

QUARTZ REEFS

OF THE

WEST COAST MINING DISTRICT, NEW ZEALAND.

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P R E F A C E.

IN preparing the following pages an attempt has been made to collect in a handy form such reliable information as is available regarding the whole of the quartz-prospecting or quartz-mining carried out in the West Coast Inspection District of New Zealand from the earliest days up to the end of 1926.

The compilation was primarily to serve as a convenient book of reference on the subject for the Mines Department, of which the writer has the honour to be an official ; but it may well prove of use to a large section of the general mining public, especially to those persons interested in prospecting or inclined to support mining effort by taking up shares in mining companies. As far as the latter are concerned, there can be little doubt that if some such volume had been available in the past it may have prevented them wasting much money put into ill-advised flotations, of which there have been so many during recent years.

A good deal of the information given has been culled from departmental files, and has never previously appeared in print, but by far the greater portion of it has already been published in one form or other. It has, however, been scattered through scores of publications issued during a period of half a century, and hence has not been readily available to the ordinary reader.

In collating the information, much difficulty has been experienced in arriving at anything like accuracy in description, both as regards the work done on the various mining areas and their results. This has been partly owing to the absence of detailed records covering the years prior to, say, 1887, and partly to many inaccuracies and contradictions that appear in existing records dealing both with that and later periods. In practically all cases, however, there has been indirect data at hand to serve as a guide, consequently the writer feels that any statements now made herein may be considered as reliable as it is possible in the circumstances to get them.

Full use has been made of such of the bulletins issued by the Geological Survey Department as have dealt with areas in the district, and particularly of Bulletin No. 18, "Geology of the Reefton Subdivision," by Dr. J. Henderson. The information given in that publication regarding the Reefton mines proved very helpful, but the writer has added to it and has brought it up for a further fourteen years.

*Office of the Inspector of Mines, Reefton,
30th November, 1927.*

ABBREVIATIONS.

- Mines Reps.** .. **Mines Statement, or Reports on the Mining Industry of New Zealand.**
- Geol. Reps.** .. **Geological Bulletins of New Zealand, Department of Geological Survey (New Series).**
- Reps. Geol. Expl.** .. **Reports on Geological Explorations, issued by Department of Geological Survey, New Zealand.**

QUARTZ REEFS OF THE WEST COAST MINING DISTRICT.

MARLBOROUGH PROVINCE.

THIS province has not been fortunate as yet in finding within its boundaries any quartz-mines of important value, although in at least three localities—the Waikakaho, the Wairau River, and the Wakamarina River—auriferous reefs have been discovered and developed to a considerable extent. On the first-mentioned two fields active quartz-mining has ceased for some years, but a little is still carried on at the Wakamarina. Some description of these various fields may prove of interest.

WAIKAKAHO FIELD.

The discovery, in 1899, of gold-bearing stone on a saddle between the heads of the Mahakipawa and Waikakaho Creeks caused a good deal of stir in the province, and for a time it looked as if a very promising new field had been found. Within a short time about forty licensed holdings were applied for, but on the greatest number of these little work was ever done. Gold-bearing reefs were prospected in what were known as the Mahakipawa, Kapai, Waikakaho, and Southern Cross holdings. The first-named was at the head of the right-hand branch of Mahakipawa Creek, on the Mahakipawa side of the saddle. The Kapai holding was on the saddle, and adjoining the former. The Waikakaho holding adjoined the Kapai, on the Waikakaho fall of the range, with the Southern Cross in immediate contiguity to the south. Two strong parallel reefs, about 120 ft. apart and striking in a general north-easterly direction, traversed these holdings, and in at least one of them a third parallel reef or leader seems to have been disclosed. There is some uncertainty as to the dip of these formations, various reports dealing with the point being contradictory, but H. A. Gordon mentions* that it was south-westerly at an inclination of about 1 in 2, while the general dip of the adjoining rock was north-easterly. This description seems to be the correct one, and would indicate that the reefs cut across the strata and were thus true fissure deposits which, from their very nature, might be expected to live down to considerable depth.

No plans of the workings are available, but the annual reports of the Mines Department show that quite a lot of development work was done on the various properties, and that the prospects were most encouraging. On the Mahakipawa holding much trenching was done on the main outcrop,

* Mines Reps., 1890, p. 52.

and a winze was sunk on it to 76 ft. in stone averaging 3 ft. in width. The quartz from outcrop and winze is said to have shown gold so freely that the manager estimated it would yield from 4 oz. to 5 oz. per ton. An adit level was then started to cut the reef about 300 ft. in and 120 ft. under the outcrop, but as it was extended to 400 ft. without finding stone it would appear that faulting had at this point caused serious displacement of the reef.

On the Kapai holding three parallel reefs or leaders were located. Two of them were very narrow, but a winze sunk on one to 30 ft. showed that it carried good gold-values. The other was only trenched, but is said also to have shown fair prospects. The third reef was up to 9 ft. wide in places on the surface, where it is reported to have shown gold freely. An adit was put in on this reef, to give 155 ft. of backs, and was driven along the reef for about 160 ft., the stone averaging at this depth 3 ft. in width.

On the Waikakaho claim three levels were driven. The upper adit, 185 ft. below the outcrop, was driven on reef for 360 ft. No. 2 adit, 235 ft. below No. 1, was carried in 375 ft., of which 200 ft. was on stone. No. 3 adit, 159 ft. under No. 3, was driven 160 ft. According to the Mines Reports of 1890, the reef at the mouth of No. 1 adit was 6 ft. wide, but for the 250 ft. driven on averaged from 2 ft. 6 in. to 3 ft., and the stone was highly mineralized and showed gold all through. Where struck at the end of the crosscut in No. 2 adit the reef is said to have been 8 ft. in width, but after being driven on for 200 ft. diminished to 4 ft. 6 in. The stone in this level did not show so much gold as in the upper level, but in constructing a pass up to No. 1 good gold-bearing stone was met at 50 ft. up. In driving the crosscut to intersect the main reef, another reef, 6 ft. wide, was cut, which showed a little gold, but was not driven on, the immediate object of the work being to pick up a reef that outcropped at surface. In No. 3 adit the second reef mentioned seems also to have been intersected.

In the Southern Cross workings a reef found at surface was sunk on for 35 ft., and an adit was started 160 ft. below the outcrop to pick it up at that depth. Nothing was found in this adit; but eventually, in 1891, in driving a crosscut from it, a reef from 18 in. to 2 ft. wide was met with, which, according to the Mines Reports for that year, showed gold freely.

Representative samples taken from time to time and sent away for assay are said to have given results equal to 2 oz. 15 dwt. gold per ton in the Kapai stone, and 1 oz. 10 dwt. in the Mahakipawa stone.

By the end of 1890 about 1,000 tons of quartz was at grass from the various claims, and with regard to this the Mining Inspector remarks that it showed good prospects. The Warden's reports were also very optimistic, and the owners seem to have been most confident of getting good values. In 1891 the Mahakipawa, Lucky Hit, Kapai, and Waikakaho claims were taken over by a company known as the Ravenswood Gold-mining Company, of London, which carried on vigorous prospecting, and was so satisfied with the promise of the property that it proceeded to erect a twenty-stamp battery and an aerial tramway several miles in length. This plant was completed in 1892, and crushing was commenced, but, unfortunately, the high hopes that had been entertained were destined to be destroyed. Some 950 tons of quartz from the different workings were put through for a yield by amalgamation of 112 oz. 10 dwt. gold, equal to only a little over 2 dwt. per ton. Seeing that gold was visible so freely in the stone, and that samples of the ore sent to the Cassel Company were found payable for working, this

poor return from the company's own treatment plant surprised and perplexed all parties concerned. The stone was treated in a number of parcels, and with regard to the first put through the battery H. A. Gordon remarks* that no one who had prospected the quartz taken out would have anticipated this small yield. The general opinion seemed to have been that in some way a goodly portion of the gold was being lost. The company's officials evidently attributed it to unsuitability of the plant, but H. A. Gordon, in his report just previously referred to, expressed the opinion that it was questionable if the company had in its employ any one who understood properly the system of extracting gold from the ore by amalgamation and battery treatment. A singular point about the matter was that when putting the stone through the battery in parcels it was noted that as good a return of gold was got from what was looked upon as the poorest material as from the stone that showed gold freely.

