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The Gold Fields of New Ontario

By Walter Baelz, Assessor of Mines.

(Translated by Dr. T. L. Walker^{*} from Zeitschrift F. Prakt, Geologie, Vol. XIX,

Part II., Nov., 1911, Pages 377-385.)

I. In General.

The discovery of gold-bearing quartz veins in the neighbourhood of Porcupine in 1909 is the most important made in Ontario since the discovery of the nickel deposits of Sudbury in 1886 and the silver veins at Cobalt in 1903.

As mining in the new gold belts is only beginning it will be necessary to wait for many years before being able to indicate the full extent of the gold region. At present, however, an examination of the work already done is sufficient to convince one that this gold occurrence deserves more than passing notice. On account of the promise of the Porcupine belt the Government of the Province of Ontario has recently built a railway line almost to the Metagami River and it is proposed later to extend it toward the west.

In comparison with the Porcupine district the earlier discoveries at Swastika and Larder Lake are relatively less important. The following report is in general based upon observations in the Porcupine district.

The most important information regarding the Porcupine gold fields contained in a report by A. G. Burrows entitled "The Porcupine Gold Area" was published by the Ontario Bureau of Mines in 1911. Many other reports have appeared in the technical press, particularly in the Canadian Mining Journal, published in Toronto. In addition to these the Bureau of Mines has already issued a reconnaisance map of the Porcupine district on the scale of one mile to the inch. This map indicates the geology in the vicinity of the Hollinger and Dome and is accompanied by a brief geolo-

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gical statement of Prof. W. G. Miller. Naturally, this map is not complete and in the later editions the topography and geology will appear in greater detail. I wish to add that Dr. M. Maclarent very kindly indicated to me the geological relationships in the Township of Tisdale and further that I have had the benefit of the examination of numerous specimens by the Geological Survey at Berlin.

II. Extent of the Gold-Bearing Region.

It is not possible at present to definitely indicate the geographical boundaries of the region in which the gold-bearing quartz claims occur. Already about 10,-000 claims representing an area of about 400,000 acres have been recorded. It must not be taken for granted that gold-bearing quartz veins occur on all of these claims—possibly some of the claims do not show quartz veins of any kind. On the other hand new discoveries continue to be made in districts in which valuable deposits were not previously known.

The most important deposits so far located lie to the east of the Metagami River in the Townships of Tisdale and Whitney, but recently discoveries have been made to the west of the Metagami in the Township of Bristol[;] the Cripple Creek district.

III. Topography.

The region is generally level or slightly undulating and possesses an average altitude of about 300 metres. The surface is usually covered with glacial boulders, sand and clay. Upon the compact clay a substance resembling turf is formed. The older rocks project through the younger sediments and form ridges which seldom rise more than 20 metres above the plain. In these ridges the quartz veins appear.

The region contains numerous lakes which vary from three to six metres in depth. The Metagami, which is the most important of the rivers, forms a wide sluggish stream when in the region of the recent sediments. Where, however, this stream cuts the altered rocks it forms rapids well suited for the development of electric power.

Until recently the whole district was difficult of access and covered with coniferous forests with thick

†Author or "Gold, Its Geological Occurrence and Geographical Distribution."



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(The Townships shewn on this map as well as several adjacent Townships are almost all taken up as mining claims.)

- The broken lines indicate the course of the Hollinger Dome Vein Zone.
 - Chief Shafts of the more important mines.
- Some of the richer gold outcrops on the less developed claims.

moss. More recently forest fires have removed much of the vegetable covering and facilitated the work of prospecting in a remarkable degree.

IV. The Ore Bodies.

1. Geological Relationships.

The stratagraphical relationships of the country rock may be indicated as follows.

Quaternary.

E.-Glaeial.

Gravei, sand and clay.

Unconformity.

Precambrian (Algonkian).

D.-Post Huronian.

Younger diabase, usually containing olivine.

Slight unconformity.

C.-Huronian.

Lower Huronian slates, graywacke and conglomerate.

Archaean.

B.-Laurentian

Coarsely crystalline granite and granite gneiss.

