GEOLOGICAL SURVEY OF CANADA

ROBERT BELL, LL.D., M.D., D.Sc. (CANTAB.), LL.D., F.R.S.,

THE MINERAL PIGMENTS OF CANADA

BY

C. W. WILLIMOTT.

OTTAWA

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To Robert Bell, I.S.O. M.D., D.Sc. (Cantab), LL.D., F.R.S., &c.
Acting Director Geological Survey of Canada.

Sir, -I beg to submit herewith the report of some experiments with the various pigments that can be derived from minerals, ochres and clays, either in their crude state or by burning.

I have the honour to be, Sir,
Your obedient servant,

C. W. WILL MOTT.

Ottawa, May, 1905.

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THE MINERAL PIGMENTS OF CANADA.

This work was commenced about two years ago when experiments were made on such number of ochres, clays and other minerals as were thought might possess sufficient colouring matter. Each substance was reduced to a fine powder and then ground in rectified linseed oil. The paint thus obtained was applied to the surface of academy board and allowed to stand exposed to sunlight and dampness for two years. This year all the preceding substances were again ground in oil, and the fresh paint was compared with those that had been exposed, when it was found some interesting changes had taken place, more particularly with the unburnt ochres. Some of these had changed their tints entirely, others were more or less darkend, while a great number remained permanent. A noticeable feature, however, with nearly all the ochres is their tendency to darken, rather than lighten, after long exposure, which is invariably the case with imported pigments.

That the class of pigments at present in use in the majority of cities of Canada is of very inferior quality no one who knows anything of the pigment trade will seriously deny. Most of the imported paint is adulterated to an almost incredible degree. A sample of Venetian red in this city examined by me did not contain per cent of the sesquioxide of iron. Allowing some 20 per cent for colouring matter, it would then be adulterated to the extent of about 60 per cent. How different is this from the pigments sometimes used by first-class consumers! Take, for instance, the Pennsylvania Railroad Company. Their specifications stipulate for paints that show no adulteration at all. Their freight car colour consists of

Sesquioxide of iron	25	per cent	by weight.
Inert material	7½	" "	
Carbonate of lime	3½	" "	

Their Tuscan red must contain the greatest possible amount of the sesquioxide, a quantity of carbonate of lime ranging between 3 and 5 per cent, and organic colouring matter not exceeding 15 per cent. For this particular colour they refuse any paint that contains less than 75 per cent of the sesquioxide.

It is bad enough to know that the pigment trade of Canada insists on highly adulterated goods, but if the trade must have such inferior colours at least let us do our own mixing. We have all the inert materials at hand—gypsum, silica, serpentine, soapstone, asbestine, etc.—all of which may be used judiciously in the light coloured paints but must be shunned in the darker or heavier ochres, if the depth of colour is to be sustained.

Not only, however, may the inert material be found in abundance in this country but the paint material itself is so frequently met with and is in general so easily mined that it is altogether surprising so little advantage is taken of the resources that nature has laid, so to speak, at our doors. Indeed, the quality of our ochres is so superior that there is no real reason why any inert material should be used at all. In the following pages are included the more important results of experiments on some hundreds of samples of our Canadian ochres. They are given in the hope that they may help the paint manufacturers of Canada to give the home produce a chance and they are written with a view to show that in almost every colour a paint of good body and permanent tone may be produced.

Over two hundred samples of clays collected between the Atlantic and Pacific oceans were tested for their colouring properties. Each sample was ground to a fine powder, a portion of which was used in its raw state, another portion being exposed for fifteen minutes to the heat of a blast lamp, the results of which will be found embodied in the following pages. Many of the crude clays were found to possess ample bodies and colours to constitute good paints, and though their durability may be safely predicted, it can only be determined by prolonged exposure. The same may be said of the burnt material, but it is reasonable to expect that their permanency may be regarded with less doubtful apprehension.—on account of the destruction of all organic matter.

The colours "yellow," "brown" and "brown yellow" referred to so often in the following pages are in tone similar to the raw sienna of commerce but vary very much in each case, although some good typical raw sienna colours were obtained from the burnt clays.

Numerous experiments have been made with such minerals as were thought to possess sufficient body for making paints. Each mineral was reduced to a fine powder, ground in oil on plate glass to the consistency of ordinary paint and then applied to the surface of academy board, which was allowed to stand for about two years exposed to sunlight and damp, but in the interior of a building. The results of this

procedure will be given under each mineral so treated. Besides using these minerals in their crude state each one, after previous grinding, was exposed for about fifteen minutes to the heat of a blast lamp and many brilliant colours were obtained by this oxidizing process.

It would appear from remarks made from time to time by interested paint manufacturers that they look for material that is suitable for their particular machines rather than provide machines suitable for the material. I have found, that, although many of our ochres and clays are free from grit, it is present in others. In condemning those containing gritty material that, in many cases, does not constitute one per cent and which cannot possibly detract from its body, some of the most valuable pigments must be ignored. I found no difficulty in reducing these ochres and clays, and, although they appeared gritty in grinding they eventually made a perfectly smooth paint. I have also heard from paint manufacturers that we have no Canadian ochres fit for use, more especially yellow ochre. To a certain extent this is true respecting this particular colour for although we have many bright coloured ochres which have the desired shade when in dry powder, they become brownish when ground in oil. If this ochre be mixed with forty to sixty per cent of some light coloured material such as clay, gypsum, etc., it will then be found to possess a larger percentage of oxide of iron than most of the imported material and will at the same time produce the desired shade of colour. I may mention that a sample of imported yellow ochre, purchased in this city, was found to be extremely gritty, much more so, indeed, than many of our local ochres. Mr. M. F. Connor found it to contain seventy-five per cent insoluble and ten per cent of oxide of iron; from this we may infer that either a ferruginous clay, or a clay mixed with ochre, was used.

Many of our metallic minerals, when ground in oil, were found to possess very strong covering bodies, several of which will cover well with one application. The questions naturally arise, will those colours stand, most of them being subject to oxidation by the atmosphere: and what length of time will be required to cause this oxidation. Judging from my observations of minerals exposed to the atmosphere in the Museum yard, their deterioration would require a greater lapse of time than is required to deface our modern paints.*

About two years ago I discovered that magnetic iron ore, when ground in oil, had a very strong body and would cover almost any

* When pointing out the durability of some of these metallic paints to a certain paint manufacturer he replied that the paints that required renewal every two years were those mostly supplied.

surface with one coat. Last year, I believe, magnetic iron ore, said to come from Lake Champlain, was being ground in Pennsylvania for making paint.

BLACK.

Pyrolusite.—Tennycape, Hants Co., N.S.

This mineral is easily reduced to a fine powder and when ground in oil, makes a very good black paint of an extra strong body,—if the mineral be previously burnt, the colour is somewhat enhanced. This has not been tested for exposure.

If this black, particularly the unburnt mineral, be mixed with white, it makes fine, warm grays.

Pyrolusite is found at several places in Nova Scotia in segregated accumulations in the Carboniferous, but the high price of this mineral will probably preclude its use as a paint.

Stibnite.—Rawdon, Hants Co., N.S.

This mineral is easily ground in oil, and makes a blue black paint of very good body. It lightens slightly on exposure. In a deposit known as the West Gore Mine Hants Co., N.S. a vein of this mineral about six feet wide occurs in talcose slate, and has been worked at intervals. This mineral is also found at Prince William in New Brunswick and in South Ham in Quebec. Mining operations were carried on some years ago in both these provinces.

Chalcocite.—Dorchester, Westmorland Co., N.B.

This mineral is rather easily reduced to a powder, and when ground in oil, makes a very good black with a heavy body, and is permanent after exposure. It is generally accompanied by the oxide or carbonates and although their presence will not detract from its usefulness as paint they will naturally tend to modify both its colour and durability.

Chalcocite is found associated with ores of copper in nearly all the provinces and has been worked as an ore of copper in several of them. —See Chalcocite, under Brown.

Manganite.—Jordan Mt., Sussex, Kings Co., N.B.

This mineral is easily reduced to fine powder, and when ground in oil, makes a grayish black paint, with strong covering body. Its tones are slightly bluish and become almost imperceptibly lighter after exposure. If the mineral be previously roasted and then ground in oil, its colour is greatly intensified ; when mixed with white, it produces fine, warm gray tints, and has a body stronger than lamp-black.

