in this great conflict.

From the research work that lies behind our military progress and our military activities, there will come great advances in almost every realm of science. I know something of those that are coming in the field of medicine. Have you ever thought that the fact that air power plays so great a part at the present time in the struggle calls into being a whole series of medical problems in connection with aviators, and there is growing up a great department of aviation medicine upon which very little has been written up to date.

I know in our own laboratories in the medical department of research in the University of Toronto, Sir Frederick Banting, the discoverer of insulin, inaugurated a programme of investigation into problems of aviation medicine. You can easily guess what these are.

How can you guard against the aviator's blackout which comes as you drop from 45,000 feet elevation to 5,000—You are blind! Can you avoid it? How can you fight against

the physical effect upon the aviator of these different altitudes? There will be research in medicine on the sea. How are you going to deal with a man as he passes from a lighted cabin to the blackness of the outer night? He is blind. Can you overcome that difficulty?

In the realm of chemistry the story of what is being discovered in the way of new materials, new processes, the substitution of one thing for another, is as marvellous as any fairy tale. We shall come out of this war having made tremendous advances in pure and applied science.

The man who could tell you infinitely more about that than I can is seated here at this table in the person of Dean Mackenzie who directs our National Research Council at Ottawa. But not even the most interesting of these stories can be told as yet.

The reason is that these things must now be kept secret; some day they will be the common possession of the scientists of the world.

This is a great war of ideas and ideals. Many of you when you were boys and girls read that famous old allegory, John Bunyan's "Pilgrim's Progress." I often think that the picture there of the Pilgrim, Christian, going down into the Valley of Humiliation and being confronted by the destroyer, the Devil, the old serpent, Apollyon, was a picture of what really lies behind this whole struggle.

Here is Christian, aware of his weaknesses, repenting of all his faults and failures in the past, stumbling often, and yet heading in the right direction, and here is Apollyon, the destroyer, come to cast down that which is morally exalted, come to block the way of all that is noblest in progress and achievement. Here are the twain in stark antagonism.

And that is the situation today. Every fundamental that we hold most dear, that we hold as indispensable to the building of a worthy life of the individual and of the nation, is at stake and is challenged.

In the university from which many of us come, there stands in the very centre of our campus a beautiful memorial tower in which is a carillon of bells. That is flanked by a screen bearing the names of 600 men or more who gave all that men can give, life itself, for the cause of human freedom, decency, justice, and mercy in the last great war.

Above the names there is engraved in the stone a glorious sentence from an old Greek writer, Thucydides. It is a sentence from the speech of the great Athenian statesman, Pericles, over the dead of Athens who had laid down their lives to prevent the tyranny of Persia from passing over the narrow seas and becoming dominant in Athens, the glory that was Greece.

Ah, ladies and gentlemen, the glory that was Greece in those heroic ages has been repeated in our own generation. Today dying and agonized Greeks, men, women, and children, are repeating in another form the glory of devotion to the noblest of causes, the glory of self-sacrifice. May God help and spare and bless those heroic people!

Here is the sentence which every one in our university who passes that tower may read:

"Take these men as your ensamples and like them remember that prosperity is only for the free and that freedom is the sure possession of those alone who have the courage to defend it." That is a golden sentence; it is an inspiration; today every man with power and nobility wants to give all he has himself to the great cause of freedom.

The topic upon which I desire especially to speak is, that we are in this together for no other purpose than for the defence and the preservation and the enrichment and the transmission of civilization at its best and highest.

What does civilization mean? It does not necessarily involve an increase of speed. A foolish person may climb into an aeroplane and be whizzed from one spot to another at the rate of 300 miles or more an hour, but if there has taken place in him no change of character he will laud at the other end still a foolish person. So, speed alone does not constitute civilization.

Comfort does not constitute civilization. Ladies and gentlemen, we have been besotted and I believe degraded for some years past by making comfort the god to be supremely revered. Many have been teaching us in college and in the press and in magazines and books that the worst thing that could happen to any man or woman, boy or girl, was to have to do something difficult, was to have to face hardship, was to have to endure suffering. Discomfort was the hell to be avoided.

That doctrine has meant deterioration of character. But thank God it has not gone far enough to do its deadly work on this young generation that is offering itself for the great fight. Some thought this generation of youth had become soft and perhaps even cowardly, but thank God when the day of testing came, they were worthy.

The other day one of our most brilliant young medical graduates, whose father was a professor in our medical faculty, was lost at sea. His father and his elder brother had contracted some infection and died while in pursuit of some scientific investigation. Then the younger brother determined to carry on the family tradition in medicine. So he studied medicine. He graduated, and went on the *Ottawa* as surgeon. The ship was torpedoed.

Four days they kept up the fight and the young Dr. Henry worked all that time, practically without sleep, tending the sick, performing major operations. Then when the ship was sinking he and the captain reached a raft but they were too exhausted to cling to it on the heavy sea. A few of the men were stronger, and were able to get on the raft again, but the captain and Dr. Henry went down.

The younger generation has been all right. It has proved its merit.

In worshipping comfort, we thought of it as an essential part of civilization; but we know now that it isn't an essential quality.

What is civilization? I think it is something like this: The organization of men and women in such a fashion that in their relations one to another they may enlarge and enrich their personalities, they may enlarge and enrich life. Civilization is really the enlargement and the enrichment of human life.

If that is civilization how does it come about? What are the elements that make it up? Well, civilization is made of manifold elements and they are all combined. May I briefly summarize them?

First of all, we have received from ancient Greece the contribution of the search for truth, the love of beauty, the passion for freedom. That is the Greek contribution.

Then when the Romans came, they made their own contribution, law, reverence for law, for order, for organization, for justice between man and man, and nation and nation. That was the Roman contribution in the great days of old, before the little dictators had been thought of.

And the third contribution came from our Jewish-Christian teaching, the teaching that the individual man is of infinite value in the sight of God, that human personality is a sacred thing and therefore there is an obligation to kindness and helpfulness and to care for the needs of others.

Come down through the years and you find those ages of chivalry that contributed the element of help of the underprivileged, tolerance, generosity. Come down a little further to the era of the Reformation or the Renaissance when once more the right and glory of the individual were emphasized.

Come down further to the contribution that France made—not so very long ago—in laying stress upon logic and good taste, and intellectual integrity. Then come to the element that old Britain contributed, that element of beauty, that element of doing the decent thing.

A modern writer has well said that you can summarize the British contribution whether in the Old Islands across the sea or in the broad republic or in the Dominion on this side, under two heads, doing your duty, and being a gentleman.

There are some things we ought to do and there are some things that no decent man would dream of doing. Decency and duty are the great British contributions to this idea of civilization.

Now take all those and blend them together, the Greek and the Roman, and above all, the Christian contribution and the historical contribution through the ages. My point is this, that we are engaged in a vastly more than political struggle. We are fighting for survival. Perhaps more than half of us do not yet realize that fact, but we are in cold earnest, the American Republic, the United Kingdom, all the overseas Dominions, Russia, and China—we are all fighting for survival, and the utmost at the moment perhaps that we can say is this: We have not been beaten. We have not won yet. We believe we shall. But let us be humble and devoted, remembering that we have escaped being beaten and we have our chance to win.

It is no ignoble motive to say that a nation is fighting for its life. Ladies and gentlemen, this is a life and death struggle; make no mistake about it. Aye, and it is a struggle between life and death, between all the factors that go to make up worthy living, individual or national, and all those forces that tend to the degradation and the death of that which is truly and nobly human. It is a life and death struggle.

But we are struggling for the defence of all those precious elements that enter into our civilization to-day. Every one of them has been repudiated, scorned, trodden underfoot, not simply in regard to individuals but in regard to nations, by the Nazi group and those whom they are leading to-day.

Truth, the sacredness of contract, kindness—and one might go on through the whole enumeration—every one of those is scouted by the enemy. I think we sometimes are amazed at that. Language as we use it does not seem to mean the same thing to the enemy as it means to us. Things that to us are simply impossible of conception or of action seem to be taken for granted as the right thing by the enemy forces.

I am sure you have all been reading—you can't help it—every day in the newspapers, some of the results of this "New Order," as it is called, in Europe. It is a curious thing, but if you look on the back of an American dollar bill you find perhaps the first use of that phrase, the *Nova Ordo*, the new order of freedom that was ushered in on this continent.

But the Nazi new order is not really new, for it is as old as the tyrannies and repressions of the past. Under it, law has passed out of existence in Europe; there, law is only the will of the Führer. Plenty is changed to famine for the multitudes that are conquered, while those who have conquered are fattening upon their very means of living.

May I repeat that every one of these great fundamentals that make up a worthy life for an individual or a nation is being called in question in this great struggle to-day. That is why we are standing in defence to-day of all that is best and noblest in what we call civilization. It is a struggle of ideals. If the enemy won, where should we be individually? Where should we be as families? Where would our educational system be? There is not a university in Europe where the cloven feet of the Führer and his myrmidons have not trodden. No universities can exist save in free countries. Sometimes when people propose to close down universities in wartime I would protest that that is a purely Hitlerian

proposition and that loss of freedom would follow such suppression.

There can be universities, with their freedom of thought, only where there is political freedom.

Now, is the struggle then worth while? Is it worth while to maintain the fundamental basis of democracy, namely, that every individual is of value in the sight of Almighty God, the great moral principle that human personality is the most precious thing in the world, the great political principle of freedom of the individual, of the individual conscience, and the great domestic principle of the sacredness of the family, which is the expanded individual?

Is it worth while to maintain these fundamentals, for they are all at stake and every one of them would be suppressed or so transformed and degraded as to be really non-existent, if the enemy won?

It seems to me that the enemy has given up hope that he can win a decisive victory. I think the best he hopes for and what he is struggling for to-day is a drawn war, and a peace that would grow out of such a draw. He has to admit that things have not gone as well as he would like.

And yet, do not underestimate the tremendous power the man still has. He practically has all Europe at his disposal, with all its natural resources. He is still desperately cunning and desperately strong.

So let us remember we must do our utmost; we have to go on or we shall go under. Never was the chance better, the challenge greater than it is at this present moment. Therefore, let us be of strong will and stout heart, and high hope.

We cannot help looking forward to what will be after the war, keeping in mind that the kind of peace we have after the war will grow out of our conduct in the war. No great barrier will shut off the days to come from the days that now are. As we conduct ourselves now and as we organize ourselves now, so shall we be laying the foundation for the future. Will that future be good, bad, or indifferent? It depends on us. But as we believe that truth is stronger than lies, and that ultimately justice is stronger than injustice, and that freedom is stronger than slavery, because each one of those is a reflection of the character of the Almighty Himself, so we believe that if we do our part, surely God will defend the right and the day of victory will come.

In the last war the editor of that famous English journal, *Punch*, Sir Owen Seaman, wrote lines that might with equal applicability be written and used to-day to cheer. May I read them to you?

"Ye that have faith to look with fearless eyes  
Beyond the tragedy of a world at strife,  
And trust that out of night and death shall rise  
The dawn of ampler life;

"Rejoice, whatever anguish tears your heart,  
That God has given you the priceless dower  
To live in these great times and have your part  
In freedom's crowning hour;

"That ye may tell your sons who see the light  
High in the heavens, their heritage to take,  
'I saw the powers of darkness put to flight,  
I saw the morning break!'"

God hasten that day!

# TENTH ANNUAL MEETING OF E.C.P.D.

The *Journal* is indebted to George A. Stetson, editor of *Mechanical Engineering*, for the following account of the meeting.

At the annual meeting of the Engineers' Council for Professional Development, R. E. Doherty, president, Carnegie Institute of Technology, was re-elected chairman. The meeting was held on Sunday, October 18, at the Engineering Societies Building in New York, and was followed by a dinner, at the Engineers' Club, to which members of the governing boards of the constituent societies had been invited to listen to résumés of the annual reports of the Councils' committees. A feature of the dinner was a tribute to R. L. Sackett who retired following ten years of service as chairman of the E.C.P.D. Committee on Student Selection and Guidance.

Other officers elected at the meeting are: S. D. Kirkpatrick (A.I.Ch.E.), vice-chairman; A. B. Parsons (A.I.M.E.), secretary; and S. L. Tyler (A.I.Ch.E.), assistant secretary.

Members of the Council appointed to serve for the term 1942-1945 were: George W. Burpee, R. L. Sackett, O. W. Eschbach, Arthur Surveyer, Chas. F. Scott, and C. M. A. Stine (all reappointments); and A. F. Greaves-Walker (A.I.M.E.) and D. B. Prentice (S.P.E.E.) new appointments.

Chairmen of the committees of the Council were announced as follows: A. R. Cullimore, Committee on Student Selection and Guidance; D. B. Prentice, Committee on Engineering Schools; Everett S. Lee, Committee on Professional Training; Chas. F. Scott, Committee on Professional Recognition; and E. H. Robie, Committee on Information.

Members of committees appointed to serve for the term 1942-1945 are:

Student Selection and Guidance, A. R. Cullimore and G. B. Thomas (reappointments), and W. B. Plank.

Engineering Schools, J. W. Barker, E. L. Morland and B. M. Woods (reappointments).

Professional Training, G. B. Holderer (new appointment) and John C. Arnell (reappointment).

Professional Recognition, N. W. Dougherty, Webster N. Jones, and George A. Stetson.

Information, F. A. Lewis, to succeed G. Ross Henninger.

The Engineering Institute of Canada was represented at the meeting by the following officers: President C. R. Young, Past-Presidents Arthur Surveyer and J. B. Challies, Councillor J. H. Vance and General Secretary L. Austin Wright.

## R. E. DOHERTY REPORTS TO COUNCIL

In his report to the Council, R. E. Doherty, chairman, said that E.C.P.D. had not escaped the pressures of war and the prospects were that it would feel them still more. It was his opinion that the Council should take an aggressive position and "pursue at an accelerated rate every activity, within its charter, that gives promise of supporting the war effort or that would lay foundations of professional development that may now appear to be essential for the most effective service to the country by engineers and the engineering profession in peace-time reconstruction."

Mr. Doherty reviewed two general avenues of approach to the accomplishment of its objectives of professional development. One was to cultivate among constituent bodies an attitude of co-operation and an improved practical facility in taking joint action. The other was an educational campaign "to inform the individuals among the boards of direction and the memberships of the several constituent bodies—indeed, all engineers—with respect to the purposes and activities of E.C.P.D. and to encourage them to have an active interest."

Although the problem of reaching individual engineers was more complicated than that of reaching the constituent bodies themselves, he said, nevertheless the main elements of necessary machinery were in existence. "The channels of

flow from the Council to such individuals are the national organizations of the constituent bodies. In all major cities and industrial centres there are local branches or sections of the national organizations; and on the campuses of most engineering schools there are student branches . . . It remains to organize at such centres, where the organizations do not already exist, joint groups in which activities relating to professional development can be centred, and which, through local branches or sections, can be in communication with E.C.P.D. through the national organizations." Such a plan, he continued, was essential and he and J. F. Fairman had undertaken to formulate the details of it.

Mr. Doherty then outlined the work of the standing committees, and his comments follow.

## STUDENT SELECTION AND GUIDANCE

(E.I.C. REPRESENTATIVE: H. F. BENNETT)

The selection of students who are intellectually qualified and the guidance of such students into the engineering profession now represent one of our most critical problems. Normally, it is a problem of basic importance that the aptitudes of students yet in high school be determined. But this problem becomes critical in the war effort which demands more full-fledged engineers and that everybody, including students, be placed where they can render the most service. Then these students could be properly selected and guided. The expensive and insufficient facilities for engineering education must not be wasted upon so many students who can not make the grade. And the only hope now apparent of solving this problem is the further active development of the distinguished work Dean Sackett's Committee on Selection and Guidance has already accomplished. He has laid a sound foundation of procedure in connection with the knotty problem of selection—of determining aptitude. After the exploration of earlier years, studies that have been made during the last two with the very substantial support of President Cullimore have apparently begun to open the way to the solution of this problem. And in guidance, from the experiments sponsored and studied by Dean Sackett's committee in a number of urban centers, notably New York, have emerged procedures that constitute the beginning of a solution of this difficult problem. I would urge upon you my belief that the work of this committee probably represents our most important immediate opportunity.

And I cannot leave this matter without expressing to Dean Sackett, on behalf of the Council, a deep and enduring gratitude for the foundation he has laid under this important work during a whole decade of patient, unremitting, unsung toil, and until the last year or two with practically no funds at his disposal. And I hope that as he now retires from the committee he will find satisfaction in both a job well done and the gratitude of his colleagues in E.C.P.D.

## ENGINEERING SCHOOLS

(NO E.I.C. REPRESENTATIVE)

The problems of the Committee on Engineering Schools are increasing in both difficulty and scope. War pressures raise questions not alone as to modification of the accrediting programme; it now appears that the whole structure of higher education, including engineering, may be torn apart for the duration. What the engineering profession, as represented by E.C.P.D., can do to hold to a minimum this impending devastation and to lay such foundations as fall within the Council's scope for post-war reconstruction of engineering curricula, is a problem with which the Committee on Engineering Schools, presumably, must deal. As Chairman Prentice of the committee has indicated,

there may be also an opportunity of assisting in some way in connection with war plans in the engineering colleges. Hence it seems very clear that although the accrediting programme itself will be suspended, the efforts of this committee should not be relaxed, rather should they be re-directed to the war problems.

In this general connection I would report that the Executive Committee undertook to explore the problems created by confused authority and policy in connection with professional engineering man-power in the war effort, and with this purpose in mind organized a meeting held in New York on September 20. The group included Dr. E. C. Elliott, chief, professional and Technical Division, War Man-power Commission, Dr. Leonard Carmichael, director of the National Roster of Scientific and Professional Personnel, L. Austin Wright, assistant director, Canadian Selective Service, and a few representatives of war industries, in addition to the Executive Committee and others associated with E.C.P.D., including the national secretaries. After a period of general discussion, Dr. Elliott appointed the entire group as a special committee of his division of the War Man-power Commission, and as such it passed a resolution to be reported at the meeting to-day.

#### PROFESSIONAL RECOGNITION

(E.I.C. REPRESENTATIVE: J. A. VANCE)

The Committee on Professional Recognition has had from the beginning a thorny and uncertain path. As Professor Scott, its present chairman, has reported, the decision was reached a few years ago that the profession was not yet ready, not sufficiently like-minded, to settle upon formal criteria of recognition, and that therefore the committee's work should be redirected toward an educational programme regarding the profession, reaching college students and junior engineers. Thus would a more unified understanding of the profession be cultivated and the foundation laid for future action regarding the problem of professional recognition. Professor Scott's pursuit of this wise change in committee policy is to be commended, for I venture to say there are few students and junior engineers and probably no engineering teachers who have not felt the touch of his campaign, about which he has given full report.

#### PROFESSIONAL TRAINING

(E.I.C. REPRESENTATIVE: C. R. YOUNG)

The Committee on Professional Training has taken a new lease on life. Under its energetic chairman it has cleared its mind as to purpose, settling upon the preparation of a "Manual for Junior Engineers" as its primary undertaking, at the same time carrying forward as far as may be practicable under war pressures other important, but secondary, projects; and this I believe to be a wise plan. The new manual will be as important to junior engineers as the pamphlet "Engineering as a Career" is to high-school and college students, and we must now make financial plans for its publication so that no time will be lost when the manuscript is ready. It is now approaching the end of the planning stage. Recalling the long hunt for outside funds for publishing "Engineering as a Career," I wish to prepare now for the manual and am recommending herein appropriate action.

#### ETHICS

(E.I.C. REPRESENTATIVE: C. R. YOUNG)

The Committee on Ethics, which had been organized under the late American Engineering Council, came to E.C.P.D.'s sponsorship about two years ago. Under the leadership of Prof. D. C. Jackson the committee has succeeded in the difficult task of formulating a code and a "Statement of Faith" that at least have the unanimous approval of the committee. The importance of such documents to the profession, if generally accepted, needs no argument here. Moreover, I need not remind you of the extended and careful thought that these documents have

had. Hence it is my hope that the Council may see fit to approve them.

#### INFORMATION

(E.I.C. REPRESENTATIVE: L. AUSTIN WRIGHT)

The Committee on Information under the chairmanship of G. Ross Henninger, has followed the customary policy of a number of years with respect to publicity of merely reporting the facts regarding actual work of E.C.P.D. and results accomplished. In addition it has carried out the special assignment during the last year of re-editing and printing the pamphlet "Engineering as a Career," which has been warmly received by the schools and colleges.

#### WAYS AND MEANS

Our situation is sound. Against the proposal to support the work of the Committee on Selection and Guidance that has significance in war as in peace, to finance the publication of the "Manual for Junior Engineers," and to protect the Council's responsibility for restoring the list of accredited curricula after the war, the Council has a substantial balance, as indicated on the financial statement. I have recommended that appropriate amounts be set aside now as special reserves for these purposes. Then against the regular expense budget for the year 1942-1943 submitted to-day for your approval, is an adequate income from The Engineering Foundation and constituent bodies. I am gratified to report that the Foundation has already appropriated for 1942-1943 a sum of \$5,000, an increase of \$500 over last year. I have expressed the Council's appreciation both to the Foundation for its continuing interest in E.C.P.D.'s work, and to Dean Potter for his good offices in supporting the Council's request. And there is every indication that the several appropriations from the constituent bodies for the year just closed will be renewed in full for the coming year, and for this, of course, we are most grateful.

Last year when it was decided to abolish the fees collected from colleges for reinspection of accredited curricula, it was necessary to obtain new funds. The chairman was authorized to seek the funds from the constituent bodies. The A.S.M.E., A.I.E.E., A.S.C.E., and A.I.Ch.E., responded by doubling their respective appropriations, and the problem was thus solved.

#### CONSTITUENT BODIES REPORT

A customary feature of E.C.P.D.'s annual meetings is a report from each of the constituent bodies on what has been accomplished during the year with suggestions as to how the Council could better approach its objectives. Abstracts of these reports for 1942 follow.

#### AMERICAN SOCIETY OF CIVIL ENGINEERS

On behalf of the American Society of Civil Engineers, E. E. Howard read from a report by R. E. Bakenhus. The report said that the A.S.C.E. had endeavored continuously to uphold the policies of the E.C.P.D., particularly in its accrediting programme. This was done in part through student-chapter organizations. The A.S.C.E. representatives on the Council were proud to report the continued activity of the New York Engineers' Committee on Student Selection and Guidance, which for the past five years had been under the chairmanship of an A.S.C.E. member, Arthur G. Hayden. This committee was made up of members of the five engineering societies participating in E.C.P.D., the civil engineering subcommittee consisting of 20 members. Mr. Hayden's report for 1941-1942 had stated that 28 group meetings and three general assemblies had been held in the high schools of New York City, at which more than 7,000 students had been in attendance.

Representatives of A.S.C.E. had attended the conference with the War Man-power Commission held under the auspices of E.C.P.D. on September 20. Although A.S.C.E. had expressed no formal opinion, it might be stated that

"the Society thoroughly endorses the stand: first, that every effort should be made to supply the armed services with engineers of the type that are required and in the tasks that require engineers; second, that every effort be made to supply necessary and vital industrial establishments with engineering talent for use in the tasks where it is necessary; and third, that the supply of trained engineers be kept up as the war needs indicate."

As to what E.C.P.D. might do, the report called attention to the expressed desire of the A.S.C.E. Board of Direction "that E.C.P.D. might well limit its work of accrediting curricula to the five major fields of engineering." The report also stated that "any steps in the direction of greater solidarity of the profession and greater effectiveness in dealing with technical, social, and economic problems, particularly in these times when the country is under great stress due to the war and social changes, would be desirable."

#### NATIONAL COUNCIL OF STATE BOARDS OF ENGINEERING EXAMINERS

Reporting for the National Council of State Boards of Engineering Examiners, N. W. Dougherty expressed pleasure that the distribution by E.C.P.D. of Wickenden's "The Second Mile" (published in *The Engineering Journal*, March, 1941, pages 111-114) was well under way, that a guide for senior students and junior engineers was being prepared, and that a "code of ethics" has been written, as these projects all concerned N.C.S.B.E.E.

E.C.P.D., said Mr. Dougherty, had been organized to enhance professional status. Four phases of a continuing programme of procedure for promoting E.C.P.D. objectives were: (1) Better practitioners, about which N.C.S.B.E.E. had done much; (2) Co-operation of the different engineering agencies, about which they had done little, except as something had been done through overlapping of memberships; (3) recognition on the part of engineers that they are members of a profession; and (4) public recognition that engineers deserve a place of esteem about which much was yet to be done.

#### THE ENGINEERING INSTITUTE OF CANADA

The report on behalf of The Engineering Institute of Canada was presented by Dean C. R. Young, president of the Institute. Under the direction of the Institute's Committee on the Training and Welfare of the Young Engineer, a pamphlet entitled "The Profession of Engineering in Canada" had been printed and 9,000 copies distributed without charge to the engineering colleges and to each of the secondary schools of Canada where the instruction is given in English. A French language edition of the brochure was now in the hands of the printers.

Student guidance committees had been set up in 16 of the 25 branches of E.I.C. in Canada, and the remaining nine branches were preparing to name similar committees. Favourable comment on the work of student guidance had been voiced and the Institute had been commended for its action. Arrangements were being made to distribute the E.C.P.D. manual for committees who aid young men interested in engineering education and the engineering profession to all counseling committees of the Institute.

It was planned, he said, that the E.I.C. Committee on the Training and Welfare of the Young Engineer would expand its activities in the direction of the training of the young engineer following graduation. Steps to foster competition of student and junior members for prizes offered by the Institute had been taken.

The Institute had also created a sentiment for the greater solidarity of engineers in all that is essential to their professional life.

#### THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Dean R. L. Sackett presented the report of representatives of The American Society of Mechanical Engineers, who are

A. R. Stevenson, Jr., and H. T. Woolson, in addition to Dean Sackett. The report follows:

This Society has two committees which co-operate with E.C.P.D. in furthering its programmes.

The Committee on Relations with Colleges is charged with the supervision of the 120 student branches of the Society. Copies of the address by President Wickenden entitled "The Second Mile" were sent to each student branch chairman and honorary chairman with a letter suggesting the use of the address as the basis for student and faculty programmes.

The Committee on Local Sections sent to each section chairman a reminder of the need for local guidance in the high schools for those boys who were interested in an engineering education. Only five sections out of 22 answering the enquiry had organized guidance committees.

If the experience of other societies is similar, it indicates a low interest in civic affairs and in the future status of the engineering profession.

It is desirable that Society committees in charge of local sections and student chapters or branches should promote the efforts of E.C.P.D. which are designed to encourage, inform, and help members and prospective members. Society publications provide reviews of E.C.P.D. meetings and the programmes of committees but local section and student meetings give scant attention to subjects of immediate concern to the progressive individual.

The Committee on Education and Training for the Industries held two sessions at the Cleveland Meeting, June 8-10, 1942, on "Education and Training for Industry Before and After the War," "Co-operative Education," and "Looking Ahead in Adult Education."

At the Rochester meeting, October 12-14, "Training Women for Engineering Jobs" was discussed by Mrs. Lillian M. Gilbreth, A.S.M.E., and others, and a panel discussion on "Education for Industry" was held.

The A.S.M.E. has increased its appropriation for the support of E.C.P.D. to \$1,700 for the year.

It is understood that leadership is woefully lacking in candidates at Officers Training Camps; the same qualities or similar abilities are needed in industry, which finds them difficult to discover. E.C.P.D. has discussed the subject since in its objectives it is authorized to co-ordinate and promote efforts and aspirations directed toward "greater effectiveness in dealing with technical, social, and economic problems."

One way for E.C.P.D. to help in accomplishing this purpose would be to ask the education committee of each constituent society to put on programmes designed to inform the engineering profession concerning social problems and its responsibility in solving those particularly to which it has contributed. Leadership depends on the engineer's sensing the part he has played in creating social and economic problems, and applying his intelligence, jointly with other forces, to the improvement of labour relations and human understanding of the conditions involved.

#### THE SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION

Reporting for the Society for the Promotion of Engineering Education, C. C. Williams said that "the activities of S.P.E.E. for the year have been directed toward rendering the colleges of engineering maximally useful in the war effort. "The effectiveness," he said, "has been hampered by two circumstances: (1) A lack of up-to-date comprehension at Washington of the distribution and potentialities of the technologic and research activities in the universities, and (2) a lack of knowledge on the part of engineering educators of the technical needs of the war effort."

"In the present disturbed state of engineering education," he concluded, "it seems likely that E.C.P.D. may well devote its attention to the relations of the engineering profession to the war effort and allow engineering education to find its own way. The exigencies that will arise in the

colleges of engineering will have to be handled by the individual institutions in view of their own conditions and by organizations in S.P.E.E. and other associations most immediately concerned with educational administration. When engineering education begins to enter the period of post-war adjustment, E.C.P.D. may well give thought to the part that undergraduate and graduate education have in the comprehensive project of professional development."

#### AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS

In presenting a report on behalf of the American Institute of Mining and Metallurgical Engineers, W. B. Plank told of a special committee of the Institute which "has made a preliminary report outlining a plan whereby, mainly through local sections, special attention will be given to new engineering graduates, to make them acquainted with other young engineers and to make it possible for them to participate both technically and socially in local-section activities."

He mentioned also a committee which has made a study of the Selective Service as it affects young mining and metallurgical engineers. Through advice to deans of schools and correspondence with Selective Service officials, and later with the War Man-power Commission, the committee had been instrumental in clearing up many questions.

A second edition of a booklet by T. T. Read, "Careers in the Mineral Industries," had been issued during the year. Also during the year the A.I.M.E. had sponsored publication of a notable book by T. T. Read, "The Development of Mineral Education in the United States."

#### AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

After reporting that he fully expected favourable action on the part of the Board of Directors of the American Institute of Electrical Engineers on the request for continuance of an increased appropriation for the work of E.C.P.D., J. F. Fairman, speaking for A.I.E.E. representatives, told about the presentation of an address, "What the Sections Can Do to Assist E.C.P.D.," delivered at the 1942 Summer Convention of the Institute.

"During the year," Mr. Fairman continued, "we have reviewed the situation as to the existence of student branches of the Institute at institutions whose curricula in electrical engineering were not accredited by E.C.P.D. In 1940 there were eleven cases. In 1941 there were seven. If Council approves the recommendations of its Committee on Engineering Schools, after this meeting there will remain only five. This seems to indicate progress and a definite effort on the part of the schools to get themselves on the accredited list."

As to suggestions for the work of E.C.P.D., Mr. Fairman said, "Our own opinion . . . is that E.C.P.D. would do well to concentrate on its immediate objective and to avoid the temptation to adventure in broader fields."

#### AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

B. F. Dodge, speaking on behalf of the representatives of the American Institute of Chemical Engineers, applauded the E.C.P.D. for its resolution of September 20 on the subject of man-power. He said that the demand for chemical engineers greatly exceeded the supply. Inasmuch as chemical engineering was a young man's occupation, there was no pool of older men upon which to draw. It was his opinion that the place of the chemical engineer was in the production army. He was thankful that there were no outstanding differences between the A.I.Ch.E. and E.C.P.D. The A.I.Ch.E., he said, had 5,000 student members.

