

OFFICE COPY,
Not on Charge

189

1/8

REPORT ON DEPOSITS OF OPAL AT BOTHWELL, AND AN ALLEGED DISCOVERY OF GOLD AT HUNTERSTON, ON THE SHANNON.

Government Geologist's Office,
Launceston, 26th May, 1902.

SIR,

I HAVE the honour to report that, per your instructions, I visited the opal field at Bothwell on the 21st of January last, and proceeded from there to the Shannon, where abortive mining operations were carried on some years ago in the hope of proving a deposit of supposed gold-bearing stone.

Opal at Bothwell.

The township of Bothwell is situate on both banks of the River Clyde, about 1150 feet above sea-level. Crossing the Clyde at the township, and going west, the country is composed of white and buff sandstone, lithologically similar to that at Ross, and, like it, may be referred (though with some hesitation) to the variegated strata forming the lower beds of the Mesozoic. That there is, however, some of the Permo-Carboniferous present, would appear from the discovery of marine fossils on Barrack Hill, just west of the township.

Mr. Alex. Reid and Mr. Geo. Allison accompanied me to the field, about $1\frac{1}{2}$ mile W. and N.W. of Bothwell, where the former started prospecting for opal five or six years ago. Eighteen months since, Mr. Petersen began to make a stir on this field, which comprises a large sandstone plain, bounded on the S.W. and N.E. by intrusive masses of igneous rock (diabase, dolerite, bluestone, &c.). On this plain for a long distance surface-stones and outcrops give indications of veins, seams, and nests of common opal, of milk-white, resinous, bluish, and brown jasperoid varieties. Some of the opal gives orange or reddish flashes when turned in the hand, and betrays a tendency to a play of colours. Greenish and agatoid varieties were seen, but no specimens of precious opal, and I was assured at Bothwell that the true fire had not been seen in any of the stone yet.

I saw Petersen's workings on Robert Swindel's property in a couple of pits which had been sunk in yellow crystalline

sandstone, seamed with facings and veins of common opal. The veins form thin facings on the bedding-planes and the joints at right angles to these. The adjacent stone is often very siliceous from the permeation of the silica solutions through its substance. In vughs I noticed mamillary chalcedony, a mixture of crystalline silica and opal. I was told that some fossicking on Barrack Hill had also resulted in finding a little opal.

North of Petersen's pits, on A. Reid's 1400 acres, I was shown a small shaft in white sandstone, veined irregularly in all directions with white and bluish common opal. At the surface the opal is very opaque and white; a little way down it changes to waxy yellow and other tints. It is noteworthy that a low bank of diabase rock is not far from this pit. Along a fence on the property the grass is strewn with stones of opalised and chalcedonic rock, evidently derived from some outcrop. This bears a resemblance to mineral veinstone. The stones belong apparently to a vein of chalcedony and semi-opal, and are plentifully sprinkled with white iron pyrites (marcasite). A sample was given to Mr. W. F. Ward, the Government Analyst, for assay, but he reports it as containing only traces of gold and silver. I have no doubt that the occurrence is due to the contact of the Mesozoic diabase with the sandstone, and consequently economic minerals need not be expected. Near the Shannon Road on this estate is some concretionary limonite, and ironstone gravel is seen on the road itself. This mineral is further evidence of contact.

S.W. of Petersen's workings a hill-range of moderate elevation runs N.W.-S.E., on the crest of which is diabase abutting against opalised sandstone, some iron ore also marking the contact. The opal is milk-white and bluish, in veins and mamillary forms.

I take it that the presence of the eruptive rock indicates the origin of the opal. The heat imparted by it would appear to have started the silica solutions in the adjoining sandstone. The silica has been derived, not from the diabase, but from the sandstone, through which the thermal solutions have slowly meandered.

Why common opal is so abundant and the precious opal is absent it is impossible to say, but it is probably due to the conditions of formation. The iridescence or play of colour in the noble variety is due to the diffraction of light by the striated walls of excessively-minute fissures in the stone; the varying sizes of the fissures condition the different colours. The fissuring is apparently not due to pressure or

shattering from rock movements, but to internal strain on hardening.