This ore occurs in pockets and lenticular masses near the contact of the Carboniferous and older rocks, on the southeast side of Jordan mountain and has been worked to some extent.—(See Report, 1878-79, p. 24 D). It also occurs under similar conditions in several places in the province of Nova Scotia.

Ilmenite.—St. Urbain, Bay St. Paul, Charlevoix Co., Que.

If this mineral be reduced to a fine powder and ground in oil it makes a gray-black paint with a strong body, and is permanent after exposure. It sometimes contains grains of rutile and, although this does not detract from its quality, it will of course help to make the black much warmer.

At St. Urbain, this mineral constitutes a bed ninety feet thick. About thirty years ago, blast furnaces were erected to smelt the ore, but were not successful.

Cement-Stone.—Quebec City, Quebec.

If this stone be reduced to a fine powder and then ground in oil, it produces a very good black paint, suitable for outside use. It has a fairly good body and is unchanged after exposure.

There are large deposits of this argillaceous limestone in the City of Quebec that have been worked almost continuously during the past forty years for making cement. See Report 1863, p. 805.

Bornite.—Leeds, Megantic Co., Que.

If this mineral be reduced to fine powder and then ground in oil, it makes a very good brown-black paint of a strong body, which lightens a little after exposure. If the mineral be roasted before it is ground in oil its colour is more intense and blacker; if these colours be mixed with white, their middle tints are purplish and their lower tints very warm grays.

Bornite is often associated with other ores of copper, as at the old Harvey Hill Mines in Leeds, where it is frequently mixed with copper pyrites, although large pockets of Bornite occur free from the yellow sulphide. This mineral is met with in several other places in the Province of Quebec. Parry sound, Ont., and Howe sound, B.C. may be cited as the more prominent localities where this mineral is known to occur, but it is found in other places in British Columbia as also in the Yukon.

Magnetite.—Haycock Mine, Templeton, Wright Co., Que.

If this mineral be reduced to a fine powder and then ground in oil it makes a gray black paint of a very strong body, and is permanent after exposure.

Magnetite occurs in veins, (in a highly feldspathic gneiss), which are from a few inches to several feet in thickness. This property was first opened in 1872. At that time extensive preparations were made to smelt the ore on the spot. Charcoal furnaces and other accessories were constructed, but the venture, so far as I can learn, was not attended with success. The mine has recently been acquired by Mr. J. O. Hibbard, of Detroit, U.S.

The localities from which magnetite has been derived are too numerous to mention in detail. It is found in nearly all the Provinces of the Dominion but has been more particularly developed in Ontario.

Arsenopyrite.—Marmora Tp., Hastings Co., Ont.

This mineral is rather easily reduced to a fine powder and when ground in oil, makes a grey black paint which lightens, on exposure, to a greenish black; it has a very good body. If this black be mixed with white, its tints are decidedly purple.

Arsenopyrite is generally associated with the auriferous rocks, sometimes forming the gangue of gold. It occurs in the township of Marmora in some quantity and is also found in the Provinces of Nova Scotia, Quebec, and British Columbia.—See Arsenopyrite under "Brown Red."

Pyrrhotite—Blezard Tp., Nipissing dist. Ont.

This mineral grinds rather easily and, when ground in oil, makes a gray black paint of a strong covering body, but develops, on exposure, grayish streaks that mar its uniformity.

As this mineral is widely distributed throughout the Dominion, it is needless to mention any particular locality, but it is found more particularly developed in the Sudbury region where it is mined for the nickel it contains. See Pyrrhotite under Indian Red.

Anthracite.—Anthracite, Alberta.

This mineral requires a little time to reduce it to a fine powder. It must then be thoroughly dried and ground in oil, when it makes a black of fairly good body. It has not been tested by any lengthy exposure.

Galena.—Grover claim, Slocan, West Kootenay, B. C.

If this mineral, free from impurities, be ground in oil it makes a very fine blue black paint of extra strong body, with exceedingly good covering properties and is apparently unchanged on exposure. The colour is not changed after roasting.

Galena has a very wide range throughout the Dominion, being found in nearly all the provinces. I shall not therefore attempt to particularize any locality, for no doubt its properties as a paint will vary little from whatever source it be obtained.

RAW UMBER.

Iron ochre.—East Chester, Lunenburg Co., N. S.

This ochre which is free from grit and which, when ground in oil makes an excellent raw umber paint, has good covering properties, is almost permanent and should commend itself to all manufacturers of paints.

Small quantities of this ochre have been used locally for several years from deposits which occur at different points along St. Margarets Bay. Their relative thickness and area have not been ascertained. See Iron Ochre under Burnt Umber.

Limonite.—Londonderry, Colchester Co., N. S.

This sample was very much oxidized, and when reduced to powder and ground in oil assumed a distinctly brown colour which can be referred to burnt umber, but after exposure its tone changed to that of raw umber: it has a very strong body.

Limonite occurs as a decomposition product resulting from the alteration of the siderite and ankerite that occur in veins and segregated accumulations, more particularly in the counties of Colchester and Pictou, Nova Scotia. This mineral is found in many places in these counties and minute descriptions of its mode of occurrence and working are elaborately dwelt on in the Reports of the Geological Survey. See particularly Report 73-74. See Limonite under Brown Red, Brown Ochre and Indian Red.

Bog Manganese.—(Wad). Mechanics Settlement, Hillsborough, Albert Co., N.B.

This is slightly gritty but easily reduced to a fine powder and when ground in oil produces a dark brown paint approaching raw umber but with a warmer tone. It has a good covering body and is but little changed after exposure. This deposit covers an area of from eighteen to twenty acres and is from a few inches to thirty feet in

thickness, covered with a few inches of vegetable matter. This has been used in a briquetted form in the manufacture of spiegeleisen and ferro-manganese. See Bog Manganese under Vandyke brown.

Chromite.—Coleraine, Megantic Co., Que.

If this mineral be reduced to a fine powder and then ground in oil, it produces a raw umber, of a middling body, which, however, darkens and changes to a Vandyke brown after exposure.

Chromite is known to occur in the counties of Brome, Wolfe and Megantic, Que., and on Mount Albert in Gaspé peninsula: it was recently worked in the township of Coleraine, where it occurs in accumulative bodies in serpentine. The extracted ore, which is used as a source of chrome, was shipped to Baltimore, U.S.

See Chromite under Vandyke Brown. For Chrome colours see pages 31, 32.

Ferruginous Clay.—St. Malo, Champlain Co., Que.

This clay (which is worked by the Canada Paint Company of Montreal) is free from grit, and, when ground in oil, produces a raw umber of a good body, but darkens very much on exposure. See Ferruginous Clay under Indian Red.

BURNT UMBER.

Iron Ochre.—East Chester, Lunenburg Co., N.S.

If this ochre, which is free from grit, is burnt and then ground in oil it produces a rich burnt umber paint, somewhat stronger in body than the raw, and is almost permanent, and, like the raw, (which see, page 11), should commend itself to all pigment manufacturers. See Iron Ochre under Raw Umber.

Ankerite.—Londonderry, Colchester Co., N.S.

This mineral in the raw state has not much body, but if it be reduced to a fine powder (which is accomplished without much difficulty) and then roasted, it makes a very fine burnt umber paint of an extra strong body and which has remained unchanged after exposure.

This mineral occurs in veins and segregated accumulations near the contact of the Carboniferous and older rocks, more particularly in the counties of Colchester and Pictou, N.S. See Report 1873-4.

Siderite.—Londonderry, Colchester Co., N.S.

This mineral has no body in its raw state, but if it be reduced to a fine powder and roasted, and then ground in oil it makes a very fine

burnt umber paint of an extra strong body and has remained unchanged after exposure. This mineral often occurs associated with ankerite in veins and accumulated masses near the contact of the Carboniferous and older rocks, particularly in the counties of Colchester and Pictou, N. S. See Report 1873-74.

Clay.—Limehouse, Halton Co., Ont.