#### E.C.P.D. ANNUAL DINNER

Col. C. E. Davies, secretary, A.S.M.E., acted as toastmaster at the annual dinner of E.C.P.D. which was held at the Engineers' Club, New York, N.Y., on Sunday evening, October 18, following the annual meeting of the Council. In addition to members of the Council and its

committees there were also present at the dinner representatives of the governing boards of several of the constituent bodies.

Colonel Davies recalled how the E.C.P.D. had been formed following a "Conference on Certification" held ten years ago. A profession, he said, was nothing without ideals, ideas, and leaders. We had to be realistic about the engineering profession and to realize that we had hardly started to build a profession of engineering. A wide range of viewpoints existed which had to be considered. E.C.P.D. had started in 1932 as "a conference of engineering bodies," and its purpose was to suggest to operating groups what should be done. In order to have leadership, he continued, acquaintanceship was essential, and such gatherings as the one he was addressing were a means to such an end. The ten years of E.C.P.D.'s activities had, in his opinion, been worth while, and he proposed to call upon representatives of E.C.P.D. committees to tell briefly what E.C.P.D. was thinking about.

Col. Davies then called upon Chas. F. Scott, Committee on Professional Recognition; D. C. Jackson, Committee on Ethics; S. D. Kirkpatrick, Committee on Engineer Training; D. B. Prentice, Committee on Engineering Schools; and R. L. Sackett, Committee on Student Selection and Guidance; who spoke briefly of the work of their committees. As the reports of these committees have been summarized elsewhere in this account of the E.C.P.D. annual meeting, no attempt to repeat these reports will be made here.

#### TRIBUTE TO DEAN SACKETT

Following Dean Sackett's brief address, the toastmaster called upon George A. Stetson to report for a special committee which had been appointed to prepare a tribute to Dean Sackett who retires from the Chairmanship of the Committee on Student Selection and Guidance after a service of ten years. After reviewing the importance and significance of the work of this committee under Dean Sackett's leadership, the tribute read:

"We have listened to-day to the report of one of your committee chairman who has lived through this period of evolution. Long years of service in the field of engineering education have matured his wisdom and judgment. Experience with several generations of youth, with practising engineers, and with the men and women of this nation has been his in rich measure. Some inner quality of alertness to men and events has kept his mind youthful and his vision clear. Although justified by years and the value of his accomplishments in enjoying the leisure that the vigour of his health would make a pleasure rather than a burden, he has preferred to pioneer in the field of selection and guidance of young engineers, and has devoted his time and energy to a new and important aspect of engineering education upon which the quality of future generations of engineers will indubitably depend. To the professional social scientist and the pedagogical psychologist he is a layman; but those who have known him and worked with him recognize that new ideas in any field coalesce into the substance of practicability when exposed to the influence of his maturity and experience.

"Dean Sackett, it is my privilege to extend to you on behalf of this group of your friends and fellow workers their congratulations and their tribute to you for your service in the field of engineering education and particularly for your ten years of leadership in developing the techniques of selection and guidance of engineering students. As your studies bear fruit in application in education and engineering, more and better leaders will be developed and a larger and more intelligent group of young men will rally to wise leadership. You cannot pass on to them your maturity and experience; but, when peace returns, following your example and aided by the influences you have set in motion, they will be able to distinguish between true leadership and false, bring education to serve the liberties and well being of mankind, and build a nobler profession that will be the

master and not the victim of applied science through a wise use of maturity and experience."

In his response Dean Sackett, to whom the tribute had come as a complete surprise, said that his service on the committee had been a pleasant experience in spite of the resistance he had encountered. In such a part a certain amount of mulishness was necessary. Many times, he confessed, he had not known whether he had been kicked downstairs or up. He had not been indifferent but ignorant of having been rebuffed.

Following the tribute to Dean Sackett, F. L. Bishop, secretary, S.P.E.E., called attention to the fact that normally the work of E.C.P.D. and the engineering colleges had to do with students who had the financial backing necessary for getting an engineering education. When the Army and Navy takes over, he said, twice as many young men would be able to enter engineering colleges as had been the case under normal conditions.

#### CANADIAN ENGINEERS COMPLIMENT E.C.P.D.

Calling attention to the fact that The Engineering Institute of Canada was the only constituent body which had sent its full delegation of representatives to the E.C.P.D. annual meeting, Col. Davies asked Arthur Surveyer to speak for the E.I.C. representatives.

Mr. Surveyer said that he was attending his first E.C.P.D. annual meeting. He had, he said, a feeling of pride that The Engineering Institute of Canada had been asked to become one of the constituent bodies of E.C.P.D. E.C.P.D., he recalled, had worked relentlessly to improve the status and education of engineers and to guide high-school students.

Appraisal of aptitudes for a profession was important, he said. No other profession, in his opinion, had given so much thought to the question of selection or had gone so far in saving young men from the disappointment of making a wrong choice. Lawyers and doctors, he pointed out, remained practitioners throughout their lives, while engineers usually advanced to administrative positions. In this advancement the engineer generally had to discard the practice that had helped him to rise. It was his habit to look for fine qualities in men and to help their development.

It was difficult for laymen, he said, to understand how a group of men having such differences of background and function as engineers exhibit could constitute a profession. However, professionalism for engineers was an attitude of mind, an ability to analyze and to sift essentials from non-essentials.

It was now necessary for engineers to assist in winning the war and the peace which was to follow. No men, Mr. Surveyer concluded, were better trained than the engineers of the United Nations. With the discipline of their education they should participate in the bringing of peace.

J. B. Challies, also of the E.I.C., followed Mr. Surveyer and spoke briefly. He had had something to do with the suggestion that E.I.C. be associated with E.C.P.D. Engineers in Canada were not separate, and they appreciated being members of the "supreme Court of Organized Engineering in North America," the E.C.P.D.

In introducing L. Austin Wright, secretary of The Engineering Institute of Canada, Colonel Davies said that he had been impressed with man-power controls in Canada. Mr. Wright was deputy director of National Selective Service in Canada, under Elliot M. Little, former director, also an engineer, to whom the job had been given because of the success which had attended his handling the Wartime Bureau of Technical Personnel organized by three Canadian engineering societies.

Mr. Wright described briefly but clearly the operation of the National Selective Service system in Canada and the controls of man-power that are exercised there. He also told about the control of engineering students and their allocation, upon graduation, to the armed forces and to industry. Students in Canadian universities were permitted to finish their courses, he said, and in the case of engineering students, summer work in industry was required, inasmuch as the courses were not "accelerated" as they have been in the United States. No more postgraduate courses are offered and one failure would be sufficient to remove a student from school. Changes of courses were not permitted students, unless the changes were in the national interest. All students were to be called up for active service upon graduation and those physically unfit for military service would be required to take positions in industry. Allocation of graduates to the armed forces and industry was under the control of the National Selective Service and was caused out in accordance with national need. It was planned, he said, to carry the control back to the high schools in order to provide an adequate supply of college-trained men for the armed forces, the government, and industry.

#### OFFICE OF TECHNICAL DEVELOPMENT

Webster W. Jones, dean of the College of Engineering, Carnegie Institute of Technology, reviewed informally the survey made for the War Production Board which resulted in the recommendation that a group of engineers and scientists be set up as an Office of Technical Development. The Office, he said, would be advisory to Donald M. Nelson, W.P.B. director.

#### PRESIDENT-ELECT H. V. COES, OF A.S.M.E., SPEAKS

Asked by Colonel Davies to speak to the Council, H. V. Coes, president-elect of The American Society of Mechanical Engineers, said that he had followed the work of the E.C.P.D. with interest for several years. It had set a pattern for co-operative efforts of engineering groups which too often conducted their affairs in such "airtight compartments" that they lost track of their objectives.

In bringing the dinner to a close, President Doherty said that it was heartening to the officers of E.C.P.D. to see the interest taken in its affairs and discussions. He appreciated the spirit of the discussions he had just listened to and the help of our Canadian colleagues. We could, he said, face the coming year with encouragement and determination to aid in the war effort.

## ACCIDENT PRONENESS

From *Engineering* (LONDON), SEPT. 11, 1942

Factory accidents are not purely fortuitous occurrences, the incidence of which can neither be foreseen nor controlled. If they were, their distribution would follow definite arithmetical rules such as are exhibited in cases of pure chance. A simple example is given by the tossing of a coin. If a large number of people, say a million, toss for heads or tails, then obviously, on the first occasion, there will be 500,000 winners and 500,000 losers. If the process is repeated, there is an even chance that each winner will toss head or tail with the result that 250,000 people will win twice. Equally, 250,000 will lose twice. With large numbers this process may be repeated over many stages so that after, say, six tossings there will be 18,000 people who have won six times and a similar number who have lost. There will be a tendency for the winners to suppose that they have some peculiar personal qualification making them persistently lucky and for the losers to describe themselves as always unlucky. Actually any of them have an equal chance of winning or losing next time and the fact that some have a run of luck or misfortune has nothing to do with them personally. It is an arithmetical necessity. The possibility of sustaining an accident in a factory is not a simple yes-or-no chance like tossing a coin, but it is amenable to the same kind of statistical treatment, and it can be shown that some people will necessarily have more than their share of accidents. Examination of many records, however, indicates that this is not a sufficient explanation of the distribution of industrial accidents. Some extraneous factor interferes with the laws of probability.

An example illustrating this was given by an investigation, carried out before the war, in a factory in which women were engaged on machine operations in the manufacture of shells. Although, from a statistical point of view, the number of workpeople concerned was not large, it was great enough to indicate that other factors than chance helped to determine the results. The data obtained concerned the activities of 648 women over some months. It was found that the number suffering no accident was 448, while 132 had one accident; 42, two accidents; and 26, three, four or five accidents. Further observation showed that groups of women free from accidents tended to maintain that status, while other groups which had previously suffered one or more accidents continued in the same type of liability. A probability calculation in this case showed that, had the distribution been determined by chance, instead of 26 women sustaining three to five accidents, the number would have been eight.

The chance of an accident occurring to an individual is naturally largely determined by the degree of risk to which he or she is exposed. Many investigations of the type mentioned above, however, have shown that some people are more likely to sustain an accident than others. This likelihood has been termed "accident proneness" and is the factor which nullifies probability calculations. In its broad aspects, the existence of accident proneness has probably been realised throughout human history, although it has had to wait for a scientific era to acquire a name. That people who are thoughtless, careless, clumsy or "all thumbs" are more likely to injure themselves in mechanical operations than those of greater care and finesse must have been realised since tools were invented. It is only in recent years, however, that investigation has shown that this broad and elementary concept is not in itself sufficient to distinguish accident-prone people from those who are naturally accident-free. Mental and physical qualities of a less obvious kind have significant bearing in the matter.

This subject, which has always been of importance in connection with factory work, has become of increasing

## Abstracts of articles appearing in the current technical periodicals

moment with the large increase in the number of people engaged in workshop operations. That the enormous increase in the factory population should be accompanied by an increase in factory accidents was only to be expected; the increase, however, is relative as well as actual. This also was, perhaps, to be expected, in view of the fact that very many of the additional workers are new to factory life, but this does not make it satisfactory. Apart from the question of suffering for individuals, and attendant expense, all accidents delay production in some measure. The question of accident proneness is but one item in the board question of accident prevention, or rather, minimization, in factories, but present conditions have given it a new urgency. The new factory populations are necessarily engaged, in the first place, with but little individual selection, and it is more than probable that the proportion of accident-prone people engaged exceeds the normal average encountered in peace-time industrial experience.

In order to assist works executives in dealing with this matter as profitably as possible, the Industrial Health Research Board has published a pamphlet entitled "The Personal Factor in Accidents."<sup>1</sup> It forms the third of the Board's Emergency Reports. The pamphlet does not contain new material. It is in essence a summary of the conclusions which have been arrived at as a result of the Board's work in this field in recent years. Particulars of the various investigations have been published in the past, but this digest of a large amount of material will be of value to many who, at the present time, are certainly not in a position to study any extensive series of reports.

The question of importance at the moment is whether it is possible in any way to recognize accident proneness so that individuals affected may be employed on operations in which risk of injury is small. Various tests have been developed by means of which the sensori-motor co-ordination of individuals may be measured, or at least indicated. The tests which are termed "aesthetokinetic" give a measure of the rapidity and accuracy of the co-ordination between hand and eye, which is to some extent a measure of accident proneness. It cannot be said that these tests have been developed to a stage at which they form an infallible guide in selection, but they give a useful indication. They have proved most reliable in connection with skilled operations. The whole question of selection by means of individual tests has been much studied in recent years and a good deal has been done in connection with Army recruits. It would be difficult, however, particularly from the point of view of the supply of suitable observers, to apply the method on any comprehensive scale to the thousands of new entrants now being brought into industrial life.

The second method of dealing with the matter which is mentioned in the pamphlet appears to be more generally applicable. This is based on the use of accident records. Like an accident itself, the severity of an accident is largely a matter of chance, and although anyone who is accident-prone may suffer more than the average number of mishaps, he may be so fortunate that they are all minor. This, however, is no guarantee for the future; the next in the series may be serious. It is in virtue of this that the pamphlet recommends the keeping of records which shall contain information about all accidents, no matter how trivial. It is proposed that the records should be kept on cards, one for each employee. Such a collection of cards, divided into packs corresponding to the departments of a works, would show at once which accidents were the most dangerous,

<sup>1</sup>H. M. Stationery Office (Price 4 d net).

and which department offered the most fruitful field for a more detailed investigation. Further, each pack would distinguish the individuals in the particular department concerned who were most liable to accident, and those in the most dangerous departments could be transferred to work of a safer type before they had done themselves serious harm. Probably all factories already keep some type of accident record, but frequently only accidents involving absence from work are considered worthy of attention. Those who are operating factories at the present time are keeping records of many kinds and probably do not wish this particular type of activity to be added to. If, however, an elaboration of a system already in operation would assist in reducing the accident rate, which is undesirably high, it might prove profitable not only in eliminating some suffering, but in increasing output.

## GRATICULES

From *Monthly Science News* (LONDON, ENG.), August, 1942

In many types of measuring instruments mechanical methods in which vernier and micrometer scales were employed are now being replaced by optical methods in which the standards of measurement are provided by graticules. These are the cross-lines seen in surveying telescopes and other instruments. This replacement has largely been made possible by the development of special photographic methods in the laboratories of the British Scientific Instrument Research Association for the reproduction of graticules, and accurately divided circles bearing circular measuring scales.

Prior to the development of these methods it was necessary to rule each circle or graticule individually. This ruling was carried out by means of a diamond on the uncoated glass surface, or by a steel tool which cut through a layer of resistant material spread over the surface thus exposing the underlying glass which could then be etched where the rulings had been made. Both these methods are subject to severe limitations. In the first place, by the ruling processes it is difficult to obtain lines with abrupt ends or to stop lines short at a point of intersection with another line. Under the high magnification to which graticules are subjected any gap or overrun becomes plainly visible. In the second place, a complicated graticule is exceedingly difficult to produce by any method of ruling and etching.

In the photographic method of graticule production a master of the graticule is drawn which may be a hundred times the required size. Sharp edges can be given to the lines of the master and all spacings can be accurately proportioned. From this master, reproductions can be easily and rapidly made with the elimination of all capricious and uncontrollable operations. One important feature of these graticules is that, although prepared by a photographic process, the transparent portions of the finished graticule are devoid of any film, thus eliminating the optical defects which arise in using ordinary photographic emulsions of silver halides in gelatine or collodion.

The use of the photographic process enables complicated graticules to be reproduced with ease, results in economy of production, and, as the processes involved are controllable, permits of a production time-table. When circles or scales so made are used for purposes of measurement, the brilliancy of the image seen, the opacity of the graduation marks against a bright background, and the large magnification employed, make it possible for readings to be taken with great ease and precision.

## JOINT PLAN FOR BASE METALS

From *Trade and Engineering*, (LONDON), SEPT., 1942

The Governments of the United States and Canada have worked out arrangements to procure still greater quantities of industrial minerals from the Dominion. Washington's announcement that the Reconstruction Finance Corpora-

tion will finance development of marginal and sub-marginal deposits of copper, lead, zinc, and graphite in Canada for the Metals Reserve Corporation, a wartime organization owned by the United States Government, is only part of the story; it is believed that, in addition, advances will be made where required, to enable companies already producing to expand their output, and that financial assistance may be provided also for prospecting for new properties.

The Ottawa administration and the Provincial Governments are helping. Moderate exemptions from income-tax have been allowed to prospecting syndicates and mining and exploration companies. Base-metal producers of less than three years standing have been exempted entirely from the excess profits tax, so that they will pay only 18 per cent on their net profits, after provision for depletion and depreciation, whereas the minimum tax payable by other corporations is 40 per cent and earnings of other industries now are subject to the 100 per cent excess profits levy. In addition the base-metal enterprises will have priorities for labour and materials.

Canada's War Metals Advisory Committee, which was organized by the Metals Controller, is making a careful survey of the possibilities of obtaining increased output of strategic minerals, and it is expected that any special assistance, whether from the Dominion Government or from the Reconstruction Finance Corporation of the United States, will be made in accordance with the recommendations of this committee. Such arrangement will provide a measure of advice and direction for development by the ablest and most experienced mining brains in the Dominion, and promises to be highly important in the future exploration and exploitation of this country's mineral resources. In addition to the more common base metals, occurrences of molybdenite are being given considerable attention.

## TUBE SHELTERS

From *The Engineer*, (LONDON), SEPT. 18, 1942

Eight new tube shelters in the London area are now so nearly completed that in emergency they could be brought into use without delay. Actually it is not intended to throw them open for the use of tube shelterers unless and until there is a need for the extra accommodation they will provide. These shelters, the design of all of which is practically the same, have been constructed in such positions that they can become parts of new tube railways that may be driven below London when the war is over. Each shelter consists of two tunnels side by side, each 16½ ft. dia. These tunnels were driven by methods similar to those unusually employed for boring such tunnels in the London area. But it is interesting to note that the place of the more usual cast iron lining has been taken to a considerable extent by pre-cast concrete blocks. The use of this alternative material was referred to by Mr. Halcrow, in his Thomas Hawksley Lecture before the Institution of Mechanical Engineers last November. For their special use as shelters, the tunnels are divided by a concrete slab forming upper and lower "floors." Each shelter is about 1,200 ft. long and capable of holding 2,000 people. Cross-passages provide space for medical aid posts, control rooms and the like. The tunnels lie at levels between 75 ft. and 110 ft. below ground level and to each there are several alternative entrances. Four of the shelters are north and four south of the Thames. The Exchequer is paying for the cost of the construction of these shelters and for their maintenance.

## MOTOR SHIPBUILDING

From *Trade and Engineering* (LONDON), SEPT. 1942.

It is reported from Copenhagen that during the course of this month the first gas-engined ship built by Messrs. Burmeister and Wain will go on trials. Much interest was aroused last year when it was announced that Messrs. Burmeister and Wain, who may be regarded as pioneers in motor-ship construction, had taken up the manufacture of a

marine gas engine and would instal the first unit in a 3,000 ton cargo ship. It was also announced that although the first engine had an output of only 900 b.h.p., plans had been laid for the manufacture of much larger units.

The first vessel, now completed, is to the order of the Danish company, A. S. Navitas, which is apparently a new shipping company established probably with the idea of trying out this new development. The engine is a seven-cylinder four-stroke trunk-piston type, to which gas is supplied from two generators. Apparatus is provided for crushing the coal, and gas coolers are provided. The general design of the engine is similar to that of a Diesel engine but without normal fuel valves and fuel pumps. A special design of gas inlet valve is employed. The producer plant is installed forward of the engine-room, and sufficient bunkers for operation at full speed for twenty days can be carried. Ordinary coal is utilized, and the consumption is 0.7 lb. per i.h.p. hour when using fuel having a calorific value of 7,000 B.Th.U. per lb. In port, current is obtained from a gas-engine dynamo, a small independent coal-fired gas producer being fitted. Arrangements can be made for converting the propelling engine to operate on Diesel fuel as a Diesel motor, and it is stated that this conversion can be carried out in about three days.

#### VARIABLE-PITCH PROPELLERS

The Swedish Johnson Line has ordered a 7,800 ton cargo passenger ship in which the normal fixed propellers will be replaced by variable-pitch propellers. There are to be two single-acting 3,500 b.h.p. engines, and the propellers are of the Kamewa type, which have now been adopted in about forty Scandinavian ships. As the largest of these has machinery of under 1,000 h.p. the new ship represents an important advance.

The design of the propeller is based upon that of the impeller of the well-known Kaplan water turbines, which are built in sizes up to 60,000 h.p. The movement of the blades to provide variation in pitch is effected by an oil-operated servo-motor enclosed within the hub of the propeller. Among the advantages hoped for is a higher overall propeller efficiency under all conditions of speed and load, since the blades can be fixed to give the most desirable pitch for any circumstances of operation. Complete control can be effected from the bridge, and the engines may be of the non-reversible type. Further, they will run at constant speed during all manoeuvres, starting and stopping during the manoeuvring period thus being avoided. It remains to be seen whether these advantages will outweigh the additional cost which apparently will necessarily be involved.

#### FRENCH PASSENGER LINERS

It is a curious fact of the war situation that while no large passenger liners are being built in any of the belligerent countries, work should continue on a vessel of this class in France. A 24 knot turbine-driven liner, Kairouan, built for the Marseilles-Tunis route, was launched a short time ago, and the propelling machinery of a much larger vessel, the Maréchal Pétain, has lately been completed. It is now stated that the Maréchal Pétain will be launched at the end of the year. She will be the highest-powered oil-engined passenger liner constructed in France, having a gross tonnage of 18,000, with a length of 594 ft. and a beam of 75 ft. 9 in. The three Sulzer propelling engines have been built in France at St. Denis, near Paris, and are each

designed to develop 8,300 b.h.p. at 131 r.p.m. They will normally give a speed of 20 knots, but the total output may be increased to 31,000 s.h.p. when required, this enabling a speed of 22 knots to be maintained for some hours. A remarkable feature of this ship is that all auxiliaries, including winches and other deck machinery, are to be driven by electric motors of the alternating current type.

#### HIGH-POWERED TUGS

Tugs of various types have been ordered in this country and America, and some of these vessels are now coming into commission. They are interesting from the point of view of the methods of propulsion employed. Several of the largest built in America employ Kort propellers, two 1,200 b.h.p. engines driving separate propellers through reduction gearing. The engines in this case are of the four-stroke pressure-charged type and are connected to the pinions of the reduction gear through electric couplings. In other still larger tugs there are four 950 b.h.p. high-speed engines driving dynamos which supply current to a single electric propelling motor. In yet another type utilizing electric propulsion two-stroke General Motors Diesel machinery is installed. These tugs have the further interest that the propelling motor is of the high-speed type and drives the propeller through reduction gearing.

### TRACTOR PLOUGHING BY NIGHT

From *The Engineer* (LONDON), SEPT. 4, 1942

In order to meet any future shortage of new tractors, likely to be brought about by the cutting down of the American and Canadian farm machinery manufacturing programmes, the Ministry of Agriculture, which is anxious to get the bulk of the increased acreage of wheat sown in this country by the end of November, recommends the use of night ploughing, wherever this can be arranged. The training of night-shift tractor drivers is to be begun, and the Ministry of Agriculture has collaborated with the Ministry of Home Security in drawing up regulations for the lighting of tractors by means of motor-car headlamps. The use of lighted tractors must in every case conform with the security limits. Experimental tests have shown that straightforward ploughing can be successfully carried out using one masked motor-car headlamp fixed near the bottom of the radiator, and another at the back of the driver's seat. In addition, the use of a masked torch will be permitted, in order to be sure that all is going well with the plough. Even with the amount of lighting permitted it is pointed out that in a general way turning at headlands and the marking out of fields and the making of finishing runs may be difficult. It is therefore recommended that fields to be ploughed by night should be marked out in daylight and the finishing runs left till the following morning. Some few tractors are already equipped with lighting sets, but in the case of most of the tractors it will be necessary to add headlamps and fixing brackets and a lighting dynamo or battery; 36-watt bulbs have been found satisfactory. Much of this equipment, it is stated, may be found on old motor scrap dumps. Although the number of tractors coming to this country will be reduced, and the manufacturing of lower-powered crawler tractors has been stopped in order to provide higher-powered tractors for military and civil engineering purposes, arrangements have been made to assure a sufficient quantity of spare parts to keep tractors already in service in good repair.

FIFTY-SEVENTH  
ANNUAL GENERAL MEETING  
AND  
GENERAL PROFESSIONAL MEETING  
THE ENGINEERING INSTITUTE OF CANADA

**Toronto** - *Thursday and Friday...  
February 11th and 12th, 1943*

**THE ENGINEER AND THE WAR**

*The Toronto Branch  
has set up a special  
committee*

under the chairmanship of  
W. S. Wilson, M.E.I.C., to handle  
all arrangements



*All sessions will be  
held at the  
Royal York Hotel,  
Front Street*

**PRELIMINARY PROGRAMME**

*Thursday, February 11th*

- 10.00 a.m.—Annual Business Meeting.
- 11.00 a.m.—Discussion of the work of the Committee on Engineering Features of Civil Defence.
- 12.30 p.m.—Luncheon—Address on: "The Alaska Highway," by Brig.-Gen. C. L. Sturdevant, Assistant Chief of Engineers, U.S. Army.
- 2.30 p.m.—Discussion on the work of the Committee on Industrial Relations.
- 7.30 p.m.—Banquet and Dance.

*Friday, February 12th*

- 10.00 a.m.—Discussion on The Application of Statistical Control to the Quality of Materials and Manufactured Products.
- 12.30 p.m.—Luncheon—Address on: "Canada's Wartime Achievements in Shipbuilding," by Desmond A. Clarke, Director-General of Shipbuilding, Department of Munitions and Supply.
- 2.30 p.m.—Discussion on Post-War Planning and Reconstruction.
- Evening— Joint Smoker with Association of Professional Engineers of Ontario.

*See the January Journal for full details*

### YOUNG ENGINEERS ON E.C.P.D. COMMITTEE

Some time ago a suggestion was made that the contribution of The Engineering Institute of Canada to the work of the Committee on Professional Training of the Engineers' Council for Professional Development might be increased if one or two members of the Institute were appointed to the junior division of the Committee.



J. W. Brooks, Jr. E.I.C.

On discussing this matter with Mr. Everett S. Lee, chairman of the Committee on Professional Training, and with Dr. R. E. Doherty, chairman of E.C.P.D., President Young of the Institute found them most sympathetic. The matter was then brought to the attention of E.C.P.D. Executive Committee, on October 17th, by Mr. Lee and, as a result, Dean Young was asked to submit the names of two of the younger members of the In-

stitute to serve on the junior committee.

At its meeting held at Headquarters on November 21st, Council approved of the recommendation submitted by Dean Young that the following members of the Institute be appointed to the junior division of the Committee on Professional Training of the Engineers' Council for Professional Development: J. W. Brooks, Jr. E.I.C., structural designer with H. G. Acres and Company, Niagara Falls, Ont.; and W. E. Brown, Jr. E.I.C., wire rope engineer, B. Greening Wire Company, Limited, Hamilton, Ont.

Mr. Brooks is an honour graduate in civil engineering of Queen's University of the class of 1939. He was president of the Civils Club and is a member of the class '39 permanent executive. For two years after graduation he was demonstrator and lecturer in civil engineering at Queen's University. For one summer he was employed on surveying and structural design by the Beauharnois Light, Heat and Power Company. He is a member of the executive of the Niagara Peninsula Branch of the Institute.

Mr. Brown is an honour graduate in civil engineering of the University of Toronto of the class of 1932. For the first year after graduation he was engaged in highway construction. The following year he joined the staff of the B. Greening Wire Company, Limited, spending some time in the plant and later being transferred to the engineering department. For the past five years he has been the wire rope engineer for the company. He is the nominee for the post of secretary-treasurer of the Hamilton Branch of the Institute for 1943.



W. E. Brown, Jr. E.I.C.

It is expected that these two young men will be most creditable representatives of the Institute on the committee and that their contribution, in presenting the point of view of the young engineer, will be most valuable.

### WASHINGTON LETTER

The War Production Board is again being reorganized. Mr. Donald Nelson has announced what almost amounts to a reconstitution of the board. Personnel and departments will be regrouped under the control of the office of the programme vice-chairman. The programme vice-chairman is Mr. F. Eberstadt, one time chairman of the Army and Navy Munitions Assignment Board. Governing all operations of the War Production Board is the Requirements Committee of which Mr. Eberstadt is also chairman. Directly under him in his capacity as programme vice-chairman are four major bureaus: Programme Bureau, including in its scope studies of supply, man-power, adjustment of programme and requirements, priority ratings and materials distribution systems; Facilities Bureau, which is responsible for construction programme, plant facilities, utilization of existing equipment and so on; Distribution Bureau, which is charged with the job of ensuring the continuity of flow of material; Resources Bureau, which will direct stockpiling, conservation, simplification, standardization, etc. The industrial branches of W. P. B. have been raised to the status of divisions. There are thirty-six of them and they have been placed directly under the control of the programme vice-chairman. Also under him, and exercising local authority, are twelve regional offices covering the United States. Aircraft, radio, shipbuilding and rubber divisions remain outside Mr. Eberstadt's scope.

Tied in with the reorganization of W. P. B. is the announcement of the new "Controlled Materials Plan." This is a newly evolved plan to control the distribution of certain critical materials and, through them, the whole production cycle. "Bills of Material" are to be prepared, showing the amounts of critical material in all the major commodities including both war requirements and civilian supply. The three critical materials chosen to inaugurate the plan are steel, copper and aluminum. All requirements both military and civilian will be produced for one of seven agencies: War Department, Maritime Commission, Aircraft Scheduling Unit, Office of Lend-Lease, Board of Economic Warfare and Office of Civilian Supply. These seven agencies have been termed "Claimant Agencies". Each agency will present its requirements to the Requirements Committee of the War Production Board. On the basis of the "Bills of Material", it will be possible to check the amount of critical material required to fill these programmes. The Requirements Committee, on the other hand, will be fully informed as to the available supply and the whole purpose of the plan is to "assure a balance between supply and demand of controlled materials, to the end that such materials shall be available in the quantity and form and at the time required to meet authorized programmes and schedules". If necessary, the programmes of the various Claimant Agencies are revised to suit supply. At the time of writing I have just spent a whole afternoon in conference with several others trying to understand and digest the 58-page W.P.B. pamphlet which explains the plan and sets forth the procedure. As may well be imagined, the mechanics of such a plan are very involved and it is not expected that it will be possible to put the plan



## INDUSTRIAL RELATIONS COMMITTEE

It was reported, at the last Council meeting, by the chairman of the Committee on Industrial Relations, that his committee had been requested to take charge of one of the sessions at the Annual Meeting of the Institute. It is planned to have two speakers—one dealing with the general Canadian situation, and one with the scientific approach to the problems of employee relations. Arrangements are not yet completed for the Canadian presentation, but Professor M. S. Viteles, associate professor of psychology, University of Pennsylvania, and director of personnel research and training of the Philadelphia Electric Company, will present a paper entitled "A Scientific Approach to the Problems of Employee Relations."