Hence, wherever common opal occurs there is no known reason for excluding the precious stone, though the latter is not necessarily found with it. Depth, too, has nothing to do with its occurrence, as is very plainly shown by the deposits of opal in New South Wales and Queensland, a few words concerning which may be acceptable.

At the White Cliffs opal field, in New South Wales, 60 miles N.W. of Wilcannia, the workings do not go down deeper than 40 to 50 feet from the surface. The industry supports 1500 persons, and the output for 1900 was estimated at £80,000. Some of the precious opal realises £40 per ounce, and £5 to £20 is a frequent price. Some only fetches 10s. per ounce. The common opal forms 95 per cent. of the whole. The gemstone is found in horizontal veins and bands in marine strata, associated with fossil wood and shells, or as cementing broken boulders of sandstone and quartzite. Common opal is regarded as the indication. At first the quality of the patches was thought to improve with depth, but later work has shown the relation of quality to depth to be purely accidental. As far back as 1890 the New South Wales Department of Mines reported that opals were found within a few feet of the surface in layers between a hard siliceous sandstone. In 1894 Mr. E. F. Pittman, Government Geologist, reported that this sandstone was an Upper Cretaceous grit opalised by thermal springs, and that there was no surface indication of the presence of the gem, which was being recovered chiefly from about 12 feet below the surface. He adds:—"And the workings have mostly been confined to this level, apparently under the impression that it would be useless to look deeper for the stone. I am of opinion, however, that this is a mistake, and that opal may be expected to occur at much greater depths than it has hitherto been found."

In Queensland the 1901 yield of opal was valued at £7400. It is found in Upper Cretaceous (Desert) sandstone, or in nodules derived therefrom, and here also Mr. C. F. V. Jackson, Assistant Geologist, says that fully 95 per cent. contains little or no colour. The average depth of the shafts is stated at 14 feet, the greatest depth 65 feet.

In Europe the occurrences are entirely different. Pockets of opal are found in decomposed trachytic rock in Hungary.

The fact that no noble opal has yet been found at Bothwell, in spite of some industrious fossicking, is somewhat dis-

couraging. Of course, it must be allowed that very little real work has been done in the way of exploration, and that has to count for something. It would be foolish to deny the possibility of gemstone existing there, as yet undiscovered. At the same time there is nothing disclosed so far which would justify any great outlay. The nature of the deposit makes the adoption of a methodical scheme of exploration costly. It may be described as a magnified open meshwork of infiltration veins, which swell out here and there into bunches and nests, most likely connected with one another by mere tracks and narrow channels, or possibly only by silicified country rock. The deposit can only be proved by a regular series of prospecting shafts in rectangular directions covering the whole ground. This obviously involves an expense which intending explorers would do well to consider, and the proportion of failures in striking precious opal must be low, or the work will not pay, for though the hydrous silica is found developed here and there at several points throughout the field, there does not appear to be very much of it at any one spot. The deposit is very irregular, and no continuous vein can be followed; hence, I am inclined to believe that if anything valuable is ever found here, it will be by fossicking at intervals over the area, rather than by the more costly search by shaft-work just mentioned, which scarcely seems warranted by present appearances.

Gold at the Shannon.

On the 23rd January I visited the River Shannon where it flows through the estates of Meadfield and Hunterston, 12 miles N.N.W. of Bothwell, and about 450 feet higher than that town. The bank of the river near Henry Tarr's cottage, on the Meadfield run, had been the scene of operations of the Golden Dawning Mining Company, which was formed in 1897, with a nominal capital of £30,000, to work what was described as an extensive pyrites deposit on a 100-acre flat. The flat and surrounding hills were stated to be a mass of pyrites veins, carrying gold and silver. The promoters stated that assays had been made of quartz, pyrites, and slaty matter, yielding—gold 1 oz. 6 dwts. 3 grs. and silver 13 dwts. 1 gr. per ton. I was told on the spot that some of the pyrites was assayed at the Ballarat School of Mines, and returned 2½ dwts. gold per ton. The samples which were sent by Mr. A. Montgomery to the Government Analyst for assay contained only traces of gold, and

if Mr. Montgomery's report on this occurrence in 1895 had been published at the time, the probability is that the investors in the Golden Dawning Mine would never have been invited to sink their money in an enterprise foredoomed to failure. They obtained a report in 1897 from Mr. J. Davies, of the Tasmania Mine, Beaconsfield, who, however, saw nothing very definite in the occurrence, and, after a few months' struggle, work was finally abandoned. A feeling that the deposit was ill understood, and that there might be something of value in it yet undiscovered, led to the instructions for my visit.