To further perplex the management, the results of five parcels of the quartz sent to Australia and London showed that it contained much better values than could be recovered at the mine, and that the values were payable. A few tons of ore had been left in the bins, and of this two separate parcels of 6 tons each were sent to Sydney. The first parcel on being treated yielded 8 dwt. 8 gr., and the second 15 dwt. gold per ton. The three other parcels, of 10 cwt. each, were despatched to London, and are said to have yielded respectively 16 dwt. 6 gr., 14 dwt. 19 gr., and 10 dwt. 12.7 gr. per ton. The average yield for the five parcels was thus 12 dwt. 23 gr. gold per ton, which would have been payable. In the face of these results it certainly seemed as if the battery was losing a good deal of the gold, and with a view to obtaining a better recovery a small cyaniding plant was erected, and, to assure this being run in the proper way, the services of one of the Cassel Company's men were secured. A certain amount of tailings was put through this plant, but the available records are not at all clear as to the results achieved. According to the Mines Reports for 1895 (p. 70) 25 tons of quartz were crushed for the previous year for a yield of 14 oz. gold, equal to 11 dwt. per ton; and, seeing that no yield approaching this in value had previously been got from the stone, it would seem safe to assume that the quantity of quartz mentioned was actually mined, crushed, and cyanided to obtain it. On the other hand, the same report mentions that Mr. Turner, the company's manager, had informed the Assistant Inspector of Mines, N. D. Cochrane, that 175 tons either of stone crushed or of tailings had been treated by the cyanide process for a return of only 16 oz. gold. It is possible that these differing results were from two separate tests that were made; but, be this as it may, after a very brief test with the cyanide plant the company ceased operations, and very little further work was done on the field. In 1906 it was reported that a miner named Thomas had succeeded in tracing the reef system down the western, or Mahakapawa, side of the range, getting good surface prospects; and in the following year a small party was engaged in cleaning out the old Kapai workings; but this seems to have been all the further prospecting done in the locality.

In his annual report for 1895, Inspecting Engineer of Mines, H. A. Gordon, states that when visiting the mines some eighteen months previously, in company with Mr. R. A. F. Murray, Government Geologist, Victoria, and Mr. Alex. McKay, Mining Geologist, his impression was that working the property would prove a failure. This opinion may have been well founded, but it

* Mines Repts., 1893, p. 77.

was given expression to after the company had closed down, which somewhat lessens its value. It is quite likely that neither the reefs nor the values in the stone ever really showed the promise early reports would lead a reader to think they did, and that no method of mining or treatment would have given more satisfactory results; but in view of all the circumstances some slight doubt is left as to whether the field as a whole received as full a testing as it might have had.

WAIRAU RIVER FIELD.

What may be described as the Wairau River field covers an area drained by Top Valley and Armchair Creeks, which have their source in a range separating the Wairau Valley from the Wakamarina Valley and flow northerly into the former.

A number of auriferous quartz reefs were located in it, upon which much development work was done, but the results were not very satisfactory, the average value of the stone being too low to admit of any profit being made. The first discovery seems to have been made near the head of Top Valley Creek about 1889, when a reef was found outcropping on an elevated terrace. The Jubilee Gold-mining Company was formed to work this, and it erected a ten-head battery of very primitive construction, and put a number of test crushings through from the outcrops, with results that seemed to show payable values in the quartz. A commencement was then made to open the reef up systematically. Only very incomplete plans of the workings are available, but they serve to show that an adit cross-cut was first run in to cut the reef at 125 ft. This was followed by the putting-in of another adit to cut the formation at 160 ft., and up to November, 1900, when operations were suspended for a time, the reef had been driven on in this last level for 60 ft. north and 30 ft. south, and a connection made through to the surface for ventilation. In the following year work was resumed, but was confined to extending No. 2 adit, where values were evidently developed sufficiently encouraging to stimulate the management to materially improve the crushing facilities at the mine, notably by installing water-power in place of steam-power for driving the battery. Operations then continued steadily for several years.

In the meantime several other small mines were opened up in the same locality. One of these was known as the Wellington, owned by the Wellington Syndicate. It may here be remarked that this particular period of New Zealand history was one in which the carrying-on of mining effort had to depend on small-syndicate-financing, very little money coming from outside the colony for the purpose, with the result that many small mines that were prospected were tested but very indifferently. The funds of the syndicates were usually strictly limited, and unless good values were struck almost from the start the available money was soon used up, and operations came to an end. Further, in many cases it was impossible to carry out development necessary to prove the value of a find definitely, so the funds in hand were often spent in futile and unnecessary work. The Wellington Syndicate was evidently similar to scores of others formed at the time.

The Wellington Mine was situated on the Jubilee Range, about a mile and a half up-stream from the Jubilee battery. A strong outcrop was found, on which a winze was sunk to a depth of 35 ft., the reef proving to be from 2 ft. to 3 ft. in width. Later on, two adits were driven on the

stone, the upper of which cut the reef 50 ft. below the outcrop, and the other about 115 ft. still lower. Connection was made between the adits. A ten-stamp battery was erected, but there is no record of any stone having been crushed in it.

Another mine was the Luck at Last. In this a drive was put in on a large formation, but the stone was found to be of too low grade to pay for working.

Other mines were known as the Duke of Cornwall and the Baden Powell. In the former, four shallow crosscuts were made through the cap of a reef, and a winze was sunk to 53 ft. on stone said to average 4 ft. in width. From the latter a small crushing was taken out in 1903 from shallow workings, but the result was so unfavourable that the syndicate abandoned the ground. No crushing, as far as can be learned, was made of stone from the Duke of Cornwall.

In 1905 a reconstruction of the Jubilee, Luck at Last, and Wellington Syndicates took place, the three being amalgamated under the title "Wairau Gold-mining Company." This new company concentrated all its efforts on the Jubilee Mine. By this time the small reef on which all the work so far had been done had been practically stoped from No. 2 adit to the surface. An effort was therefore made to extend No. 2 adit a further 1,100 ft., making 1,260 ft. in all from the portal, to cut a large formation outcropping to the westward. While this work was being pushed ahead, the stoping of such quartz as remained above the adit was taken over on tribute by the manager, Linstrom. Another adit was also put in to develop a small reef found 225 ft. below No. 2 level, and a crushing was taken from it. No stone was crushed after 1908, but, in a desultory way, No. 2 adit was continued towards the western reef. What distance this adit finally reached there is no record to show, but Inspector of Mines Whitley reported in 1910 that it had reached 800 ft. In the succeeding years till 1913 some further advance was made that would probably bring the total length driven to about 1,000 ft. In any case, the western reef does not seem to have been reached.

The Jubilee Mine is the only one in connection with which the figures are available as to crushings, 3,673 tons of quartz having been treated, for a yield of 1,187 oz. 0 dwt. 17 gr. gold, valued at £4,182 19s. 2d.

Tasman's Choice Mine.—Somewhere about 1909 or 1910 a good deal of work was done on another reef near the head of Armchair Creek, the right-hand branch of Top Valley Creek. A fairly strong reef was traceable on the surface for a considerable distance—probably 30 chains. Three shafts were sunk on it, to 30 ft., 40 ft., and 89 ft. respectively, following the reef on a rather flat underlay, and an adit was driven which connected with the bottom of the shallowest shaft. Throughout these workings the reef averaged about 2 ft. 6 in. to 3 ft. in width, but the stone was not solid all the way, having a tendency for considerable distances to split up into a series of stringers of quartz banded with country rock. At 86 ft. below the adit referred to another was started, which should have given about 250 ft. of backs at the deepest shaft. This adit was carried in as a crosscut for 153 ft., and needed to be driven a further 90 ft. or so to reach the reef.