It would appear, as a result of a survey made by the committee, that none of the Canadian universities "offer courses to engineering students ample enough to serve the needs of modern industry with respect to industrial relations," and that often, such courses as are offered are not fully taken advantage of by the students. Realizing the importance of such a subject in time of war, as well as afterwards if industrial peace is to be maintained, the committee asked authorization from Council to communicate with the universities, urging them to organize courses in industrial relations. While it was realized that the engineering curricula were already heavily loaded, it was thought that perhaps it might be possible, at some universities, to arrange for extra-mural courses on this subject, perhaps in the evening, so that graduate engineers might attend. The attendance at courses in personnel management instituted in some of the universities this year would indicate that there is a large demand for such activities.

Accordingly, Council authorized its committee to communicate with the universities, drawing attention to the great desirability of giving adequate consideration to matters of industrial relations in courses for undergraduate or graduate engineers. The Canadian universities have been circularized and have been informed of the committee's desire to be of assistance to them in such matters.

At a meeting of the committee held at Headquarters on November 25th, it was agreed that the following statement, written by the Archbishop of Canterbury, and published recently in an American magazine, should be reproduced in the *Journal* for the benefit of all members.

### THE FULL DEVELOPMENT OF INDIVIDUAL PERSONALITY

The structure of life as we knew it before the war has already been profoundly modified. How far do we want to restore it if we can?

The task of the Church in face of social problems is to make good Christian men and women. That is by far its most important contribution.

But it is also part of the duty of a Christian to judge how far particular evils are symptoms of a disease deeper than the evils themselves.

Thus, in the economic field, goods are produced so that men can satisfy their needs by consuming them. If a system comes into being in which production is regulated more by profit than by the needs of the consumer, that system is symptomatic of something wrong.

There is nothing wrong about profits as such. It has always been recognized that both the producer and the trader are entitled to a profit which they have earned by their service to the community. But it is possible, nonetheless, for these two to get in the wrong order. Then the consumer is treated only as a *means* to success . . . whereas he ought to be considered the *wholes end* of the process.

If that is true, it is the duty of Christians to become aware of it and to demand a remedy. I offer these suggestions as a goal to aim at immediately:

1. Every child should find itself a member of a family

housed with decency and dignity, so that it may grow up as a member of that basic community in a happy fellowship unspoiled by underfeeding—or over-crowding, by dirty and drab surroundings—or by mechanical monotony of environment.

2. Every child should have the opportunity of an education till years of maturity, so planned as to allow for his peculiar aptitudes and make possible their full development. This education should be inspired by faith in God and find its focus in worship.
3. Every citizen should be secure in possession of such income as will enable him to maintain a home and bring up children in such conditions as are described in paragraph 1 above.
4. Every citizen should have a voice in the conduct of the business of industry which is carried on by means of his labour, and the satisfaction of knowing that his labour is directed to the well-being of the community.
5. After the war, every citizen should have sufficient daily leisure, with two days of rest in seven, and, if an employee, an annual holiday with pay, to enable him to enjoy a full personal life with such interests and activities as his tasks and talents may direct.
6. Every citizen should have assured liberty in the forms of freedom of worship, of speech, of assembly, and of association for special purposes.

Utopian? Only in the sense that we cannot have it all to-morrow. But we can set ourselves steadily to advance towards that six-fold objective. It can all be summed up in a phrase: *The aim of a Christian Social order is the fullest possible development of individual personality in the widest and deepest possible fellowship.*

I should give a false impression of my own convictions if I did not here add that there is no hope of establishing a more Christian social order except through the labour and sacrifice of those in whom the Spirit of Christ is active.

(Signed) WILLIAM CANTUAR,

(Archbishop of Canterbury.)

## ACTIVITIES OF THE CIVIL DEFENCE COMMITTEE

At the November meeting of Council, the chairman of the Committee on the Engineering Features of Civil Defence presented a progress report from which the following notes have been extracted for the information of all members.

Through the Edmonton Branch Committee, Professor I. F. Morrison, of the University of Alberta, has offered to let anyone make suitable use of a lecture and slides which he has prepared in connection with the Webster Toronto lectures. This lecture has already been presented before several branches and is reported to be very interesting.

At the request of Mr. E. P. Goodrich, chairman, American Society of Civil Engineers National Committee on Civilian Protection in Wartime, the A.S.C.E. has been sending to the Institute Committee a substantial volume of very interesting literature, including U.S. Office of Civilian Defence specifications and bulletins and much other material. Branch Committees have been advised of the existence of this information, which is on file and can be secured for perusal from Headquarters.

Headquarters has issued a small number of copies of "Structural Defence Against Bombing" to Branch Committee chairmen on consignment. The demand for this publication, 510 copies of which have been purchased by Dr. Manion, has been such that the first printing of 1,000 copies has been exhausted. A second printing had to be ordered and is now available.

A joint committee representing the Royal Architectural Institute of Canada, the Canadian Construction Association and the Institute, has prepared a memorandum on the engineering features of civil defence in Canada, accompanied by an organization chart, all of which is intended to cover that portion of the civil defence field lying between the field covered by Dr. Manion's A.R.P. organization and that covered by the armed forces. It has also prepared a letter of transmissal to the Rt. Hon. W. L. Mackenzie King, Prime Minister of Canada. Both documents were signed by Mr. J. B. Stirling, president, C.C.A., Mr. Gordon McL. Pitts, president, R.A.I.C., and Dean C. R. Young, president, E.I.C., and transmitted to the Prime Minister under date of November 3rd, 1942. Acknowledgment has been received from Mr. H. L. R. Henry, Private Secretary to the Prime Minister, stating that the submission will receive early consideration by the War Committee of the Cabinet.

#### BRANCH COMMITTEE REPORTS

The committee, under the chairmanship of Mr. I. P. Macnab, which is serving as the Branch Committee for both the Halifax and Cape Breton Branches, has set up sub-committees to deal separately with six divisions of its work, as follows:

1. Shelters.
2. Incendiary bombs and emergency fire protection.
3. Strengthening existing buildings, repairs to existing buildings in case of damage, and design of new industrial buildings.
4. Protection of industrial plants and buildings.
5. Public utility services.
6. Railways, highways and transportation generally.

The London Branch Committee, under the chairmanship of Mr. H. F. Bennett, reports that a meeting of its representatives from London, Woodstock, St. Thomas and Stratford was held on November 5th. In London, members of the Institute form the greater part of the local A.R.P. Committee and are specially responsible for the organizations covering gas, shelters, utilities and demolition. Six members are speaking weekly to A.R.P. posts on these matters. On the evening of November 5th, a semi-public meeting of the Branch, attended by A.R.P. officials from London and St. Thomas, was addressed by Mr. H. F. Bennett on the structural aspects of civil defence. Mr. Bennett is to address the St. Thomas Kiwanis Club early in December on this subject. The committee believes it is making progress in London and that similar progress will follow at Woodstock, St. Thomas and Stratford in due course.

On page 580 of the October *Journal*, a list of the British Standards, A.R.P. Series, was published. The chairman of the Institute Committee on the Engineering Features of Civil Defence has secured, through the secretary of the Canadian Engineering Standards Association, information on the applicability of these specifications in Canada. This appears under Library Notes in this issue.

The following additions have been made to the library of the Institute since publication, on page 580 of the October *Journal*, of the list of literature available on Air Raid Precautions and Civil Defence:

**Great Britain. Ministry of Home Security—Research and Experiments Department—Bulletin:**

*No. C11—Kilo magnesium bombs and resultant fires—Use of chemical fire extinguishers. 2nd ed. Aug. 19, 1942.*

**Great Britain. Dept. of Scientific and Industrial Research—Building Research—Wartime Building Bulletin:**

*No. 14—Centreless arch designs.*

**American Gas Association:**

*War protection of the gas industry.*

The following material consists of pamphlets and leaflets on the subject of air raid precaution and civilian defence. For convenience it is arranged by subject.

**Protection against gas:**

*U.S. Office of Civilian Defence, Dec., 1941. 74p.*

**E. P. Goodrich:**

*A.S.C.E. National Committee on Civilian Protection in Wartime Bulletin for May 13, 1942, re gas masks and gas.*

**Mechanism of action of ordinary war gases:**

*C. D. Leake and D. F. Marsh. Excerpt from "Science" for August 28, 1942.*

**Pliofilm:**

*Dr. A. B. Ray.*

**How to protect yourself against gas:**

*U.S. Office of Civilian Defence, operations letter No. 46, June 9, 1942.*

#### BLACKOUTS

**A new blackout bulb:**

*Excerpt from "Science" supplement, April 3, 1942.*

**Traffic control signals during blackouts:**

*Institute of Traffic Engineers.*

#### CAMOUFLAGE

**Camouflage:**

*Paper delivered by Greville Hickard. U.S. Office of Civilian Defence, May, 1942.*

**Industrial camouflage:**

*Excerpt from Engineering News Record, July 30, 1942.*

#### TRANSPORTATION

**Local passenger transport:**

*U.S. Chamber of Commerce, Transportation and Communication Dept., April, 1942. 13p.*

**Conservation of vital war transportation:**

*U.S. Chamber of Commerce, Transportation and Communication Dept., May, 1942. 16p.*

**Office of Defence Transportation:**

*Notice to operators of street cars and buses, April, 1942.*

#### ENGINEERING

**Engineering in the traffic accident emergency:**

*Chicago, National Safety Council, 1942.*

**Value of modern building methods shown by bombing of England:**

*Engineering News Record, February 26, 1942.*

#### A.R.P.

**Commerce and Industry Association of New York, Inc.:**

*Bulletin on A.R.P. for buildings in non-residential areas.*

**A.S.C.E. National Committee on Civilian Protection in Wartime:**

*Bulletin re Engineers and A.R.P. by Ernest P. Goodrich.*

**Standard Oil Company of California, Bulletin:**

*Our friend the sand bag, March, 1942.*

**Civilian Defence:**

*An address by James M. Landis, Director of the Office of Civilian Defence, March, 1942.*

**British A.R.P. Experiences:**

*Reprinted from the Journal of the American Water Works Association, February, 1942.*

#### MISCELLANEOUS

**Treated timber in explosion bunkers and barricades:**

*Wood Preserving News, May, 1942.*

**British Utilities weather the blitz:**

*Reprinted from the Municipal Review, April, 1942.*

**Wartime water works maintenance in Britain:**

*Reprinted from the Journal of the American Water Works Association, February, 1942.*

**Wartime Health Protection:**

*Second progress report of the Sanitary and Public Health Engineering Division of the A.S.C.E. National Committee on Civilian Protection in Wartime.*

**American Institute of Architects:**

*First annual report of the Committee on Civilian Protection.*

#### BIBLIOGRAPHIES

*References that have been found useful to the National Chairman of the A.S.C.E. National Committee on Civilian Protection.*

At its last meeting the Institute Council approved a memorandum submitted by the Committee on Professional Interests, setting forth certain amendments which are thought desirable to facilitate the operation of the agreement now existing between the Institute and the Association of Professional Engineers of Saskatchewan.

It is gratifying to both parties to note that the agreement has been found to work so satisfactorily as regards all its main provisions. But those responsible for drafting a document of this kind could not be expected to foresee all the possible contingencies or changes of conditions which might arise, or to provide for remedial action in every conceivable eventuality.

Experience gained in the practical working of the several agreements now in force has naturally brought to light minor omissions which have been taken care of in drafting the later agreements. It will be remembered that the Saskatchewan Association was the first to enter into a co-operative agreement with the Institute; its formal signature having taken place in Regina in October, 1938.

In fact a few unforeseen minor difficulties have been found in connection with the operation of the Saskatchewan agreement. They have been considered by the Institute Committee and by the Association, and amendments to cover them have now been approved by the Councils of the two bodies concerned.

These amendments deal with three points:—

*First*, the agreement already provides for the payment to the Association of a single annual joint membership fee, covering membership in both bodies. The original intention was that this arrangement would apply only to persons permanently residing in the province, but the wording of the agreement did not make this clear. An amendment to clause six now does so, by adding the words "and shall apply only to permanent residents of the province of Saskatchewan."

*Second*, under the agreement, members of the Institute may join the Association without paying its admission fee, if application is made within twelve months of taking up residence in the province. In effect this means that if he applies after the twelve-month period, an Institute member must pay the regular Association admission fee. An amendment now provides that in such a case, the Institute member may enter the Association on payment of the difference between the regular Association entrance fee and the amount he has already paid to enter the Institute, an arrangement which is a reasonable one.

*Third*, there has been some question as to the legality in Saskatchewan of any disciplinary action which might be taken by the Institute against a joint member in the province. The original clause seven of the agreement will be repealed and a new clause substituted, making it clear that nothing in the agreement shall prevent either party from exercising the rights conferred by its charter and by-laws as regards the disciplining, suspension or expulsion of any of its members.

In case of a joint member, however, neither party is to take final action until it has furnished the other party with sufficient information to decide whether the circumstances warrant its taking action also. In other words, separate disciplinary action by the Institute and the Association is provided for.

The Institute Council, having approved the proposed memorandum of amendment to agreement, has authorized the president and general secretary to sign the document on behalf of the Institute.

Verdun S.A.A. Plant,  
425 River Street.  
Verdun, Que.  
October 27th, 1942.

Secretary,  
The Engineering Institute of Canada,  
Montreal, Que.

Dear Sir:

With reference to Mr. D. C. Tennant's paper on bombing and structural defence given in Montreal on the 22nd instant (published in this issue), during the discussion period one of the members submitted a question relating to an apparent anomaly appearing in the tabulation of depth penetration of bomb fragments, resulting from both light case and heavy case bombs in soft timber and gravel, which question Mr. Tennant did not have time to answer.

Probably the following information may clear up this matter:

Primarily, it must be understood that many of the tabulated figures given by Mr. Tennant were derived from experimental and laboratory type-tests taken under assimilated conditions and not from actual bombing, from which latter it is almost hopeless to expect to secure accurate and conclusive data. Further, in taking laboratory type-tests on explosive missiles, such as bombs and shells, the results obtained from two similar types of bombs are often very dissimilar; no two explosions producing the same result.

Only the mean of many tests and experiments can be taken as a basis for tabulation. Further, a number of factors are introduced which may or may not occur under actual bombing conditions. All such data should, therefore, be accepted as purely empirical and with such it is practically impossible to differentiate to any degree of exactness, the two effects of fragments striking different materials.

The three most important factors likely to affect depth of penetration are: First, the brizant qualities of the bomb casing irrespective of whether it is a light or heavy case; second, the superficial area of the face of the fragment on impact; and third, the quality of explosive and its degree of tamping in the bomb at the time of detonation.

The number of fragments of all sizes of bomb, range between 2,000 and 6,000 of all shapes and sizes. The maximum velocities obtained (under experimental conditions) lie within the limits of 4,000 and 7,000 feet per second, and are reached within less than ten feet from the bomb.

The depth which a given fragment will penetrate may be taken to vary (only as very approximately) inversely as the specific gravity of the material hit.

As far as penetration in wood is concerned, a purely empirical formula has been derived and is used only for statistical purposes. In its use, large differences must be allowed for, due to numerous influences affecting the penetration especially if it is desirous to make comparisons, as our friend was attempting to do.

This formula may be of interest to Mr. Tennant and other members, and is given as follows:

Assuming:  $D$ , depth of penetration in inches,  
 $M$ , mass of fragment in ounces,  
 $V$ , velocity of fragment in ft. per sec.,  
 $A$ , area of the face of fragment presented to the target;

$$\text{then: } D = \frac{K \times M \times V}{A}$$

$K$ , being a constant for the material relative to the functions of density and resiliency, for normal soft woods such as fir, is equal to  $1.4 \times 10^{-3}$ .

By taking the specific gravity of fir at .53 and gravel at 2.0, the constant  $K$  would approximate for gravel.  $37 \times 10^{-3}$ , and neglecting the other multitude of variables likely to affect penetration, it will be seen that if a fragment of the same type, size and face area could be made, through explosive action, to strike the two different materials at exactly the same angle, it would be reasonable to expect that penetration in the timber would approximate a depth of four times that of the depth in gravel, but taking all factors into consideration and noting the fact that it is a well established ballistic axiom that loose material has a greater stopping effect on bullets and fragments than monolithic or solid material, the result as a whole is a problematic uncertainty.

Yours very truly,

(Signed) CAPT. A. C. RAYMENT, M.S.M., M.E.I.C.

THE KING vs PARADIS AND FARLEY

University of Toronto,  
Toronto, Ont.,  
November 26, 1942.

The Editor,  
*The Engineering Journal*,  
Montreal, Que.

Dear Sir:

In the November issue of the *Journal*, Mr. E. P. Muntz presents some interesting comments upon the Supreme Court judgment in the case of *The King vs Paradis and Farley*, previously published in the September issue.

As would be obvious to all who read the Supreme Court judgment, this case is one of great importance to engineers. In view of this, and of familiarity with the case, I had promised to write a brief summary for the *Journal* when time permitted. Unfortunately, the pressure of other work has so far prevented the preparation of this summary, but I venture to mention the matter in this way, with a promise of its submission as soon as possible, in view of certain statements of Mr. Muntz.

In his letter, Mr. Muntz says that he may "have been misled by improper information." As the Supreme Court judgment did not go into technical details, it is rather the lack of information that has led Mr. Muntz to say "That His Majesty or any owner should retain or employ engineers, and then by outrageously one-sided contractual obligations attempt to safeguard the owners from all possible errors, omissions or misjudgments of the engineers, appears to me grossly unjust to the contractor, apart from being a very terrible reflection on the integrity and capabilities of the engineers."

Although probably not so intended, this statement as published appears to relate to the Paradis and Farley case, and so to the Department of Public Works of Canada. As the facts of the case were exactly the reverse of Mr. Muntz's suggestion, I would ask you to publish this letter, as a correction to possible misunderstandings, pending the publication of full details of the case in question.

Yours truly,

(Signed) ROBERT F. LEGGET, M.E.I.C.

1538 Sherbrooke Street W.,  
Montreal, Que.  
November 28, 1942.

The Editor,  
*The Engineering Journal*,  
Montreal, Que.

Dear Sir:

I have received from Mr. R. F. Legget a copy of his letter dated November 26, addressed to you.

Reading my letter in the November issue of the *Journal*, in the light of Mr. Legget's letter, it appears that I must emphasize the bases of my argument, though I am convinced they are self-evident. They are the full written judg-

ment, as well as the summary appearing in the September issue of the *Journal*, and the first two sentences of the second paragraph of my letter, "The learned judges say that the contractor was obligated to drive piles in a specified location, not in a specified material. Suppose the test borings, which were probably not closer than 100 ft., by chance did not in any way represent the material, and it developed that piles could not be driven at all instead of at some additional cost."

My argument then developed from the hypothesis, it seems to me abundantly clear that I had reference to the iniquitous practice of giving information, and at the same time disclaiming responsibility for such information.

There is no reflection on any individual in my letter, except insofar as the individual may be party, tacitly or otherwise, to the custom too often practised by our various Departments of Public Works and others. This practice, I am firmly convinced is wrong, unjust to the profession and unfair to the contractor.

I appreciate Mr. Legget's letter, since it helps to give more emphasis to my argument. He, however, is guilty of misquoting, both directly and by inference. My letter stated clearly, that "I have been misled by improper information," not that I may have been misled. Mr. Legget joins this reference in his second paragraph with context with which it was not associated in my letter, and infers that this context was predicated upon *The King vs Paradis and Farley Incorporated*, whereas the context is general. "As I see it, the contractor buys every job for which he signs a contract" immediately precedes in my letter the second quotation given by Mr. Legget.

Technical details preceding the judgment have nothing to do with my contention that it is wrong to publish information on plans or in specifications which cannot be readily verified by a contractor, and then to disclaim responsibility for such information.

The information given in the case of the work reviewed in *The King vs Paradis and Farley Incorporated* may have been of the highest order, and responsibility may have been assumed for it.

The fact still remains that it is wrong to give such information unless responsibility is assumed for it.

Yours very truly,

(Signed) E. P. MUNTZ, M.E.I.C.,  
Past President, National Construction Council.

Here are some additional letters received at Headquarters thanking council for its action in remitting again this year the fees of members in combatant areas, as an appreciation of the privations and disturbances to normal living that they are enduring. Some of these letters contain invitations to members on active service overseas.

26 Irwin Road, Bedford.  
(rec'd Sept. 16th, 1942)

Dear Mr. Wright,

I greatly appreciated your kind letter of June 1st, and the decision of Council to continue the remission of fees of members of the Institute resident in England. I need hardly say that it was owing to severe indisposition that I did not acknowledge your letter at the time. It is cheering to feel that fellow members are animated by goodwill to us here. You may have read that the enemy claimed to have bombed us here in Bedford. Well, I must admit that my garden fence was damaged, but it is not beyond repair!

I have been receiving copies of the *Journal* regularly, and am interested to hear of progress of the Institute, and the doings of members.

With all good wishes and thanks,

Yours sincerely,

(Signed) C. O. THOMAS, M.E.I.C.

"Goyt Bungalow,"  
Church Hill, Helston,  
Cornwall, July 25th, 1942.

c/o Canada House,  
Trafalgar Square,  
London, S.W.1., July 19th, 1942.

Dear Mr. Wright,

I have to thank you for your letter of June 1st and wish to express my sincere appreciation of the Institute's generous consideration for those of us resident in this country. I feel that my inclusion amongst those accorded this generous treatment is somewhat like obtaining money under false pretences as I must consider myself a permanent resident in this country and therefore not strictly entitled to special consideration.

Although an Englishman by birth I was only a child when I went to Canada where I received all my education so that I have a sort of mental resentment as not being able to call myself a Canadian but I can, at least, appreciate the wonderful effort Canada has made much more than those to whom Canada is either but a name or a place where they have some relatives living there "somewhere." It is—or should I say "was"—a great pity that those of either side of the water knew so little about those on the other side and it is to be hoped that one of the good results of this war will be to bring to both Canadians and English a better appreciation of each others qualities.

Your kind offers of assistance are very greatly appreciated but it would please me far more to be of some help to some of our Members who are over here on War Service. Unfortunately, I am not now residing at my own home as I took over a wartime job here in Helston and have no spare accommodation. My wife and I do what we can in a small way to extend hospitality to the few Canadian personnel (mostly airmen) who happen to be on duty in this area and I would like to suggest that Members of the Institute proceeding overseas to England be given a list of the names and addresses of those of us ordinarily resident in this country; I am quite sure I speak for us all when I say we should be delighted to meet any colleagues who find themselves in our neighborhood and would welcome the opportunity of entertaining them to the best of our ability under existing conditions.

For the "duration" I am filling a post as Assistant Divisional Surveyor to the Cornwall County Council on highway maintenance. After the war I have great hopes of being able to visit Canada and am considering moving my family over there for good.

You will be interested to hear I have received every copy of the *Journal* in due course and look forward to its arrival.

Please accept my very sincere good wishes for the welfare of the Institute and its Members.

Very sincerely yours,  
(Signed) BERNARD H. HUGHES, M.E.I.C.

Kitwe, N. Rhodesia,  
August 15th, 1942.

The General Secretary,  
The Engineering Institute of Canada,  
Montreal, Que.

Dear Mr. Wright,

It is indeed gratifying to learn of your decision to continue remitting the annual fees of members resident in the combatant areas, although we at Kitwe are not nearly so affected by hostilities as are members at home, except, of course, that we are very intimately concerned with the fabrication of the wherewithal to oust the Hun.

"Thanks to the Navy," *The Engineering Journal* continues to reach me regularly and affords me much enjoyment. It keeps me in touch with activities at home.

Your good wishes and kind thoughts are appreciated and reciprocated and I shall certainly avail myself of your very kind offer of assistance should the occasion arise.

With best regards,  
Yours sincerely,  
(Signed) A. M. MORTON, M.E.I.C.

Dear Mr. Wright,

This is to acknowledge with much thanks your letter dated June 1st on behalf of the Institute. I am sure that the provision made to us over here is universally and heartily appreciated though a good many of us would no doubt be glad to get back.

More than once you have asked me for illuminating letters on what I am doing, but of late, particularly, a rather strict censorship prohibits that, and all I can do is more or less generalize.

For the past year, I have been on operational duty in Iceland, and only just left quite recently. The job on land not being too all-absorbing, a few of us managed to see something more of it than others, and one, being an experienced geologist was able to show us a good many interesting features. The basic structure of the whole island is volcanic, and we can see that everything in the way of life and habitation hinges around that fact and is limited as a result. Some of us were fortunate to get a glimpse of Greenland, too, though our American friends, being established there, could be much more informative as to that.

Having finished my first operational tour, I have been brought back to the Home Forces, and am in the process of becoming a staff pilot, instructing at an operational training unit. The Air Ministry calls it a "rest," but it will mean anything but an easy time, it is merely a rest from operational duty. However, it all means assimilating more knowledge, and even passing it on where it can be of use. Hope that at a not-too-distant date that I will be able to pass on some of it to be of use to some one or to some section of the Institute.

Again let me express my appreciation to you, and the Council, for your thought. I trust I can put that appreciation into more concrete form when I am able to take a more active part in the programme and doings of the Institute.

Until then, I remain,

Yours sincerely,  
E. B. A. LEMAITRE, S.E.I.C.

56 Cathedral Road,  
Cardiff, 1st July, 1942.

Dear Mr. Wright,

I thank you very much for your letter of June 1st, and assure you that we fellows in England who are members of the Institute greatly appreciate the support and goodwill of our Canadian colleagues.

I think that in remitting our annual subscription the Institute shows a most patriotic spirit, not only to its members but to the great Commonwealth to which we all belong.

*The Engineering Journal* has been arriving month by month and I enjoy it tremendously, not only from the technical aspect but often in its pages I run up against old friends, particularly when dealing with matters out in the West.

You will remember that I lost my home in one of the air-raids and therefore had to change my address. The *Journal* and correspondence are still going to the old address—would you therefore, please note that I now live in 67 Ninian Road, Roath Park, Cardiff; and for the purpose of your records I am now engaged in the Civil Service as Deputy Area Officer (Wales) of the Machine Tool Control.

With regard to the end of your letter, I myself am looking forward to the day when I shall be able to meet some of my old colleagues in Canada and some of the numerous friends I have who live south of the border.

Yours sincerely,  
(Signed) C. H. OAKES, M.E.I.C.

Dear Mr. Wright,  
14 Cotham Lawn Road,  
Bristol, England, 1st July, 1942.

Many thanks for your letter of 1st ult. I appreciate very much the Institute's kindly gesture in the matter of membership fees, but really things are not quite so bad in the Old Country as one might imagine, and we are carrying on quite comfortably.

I am glad to say I am receiving the *Journal* regularly, and look forward to it very eagerly as practically the only link, at present, with Canada. I am still trying to get back into the service, with the R.E. or the R.C.E., with both of which I have served, but I am told I am too old. Although I am still physically fit and able-bodied and have had nearly 25 years military engineering experience, in addition to my civil work.

For your information my present engagement is resident engineer on construction of new reinforced concrete oil berths somewhere in England.

I should like to get in touch with any members who are now in England, if you can let me know where to find them. With regard to the last paragraph of your very welcome letter, you may be sure that I shall not hesitate to apply to you for any information or advice I may need in the future.

I am,

Sincerely yours,

(Signed) A. G. ASHFORD, M.E.I.C.

Southern Railway,  
Chief Electrical Engineer's Office,  
Deepdene Hotel, Dorking, Surrey,

Dear Mr. Secretary,  
2nd July, 1942.

I am in receipt of your letter of the 1st instant and wish to assure you that the gesture of the Council in remitting the annual fees of members resident in the United Kingdom is very much appreciated indeed.

When your first notification to this effect reached me a year ago, I was so impressed by the gesture that I showed your letter to a number of engineering colleagues who were equally impressed.

*The Engineering Journal* arrives regularly and I find that it contains much of interest.

With best wishes to the Institute and to you, personally,

Yours truly,

(Signed) H. C. BECK, M.E.I.C.

11 Glencairn Dr.,  
Glasgow, S.1. (rec'd July 27th, 1942.)

Dear Mr. Wright,

I have to thank you for your very kind letter of the 1st June in which you give notice that the Council have graciously resolved to continue the practice of remitting the annual fees of members residing in the United Kingdom.

I can assure you that this gesture of goodwill and your kind reference to the difficult conditions under which we are living is greatly appreciated.

*The Engineering Journal* which reaches me regularly is, I find, most interesting as it keeps me in touch with the current engineering undertakings and its has brought home to me the heartening evidence that the Engineers of Britain who are putting forth their maximum effort to win the war are being whole-heartedly supported by the enormous contribution to the war effort by the engineers of Canada.

When the wastage of war and the din of battle is past and we can again settle down to more noble undertakings, I am sure, if we maintain the same spirit of co-operation and understanding, the engineers of the Empire will be able to take their places in the rebuilding of a better and happier world.

Most kind regards.

Yours sincerely,

(Signed) JOHN SHANNON, M.E.I.C.

e/o Royal Bank of Canada,  
6 Lothbury, London, E.C.

May 7th, 1942.

The General Secretary,  
The Engineering Institute of Canada,  
Montreal, Que.

Dear Sir,

Your letter to my husband came a few days ago and, as I am looking after things generally for him while he is abroad, I opened it. I am sending on your letter to him, but as it will take so many months to reach him, I felt I should acknowledge it. I am sure that my husband, as all other members of the Institute here, will greatly appreciate your most generous action.

Last year he was recalled to the R.E. and is now in India with railway troops. In case you are interested his address is:

Major C. B. R. Macdonald, R.E. (M.E.I.C.),  
No. 2 Trans Training Centre,  
Jullunder Cantonment,  
Punjab, India.

Yours sincerely,

(Signed) MRS. C. B. R. MACDONALD.

I.C.I. (Alkali) Limited,  
Middlewich, Cheshire,  
England, July 7th, 1942.

Dear Mr. Wright,

Thank you very much for your cordial letter dated June 1st, in which you notify me of the remission of fees to the Institute for the duration of the war.

I was greatly interested to read the inspiring address given by General McNaughton at the annual meeting.

I heartily reciprocate your good wishes, and remain,

Yours sincerely,

(Signed) G. H. BRUNNER, M.E.I.C.

#### MEETING OF COUNCIL

A meeting of the Council of the Institute was held at Headquarters on Saturday, November 21st, 1942, at ten thirty a.m.

*Present:* President C. R. Young in the chair; Vice-Presidents de Gaspé Beaubien and K. M. Cameron; Councillors J. E. Armstrong, E. D. Gray-Donald, J. G. Hall, R. E. Heartz, W. G. Hunt, C. K. McLeod and G. M. Pitts; Treasurer E. G. M. Cape; Secretary Emeritus R. J. Durley, General Secretary L. Austin Wright and Assistant General Secretary Louis Trudel.

Mr. Hall and Mr. Gray-Donald were appointed scrutineers to canvass the ballots for the award of the Julian C. Smith Medals. They presented their report and accordingly, Julian C. Smith Medals for the year 1942 will be awarded to—

H. G. ACRES, M.E.I.C.,  
Consulting Engineer,  
Niagara Falls, Ont.

R. M. SMITH, M.E.I.C.,  
Deputy Minister,  
Department of Highways, Ontario,  
Toronto, Ont.

Mr. Wright reported that he had investigated the possibilities of getting dies made for the new medals. He had found out that it might be possible to get the dies cut providing there was no great hurry about it. It was proposed that the actual designs might be proceeded with but that the matter be given more consideration before it was decided to go ahead with the making of the dies. It was also agreed that further consideration of the entire matter be left in the hands of Mr. Durley and the general secretary, and that they report at a subsequent meeting of Council.