This sample, which has a greenish-gray colour and is free from grit, has no body in itself, but, when mixed with white it makes some delightful gray tones that could be obtained only by the most expert artist. If this clay be burnt and then ground in oil it makes a light-bodied burnt umber which has remained permanent after exposure. This material was used some years ago by Mr. James Newton, Paint Manufacturer, Limehouse, Ont.

Siderite.—Helen mine, Michipicoten, Algoma, Ont.

This mineral in itself is of little use as a pigment except when mixed with a small proportion of the oxide: it then produces some nice shades of the umber. If it be roasted and then ground in oil it makes a good burnt umber with a strong covering body. This has not been tested for any length of time but it will probably darken a little. Three samples were tried from the above locality.—(*a*), siderite, (*b*) siderite slightly oxidized, (c) Weathered oxide; the best and brightest colours were obtained from the pure burnt siderite, although all three had very good covering qualities. This mineral occurs on the summit of Hematite mountain about eleven miles from Michipicoten harbour, and is supposed to be in some quantity.

Clay Iron Stone.—Edmonton, Alberta.

This mineral is easily reduced to a fine powder and when ground in oil has apparently very little body, but when exposed for a year or two it assumes a raw umber tone. If this mineral be burnt and then ground in oil, it makes a good burnt umber of very good body, and is permanent. It is widely distributed in Alberta and Saskatchewan associated with the coals and lignites, often in considerable quantity and is found in the provinces of British Columbia, Quebec and Nova Scotia.

BROWN.

Chalcocite.—Dorchester, Westmorland Co., N.B.

If this mineral be reduced to a powder, then roasted and ground in oil, it makes a paint of a dark brown colour, having a very good covering quality; if this be mixed with white it makes a good substitute for bone brown. See Chalcocite under Black.

Ferruginous Rock.—Sackville, Westmorland Co., N.B.

This rock is easily reduced to a fine powder and is free from grit. When ground in oil it produces a fine brown paint although, when mixed with white, its tints are decidedly pinkish. It has a very good body and is permanent. If the rock be previously roasted its colour is greatly enhanced and slightly redder.

Sphalerite. Calumet Island, Pontiac Co., Que.

This mineral was mixed with a small quantity of galena, and when ground in oil, made a fine brown paint resembling the middle tones of Cappagh brown ; it has a good covering body and is permanent after exposure.

Sphalerite was mined rather extensively for zinc, some years ago, by the Grand Calumet Mining Co. See Sphalerite under Yellow Ochre.

VANDYKE BROWN.

Bog Manganese;—(Wad). Mechanics Settlement, Hillsborough, Albert Co., N.B.

If this wad be burnt and then ground to oil it produces a very good Vandyke brown with a heavy body. This would probably be permanent. See Bog Manganese under Raw Umber

Chromite.—Coleraine, Megantic Co., Que.

If this mineral be reduced to a fine powder and roasted and then ground in oil, it will produce a fine Vandyke brown of a good body which remains unchanged on exposure. When mixed with white, its various tints will be found to compare with the best known commercial colours. See Chromite under Raw Umber.

BROWN OCHRE.

Limonite.—Londonderry, Colchester Co., N. S.

This mineral is easily reduced to a fine powder and when ground in oil makes a brown ochre paint of very strong body, but changes its tone entirely after exposure, without darkening.

See Limonite under Brown Red, Indian Red and Raw Umber.

Iron Ochre.—Cap de la Madeleine, Champlain Co., Que.

This ochre was found to be free from grit and when ground in oil produced a brown ochre paint of a heavy body which, however, darkens considerably on exposure.

See Iron Ochre under Burnt Brown Ochre and Burnt Sienna.

Iron Ochre.—Cap de la Madeleine, Champlain Co., Que.

This sample was found to be a little gritty but, when ground in oil, produced a smooth paint of a brown ochre colour, which when mixed with white produces tints of yellow ochre and has a very good body.

See Iron Ochre under Burnt Sienna.

Iron Ochre.—Pointe du Lac, St. Maurice Co., Que.

This ochre was found to be free from grit and when ground in oil made a brown ochre paint of a light body, which slightly darkened on exposure. See Iron Ochre under Cappagh Brown, Caledonian Brown, Burnt Brown Ochre, and Burnt Sienna.

Bog Iron Ore.—Mallorytown, Leeds Co., Ont.

This mineral is free from grit and when ground in oil makes a brown ochre paint of a very strong body and is unchanged after exposure.

A similar colour was prepared some years ago by the Leeds Paint Manufacturing Co., Leeds Ont. See Bog Iron under Burnt Sienna.

Iron Ochre.—Ste. Anne de Montmorenci, Montmorency co., Que.

This ochre is comparatively free from grit and when ground in oil produces a brown ochre paint of a middling body, but darkens considerably on exposure.

See Iron Ochre under Burnt Sienna and Raw Sienna.

Limonite.—Helen Mine, Michipicoten, Algoma, Ont.

When this mineral is reduced to a fine powder, and then ground in oil it makes a brown ochre paint of a very good body and is but slightly darkened after exposure.

Iron Ochre.—Six or seven miles south of summit of Crowsnest pass, Rocky Mountains.

This ochre is slightly gritty but easily reduced to a fine powder and when ground in oil produces a very good brown ochre paint of a middling body that darkens very slightly on exposure.

See Iron Ochre under Prussian Brown.

BURNT BROWN OCHRE.

Iron Ochre.—Pointe du Lac, St. Maurice Co., Que.

This ochre was found to be free from grit: when burnt and ground in oil it makes a burnt-brown ochre paint of a weak body which darkens very much on exposure.

See Iron Ochre under Cappagh Brown, Caledonian Brown, Brown Ochre and Burnt Sienna

Iron Ochre.—Cap de la Madeleine, Champlain Co., Que.

This ochre was found to be free from grit. It was then burnt and ground in oil and produced a paint which I shall provisionally call burnt-brown ochre; it has a very strong body and is almost permanent.

Iron ochre extends in this neighbourhood over an area of 600 acres, is interstratified with peat and underlaid by shell marl and affords several different colours.

See Iron Ochre under Brown Ochre and Burnt Sienna.

PRUSSIAN BROWN.

Iron Ochre.—Cote St. Charles, Vaudreuil, Vaudreuil Co., Que.

This ochre is rather gritty in grinding but is otherwise easily reduced to a powder. When this is burnt and then ground in oil it makes a paint resembling prussian brown, of a good body and permanent after exposure.

See Iron Ochre under Raw Sienna.

Iron Ochre.—Six or seven miles south of summit of Crowsnest pass, Rocky Mountains.

If this ochre be burnt and then ground in oil, it produces a prussian brown paint of a strong body with both clear and bright tones. It is unchanged on exposure.

This sample was sent in by Mr. W. T. Jenning and is said to occur in some quantity. See Iron Ochre under Brown Ochre.

Iron Ochre.—Harrison lake, about 20 miles north of Hot Springs, B.C.

This ochre is slightly gritty in grinding and when ground in oil produces a paint resembling prussian brown, of a very good body and darkening but slightly on exposure.

Sample sent by Mr. John P. Brown.

CALEDONIAN BROWN.

Iron Ochre.—Pointe du Lac, St. Maurice Co., Que.

This ochre was found to be free from grit and when burnt and ground in oil makes a good caledonian brown, of a middling body which is darkened but slightly by exposure.

In the St. Nicholas range of the above seigniory several hundred acres are covered with various colored iron oxides varying in thick-

ness from six inches to four feet, with perhaps an average of eighteen inches. See Iron Ochre under Cappagh brown, Brown Ochre, Burnt brown Ochre and Burnt Sienna.

CAPPAGH BROWN.

Bog Iron Ore. Ste. Anne de Montmorenci, Montmorency Co., Que.

This is free from grit and grinds easily in oil to a brown paint resembling Cappagh brown; it has a middling body, and is only slightly darkened on exposure. See Bog Iron Ore under Verona Brown, Brown Red and Burnt Sienna.

Iron Ochre.—Pointe du Lac, St. Maurice Co., Que.

This ochre was found to be free from grit and when ground in oil made a paint resembling Cappagh brown; it has a fairly good body but darkens a little on exposure. See Iron Ochre under Burnt Sienna, Caledonian Brown, Brown Ochre and Burnt Brown Ochre.