A.-Keewatin.

Acid porphyry, frequently schistose.

Older diabase with amphibolite and scrpentine. Iron formation.

Greenstone and Greenschists (Amygdaloidal basalts).

The Kcewatin is the oldest and at the same time the most widely distributed formation of the district. In it the most of the gold-bearing quartz veins occur. It has been built up by a series of volcanic outbreaks. These volcanic rocks as they appear to-day are more or less metamorphosed. Sediments played in this formation only a subordinate role.

The greenstone is very abundant. It is light to dark green in colour and occurs schistose as chlorite schist, serpentine schist and sericite schist, which have been formed by the metamorphism of basic lava, tuff and ash. The Canadian geologists refer to the original rock as basalt or, in some cases on account of the cellular structure, as amygdaloidal basalt. The cells in this greenstone are usually filled with calcite. The basalts are overlain lossify by a deposit of iron bearing sediments. This iron formation, which is eoposed of alternate layers of magnetite and red jasser occurs principally in the southern part of White It is regarded ϵ equivalent to the Keewatin iron formation of Lak Superior.

After the ?. positation of the sediments occurred an eruption of diabase. as may be seen in Whitney Township. This older diabase is frequently altered to amphibolite.

The volcanic activity of the Keewatin came to its elose with the extrusion of a mass of porphyry, usually acid. It ocenrs as felsitie quartz porphyry, but frequently, as in Delora, it appears in the form of coarsely crystalline granite perphyry. In the neighbourhood of Pearl Lake the quartz porphyry has been altered to sericite school, which we be distinguished from the scrieitic greenschist by its orghter colour.

The coarse crystalline Laurentian granite occurs in Porcupine in only a few places. It is very frequent in Swastika, where it frequent's forms veins.

Unconformally 100n the Archaean rests the sedi-. .nt of the lower rinronian composed of conglomerate. greywacke and more rarely grey slate. The eonglomerate carries numerons boulders, usually of gran-The Huronian represents only a small developite. ment because it has been partly worn down by glacial In contrast to Cobalt. where the Huronian action. conglomerate appears in only slightly disturbed arrangement, it is in Porcupine strongly folded and altered frequently into conglomerate schists containing flattened boulders. Before the close of the Precambrian there occurred an strusion of olivine diabase and of other basic ernptives (Post Huronian), which occurs mostly in veins and are regarded as the equivalent of the similar diabase of the Sudbury region.

A part of the older rocks was earried away by the glaciers in their sonthward movement. Glaeial elay and sand were deposited over wide areas, thus hiding the Archaean and Precambrian formations and the quartz veins which occur within them.

2. Age.

The gold-bearing veins ent through the Keewatin and lower Huronian formations, but are themselves intersected by the younger post-Huronian diabase. They are, therefore, either upper or post-Huronian in age and belong to the older gold formation.

3. Form and Composition.

The ore deposits seldoù form simple veins with sharp contacts on the country rock, but rather form compound veins, sending out numerous stringers into the The strike and dip of the veins is very country rock. Sometimes the veins are only a few centivariable. ineters aeross; on the other hand, they oceasionally expand and form enormous quartz masses which, like domes. rise above the surrounding country. These vein formations seldom oceur singly, but rather form series of veins and stringers approximately parallel, constituting a broad zone of veins. These extend for long distances in the direction of the strike and as they possess considerable width one is forced to assume for them great depth.

The veins usually strike west, southwest to east, northeast. In rare instances veins have been observed which strike south, southeast, to north, northwest, as may be seen at the East Dome mine.

The dip is often almost vertical. Frequently, however, the veins appear to be strongly faulted by later earth movements. Such a fault has been discovered in shaft No. 2 of the MeIntyre mine.