To comply with the by-laws, it was unanimously resolved that the Annual General Meeting be convened at Headquarters on Friday, January 15th, 1943, at eight o'clock p.m., the meeting to be adjourned and re-convened at the Royal York Hotel, Toronto, Ontario, at ten o'clock a.m., on Thursday, February 11th, 1943. It was noted that the president would preside at this meeting and would afterwards be the principal speaker at the meeting of the Montreal Branch.

President Young reported briefly on the progress being made by the Annual Meeting Committee. Past-President Gaby had accepted the chairmanship of the Finance Committee, replacing Mr. Ross Robertson who had passed away recently. For one of the technical sessions an effort was being made to secure one of the United States Army Officers who had been associated with the work on the Alaska Highway.

The general secretary read a report from the Committee on Post-War Problems, transmitting the various suggestions and recommendations received from the Institute branches on the form entitled "Considerations for Evaluating Projects," which had been prepared by Mr. K. M. Cameron's sub-committee on Construction of Dr. James' committee on Re-Construction.

From the report it appeared that the majority of the branches, after considering the matter, had found the proposed form generally acceptable, although several branches had made certain suggestions and recommendations. The committee had not made any pronouncement as to whether or not, in its opinion, such changes were desirable.

After discussion, on the motion of Mr. Pitts, seconded by Mr. Hartz, it was unanimously resolved that the report be accepted and that Council transmit to Mr. Cameron's sub-committee the assurance that The Engineering Institute of Canada generally approves of the document, but submits certain suggestions and recommendations for consideration.

A further report was presented from Mr. Miller, advising that his committee, in accordance with the authority given at the last meeting of Council, had written to all Institute branches, suggesting that they encourage their members to interest themselves in the work of the local committees set up under the auspices of the Department of Pensions and National Health to study problems concerned with the rehabilitation of returning soldiers. The report was noted and the secretary was directed to thank Mr. Miller and his committee for their interest in this activity.

In presenting two progress reports, Mr. Armstrong, Chairman of the Committee on the Engineering Features of Civil Defence, asked if Council had any suggestions to offer as to the dates on which these monthly progress reports should be presented. There had been some difficulty in selecting a date which fitted in with the date of the Council meeting, and the dead line for publication in the *Journal*. President Young assured Mr. Armstrong that the reports would be very acceptable at any time convenient to the committee.

Mr. Armstrong then presented two reports, dated October 24th and November 19th respectively, commenting upon the more important items in each.

It was noted that the memorandum on the Engineering Features of Civil Defence in Canada, accompanied by an organization chart prepared by a joint committee representing the Royal Architectural Institute of Canada, the Canadian Construction Association and the Engineering Institute of Canada, had been signed by the Presidents of the three organizations and transmitted to the Prime Minister under date of November 3rd. Acknowledgment had been received from the Prime Minister's private secretary, stating that the submission would receive early consideration by the War Committee of the Cabinet.

As this was a very lengthy document, it was decided that it should not be read to the meeting. Mr. Armstrong pointed

out that if any member of Council was particularly interested, a copy was available, although at the present stage, it was not available for publication. He expected that at a later date it would be possible to send a copy to the branches and to all members of Council.

It was noted that the financial statement to October 31st, 1942, had been examined and found satisfactory. Six thousand dollars had been invested in the Third Victory Loan Bonds.

It was noted that a suggestion from the Joint Finance Committee in Alberta that the Institute make a total rebate of \$20.00 for the year 1942 to the Lethbridge Branch in order to bring their total rebates from the Institute and the Association up to the minimum of \$100.00, had been approved by the Institute's Finance Committee.

A letter had been received from P O E. S. Braddell, M.E.I.C., suggesting that further consideration be given to remitting the fees of members in the active forces while serving in Canada. On the recommendation of the Finance Committee it was decided that no change should be made in Council's present policy of remitting the fees of members only when service requires them to leave Canada for overseas.

The general secretary read a telegram from the Toronto Branch executive urging that the \$1.00 charge for *The Engineering Journal* to members overseas be cancelled and that copies of the *Journal* be sent free to all such members.

In Colonel Cape's opinion very few of the members serving overseas would have the time or convenience to read the *Journal*, and those who had the time would be quite willing to pay the small charge of \$1.00. Following some discussion, it was decided that no change should be made in Council's present policy in this respect.

The general secretary read a letter from Dr. Challies, chairman of the Institute's committee on Professional Interests, submitting a proposed "Memorandum of Amendment to Agreement" between the Institute and the Saskatchewan Association, and recommending that this Memorandum be approved.

These proposed amendments have already been approved in principle by Council, and on the motion of Mr. Beaubien, seconded by Mr. Pitts, it was unanimously resolved that the proposed Memorandum of Amendment to Agreement be approved, and that the President and General Secretary be authorized to sign the document on behalf of the Institute.

Mr. Wright presented a letter from Mr. A. B. Parsons, Secretary of the Engineers' Council for Professional Development, with which he enclosed a copy of a proposed "Canons of Ethics for Engineers." This had been prepared by the Committee on Principles of Engineering Ethics under the chairmanship of Dr. Dugald C. Jackson, and was being referred to the constituent bodies of E.C.P.D. with a request for comments and suggestions.

Mr. Wright read a letter from Dr. Challies, one of the Institute's representatives on the committee of E.C.P.D., giving his views on the proposed "Canons of Ethics for Engineers," and suggesting that Council might take one or other of the following courses:

- (a) Reference to a special committee of Council and others to be named by the President.
- (b) Reference to the Branch Executive Committees.
- (c) Consultation with those provincial associations with which the Institute has agreements.
- (d) Discussion at the next Annual General Meeting.

A letter was also presented from Dr. Surveyer, another of the Institute's representatives on the executive committee of E.C.P.D., suggesting that the Institute should approve in principle the Canons as drafted by Dr. Dugald C. Jackson, and his committee, on which the Institute was represented by President C. R. Young.

Discussion followed as to the best way of securing the opinion of the Institute membership on the proposed Canons of Ethics. In President Young's opinion, it would be very desirable to have a statement of ethics subscribed

to by all the constituent bodies of E.C.P.D., but he realized the difficulty of obtaining an absolutely unanimous opinion on the matter. The present draft was the fourth or fifth which had been prepared, and it had been carefully reviewed and rewritten before presentation at the annual meeting. The main criticism now was that it was too long.

One member of the committee had thought that a code of ethics should consist of about ten short items, but the majority opinion was that as a code would be of more direct importance to the younger engineers, it should embody a certain amount of instruction and guidance which could not be incorporated in a shorter code. Another suggestion had been that an abstract of the thirty-one canons of ethics might be prepared for the use of anyone desiring a shorter code.

Following further discussion, on the motion of Mr. Hertz, seconded by Mr. Gray-Donald, it was unanimously resolved that a copy of the proposed "Canons of Ethics for Engineers" be sent to all members of Council with a request for written comments, so that the matter might be further discussed at the January meeting of Council.

A letter was presented from E.C.P.D. asking the Institute to nominate a representative to a new committee on Unionism as Related to Engineers and Technologists. It was suggested that the Committee on Industrial Relations might make a recommendation and, after some discussion, it was decided to leave it to the president and the general secretary to make the nomination after consultation with the chairman of the Committee on Industrial Relations.

The general secretary read a letter from Dr. Challies, commenting on a communication which he had received from Mr. J. F. Fairman, the American Institute of Electrical Engineers representative on the E.C.P.D. executive committee, with reference to the policy of the A.I.E.E. towards student branches in those institutions in the United States whose curriculum in electrical engineering has not been accredited by E.C.P.D.

In the papers accompanying Mr. Fairman's communication it was pointed out that the Board of Direction of the American Society of Civil Engineers has recently decided that eleven student chapters at institutions in the United States where the civil engineering curriculum has not been accredited by E.C.P.D., will have their charters withdrawn on January 1st, 1944, unless in the meantime the civil engineering curriculum is duly accredited. Dr. Challies doubted whether the communication had any special significance to the Institute except perhaps to raise the question of the inadvisability of any of the founder societies establishing student chapters at any of the engineering schools in Canada.

President Young pointed out that the question of the founder societies establishing sections or branches in Canada was constantly before the Institute. The general secretary had it in mind in all his conversations with the societies and he, himself, had been keeping in close touch with the situation. Following some discussion, it was decided that the general secretary should communicate with Mr. Fairman.

The general secretary read a letter from the president advising that the National Construction Council contemplates setting up regional committees in twenty of the more important cities in Canada. It was proposed that certain organizations, including The Engineering Institute of Canada, should be asked to appoint a representative in each of the cities named to serve on the regional committee. The Council would like to know beforehand if the Institute would be willing to appoint representatives if the proposal is proceeded with. These committees would deal with matters of concern to the National Construction Council and to the construction industry in general. On the motion of Colonel Cape, seconded by Mr. Pitts, it was unanimously agreed that the Institute would be prepared to name representatives to these regional committees should they be established.

A number of applications were considered and the following elections and transfers were effected:

ADMISSIONS	
Members.....	14
Junior.....	1
Students.....	30

TRANSFERS	
Junior to Member.....	8
Student to Member.....	12
Student to Junior.....	32
Student to Affiliate.....	1

It was decided that the next meeting of Council would be held in Montreal on Saturday, December 19th, 1942. Following a suggestion of Councillor E. D. Gray-Donald, it was unanimously agreed that Saturday morning meetings in Montreal would in future convene at ten o'clock a.m. instead of ten thirty.

The Council rose at one forty-five p.m.

## ELECTIONS AND TRANSFERS

At the meeting of Council held on November 21st, 1942, the following elections and transfers were effected:

### Members

- Jomini**, Harry, B.Sc. (C.E.), (Univ. of Man.), B.Sc. (Mining), (McGill Univ.), railroad supt., Demerara Bauxite Co. Ltd., Mackenzie, Demerara, British Guiana, S.A.
- Lauriault**, Wilfrid Eldege, B.A.Sc., C.E., CHEM. ENGR. (Ecole Polytechnique), consultg. engr. and Quebec land surveyer, Montreal, Que.
- Riddell**, John Morrison, Major, R.C.E., B.A.Sc., (Univ. of Toronto), O.C. 28th Field Coy., R.C.E. (A), Ottawa, Ont.
- Wideman**, Norman Edward, B.A.Sc. (Elec.), (Univ. of Toronto), district relay engr., H.E.P.C. of Ontario, Port Arthur, Ont.

### Juniors

- Carter**, Harry Akers, B.Sc. (Queen's Univ.), S.M. (Mass. Inst. Tech.), research assistant, Aero. Engrg. Dept., Massachusetts Institute of Technology, Cambridge, Mass.
- Cole**, Donald Lorne, B.A.Sc. (Elec.), (Univ. of Toronto), junior engr., Can. Gen. Elec. Co. Ltd., Peterborough, Ont.
- Transferred from the class of Junior to that of Member*
- Davis**, William Roe, Jr., B.Sc. (Elec.), (Univ. of Alta.), asst. elec. engr., Montreal Engineering Co. Ltd., Montreal, Que.
- Forbes**, Donald Alexander, B.Sc. (Civil), (Univ. of Sask.), asst. to chief engr., Price Bros. & Co. Ltd., Kenogami, Que.
- Ford**, John Norman, B.Sc. (Univ. of Alta.), constrn. and mtce. engr., Calgary Power Co. Ltd., Calgary, Alta.
- Fullerton**, Roland McNutt, B.Sc. (Elec.), (N.S. Tech. Coll.), shift engr., Aluminum Co. of Canada Ltd., Arvida, Que.
- Guenette**, Joseph Antoine Paul, B.A.Sc., C.E. (Ecole Polytechnique), head of planning dept., Regent Knitting Mills Co. Ltd., St. Jerome, Que.
- Neilson**, Charles Shibley, B.Sc. (Civil), (Queen's Univ.), squad boss, Canadian Bridge Co., Walkerville, Ont.
- Wellwood**, Frank Elvin, B.A.Sc., (Univ. of Toronto), engr., Dept. of Buildings, City of Toronto, Ont.

### *Transferred from the class of Student to that of Member*

- Boutillier**, Tremaine Thompson, B.Eng. (Elec.), (N.S. Tech. College), mfg. engr., Northern Electric Co. Ltd., Montreal, Que.
- Bowering**, Reginald, B.Sc., (Univ. of Man.), M.A.Sc., (Univ. of Toronto), public health engr. and chief sanitary inspr., Provincial Board of Health of British Columbia, Vancouver, B.C.
- Buteau**, Lucien, B.A.Sc., C.E., (Ecole Polytechnique), field engr., Bell Telephone Co. of Canada, Quebec, Que.
- Crepeau**, Marcel, B.A.Sc., C.E., (Ecole Polytechnique), mtce. of bridges, Dept. of Public Works, Quebec, Que.
- Cuthbertson**, Charles Cassells, B.Sc., (Chem. Eng.), B.Sc., (Chemistry), (Queen's Univ.), process supervisor, Canadian Industries, Ltd., Alkali Divn., Shawinigan Falls, Que.
- DeGuise**, Yvon, B.A.Sc., C.E., (Ecole Polytechnique), civil engr., hydraulic service, Dept. of Lands and Forests, Quebec, Que.
- Demie**, Thomas, B.A.Sc., M.A.Sc., (Univ. of Toronto), estimating and design dept., McGregor-McIntyre Divn., Dominion Bridge Co., Toronto.
- London**, Woodrow P., B.Sc., (Elec.), (Univ. of N.B.), designing dftsmn., H. G. Acres & Co., Niagara Falls, Ont.
- Love**, Edwin Reginald, Capt., B.Sc., (Elec.), (Univ. of Man.), second in command of School of Instruction, C.S.T.C., R.C. Signals, C.A., Kingston, Ont.

- Mahoux**, Raymond Jean, B.Eng. (Mech.), (McGill Univ.), chief planner, Delorimier Plant, Federal Aircraft Ltd., Montreal, Que.
- Saintonage**, Jean-Jacques Rosaire, B.C.Sc., C.E., (Ecole Polytechnique), asst. plant engr., Consolidated Paper Corp. Ltd., Port Alfred, Que.
- Stafford**, James Walter, B.Sc., (Elec.), (Univ. of Alta.), genl. electl. supt., plant Nos. 1 and 2, Aluminum Co. of Canada, Ltd., Shawinigan Falls, Que.
- Transferred from the class of Student to that of Junior*
- Aird**, Joseph Andre Philippe, F/O., B.A.Sc., C.E., (Ecole Polytechnique), officer i/c Depot Inspn. secn., No. 9 Repair Depot, R.C.A.F., St. Johns, Que.
- Archambault**, Georges Louis, B.Eng. (Mech.), (McGill Univ.), mtec. engr., Aluminum Co. of Canada, Arvida, Que.
- Asselin**, Hector, B.A.Sc., C.E., (Ecole Polytechnique), engr., Arthur Surveyer & Co., Montreal, Que.
- Boisclair**, Robert, B.A.Sc., C.E., (Ecole Polytechnique), engr., Aluminum Co. of Canada, Passe Dangereuse, Que.
- Deslauriers**, Charles-Edouard, B.A.Sc., C.E., (Ecole Polytechnique), hydraulic service, Dept. of Lands and Forests, Quebec, Que.
- Duckett**, William Anderson, B.Eng. (Elec.), (McGill Univ.), asst. engr., Bell Telephone Co. of Canada, Montreal, Que.
- Flahault**, John E., B.A.Sc., C.E., (Ecole Polytechnique), B.Sc., (Met.), (Carnegie Inst. of Tech., Pittsburgh), supervisor in potrooms, Aluminum Co. of Canada, Ltd., Arvida, Que.
- Frigon**, Raymond A., B.A.Sc., C.E., (Ecole Polytechnique), M.Sc. (Mass. Inst. of Tech.), asst. Materials Testing and Research Lab., Ecole Polytechnique, Montreal.
- Goddard**, Albert Reginald, B.Sc., (Civil), (Univ. of Man.), jr. asst. engr., Dept. of National Defence, R.C.A.F., Winnipeg, Man.
- Gohier**, Roch Edouard, B.Eng., (Met.), (McGill Univ.), metallurgist, Sorel Industries, Ltd., Sorel, Que.
- Hopkins**, Albert Parker Eugene, B.A.Sc., (Univ. of Toronto), asst. mining engr. and surveyor, Hallnor Mines Ltd., Pamour, Ont.
- Hopkins**, Alfred, B.Eng., (Elec.), (N.S. Tech. Coll.), engr. service dept., Canadian Westinghouse Co. Ltd., Hamilton, Ont.
- Huggard**, John Harold, B.Sc., (Elec.), (Univ. of N.B.), engr. at Shipshaw Power Development for H. G. Acres & Co., Kenogami, Que.
- Kennedy**, Dorwin Elmore, B.A.Sc., (Univ. of Toronto), junior engr., Hydraulic Dept., Hydro Electric Power Commn., Toronto, Ont.
- Kennedy**, Harold Edward, B.Sc., (Mech.), (Queen's Univ.), structl. designer and dftsmn., Hydro Electric Power Commn., Toronto, Ont.
- Kent**, A. Douglas, B.Sc., (Queen's Univ.), foundry supt., Aluminum Co. of Canada, Arvida, Que.
- Kerfoot**, John Grenville, B.Sc., (Queen's Univ.), tool engr., Defence Industries, Ltd., Verdun, Que.
- Lefort**, Jean, B.Eng., (McGill Univ.), junior engr., Stevenson & Kellogg Ltd., Montreal, Que.
- Leroux**, George Gustave, F/Lt., B.Eng., (McGill Univ.), asst. chief instructor, No. 8 Air Observer School, Ancienne Lorette, Que.
- Levine**, Samuel Dave, B.A.Sc., (Chem.), (Univ. of Toronto), examiner, Inspection Board of the United Kingdom and Canada, Newark, N.J.
- Menard**, Raymond, B.A.Sc., C.E., (Ecole Polytechnique), res. engr., Roads Dept., Province of Quebec, Montreal, Que.
- Mullins**, Harrison Alexander, B.Sc., (Elec.), (Univ. of Man.), asst. project engr., Defence Industries Ltd., Montreal, Que.
- McMath**, John Proctor Clark, B.Sc., (Elec.), (Univ. of Alta.), design engr., wires and cables, Northern Electric Co., Montreal, Que.
- Nadeau**, Yvon, B.A.Sc., C.E., (Ecole Polytechnique), instrumentman and asst. engr. at Aluminum Plant, LaTuque, Que., for Frascr Brace Ltd.
- Ostigny**, Joseph Ephrem Maurice, B.A.Sc., C.E., (Ecole Polytechnique) asst. divnl. engr., Roads Dept., Province of Quebec, Waterloo, Que.
- Rioux**, Joseph Henri Rene, B.A.Sc., C.E., (Ecole Polytechnique), asst. divnl. engr., Dept. of Roads, Province of Quebec, Que.
- Rowan**, Russell Gillespie, B.Sc., (Queen's Univ.), engrg. asst., Bell Telephone Co. of Canada, Montreal. Now posted as Pilot Officer in the Special Reserve, Navigation Branch, R.C.A.F.
- Shearer**, John Alexander, B.Sc., (Civil), (Univ. of N.B.), transitman, Canadian Pacific Rly., Sudbury, Ont.
- Sinclair**, George, B.Sc., M.Sc., (Univ. of Alta.), research asst., Ohio State Research Foundation, Columbus, Ohio.
- Torrington**, Frank Delbridge, F/O., B.Sc., (Mech.), (Univ. of Sask.), res. technical officer, R.C.A.F., Longueuil, Que.
- Wallis**, William Herbert Cyril, P/O, B.Sc., (Civil), (Univ. of N.B.), flying instructor on service aircraft, R.C.A.F., Montreal, Que.
- Woods**, George Maitland, B.Sc., (Mech.), (Univ. of Sask.), senior foreman, Defence Industries Ltd., Verdun, Que.
- Archibald**, Huestis Everett, (Univ. of Toronto), 11 Poplar Plains Crescent, Toronto, Ontario.
- Berbrayer**, Abram M., (Univ. of Manitoba), 114 Granville St., Winnipeg, Man.
- Bernstein**, Saul, (McGill Univ.), 369 Laurier Ave. West, Montreal.
- Bolton**, Gerald Henry, (Univ. of Manitoba), 1206 Wolseley Ave., Winnipeg, Man.
- Brasloff**, Reuben Isaac, (McGill Univ.), 5617 Jeanne Mance St., Montreal, Que.
- Carignan**, Louis-Georges, (Ecole Polytechnique), 353 St. Joseph St., Lachine, Que.
- Cloutier**, Jean Paul, tool supervisor, Sorel Industries Ltd., Sorel, Que.
- Decarie**, Maurice, (McGill Univ.), 3533 Oxford Ave., Montreal, Que.
- Dutton**, Vernon LeRoy, (Univ. of Man.), 37 Kennedy St., Winnipeg.
- Fitzgerald**, Joseph John Gerry, (McGill Univ.), 1963 Kent Ave., Montreal, Que.
- Freeman**, John Edward, (McGill Univ.), Douglas Hall, McGill University, Montreal, Que.
- Gagnon**, Paul, (McGill Univ.), 386 Wiseman Ave., Montreal, Que.
- Gauthier**, Edouard Antoine, (McGill Univ.), 645 Querbes Ave., Outremont, Que.
- Glen**, Andre, (Ecole Polytechnique), 7860 St. Denis St., Montreal, Que.
- Gordon**, Lynn Marshal, (Univ. of Toronto), 203 St. Paul St. West, Kamloops, B.C.
- Gronlines**, J. Leon, (Ecole Polytechnique), 1431 Joliette St., Montreal, Que.
- Hink**, Anthony Albert, (Univ. of Man.), 426 Stradbroke Ave., Winnipeg, Man.
- Howe**, Lloyd G., (McGill Univ.), 3580 Durocher St., Montreal, Que.
- Killam**, Robert Bradbury, (McGill Univ.), Douglas Hall, McGill University, Montreal, Que.
- Klein**, Max, (McGill Univ.), 362 Fairmount Ave. West, Montreal.
- Lackman**, Gerald Leonard, (McGill Univ.), 639 de l'Epee Ave., Outremont, Que.
- MacLean**, Donald Gordon, (Univ. of Toronto), 40 Spring St., Guelph, Ont.
- Matthews**, C. Robert, (McGill Univ.), 3580 Durocher St., Montreal.
- Oldreive**, Donald Drake, (Univ. of Toronto), 321 Bloor St. West, Toronto, Ont.
- Polley**, Edward Victor, B.A.Sc., (Civil), (Univ. of Toronto), Lieutenant, R.C.E. (Section officer), Officers' Mess, C.E.T.C. (AS), Petawawa, Ont.
- Ray**, Louis William, (Univ. of Toronto), 273 Danforth Ave., Toronto.
- Roy**, Henry George, (Ecole Polytechnique), 4669 Pontiac St., Montreal, Que.
- St. Pierre**, Robert, (Ecole Polytechnique), 6665 De Normanville St., Montreal, Que.
- Wallace**, W. Robert J., foreman electrician, Canada Strip Mill, Montreal, Que.
- Yespelkis**, Charles Robert, (Ecole Polytechnique), 2055 Montgomery St., Montreal, Que.

By virtue of the co-operative agreement between the Institute and the Association of Professional Engineers of Nova Scotia, the following elections and transfers have become effective:

#### Members

- Buckley**, Frederick William, (N.S. Tech. Coll.), asst. engr., N.S. Power Commission, Halifax, N.S.
- Harrington**, Arthur Russell, B.Eng., (Elec.), (N.S. Tech. Coll.), engr., N.S. Light & Power Co. Ltd., Halifax, N.S.
- Hunt**, William Murray, B.Sc., (Elec.), (N.S. Tech. Coll.), gen. traffic supervisor, Maritime Telephone and Telegraph Company, Halifax, N.S.
- Nunn**, Thomas Andrew, field engr., N.S. Light & Power Co. Ltd., Halifax, N.S.
- Parsons**, Alfred Medley, Lieut., M.C., overseers' office, Naval Service, H.M.C. Dockyard, Halifax, N.S.
- Pippy**, George Alexander, B.Sc., (N.S. Tech. Coll.), supervisor, fuel oil and burner dept., Imperial Oil Limited, Halifax, N.S.
- Roger**, William Hugh Gregory, Lieut. Commander (S.B.), R.C.N.V.R. mgr. of elec. engrg., H.M.C. Dockyard, Halifax, N.S.
- Rosier**, Claude Harry, B.Eng., (Mech.), (N.S. Tech. Coll.), Sub. Lieut., R.C.N.V.R., asst. inspr. of naval ordnance, H.M.C. Dockyards, Halifax, N.S.
- Smith**, James Joseph, Lieut., R.C.N.V.R., i/c naval elec. repair section, H.M.C. Dockyard, Halifax, N.S.
- Wells**, Alexander Victor, Lieut.-Commander, R.C.N.V.R., Engineer Officer in Charge, H.M.C. Dockyard, Sydney, N.S.

*Transferred from the class of Junior to that of Member*

- Dobson**, Richard Nesbitt, B.Eng., (Mech.), (N.S. Tech. Coll.), asst. works mgr., i/c production and engrg., Canadian Car & Foundry Co. Ltd., Amherst, N.S.

# Personals

## News of the Personal Activities of members of the Institute, and visitors to Headquarters

**H. Forbes-Roberts**, M.E.I.C., has recently been appointed manager of the Newfoundland Light and Power Company Limited. He was previously with the Calgary Power Company, at Calgary, Alta. Coming to Canada from England in 1913, he was engaged as construction engineer with Northwestern Electric Company Limited, at Regina, Sask. In 1919 he became manager and proprietor of Akola Light and Power Company, at Arcola, Sask. In 1927 he joined the staff of the Montreal Engineering Company Limited, at Regina, Sask.

**Noel N. Wright**, M.E.I.C., has joined the R.C.N.V.R. as a lieutenant and has taken up his new duties at Ottawa. Since his graduation from the University of Illinois in 1928, he has been with Ferranti Electric Limited and has been attached to the eastern district as sales and service engineer, at Montreal.

**Gordon D. Hulme**, M.E.I.C., has been promoted to assistant manager of the department of development of The Shawinigan Water and Power Company, Montreal.

Graduating with honours from McGill University with a degree of Bachelor of Science in electrical engineering, Mr. Hulme joined the Shawinigan Company in 1931. After being located successively at Valleyfield, Trois-Rivières, Victoriaville, Quebec, Montreal and Shawinigan Falls, he returned to Montreal and was attached to the transmission line and communication department, where he became assistant to the superintendent. In 1937 he joined the department of development, where he now becomes assistant manager.

Mr. Hulme is on the executive of the Montreal Branch



Noel N. Wright, M.E.I.C.



Flying Officer M. S. Layton, Jr.E.I.C.



Gordon D. Hulme, M.E.I.C.

**Flying Officer M. S. Layton, Jr.E.I.C.**, is reported as having acted as navigator on the bomber which took Prime Minister Churchill to Moscow a few months ago. Before his enlistment in October, 1940, he was assistant chemical engineer with the Steel Company of Canada at Montreal.

Mr. Layton was awarded the Duggan Medal and Prize of the Institute in 1940, for his paper "Coated Electrodes for Electric Arc Welding," which was published in the July 1940, issue of the *Journal*.

**Leon A. Duchastel**, M.E.I.C., has been appointed manager of the Power Sales Division, Commercial and Distribution Department of the Shawinigan Water & Power Co., Ltd. Mr. Duchastel is the secretary of the Montreal Branch of the Institute.

**T. R. Durley**, M.E.I.C., has been granted leave of absence by the Manufacturers Mutual Fire Insurance Company and has been appointed superintendent of shell filling, at the plant of Stormont Chemicals Limited, Cornwall, Ont.

**George W. Howse**, M.E.I.C., district inspector of the Hydro Electric Power Commission of Ontario, at Hamilton, has been elected first vice-president of the International Association of Electrical Inspectors at their convention, in Detroit, Mich., held on October 5th, 6th and 7th, 1942.

of the Institute and is a councillor of the Montreal Junior Board of Trade.

**Flying Officer W. E. Seely**, M.E.I.C., who for the past year had been stationed at No. 8 Service Flying Training School, at Moncton, N.B., has recently been transferred to Montreal.

**S. N. Tremblay**, M.E.I.C., has obtained leave of absence from the Quebec Streams Commission, Montreal, to join the Veterans' Guard of Canada as a lieutenant and is at present posted at Toronto, Ont. Lieutenant Tremblay served overseas in the last war and was a major when he was demobilized. Before joining the staff of the Quebec Streams Commission in 1930 he had been employed since 1926 as a field engineer with the Gatineau Power Company, Ottawa, Ont.

**N. A. Bradley**, M.E.I.C., who was on the staff of the Department of Public Works of Alberta, at Edmonton, has joined the Doncaster Construction Company of Edmonton.

**J. B. Snape**, M.E.I.C., has transferred his services from the Department of Mines and Resources at Jasper, Alta., to the Works and Buildings Branch of the Naval Service, at Esquimalt, B.C., where he is employed as a reconnaissance engineer.

**A. D. Turnbull**, M.E.I.C., assistant chief engineer for Dominion Sound Equipments Limited, Montreal, is on loan to the National Research Council at Ottawa, where he performs certain technical administrative duties, under the direction of the Deputy Director of Scientific Research in connection with the work that the Council is doing for the Royal Canadian Navy.

Mr. Turnbull graduated in mechanical engineering from Nova Scotia Technical College in 1928 and spent a year with the Dominion Steel Company Limited, at Sydney, N.S. He joined the staff of Northern Electric Company Limited as a service engineer in 1929. In 1935 he was appointed assistant chief engineer of Dominion Sound Equipments Limited. Mr. Turnbull was, since 1933, on the staff of the evening faculty of science of Sir George Williams College, Montreal, lecturing in radio-physics and electricity.

**Maurice Bélanger**, Jr.E.I.C., formerly concrete designer with Baulne and Leonard, civil engineers, Montreal, has joined the staff of Sorel Industries Limited, at Sorel, Que. He graduated from the Ecole Polytechnique, of Montreal, in 1939.

**G. A. Campbell**, Jr.E.I.C., is employed with E. G. M. Cape and Company at Dartmouth, N.S. He returned a few months ago from Trinidad, B.W.I., where he had been employed for the last few years with United British Oilfields.

**J. A. Caverly**, Jr.E.I.C., has returned to his former position as assistant geologist with the Britannia Mining and Smelting Company Limited, at Britannia Beach, B.C. For the past year he had been employed as an exploration engineer in northern Manitoba with the Howe Sound Company of New York. He graduated from the University of Saskatchewan in 1941.

**Major Alexandre Dugas**, Jr.E.I.C., is now back overseas after having spent this last year in Canada where he was stationed for some months as an instructor at the Officer's Training Centre at Brockville, Ont., and later at the Staff College at Kingston, Ont. Major Dugas enlisted at the outbreak of war and first went overseas with the Régiment de Maisonneuve in 1940.