YELLOW OCHRE.

Iron Ochre.—Carleton, Bonaventure Co., Que.

This ochre was found to be free from grit and when ground in oil made a typical yellow ochre paint; it has a middling good body and is only slightly darkened after exposure.

Sphalerite,—Calumet Island, Pontiac Co. Que.

This mineral, mixed with a small quantity of galena, then reduced to a fine powder and burned and then ground in oil, produces a yellow ochre paint, but if mixed with white it produces tints of Caledonian Brown; it has a very good body but has not been tested for exposure.

See Sphalerite under Brown.

Iron Ochre.—Walsingham, Norfolk Co., Ont.

This ochre is slightly gritty in grinding but otherwise it is easily reduced and when ground in oil produces a yellow ochre paint of a middling body which darkens considerably on exposure. It was used some years ago by the Buchanan Mineral Co. of Hamilton, Ont.

GOLDEN OCHRE.

Iron Ochre.—Paint Brook, one mile east of Elmsvale, Halifax Co., N.S.

This ochre was found to be free from grit and when ground in oil made a golden ochre paint of a very superior quality; it is equal, if not better than, the imported colour in tubes. It has very good body

and should constitute a very useful pigment. It is found in several places in the neighbourhood associated with a reddish ochre and underlaid by clay iron.

See Iron Ochre under Burnt Sienna.

Ste. Rose, Joliette Co., Que.

This ochre was found to be gritty in grinding, but when ground in oil made a very smooth paint; its colour is that of a golden ochre, extremely bright with a good body, and constitutes an excellent pigment.

CINNAMON YELLOW.

Ferruginous Clay.—Punk island, Lake Winnipeg, Man.

This is slightly gritty in grinding but is otherwise easily reduced to a fine powder and when ground in oil produces a cinnamon yellow paint; but unfortunately, this brilliant yellow darkens considerably on exposure and is otherwise marred by its streaked appearance, due to the large amount of organic matter mixed with it. See Ferruginous Clay under Canadian Red.

RAW SIENNA.

Iron ochre.—Ste. Anne de Montmorenci, Que.

This sample was free from grit and when ground in oil made a raw sienna paint of a fairly good body which was unchanged after exposure. This colour is very typical and may be ranked as one of the best pigments yet observed. See Iron Ochre under Burnt Sienna, Brown Ochre.

Elizabeth, Joliette Co., Que.

This ochre is slightly gritty and when ground in oil produces a raw sienna paint of a thin body which darkens slightly on exposure. This ochre is probably derived from the disintegration of the bog ores that occur in this neighbourhood. See Iron Ochre under Burnt Sienna.

Lot 13, Range 9, Stanstead, Stanstead Co., Que.

This ochre is apparently free from grit and when ground in oil makes a raw sienna paint which darkens slightly on exposure; it has a very good covering body.

Cote St. Charles, Vaudreuil Co., Que.

This ochre is slightly gritty in grinding but is otherwise easily reduced and when ground in oil makes a good raw sienna paint of a strong body, which is very much darkened after exposure.

The deposit, about one foot thick, overlies a bed of bog iron ore about eight feet thick. See Bog Iron Ore under Caledonian Brown and Brown Red; and Iron Ochre under Prussian Brown.

Iron Ochre.—Leslie, Lot 30, Range 2, Pontiac Co., Que.

This ochre is slightly gritty in grinding but when ground in oil it produces a paint approaching raw sienna. It has a very good body and darkens very slightly on exposure.

Iron Ochre.—Vicinity of Madawaska Station, Renfrew Co., Ont.

This ochre is exceedingly gritty but is otherwise easily reduced to a fine powder, which, when ground in oil produces a raw sienna paint of rather a weak body that darkens on exposure.

Iron Ochre.—Lot 2, Range 11, Nottawasaga, Simcoe Co., Ont.

This ochre is slightly gritty in grinding but is otherwise easily reduced to a fine powder and when ground in oil makes a raw sienna paint, but if it is mixed with white it produces tints of brown ochre; it has only a middling body but is fairly permanent after exposure.

See Iron Ochre under Brown Red.

Iron Ochre.—Conestogo, Waterloo Co., Ont.

This ochre is rather gritty in grinding but is otherwise easily reduced to a fine powder and when ground in oil makes a fine raw sienna paint of a fairly good body and permanent after exposure.

This colour was prepared some years ago by Mr. James Newton, Limehouse, Ont.

Iron Ochre.—Silver Creek, Harrison Lake, New Westminster dist. B.C.

This ochre was found to be free from grit but very much mixed with organic matter which would necessitate washing before it is ground in oil; it makes a good raw sienna paint with a middling good body. This sample was sent in by Mr. John I. Brown. See Iron Ochre under Brown Red.

Bog Iron Ore.—Mallorytown, Leeds Co., Ont.

This grinds very easily to a fine powder and when ground in oil makes a good raw sienna of a strong body; it darkens very slightly on exposure. This colour was used some time ago by the Leeds Paint Manufacturing Co. of Leeds, Ont.

Bog Iron Ore.—Vaudreuil, Vaudreuil Co., Que.

This sample was free from grit and when ground in oil made a dark raw sienna paint with a good body which, if mixed with white, pro-

duces tints of caledonian brown. See Iron Ochre under Prussian Brown.

Apatite.—Portland, Wright Co., Que.

The red variety of this mineral when reduced to a fine powder and then ground in oil makes an excellent raw sienna paint of good body. On exposure it is liable to change to a brown of a bright tone. It is unchanged by burning. Apatite has a wide range in Wright and Labelle counties, but the red variety, the only one of use for paint, is limited to a few localities and even then is generally mixed with the green.

This mineral is also found in several places in Ontario.

Clay.—Limehouse, Halton Co., Ont.

This clay is free from grit and in its raw state is useless as a pigment although it has been used both alone and mixed with various oxides to produce different shades of colour. If, however, this clay is previously roasted and then ground in oil, it makes a raw sienna paint of a fairly good body and permanent after exposure.

This was manufactured some time ago by Mr. James Newton Limehouse, Ont.

If the raw clay is mixed with white it produces tints similar to bitumen and mummy.

REDS.

Ferruginous Clay.—Punk Island, Lake Winnipeg, Man.

This clay is slightly gritty but is otherwise easily reduced to a fine powder which when burnt and then ground in oil produces a rich red paint that I have provisionally called "Canadian Red" as it differs in tone from all other mineral reds. It has an extra strong body and is unchanged after exposure. This clay is probably derived from the shaly beds that underlie the limestones at the west end of the island.

Ferruginous Clay.—Limehouse, Halton Co., Ont.

This clay is a little gritty in grinding but is easily reduced to a fine powder and when ground in oil makes a red paint which becomes decidedly brown on exposure. If this clay be roasted before it is ground in oil its colour is very much enhanced and will remain permanent after exposure. It has a good body and should make a useful pigment.

Hematite Rock.—Limehouse, Halton Co., Ont.

This rock is rather gritty in grinding and must be reduced to a very fine powder before it is burnt. When ground in oil it makes a Canadian Red with middling body, but gritty after drying. This material and the one above were used some time ago by Mr. James Newton, paint manufacturer, Limehouse, Ont.

Cinnabar.—Near west end of Kamloops lake, B.C.

The available sample used was not quite pure but when ground in oil made a good red paint, much darker and browner than the commercial Vermillion; it has a very good body and appears to be permanent after exposure

Cinnabar is found in veins of quartz, calcite, and dolomite traversing eruptive rocks. This industry is as yet in its infancy, and although rich pockets rarely have been met with, it is generally expected that important deposits will be found in connection with this mercury bearing belt.

INDIAN RED.

Hematite.—Torbrook, Annapolis Co., N.S.

This mineral is a little hard to reduce to a fine powder but when ground in oil makes a good Indian red which lightens, on exposure, to a richer tone. It has a good covering body and is unchanged by burning.

The deposit is said to have been traced for a long distance, is nine feet wide and has been worked by the Nova Scotia Steel Company, of New Glasgow.

Hematite.—Wallbridge Mine, Madoc, Hastings Co., Ont.

This is reduced with some difficulty, but when ground in oil produces a rich Indian red paint, which darkens considerably on exposure to a rich brown. It has a strong covering body and is unchanged by burning.