A series of nine or ten shallow pits, most of them 4 or 5 feet deep—one 18 feet—have been sunk on the east bank of the River Shannon from near Henry Tarr's cottage to Gage's Bridge. The country-rock consists of sandstone, carbonaceous and mudstone grits, belonging to the Permo-Carboniferous system. A general feature is the presence of pyrites disseminated through the rock, and more especially on the faces of the joint-planes. It is this pyrites which has been the *ignis fatuus* of the gold-seekers. No free gold has ever been seen here. The samples of stone which I brought away with me, when crushed and washed, yielded no colours, and the pyrites failed to show any trace of gold.

Secondary pyrites is common enough in these rocks elsewhere in the Island, sometimes resulting from the influence of organic matter, sometimes connected with the intrusion of diabase. The Permo-Carboniferous mudstones of Mt. Wellington are charged with pyrites within a short distance from the contact with the mountain mass of eruptive rock.

At the Shannon No. 1 and No. 2 pits are situate on the very contact-line of a dyke of pyritiferous diabase, which descends Castle Hill like a standing wall, projecting 30 or 40 feet from the ground. The dyke is about 8 feet wide, is vertical, traverses argillaceous grit, and crosses the river-bed in a direction N. 65° W. It is concealed easterly under the flat, but loose stones of it on Tarr's Hill indicate its extension below the soil in that direction. It is fine-grained and—an unusual thing for diabase in this Island—contains microscopic zeolites. Pyrites is disseminated through it. The pyrites in the sedimentary grit which it traverses has probably been developed under its influence. Although the sedimentary rocks carry pyrites at a considerable distance from any outcrop of diabase, yet the entire district is intersected by diabase dykes, and bodies of the eruptive rock may exist anywhere not far below the surface.

On the Hunterston estate, east of the woolshed, there is another zeolitic diabase dyke protruding from the grass

about 3 feet in width. This is an extremely fine-grained basaltoid diabase, bluish in tint, with a ground-mass compact and aphanitic to the eye, dotted with black porphyritic crystals of pyroxene (augite), also olivine and white zeolites. Its direction is also N.W.

About 100 yards north of Manning's Bridge, over Blackman's Rivulet, on the Lake Road, a dyke of typical diabase occurs, about 100 feet wide. This also contains pyrites. Fossiliferous mudstone lies on the N. side, and limestone to the S. of the dyke, but I could not prove the actual contacts. Pyrites is present in all the diabase rock of the district, but its presence in the sedimentary rock is to be regarded as the result of a reducing action rather than direct impregnation from the igneous rock. The latter is much younger than the gold-bearing quartz reefs of the Island, and there is no proof anywhere that it has been a gold-carrier. It has never done anything beyond starting solutions of hydrous silica, or converting sandstones into quartzite at its contact with them, and originating a little quartz and iron ore at such places. This has given rise to Mystery and Puzzle shows *et omne hoc genus*, which are mysterious and puzzling only to those who expect gold-bearing reefs in country which was formed long after our gold reefs came into existence. Mr. George Allison took me to see one of these formations at Christian (or Crystal) Marshes, where a profusion of loose broken quartz was believed to indicate the existence of some concealed reef. I found it to be a fine illustration of contact metamorphism produced by the diabase impinging on sandstones. It is noteworthy that the proof of intrusion here is not that of a mere dyke, but it is the margin of the large body of diabase forming part of the Tier country. I drove over at least a mile of it. Blocks of quartz and quartzite are strewn about on the west bank of the Shannon on F. and W. Synnot's 640 acres, but the key to the occurrence is to be found in the bed of the river, where flat-bedded pinkish quartzite is seen at the water's edge between the bridge and opposite Mr. Hill's cottage. Just east of this is the boundary of a large area of diabase rock, which stretches east from here to Blackman's Rivulet. This rock rises into a little knoll close to Hill's, crosses the river, and its contact has undoubtedly altered the sandstone to quartzite, and developed in it veins of pure white quartz from an inch to nearly a foot in width. These veins are confined to the quartzite, and are absent from the diabase. As might be expected, the quartz does not carry gold.