In 1922 an attempt was made to float a company, to be known as the Tasman's Choice Gold-mining Company, Ltd., for the purpose of further developing the reef, but the flotation apparently fell through for lack of support. In the prospectus issued at the time statements were made that values up to £35 5s. had been got in the stone, but the average value was

estimated to be £2 14s. 6d. per ton. It is possible, and likely, that in parts the reef carried fair values, but when visiting the mine in the early part of 1924 the present writer took a few samples from various portions of the workings, none of which on being assayed gave more than the barest traces of gold.

Mount Patriarch Reef.—About 1907 a party of working-miners opened up a reef in the vicinity of Mount Patriarch, about twelve miles higher up the Wairau River than Top Valley Creek, and forty-five miles by road from Blenheim. A shaft was sunk on the outcrop for 40 ft. on reef said to have averaged from 3 ft. to 4 ft. wide. A crosscut adit was also driven, at about the level of the bottom of the shaft, which intersected the reef at 127 ft., from which point the stone was driven on for 57 ft. In this working the reef was 3 ft. in width, and is described as being of a crumbly nature, very easily broken. Owing to the party's funds becoming exhausted, operations were suspended at this juncture, and, despite the fact that a number of samples taken from various parts of the reef by Inspector of Mines A. W. Richards were said to have shown values in gold equal to from £6 to £8 per ton, no more work was done on the mine for several years.

In 1909, as a result of an interview between members of the party and the then Minister of Mines, a subsidy was granted to assist in the putting-in of another adit, 60 ft. below No. 1, to test the reef to that depth, but the party did not avail itself of this grant. Instead, it erected a small three-stamp battery, which was of little use for anything but purely testing purposes, and having once more exhausted its finances in the purchase and installation of this primitive plant it again ceased operations, and nothing has since been done on the reef. If the values as revealed by the assays of the samples taken by Inspector Richards are to be relied on, it would look as if this prospect might deserve some further examination.

WAKAMARINA RIVER FIELD.

The name of the Wakamarina Diggings is well known as that of one of the rich alluvial fields of the early days of New Zealand mining. Gold was found there first about 1860, and a large population was quickly drawn to the locality. Owing to the gold being mainly confined to the narrow river-bed, the field did not last long, being practically worked out by 1865. During the intervening years, however, it is known that approximately 33,000 oz. of gold, valued at £130,000, were exported, and this only represented part of the actual recoveries, for many miners are said to have taken their winnings away with them. Much of the gold is reported to have been of specimen character—that is to say, it had more or less quartz adhering to it; but the miners of those days do not seem to have been interested in looking for quartz reefs, and apparently searched but little for them. Consequently it was not till about 1874 that the existence of auriferous quartz reefs was noted, a lode being found in that year in the valley of Deep Creek, which enters the Wakamarina River about six miles up from its junction with the Pelorus River. This find was soon followed by that of further quartz lodes about two miles southward, but on none of these does any work appear to have been done till some years later. In 1881 a quartz vein about 10ft. in width was discovered between Dead Horse Creek and Deep Creek, and the Golden Bar Gold-mining Company was formed to develop it. A good deal of stone was broken out, but evidently the prospects were not such as to warrant putting up crushing plant, and the company abandoned its ground

in 1885. On the discovery of the Golden Bar reef other claims were taken up in the vicinity, and a lot of prospecting by means of tunnels driven into the hillside was carried out on them, but without finding anything of a payable nature. The reefs were then neglected till towards the end of 1893, when Mr. James Wilkie and party went into one of the old adits on the Empire City Claim, which adjoined the Golden Bar on the north, and found there a quartz reef that had been cut through by the earlier prospectors and left by them as unpayable. Wilkie's party did some driving on this reef, which was 8 ft. in width between well-defined walls. They found that it carried a little gold and some scheelite, and were so hopeful of the prospect that they erected a small Otis crushing plant to treat the stone. No records are available as to the amount of quartz crushed in this plant, nor as to the results, but evidently the stone proved very poor, and operations on the field were once more suspended. Some tests of the quartz were also made on behalf of the party at Thames, but these did not yield payable results, the best values recovered being only equal to 17s. 4d. per ton for gold.

The field lay idle this time till about 1907, when a few men were put on to clean out the old drives on the Golden Bar and Federated Yorkshire Claims; but no active developments were entered on till 1910, when the Empire City, Golden Bar, and Federated Yorkshire Claims were taken up by Messrs. Humphries Bros., and a company known as the Dominion Consolidated Developing Company was formed to work them in a large way. This company was registered in January, 1911, and at once erected a twelve-stamp battery. By the end of 1912 the battery had been increased in size to twenty-five heads of stamps, and Frue vanners were installed to save the scheelite. Despite every effort made, however, to economize in the handling and treating of the stone the company failed to make any reasonable profit, but it struggled along for about twelve years, eventually going into liquidation in 1923. During the period the company operated it crushed 99,756 tons of quartz for a yield of 15,440 oz. 1 dwt. 14 gr. gold, valued at £58,969, and recovered as well 380 tons of scheelite valued at approximately £61,257, but only managed to pay in dividends the small sum of £3,750. The average value recovered was equal to 11s. 9d. per ton for gold, and 12s. 3d. per ton for scheelite.

In 1925 a further attempt to work the property was made by a syndicate that had taken it over from the liquidator. On this occasion a system of shrinkage stoping was introduced in the hope that this method of working would enable economies to be effected that would leave a small margin of profit on the mining and treatment. The effort was, however, no more successful than the previous one, 3,615 tons of quartz being mined and treated for gold valued at £2,857 3s. 10d., equal to 15s. 9d. per ton. This recovery was a little better than the company's, but was still insufficient to pay working-expenses. The market for scheelite having collapsed, there was no added return from this mineral.

In the following year still another attempt was made to work the mine successfully, this time by a party led by Mr. T. H. Harrison, and this was the most promising in the history of the property, 1,287 tons of quartz being crushed in 1926 for a yield of 651 oz. 17 dwt. gold, valued at £2,411 1s. 3d., equal to 37s. 5d. per ton of ore. Unfortunately, just before the end of the year Mr. Harrison was accidentally killed by a fall of ground in the mine, since when, up to the time of writing, mining operations have not been resumed.