The Wallbridge mine was first opened in 1880 and over 10,000 tons are known to have been extracted at intervals between that year and 1900.

Limonite.—Londonderry, Colchester Co., N.S.

If this mineral be ground and then roasted and afterwards ground in oil it makes a dark Indian red paint of an extra strong body and can be mixed with a lot of baryte without destroying its colour, although such an admixture is not desirable, as all mixtures containing baryte have a tendency to lighten. See Limonite under Brown Red, Raw Umber and Brown Ochre.

Chalcopyrite.—Huntingdon mine, Bolton, Brome Co,, Que.

If this mineral be reduced to a fine powder, then strongly roasted and ground in oil, it make a good Indian red that darkens slightly after a few days exposure. It has a very strong covering body. See Chalcopyrite under Green.

Pyrite.—Lot 12, Range 1, Wakefield, Que.

If this mineral be finely ground in oil and strongly roasted, it makes a good Indian red paint of a very strong covering body ; it darkens slightly after a few days exposure. See Pyrite under Green.

Ferruginous Clay.—St. Malo, Champlain Co., Que.

If this clay be burnt and then ground in oil it produces a red paint approaching Indian red. It has a strong body, but darkens on exposure.

A paint from this clay is manufactured by the Canada Paint Company, Montreal.

In the St. Malo range in the seigniory of Cap de la Madeleine iron ochre of various shades is distributed over several hundred acres, the deposit being from six inches to two feet in thickness. See Ferruginous Clay under Raw Umber.

Pyrrhotite.—Blezard Tp. Nipissing, Ont.

This mineral when finely ground and strongly roasted and then ground in oil makes a good Indian red paint that darkens slightly after a few days exposure. See Pyrrhotite under Gray Black.

Limonite.—Helen Mine, Michipicoten, Ont.

When this mineral is reduced to a fine powder then burnt and ground in oil it makes a very good Indian red paint of a strong body.

BROWN RED.

Limonite.—Londonderry, Colchester Co., N.S.

If this mineral be reduced to a fine powder and roasted and then ground in oil it makes a brownish-red paint of a very strong body and is but slightly darkened after exposure. See Limonite under Raw Umber.

Bog Iron Ore.—Ste. Anne de Montmorenci, Montmorency Co., Que.

This mineral is free from grit and when burnt and ground in oil produces a brownish-red paint with a strong covering body, which darkens almost to a black on exposure. See Bog Iron Ore under Cappagh Brown, Verona Brown and Burnt Sienna.

Bog Iron Ore—Vaudreuil, Vaudreuil Co., Que.

This sample was free from grit and when burnt and ground in oil made a smoth paint of an excellent brown-red colour with an extraordinary body. See Iron Ochre under Raw Sienna and Prussian Brown.

Bog Iron Ore.—Mallorytown, Leeds Co., Ont.

This mineral is free from grit and easily reduced to a fine powder. If this be burnt and then ground in oil it makes a brownish-red paint of a very strong body and is but slightly changed after exposure. Paint from this ore was manufactured by the Leeds Paint Manufacturing Co., Leeds, Ont.

Iron Ochre.—Lot 15, Range 10, Hull, Wright Co., Que.

This ochre is slightly gritty in grinding but is otherwise easily reduced to a fine powder which, when ground in oil, makes a good brownish-red paint of a very strong body. If this is mixed with white it produces rich flesh tints superior to those obtained from other mineral reds. It is fairly permanent after exposure and is unchanged by burning.

This ochre is distributed over several acres underlying a clay soil.

Iron Ochre.—Carleton, Bonaventure Co., Que.

This ochre which was found to be free from grit made when burnt and ground in oil a brownish-red paint of a fairly good body, which darkens on exposure.

Iron Ochre.—Lot 2, Range II, Nottawasaga, Simcoe Co., Ont.

This ochre is slightly gritty but is otherwise easily reduced to a fine powder and when burnt and ground in oil makes a brownish-red paint of a strong body, but darkens very much after exposure.

This ochre is derived from chalybeate springs that issue from the Clinton formation ; several deposits are known to occur, one of which was tested to the depth of two and a half feet without reaching the bottom. Iron Ochre under Raw Sienna.

Iron Ochre.—Silver creek, Harrison Lake, New Westminster dist. B.C.

This sample was found to be free from grit and when burnt and ground in oil it made an excellent brown-red paint with a very strong body. Should this prove permanent after exposure, and there is no reason to suppose that it will not, it should commend itself as a very

good pigment. The sample was sent in by Mr. John P. Brown. See Iron Ochre under Raw Sienna.

Hematite.—Beckwith, Lanark Co., Ont.

This mineral is a little hard to reduce to fine powder but when ground in oil makes an exceedingly good brown-red paint which remains permanent after exposure. It has a very good covering body and is unchanged by burning.

Arsenopyrite.—Marmora Tp. Hastings Co., Ont

If this mineral be reduced to a fine powder and then roasted it makes a very fine brown-red paint of a good covering body. It has not been tested for any length of time. See Arsenopyrite under Black.

Ferruginous Rock.—Mallorytown, Leeds Co., Ont.

This sample was found to be free from grit and when ground in oil makes an excellent paint of a brownish-red colour with an extra-strong covering body. This will probably darken a little on exposure.

Hematite.—Limehouse, Halton Co., Ont.

This material is rather gritty in grinding and its reduction to a fine powder is attended with some difficulty. The sample I ground in oil was not thoroughly reduced after considerable time had been bestowed upon it; its colour is brownish-red with a middling body.

BURNT SIENNA.

Iron ochre. Paint brook, one mile east of Elmsvale Post Office, Halifax Co., N. S.

This ochre was found to be free from grit and when burnt and ground in oil it made an excellent burnt sienna; it is exceedingly bright and has a very good body; it can be ranked as a superior pigment. See Iron Ochre under Golden Ochre.

Ste. Anne de Montmorenci, Montmoreney Co., Que.

This ochre which is comparatively free from grit when burnt and ground in oil produces a burnt sienna paint of a middling body but changes to a dark brown when exposed.

Deposits of iron ochre occur about a mile and a quarter above the mouth of Ste. Anne river and appear to extend over about four acres and are from four to seventeen feet in thickness.

From the same locality another sample was tested. It was free from grit and when burnt and ground in oil it made a dark burnt sienna paint, which darkens a trifle more after exposure; it has a very

strong covering body and can be commended as a good pigment. See Iron Ochre under Raw Sienna and Brown Ochre.

Iron Ochre.—Cap de la Madeleine, Champlain Co., Que.

This sample was a little gritty in grinding but when burnt and ground in oil it makes a dark burnt sienna paint of an excellent colour with an extra strong body. From the same locality another sample was taken. It was slightly gritty in grinding but otherwise easily reduced and when ground in oil produced a brownish-red paint approaching burnt sienna. It has a middling body but is darkened on exposure. This ochre was unchanged by burning.

In the St. Malo range of the above seigniory iron ochre of various shades covers several hundred acres of from six inches to two feet in thickness. See Iron Ochre under Burnt Brown Ochre, Brown Ochre and Burnt Sienna

Iron Ochre.—Pointe de Lac, St. Maurice Co., Que.

This ochre is apparently free from grit and when ground in oil makes a burnt sienna paint which darkens on exposure and turns brown, of rich tone. It has a very good body. This sample was probably locally burnt, as the portion that was burnt by me was not changed. See Iron Ochre under Brown Ochre, Burnt Brown Ochre, Caledonian Brown and Cappagh Brown.

Iron Ochre.—Ste. Rose, Joliette Co., Que.

This sample was found to be very gritty in grinding but when ground in oil made a very smooth paint of the burnt sienna type. In its concentrated form it is much yellower than the typical colour and its lowest tints are much more pinkish. It has a very strong body and is probably permanent. See Iron Ochre under Golden Ochre.

Iron Ochre.—Elizabeth, Joliette Co., Que.

This ochre is gritty in grinding and when ground in oil produces a burnt sienna paint of an indifferent body and darkens considerably on exposure. See Iron Ochre under Raw Sienna.

Iron Ochre.—Lot 43, Range 9, Stanstead, Stanstead Co., Que.