**J. W. Kerr**, Jr.E.I.C., has joined the Royal Canadian Air Force as an aeronautical engineering officer. Since his graduation from the University of Toronto in 1937 he has been on the staff of Canadian Westinghouse Company Limited, at Hamilton, Ont.

**James R. Rettie**, Jr.E.I.C., is on loan from the Manitoba Department of Mines and Resources, The Pas, Man., to Fraser-Brace Company Limited, at La Tuque, Que.

**R. B. Warren**, Jr.E.I.C., has joined the staff of the Aluminum Company of Canada Limited at Montreal, Que. He was previously employed with the Prairie Farm Rehabilitation Administration, at Regina, Sask.

**Sub-Lieutenant (E) C. S. Baburek**, S.E.I.C., R.C.N.V.R., is at present on loan to the Royal Navy. He graduated in mechanical engineering from McGill University in 1941.

**E. H. Bartlett**, S.E.I.C., has been transferred from Seebe, Alta., to the head-office of the Calgary Power Company, at Calgary, Alta., and he is now employed in the transmission and distribution lines department.

**A. M. Forster**, S.E.I.C., has recently left his position with the Aluminum Company of Canada Limited, Montreal, to join the R.C.N.V.R. as a Sub-Lieutenant.

**James J. Hurley**, S.E.I.C., has returned to the University of Toronto to resume his course after having worked last summer at Gander, Nfld.

**Maurice Laquerre**, S.E.I.C., has joined the staff of the Aluminum Company of Canada Limited at Arvida, Que.

He graduated from the Ecole Polytechnique, Montreal, last spring.

**D. O. D. Ramsdale**, S.E.I.C., has left his position with the English Electric Company of Canada Limited, in Toronto, to join the R.C.N.V.R. as a Sub-Lieutenant.

**D. L. Rigsby**, S.E.I.C., has recently joined the staff of the Aluminum Company of Canada Limited, at Kingston, Ont.

**C. C. Simpson**, S.E.I.C., has been transferred from Edmonton, Alta., to the general sales department, power apparatus division, of the Northern Electric Company Limited, at Montreal. He joined the company upon graduation in electrical engineering from the University of Alberta, in 1937.

**T. C. York**, S.E.I.C., has joined the staff of Murray, Jones and Company, at Toronto, Ont., as a tool designer. He was employed previously by Noorduyn Aviation Limited, Montreal.

**Pilot Officer H. B. Young**, S.E.I.C., has left the employ of Demerara Bauxite Company, Mackenzie, British Guiana, to join the Royal Canadian Air Force and is now stationed at Winnipeg, Man. He graduated in civil engineering from the University of Manitoba in 1941.

**H. S. Olafson**, S.E.I.C., who graduated as a B.Sc. in electrical engineering from the University of Manitoba in 1941, is now a Lieutenant in the Royal Canadian Signal Corps and is at present stationed at Kingston, Ont.

**S. M. Schofield**, S.E.I.C., is a Lieutenant with the Royal Canadian Engineers and is at present training at Chilliwack, B.C. He graduated in civil engineering from the University of Manitoba in 1941.

#### VISITORS TO HEADQUARTERS

**René Dupuis**, M.E.I.C., director, Department of Electrical Engineering, Faculty of Applied Science, Laval University, Quebec, Que., on October 28th.

**Jacques Vinet**, M.E.I.C., cost engineer, The Foundation Company of Canada Limited, Shipshaw, Que., on November 5th.

**Edgar H. Davis**, Jr.E.I.C., St. John Dry Dock and Shipbuilding Company Limited, Saint John, N.B., on November 9th.

**Lieutenant-Colonel Theo. Miville Dechene**, M.E.I.C., bridge engineer, Department of Public Works, Quebec, Que., on November 11th.

**Georges Demers**, Jr.E.I.C., consulting engineer, Quebec, Que., on November 11th.

**Herbert E. Ziel**, Albert Kahn, Associated Architects and Engineers Incorporated, Detroit, Mich., on November 12th.

**G. E. Booker**, M.E.I.C., Wartime Housing Limited, Toronto, Ont., on November 25th.

**D. Hutchison**, M.E.I.C., Mgr., Mackenzie River Transport, Hudson Bay Co., Edmonton, Alta., on November 23rd.

**Lieutenant C. L. Stevenson**, M.E.I.C., Dept. of Munitions & Supply, Army Engineering Design Branch, R.C.O.C., Ottawa, Ont., November 27th.

**T. M. Moran**, M.E.I.C., Vice-President, Stevenson & Kellogg Ltd., Toronto, Ont., on December 10th.

**W. B. Redman**, M.E.I.C., assistant engineer, Canadian National Railways, Toronto, on December 10th.

**Paul E. Cadrin**, Jr.E.I.C., Sorel Industries Ltd., Sorel, Que., on December 11th.

# Obituaries

*The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.*

**Claus Marius Bang**, M.E.I.C., was among the missing passengers of the ill-fated S.S. "Caribou" which was sunk by the enemy on the Atlantic Coast on October 14th, 1942. He was born at Copenhagen, Denmark, on July 21st, 1882, and graduated in 1906, as a Bachelor of Science in mechanical engineering from the Polytechnical Academy of Copenhagen. After a few years spent on the teaching staff of the Academy he came to Canada in 1911, where he joined the staff of the Northern Electric Company, in Montreal. The following year he went with the Cedars Rapids Power and Manufacturing Company, as an electrical draftsman. During the last war he was engaged as a draftsman and tool designer with several of the munitions plants in Montreal. In 1918 he joined the staff of the Wayagamack Pulp and Paper Company, at Three Rivers, Que., as an electrical designer. In 1924 Mr. Bang went to Corner Brook, Newfoundland, as an electrical engineer on the staff of John Stadler, M.E.I.C., during the construction of the paper mill. Upon completion of construction in 1926, he left Corner Brook to take up an appointment as electrical engineer on the construction of a new paper mill at Dolbeau, Que.

In 1928 Mr. Bang married Miss Jean Fisher, daughter of Mr. Joseph Fisher, of Corner Brook; they made their first home at Dolbeau, Que., remaining there until 1930 when Mr. Bang accepted the appointment of electrical superintendent at the Canadian International Paper Company's mill in Three Rivers, Que.

In November 1936, he was transferred, by the same company, to Newfoundland as manager of Hydro-Electric Power Development with International Power and Paper Company of Newfoundland Limited and took up residence at Deer Lake in May 1937. He retained this office until the time of the disaster.

Mr. Bang joined the Institute as an Associate Member in 1922 and he became a Member in 1940.

**Earle Munro Dennis**, M.E.I.C., died in the hospital at Ottawa, Ont., on November 1st, 1942. He was born at Holbrook, Ont., on January 26th, 1883, and was educated at Queen's University, Kingston, Ont., where he graduated as a Bachelor of Science in 1904. He obtained his commission as Dominion Land Surveyor in 1908. Upon graduation he joined the Civil Service in the office of the Surveyor General at Ottawa. Between the years 1905 and 1907 he was engaged in survey work in Saskatchewan and Alberta.

In 1912 he was appointed assistant chief of a division in the Topographical Surveys Branch of the Department of the Interior. In 1924 he was made chief of administration in the Topographical and Air Survey Bureau of this department and held this position until 1937 when he became chief of administration of the Hydrographic and Map Service of the Department of Mines and Resources. In 1939 he became general executive assistant in the Lands, Parks and Forests Branch of the Department of Mines and Resources which position he held till the time of his death. In religion a Baptist, he attended Fourth Avenue Baptist Church where he was secretary and clerk of the roll. He is survived by his widow, three sons and one daughter.

Mr. Dennis joined the Institute as an Associate Member in 1921 and became a Member in 1940.

**D. A. Jackson**, M.E.I.C., died at Chatham, N.B., on June 3rd, 1942. He was born at Montreal, Que., on January 27th, 1888, and was educated at McGill University where he received the degree of Bachelor of Science in electrical engineering in 1910. From 1914 to 1916 he was engaged as an electrical engineer at the wireless plant at Newcastle, N.B., of the Universal Radio Syndicate Limited of London, England, and from 1916 to 1920 he was engineer in charge of the station. In 1920 he became town superintendent

and engineer at Chatham, N.B. At the time of his death he was employed in the Highway Division of the Department of Public Works of New Brunswick, at Chatham.

Mr. Jackson joined the Institute as a Member early this year.

**William Matheson Macphail**, M.E.I.C., died in Winnipeg, Man., on June 9th, 1942. He was a member of a notable and distinguished Prince Edward Island family which for several generations had a tradition of learning and scholarship. His father, the late William Macphail, was in the earlier years of his life superintendent of schools in Queen's County, P.E.I., and latterly supervisor of the Prince Edward Island Hospital for Mental Diseases. His mother, Catherine Smith, was well known in the community for her strength of character and high ideals.

Mr. Macphail was born at Orwell, Prince Edward Island, on March 18th, 1872. He was educated at Uigg Grammar School and Prince of Wales College, Charlottetown, where he obtained university matriculation. After teaching for a few years he proceeded to McGill University, Montreal, Que., and graduated as Bachelor of Applied Science in 1898. During university summer vacations he worked on import-



**William Matheson Macphail, M.E.I.C.**

ant engineering projects, combining classroom and laboratory instructions with practical experience.

Following graduation he engaged in turn in municipal, railroad and hydraulic engineering, being one of the pioneers in water power development at Niagara Falls. Later he was assistant city engineer of Toronto.

In 1906 he went to Winnipeg where he organized Bitulithic and Contracting Limited, in association with Warren Brothers, Boston, Mass., and for the next ten years had large paving contracts throughout the West. In 1917 he became manager of Warren Brothers operations in the Pacific Coast States and in Montana. In 1928 he went to Warsaw, representing Warren Brothers, and carried on operations in Poland and Hungary, also in Spain.

After returning to Canada in 1933, he associated himself with the Carter-Halls-Aldinger Company and for the past three years had supervision of airport contracts in the Prairie Provinces and in British Columbia.

In 1910 he married Ethel Penrose of Winnipeg. He is survived by her and two daughters, Marion, wife of Lieutenant Lawrence Delbridge, and Catherine, wife of Lieutenant Vincent Jackson, of Winnipeg. Other survivors include three sisters, Mrs. A. N. Jenkins, Vancouver, B.C., Miss Janetta Macphail, Saint John, N.B., and Mrs. S. M. Martin, Middleton, P.E.I., also two brothers, Colonel Alexander Macphail, C.M.G., M.E.I.C., Kingston, Ont., and J. G. Macphail, M.E.I.C., Ottawa, Ont.

Mr. Macphail joined the Institute as a Student in 1897, becoming an Associate Member in 1901. He was transferred to Member in 1916. He was also member of the American Society of Civil Engineers.

**A. Ross Robertson**, M.E.I.C., manager of the Ontario division of the Dominion Bridge Company Limited, at Toronto, Ont., died in the hospital on November 4th, 1942. He was born at Glencoe, Ont., on May 22nd, 1888. He was educated in Glencoe public and high schools and graduated from the University of Toronto School of Practical Science in 1909 as a Bachelor of Science. He began his engineering practice with his father at Glencoe, and shortly afterwards joined the City of Toronto roadways department. A few months later he entered the drawing offices of Canada Foundry Limited. In 1912 he joined the firm of McGregor and McIntyre Limited, then he became vice-president on the formation of McGregor-McIntyre Structural Steel Limited, in 1928. When the company was purchased by Dominion Bridge Limited, he became manager of the Ontario division.

At the outbreak of the first Great War, Mr. Robertson held the rank of captain with the 169th Battalion. In order to go overseas, he reverted to lieutenant and went overseas in 1916. He was then transferred to the Royal Canadian Engineers and promoted to captain. He was wounded, and demobilized in 1919.



**A. Ross Robertson, M.E.I.C.**

Mr. Robertson joined the Institute as an Associate Member in 1920 and became a Member in 1940. He was a past chairman of the Toronto Branch of the Institute.

He was a past president and honorary treasurer of the Industrial Accident Prevention Association of Ontario, a director of the Canadian National Exhibition, a director of the Toronto Industrial Commission, a past chairman of the Ontario Division, Canadian Manufacturers' Association and a past president of the University of Toronto Engineering Alumni Association.

He was a member of the Deer Park United Church in Toronto. He is survived by his widow, the former Grace Irene Gammage, of Chatham; two daughters, Mrs. W. R. Carruthers and Miss Dorothy Robertson; his father, James Robertson; a brother, J. Murray Robertson, and a sister, Miss Helen Robertson, all of Toronto.

"He was the most reasonable of men," said W. R. Plewman, a close friend. "Unassuming and simple in his mode of life, he stood for everything that is worth while in our national life. Nobody sought more diligently and with greater success to ameliorate the differences between workmen and employers."

**Squadron Leader Joseph J. White**, M.E.I.C., died in Winnipeg, Man., on October 23rd, 1942. He was born at Oldham, England, in 1896 and came to Canada as a youngster. From



**Squadron Leader Joseph J. White,  
M.E.I.C.**

1912 to 1915 he was engaged in general building construction with Frid Lewis Company. Veteran of the first Great War, Squadron Leader White served in France with the Canadian Expeditionary Forces, later transferring to the Royal Air Force.

Returning to Regina from overseas in 1919, he worked in the city for a while and, in the fall of that year, entered the University of Saskatchewan where he graduated as a Bachelor of Engineering in 1925. During his undergraduate days, he became associated with C. M. Miner's Construction Company with whom he stayed until 1939, when he was appointed building inspector for the city of Regina. During his period of office at the Regina city hall, he prepared for the architectural profession and passed his final examinations in 1937.

In August, 1940, Squadron Leader White joined the R.C.A.F. and had been attached as an engineer officer to the Works and Buildings Branch at No. 2 Training Command, Winnipeg, Man.

Squadron Leader White joined the Institute as a Student in 1924, becoming an Associate Member in 1928. He was transferred to Member in 1936. Squadron Leader White has always been active in engineering circles and for four years he served as secretary-treasurer of the Saskatchewan Branch of the Institute and registrar of the Association of Professional Engineers of Saskatchewan. He was responsible in no small part for the successful conduct of the negotiations which brought about the signing of the agreement between the Institute and the Association in 1938, and almost entirely for the subsequent arrangement of operating details.

He is survived by his wife, the former Bertha Dymott, of Regina.

#### COMING MEETINGS

**Canadian Construction Association.**—Annual Convention, Log Chateau, Seignior Club, Que., January 20-22, 1943. General Manager, J. Clark Reilly, Ottawa Building, Ottawa, Ont.

**Canadian Pulp & Paper Association.**—30th Annual Meeting, January 27th, 28th, 29th, Mount Royal Hotel, Montreal. Secretary, A. E. Cadman, 3420 University St., Montreal, Que.

**The Engineering Institute of Canada.**—57th Annual General Professional Meeting, Royal York Hotel, Toronto, Ont., February 11-12, 1943. General Secretary, L. Austin Wright, 2050 Mansfield St., Montreal, Que.

## CALGARY BRANCH

K. W. MITCHELL, M.E.I.C. - *Secretary-Treasurer*  
J. N. FORD, JR., E.I.C. - *Branch News Editor*

Mr. S. N. Green, formerly aero-engineer with United Transport Company, and at present instructor of aeronautical engineering at the Provincial Institute of Technology, addressed a meeting of the Calgary Branch at 8 o'clock Wednesday evening, October 28, 1942, in the west small dining room of the Palliser Hotel. The subject of his address was **History of Aircraft Construction over the Past Thirty Years.**

Mr. Green introduced his subject by a group of slides depicting how man had dreams of flying thousands of years ago. Leonardo da Vinci studied flying as far back as the 15th century. Up to the 19th century all flying attempts were made by man by means of wings attached to his body. It was soon realized that man's muscular development was not sufficient and so our inventors turned to the use of engines. Later Horatio Phillips developed the wind tunnel in the early nineties. By this means he was able to study the effect of varying weather conditions on model planes. This method is still used for modern design. In the late nineties Octave Chanute developed the glider and made very valuable discoveries in his many glider flights until he finally crashed and was killed. His discoveries were used extensively by Orville and Wilbur Wright who made their first successful flight in December, 1903.

The United States of America adopted the aeroplane immediately and a great deal of development was made. By 1914 all planes were still underpowered and unreliable. However, they were used extensively in the war by the year 1915. After the war huge sums of money were spent in their further development and in 1920 the first commercial transport plane was used to carry mail.

Aircraft may be classified as follows:

1. Landplane which can be converted to a ski-plane or seaplane by means of skis or floats.
2. A flying-boat in which the fuselage is in the shape of a hull for use on water only.
3. An Amphibian which may be used for landing on land or water at will. This latter type would be ideal for flying in Northern Canada. However, it is more expensive to build and so has not been used.

In designing aircraft a designer must consider two points: firstly, the performance of the aircraft, i.e., it must be able to carry a paying load; secondly, it must be structurally strong and efficient. One of the finest things done for flying was the formation of the Aircraft Inspection Department under the Department of Transport. The inspectors are qualified engineers and flyers and they insist on good design and material being used.

Mr. Green then showed slides of different types of wing construction. He mentioned the internally braced monoplane such as is used in the Ferry Battle as the ideal type. The externally braced wing has not the aerodynamic efficiency of the internally braced wing but it is cheaper to build. The aerodynamic efficiency of the biplane is lower than the monoplane but the biplane is stronger for its weight and is excellent for training purposes.

Mr. Green cited the Composite Flying Boat as another step in flying progress. In this case a large flying boat is used to take a smaller craft into the air and then release it to continue on its way. The smaller aircraft is then able to carry heavier loads as a plane does not need as much power in the air as it does on take-off.

Material used for plane design may be all metal or wood and metal. The woods used are citrus spruce, mahogany and birch. Metals used are aluminum, magnesium, copper, steel and their alloys. Where fabric is used for the skin on a plane it is protected by a liquid called dope. This liquid shrinks the fabric and makes it air and waterproof.

## Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

Mr. Green finished his address with a group of slides showing detailed wing and fuselage construction.

Mr. McEwen, Chairman of the Branch, expressed the appreciation of the meeting for a very interesting and instructive paper.

## EDMONTON BRANCH

F. R. BURFIELD, M.E.I.C. - *Secretary-Treasurer*  
L. A. THORSEN, M.E.I.C. - *Branch News Editor*

The Edmonton Branch of the Institute opened its winter activities by inviting the engineers from the United States to attend a reception in the Macdonald Hotel on Friday, November 6th. Some thirty-five American engineers, now living in Edmonton while working for the United States Government on defence projects, attended the reception thus affording an opportunity for the American and Canadian engineers to become acquainted. The evening was thoroughly enjoyed by all who attended.

The first regular dinner meeting of the branch was held in the Macdonald Hotel on November 13th, at which many Americans again made their appearance. In the absence of Mr. Hansen, R. M. Hardy was in the chair. Mr. G. M. Hutt, assistant development commissioner, Canadian Pacific Railway, Winnipeg, Man., spoke on **The Development of Natural Resources in Relationship to the Railways.** He pointed out how the railways had opened up a great deal of Canada by building lines into hitherto unused areas thus permitting their development. He illustrated this statement by references to a number of the agricultural, mining and lumbering areas that had been developed through the foresight of the railways. The work of the railway along experimental lines, such as various C.P.R. experimental farms, was noted by the speaker. Incidental to the main theme of his talk, Mr. Hutt, also pointed out some of the factors governing express and freight rates as charged by the railways. The paper was followed by a quite lively discussion demonstrating the interest taken in Mr. Hutt's remarks.

The main business of the meeting was the election of a new chairman. Our chairman for the coming year, Mr. D. A. Hansen, resigned his position on being transferred to the Calgary office of the Calgary Power Company. Mr. D. Hutchison, present vice-chairman was elected to fill the vacancy, while Mr. C. W. Cary becomes our new vice-chairman.

During the meeting, Mr. J. Garrett presented to Mr. H. T. Stevinson, a student at the University of Alberta, the Institute's prize for his accomplishments during the 1941-42 session at the university.

## HALIFAX BRANCH

S. W. GRAY, M.E.I.C. - *Secretary-Treasurer*  
G. V. ROSS, M.E.I.C. - *Branch News Editor*

**Aircraft—Overhaul and repair for the R.C.A.F.** was the subject of a talk given at a dinner meeting of the Halifax Branch at the Halifax Hotel on November 19th. The speaker was D. B. Lindsay, manager of the Clark Ruse Aircraft Limited, of Eastern Passage, N.S.

An aircraft that has figured in a crash is classed in one of three ways. "A" is a washout, or one which is damaged beyond repair and has only salvage value; "B" is one which has suffered sufficient damage to require overhaul in a civilian repair shop; "C" is a crash which puts a plane out of action but repairs can be made by the R.C.A.F. The decision on the type of crash is made by technical officers of the R.C.A.F. and in the case of "B" crashes, notice is sent

out to the civilian repair plant that a plane of certain type will be in for repairs.

On receipt of the plane, crew chiefs proceed to dismantle it, all parts are inspected and the planning engineer obtains new parts or supervises repairs to damaged parts. All the undamaged parts, repaired parts and replacements flow into a room for one aircraft only and rebuilding is carried out under the same crew chiefs who supervised the tearing down process. When completed the plane is turned over to the test pilot and flight engineer.

Sometimes thirteen or fourteen different types of planes may be in the shop at one time, for some of which the company may not have any blueprints. It is necessary that the engineering department be able to design new parts and that the shops be able to construct them. The men engaged on the work are specialists and each group handles only its own speciality.

Mr. Lindsay has had a varied career in aeronautical work. In 1937 he was a member of a party on an experimental flight from England to Australia. Just five days before the outbreak of the war he made a forced landing at an Italian air force field and while waiting repairs was able to inspect Italian planes which he found to be badly built and of very inferior quality. At the start of the war he was attached to the R.A.F. in France. The greatest handicap under which the R.A.F. worked was a lack of repair depots near the front. The French fliers he found to be excellent but their planes were obsolete, comparatively unarmed and overhaul and repair services inadequate.

For some time Mr. Lindsay was engaged in production work on Sterling bombers and Sunderland flying boats and he has recently inspected the new Avro Lancaster bombers. He classed these as "magnificent machines" and the equal or better than any planes produced anywhere in the world.

Eighty-four members and guests, including a number of technical officers of the Eastern Air Command, were present.

#### HAMILTON BRANCH

A. R. HANNAFORD, M.E.I.C. - *Secretary-Treasurer*  
W. E. BROWN, Jr.E.I.C. - *Branch News Editor*

In accordance with wishes of Headquarters this branch has formed a committee on "Engineering Features of Civil Defence", and its personnel is interesting because all are not members of the Institute, but all except one were present at the Webster lectures.

W. L. McFaul, M.E.I.C., City Engineer, Chairman;  
Mr. D. P. Brown, Canadian Westinghouse Co.  
Mr. C. J. Porter, Steel Company of Canada;  
Mr. I. J. MacPherson, Otis-Fensom Elevator Co.;  
C. H. Hutton, M.E.I.C., Hamilton Hydro Electric System;  
C. C. Parker, M.E.I.C., Hamilton Bridge Co.;  
G. W. Howse, M.E.I.C., Hydro Electric Power Commission;  
A. R. Hannaford, M.E.I.C., City Engineers Department.

The first meeting of the committee was taken up with considerations as to how best the general public could be served in the hour of danger. It was decided to ask the papers to insert a prominent notice stating that the Hamilton Branch of the Institute was prepared to accept inquiries as to the best method of using present buildings or strengthening same in case of air raids.

There have been some requests and in each case a sub-committee of three makes a careful examination of all conditions and after reporting back to the committee and discussing all points a written reply is given to the party concerned. The committee hopes to branch out into more general useful application, as well as continue with the original idea.

A group has been formed by Professor C. H. Stearn, McMaster University, and Miss Freda Waldron, Librarian of the Hamilton Public Libraries, which has now been styled "Hamilton Council of Adult Education Agencies". The first

meeting was a dinner gathering at McMaster University at which this branch was invited to attend. Thirty-seven societies and bodies were represented there and later in the day an exhibition was held in the main Public Library building. Each body had been asked to present a poster for this exhibition, outlining their respective objects. The Hamilton Branch poster carried the exact colours of the cover of *The Engineering Journal*.

The first meeting was held early in September and at the second meeting some definite line of action was arrived at. During the evening Dr. A. H. Wingfield, a member of our executive, was appointed to one of the sub-committees. For the purpose of grouping the various bodies they were divided into groups as follows: hobbies, cultural or lecture, and professional; the Institute coming under the latter heading.

#### LAKEHEAD BRANCH

W. C. BYERS, Jr.E.I.C. - *Secretary-Treasurer*  
A. L. PIERCE, M.E.I.C. - *Branch News Editor*

On Wednesday evening, November 11th, Mr. Jules J. Cross, M.E., well known engineer of Port Arthur, addressed the members of the Institute resident in Fort William and Port Arthur.

Mr. Cross, who was the discoverer of the great hematite ore body at Steep Rock Lake near Atikokan, Ontario, spoke on the **Iron Ore Occurrences in the Lake Superior District** with special reference to the Steep Rock Lake project.

The speaker was introduced by Mr. S. E. Flook, city engineer of Port Arthur.

Mr. Cross spoke with a wide knowledge of the potential iron resources of the Lake Superior area and warned the meeting that "if we are to take full advantage of our iron ore position it will not be by shipping ore but by the establishment of industries that will produce finished steel in Canada."

Miss E. M. G. McGill, chairman of the Branch, presided, and some 35 members and guests were in attendance.

Messrs. W. L. Bird and E. J. Davies moved a vote of thanks to the speaker.

#### MONTREAL BRANCH

L. A. DUCHASTEL, M.E.I.C. - *Secretary-Treasurer*  
W. W. INGRAM, S.E.I.C. - *Branch News Editor*

On Thursday, November 19th, the branch held its annual student night. The chairman for the evening was J. D. Anderson, a student of McGill University. The judges for the papers were Messrs. R. E. Heartz, Aimé Cousineau and E. V. Gage.

The first paper was presented by R. A. Ritchie, from McGill, on the **Assembly of Marine Engines**. The engines are built vertically and lengthwise for weight distribution in the ship and are four-cylinder engines. The bedplate is machined for the columns, which support the cylinders, and the crankshaft bearings. The crankshaft is built up of the webs and pins which are shrunk together and the shaft which is bolted on. The cylinders are set on the columns which have been leveled up. The piston rod is put in from the bottom and the piston bolted to it. The cylinders are checked by means of piano wire strung across the top and a telescoping micrometer. The connecting rod, way shaft or reversing mechanism and other smaller parts are then added. The pistons are lined up with the valves by means of wooden battens, one on the piston and one on the valve. The completed engine has the underside painted aluminum to increase the light for inspection.

The second paper was presented by P. E. Salvat, from the Ecole Polytechnique, on **Launching of Ships**. The launching of a ship is the transfer of the ship from the ways to the water and is really the birth of the ship. Usually it is necessary to reinforce the ground with piling to carry the heavy weight of the ship during construction. The keel is

usually laid on heavy wooden blocking about five feet above ground level on a slope of one-half in. per ft. For launching, the declivity is usually  $11/16$  to  $3/4$  in. per ft. Small and medium-sized ships are sometimes launched sideways. The advantages are that the ship is vertical and on an even keel. The disadvantage is the large space required, the necessity of removing the construction equipment on the river side and the danger of capsizing the ship. For the heavier ships, stern launching is the usual method. The ship is held in puppets fore and aft on brackets welded to the ship. The ship is held by doghouses and triggers while she is being prepared for launching. The bearing pressure is about two and a half tons per ft. As the ship is sliding down the way, the balance is very important. Tipping and pivoting are liable to occur if the balance is not proper. Once the ship is waterborne she is usually stopped by the drag of chains in the water.

The third paper was presented by J. H. Maclure, of McGill, on **Wooden Shipbuilding**. The building of wooden ships is an art which had its beginning in the ark built by Noah. The art has been revised by the use of wooden ships as minesweepers in the present war. The usual shipyard which the author has visited consists of two or three buildings; the staff is made up of the owner and builder, a bookkeeper, several carpenters and a blacksmith. Labour consists of farmers and fishermen who are very unreliable at some seasons. The use of mold loft practice, the transfer of the ship's dimensions to the floor of the mold loft of the longitudinal vertical, and the longitudinal horizontal plans plotted from a table of ordinates and the transverse vertical made from a combination of the above plans. By the use of diagonals the final fairing, which removes any flat spots, is made. The rabbeting and bearding takes care of the intersection of the planks in the prow and heel of the ship. For the trial run of the ship usually everyone who had something to do on the ship is on board.

The fourth paper was presented by G. Bisailon, from the Ecole Polytechnique, on **Long Range Cruising Control**. Twenty years ago an aviator crossing the Atlantic was a hero. Today it is quite common for aeroplanes to fly to all parts of the world in the ferry service. The main factors to long range flight are the altitude of the plane and engine performance at altitude. The forces acting on the plane are the weight counteracted by the lift and the drag caused by the air resistance. The effect of altitude is such that a plane can fly faster at altitude than at ground with the same fuel consumption. The engines are most efficient at altitude with full throttle and low engine r.p.m. For commercial flight the most economical altitude is from eight to ten thousand feet as no heat or oxygen is necessary.

While the judges were arriving at their decision, Mr. J. A. Lalonde, branch chairman, presented the Institute prizes to engineering students to Sam Gerstein, of McGill University, and to Henri Audette, of the Ecole Polytechnique.

The judges awarded the first prize, \$15.00, for the evening, to P. E. Salvas and two second prizes of \$10.00 each, to J. H. Maclure and G. Bisailon.

The meeting then adjourned for refreshments.

### OTTAWA BRANCH

A. A. SWINNERTON, M.E.I.C. - *Secretary-Treasurer*  
R. C. PURSER, M.E.I.C. - - - *Branch News Editor*

At a luncheon meeting of the Ottawa Branch on November 5, R. M. Gooderham, B.A.Sc., M.E., of the Shipbuilding Branch of the Department of Munitions and Supply, gave a talk on **Increasing Welded Production**. Mr. Gooderham's duties relate to the improvement of welding methods in Canadian shipyards. N. B. MacRostie, local chairman, presided and the luncheon meeting drew an exceptionally large attendance.

In the last war, stated Mr. Gooderham, welding was primarily used for salvage and repair operations whereas

in this war it is used as a production tool as well. In United States, for instance, taking into account all the different kinds of welding, it is reckoned as the eighth largest industry with a total annual volume of sales of well over \$200,000,000. Of this arc welding is in the greatest proportion with about 150,000 arc welders employed. In spite of this fact, welding is still considered to be in its infancy.

The speaker went on to say that "in the near future" it is predicted that 90 per cent of all rivetting will be replaced by welding, although one thing that will have to be taken into account is the large amount of rivetting equipment that will still have to be used up. Advantages of welding over rivetting include the use of rolled steel over cast iron. The former is from four to five times as strong in tension and from two to two-and-a-half times stiffer. With rigidity one of the prime factors in any engineering design the latter point becomes most important.

In arc welding, which essentially embodies the principle of the melting of metal the rate of welding accomplished is almost directly proportional to the amount of current used. Thus as a first principle if the amount of welded production is to be increased the amount of current must be increased. Another thing to take into account is that welding can only be carried on while the arc is going. The number of minutes out of the hour in which welding actually takes place—the operating efficiency—must be increased if the amount of welding is to be stepped up. In some plants some operators, for instance, do not actually weld more than six minutes out of the hour whereas many times this efficiency should be aimed at. The rest of the time is taken up in assembling his materials and putting them in proper position for doing his welding work.