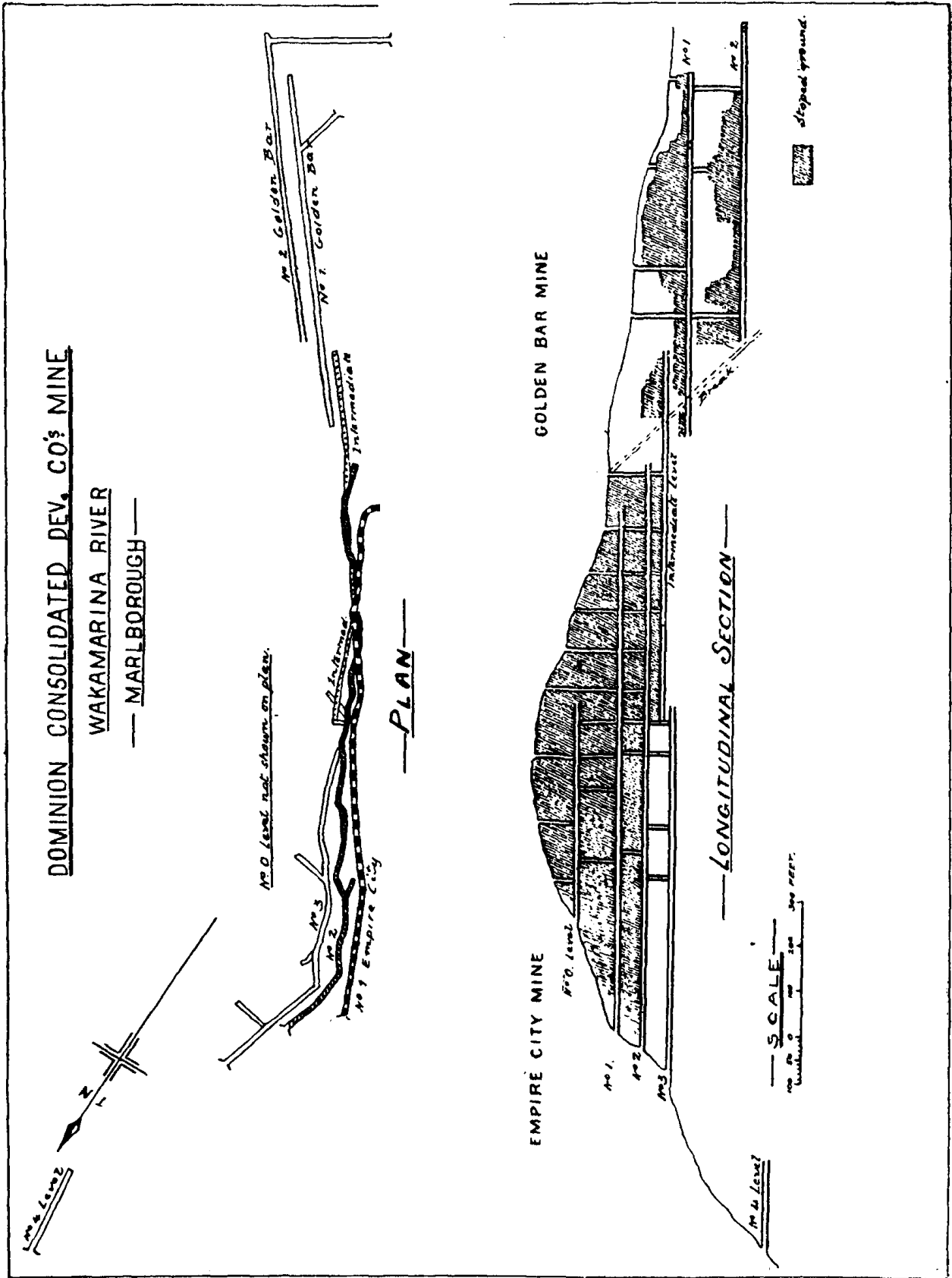


FIG. 1.—PLAN AND SECTION, DOMINION CONSOLIDATED COMPANY'S MINE, WAKAMARINA.

The one reef traverses all the claims on a north-north-westerly strike, and with an underlie varying from 30° to 75° , and is traceable on the surface for about 90 chains. A very considerable amount of development has been done on it, mainly within the boundaries of the Empire City and Golden Bar sections (see Fig. 1). Four adits were driven in the Empire City Claim, and a fifth was started. In the surface adit, No. 0, there was solid reef for 500 ft., and in Nos. 1 and 2 for 1,100 ft. and 1,350 ft. respectively. No. 3 adit was, however, in crushed country carrying streaks and veinlets of calcite and quartz. An intermediate level was driven from No. 3 rise on No. 3 level, and only 15 ft. above the latter, and this was extended for 850 ft., the last 350 ft. of which was in solid stone, which was afterwards stoped to surface. At a point above 650 ft. along this intermediate level a fault or break was intersected which cut the reef off, but on driving a few feet through it the reef was picked up again on the Golden Bar side, which was, subsequently, also stoped out to surface. This was the only level on the Empire City side that penetrated the break. On the Golden Bar side two adits were put in, No. 1 being 40 ft. below the Empire City intermediate level, and No. 2 120 ft. lower. Both these adits were driven on solid stone up to 8 ft. to 10 ft. wide. A good deal of stoping was done along each, but the ore on the whole was of low grade. In 1925, No. 1 Golden Bar adit was driven to the break previously referred to, when further advance was stopped. In 1926, however, under the management of Mr. Harrison, the break was penetrated at this point, with the result that the reef was picked up beyond it in a few feet of driving. It was about 8 ft. wide where struck, but opened out quickly to nearly 20 ft., and was apparently richer in gold than the stone found in any other part of the mine, for it was from here that all of the decidedly improved quality quartz evidently came that was treated in 1926.

Henderson* describes the country in which the reef occurs as consisting of gently dipping schists evidently altered from massive greywacke containing thin bands of finer material, and the reef itself as a fissure-lode, formed by the replacement of crushed rock in a fracture-zone by quartz, calcite, scheelite, pyrite, and gold derived from the general mass of the schist, the vein material having been brought to its present position by surface waters. On the surface the reef is massive, but with depth it shows a tendency to split up into an aggregate of small veinlets, indicating partial replacement of the crushed and sheeted country. Thus, while Nos. 1 and 2 levels of the Empire City Claim were driven in solid ore for 1,100 ft. and 1,350 ft. respectively, No. 3 was driven 750 ft. in a formation consisting merely of stringers and veinlets of quartz, while in the Federation lease on the other end of the line a tunnel driven under solid quartz only cut a similar zone of silicified country. Towards the centre line of the property the solid reef may, however, carry to considerably greater depth, and has indeed been proved to live down to No. 2 adit of the Golden Bar, 160 ft. lower than No. 2 Empire City, and there is in the former a run of fully 1,000 ft. of compact reef.

In view of the developments at the mine under Mr. Harrison's management, and of the fact that in the intermediate above No. 3 level in the Empire City section of the mine a run of some hundreds of feet of solid reef occurred north of the break, it seemed reasonable to expect that a similar run of good stone would be got down to, and below, No. 2 adit of the Golden Bar. Some further prospecting carried out, in the nature of driving the latter adit, and rising from it to No. 1 adit, served to show, however, that

* J. HENDERSON: Notes on the Geological and Mineral Occurrences of the Wakamarina Valley. *N.Z. Journal of Science and Technology*, Jan., 1918.

solid stone only lives down to a point about 20 ft. above No. 2 adit. Below that point the reef breaks up into stringers or veinlets in much the same way as on the extreme north and south ends. This stringer formation carries gold, but not in quantities payable for working. There is still a fair amount of stone of possibly payable grade to be won from between the No. 2 Golden Bar adit and the intermediate mentioned, but failing some other discovery of importance this cannot keep the mine going for more than a brief period.

As far as prospecting in the locality away from this particular reef is concerned, it must be said that there seems little to justify it. A number of reefs have been located in the ranges higher up the Wakamarina River, but they have in all cases been barren.

In 1915 G. E. Humphries and party prospected some reefs a little north of the Dominion Consolidated Company's property, near Deep Creek. These reefs varied in width from a few inches to 5 ft., and on the outcrops some of them appeared to contain fair gold content, with, at times, a percentage of scheelite. Reporting to his Department in May, 1915, Inspector of Mines T. O. Bishop stated that from three of them he had obtained fair prospects of fine gold by panning. By March, 1916, one of the reefs, the Smile of Fortune, had been driven on for 136 ft. near the surface, and had been intersected about 60 ft. lower down by a crosscut about 200 ft. in length, at which point it was said to be 3 ft. in width and to show fair prospects of gold. Further work on this reef indicated, however, that it did not live down, and a similar result followed considerable work by way of tunnelling done on other formations in the vicinity. In practically all cases the reefs appeared to die out in depth, and the values generally were found to be low and patchy. The syndicate erected a ten-stamp battery, but no crushing was ever done in it.

About two miles farther north, Alford and party, subsequently known as the "Mountain Camp Mining Partnership," found in 1915 a small reef, dipping easterly at a low angle, at a considerable elevation on the hillside north of Mountain Camp Creek. A shallow adit was put in on this for about 60 ft., and in parts the reef carried fair values. Two samples, taken from 55 ft. and 60 ft. in the drive, gave on assay 17 dwt. gold and 6.99 per cent. scheelite, and 3 dwt. gold and 6.79 per cent. scheelite, respectively, but the results of further assays showed the general values to be much lower than this.