On the hill east of Tarr's cottage, and about three-quarters of a mile from the latter, I was shown another

7/20

place where stones of quartzite, quartz, gneissose mica schist, granite porphyry, and other rocks occur loose in and on the surface of the soil. No solid reef has been found, and possibly a hidden diabase-sandstone contact exists here too; but, in view of the heterogeneous nature of the stones, foreign to the district, I am rather inclined to regard them as having been released from Permo-Carboniferous conglomerates, of the degradation of which they are the residue. The samples which I collected contained no gold, but Mr. Davies reports 1 dwt. 12 grs. per ton as the result of an assay from stone collected by him from here. If the quartz and quartzite have been derived from more ancient rocks, the mere presence of a little gold in some of the samples is unimportant from a mining point of view, as the stones are now widely sundered from their parent mass. If, on the other hand, the quartz has been abraded from a diabase contact, there is no use searching for gold. The fact of gold being obtained from Mr. Davies' samples is in favour of the theory that the quartz originally formed part of a conglomerate.

All these occurrences at the Shannon are illusive, and it is to be hoped that no further expenditure of time or money will be wasted on them.

The ground from Hunterston, a plain of Permo-Carboniferous grits, rises gradually to the foot of the Shannon Tier, which shuts in the northern horizon in a slightly-crescentic form. The Tier itself rises from the flat land about three miles north of Gage's Bridge to a height of 800 feet above White's and Westell's selections, or 1200 feet above Tarr's cottage, and 2800 feet above sea-level. The horizontally-bedded sandstones ascend the flank of the mountain to within two or three hundred feet of the top, when the Mesozoic diabase begins to show itself as columnar crags.

I was accompanied to the top of the Tier by Mr. George Allison, whose love of geological exploration and prospecting led a few years ago to his discovery of the interesting volcanic nephelinite and melilite basalt rock of Tertiary age occurring in the form of small cones, 30 to 50 feet high, which have been ejected through the diabase on the summit. The rock was described by Mr. W. F. Petterd and myself in 1899, and the description was published in your report for 1898-9.

North of White's is the largest cone, a double one, consisting of bluish-looking compact melilite basalt, breaking with a conchoidal fracture. This is known as the Haystack, and, owing to the small clearing in which it stands, it

8/9

can be seen from a good distance on the Hunterston plain. No ashes are preserved, and the cone is probably a surviving neck. Between the two cones, and at the base of the north side of the larger one, the grass conceals a very coarse nepheline-augite rock = nephelinite, composed of augite in long prisms and light-coloured nepheline. Much of the nepheline has decomposed into radiating snow-white natrolite, and Mr. Petterd has identified some beautiful zeolitic needles as Thomsonite. The long prisms of augite were surmised to be tourmaline on the first discovery of the rock. It was thought that some useful mineral might be disclosed, and accordingly a little work was done at this spot. The coarse nephelinite seems to penetrate and fill the joints of the finer basalt, presumably by a process of segregation, for the two rocks must be contemporaneous. It would be interesting to prove whether it underlies the cone. It varies occasionally into a rock of finer grain. Proceeding west along the edge of the Tier, over diabase rock, for half a mile, a smaller melilite basalt cone is met with, about 30 feet high, with a north and south basal diameter of 120 feet and 50 feet E. and W. This may be called the Beehive, and about 100 feet west of it is a still smaller cone, not more than 12 feet high, which is the Anthill. The discovery of these rocks was unique in Australasia; at the end of last year, however, the volcanic fayalite rock at the Alexandra Battery, Sandy Bay, was found to be also a melilite basalt. The rock at the Shannon is not likely to yield gold or any other metal of economic value.

The geological examination of the Shannon district shows that it offers little promise of payable lode-deposits, unless the underlying granitic bed-rock can be found exposed somewhere. The only chance which it appears to have would be the existence of coal seams in some of the higher sandstones on the slopes of the Tier, as, possibly, Mesozoic strata may be found at the higher levels.

I have the honour to be,
Sir,

Your obedient Servant,

W. H. TWELVETREES,
Government Geologist.

W. H. WALLACE, Esq.,
Secretary for Mines, Hobart.