This ochre, which is apparently free from grit, when ground in oil makes a burnt sienna paint: it has a very good body but darkens a little on exposure.

Iron Ochre.—Leslie, Lot 30, Range 2, Pontiac Co., Que.

This ochre is slightly gitty in grinding but is otherwise easily reduced to a fine powder. If this is burnt and then ground in oil it makes a paint approaching burnt sienna ; when mixed with white its lower tints correspond exactly with that colour. This darkens considerably on exposure.

Iron Ochre.—Vicinity of Madawaska Station, Renfrew Co., Ont.

This ochre is exceedingly gritty but is otherwise easily reduced to a fine powder. If this is burnt, then ground in oil it produces a burnt sienna paint of a good body and but slightly darkens after exposure.

Ferruginous Rock.—Mallorytown, Leeds Co, Ont.

This mineral was found to be free from grit and when reduced to a fine powder and burnt and afterwards ground in oil made an excellent burnt sienna paint with a very strong body. If this colour should prove permanent, and there is every reason to suppose it will, it may be ranked as one of the best pigments in Canada. It was manufactured some years ago by the Leeds Paint Manufacturing Company, Mallorytown.

Ferruginous Dolomite.—Limehouse, Halton Co., Ont.

This material was found to be very gritty and difficult to reduce to a fine powder. When ground in oil it has a brownish colour, and if previously roasted it makes a burnt sienna, both of which have very poor bodies, and if the sample I used is fairly representative of the above material, I think we can safely turn our attention to other sources that will give much better results. This was used some years ago by Mr. James Newton, Limehouse, for the manufacture of paint.

Bog Iron Ore.—Mallorytown, Leeds Co., Ont.

If this mineral be reduced to a fine powder and burnt, and then ground in oil it produces a burnt sienna paint of a very good body and remains unchanged after exposure. This colour was manufactured some years ago by the Leeds Paint Manufacturing Co. of Mallorytown. See Bog Iron ore under Brown Ochre.

Bog Iron Ore.—Ste. Anne de Montmorenci, Montmorency Co., Que.

This is apparently free from grit and is easily reduced to a fine powder : when it is ground in oil it makes a paint resembling dark raw sienna, but when mixed with white it makes a verona brown, but with much more body If one coat of this paint is applied it remains permanent but if two or more are used it darkens a little. It has a good covering body. See Bog Iron Ore under Cappagh Brown, Brown Red and Burnt Sienna.

Iron Ochre.—Lot 12, Range 14, Walsingham, Norfolk Co., Ont.

This ochre is slightly gritty but is otherwise easily reduced. When burnt and ground in oil it produces a burnt sienna of a middling body but darkens on exposure to a rich brown. This ochre was used some years ago by the Buchanan Mineral Co. of Hamilton for making paint.

Iron Ochre.—Conestogo, Waterloo Co., Ont.

This ochre is rather gritty in grinding but is otherwise easily reduced to a fine powder and when burnt and ground in oil makes a fine burnt sienna paint of a strong body and is permanent after exposure. This colour was manufactured some years ago by Mr. James Newton, Limehouse, Ont.

Iron Ochre.—Harrison Lake, New Westminster dist. B.C.

This ochre is slightly gritty in grinding but is otherwise easily reduced. Burnt and ground in oil it produces a burnt sienna paint of a strong body, but is darkened slightly on exposure; otherwise it is brilliant and clear in tone.

This sample was sent in by Mr. John P. Brown.

PURPLE.

Specular Iron Ore.—Glencoe, Pictou Co., N.S.

The sample used was free from grit and when ground in oil made a rich purple paint of an extra strong body. This I have named Canadian Purple and as it is apparently permanent after exposure I think the extra qualities of this material as a pigment should commend itself to all paint manufacturers, as one coat of this paint properly prepared will cover any surface. This particular ore has been generally observed in contact with dikes, from which we may infer the influence of igneous action. It is distributed over several counties, and thousands of tons have been extracted from a single deposit. It also occurs in the provinces of Quebec and Ontario. See Report 1873-4.

GREEN.

Pyrite.—Lot 12, Range I, Wakefield, Wright Co., Que.

This material when ground in oil makes a greenish paint which is dark in colour when freshly applied; after exposure for a year or two it lightens and assumes almost a neutral tint and would appear to be a very desirable shade for exterior use. It has a strong covering body and appears perfectly uniform after two years exposure.

Pyrite has a wide range in the Dominion, being found in every province; its adaptability will of course depend on its purity. See Pyrite under Indian Red.

Chalcopyrite.—Huntingdon Mine. Bolton, Brome Co., Que,

If this mineral, which is very easily reduced to a fine powder, is ground in oil it makes a greenish paint which lightens on exposure and assumes almost a neutral tint slightly darker than that produced from pyrite. It has a good covering body and would appear to be a desirable shade for exterior use. Chalcopyrite has a very large range in the Dominion, being found in all the provinces.

See Chalcopyrite under Indian Red.

Malachite, Azurite and Iron Oxide, Campbell's claim, Jubilee Mountain, E Kootenay, B.C.

These three minerals are found associated in a deposit said to be of some importance and when reduced to a fine powder and ground in oil produce a greenish paint of a very good covering body. The shade will necessarily vary with each grinding, according to the predominance of each mineral, producing either blue or yellow greens.

BRONZE PINK.

Ferruginous Clay.—Chaplins Island, about 14 miles from Redbank, Northumberland Co., N.B.

This clay is slightly gritty in grinding but is otherwise easily reduced to a fine powder and when ground in oil produces a bright bronze pink colour that has remained permanent after two years exposure. It has a strong covering body and may be considered one of the best pigments in Canada. It is unchanged by burning. I am informed by Mr. R. Chalmers that, so far as he was able to ascertain, the deposit was not very large.

BROWN PINK.

Ferruginous Rock.—Limehouse, Halton Co, Ont.

This material was found to be free from grit and when reduced to a fine powder and ground in oil made a paint resembling brown-pink of a light or transparent body. This colour can be very much heightened by burning the raw material, both burnt and unburnt making only transparent colours.

Having mentioned in the foregoing pages certain minerals that can be used in their crude or their roasted state for making pigments, I

will refer to some others, which, by certain chemical treatment, can be made to produce many bright and permanent colours.

WHITE.

White Lead.

The white lead of commerce is essentially a carbonate and hydrate of lead, sometimes mixed to a large extent with baryta and is, I believe, being manufactured by electricity direct from galena. As this mineral is largely distributed in British Columbia and Ontario, especially where the proportion of silver in the galena is not high, I think it could be converted into the carbonate with more remunerative success than by the tedious operations of smelting and refining.

Baryta.

Baryta is largely used to mix with white lead, not so much as an adulterant as is supposed, its presence, in discriminating quantities, tending to elevate the standard of that paint. A large number of samples of white lead, put up in tins, were analyzed by the Inland Revenue Department, some of which were found to be very pure while others were largely "adulterated," or, in other words, contained large proportions of baryta. The pureness of the lead or the absence of baryta need not be points of recommendation. The essential feature of either of those materials is their fineness. A paint may be found to be absolutely pure lead, but coarse grinding would necessarily detract from its quality. On the other hand, lead, mixed with ten or twenty per cent baryta, and finely ground, would be much superior, both in durability and covering properties, although the baryta in itself has no body and will not assist in strengthening the body of any other paint. Its important use lies in keeping the finely divided particles of lead from adhering together and becoming lumpy, which is the habit with particles of pure lead. We frequently hear of white lead peeling off, after a short time, and the prevailing opinion is that it is caused by the contained baryta. If this defect be carefully watched it will be found that it is the lead that is falling off, simply because the material has not been ground fine enough,—the coarser particles therein protrude from the oil, allowing free access to the ever floating gases which attack it at every exposed point, but more particularly at the line of contact with the oil. As this erosion progresses, the adhering point is weakened and the exposed portion is too heavy to be longer supported.

Baryta occurs in several of the provinces, chiefly as a sulphate: the carbonate, witherite, has been found within the township of Gillies,

Thunder Bay district. In the Lake Superior region there are some very important veins of the sulphate, ten feet thick and upwards, which constitute the gangue of the silver ores. Veins of comparatively pure sulphate occur in the townships of Galway, Burgess and Pakenham in Ontario and in several places in the township of Hull, Wright Co., Quebec, where it is at the present time being worked. It has also been mined to some extent in Nova Scotia.