A crosscut was later started to intersect the reef about 60 ft. below the outcrop, but it was not carried in far enough to effect its purpose. In the meantime the market for scheelite failed, and the gold content of the reef being not nearly high enough to pay for working, operations were suspended and have not since been resumed.

WESTLAND PROVINCE.

The Westland Province, although it has produced a wealth of gold from its alluvial deposits, has, like Marlborough Province, not as yet had the good fortune to find any quartz-mining field of importance. The only locality within the province from which gold has been won from quartz is the neighbourhood of Ross, where, at Cedar Creek and Donnelly's Creek, reefs were opened up and worked for a time. There are other localities, however, such as the Taipo River, the Wilberforce, Mount Rangitoto, and Cook's River, where auriferous reefs have been noted and more or less prospected.

CEDAR CREEK REEFS.

Auriferous quartz seems to have been first found in the early "eighties" in this locality, which is well up the slopes of Mount Greenland, about 2,000 ft. above sea-level, and nine miles from Ross by a steep mountain-track. A number of claims, known as the William Tell, Swiss Republic, All Nations, and Larnach, were taken up, but after very little prospecting had been done all the ground was abandoned. In 1887 the William Tell Claim had some further work done on it, when quartz showing free gold was met with in an adit level driven 57 ft. below the outcrop of a reef exposed in the creek. This adit was driven for 225 ft. on the course of the reef, about 200 ft. of the distance being on solid stone said to have been 4 ft. wide, with gold fairly distributed through it. A winze was then sunk on the reef at 76 ft. from the western end of the adit, but the stone became broken and finally disappeared a few feet down. Another adit was driven, 85 ft. lower than No. 1, for a distance of 567 ft., where a rise was put up to connect with the bottom of the winze. Although the prospects were not very promising, the company that held the claim erected a battery at considerable expense, and started to work out the quartz above the upper adit. No records are available as to the quantity of quartz mined from here, nor as to the yield of gold, but evidently the recoveries were much below what had been anticipated, for in the same year (1890) the company collapsed, and abandoned the ground after selling the battery to Mr. G. Perotti, of Greymouth, who removed it to the Minerva Mine at Blackball.

The Swiss Republic Mine adjoined the William Tell on the west. In 1888 a reef 3 ft. wide at the outcrop was prospected, which showed a little gold. An adit level was driven on it for about 400 ft., and at 60 ft. from the portal a crosscut was put out in a southerly direction for 240 ft. In this crosscut two small leaders and a reef 4 ft. in width were intersected, all of which were said to carry gold. A winze was then started in the lode, near the portal of the adit, at a place where the reef was about 2 ft. 6 in. wide, but it was apparently not sunk to any depth, and very little more work was ever done on the claim.

Simultaneously with the carrying-on of the foregoing work in the William Tell and Swiss Republic Claims, the All Nations and Larnach Companies, which held ground to the east of the William Tell, were engaged in putting out long crosscuts in their respective areas. The All Nations extended its crosscut for about 610 ft. in a north-easterly direction, in the course of which it cut a 9 in. reef at 34 ft., an 11 in. reef at 73 ft., and what is described as a reef formation 14 ft. wide at 346 ft., as well as a number of smaller leaders. As far as can be learned, none of these formations carried gold in payable quantities. At about 270 ft. farther to the east, and nearly parallel to the All Nations crosscut, the Larnach Company ran one out for 1,000 ft., cutting on the way all the reefs or leaders met in the All Nations workings. No payable values were found in any of them.

With the collapse of the William Tell Company in 1890, and the removal of the battery, the efforts of the other companies were paralysed, and no more work appears to have been done in the locality till 1896, when a company known as the Alpha Special Claim Syndicate took up all the

old claims, and did a little prospecting on them. Some quartz carrying gold-values was said to have been found on the surface, and a drive was put in on it. One ton of the stone is reported to have been crushed for a yield of 4 oz. 2 dwt. gold. The adit was carried in for 223 ft., but as the reef was driven on it became very poor, and after doing some little further prospecting on the same formation at a few feet greater depth the syndicate became discouraged, and once more the claims were abandoned.

A little later a syndicate of Wanganui mining enthusiasts became interested in these old properties, and set a few men at further prospecting them. The William Tell old No. 2 adit was advanced for some distance to the north-east without meeting anything of value, but in extending the western drive beyond the old rise put up in 1888 by the original company a body of quartz about 8 ft. wide was met in a short distance and found to carry very fair gold, particularly on the hanging-wall side. Encouraged by this discovery, the syndicate, now known as the Mount Greenland Gold-quartz-mining Company, erected a five-stamp battery, taking the necessary parts with much labour and expense up the nine-mile track from Ross. Crushing was commenced in 1917, and was continued in a very small way for about five years, during which time 1,939 tons of quartz were treated for a yield of 2,030 oz. 14 dwt. 5 gr. gold, valued at £8,107 19s. 4d., equal to £4 3s. 7d. per ton, and £500 was paid in dividends. This return, as far as it went, was satisfactory, but it unfortunately happened that the supply of stone was strictly limited. The shoot of quartz only extended about 60 ft. in a north-westerly direction when it was cut clean off by a fault, beyond which it could not be found, and, in stoping upward, the reef was also found to disappear in a short distance. The pay-stone was still going underfoot in the adit, but to enable it to be mined the company was faced with the great expense of either sinking a shaft or putting in a very long tunnel at a lower level. The amount of stone to be won between levels did not promise to be nearly sufficient to warrant shaft-sinking, especially as winding plant, timber, &c., could only be got to the mine with tremendous difficulty, so any thought of doing this was set aside. For some considerable time, however, the company seriously considered the idea of putting in a low-level tunnel at a depth of 400 ft. to 500 ft. below the old workings. There is a strip of reef-bearing country traceable in the vicinity for well over a mile, and the idea of driving an adit for upwards of 2,000 ft. along this at depth in the hope of proving further pay-shoots appealed to the directors. The work would certainly have been a very plucky prospecting effort, but, in view of the fact that the reef-line had been cut by numerous crosscuts for a distance of about 1,500 ft. along the route of the proposed tunnel, and surface-trenched for the whole distance, without finding any pay-stone other than the short 60 ft. shoot in the far north-west end of the old workings, it could not be said that there was any evidence from past operations to justify the large expenditure the carrying-out of the project would entail. The Mines Department was invited to contribute towards the cost, but could not entertain the application; and, as the company was not sufficiently strong financially to undertake the whole enterprise, the proposal was dropped. The plan and section shown in Fig. 2 will serve to give a good idea of the work done in the locality.