In stepping up efficiency the operator should be given every facility toward keeping his arc going, as well as a monetary incentive. The latter could be effected by payment of a piece work on bonus system basis. The speaker did not agree with those who prophesied that under such circumstances the quality of the work would suffer. He dwelt at some length on this and outlined various systems of procedure whereby such a possibility would be obviated.

One feature of the question of increased production to which a great deal of attention has not yet been given, according to Mr. Gooderham, is that of the operator's comfort. Greater attention should be paid to the reduction of eye fatigue, the use of more comfortable clothing, the dissipation of heat, and other comfort-producing items. Such things have generally been neglected in the past.

With the main job now to increase our efficiency in the matter of production, engineers as a class should more surely acquire that sense of urgency in getting things done and more closely study every means possible toward that end.

The luncheon talk was followed by a motion picture film in full colour and sound illustrating the right and wrong ways to go about the job of welding.

At an evening meeting on November 19, at the auditorium of the National Research Laboratories, members of the branch and their friends were treated to a most interesting address and demonstration on "**Your Voice as Others Hear It.**" This was given by George L. Long who for the past six years has been in charge of the Telephone Museum and Historical Collection of the Bell Telephone Company of Canada in Montreal. He has had many years experience in telephone engineering, including the training and instructing of telephone workers.

Mr. Long demonstrated the operation of a microphone and of a magnetic tape recording device which enabled members of the audience to hear how their voices were heard by others. Through its use, it was possible for one to appraise his own *voice appeal* and to take steps to improve his own speech.

The meeting, which was open to the public, was particularly well attended and there were many ladies in the audience.

## SAGUENAY BRANCH

A. T. CAIRNCROSS, M.E.I.C. - - *Secretary-Treasurer*  
GEORGE ARCHAMBAULT, Jr., E.I.C. - *Branch News Editor*

On October 8th the Branch was entertained at the showing of the film **Inside Arc Welding**, produced by the United States Government and sponsored by the General Electric Company. Mr. C. Miller, M.E.I.C., acted as chairman.

Mr. John Ward moved a vote of thanks to Messrs. R. N. Fournier and R. H. McBrien, who showed the film.

OCTOBER 15TH—

The speaker of the evening of October 15th was Mr. A. W. Whitaker, Jr., general manager of the Aluminum Company of Canada, Limited, who spoke on **The Aluminum Industry and the War Effort**. Mr. R. H. Rimmer, M.E.I.C., acted as chairman.

Mr. Whitaker briefly outlined the story of aluminum from its *discovery* in the metallic form by a Danish chemist, H. C. Oersted, in the year 1825. In 1886 the electrolytic method of producing aluminum—the present commercial process—was discovered at about the same time by Charles Martin Hall, an American, and Paul L. T. Héroult, a Frenchman. Hall and Héroult worked along the same lines, unknown to each other, and both had patents granted them by their respective governments. When aluminum was produced on a commercial scale for the first time, the producers could find no ready market for the new light metal and it was not until the pot and pan industry was entered that aluminum came into its own. Since then, and particularly during the last decade, the uses for aluminum have increased so that to-day it is a vital necessity in the war effort and a potential wonder for post-war prosperity.

Mr. Whitaker took the audience on a tour of some of the Company holdings, by means of beautifully coloured pictures taken by himself during various trips to the distant points. The pictures showed life and work at such places as Northern Quebec, Newfoundland, British Guiana, and Greenland. Through the pictures and his knowledge of the subject the speaker was able to bring clearly to the minds of the audience the part being played by many individuals spread over a great portion of the Western Hemisphere in the production of the vitally essential aluminum.

Mr. S. J. Fisher, M.E.I.C., thanked the speaker on behalf of the Saguenay Branch.

OCTOBER 30TH—

On October 30th Mr. F. T. Agthe, engineer with the Allis-Chalmers Company of Milwaukee, addressed a meeting of the branch on the subject **Processing Equipment—Mills and Kilns**. Mr. C. Miller, M.E.I.C., acted as chairman.

Mr. Agthe divided his lecture into two parts, dealing separately with mills and kilns and showing slides depicting each.

MILLS

The speaker said that grinding has played an important part in the life of man, dating back hundreds of years to the time when all grain was ground between rotating stones. The first known departure from stone grinding was about 1868 when a ball mill was introduced to South Africa, and since then grinding methods have continued to advance yearly.

Grinding is divided into two distinct classes: wet and dry. The wet process has been used in most metallurgical grinding operations, and the dry method has been used most extensively in the cement and ceramic industries. The speaker also explained the meaning of ball mills, tube mills, ball-peg and ring mills.

Cement dry mills, Mr. Agthe said, were successfully operated for the first time in America during 1895, and from then until 1930 production was the moving power behind cement producers. The great dam building projects, introduced about 1930, necessitated the introduction of special cements and this caused the producers to investigate the mining fields where the wet process was used. To-day two-stage, dry-wet grinding of material is common practice,

with the result that cements may be produced for particular uses in varied climates and utilizing different pouring methods.

KILNS

Mr. Agthe said that the first known experiments with kilns were done in England. In America the first commercial kiln was operated at Coplay, Penn., about 1896. It was fired with oil at the beginning, but in 1898 the fuel was changed to pulverized coal. The kiln was 6 ft. by 60 ft. and had a capacity of 25,000 barrels per day. As knowledge grew with the use of this and other kilns, the sizes of the kilns grew to modern lengths of over 500 ft. with diameters in excess of 12 ft.

As the capacity of the kilns increased, more and more control over the processing became necessary. Continuous filters and coolers were introduced to take care of the incoming mixture and the outgoing product. Incoming primary and secondary air, fuel, and outgoing gases all have to be carefully watched in order to secure a uniformly graded product. Automatic control has now been introduced and the human eye and mind have been replaced by such instruments as the pyrometer and the potentiometer, which never fail if correctly operated.

Mr. M. G. Saunders, M.E.I.C., thanked the speaker on behalf of the Saguenay Branch.

## SASKATCHEWAN BRANCH

STEWART YOUNG, M.E.I.C. - *Secretary-Treasurer*

The Saskatchewan Branch met jointly with the Association of Professional Engineers in the Kitchener Hotel, Regina, on November 19 to hear an address by Dr. John Mitchell, Head of the Soils Department, University of Saskatchewan, on **"The Soils of Saskatchewan."** The attendance was 50 and the address preceded by a dinner at 6.30 p.m.

The various soil formations in Saskatchewan lie parallel with the south westerly limit of the Pre-Cambrian structure in the northerly half of the province and at right angles to the various ice advances and recessions in the respective glacial periods; in the southwest, there is the short grass area, followed in a north easterly direction by the clay belt (best suited to wheat), then the park area (mixed farming) and lastly the gray soils area which merges into the forest area of the Pre-Cambrian structure.

In developing his subject Dr. Mitchell stressed the damage through improper farming from chemical (principally phosphorus) exhaustion, soil drift and erosion, mentioning briefly the methods to be employed to counteract deterioration. He pointed out that for the past 15 years the acreage of land in Saskatchewan under cultivation had remained static and that, while new land had been brought under cultivation, it had been offset by the withdrawal of submarginal land for community pasture purposes. This fact, he intimated was a fair indication that Saskatchewan had now reached the maximum of farm land settlement. The address proved both interesting and instructive and was followed by numerous questions from those in attendance.

Following Dr. Mitchell's address, Major H. L. Roblin gave a brief outline of the objective in organizing the 14th Reserve Field Coy., R.C.E.; afterwards Mr. Geo. E. Kent, assistant superintendent, Imperial Oil Company Plant, showed several reels of coloured film taken in Bolivia and Peru and depicting in particular the rugged nature of the country.

Mr. A. M. Macgillivray concluded the meeting by expressing thanks to the several speakers.

## SAULT STE. MARIE BRANCH

O. A. EVANS, Jr., E.I.C. - *Secretary-Treasurer*  
N. C. COWIE, Jr., E.I.C. - *Branch News Editor*

The fifth general meeting for the year 1942 was held in the Grill Room of the Windsor Hotel on October 30th, 1942, when sixteen members and guests sat down to dinner at 6.45 p.m. At 8:00 p.m. Chairman L. R. Brown rose and asked the members to drink a toast to the King.

The chairman explained that the meeting had been called to have a round table discussion on **Post-War Reconstruction and Rehabilitation** and invited the views of the members. P. P. Martin started the discussion by saying that the boys returning would have absorbed a certain amount of culture from the foreign countries that they have been in and would hold divergent views from ours on their return. He maintained that after the war we should not look on the purely monetary side of affairs, but on actual values as the wealth of a nation is not its gold hoard but its productiveness. C. Stenbol said that we must make the rural districts of the country more attractive to live in. He believed that the real basis of national wealth was originally derived from the rural districts. He maintained that one way to make the rural districts more congenial to live in was to have the electric current in all rural homes, which could be done by a long term amortization plan. J. O. Fitzgibbons maintained that the city needed an adequate system of sewage disposal and that in reforestation the primary object was the correct disposal of slash which he felt was not being done in Ontario. The chairman said that a great number of roads needed to be built and surfaced which would absorb man-power. G. W. MacLeod felt that none of the schemes elaborated would take care of the great host of skilled and technical people released after the war. The secretary felt that there was a great need for socialized medicine and hospitalization after the war.

A committee to study the Post-War Problems was then set up under the pro-tem chairmanship of J. L. Lang. The committee nominated consisted of J. L. Lang, P. P. Martin, G. W. MacLeod, K. G. Ross and E. M. MacQuarrie.

At this moment J. O. Fitzgibbons arose and went on record that he would like this committee to consult him as he was very interested in this subject.

The executive and branch would welcome suggestions from non-resident members on solutions to the Post-War Problems.

#### TORONTO BRANCH

S. H. DEJONG, M.E.I.C. - *Secretary-Treasurer*  
D. FORGAN, M.E.I.C. - *Branch News Editor*

In opening the initial meeting of the Toronto Branch for the current season, the chairman, Col. W. S. Wilson, fittingly referred to the great loss which the profession as a whole and The Engineering Institute in particular, has sustained by the recent death of Ross Robertson (which is referred to elsewhere in the *Journal*). On the motion of Prof. Morrison the branch formally recorded its deep sense of loss and its sympathy with his family.

The meeting was held in the Debates Room, Hart House, on November 5th, about 70 attending. Amongst those whom the branch welcomed as visitors and guests were Messrs. Callander and Foote of the Canadian Westinghouse Company, Hamilton, the latter being president of the Ontario Section of the A.I.E.E., and also Squadron Leader Spence of No. 1 Air Training Command. The presence of several other members of the A.I.E.E. was noted with pleasure.

The speaker of the evening was Mr. Thomasson of the Canadian Westinghouse Company, who described present day practice in the **Welding of Large Electrical Equipment**. Added interest was given to Mr. Thomasson's paper by the fact that he was one of the successful contestants in a recent competition sponsored by the Lincoln Electric Company of the U.S.A. His paper won high place out of more than 2,000 entries received from 17 different countries, and brought Mr. Thomasson a prize of several thousand dollars.

His most interesting talk, which occasioned considerable discussion at its finish, dealt with the assembly, fabrication, and construction of large electrical equipment such as generators, transformers, oil breakers, etc., by the use of welding equipment. The economies in time, labour and material which recent developments in this art have made effective were illustrated both orally and graphically by the speaker, with the aid of lantern slides, the presentation

of which took the audience through the shops where these operations are conducted.

After a vote of thanks happily expressed by Mr. C. Sisson of the Canadian General Electric Company the meeting was adjourned for refreshments.

#### VANCOUVER BRANCH

P. B. STROYAN, M.E.I.C. - *Secretary-Treasurer*  
A. PEEBLES, M.E.I.C. - *Branch News Editor*

On Monday, November 9th, members of the branch were guests at a meeting of the Vancouver section of the American Institute of Electrical Engineers. Their speaker was Dr. H. S. Osborne, plant engineer of the American Telephone and Telegraph Company, and national president of the American Institute of Electrical Engineers. He gave an address on "**The Conservation of Critical Materials**," treating his subject under the following headings:

- A. Making the greatest possible use of what we have.
  1. Increasing the extent of use and capacity of plant.
  2. Prolonging plant life.
  3. Re-use of material recovered in alterations.
- B. Limiting additions and changes to those necessary for essential service.
- C. Making minimum use of critical materials in necessary plant extensions.
  1. Substitutions of less critical materials.
  2. Re-design to use less material.
  3. Addition of plant for immediate needs only.
  4. Standardization.
- D. Placing back into circulation materials which can be spared.
  1. Clean up and dispose of junk.
  2. Reduction of inventories.
  3. Taking materials out of working plant.

Dr. Osborne gave examples of the application of each of the above procedures, mainly appertaining to the electrical industry, but to be found in all branches of industry and engineering.

Loads on transformers may be increased by better cooling arrangements. Capacitors may be used to take reactance. Worn parts may be built up by using sprayed metal. Tools should be given better care and supervision. Better care of material in dismantling operations will increase the amount of salvage. Economic requirements may be secondary to the use of materials in the emergency. An exchange of inventory can often be made between companies.

Silver has been substituted for copper on some government work for bus bars, windings, and in switch gear. Steel wire and copper clad steel tubing are being substituted for solid copper in carrier systems by using higher frequency transmission. Lead may be substituted for zinc in rust-proofing exposed metal such as pole line hardware. A more careful study of wiring diagrams will often save considerable material. Shorter life designs are justified, even as low as one to three years. Standard parts usually use less material than those of special design. Saving material against a scarcity is not justified at the present time.

The electrical industry in 1941 used 50 per cent of the available supply of copper. In 1942 it will consume only 20 per cent of 1941 requirements, and this will represent but one per cent of the total supply. The problem of conservation is made more difficult by reason of the greater demand for service. A compromise is nearly always possible. The address was followed by considerable discussion, some of which pointed to the possible saving of material which could be effected in contracts for the government and the armed services, by a revision of their specifications. The chair was occupied by T. Ingledow, chief engineer of the British Columbia Electric Railway Company and chairman of the local section of the American Institute of Electrical Engineers. Eighty persons were present.

# News of Other Societies

## UNIVERSITY OF TORONTO ENGINEERING ALUMNI REUNION

On Saturday, November 14th, another in the long series of triennial reunions took place at Toronto. In spite of the handicap of being only one day in duration instead of two, it equalled in enthusiasm and attainment all its predecessors.

The morning was given over to sessions of Council and special committees. At noon, class luncheons were held, some of them being so successful that adjournments were obtained only about in time for the banquet.

The afternoon was taken up with the annual business meeting. It was a great tribute to the officers of the society that this was the best attended business meeting within the memory of anyone present.

At night the dinner was held. This was the feature of the whole reunion. Between four and five hundred assembled to see alumni medals presented to W. P. Dobson, M.E.I.C., '10, Chief Research and Inspection Department, Hydro-Electric Power Company of Ontario, and Colonel W. E. Phillips, '14, President of Research Enterprises Limited, and to hear Major J. E. Hahn, Director General, Army Technical Division Board, the speaker of the evening. W. E. Wingfield, President of the alumni, was in the chair.

Alumni officers were elected for the next three years.

## Items of interest regarding activities of other engineering societies or associations



*Above:* M. B. Hastings, incoming president of the Engineering Alumni and president of the Alumni Federation of the University of Toronto, addresses the meeting. On his right, Maj. Hahn.

*Below:* Dr. J. L. Morris, M.E.I.C., the oldest living graduate of the School, and Balmer Neilly, of McIntyre Poreupine Mines Ltd.



*Above:* Major J. E. Hahn, the speaker of the evening, and H. E. Wingfield, M.E.I.C., chairman and president of the Alumni. At the microphone: N. F. Parkinson.

*Below:* H. J. A. Chambers, M.E.I.C., chief engineer of the Hamilton Bridge, and Wm. C. Foulds, manager, Engineers' Club of Toronto.



W. P. Dobson, M.E.I.C., one of the recipients of the Alumni Medal.

## ASSOCIATION OF PROFESSIONAL ENGINEERS OF ALBERTA

The Calgary District Meeting of the Association of Professional Engineers was held at 10.15 p.m., Saturday, October 17th, 1942, at the Renfrew Club.

The District Meeting, at this time, should have been held in Lethbridge, but owing to the fact that there was to be a joint dinner in honour of Mr. H. J. McLean, who is leaving Calgary to reside in Montreal, Council decided to hold the Calgary District Meeting at this time and the Lethbridge District Meeting early in the new year.

Since members of the engineering profession are so busy at the present time, Council decided to hold the district meetings this year after the evening programme.

The president, Mr. S. G. Coultis, called the meeting to order and spoke for fifteen or twenty minutes on the activities of the Association, since the Annual Meeting last March.

Mr. Coultis announced that six new members had been admitted at the Board of Examiners meeting in April. Twenty-three new engineers-in-training were also admitted. During the summer, five new licenses were granted. The membership now stands at 306, members, made up as follows:

16 life members; 290 members (23 of whom are on active service). There are now 97 engineers-in-training registered with the Association.

Under discipline and enforcement, the president stated that there were no particular cases at the present time. He discussed the use of the word "engineer" and informed the meeting that the Council had decided that the Association should take all practicable steps to publicize its proprietary rights to the use of the term "professional engineer" as set forth in the Engineering Profession Act of 1930. He informed the meeting that the membership card for 1943 would be altered so as to bring before the public, the term "professional engineer."

Mr. Coultis next outlined the schedule of rates and categories into which licensees are classified.

The president notified the members that Council had set the fees for 1943 the same as they were at the present time. He also mentioned that for members on active service, the Association and The Engineering Institute of Canada remit all fees when they leave for overseas.

This year the Association lost three members who passed away since the Annual Meeting. These were: Life Members, Messrs. W. D. L. Hardie and O. E. S. Whiteside, and the registrar, Mr. Harry R. Webb.

After this outline of activities of the Association since the Annual Meeting, the president asked if any members present had any questions or business to bring before the meeting.

The president next called on the newly appointed registrar, Mr. W. E. Cornish; the vice-president, Mr. Vernon Pearson; and the Lethbridge councillor, Mr. Donaldson, to say a few words.

Mr. deHart gave a brief report on the Dominion Council Meeting held at Saint John, N.B. on May 22nd, 23rd and 24th, 1942. He discussed the informal meeting held in Montreal at 10.30 a.m. on Thursday, May 21st, consisting of delegates to the Saint John meeting of the Dominion Council and others. This meeting discussed a previous resolution of Dominion Council which looked to the co-ordination of the voluntary engineering societies in Canada, and the forma-

tion by them of a board or council which would be available to take joint action in cases where common effort was desirable.

Dominion Council discussed the possibility of setting up a central Examining Board, which might conduct examinations of no lower standard than those currently being conducted by the associations. The results of such examinations could be accepted by all associations as equivalent to their own. To do this, certain associations would have to make drastic changes in their Acts.

The president finally called on Mr. H. J. McLean to say a few words.

The meeting adjourned at 11.00 p.m. There were 37 members present at the meeting.

## SAFETY ENGINEERING ORGANIZATION HEADED BY CANADIAN

Wills Maclachlan, M.E.I.C., has been elected general chairman of the Engineering Section of the National Safety Council for 1943.



Wills Maclachlan, M.E.I.C.

This organization, with headquarters in Chicago, has been engaged for the past thirty years in the prevention of accidents in industry, in homes, on streets and highways and in other public places, and the prevention of occupational diseases. Its voluntary committees now include more than a thousand men and women in various fields, who are contributing their time and effort to promoting the work of the Council.

The Engineering Section was organized in 1921. In 1924 it absorbed the American Society of Safety Engineers and today, the organization is still known as the A.S.S.E.—Engineering Section of the National Safety Council. Its object is the promotion of the arts and sciences connected with engineering in its relation to accident prevention and the conservation of life and property, and the development of safety engineering as a profession.

Mr. Maclachlan is the first Canadian to be elected as general chairman of the Engineering Section. He is an engineering graduate of the University of Toronto from the class of 1907. After serving an apprenticeship with Westinghouse Electric and Manufacturing Company, he was engaged for several years in the engineering division of the power industry. In 1915, he became connected with the Electrical Employers Association of Ontario, of which he is still secretary-treasurer and engineer. Since 1917 he has also been in charge of the Employees Relations Department of the Hydro-Electric Power Commission of Ontario.

Mr. Maclachlan is also a consultant in industrial relations and he is at present chairman of the Committee on Industrial Relations of The Engineering Institute of Canada.

### BS/ARP STANDARDS

#### COMMENTS

#### RELATIVE TO APPLICATION IN CANADA

The following comments, supplied by the Canadian Engineering Standards Association, have been submitted by representative and authoritative Canadian interests in response to direct inquiries as to the applicability in Canada of the specifications issued by the British Standards Institution with regard to Air Raid Precautions.

#### BS/ARP No. 3—Electric Hand-lamps:

*Clause 1, General, Note—Change "torch" to "flashlight." Re Battery—Consult manufacturers before deciding specified capacities, etc.*

#### BS/ARP No. 6—Shelter Lighting:

*Editorial rearrangement and rewording of clauses. Desirable to consult manufacturers of batteries, low-voltage lighting sets, etc., before deciding capacities, etc.*

#### BS/ARP No. 7—Electric Lighting of Report and Control Centres:

*Editorial rearrangement and rewording of clauses. Desirable to consult manufacturers of batteries, low-voltage lighting sets, etc., before deciding specified capacities, etc.*

#### BS/ARP No. 8—Galvanized Wire Netting and Cloth for Protection Against Flying Particles:

*Part I— $\frac{1}{2}$ -in. netting not manufactured in Canada. Suggested that 1-in. be used, as this is available. Part II— $\frac{1}{2}$  in. by  $\frac{1}{2}$  in. is available in Canada—applicable.*

#### BS/ARP No. 10—Rubber Gaskets for Rendering Doors and Windows Gas Tight:

*Applicable, but if a new specification is to be prepared some slight changes would be suggested.*

#### BS/ARP No. 11—Adhesive Tape for Repairing Damaged Material, Sealing Apertures and Cracks.

*Applicable to conditions in Canada.*

#### BS/ARP No. 12—Petroleum Jelly for Sealing Gas-tight Doors, etc.:

*Drop Point—Suggested that ASTM D 127-30 be specified. Penetration—Suggested that ASTM 217-38T for method of test be specified. Revise lower limit of penetration from 200 to 170. Would revise specification to include both ASTM specifications.*

#### BS/ARP No. 14—Window Blind Material (Paper):

*In general, the important point is not colour but opacity. A point to be considered also is the reflectance of glass windows even when they are blacked out.*

#### BS/ARP No. 16—Methods of Providing Even Illumination of Low Intensity (0.002 foot-candle):

*For adoption in this country a few changes will be necessary in order to have equipment conform to Canadian standards.*

#### BS/ARP No. 18—Fluorescent and Phosphorescent Paint:

*Specification acceptable but suggests going further. Eastman Kodak Company sent copy of report of their laboratory covering review of this specification.*

*The specification is cumbersome and requires specially built testing equipment; it appears to be of little use in Canada. It might be accepted if the ultra-violet source were more carefully specified, if the amount of paint spread on the surface was specified, and if the specification was broadened to include radium-excited luminous paints.*

*American Standards Association sent copies of "Summary of American Opinion," prepared by the Eastman Kodak Company. Specification seems satisfactory—have no criticisms to offer.*

#### BS/ARP No. 20—Methods of Providing Even Illumination of Low Intensity (0.02 foot-candle):

*For adoption in this country a few changes would be necessary to have equipment, etc., conform to Canadian standards.*

#### BS/ARP No. 21—Methods of Providing Even Illumination of Low Intensity (0.2 foot-candle):

*For adoption in this country a few changes will be necessary to have equipment, etc., conform to Canadian standards; suggests necessary changes.*

#### BS/ARP No. 23—Obscuration Value for Textile Materials for Curtains:

*Satisfactory for Canadian use in present form.*

#### BS/ARP No. 26—Reduced Scheme for Lighting of Shelters where A.C. Mains are Available:

*Editorial rearrangement and rewording of clauses suggested. It would be desirable to consult manufacturers of batteries, low-voltage lighting sets, etc., before deciding specified capacities, etc.*

#### BS/ARP No. 27—Testing Incombustible Material Resistant to Incendiary Bombs:

*Specification applicable to Canadian conditions with suggestions on the following minor points: (1) Arrangements for a supply of the one kilo magnesium thermite bombs should be made. (2) Tests on more than one specimen would probably be advisable, particularly with material apt to crack.*

*Specification applicable. It was pointed out, however, that the chief differences involved would be the impact resistance of the ordinary roof structures in Canada as compared with the tile and other types of resistant roof structures used in Europe.*

#### BS/ARP No. 30—Gauges for Checking Low Values of Illumination (0.001 to 0.2 foot-candle):

*Suggested that Clause 3 be revised as follows: "The angle subtended by the field of view at the observer's eye shall be nowhere less than 7 deg. under normal conditions of use. If a concentric type of field is used, the diameter of the central area shall not be less than 5 deg.*

#### BS/ARP No. 32—Illuminated and Non-illuminated ARP Signs:

*Suitable for use under Canadian conditions with slight changes in nomenclature which would be unfamiliar to Canadians. Map symbols in use in Ontario were submitted. Slight changes in nomenclature were suggested also by the Province of Quebec.*

#### BS/ARP No. 33 and Supplement—Stirrup Pumps:

*No comments. Survey of manufacturing possibilities were made in Canada.*

#### BS/ARP No. 35—Illuminated Display Cabinets:

*For adoption in this country a few changes would be necessary to have equipment, etc., conform to Canadian standards.*

#### BS/ARP No. 36—Headlamp Masks for Motor Vehicles:

*For adoption in this country a few changes would be necessary to have equipment, etc., conform to Canadian standards.*

#### BS/ARP No. 37—Street Lighting Under Wartime Conditions:

*Specification seems satisfactory, with slight modifications. Similar specification has been given preliminary consideration by the Canadian Region of the Illuminating Engineering Society. Conditions differ somewhat in Canada from those in England.*

#### BS/ARP No. 38—Traffic Paints:

*No Comments.*

#### BS/ARP No. 39—Testing Fire-retardant Timber Treatment by Exposure to Action of Incendiary Bomb:

*Specification satisfactory for the purpose intended. (See Forest Products Laboratories' Report on Fire Retardant Paints). "There is some question as to whether or not the exposure of an electron bomb in the British test is more severe than the Bunsen burner used in our test."*

#### BS/ARP No. 40—Bleach Ointment (Anti-gas Ointment No. 1):

*Specification satisfactory as long as materials are available in Canada.*

#### BS/ARP No. 41—Front Lamps for Tram Cars:

*Specification might be revised to agree with U.S. standards, which would be more applicable to Canadian conditions.*

#### BS/ARP No. 43—A Closet for Use in Air Raid Shelters:

*No comments.*

#### BS/ARP No. 47—Testing Incombustible Material to Provide a Minimum Standard of Protection Against Incendiary Bombs:

*Specification applicable. It was pointed out, however, that the chief differences involved would be the impact resistance of the ordinary roof structures in Canada as compared with the tile and other types of roof structures used in Europe.*

#### BS/ARP No. 48—Fabric-bitumen Emulsion Treatment for Roof Glazing:

*Specification applicable, with exception possibly, of the following minor points—the ring test under Appendix D is essentially the ASTM test except that the brass ring shown has double the ASTM wall thickness and has no bevel. It is unlikely that this will influence the test results but a few comparative tests of commercial bitumens might be in order.*

**BS ARP No. 52—A Simple Portable Standard of Brightness:**

Appears to be suitable for use in Canada and is actually in use in the optics laboratory of the National Research Council.

**BS/ARP No. 53—Detection of Incendiary Bomb Fires by Heat-sensitive Devices:**

Appears to be suitable with the minor exception that the words "accumulator" and "Leclanche cell" are not commonly used in Canada.

**BS/ARP No. 53 (Cont'd)—Fire-Detection Devices with Special Reference to the Detection of Incendiary Bombs—A Memorandum by the I.E.E. Advisory Committee to Ministry of Home Security:**

This is a general circular containing information that might be useful to scientific workers.

**BS/ARP No. 54—Electrical Heating of Shelters:**

For adoption in this country a few changes will be necessary to have equipment, etc., conform to Canadian standards.

**ADDITIONS TO THE LIBRARY****TECHNICAL BOOKS****The Steam Locomotive:**

Its theory, operation and economics. Ralph P. Johnson. N.Y., Simmons-Boardman Publishing Company, (c. 1942). 6 x 9½ in. \$3.50.

**Motion and Time Study:**

George W. Chane. N.Y., Harper and Brothers, (c. 1942). Rochester Technical Series. 6¼ x 9¼ in. \$1.40.

**Materials Testing and Heat Treating:**

William A. Clark and Brainerd Plehn. N.Y., Harper and Brothers, (c. 1942). Rochester Technical Series. 6¼ x 9½ in. \$1.75.

**Industrial Inspection Methods:**

Leno C. Michelin. N.Y., Harper and Brothers, (c. 1942). 8 x 11 in. \$3.50.

**Internal Combustion Engines:**

2nd ed. J. A. Polson. N.Y., John Wiley and Sons Inc., 1942. 6 x 9 in. \$5.00.

**Alternating Current Machines:**

2nd ed. A. F. Puchstein and T. C. Lloyd. N.Y., John Wiley and Sons, Inc., 1942. 6 x 9¼ in. \$5.50.

**Food for Thought:**

A treatise on the utilization of farm products for producing farm motor fuel as a means of solving the Agricultural Problem. Herman F. Willkie and Dr. Paul J. Kolachov. Indianapolis, Indiana Farm Bureau, Inc., (C. 1942). 6 x 9¼ in. \$2.00.

**A.S.M.E. Mechanical Catalogue and Directory, 1943:**

Thirty-Second annual volume issued October, 1942, by the American Society of Mechanical Engineers.

**Canada Year Book 1942:**

Dominion Bureau of Statistics. Ottawa, King's Printer, 1942. 6¼ x 9 in. \$1.50.

**Canadian Engineering Standards Association—Standard Specifications:**

A56—Round timber piles. Sept., 1942, 50c. C22.2 No. 46—Construction and test of electric air-heaters. 2nd ed. Oct., 1942, 50c. No. 77—Construction and test of inherent overheating protective devices for motors. Oct., 1942, 50c.

**American Standards Association:**

New list of American Standards for 1942. (This list may be obtained free of charge by writing to the American Standards Association, 29 West 39th Street, New York City.)

**TRANSACTIONS, PROCEEDINGS****U.S.—National Research Council—Highway Research Board:**

Proceedings of the twenty-first annual meeting held at the John Hopkins University, Baltimore, December 2-5, 1941.

**Institution of Mining and Metallurgy:**

Transactions, Vol. 50, 1940-41. London, The Institution, 1941.

**North-East Coast Institution of Engineers and Shipbuilders:**

Transactions, Vol. 58, 1941-42. London, The Institution, 1942.

**The Royal Society of Canada:**

List of Officers and members and minutes of proceedings, 1942. Ottawa, The Society, 1942.