The gangue consists for the most part of milky quartz and more or less silicified country rock. This quartz eontains gas and liquid inclusions.** as well as feldspar erystals and fine needles of tourmaline. As a result of earth movements the quartz is much fissured and, consequently, easily broken. Along with the quartz, siderite and a brownish mineral with rhombohedral cleavage-ankerite (CaMgFe) CO3-are fairly prominent. In a vein on the West Dome mine, ankerite is the chief mineral in which the quartz forms only slender stringers running aeross the vein. The vein body consisted therefore originally solely of earbonates and only after later movements in the old fissure did the introduction of the rising solutions carrying gold and siliea become possible. A metasomatic replacement of the earbonate by quartz has been fre-The ankerite sometimes carries a quently observed.

**J. Stanford : Microscopic Examination of Some Typical Specimens of Porcupine Rocks and Vein Matter Canadian Mining Journal, 1911, p. 109. little gold, but this has been derived from the solutions which introduced the quartz. The appearance of ankerite in large proportions is not always a favourable



Fig. 3.-Faulting as shewn in Shaft No. 2, McIntyre Mine.

sign for the occurrence of gold values evenly distributed through the vein.

The chief metallic minerals are pyrite, marcasite, magnetite, calcopyrite and occasionally a little galena and zine blende. In the veins in Bristol Township arsenopyrite plays an important role.

More than half of the gold contained in the veins and stringers occurs as native gold. This appears as a rule in the form of fine plates within the quartz, espeeially along the lines of contact between the quartz and the country rock. The remainder of the gold is combined with the sulphides and arsenides which form large mineralization zones in the country rock.

It is interesting to note that in the northwestern part of Tisdale the native gold occurs in serpentine asbestos, which along with actinolite and calcite is found as veins in serpentine. According to Dr. Mc-Laren, this type of gold occurrence had been previously observed in only one locality—Western Australia.

Gold telluride occurs in small amounts in a quartz ankerite vein to the east of Larder Lake. Up to the present telurides of gold have not been observed in the Porcupine district.

No considerable development of gossan formation is present. The primary zone with milky quartz and undecomposed sulphide reaches almost to the surface. This is due to the fact that the glaciers have removed the oxidation and cementation zone—probably originally present—and that since the glacial period a suffieient time has not elapsed for the formation of extensive secondary zones. Only at the very surface may the decomposition of the sulphides and ankerite be observed. In this rusty mass the gold values are higher. This slight evidence of secondary enrichment is rarely marked at a depth greater than two to three metres.

From this point of view the exposures at the Jupiter mine are very instructive. Here the milky quartz containing scales of sericite and tournaline needles is well banded with light and dark bands. It is well exposed from the surface to about fourteen metres below the ground water level. and is of a fairly uniform charac-The gold, which is finely divided, may be seen ter. without the aid of a lense, occurs in the native form and is scattered through the fresh quartz in such a manner that, notwithstanding the high values, one may not regard it as the product of secondary enrichment. Similar observations were made at the Hollinger mine which, at present, is the deepest in the district. Its shaft has attained a depth of about 60 metres, while its drilling operations have probably not exceeded 170 metres measured from the surface. It is just possible that this primary gold value may diminish with depth. as has been found to be the case in many mines in Inasmuch as the primary zone Western Australia. extends right to the surface the valuation of these ore bodies is considerably simplified.

It is very hazardons to value and purchase gold properties on the basis of surface observations, as is frequently done in the Porcupine district. It should not be forgotten that even in primary ore bodies bonanzas may oecur representing portions of the vein primarily enriched. These bonanzas must be considered along with large amounts of poor ore to be enconntered in following the vein either horizontally or vertically. In order to be able to determine whether we are dealing with isolated portious of rich ore accidentally occurring near the snrface and of larger or small extent, as much of the vein as possible should be uncovered. Diamond drilling should be undertaken and test pits sunk to the depth of at least 20 to 30 metres.

These explorations should be along the vein as well as across it, and at short intervals.

Such explorations are strongly recommended also on account of the constant variation in the size of the vein.