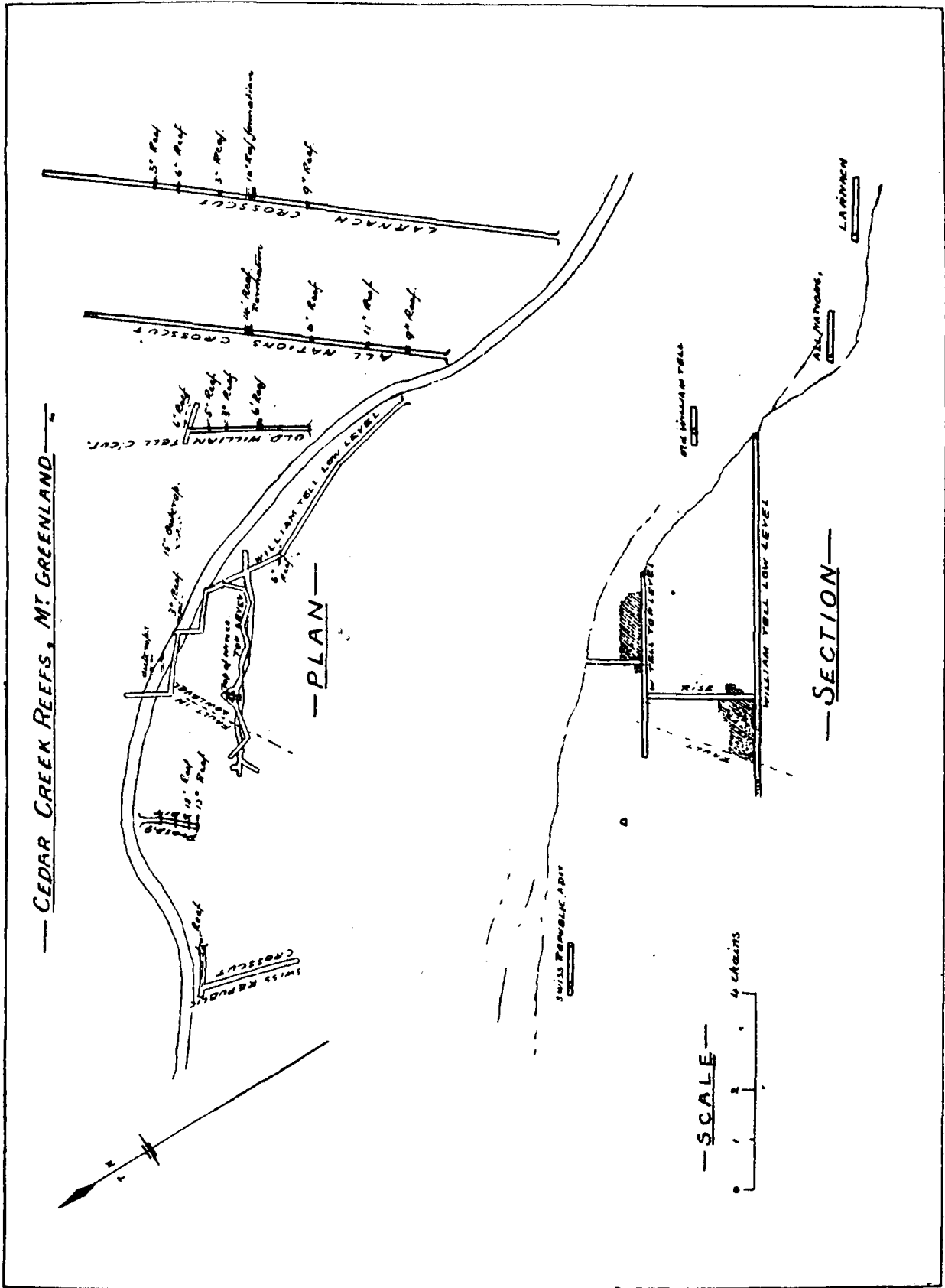


FIG. 2.—PLAN AND SECTION OF WORKINGS, CEDAR CREEK REEF, ROSS.

DONNELLY'S CREEK REEFS.

The only other quartz reefs worked to any extent in the Ross district were in the neighbourhood of Donnelly's Creek, at a much lower elevation than the Cedar Creek reefs, and within a mile or so of Ross Township. From the creek itself, and from the terraces on its southern bank, a very large quantity of alluvial gold was won years ago, much of it being specimen; and as the gold was heavy—the Roddy nugget of 99 oz. found there was the largest located in the Dominion—the general opinion was that it had not travelled far, and much searching was done in the hope of finding the reef or reefs from which it came. A few small reefs or leaders were found, from which crushings were taken that yielded up to an ounce of gold per ton, but in all cases the leaders failed to live to any distance in any direction. One of these was worked in what was known as Donnelly's Creek Mine by a man named Yarworth, who in 1895-96 took out 299 tons, which yielded 160 oz. gold. Another was worked by H. Osmer, who took out, between 1908 and 1910, small crushings totalling 432 tons, from which 616 oz. gold was recovered. The reef was only a little over 1 ft. wide, and was found, when followed, to come out to surface again only 40 ft. below the outcrop, showing that it was contained in an earth-block shifted by faulting from its original position.

FARMER CREEK REEFS.

That well-known old prospector Antonio Zala did a lot of work on small reefs in this locality, about four to five miles west of Ross, in the "nineties." Two reefs, known as the Captain Russell and the Helvetia, were opened up, but they were found to be in very wet and broken country, and the quartz only occurred in blebs or boulders. Zala erected a small battery close to the reefs in 1896, and took out a crushing from the Helvetia which is said to have yielded 8 oz. gold. A parcel of 900 lb. from the Captain Russell is said to have yielded at the rate of 15 dwt. gold per ton. The results of the work being unsatisfactory, the locality was abandoned and no further prospecting has since been done there.

MOUNT RANGITOTO REEFS.

In the early "seventies" attention was drawn to a small reef outcrop in an isolated belt of greywacke surrounded by granite, and probably underlain by it, immediately south of Mount Rangitoto, in Totara Survey District, about eight miles south of Ross. The reef or lode was a mixture of quartz and pyrites, with a minor amount of galena, and the Mount Rangitoto Silver-mining Company was formed to work it for silver. A considerable sum of money was spent in development and the erection of treatment plant. Samples of the ore sent away were reported to have shown high silver values. Mr. W. Skey, Colonial Analyst, mentions* that two samples sent to Germany yielded silver at the rate of 17 oz. 19 dwt. and 16 oz. 6 dwt. respectively, and that Professor Bickerton and Mr. Isaac Lewis had made assays which showed 69 oz. and 46 oz. silver per ton, while Professor Kirkland, of the Melbourne University, is said to have obtained results from the ore equal to 735 oz. silver per ton.

* Twelfth Annual Report on the Colonial Museum and Library, 1878, p. 33.

The lode was, however, very narrow, and evidently only carried low average values. As seen by P. G. Morgan* in 1906, the outcrop was but about 6 in. wide, and in the Mining Handbook of 1887, p. 170, it is described as being from 3 in. to 6 in. in width, but widened out at one place to 3 ft. Cox, who visited the locality in 1875 or 1876, states that its character was uniform throughout, consisting of pyrites, with about 20 per cent. of galena, and remarked that it was not of sufficient value to work on its own account.† A sample taken by him yielded on assay only 1 oz. 17 dwt. silver per ton. About 1876 Skey made a number of analyses of samples of the ore, taken with a view to arriving at reliable data as to the true character of the lode. Nine of these assays gave results ranging from 7 oz. 19 dwt. to 45 oz. silver per ton.

It is evident that the company had no thought but to work the lode for its silver content, but even had the values in this metal been payable it is questionable if the very primitive plant that was erected would have saved them. This plant was described as consisting of a three-stamp battery, an amalgamating-barrel, and a few buddles; while an open roasting-pan made of wrought iron, about 16 ft. long and 8 ft. wide, was later added to calcine the ore before crushing. H. A. Gordon states‡ that on visiting the mine on one occasion he examined the tailings, and was surprised to see them full of quicksilver. On washing some in an old frying-pan he collected in a short time about 20 lb. of quicksilver, and from 6 dwt. to 8 dwt. of gold and silver, and he judged from this that the company could never have taken a great deal of gold or silver from the ore, and whatever there was remained in the tailings.

Even had a more suitable treatment plant been provided it is almost certain that such silver values as there were in the ore would not have proved payable, but there is a possibility that if the company had given attention to the recovery of the gold rather than the silver contents of the ore it might have met with a greater measure of success. In spite of the fact that 90 tons of the ore treated at Swansea are said to have returned 2 oz. gold per ton, and that assays made by Skey showed that some of the samples carried values up to 10 oz. 2 dwt. gold per ton, no special effort seems to have been made to save this metal. P. G. Morgan* states that he took a general sample from the outcrop, and one from the broken ore lying at the mouth of the drive, which yielded on assay 1 oz. 5 dwt. 6 gr. and 1 oz. 3 dwt. 22 gr. respectively. It so happens that the lode is in freehold land, and consequently cannot be investigated by the ordinary prospector, but in view of the gold values referred to some further testing of the formation seems worth while.