**REPORTS****U.S.—Bureau of Standards—Building Materials and Structures Reports:**

BMS91—A glossary of housing terms.

**University of Illinois—Engineering Experiment Station—Bulletins:**

Circular series, No. 46—Hand-firing of bituminous coal in the home.—No. 47—Save fuel for victory.

**Ohio State University Studies—Engineering Series—Bulletin:**

No. 111—Ohio stream drainage areas and flow duration tables.

**The Connecticut Society of Civil Engineers:**

Fifty-eighth annual report, 1942.

**Nova Scotia—Department of Labour:**

Annual report for the year ended November 30, 1941.

**Bell Telephone System—Technical Publications:**

Entropy, Monograph B1347:—Diamond dies for the high-speed drawing of copper wire, Monograph B1348.

**The Electrochemical Society—Preprints:**

High-speed analysis and control of plating solutions, No. 82-17:—Studies on over-voltage. A study of hydrogen decomposition potentials under various conditions in acid solutions at platinum electrodes, No. 82-26:—Electrodeposition of iron-tungsten alloys from an acid plating bath, No. 82-27:—Control of ammonia in the electrodeposition of brass, No. 82-28.

**Canada—Dept. of Mines and Resources—Mines and Geology Branch—Geological Surveys:**

Preliminary maps to the following papers: 42-7, Takla, B.C.:—42-11, The Pinchi Lake mercury belt, B.C.:—42-12, Vasson-Dubuisson, Abitibi County, Quebec:—42-13, Beresford Lake, Manitoba:—42-14, Gem Lake, Manitoba.

**BOOK NOTES**

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet the books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

**A.S.T.M. STANDARDS ON COAL AND COKE**

Prepared by Committee D-5 on Coal and Coke. Sampling Methods, Chemical Analysis, Methods of Testing, Specifications and Classifications, Definitions of Terms. Sept. 1942, American Society for Testing Materials, Phila., Pa. 122 pp., illus., diags., charts, tables, 9 x 6 in., paper, \$1.35.

The methods of coal and coke approved by the Society and the official definitions and specifications for classifying coals by rank and grade are collected in convenient form in this pamphlet.

**AIR RAID PRECAUTIONS HANDBOOK****No. 4A (2nd edition). DECONTAMINATION OF CLOTHING, INCLUDING ANTI-GAS CLOTHING AND EQUIPMENT, FROM PERSISTENT GASES**

His Majesty's Stationery Office, London, 1942. 31 pp., tables, 7 x 5 in., paper, (obtainable from British Library of Information, 30 Rockefeller Plaza, New York, 10c.)

Precise directions are given for decontamination of clothing and personal belongings of all kinds.

**AIR RAID PRECAUTIONS HANDBOOK No. 13 (1st edition). FIRE PROTECTION for the Guidance of Occupiers of Factories and Other Business Premises**

His Majesty's Stationery Office, London, 1942. 91 pp., diags., charts, tables, 9½ x 6 in., paper, (obtainable from British Library of Information, 30 Rockefeller Plaza, New York, 30c.)

This pamphlet brings together much practical information on the measures to be taken for dealing with fires following air raids, and is based on English experience in recent years.

**AIR RAID PRECAUTIONS TRAINING MANUAL No. 3 (1st edition). RESCUE SERVICE MANUAL**

His Majesty's Stationery Office, London, 1942. 149 pp., illus., diags., tables, 10 x 6 in., paper, (obtainable from British Library of Information, 30 Rockefeller Plaza, New York, 45c.)

The organization of a rescue service, the equipment needed, the methods to be used and the training of rescue teams are set forth in considerable detail in this practical manual. The book is based on British air-raid experience.

**AIRCRAFT DRAFTING ROOM MANUAL (Cadet Series)**

By J. C. Thompson. Aviation Press, San Francisco, Calif., 1939, pages in eight sections, illus., diags., charts, tables, 11½ x 9½ in., paper, \$3.50.

The purpose of this book is to supply information on the general requirements for airplane drawings and adequate reference information for preparing them, and to explain the operation of the drafting-room system used in most aircraft factories. Part one describes drafting practices, based upon the requirements of the Army Air Corps. Part two discusses the organization of an engineering office and the establishment of a system for handling drawings. Part three contains data upon the materials used in aircraft.

**THE AMERICAN STUDENT FLYER**

By M. C. Hamburg and G. H. Twency. Pitman Publishing Corp., New York and Chicago, 1942. 692 pp., illus., diags., charts, tables, 9 x 5½ in., cloth, \$1.50.

This text is designed for use in high schools where preliminary training is offered to boys who intend to apply for appointments to Army and Navy flying corps. The aim has been to provide all the material needed for these pre-flight courses in a single volume.

**ARC WELDING JOB TRAINING UNITS (Dunwoody Series Welding Training Jobs) 103 pp.****GAS WELDING JOB TRAINING UNITS (Dunwoody Series Welding Training Jobs) 92 pp.**

*American Technical Society, Chicago, Ill., 1942, illus., diagrs., 11 x 8½ in., paper, \$1.25 each.*

These manuals present a course in welding with the electric arc and with gas, adapted to the needs of industrial schools and apprentice training. Each course consists of forty jobs, an information sheet being furnished for each. Question sheets are also provided for most jobs. The courses have been thoroughly tested in schools and industries.

#### **BASIC RADIO, the Essentials of Electron Tubes and Their Circuits**

*By J. B. Hoag. D. Van Nostrand Co., New York, 1942. 379 pp., illus., diagrs., charts, tables, maps, 9 x 5½ in., lea., \$3.25.*

The aim in this text is to select the radio tubes and circuits which experience has proved useful, present a simple explanation of how they work and where they are applied, and to provide sufficient numerical constants and other details to make them readily understandable. The text is intended for students with only a limited knowledge of physics and mathematics.

#### **BOILER FEED AND BOILER WATER SOFTENING, a Boiler Operators' Manual**

*By H. K. Blanning and A. D. Rieh, 3 ed. Niekerson & Collins Co., Chicago, 1942. 164 pp., charts, tables, 11 x 8½ in., cloth, \$3.50.*

Methods of testing water, the interpretation of tests and the various treatments available for softening and purifying feed water are discussed in detail in this book. The subject is discussed from the point of view of the operators of power plants, especially small ones of low and medium pressure, where expert chemical assistance is not readily available.

#### **THE CHEMICAL TECHNOLOGY OF PETROLEUM (published formerly as Petroleum and Its Products)**

*By W. A. Gruse and D. R. Stevens, 2 ed. McGraw-Hill Book Co., New York and London, 1942. 733 pp., diagrs., charts, tables, 9½ x 6 in., cloth, \$7.50.*

Based upon Gruse's "Petroleum and Its Products", the present volume is twice the size of the original book and has been completely rewritten. It presents a chemical discussion of the petroleum industry as a whole. The chemical composition of petroleum, their chemical and physical properties, the group reactions of petroleum oils, the chemistry of production and the origin of petroleum are treated. Chapters are given on distillation, refining by chemical and physical methods, and on cracking and the chemical thermodynamics of petroleum hydrocarbons. Other chapters discuss motor fuels, kerosene, petroleum lubricants, paraffin, petroleum asphalts and other products.

#### **ELECTRICAL ENGINEERING, Vol. 2**

*By W. T. Maceall. University Tutorial Press, Ltd., London, 1942. 463 pp., illus., diagrs., charts, tables, 9 x 5½ in., cloth, 15s.*

This book is based on the author's former "Alternating Current Electrical Engineering". With volume one of the present work it is intended to cover all the fundamentals of all branches of electrical engineering dealt with in the usual three-year courses given in British schools. This volume discusses symbolic notation, harmonic analysis, alternating-current generators and motors, converters, mercury-arc rectifiers, transmission, protection and symmetrical components.

#### **Great Britain. Dept. of Scientific and Industrial Research. BUILDING RESEARCH, WARTIME BUILDING BULLETIN No. 20, SAND-LIME BRICKS**

*His Majesty's Stationery Office, London, 1942. 6 pp., 11 x 8½ in., paper, (obtainable from British Library of Information, 30 Rockefeller Plaza, New York, 10e.).*

A brief exposition of the properties, uses and availability in England of these bricks, with comment on some points of direct wartime interest.

#### **Great Britain. Ministry of Works and Buildings. SECOND REPORT OF THE COMMITTEE ON THE BRICK INDUSTRY**

*His Majesty's Stationery Office, London, 1942. 28 pp., tables, 9½ x 6 in., paper, (obtainable from British Library of Information, 30 Rockefeller Plaza, New York, 15e.).*

This report discusses the condition of the British brick industry and makes wartime recommendations concerning the reduction of output, a quota plan of allocation, the fixing of minimum and maximum prices, and compensation for loss of sales.

#### **GUN MANUFACTURE, compiled by the editors of "American Machinist"**

*McGraw-Hill Publishing Co., New York and London, 1942. 138 pp., illus., diagrs., charts, tables, 11 x 8½ in., paper, \$1.00.*

The articles upon gun manufacture which have appeared in the "American Machinist" during the last two years have been collected in this convenient volume. Methods of tooling up for a variety of guns, as practised in various American factories, are described in detail.

#### **HANDBOOK OF APPLIED HYDRAULICS**

*By C. V. Davis. McGraw-Hill Book Co., New York and London, 1942. 1,084 pp., illus., diagrs., charts, maps, tables, 9 x 6 in., lea., \$7.50.*

A general reference work on hydraulics, composed of brief, yet complete texts on its various branches with practical information on the planning and design of hydraulic works. Hydrology, river regulation, dams, spillways, canals, hydroelectric plants, hydraulic machinery, water supplies, sewerage, irrigation, drainage, etc., are discussed by eighteen prominent engineers with experience in various fields.

#### **HANDBOOK OF WAR PRODUCTION**

*By E. A. Boyan, with a foreword by E. H. Schell. McGraw-Hill Book Co., New York and London, 1942. 368 pp., diagrs., charts, tables, 9½ x 6 in., cloth, \$3.00.*

This handbook discusses the problems of management that are involved in the conversion of plants to the production of war materials, and in increasing the quality and speed of output. It is based upon the experience of pioneer war manufacturers. Among the subjects discussed are the procurement of contracts, materials and supplies, production planning and control, quality control, labor and expansion, conservation of strategic material, industrial accounting in wartime, estimating for war contracts, and subcontracting.

#### **HARDNESS AND HARDNESS MEASUREMENTS**

*By S. R. Williams. American Society for Metals, Cleveland, Ohio, 1942. 558 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$7.50.*

In writing this book, the author has aimed to revive interest in an active study of the subject, to promote a more general outlook on the problem, and to bring together the literature on the subject in convenient form. The theories of hardness, the conditions underlying hardness measurements, and the various methods and instruments available are discussed. There is a bibliography of over 2,000 references.

#### **INTERNATIONAL ASSOCIATION FOR BRIDGE AND STRUCTURAL ENGINEERING**

#### **MEMOIRES, ABHANDLUNGEN, PUBLICATIONS, Vol. 6, 1940-41**

*Published by the General Secretariat in Zurich, copies for sale at A. G. Gebr. Leemann & Co., Stoekerstrasse 64, Zurich, Switzerland, 1942. 306 pp., illus., diagrs., charts, tables, 9½ x 6½ in., paper, Swiss Frs. 25; RM. 15.*

The present volume of the Proceedings contains four papers in English, two in French and ten in German, which have collected at the headquarters of the Association since 1939. The papers discuss various matters related to the theory and practice of bridge and structural engineering.

#### **INTRODUCTION TO NAVAL ARCHITECTURE**

*By J. P. Comstock. Simmons-Boardman Publishing Corp., New York, 1942. 209 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, \$4.00.*

This textbook is based upon the course in theoretical naval architecture given to hull-drawing apprentices at the Newport News Shipbuilding and Dry Dock Company. It is intended for students with only high-school education and does not call for higher mathematics. The fundamentals of the subject and their interrelations are explained, and their application is shown by practical examples in design.

#### **MECHANICAL PHYSICS**

*By H. Dingle. Ronald Press Co., New York, 1942. 248 pp., diagrs., 8 x 5 in., cloth, \$2.25.*

The author divides physics into "mechanical" physics and "sub-atomic" physics, and confines himself here to the first division—the properties of matter, heat, and vibrations and sound. The text is of college grade and aims to present physical principles in a manner that will bring out especially their applications in aeronautics and related subjects.

#### **MICROWAVE TRANSMISSION (International Series in Physics)**

*By J. C. Slater. McGraw-Hill Book Co., New York and London, 1942. 309 pp., diagrs., tables, 9½ x 6 in., cloth, \$3.50.*

In this book on ultra high-frequency systems, the author presents the general theory underlying the methods used for transmitting these waves from generator to receiver, including the intermediate stage of radiation from one antenna and absorption by another. The treatment is based upon the theory of conventional transmission lines and on Maxwell's equations. The book is an advanced text and reference book.

#### **MODERN TRIGONOMETRY**

*By M. J. G. Hearley. Ronald Press Co., New York, 1942. 168 pp., illus., diagrs., charts, tables, 8 x 5 in., cloth, \$1.75.*

An elementary textbook presenting the numerical side of trigonometry in a form adapted to students with little mathematical background. The problems are practical ones, and the applications of trigonometry in astronomy, navigation and mechanics are discussed. The book is designed especially for students of aeronautics.

#### **MOTION AND TIME STUDY (Rochester Technical Series)**

*By G. W. Chane. Harper & Brothers, New York and London, 1942. 88 pp., diagrs., charts, 9½ x 6 in., cloth, \$1.40.*

A simple discussion of methods of time and motion study, and their use in shop management is offered in this concise text. The book is intended as a guide to assist management personnel in increasing efficiency.

#### **NATURAL TRIGONOMETRIC FUNCTIONS to Seven Decimal Places for Every Ten Seconds of Arc, together with Miscellaneous Tables**

*By H. C. Ives, 2 ed. John Wiley & Sons, New York; Chapman & Hall, London, 1942. 351 pp., diagrs., tables, 10 x 7 in., cloth, \$9.00.*

These tables give the natural sines, cosines, tangents and cotangents. They also include eleven other tables frequently needed by surveyors. Errors in the previous edition have been corrected, and a table giving the tangents and cotangents to single seconds from 0 to 2 degrees have been added. The tables are clearly printed and very readable.

# PRELIMINARY NOTICE

of Applications for Admission and for Transfer

FOR ADMISSION

November 30th, 1942.

The By-laws provide that the Council of the Institute shall approve, classify and elect candidates to membership and transfer from one grade of membership to a higher.

It is also provided that there shall be issued to all corporate members a list of the new applicants for admission and for transfer, containing a concise statement of the record of each applicant and the names of his references.

In order that the Council may determine justly the eligibility of each candidate, every member is asked to read carefully the list submitted herewith and to report promptly to the Secretary any facts which may affect the classification and selection of any of the candidates. In cases where the professional career of an applicant is known to any member, such member is specially invited to make a definite recommendation as to the proper classification of the candidate.\*

If to your knowledge facts exist which are derogatory to the personal reputation of any applicant, they should be promptly communicated.

Communications relating to applicants are considered by the Council as strictly confidential.

The Council will consider the applications herein described at the January meeting.

L. AUSTIN WRIGHT, General Secretary.

\*The professional requirements are as follows:—

A Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for at least six years, which period may include apprenticeship or pupilage in a qualified engineer's office or a term of instruction in a school of engineering recognized by the Council. In every case a candidate for election shall have held a position of professional responsibility, in charge of work as principal or assistant, for at least two years. The occupancy of a chair as an assistant professor or associate professor in a faculty of applied science or engineering, after the candidate has attained the age of twenty-seven years, shall be considered as professional responsibility.

Every candidate who has not graduated from a school of engineering recognized by the Council shall be required to pass an examination before a board of examiners appointed by the Council. The candidate shall be examined on the theory and practice of engineering, with special reference to the branch of engineering in which he has been engaged, as set forth in Schedule C of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Sections 9 and 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard. Any or all of these examinations may be waived at the discretion of the Council if the candidate has held a position of professional responsibility for five or more years.

A Junior shall be at least twenty-one years of age, and shall have been engaged in some branch of engineering for at least four years. This period may be reduced to one year at the discretion of the Council if the candidate for election has graduated from a school of engineering recognized by the Council. He shall not remain in the class of Junior after he has attained the age of thirty-three years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

Every candidate who has not graduated from a school of engineering recognized by the Council, or has not passed the examinations of the third year in such a course, shall be required to pass an examination in engineering science as set forth in Schedule B of the Rules and Regulations relating to Examinations for Admission. He must also pass the examinations specified in Section 10, if not already passed, or else present evidence satisfactory to the examiners that he has attained an equivalent standard.

A Student shall be at least seventeen years of age, and shall present a certificate of having passed an examination equivalent to the final examination of a high school or the matriculation of an arts or science course in a school of engineering recognized by the Council.

He shall either be pursuing a course of instruction in a school of engineering recognized by the Council, in which case he shall not remain in the class of student for more than two years after graduation; or he shall be receiving a practical training in the profession, in which case he shall pass an examination in such of the subjects set forth in Schedule A of the Rules and Regulations relating to Examinations for Admission as were not included in the high school or matriculation examination which he has already passed; he shall not remain in the class of Student after he has attained the age of twenty-seven years, unless in the opinion of Council special circumstances warrant the extension of this age limit.

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainment or practical experience qualify him to co-operate with engineers in the advancement of professional knowledge.

The fact that candidates give the names of certain members as reference does not necessarily mean that their applications are endorsed by such members.

ALLAN—JOHN CHARLES, of 5 Fleming Place, Peterborough, Ont. Born at Toronto, Aug. 3rd, 1902; Educ.: B.A.Sc., Univ. of Toronto, 1925; R.P.E. of Ont.: 1931-32, teaching automotive electricity, drafting and science, North Bay Collegiate Institute and Vocational School; with the Canadian General Electric Co. Ltd., as follows: 1925-26, test course, 1926, switchboard engrg. dept., 1926-27, distribution transformer engrg. dept., 1927-28, power transformer engrg. dept., 1928-30, apparatus sales dept., transformer section, 1934-38, panelboard engrg., Ward St. Works, 1938-40, panelboard engrg., Royce Ave. Works, 1940-42, acting supervising engrg., Royce Ave. Works, and at present, asst. industrial control engrg., Peterborough, Ont.

References: G. R. Langley, C. E. Sisson, D. V. Canning, J. Cameron, A. L. Malby, W. T. Fanjoy, B. I. Burgess.

BOUX—JOHN WILLIAM, of 450 St. Jean Baptiste St., St. Boniface, Man. Born at St. Boniface, Feb. 24th, 1916; Educ.: B.Sc. (Civil), Univ. of Man., 1940; 1940-42, tool and jig designing for fabrication and assembly of aircraft, aircraft plant layout, planning and control of production, etc., and at present, staff engrg., airport divn., Macdonald Bros. Aircraft, St. James, Man.

References: A. E. MacDonald, G. H. Herriot, W. F. Riddell, J. Hoogstraten.

KEANE—EDWARD JOSEPH, of Montreal, Que. Born at Ebbw Vale, Monmouthshire, England, June 2nd, 1900; Educ.: 1914-18, Technical Institute of Engineering, Ebbw Vale. 1914-19, apprenticeship—2 years, machine shops, 2 years, patent shop and foundry, 1 year, drawing office, Ebbw Vale Steel, Iron and Coal Co.; 1919-23, gen. engrg. draftsman, with same company; 1923-39, in practice on own account (partly architecture); 1939—, asst. chief mtce. engrg., Richard Thomas & Co., Monmouthshire; 1939-41, chief draftsman and tool designer, Edward Curran & Co., cartridge case makers, Cardiff, Waes, 1941-42, technical adviser and asst. mgr. of associated company, Curran Bros. Ltd., in Canada, and at present, director, secretary-treasurer and chief engrg., Paul Curran Limited (Canada).

References: F. W. Taylor-Bailey, R. S. Eadie, C. H. Timm, W. A. Bentley, D. N. Smith.

LAPERRIERE—J. MARCEL, of 632 Niverville St., Three Rivers, Que. Born at Three Rivers, Sept. 28th, 1914; Educ.: 1931-34, Technical School; I.C.S. Elec. Engrg. Course; with the Shawinigan Water & Power Company, as follows: 1934-36, ap'ticeship, 1936-38, draftsman and asst. tester, 1938 to date, transformer designer and tester, i/c testing floor, design and redesign operations, elec. repair dept.

References: J. H. Fregeau, A. C. Abbott, C. R. Reid.

## FOR TRANSFER FROM JUNIOR

ANDERSON—RODERICK VICTOR, of Niagara Falls, Ont. Born at Revelstoke, B.C., July 20, 1909; Educ.: B.A.Sc. (Civil), Univ. of British Columbia, 1931; 1928-29 (summers), asst., Geological Survey; 1930 (summer), drafting office, Dominion Bridge Co., Vancouver; 1934-35, chem. lab., drafting office, plant engr's office, Imperial Oil Ltd., Sarnia; 1935-40, asst. plant engr. and field engr., Tropical Oil Co., Barranca Bermeja, Colombia, S.A.; 1940-41, designing draftsman, Chemical Constrn. Corp., New York, on plant layout for chemical plant at Niagara Falls; 1941-42, mtce. engr. i/c spare parts dept., in same plant operated by Welland Chemical Works, and at present chief draftsman. (St. 1928, Jr. 1937).

References: A. M. Fennis, M. F. Ker, C. E. Carson, E. W. Dill, H. M. Rowe.

BAKER—JOHN ARTHUR, of Toronto, Ontario. Born at Innisfail, Alta., April 15, 1907; Educ.: B.A.Sc., Univ. of B.C., 1930; 1928-29, testing, Consolidated Mining & Smelting Co., Trail; 1930-33, commercial studies, Northern Electric Co., Montreal; 1933-36, radio testing, R.C.A., Victor and Canadian Marconi Co., Montreal, also radio service; 1937-38, sales engr., Taylor Electric Mfg. Co., London, Ont.; 1938-40, sales engr., Bepco Canada Ltd., Toronto; 1940 to date, inspr., Canadian Underwriters Assoc., Toronto. (St. 1930; Jr. 1938).

References: F. E. Regan, A. Matheson, V. A. McKillop, W. F. Auld, H. Lillie.

BROWN—WILLIAM EDWARD, of Hamilton, Ont. Born at Bristol, England, June 12, 1909; Educ.: B.A.Sc., Univ. of Toronto, 1932; 1929-30, progress estimates, Welland Ship Canal, St. Catharines; 1932-33, field engr., highway constrn., Rutherford & Ure, St. Catharines, Ont.; with B. Greening Wire Co. Ltd., Hamilton, Ont., as follows: 1933-34, workman, 1934-35, asst. foreman, 1935-37, foreman, rope shop; 1937-41, wire rope engr., engrg. dept.; 1941 to date, wire rope engr., sales dept. (Jr. 1934).

References: A. R. Hannaford, T. S. Glover, W. A. T. Gilmour, A. C. Macnab, S. Shupe.

BOUTILIER—ANDREW PRINGLE, of Sydney, N.S. Born at Sydney, March 7, 1909; Educ.: B.Eng. (Mech.), N.S. Tech. College, 1938; with Dominion Steel & Coal Corp., Sydney, as follows: 1926-28, rolling mills, 1928-30, roll turning apprentice, 1935-36, machinist apprentice, 1937 (4 mos.), draftsman, mechanical dept., coke ovens; 1938, fitter on plant constrn., design and constrn., coke ovens, 1939, engr., (steam) coke ovens and lubrication engr. for steel plant; 1938, 2nd Lieut., 1939-40, works officer and assistant chief works officer, and Jan. 1942 to date, chief works officer and officer commanding 3rd Fortress Co., R.C.E., with the rank of Acting Major. (Jr. 1939).

References: W. S. Wilson, J. A. MacLeod, J. H. Fraser, F. H. Sexton, S. C. Miffen.

CRAIG—WILLIAM ROYCE, of Vancouver, B.C. Born at Chicago, Ill., July 4th, 1909; Educ.: B.Sc., Univ. of Alta., 1933; 1930-34 (summers), rodman, chainman, instrumentman and draftsman, Lethbridge Northern Irrigation Dist.; 1934-35, highway gravel checker and instrumentman, Alta. Dept. Public Works, Macleod; with Canadian Sugar Factories Ltd. at Picture Butte as follows: 1935-36, surveyor during constrn. of factory, 1936, electrician and motor tester, 1937, res. engr., 1938-41, res. engr. at Picture Butte and Raymond, Alta.; 1941 to date asst. engr. in engrg. dept. of B.C. Sugar Refining Co., Vancouver, B.C. (St. 1933; Jr. 1938).

References: F. H. Ballou, P. M. Sauder, S. G. Porter, C. S. Clendening, J. Haimes.

CRAIN—HAROLD F., of Ottawa, Ont. Born at Ottawa, Feb. 28, 1908; Educ.: B.Sc., Queen's Univ., 1932; 1930 (summer), E. B. Eddy Co.; 1932-42, Crain Printers, Ltd., 1934 to date, vice-president in charge of production. Work mostly of management nature—has also laid out equipment and additions to building including preliminary plans for new building. (St. 1932; Jr. 1935).

References: W. S. Kidd, L. M. Arkley, L. T. Rutledge, W. H. Munro, N. B. MacRostie, H. E. Ewart.

EHLY—LUCAS JOSEPH, of Warspite, Alta. Born at Odessa, Sask., Aug. 1, 1908; Educ.: B.Sc., Univ. of Alta., 1941; 1928-36, chairman to instrumentman, 1937-40, highway engineer, Dept. of Public Works, Alta.; 1941-42, chem. engr., analytical and design, Royalite Oil Co., Turner Valley, Alta.; July, 1942 to date, res. engr., airport survey and constrn., Dept. of Transport, Lethbridge, Alta. (St. 1930; Jr. 1941).

References: R. S. L. Wilson, A. L. H. Somerville, J. W. Judge, N. W. Macpherson, J. L. Pidoux, H. LeM. Stevens-Guille, R. H. Goodchild.

HUMPHRIES—GEORGE EDWARD, Lieut., R.C.E., of Petawawa, Ont. Born at Wolverhampton, England, Dec. 31, 1907; Educ.: 1925-28, 1930-31, Wolverhampton and Staffordshire Technical College, Wolverhampton, Eng.; National certificate in Mechanical Engrg. from Inst. of Mech. Engrs., 1928; corres. course in civil engrg.; R.P.E. of Ont.; 1926-28 (summers), draftsman, Foster Bros. Ltd., England; 1928-29, detail draftsman, Hamilton Bridge Co.; 1929-30, structl. design, H.E.P.C. of Ont.; 1930, structl. design, McClintic Marshall Constr. Co., Pittsburgh; 1932, survey,

Dept. of Lands & Forests, Nor. Ontario: 1931-32, exploration and prospecting; 1932-33 and 1934-35, engr., Edwards Gold Mines Ltd.; 1933-34, supt., Milmac Mines Ltd.; 1935-40, design and constr., engr. in charge various mining metallurgical and power plants for Can. Comstock Co., Ltd., Toronto; 1940-42, 2nd Bn., R.C.E., C. A. Overseas; at present Lieut., R.C.E., A.5, R.C.E.T.C., Petawawa, Ont. (R.J. 1930).

References: S. W. Archibald, R. E. Kindersley, Ed. Hugli, W. B. Penneck.

DICK—WILLIAM ARTHUR, of Montreal, Que. Born at Glasgow, Scotland, June 20, 1914; Educ.: B.Eng., McGill Univ., 1937; 1935-36 (summers), apprentice engr., Thom, Lamont & Co., Hawkhead Engrg. Works, Paisley, Scotland; with American Can Co. as follows: 1937-39, asst. to machine shop foreman; 1939-40, mech. asst. in Genl. Mfg. Dept., Head Office, New York; 1940-41, asst. to plant engr., and 1941 to date, plant engr., Montreal factory. (St. 1937).

References: A. Ferguson, N. M. Barclay, S. E. Oliver, D. S. Scott.

DURANCEAU—CHARLES ARTHUR, of Montreal, Que. Born at Montreal, March 27th, 1913; Educ.: B.Eng., McGill Univ., 1937; with Duranceau & Duranceau, contractors, as follows: 1933-36 (summers) asst. to asphalt plant supt., and asst. to field engr. on Postal Terminal contract; 1937-40, civil engr. on constr. of various plants; 1940 to date, civil engr. and mgr., Chas. Duranceau Ltd., contractors. Work includes constr. of car repair shop for National Rlys. Munitions Ltd., additional concrete structures at the Montreal terminal station, asphalt and concrete pavements for the City of Montreal and Dept. of Roads, Prov. of Quebec. (St. 1937).

References: J. A. Lalonde, C. J. Leblanc, K. G. Cameron, R. Matte.

EDWARDS—MILTON CHALMERS, of Winnipeg, Man. Born at Lethbridge, Alta., Aug. 28, 1912; Educ.: B.Sc., Univ. of Alta., 1937; R.P.E. Alta.; 1935 (2 mos.), chairman, road survey, Prov. of Alta.; 1935-36 (summers) chairman, rodman, P.F.R.A., Lethbridge; 1937-38, graduate apprentice, 1938-42, sales correspondent, Canadian Westinghouse Co., Vancouver, telephone sales, entering orders and handling correspondence on same, making up quotations, checking estimates, stock control, etc. At present, signals officer, R.C.A.F. with rank of Flying Officer. (St. 1937).

References: J. T. Watson, J. Haines, W. E. Cornish, H. N. Macpherson.

ELLIS—GWILLYM LIONEL TOWNSHEND, of Toronto, Ont. Born at Edgeley, Sask., July 29, 1909; Educ.: B.Sc., Univ. of Sask., 1940; 1940 (10 mos.) inspr. with DeHavilland Aircraft Co., Toronto; 1941 (10 mos.) time study engr., Massey Harris Co. Ltd., Toronto; at present, asst. engr. with Weathermakers (Can.) Ltd., Toronto. (St. 1940).

References: I. M. Fraser, W. E. Lovell, N. B. Hutcheon, E. K. Phillips, C. J. Mackenzie.

EVANS—LESLIE MURRAY, of Esquimaux, B.C. Born at Halifax, N.S., Aug. 22nd, 1914; Educ.: 1932-37, special classes, N.S. Tech. Coll.; 1932-37, apticeship, fitter and turner, H.M.C. Dockyard, Halifax; 1938-42, i/c watch on various ships, 1940-41, on staff of resident naval overseer, Vancouver, i/c strength of material testing, testing and inspecting main and aux. mech. as asst. to overseer, and August 1941 to date, chief engine room artificer, Royal Canadian Navy, Halifax, N.S. (St. 1936).

References: G. L. Stephens, C. A. Anderson, B. Spencer, A. C. M. Davy, R. P. Donkin, S. J. Montgomery, A. D. M. Curry.

HINDLE—WALTER, of Hamilton, Ont. Born at Edmonton, Alta., Aug. 13, 1914; Educ.: B.Sc., Univ. of Alta., 1937; 1937-39, engr. apprentice, and 1940 to date, erecting engr., Canadian Westinghouse Co., Hamilton, Ont. (St. 1937).

References: J. T. Thwaites, D. W. Callander, H. Randle, T. D. Stanley, D. Anderson.