The distribution of the ore seems to be most uniform when the ore body occurs in strongly disturbed This is particularly true and fissured country rock. in the case of the schistose quartz porphyry. Under such circumstances the rising ore-carrying solutions could penetrate everywhere freely and consequently found numerous points of contact with the country A belt of quartz porphyry of this kind, now rock. largely altered to sericite schist occurs in the vicinity of Pearl Lake (Fig. 4). The quartz porphyry crops out through the glacial formations in the vicinity of Miller Lake and extends eastward on both sides of Pearl Lake to the properties of the Plenaurum and of the Bewick-Moreing syndicates, where, however, unaltered porphyry and greenstone may be observed in The metamorphosed porphyries are bounded place. to the north and to the south by old greenstones. It is a remarkable fact that the veins in the acid porphyry carry considerably higher value in gold than do the This may be most veins in the basic greenstones. readily seen on the northern contact where a vein exposed in the porphyry carried rich ore, but where it intersects the greenstone formations it becomes almost Here in the metamorphosed quartz porvalueless. phyries around Pearl Lake the gold ores occur in such richness and in such quantity as is rarely seen in primary deposits in such a small area. Those veins which are not parallel to the schistosity, but which intersect it by a sharp angle, are to be regarded as the chief The influence of the country cariers of rich ore. rock on the gold-bearing values of the veins is more marked at Pearl Lake than anywhere else in the Porcupine district. On certain other properties, however, such as the Dome. the Dome Extension, the McAuley claims in Bristol. schistose porphyries play an important part.

In refrence to the peculiar significance of this acid porphyry it may be well to point out that also in the Keewatin in the Province of Quebec, similar quartz ankerite veins have been observed, without, however, earrying any important amount of the noble metal. M. E. Wilson† considers that this lack of economic proportions of gold should be attributed to the complete absence of intrusions of quartz porphyries with which the occurrences of gold in Northern Ontario is apparently very closely connected. As a matter of fact in Northern Ontario such intrusions of porphyries have been observed to possess great extension. not only in Porcupine, but also at Swastika and Larder Lake

The favourable influence of the acid porphyry on the gold values cannot be of a genetic nature, since it is considerably older than the veins which are late Huronian. On the other hand, the chemical, and partienlarly the physical properties of this rock, which is easily altered by pressure to the schistose varieties, may be of considerable importance. "The more fissured and schistose the country rock the higher are the ore values" appears to be an important fundamental in estimating the value of these gold deposits. In the ordinary massive greenstone high values are not common, for in this hard and little fissured rock. the orebearing solutions were only able to ascend freely where the way was open to them by the steep, smooth walls of relatively wide fissnres. Such favourable conditions have been observed only rarely, as for example in the case of the chief vein of the Rea mine.

In the Porcupine district the Dome and the Hollinger mines are among the best known. The former deposit is the best representative of the dome vein type, while the latter deposit cousists of a mineralized zone containing compound veins. The Great Dome of the Dome mines forms an irregular dome rising above the glacial deposit about seven and one-half meters. It is, 180 meters long and 60 meters broad. This great body consists of several masses of milk-white quartz, some of which attain a diameter of 40 meters, and which, along with a net-work of veins and stringers, enclose large mineralized masses of schistose greenstone and of Huronian schist conglomerate. On the

†Summary Report of the Geological Survey, 1910, p. 206.





----- Contact between the Schistose Quartz Porphyry and the Basalts (Greenstone and Greenschist)---so far as known. - - Direction of the Veins in the mines she are the greatest development.

13

surface, in addition to the numerous sulphides. occasionally very handsome thin plates of native gold may be observed.

Since the gold veins of Porcupine vary, not only in dip and strike, but also in an unusual degree with regard to the thickness of the veins, it is scarcely probable that a mass of such enormous dimensions on the surface as the Great Dome. will be found to preserve such great magnitude with depth. I was not able to obtain definite evidence, however, on this point, since the shaft, which was then 36 meters deep, had been burned and on this account it was impossible to examine the underground workings.‡ According to data contained in Davis Handbook of the Porcupine District (New York, 1911). there is an orc supply of 600.000 tons§ (short tons). This has been determined by sinking shafts and other explorations. This ore contains on an average from 42 to 50 marks per ton in gold, or a total value of twenty-five to thirty million marks. (1 mark=24 cents.)