GOLD IN GRANITE AT MOUNT RANGITOTO.

In his annual report for 1893 Inspecting Engineer of Mines H. A. Gordon mentions that a considerable amount of prospecting had been done on Messrs. Pollock and Bevan's property at Rangitoto, and that it had been represented they had obtained both gold and silver of a payable character in working a granitic conglomerate which crumbles away on exposure to the atmosphere. He quotes the following extract from a letter addressed by these prospectors to the Minister of Mines:—

“ You may perhaps be aware that for a long time past we have been prospecting a huge belt of conglomerate, or a sort of bastard granite, which

* P. G. MORGAN: Geol. Bull. No. 6, p. 146.
District. G. S. Rep., 1877, p. 89.

† Report on the Westland
‡ Mining Handbook, 1887, p. 170.

crumbles away on exposure, and that we have found to be auriferous. We have had many trials from the outcrop, taken indiscriminately from an extensive surface. One trial of a ton by chlorination in Melbourne gave us 6 dwt. 12 gr. gold; another by the Cassel process yielded 6 dwt. 14 gr. Our own fire assays from the face of the formation have yielded a variety of results—some poor, some exceedingly good, but encouraging from a prospector's point of view, owing to the fact that we seldom or never failed to get gold, although nothing is visible to the naked eye. On another occasion we sent five small lumps to Reefton, and Mr. Fenton found gold in all of them, and recommended us to further prospect the discovery. In February last a tunnel was driven right into the formation. The tunnel was 4 ft. 6 in. by 6 ft. 6 in. At every 3 ft. of driving 12 lb. of stone was taken out and tried. The tunnel was driven for a distance of 40 ft., and nine if these trials of 12 lb. each were made, and in every case gold was obtained. In order to get a good all-round average the results of the nine trials were cupelled and run into one button of gold, with the gratifying result that it yielded 4 dwt. 4 gr. gold, equal to 6 dwt. 16 gr. per ton. The process adopted was by quicksilver amalgamation of the ordinary character, with but very primitive appliances at command. This mode of dealing with the stone proves that the gold is free and does not require either the Cassel process or chlorination to extract it; hence the probability of making such a huge mass pay well, for it must be borne in mind that there are simply millions of tons of stuff to operate on, which could be broken down for a mere nominal cost, probably less than 1s. per ton. The gold is very fine, and will require careful treatment; but recent amalgamation-pans and intelligent battery management ought to be sufficiently understood to make the undertaking a success."

If there was any reliability to be placed on the above description the matter should have been worth looking into, but the writer has not been able to find any record of any investigation, departmental or otherwise. It is evident, however, that when P. G. Morgan was engaged in carrying out the geological survey of the Miconui Subdivision (Bulletin No. 6) in 1905 he was aware of the report quoted, for he made some search for the formation referred to in it. He says that he did not see any signs of mineralization, but that if the Rangitoto lode passed from the enclosing greywacke into the granite, as might be the case, it was not improbable that the adjoining granite might be somewhat auriferous. A sample of decomposed granite taken by him from another part of the mountain, on being carefully analysed for traces of gold, gave a negative result.*

WILBERFORCE REEFS.

The auriferous reefs of the Wilberforce area, although known as the Westland reefs, are really in Canterbury, being just across the borders of Westland Province, about the headwaters of the Wilberforce River.

The first discovery of gold-bearing quartz there seems to have been made in 1882 by C. S. McGregor, who found shoad stone in the Wilberforce River and traced it to its source, thus discovering what has since been known as the Wilson's Reward reef. Subsequent prospecting revealed the presence of many other reefs in the belt of argillites and greywacke that here forms what may be termed the cap of the alpine range, but only a

* Geol. Bull. No. 6, p. 147.

few of them, apart from the Wilson's Reward, showed much promise of being of economic value. Next to the reef mentioned, the best values were found in Pfahlert's and Fiddes's reefs.

Wilson's Reward Reef.—This reef was located on the south-eastern slopes of Mount Harman, about one mile north of Browning's Pass, at an elevation of about 5,330 ft. above sea-level, and it occurs in an area in which a number of outcrops of considerable dimensions are revealed. Bell* describes these outcrops as having no definite alignment, but suggesting a mineralized zone instead of a definite vein, the quartz occurring as large lens-shaped masses, which weaken in the direction of the strike, die out, or are replaced by similar lenses. The general strike corresponds with that of the strata (the veins being of the bedded type) which is 5° east of north, with a dip to the westward at from 40° to 60°.

On the surface, Wilson's Reward reef is said to have shown an outcrop about 60 ft. in length and 15 ft. wide, but under the surface debris it may continue for a much greater distance. Shortly after its discovery by McGregor a syndicate was formed in Christchurch to prospect it. This syndicate is said to have taken out a parcel of 3 tons of ore, evidently gathered from the outcrop, which was sent to Auckland for treatment. The actual results from this parcel are not known, but it is said the yield was at the rate of 13 oz. gold per ton. Following on this test, a claim covering the discovery was applied for and granted, and the Wilberforce Gold-mining Company was formed to work it. This company, in 1885, started a low-level tunnel from near the base of the Wilberforce Valley to cut the reef at depth. To reach the reef this adit would have had to be driven at least 1,600 ft., but after penetrating 1,000 ft. the company's funds became exhausted, and it abandoned operations. Although the Wilson's Reward reef was not met with, it is said, however, that at about 600 ft. in from the portal another reef was passed through, from which tests of the quartz were made, with the result that it yielded by amalgamation 12 dwt. gold per ton.

After this abandonment of the ground the field was neglected till 1902, when Mr. James Darward, of Christchurch, who had been a shareholder in the company, visited the locality with a well-known Westland prospector, Mr. R. Hyndman, and did some further prospecting in the way of surface examination, but severe weather prevented them remaining for more than a very short time. A little over a year later, in January, 1904, Mr. Hyndman and Mr. M. Grey went out and took some samples from the outcrops, which on assay are said to have shown satisfactory values. The party then took out a parcel of half a ton weight, which was sent to Reefton for treatment, and it is said to have yielded 1 oz. 9 dwt. 21 gr. gold. In November of the same year Messrs. Hyndman and Cameron started a tunnel to cut Wilson's Reward reef 100 ft. vertically under the outcrop. This tunnel was driven due north in the country to the east of the formation, and it intersected the reef at an acute angle on the footwall side at 170 ft. in. The adit was then turned to crosscut the reef, but after cutting through the stone for between 13 ft. and 14 ft. without meeting the hanging-wall, work was stopped, apparently owing to the values in the quartz being so low as to discourage further effort, and up to the present time no further attempt has been made to test the deposit. J. M. Bell,† who saw the reef shortly after this work was done, described it as being of a milky-white and somewhat semi-vitreous nature, and containing irregular-shaped fragments as well as partings of argillites. A small percentage of sulphides, chiefly pyrite and chalcopyrite,

* Geol. Bull. No. 1, p. 51.

† J. M. BELL, Geol. Bull. No. 1, p. 52.

was present. Gold was occasionally visible in the vein material, more particularly in connection with the inclusions—slickensided partings and selvages of argillites. Four samples taken by him from different parts of the reef gave on assay the following results :—

—	Gold.	Silver.	Value.
	Oz. dwt. gr.	Oz. dwt. gr.	£ s. d.
1. General sample of quartz selected from various outcrops	0 0 16	..	0 2 8
2. General sample in tunnel-level from a width of 13 ft. 8 in. of reef	0 0 4.5	..	0 0 9
3. Sample from a bunch of high-grade ore showing a little gold	3 5 10	0 8 4	13 2 6
4. Sample from an outcrop on surface (21 ft. wide) but not representative of the whole	0 13 0	0 3 5	2 12 8

It is evident from these results that the reef was patchy, and that the gold values on the whole in the exposed parts were not high ; nevertheless it is to be regretted that more work was not done by driving along its course in the adit. Nearly all bedded veins of this nature are patchy in value, and it is possible that a drift along the reef would have revealed shoots of pay-ore.