Zinc White.

Zinc, permanent, or chinese white is an oxide of zinc and might be manufactured from sphalerite or zinc blende. It has been referred to in its raw and roasted state as an excellent pigment. This ore is met with in several of the provinces and has been mined in Quebec, Ontario and British Columbia

Graphite Paint.

Graphite is now being mined in the Province of Quebec and bids fair to become an important industry. It will be one of the products produced by a Buckingham firm. A similar paint is manufactured, by the Canadian Paint Company of Montreal, from a plumbaginous shale brought from New Brunswick.

Colours produced from minerals by chemical treatment.

YELLOW.

Arsenical Paints.

The yellow sulphide of arsenic known as King's yellow could be directly sublimed from the arsenical ores that are found in nearly all the provinces. Arsenopyrite has been mined in the township of Marmora rather extensively both as a source of gold and arsenic. If sulphur were added to the arsenopyrite in the retorts a yellow sulphate would be formed corresponding with the commercial article.

SCHWEINFURT GREEN.

If boiling solutions of arsenic and acetate of copper of equal weights are mixed together and the ebullition continued for some time, the arsenite of copper is formed, known under the name Schweinfurt or Vienna Green.

CHROME PAINTS.

The chromic iron ore that occurs in serpentine in Megantic and adjoining counties, and also on the Shickshock Mountains in Gaspé county in the Province of Quebec, is a source of many bright and beautiful colours.

The chromium in this ore is first extracted by fusing with potassa, when a soluble chromate of potassa is obtained.

Chrome Yellow.

Chrome yellow is obtained by mixing solutions of chromate of potassa and acetate of lead. The precipitate can then be dried and will be found to be a very powerful colour, to which may be added as much as forty times its weight of whiting or marl without greatly impairing the quality.

Chrome Orange.

This is produced by boiling the above chrome yellow with lime.

Strontium Yellow or Light Lemon Yellow.

If solutions of chromate of potassa and chloride of strontium be mixed together, a fine yellow precipitate of chromate of strontian is obtained, and if chloride of barium be substituted for the strontian the light lemon yellow of commerce is obtained. If the strontian yellow be mixed with barium yellow, the dark lemon yellow is obtained.

These two alkaline earths are derived from the minerals barite, witherite, celestite and strontianite. The two former have been described under baryta, the two latter occur principally in the Province of Ontario. Celestite or sulphate of strontium is met with in the townships of Bagot and Lansdowne, and in smaller quantities at Kingston and Forks of Credit in Caledon. Strontianite occurs in veins in the Cambro-Silurian in the township of Nepean.

Citron Yellow

If chromate of potassa be added to slightly alkaline solutions of chloride of zinc, a fine precipitate of chromate of zinc is obtained, known in commerce as citron yellow.

Siderou Yellow.

If ferric chloride of iron be added to a boiling saturated solution of bi-chromate of potassa, an orange precipitate is deposited, and is used in the arts under various names.

Mars Yellow.

If marl be added to saturated solution of bichromate of potassa, a fine yellow powder is obtained and, when ground in oil, corresponds to the so called mars yellow.

Chrome Green.

If bichromate of potassa be fused with an equal weight of sulphur, the green sesquioxide of chromium is obtained. This is a very powerful colour but not so bright as the oxides obtained in the wet way. By treating salts of chromium with metallic oxides, carbonate or sulphides, these greens become exceedingly brilliant and vary in shade according to the re-agent used.

TITANIUM.

A very fine green was made from titanic iron-ore many years ago In the Elsner process, which is said to have been patented in England, titanic acid, prepared by decomposing titanic iron-ore by fusion with bisulphate of potassa and by subsequent purification and separation from iron, is precipitated from its hydrochloric solution by ferrocyanide of potassium at a boiling heat, as a ferrocyanide of titanium.

In 1861, specifications for a patent were deposited in London by Mr. F. Versmann for the employment of compounds of titanium as pigments or colouring materials. The sulphuret is said to give some fine violet and blue colours and to resemble the sulphuret of tin, known as mosaic gold.

See Geology of Canada 1863, page 753.

MOLYBDENUM.

A fine blue pigment was prepared some years ago from molybdenum, since when a chemist proposed the blue of molybdenum as a substitute for indigo in dyeing silk, cotton and linen (See Geological Report 1863, page 754) but, probably owing to the high price of the mineral, which was about five dollars a pound at that time, its use was soon superseded by more fugitive but more brilliant colours (aniline). This mineral has however become more familiar in the last few years, and its distribution in Canada extends at intervals over three thousand miles of territory, and although the deposits are not generally in sufficient quantity to warrant development, there are a number of localities where they make a good showing. From one place in the township of Egan, Wright county, Quebec, I obtained thirty-nine pounds of pure mineral in one day with the aid of two men. Molybdenum is also found at numerous other places in the county of Wright. In the township of Ross, Renfrew Co., it occurs both in quartz and limestone and often presents considerable showing. It is reported from several other places in the same county, as also

from the county of Hastings. Some good specimens have been seen, that came from British Columbia.

ANTIMONY

According to Abel and Bloxam, a fine blue pigment, that can scarcely be distinguished from ultramarine and is said to be very effective in colouring artificial flowers, is made by dissolving metallic antimony in aqua regia and precipitating with ferro-cyanide of potassa.

If stibnite be dissolved in aqua regia and precipitated with ferro-cyanide of potassa, a light blue precipitate consisting of ferro-cyanide of antimony mixed with oxide of antimony is thrown down. When ground with oil it has little body, but as a water colour it is exceedingly bright after drying.

COLOURING OF CEMENTS AND MORTARS

In view of the recently reported statement that cement, coloured with oxide of iron, causes disintegration—a statement that my experiments so far have neither disproved nor substantiated—the time is opportune to offer some suggestions regarding the colouring of cements and mortars.

Before condemning the oxide, it is necessary to be absolutely certain of its purity. It is a well known fact that much of this pigment is prepared from by-products that often contain sulphuric acid and other impurities. Before it can be definitely stated that oxide of iron, in its pure state, is injurious as a colouring matter for cements and mortars, it is necessary to become acquainted with its previous uses and in all cases where the oxide has had deleterious effects on the paint, the colouring matter should be immediately analyzed.

Many of our ochres, in their natural state, are scarcely ready for immediate use, though some have been met with, which, when ground in oil, retained their durability for many years. To ensure this durability, it is desirable to drive off the moisture in the ochres by roasting, a process that not only expels the moisture and destroys the organic matter, but carries oxidation to its limit. Probably pigments prepared in this manner will be found more efficient as colouring matter for cements and mortars.

Museum No.	Locality.	Grinding Properties.	Colour when Ground in Oil.	Body.	Colour when Ground in Oil.	Body.	Nature of Surface.	Extent of Clay
	Nova Scotia.		Unburnt.		Burnt			
	King's Co.							
5172	Avonport	Slightly gritty in grinding.	Brown	2	Reddish brown.	2	Smooth	B T Said to be of great depth
	Pictou Co.							
5337	Salt springs, Dorchester.	"	"	3	Yellow brown.	2		
6681	McKenzie Brook, Middle Musquodoboit.		Cherry	3	Burnt sienna	2		
	Cumberland Co.							
5126	Claremont	Easy and no grit	Raw sienna	2	Dark burnt sienna.	2		
3601	River Denys, near cross roads.	Gritty in grinding	Grey	4	Brown pink	3		
	Antigonish Co.							
5391	Antigonish	Slightly gritty in grinding.	Brown	2	Dark venetian red.	2		
	Prince Edward Island.							
1937	Mouth of harbour, Charlottetown.	Gritty in grinding	Brown pink	3	Brownish red	2		
	New Brunswick.							
1948	Fredericton	Easy and no grit	Brown yellow	2	Yellowish brown	2	Smooth	B T About twenty feet
1949	Fairville	"	Brown	2	Brown red	2	"	
1950	Lewisville	Gritty in grinding	"	2	"	2		