The Great Dome is part of a vcin system which may be followed to the east and northeast past the Dome Extension mine to the Foley-O'Brien and toward the west to beyond the West Dome mine.

From the nature of this deposit as a whole it is apparently best suited for open cut work rather than for underground mining.

The Hollinger mine lies in the region of the Pearl Lake porphyry. The course of the vein at the Hollinger strikes nearly cast, as may be observed in Figure 4. On the out-crop these veins have been usually examined by test pits and in this way the gold values Underground explorations of a serious determined. character have been undertaken only in the central and richest of the larger veins. The depth attained in this work does not exceed 60 meters. This chief vein is almost vertical. At the 30-meter level it was followed along its strike for 420 meters. On this level the thickness of the vein varies with a maximum of seven meters and an average thickness of the whole length, of two meters. The vein filling consists of quartz and some country rock. Up to the present ankerite has been found in only one place. Samples carefully taken from the vein throughout the whole

Permission to make an underground examination of this mine, which is controlled by the International Nickel Company, is under ordinary conditions difficult to obtain.

§In the following references the ton is understood to be the short ton-2,000 lbs.

length of 420 meters at intervals of one and one-half metres, show, according to the data of Mr. Robbins, superintendent of the mine, an average of 212 marks per ton.

Similar explorations of the 60-meter level, where no great length has been opened up, have given results equally satisfactory. The gold occurs in the form of



Fig. 5.-Geological Sketch of the Dome Mine

Quaternary-mostly glacial sediments,



Huronian and Keewatin-Lower Huronian Con-



glomerates and Schists,

Quartz Porphyry-mostly metamorphosed,



Greenstone-Amvgdaloidal Basalts,

Quartz Veins and the Great Dome.

native gold, or in combination with sulphides. It is distributed throughout the whole body of the vein and does not show so rich in spots as in the case of many other mines. The country rock also carries high values which are greatest in the immediate vicinity of the quartz of the vein mass and stringers. As the

The other veins appear to be considerably leaner. They carry, however, according to preliminary investigations, frequently from 40 to 80 marks per ton. (1 mark=24 cents).

whole country rock between the veins is a net-work of stringers and since this always contains traces of gold wherever there is the least sign of quartz stringer, it, therefore, appears as if the country rock between the various veins constituted a zone of mineralization. This zone attains a breadth of 420 meters on the properties of the Hollinger and of the closely related Timmins syndicate. Under present conditions ore occurring in large bodies and carrying 20 marks in gold to the ten may be mined with a profit. (1 mark=24 cents.) It seems, therefore, probable that a considerable part of this mineralized zone may be regarded as profitable ore.

Similar relationships are found to the northeast, at the McIntyre and Jupiter mines. Still farther to the northeast (Fig. 2), beyond the schistose porphyry the zone of veins appears to continue in the direction of the Scottish-Ontario mine. In this extension, however, the gold values are not so high.

A southwestern extension of the Hollinger vein zone was observed on the property of the Crown Reserve. Further extension toward the southwest can only be followed with difficulty, as the outerops of the veins are frequently covered by enormous thickness of glacial material. The vein zone appears to include the free gold exposures of the Gray elaims and of several adjacent claims. It then continues farther to the Pigeon Rapids of the Metagami River. A zone of veins has been observed in the midst of these rapids. This zone strikes in a northeasterly direction, has a width of 90 meters and on both sides of the river is hidden by a covering of young sediments. Assays of specimens broken off from under the water gave values in gold varying from two to 120 marks per ton. (One mark=24 eents.)