INGRAM—WALLACE WELLINGTON, of Montreal, Que. Born at Winnipeg, Man. June 17, 1917; Educ.: B.Sc., Univ. of Man., 1939; 1937-38 (summers), machine shop helper, Quality Bed & Spring, Winnipeg; with Phillips Electrical Works, as follows: 1939 (summer) inspr. and elect. tester; 1939-40, asst. to plant supt.; 1940-42, asst. foreman, lead and impregnating depts.; Feb. to May, 1942, high tension elect. tester; May-1942 to present, foreman, lead and impregnating depts. (St. 1938).

References: L. Trudel, L. A. Wright, R. Boucher, N. M. Hall, E. P. Fetherstonhaugh.

JACOBS—CLIFFORD ROY, of 811 Byers Ave., Joplin, Miss. Born at Edmonton, Alta., April 13th, 1913; Educ.: B.Sc. (Chem.), Univ. of Alta., 1939; 1930-36 (alternate years while attending univ.), carpenter's helper and timekeeper, Carlson's Building Co., and salesman, demonstrator and estimator, Moss-Tex Ltd.; 1939-40, standards checker and asst. control chemist, Swift Canadian Co. Ltd., Edmonton; 1940 to date, with the Inspection Board of the United Kingdom and Canada inspecting explosives by chemical means—1940-41, training at McMasterville, Que., 1941, chemist, at Memphis, Tenn., and Dec. 1941 to date, asst. to inspector in charge, at Joplin, Miss. (St. 1940).

References: I. F. Morrison, J. A. Allan, F. J. Hastie, R. M. Hardy, C. A. Robb.

JONES—DAVID CARLTON, of High River, Alta. Born at Calgary, Alta., Dec. 14, 1914; Educ.: B.Eng., McGill Univ., 1937; 1937 (May-Oct.) engr. office, Proctor & Gamble, Hamilton, i/c cost analysis and efficiency of steam, water and power; 1937-40, asst. shop and theory instructor in aeronautics, Prov. Inst. of Technology and Art, Calgary; 1940 to date, chief ground instructor and chief link instructor, High River Flying Training School. (5 E.F.T.S.). (St. 1937).

References: C. K. Hurst, J. B. deHart, F. N. Rhodes, S. G. Coultis, C. A. Cook.

KLODNISKI—NICHOLAS ALBERT, of Montreal, Born at Edson, Alta., Feb. 13th, 1915; Educ.: B.Sc., Univ. of Alta., 1937; 1937-40, constr. and mtee. electrician, International Nickel Co., Copper Cliff, Ont.; 1940-41, elect. foreman, H. F. McLean Co. Ltd. on DeSalaberry Island project for D.I.L.; 1941-42, engr. dftsmn., Canadian Natl. Rlys., Montreal. (St. 1937).

References: R. G. Gage, H. F. Finnemore, P. L. Mathewson, W. E. Cornish, C. A. Robb.

LaRIVIERE—MARCEL GERARD, of 1801 Edinburgh St., New Westminster, B.C. Born at Montreal, Dec. 9th, 1914; Educ.: B.Eng. (Civil), McGill Univ., 1936; 1936 (summer), cost dept., General Steel Wares Ltd., Montreal, 1937; temp. survey, Dept. of Agriculture, Vermont; 1937, asst. supt., highway constr., Troy Paving Co.; 1937-38, engr., Lalonde & Valois, constg. engrs., Montreal; at present, junior engr., Dept. of Public Works, Canada, New Westminster, B.C. (St. 1935).

References: W. E. Keyt, J. B. Lambert, R. Laferriere, J. A. Lalonde, K. M. Cameron, F. G. Goodspeed, E. W. Martin.

MARANTZ—OSCAR, of Winnipeg, Man. Born at Winnipeg, July 29, 1915. Educ.: B.Sc., Univ. of Man., 1942; 1941 (summer), asst. to city engr., St. Thomas, Ont.; 1942 (summer) dftsmn., design dept., S. and S. Aircraft Ltd., Winnipeg; at present, demonstrator, Faculty of Engineering, Univ. of Manitoba. (St. 1941).

References: A. E. Macdonald, G. H. Herriot, R. W. Moffat, W. F. Riddell, W. C. Miller.

MERCIER—JULES MATHIAS, of Peterborough, Ont. Born at Three Rivers, Que., Feb. 12, 1915; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1940; 1937-38, Montreal Metropolitan Commn., 1939 (summer) Shawinigan Water & Power training course; 1940-41, test course, 1941 to date, meter engr., Canadian General Electric Co. (St. 1938).

References: G. R. Langley, H. R. Sills, J. Cameron, I. F. McRae, D. J. Emery.

MORIN—ALPHONSE G., of St. Jacques, Que. Born at St. Camille, Que., Dec. 20th, 1910; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1939; R.P.E. Que.; 1937-38 (summers), instr. man., surveying party and geol. party; 1939 to date, res. engr. on road constr. contracts, Quebec Roads Dept. (St. 1938).

References: A. Graton, R. Boucher, A. Circe, R. St. Pierre, E. Gohier, R. Savary, J. A. Lalonde, T. J. Lafreniere.

MOULE—GERALD WILLIAM, of Verdun, Que. Born at Luton, England, March 23, 1915; Educ.: B.Sc., Univ. of Man., 1937; 1937-40, elect. dftng., Canadian Industries, Ltd., Montreal; with Defence Industries Ltd. as follows: 1940-41, elect. engr., Montreal; 1941-42, shift supervisor, Winnipeg; 1942 to date, elect. engr., Montreal. (St. 1935).

References: E. P. Fetherstonhaugh, K. C. Karn, A. G. Moore, C. R. Bown, W. W. Timmins.

McEOWN—WILBERT R., of St. Boniface, Man. Born at Bracebridge, Ont., Sept. 3, 1915; Educ.: I.C.S., Industrial Electricity; 1935-39, apprenticeship, Leaders, Ltd., mfrs. of elect. and mechl. equipment, Winnipeg; 1939-40, instrln. and mtee. industr. electr., Canada Packers, Ltd.; 1940 to date, inspr. of electricity and gas, Dept. of Trade & Commerce, Winnipeg, Man. (St. 1941).

References: E. V. Caton, C. P. Haltalin, L. M. Hovey, J. W. Sanger, H. L. Briggs, W. Beverly.

O'DONOUGHUE—GERALD, of Mt. Rainier, Maryland, Born at Montreal, Que., Mar. 23, 1915; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1939; 1938 (summer), surveying, 1939-40, surveying and constr. of sub grade highway, Quebec Roads Dept.; 1940-42, i/c of specifications and drawings, Inspection Board of the United Kingdom and Canada, Washington, D.C. (St. 1937).

References: J. A. Lalonde, A. Circe, P. P. Vinet, R. Boucher.

RAMSDALE—DONALD OSLAND DALLAS, of Halifax, N.S. Born at Montreal, Dec. 20, 1910; Educ.: B.Eng., McGill Univ., 1933; 1930, survey and transmission line constr., Montreal Light, Heat & Power; 1933-37, estimating, 1937-40, sales, erection and service engr., Becco Canada Ltd., Toronto; 1930-42, sales, erection, service and application engr., English Electric Co. of Canada. At present Prob. sub. Lieut., R.C.N.V.R. (St. 1933).

References: C. V. Christie, R. A. Yapp, F. E. Regan, J. D. Chisholm, G. Kearney.

ROBERT—ANDRE, of Arvida, Que. Born at Leask, Sask., Sept. 27, 1914; Educ.: B.Sc., Univ. of Man., 1938; 1938-39, junior engr., 1939-41, asst. power engr., Saguenay Power Co.; 1941-42, system, distribution engr., 1942 to date, system communication engr., Saguenay Transmission Co.; (St. 1938).

References: McNeely DuBose, F. L. Lawton, J. R. Hango, C. Miller.

WESTON—NORMAN OWEN, of Hamilton, Ont. Born at Calgary, Alta., July 3, 1913; Educ.: B.Sc., Univ. of Alta., 1935; 1936, Test Dept., 1937, correspondence dept., 1938-40, Illumination Divn., 1940-42, engr., dept. supervisor, Illumination Divn., Canadian Westinghouse Co. (St. 1935).

References: L. C. Sentance, D. W. Callander, J. T. Thwaites, J. R. Dunbar.

WRIGHT—AUSTIN MEADE, of Montreal, Que. Born at Montreal, July 17th, 1918; Educ.: B.Eng. (Elec.), McGill Univ., 1941; Summers—1937, labourer, Melba Gold Mines, Noranda; 1938, transmission line constr., Beauharnois, and 1939, substation generation and mtee., Three Rivers, Shawinigan Water & Power Co.; 1940, asst. to elec. engr., Noranda Mines; April 1941 to date, Sub-Lieut., R.C.N.V.R. 1941-42, Asst. Degaussing Officer, Halifax, and 1942 (May-Sept.), Asst. Chief Degaussing Officer, Naval Hdqrs., Ottawa. At present overseas. (St. 1938).

References: R. DeL. French, R. E. Chadwick, J. B. Challis, R. E. Heartz, A. S. Runciman, J. Morse, L. A. Wright.

HUTTON—JOHN ROBERT, of Hamilton, Ont. Born at Halifax, N.S., June 2nd, 1905; Educ.: B.Sc., (E.E.), N.S. Tech. Coll., 1927; R.P.E. Ontario; with Canadian Westinghouse Co. Ltd., Hamilton, as follows: 1927-29, graduate student apprentice, 1929-32, illumination sales engr., 1932-35, lamp sales correspondent, 1935 to date, lamp engr., manufacture and design and preparation of specifications of electric lamps. (St. 1925; Jr. 1935).

References: H. A. Cooch, D. W. Callander, E. M. Coles, J. R. Dunbar.

JOHNSTON—ORVAL ELLSWORTH, of Toronto, Ont. Born at Summerstown, Ont., March 16th, 1906; Educ.: B.A.Sc., Univ. of Toronto, 1934; 1926-30, dftsmn., H.E.P.C. of Ont.; 1932 (summer), field engr.'s asst., Marrow & Beatty Ltd.; 1934-36, engr. asst. to district civil engr., and 1936 to date, designing engr., H.E.P.C. of Ontario, Hydraulic Dept., Toronto. (Jr. 1936).

References: O. Holden, S. W. B. Black, E. B. Hubbard, S. Jackson, C. R. Young.

McCANN—WILLIAM NEIL, of Toronto, Ont. Born at Peterborough, Ont., June 16th, 1907; Educ.: B.Sc., Univ. of Man., 1934; 1931-32, transitman, Trans-Canada Highway Constr.; 1935-37, instrumentman, 1937-38, junior engr., 1938-40, asst. engr., P.F.R.A.; 1940-41, res. engr., Dept. of Transport, i/c Moose Jaw airport constr.; 1941 to date, engr., construction, refinery operation, McColl Frontenac Oil Co., Montreal. (St. 1930; Jr. 1936).

References: B. Russell, G. T. Chilcott, D. A. R. McCannel, F. Small, V. E. Thierman, S. H. Hawkins.

ODDLEIFSON—AXEL LEONARD, of Seven Sisters Falls, Man. Born at Winnipeg, Man., March 15, 1909; Educ.: B.Sc., Univ. of Man., 1931; with Winnipeg Electric Co. as follows: 1934-35, electrician's helper, Winnipeg, 1935-36, electrician, Great Falls, 1936-41, electrician, Seven Sisters, 1941 to date, junior engr., Seven Sisters, Man. (St. 1929, Jr. 1936).

References: A. S. Williams, L. M. Hovey, C. P. Haltalin, E. V. Caton, N. M. Hall, G. H. Herriot.

ROBERTSON—GORDON GERRARD DICKSON, of 205-2nd St. W., Calgary, Alta. Born at Winnipeg, Man., Dec. 30th, 1902; Educ.: 1925-32 (intermittent), Univ. of Alta., one year to complete B.Sc. (Mining); 1920-28, field and office work, Topog. Surveys, Dept. of the Interior; 1929, International Boundary Comm.; 1930, asst. on subdivisions, Topog. Surveys; 1934, layout and constr., Currie Barracks, Calgary, Dept. Nat. Defence; 1935 (6 mos.), Geol. Survey in Alta.; 1936 (4 mos.), design and install., mining, elec. and oil field equipment, Wilkinson and McClean Ltd., Calgary and Edmonton; 1936 (3 mos.), constr., absorption plant, British American Oil Co., Turner Valley; 1936, Geol. Survey of Canada; 1937, designer and computer, Mechanical Industries Ltd., Calgary; 1937, i/c field engr. and supervn. of test drill, for J. S. Irwin, constg. geologist; 1937-40, dftsmn., asst. on bridge design, etc., surveys and engrg. branch, Dept. of Mines & Resources, Banff, Alta.; 1940, field engr., Geol. Survey of Canada; 1940-41, dftsmn., engrg. records, etc., Alberta Nitrogen Co., oper. by Can. Mining & Smelting Co. for Dept. Munitions & Supply; 1941, dftsmn. and field engr. for J. S. Irwin; 1941 to date, dftsmn. and field engr., Imperial Oil Co. Ltd., Calgary, Alta. (St. 1928, Jr. 1936).

References: F. H. Peters, F. M. Steel, C. A. Robb, F. G. Bird, J. V. Rogers, H. W. Tooker.

SIMMONS—HERBERT JOHN, of London, Ont. Born at Kingston, Ont. Dec. 20, 1906; Educ.: B.Sc., Queen's Univ., 1931; R.P.E., Ont.; 1927-28-30 (summers) Canadian Locomotive Co., erecting shop; 1929 (summer), Ont. Dept. of Highways; 1931-32, instrumentman, Ont. Dept. Highways; with General Steel Wares Ltd. as follows: 1934 (May-Oct.), time study engr., Toronto, 1934-36, time study engr., London; 1936, supt. and produc. mgr., London. (St. 1934, Jr. 1936).

References: L. M. Arkley, L. T. Rutledge, W. M. Veitch, R. W. Garrett.

(Continued on opposite page)

## NOTICE

Technical personnel should not reply to any of the advertisements for situations vacant unless—

1. They are registered with the War-time Bureau of Technical Personnel.
2. Their services are available.

A person's services are considered available only if he is—

- (a) unemployed;
- (b) engaged in work other than of an engineering or scientific nature;
- (c) has given notice as of a definite date; or
- (d) has permission from his present employer to negotiate for work elsewhere while still in the service of that employer.

Applicants will help to expedite negotiations by stating in their application whether or not they have complied with the above regulations.

## SITUATIONS VACANT

**CHEMICAL OR METALLURGICAL ENGINEER** with flotation experience for work in fluoride department at Arvida, Que. Apply to Box No. 2592-V.

**ELECTRICAL ENGINEER** for plant and townsite electrical maintenance work at Mackenzie, British Guiana. Apply to Box No. 2596-V.

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.

**CONCRETE DETAILER** for Arvida, Quebec. Apply to Box 2597-V.

**MINING METALLURGICAL OR CHEMICAL ENGINEER** for aluminum plant at Arvida. Industrial smelting or mining experience for experimental and technical work and supervision in remelt and shipping departments. Apply to Box 2599-V.

**DESIGNING ENGINEER WANTED** for a permanent position as chief engineer with a machinery manufacturing concern in Eastern Canada. State age, salary expected and give details of past experience. Apply to Box No. 2604-V.

**MECHANICAL ENGINEER** for Arvida, Que., to take charge of repair and maintenance of equipment, ordering spare parts, etc. Apply to Box No. 605-V.

**CHEMICAL, MECHANICAL OR CIVIL ENGINEER** for Arvida, Que. Supervision of operations and labour in alumina plant. Apply to Box No. 2606-V.

**CHEMICAL ENGINEER** for Arvida, Que., to assist in the supervision of operations and labour in the aluminum fluoride plant. Apply to Box No. 2607-V.

**DRAUGHTSMAN** for La Tuque, Que., experienced in equipment installation to take charge of engineering work. Apply to Box No. 2608-V.

**CHEMICAL, METALLURGICAL OR MINING ENGINEER** for Beauharnois, Que. To assist pro-

duction superintendent in supervision of pot rooms. Apply to Box No. 2609-V.

**CHEMICAL ENGINEER** for Arvida, Que. Assist in supervision of process control of precipitation department. Apply to Box No. 2610-V.

**GENERAL DRAUGHTSMEN** to make layouts for various kinds of plant equipment including drives, etc., for important war work in Montreal. Apply to Box No. 2611-V.

## SITUATIONS WANTED

**ENGINEER, M.E.I.C., A.M.I.Mech.E.** Available for essential responsible position. Apply to Box No. 704-W.

**ENGINEERING MANAGER, B.A.Sc., M.E.I.C., Registered Professional Engineer, Canadian, married, 20 years' thorough experience in industrial management; mechanical and electrical construction and development, production planning, precision manufacturing, very well versed in organization methods. At present in complete charge of an extensive programme now nearing completion by a large company of designers formed in Toronto about a year ago. Really responsible position with well-established company desired. Available immediately. Will go anywhere. Apply to Box No. 2437-W.**

## PRELIMINARY NOTICE

(Continued from page 724)

**STEAD—HARRY G.**, of London, Ont. Born at Wilton Grove, Ont., Jan. 26, 1908; Educ.: passed E.I.C. Exams for Junior 1938, passed mil. exam. for qual. as Lieutenant, R.C.E.; London Tech. Sch. (night classes), corres. course, Br. Inst. of Science and Technology; R.P.E. of Ontario; with E. Leonard & Sons Ltd. as follows: 1923-27, apprentice dftsmn., 1927-31, mech. dftsmn., 1931-38, chief dftsmn., and 1938 to date, chief engr., i/c design estimates and all engrg. work on boilers, tanks, pressure vessels, high vacuum equipment, power plants, etc. (Jr. 1938).

References: E. I. Leonard, J. A. Vance, H. F. Bennett, R. W. Garrett, E. V. Buchanan.

**TAMES—JOHN ALEX.**, of Vancouver, B.C. Born at Kearney, Ont., Sept. 11th, 1900; Educ.: B.Sc., Univ. of Alta., 1925; 1927-42, Assoc., and 1942, Member, A.I.E.E.; 1918-19, dftsmn, rodman, G.T.P.Rly., Edmonton; 1924-25 (summers), instrumentman, Dom. Gov. Geo. Survey; with Canadian Westinghouse Co. as follows: 1925-27, apprentice course; 1927-28, industrial service, Vancouver service dept.; 1928-37, sales engr., industrial apparatus, and 1937 to date, sales engr., central station apparatus, Vancouver, B.C. (St. 1924, Jr. 1928).

References: F. H. Ballou, A. C. R. Yuill, H. J. MacLeod, J. P. Fraser, R. E. Potter, P. B. Stroyan, T. V. Berry.

**WARKENTIN—CORNELIUS PAUL**, of Sarnia, Ont. Born at Winkler, Man., Nov. 25, 1898; Educ.: B.Sc., Univ. of Man., 1926; R.P.E. Ontario; 1926-28, dfting. and designing, Good Roads, Man. Govt.; 1928 (6 mos.) hydrographic survey, Federal Govt.; with Imperial Oil Co. as follows: 1929-33, dfting, surveying and designing; 1933-35, engr. on refinery operations, Montreal; 1935-42 designing and supervising the design of Refinery Process Equipment, Sarnia, Ont. (St. 1924; Jr. 1927).

References: T. Montgomery, G. L. Macpherson, C. E. Carson, F. C. Mechin, R. L. Dunsmore.

## FOR TRANSFER FROM STUDENT

**ALEXANDER—ALWIN PAUL**, of Siderite, Ont. Born at Granum, Alta., July 9, 1909; Educ.: B.Sc., Univ. of Alta., 1933; 1933-37, operating service station; 1937-41, domestic and commercial wiring under own name; Jan. 1942 to date, asst. to chief electr., mtee. and constr. Iron Ore Sintering Plant of Algoma Ore Properties, Ltd., Helen Mine, Ont. (St. 1933).

References: A. J. Branch, N. H. Bradley, W. L. MacKenzie, H. J. MacLeod, W. E. Cornish.

**ARMSTRONG—HOWARD ELGIN**, of Rodney, Ont. Born at Rodney, Sept. 11, 1910; Educ.: B.Sc., Queen's Univ., 1942; 1940 (4 mos.) Canada & Dom. Sugar Co. Ltd., Montreal, records and reports of engrg. dept. and dfting; Sept. 1940 to Apr. 1941, records insp. dfting., Can. Car Munitions, Montreal; 1941 (3 mos.) junior engr., Allied War Supplies Corp., Montreal; 1941 to date, Lieutenant, 27 Field Company, R.C.E., C.A., Debart, N.S. (St. 1940).

References: D. S. Ellis, J. B. Baty, E. Wing, M. W. Huggins.

**BELLE-ISLE, JOSEPH GERARD GERALD**, of St. Bazile le Grand, Quebec. Born at Ste. Madeleine, Que., July 7, 1914; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1938; 1934-37 (summers), instrument man and res. eng., and leader of surveying party, Quebec Roads Dept.; 1938-40, asst. divnl. engr., Beauceville, and 1940-41, divn. engr. at Plessisville, Que. Roads Dept.; 1941-42, outside plant engr., Bell Telephone Co. of Canada, Montreal; at present, P/O, R.C.A.F., Rivers, Man. (St. 1938).

References: E. Gohier, L. E. Ennis, R. St. Pierre, A. Circe, H. Gaudefroy, A. Duperron.

**CONNOLLY—JOHN LAWRENCE**, of Mackenzie, Br. Guiana. Born at Sydney, N.S., May 6, 1913; Educ.: B.Eng., N.S. Tech. Coll., 1936; 1935 (summer), asphalt plant and highway inspr., Milton Hersey Co. Ltd., Montreal 1935-37, still fireman and still runner, asphalt stills, Imperial Oil Refinery, Dartmouth, N.S.; 1937-40, technical order editor and price setter, Special Products Dept., Northern Electric Co., Montreal; 1940 to date, asst. plant supt., Demerara Bauxite Co. Ltd., Mackenzie, Br. Guiana, S.A. (St. 1930).

References: R. E. Williams, T. H. Henry, R. W. Johnson, R. W. Emery, P. H. Morgan.

**CROOK—DONALD GORDON**, of New Westminster, B.C. Born at Rouleau, Sask., Mar. 19, 1915; Educ.: B.Sc., Univ. of Sask., 1941; 1933-35, inspn. of refinery products, chemical lab., Imperial Oil Ltd., Regina; 1935-37, refinery mtee. and constrn., and 1937-40 (summers) process man on refinery staff, Consumers' Co-operative Refineries, Regina; 1941-42, civilian aircraft inspr., Dept. of Natl. Defence for Air; at present, planning dept., Neon Products of Western Canada Ltd., i/c procurement of special tooling and essential standard tools as required on a Navy contract. Also safety engr. for the plant. (St. 1940).

References: R. A. Spencer, J. R. Hartney, D. A. R. McCannel, C. R. Forsberg, S. Young.

### A.C. WELDERS

Canadian Westinghouse Company, Limited, Hamilton, Ont., have just issued a 12-page bulletin, No. 3136, entitled "Westinghouse A.C. Welders." This bulletin is designed to emphasize the outstanding features of a.c. welders and to provide a guide to the selection of the proper equipment for many of the present industrial jobs. Action photographs show the welders being used for different classes of welding work, while other illustrations accompany detailed descriptions of the various models. A table of specifications is included.

### AIRCRAFT TUBE, PIPE & HOSE FITTINGS

An 102-page catalogue, No. A 300-A, recently published by Weatherhead Co. of Canada Ltd., St. Thomas, Ont., is divided into six sections and presents descriptive and tabular specifications covering the numerous items under each of the the following main divisions: Hose specifications; Army Air Corps and Navy standard hose assemblies; Miscellaneous hose assemblies; Naval Aircraft Factory tube fittings; A.C. 811 tube fittings; Pipe fittings and hose nipples. Illustrations and dimensional drawings are provided throughout the text.

### ALL-PURPOSE CLEANER

"Annite Red Label" is the title of a 4-page bulletin, No. 122, being distributed by Quigley Co. of Canada Ltd., Lachine, Que. This product is described as a highly active colloidal detergent all purpose cleanser which is effective in any water. Its application in a wide variety of cleaning jobs is described and illustrated. The company has also published a booklet entitled "Directions for Using Red Label Annite."

### COMBINATION SLITTING SHEARS, PUNCHES & BAR CUTTERS

A recently issued bulletin, No. 360, containing 24 pages, by Canadian Blower & Forge Co., Ltd., Kitchener, Ont., describes and illustrates the Buffalo "Armor-Plate" Universal Iron Workers, Nos. 0, 1/2, 1 1/2 and 2. All important features are designated on a large size illustration, while each unit is treated separately in detail. A two-page spread shows close-ups of features common to all units. A series of tables gives the capacities of each machine for different classes of work in various materials. These machines have both notching and coping operations available without changing tools.

### FUSES

An 8-page bulletin, No. 200-E, issued by Powerlite Devices Ltd., Toronto, Ont., describes the Schweitzer & Conrad type "SM" fuses for heavy duty—severe short circuit conditions. These fuses are manufactured in Canada by Powerlite Devices Ltd. Construction and operation features are given, accompanied by illustrations, and a series of drawings are provided with the tables of dimensions for various types of "SM" fuse holders.

### SPEED REDUCERS

Abart Gear & Machine Company, Chicago, Ill., have prepared a 20-page bulletin, No. 800A, describing their line of single reduction type, fractional horsepower worm speed reducers, with ratios 5 1/2 to 1 up to 100 to 1 and ratings of 1/50 to 2 h.p. Large illustrations, dimensional drawings and tables of horsepower ratings at input r.p.m. are included for each of the various horizontal and vertical types of units. A phantom drawing is used to describe the construction characteristics of these speed reducers. Enterprise Agencies Limited, Montreal, Que., have been appointed Canadian distributors for "Abart" products.

### GLOBE & GATE VALVES

Crane Limited, Montreal, Que., have for distribution Bulletin No. 5, in the series of bulletins entitled "Piping Pointers" designed and produced to help industrial maintenance men keep piping systems working at peak efficiency. Each bulletin presents, in a simple but effective manner, valuable information on some important feature of pipe line maintenance. Five such bulletins have been issued to date and all are available upon application to the company. They are excellent for training purposes and for posting on shop bulletin boards.

### HEATING ECONOMY HINTS

C. A. Dunham Co., Ltd., Toronto, Ont., have issued a 24-page book in looseleaf form, presenting a brief and timely survey of the possibilities of fuel saving by the proper maintenance of heating plants now in service, with suggestions which may bring economies of value to plant owners and to the nation in wartime. Based on statistical data the subjects of day and night temperature, balanced heat distribution, proper circulation, and insulation, are discussed, while suggestions are included for the care of equipment.

### INSULATIONS FOR ELECTRICAL EQUIPMENT

A 16-page bulletin prepared by Fiberglas Canada Ltd., Oshawa, Ont., designated as Fiberglas Standards H9.3.1, features the use of various "Fiberglas" products as insulating material in the manufacture of electrical equipment. Describing, first, the forms in which "Fiberglas" insulations are made, it then gives detailed descriptions of the application of these products for the insulation of wires, coils for motors and generators, ground insulation, transformers, etc. Descriptive drawings, photographs and tables are included.

### PLASTERING

A 20-page booklet prepared by Gypsum, Lime & Alabastine, Canada, Ltd., Toronto, Ont., presents historical facts, development of methods and materials and present-day achievements in the art of plastering. Many illustrations accompany the descriptions of: types of plaster work; texture finishes; ornamental work; acoustical plasters; exterior stucco; bases for plaster; how construction details affect plastering; conditions affecting quality, and the merits of plastering.

### INDUSTRIAL MEASUREMENT AND CONTROL INSTRUMENTS

A 48-page catalogue, No. 95-A, has just been published by The Foxboro Company, Ltd., Ville LaSalle, Que. This is the most comprehensive bulletin the company has ever issued, describing its full line of instruments for the measurement and control of industrial process conditions. The contents have been arranged to make it easy for the user to choose the type of instrument best fitted to his needs. There are over two hundred illustrations. It comprises ten sections, six of them grouping and describing all the instruments, accessories and supplies appropriate to a particular field of application, such as Temperature, Flow, Pressure, Level, Humidity; while the remaining sections cover combination instruments, valves, instrument panels, and similar subjects. Thorough cross-indexing of the contents, plus an ingenious use of colours, makes it a convenient and useful reference handbook of modern instrumentation.

### DRILLING MACHINES

Canadian Blower & Forge Co., Ltd., Kitchener, Ont., have issued a 12-page bulletin, No. 2989-E, which features the Buffalo "No. 22" drill, with large size illustrations of various types, including round column and pedestal, sensitive and power feed, single and multiple spindle types. Detailed specifications are included covering drive, spindle assembly, sliding head, feeding mechanism and control, column, tables and bases, lubrication, motor and controls, capacity, and safety features. Dimensional drawings and available special equipment are also shown.

### MODERN LABORATORY APPLIANCES\*

Fisher Scientific Co., Ltd., Montreal, Que., have prepared a 966-page catalogue, No. 90, with hard cloth cover. This book of Modern Laboratory Appliances is much more than a catalogue; it is really a technical reference book of all types of apparatus and appliances required for chemical, metallurgical and biological laboratories. In it are described and illustrated the latest and most-up-to-date laboratory supplies, of which large stocks are maintained in Montreal. Obviously the items covered are far too numerous to mention here. Well over 3,500 illustrations with accompanying descriptions and reference data are included and the material, which complete, is condensed to provide more valuable information in fewer pages than used in previous editions.

\*NOTE: This catalogue is available only to Canadian organizations maintaining a laboratory, to whom it will be mailed without charge.

### SOFT PLAITED COIL PACKING

A 4-page bulletin issued by The Anchor Packing Co., Ltd., Montreal, Que., features Anchor "Angora", which is a soft plaited coil packing made from cotton and wool yarn, impregnated by a special process with graphite and lubricant. It is an ideal packing for circulating pumps, boiler feed pumps, stock pumps, white water pumps or other rotary type equipment handling non-destructive liquids.

### LECTURES AVAILABLE FOR PRESENTATION

Canadian General Electric Co., Ltd., Toronto, Ont., has published in a 4-page folder details describing a series of fourteen lectures which are designed for presentation, by C-G-E speakers only, before engineering societies, service clubs, and industrial and other groups. The company states that these lectures are presented without charge and that, while it may not be possible to accept every request, arrangements will be made for as many as possible. The folder gives the name of author and a brief outline of the subject of each of the lectures, which are identified by the following numbers and titles: (1) "Magic of the Spectrum"; (2) "Electricity in Modern Warfare"; (3) "Plastics"; (4) "Cemented Carbide—The Magic Metal"; (5) "Electric Heating in War Industries"; (6) "Some Recent Trends in Industrial Applications of Electricity"; (7) "Win the War with Welding"; (8) "Infra-Red Drying"; (9) "Power to Win"; (10) "Fluorescent Lighting"; (11) "Electronics in Industry"; (12) "Radio and Television To-day"; (13) "Power Factor Control and Correction"; (14) "The Story of Lightning." The time required for each lecture is given, and also a list of three sound film lectures which are available. This folder and additional information are available on request.