		Quebec.								
619	St. Johns	Slightly gritty in grinding.	Yellowish grey.	3	Yellowish brown	3	Smooth	B T	About twenty two feet	
1146	Montreal	Easy and no grit	"	4	"	3				
6814	Mouth of R. du Loup	" "	"	3	"	3				
1135	River St. Charles	Gritty in grinding	"	3	"	3				
1140	St. Jean Lotbiniere Co.	Easy and no grit	"	3	"	2	"			
		Ontario.								
	Glengarry Co.									
5146	Kenyon, L. 10, R. 3	Slightly gritty in grinding.	Dark grey	3	Yellowish brown	2	Smooth		About [illegible] feet.	
	Russell Co.									
5177	Russell, L. 20, R. 5	Easy and no grit	Yellowish brown	3	"	3	"	B	Said to be seventy six feet.	
	Carleton Co.									
1198	New Edinburgh	" "	Dark grey	4	"	2	"	B	Exposed several acres and is overlaid by five feet of shell marl.	
5073	Archville	" "	"	3	"	3				
5179	Richmond	" "	Yellowish brown	3	"	3	"	B	About thirty feet in thickness.	
1142	Bell's Corners	" "	Grey	4	"	3		B		
	Lanark Co.									
5074	Beckwith, L. 17, R. 11.	Slightly gritty in grinding.	Yellowish grey.	3	"	3	"	B	About five feet in thickness.	
1126	Ramsay, L. 14, R. 8	Easy and no grit	Yellowish brown	3		2	"			
5069	Ramsay, L. 20, R. 8	" "	"	3		3				
	Renfrew Co.									
5070	McNab, L. 7, R. 13	Slightly gritty in grinding.	Light grey	4	Brown yellow	3		B	About fifteen feet	
5068	Stafford, L. 30, R. 1	" "	Yellowish brown	4	Yellowish brown	3		B	About seven feet.	
5072	Pembroke	Gritty in grinding	Grey	4	Brown yellow	4	Slightly rough	B	About six feet.	
	Leeds Co.									
5175	Brockville	Easy and no grit	"	4	Yellowish brown	3	Smooth	B	About eighteen feet	
	Frontenac Co.									
1046	Kingston		Yellowish grey.	4	"	2	"	B	About three feet	
	Hastings Co.									

NOTE. B used in brick making; T used in tile making.

CLAYS—*Concluded.*

Museum No.	Locality.	Grinding Properties.	Colour when Ground in Oil.	Body.	Colour when Ground in Oil.	Body.	Nature of Surface.		Extent of Clay.
			Unburnt.		Burnt.				
4957	Belleville	Grinds gritty	Grey	4	Yellowish brown	3	"	B	About four feet.
5162	Rawdon, L. 42, R. 1 Prince Edward Co.	"	Yellowish grey	4	"	3	"	B	Three feet in thickness
5154	Bloomfield, Hallowell. Peterborough Co.	Slightly gritty in grinding.		3	"	3	"	B	About three feet.
5160	Dromabee, L. 22, R. 12. Durham Co.	Easy and no grit	"	4	Row sienna	3	"	B T	From two to eight feet.
5166	Darlington Simcoe Co.	Slightly gritty in grinding.	"	4	Yellowish brown	3	"	B	
5168	Penetanguishene York Co.	Easy and no grit	Grey	4	Brownish yellow	3	"		Sixteen feet.
4954	Doncaster	Slightly gritty in grinding.	Yellowish grey	3	Yellowish brown	2	"		
4953	Leslie St., Toronto	"	Grey	4	"	3	"	B	
4952	"	Easy and no grit	"	3	"	2	"		
1134	Yorkville	Slightly gritty in grinding.	Yellowish grey	3	"	2	"	B	Three to twenty feet.
556	Yorkville	"		4	Brownish yellow	3		B	From three to twenty five feet
1955	Carlton West Lincoln Co.	"	"	3	Yellowish brown	3	"	B	About three feet.
5192	Clinton, L. 22, R. 1 Welland Co.	Easy and no grit	Brown	2	Reddish brown	2		B T	Over six feet in thickness.
5152	Bertie, L. 29, R. 2. Grey Co.	"	Brownish yellow	4	Yellowish brown	3		B	About six feet.

1131	Owen Sound	"	"	Grey	1	Brown yellow	4	"		Depth unknown, has been tested to a depth of about six feet
	Halton Co.									
970	Nassagaweya, 2, R, 7.	L.	Slightly gritty in grinding.	Reddish brown.	2	Dark brown	2		B	
558	Limehouse	"	"	ish grey	3	Yellowish brown	3	"		
2456	"		Easy and no gr.		4	Brownish yellow	3	"		
	Wentworth Co.									
993	Hamt	"	"	ssian brown	3	Reddish brown	2	"	B	Eight feet.
	Oxford Co.									
5159	Tilson[illegible]g	"	"	Light grey	4	Brown yellow	4	"	B	About twelve feet
	Brant Co.—									
1145	Brantford	"	"	Yellowish brown	4	Brown	3	Slightly rough	B	Said to be fifty feet.
	Bruce Co.—									
5156	Brant	"	"	Yellowish grey	4	Yellowish brown	3	Smooth	B T	Said to be thirty feet
5161	Stephen		Slightly gritty in grinding.	Grey	4	Brownish yellow	4	Slightly rough	B	
1137	Kincardine		Easy and no grit	Light grey	4	"	4	Smooth		
	Middlesex Co.									
5142	Ekfrd, L. 2, R. 6.		Slightly gritty in grinding.	Yellowish brown	4		3	"	B	Twenty feet.
1141	Lambton		Easy and no grit	Grey	4	"	4	"	B	From ten to thirty feet.
5170	Westminster		Slightly gritty in grinding.	"	4	Yellowish brown	3	"		
	Elgin Co.									
5148	St. Thomas	"	"	"	4	Brownish yellow	3	"	B	Twelve feet
	Manitoba.									
862	Winnipeg.		Slightly gritty in grinding.	Yellowish grey.	4	Yellowish brown	3	Slightly rough	B	
603	Stony mountain.	"	"	Grey	4	Brown yellow	4	Smooth		Large.
869	Winnipeg		Easy and no grit	Yellowish grey	3	Yellowish brown	2	"		Nine feet
	Alberta.									
3576	Near Fort Kipp, Old Man river.		Easy and no grit	Grey	3	Yellowish brown	3	Smooth		
3578	Pincher creek		Gritty in grinding	Brown	3	"	3	Slightly rough		

NOTE. B used in brick making; T used in tile making.

CLAYS *Continued*

Museum No.	Locality.	Grinding Properties.	Colour when Ground in Oil.	Body.	Colour when Ground in Oil.	Body.	Nature of Surface.	Extent of Clay.
			Unburnt.		Burnt.			
3551	Crooked creek, near Waterton lake.	Easy and no grit	Grey	1	"	3	Smooth	
3539	Pincher creek	Slightly gritty in grinding.	"	4	Brown	3	Rough	
1908	Six miles above Medicine Hat, Saskatchewan river.	Easy and no grit	"	4	"	3	Smooth	
3540	Pincher creek	"	Purplish grey	3	Yellowish brown	2		
3537	Dutch Freds Crossing, Waterton river.	Slightly gritty in grinding.	Yellowish grey	3	Brown	2		
3533	Coal banks, Belly river.	Easy and no grit	Grey	4	Grey	4		
3535	Galt mine, Coal banks, Belly river.	Very gritty	"		Useless			
1907	Cypress hills	Too gritty						
3531	Three miles above Coal banks, Belly river.	"						
	British Columbia.							
5191	Guichon creek, about three miles from Nicola.	Easy and no grit	Yellowish grey	4	Yellowish brown	3	Smooth	

5188	Victoria	.....	Gritty in grinding	"	3	"	3	"	
5188a	"	.. ..	Easy and no grit	Grey	3	"	3	"	
5191	Park reserve, New Westminster.		Slightly gritty in grinding.	"	4	"	4	"	

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...	Rock creek	.. ..	Easy and no grit.	Dark grey	4	Yellowish grey.	4	Under clay lignite.
...	"	.	Gritty in grinding	Useless	.	Useless		

NOTE.—B = used in brick making; T = used in tile making