This exposure in the Metagami River eaused many prospectors to seek for the continuation of this zone farther to the west and to the southwest wherever the older rocks were exposed. McAuley Bros. succeeded in June. 1911, in making a discovery in the southwestern part of Bristol Township. The zone of veins appears here in the form of a high ridge rising above the surrounding country and has been exposed partly by stripping and partly by blasting. In this way it has been uncovered for 140 meters in the direction of It is noteworthy that in this exposure a the strike. diabase dyke 12 meters across intersects the quartz vein and strikes in a north-south direction. This dyke of younger olivine diabase apparently occupies a fault fissure. To the west of this dyke the ore body, which is about 20 meters across, includes quartz, a little an-To kerite and some strongly pressed country rock. the cast of this dyke, however, two veins of similar dimensions are observed about 40 metres apart. The country rock between these veins contains numerons stringers of quartz, but it does not appear to be strong-The body of the vein exhibits throughly silicified. ont its whole length, exposures of free gold, sulphides. and arsenides of a promising character. Here the conditions do not appear on the whole to be quite so favourable as at Pearl Lake, since the country rock is not quite so schistose and is only in part made up of metamorphosed quartz porphyry. It will be necessary to await the results of assays of samples and underground development before one can judge as to whether this occurrence is really of a superior quality.

Gold has recently been found in a vein which may belong to the same zone, immediately to the south of the McAnley claims.

To the northwest of these claims I examined a quartz dome about 35 metres broad, 50 metres long, and four meters high. On the surface this showed absolutely no sign of mineralization. In a small pit located on the east side of this dome, where the quartz contains numerons masses of the country rock. I observed some marcasite and arsenopyrite which gave promise of gold and which apparently increased in amount with depth.

The further extension of this gold-bearing belt to the southwest of the McAnley claims is seen in the remarkable arrangement—as indicated on the map of the Cripple Creek district—of all the free gold discoveries hitherto made in the Townships of Carscallen, Denton, and Keefer. All these discoveries are approximately in line with the west southwestward extension of the Hollinger belt.

This Hollinger belt extends in the direction of the strike for at least 50 kilometers. It represents a strongly foliated zone inside of which the gold-hearing solutions were able to find a most convenient way in In this belt are found the majority of their ascent. the promising deposits-the Great Dome, while appearing to lie ontside of this zone. may possibly be regarded as an offset. Inside this zone, however, the deposits appear to be particularly rich where this teetonic zone intersects quartz porphyries and their foliated derivatives. I do not wish to be understood to maintain that promising discoveries have not been made in other parts of the district or that they will not be made in the future or that other zones of the same The Hollinger zone is kind may not be established. nevertheless of the greatest significance for the development of this district. That part of the vein which is to-day hidden by the extensive glacial sediments so as to render difficult the work of the miner, will later play a very important part.

I observed at Swastika a teetonic zone almost identieal in character and striking in the same direction. In this region several insignificant gold discoveries were made as early as 1907, but systematic prospecting did not oecur, however, nutil 1911. In July and August, of this year, large veins and very rich occurrenees of free gold were discovered along the abovementioned zone. Rich deposits were specially observable where the veins filled in a fissure between the Keewatin rocks on the one side and an arm of Laurentian granite on the other (Lucky-Cross claims). Prospeetors surmise that this zone extends in a northeastern direction as far as Larder Lake. My own observations do not permit me to express an opinion in this matter.

4. Genesis.

Professor W. G. Miller is of the opinion that the gold-bearing magma is connected with great granite intrusions which forced their way upward after the lower Huronian period. Not far from Porenpine at the present time masses of such granite outcrop. The occurrence of feldspar, tourmaline, and inclusions of gas are in harmony with this view; moreover, in certain veins specimens have been found possesing the composition of granite and exhibiting free gold.

5. Economic Outlook.

The great forest fire which swept this country last July has set back the development of this gold district for at least several months by the destruction of many structures connected with the mining and winning of the ore values. As a result of this no considerable gold production is to be expected before the beginning of next year.

Keeping in mind all the conditions referred to, it is difficult to believe that more than a small minority of these mining ventures have any possibility whatever of success. In addition to many gold regions whose development is only in the initial stage there are already six to eight mines, which, judged by present appearance justify in some cases even the very highest hopes. These new gold fields will, therefore, in the course of a few years, play a part in the gold market and in time approach in importance the best American gold regions.

Those in attendance at the next International Geological Congress, which will be held in Toronto in 1913, will certainly have an opportunity to visit this region.