In 1910 a party known as the Wilson's Reward Syndicate is said to have cleaned up Hyndman and Cameron's adit, and taken further samples from it and from the outcrops, but no other information is available as to their operations.

Fiddes's Reward Reef.—This reef was located about five and a half miles south-westerly from the Wilson's Reward, and at an elevation of about 600 ft. higher, near the head of Spencer's Creek, a small tributary of Grave Creek. It was traceable on the surface for a much greater distance than any of the other reefs in the locality (at least 30 chains), striking north and south, and dipping westerly. It was, however, very narrow, sometimes opening out to 2 ft. but averaging only about 6 in. The quartz in appearance much resembled that of Wilson's Reward, having the same thin slaty partings, and containing splashes of pyrite and chalcopyrite, and seemed to be equally patchy in respect to its gold content. The results of three samples taken by Bell for assay were as follows :—

—	Gold.	Silver.	Value.
	Oz. dwt. gr.	Oz. dwt. gr.	£ s. d.
1. Northern portion, general sample of quartz, showing no visible gold	0 3 1	0 0 10	0 12 2
2. Northern portion—specimen quartz ..	10 4 4	0 15 15	40 18 2
3. Southern portion—high-grade selected ore, showing gold	4 7 17	0 8 1	17 11 7

For several years following 1905 a little desultory prospecting was apparently done on this find, and on certain other reefs in the vicinity, but in 1908 a start was made to put an adit in on it at a distance below the outcrop sufficient to give about 250 ft. of backs. For 55 ft. the reef was reported by Inspector of Mines A. Whitley to average 15 in. in width, and show good dish prospects as well as colours of gold. In 1909 Inspector of Mines Richards visited the claim, when the drive was in 117 ft., and reported that for the

last 47 ft. the reef was only about 6 in. wide. When the drive had been carried in to 232 ft. a company known as the King Gold-mining Company was formed to take the property over. This company is said to have extended the level to about 532 ft., but there is nothing in the available records to indicate whether or not the reef lived for this distance, or what its width or value was. However, the fact that the company gave up its efforts after driving to the distance mentioned leads to the presumption that on the whole the developments could not have been satisfactory. Since 1911 no work has been done on this reef, or, indeed, in the field.

Pfahler's Reef.—This reef was found outcropping near the head of Snowy Creek, about three-fourths of a mile south of Fiddes's reef, and is probably the southern continuation of the same. Regarding it, Bell and Fraser* state that southward from the creek it had been exposed by trenching for a distance of about 250 ft., with some indication of further extension under the rock talus. Its strike was about 19° west of north, and the dip 40° to 50° to the westward. As calculated from six of the cross-sections in the trenches, its width averaged about 30 in., the maximum width being 5 ft. The stone was said to be of a favourable character, gold being seen at frequent intervals throughout the full length of the better-defined portions of the outcrop, generally associated with the rusty slaty selvages and partings, but occasionally in the solid quartz. A general sample taken by the geologists from various points along the full length of the outcrops yielded on assay only 1 dwt. 5 gr. gold per ton, but another assay made from fragments of quartz showing gold yielded at the rate of 8 oz. 9 dwt. 21 grs. gold per ton. Beyond the surface trenching referred to no further work seems to have been done on this reef.

Among the other reefs located, and on which a little prospecting, mainly of a superficial nature, was done, may be mentioned those known as Hyndman's reef, on the south-western slope of Mount Harman; the Kanieri Syndicate's reefs, on the eastern slope of the same mountain; the Grave Creek reef, Billett's reef, and Fiddes's stringer reefs; but none of them showed any special promise. In 1909 and 1910 Callieri and party drove a tunnel on what may be considered the continuation of Fiddes's reef northward of Grave Creek. Good surface prospects were got from the outcrops, but in the tunnel very little solid stone appears to have been seen.

Bell and Fraser point out that the area within which these various reefs were found has been subjected to extensive glacial action, and that the disintegration and rapid erosion of the surface may have had the effect of removing the upper and richer portions of the reefs, and that the numerous barren reefs may really represent the downward continuation of some from which the more valuable upper parts have been entirely eroded. This explanation of the position may well be correct—nevertheless it seems to the present writer that this field deserved more vigorous and thorough testing than it received; but no doubt the fact that the country containing the reefs was all well above the snow-line and could only be worked for a small part of the year was a serious drawback to operators. The isolation of the locality and the difficulty of maintaining supplies in it were further hindrances to effective prospecting. The time will doubtless come when the region will receive further attention from the prospector, and, either there or along the belt of greywackes and argillites that seems to crown the Alpine range for a number of miles both north and south of it, there is a possibility that important reefs will yet be revealed.

* Geol. Bull. No. 1, p. 55.

TAIPO RIVER REEFS.

What are known as the Taipo reefs occur in a belt of country that may be considered the northern extension of the Wilberforce area. The Taipo River has its source immediately north of Mount Harman, and flows in a general east-north-easterly direction for about fourteen miles, when it turns north-westerly till it junctions with the Teremakau River. Most of the known outcrops of quartz occur in the creeks running into it from the western side. Very little prospecting has ever been done in this region, and practically all that is known of its reef-occurrences is contained in Bell and Fraser's "Geological Survey of the Hokitika Sheet, North Westland Quadrangle" (Bulletin No. 1, New Series), most of the outcrops having in fact been located by members of the party engaged in that survey. It cannot be said that many of the outcrops discovered showed any decided promise, but there was sufficient evidence of gold in some of them to indicate that the area containing them was worthy of further examination. The geologists referred to describe the belt of likely rocks as being about five miles in width, bounded by an artificial line drawn from the north-eastern corner of Turiwhate Survey District, in a direction of south 38° west, to the south-western boundary of Browning's Pass Survey District. Following the Taipo River down, outcrops were found in Gold Creek, Dunn's Creek, Freitas Creek, Scotty's Creek, and Low's Creek. Careful washing of the decomposed vein stuff, and crushing and panning of freshly broken quartz, served to show that a little gold occurred in most of them, but in only one was what appeared payable quantity of the metal noted. This was in an occurrence in Gold Creek, a small tributary entering the Taipo River well up towards its source. In the bed of the creek, and about seventy-five paces from its mouth, the survey party discovered a bedded reef formation consisting of narrow alternating bands of greywacke and quartz striking north 60° east and dipping at a high angle to the eastward. The formation was exposed for about 3 ft. from the foot-wall, but the hanging-wall portion was covered with heavy creek debris, so that the full width was not ascertained. Along its line the formation seemed to have no continuity to the north, while to the south talus debris covered everything up. The visible portion of the outcrop was only about 6 ft. in length. The quartz bands in the formation only formed a minor proportion of the whole, and were narrow, the widest being about 4 in. The quartz was of a favourable character, showing numerous small angular slaty inclusions and pyrite throughout. One of the quartz bands was highly auriferous, and where it was widest (4 in.) every fragment broken out showed coarse gold, and others of the small quartz bands contained gold in lesser quantity. Samples taken from portions of the formation showing no gold gave on assay 1 dwt. 14 gr. gold per ton, while two other samples from which everything showing gold was selected and discarded gave 1 dwt. 16 gr. and 1 dwt. 6 gr. respectively. An assay of a sample from the rich band yielded at the rate of 5 oz. 3 dwt. 8 gr. gold and 17 dwt. 15 gr. silver. The quartz bands in the formation showed a tendency to widen in a southerly direction below the talus debris, and further investigation of it in that direction seemed warranted.

It may be mentioned that about three years ago a party of prospectors under the direction of Mr. Sidney Fry went into the locality specially to make further investigation of this formation. Owing to the chairs that had been used for crossing some of the streams along the route having been swept away or rendered unsafe, and the old track being badly blocked by

slips and deadfalls, the party had considerable difficulty in reaching their objective, and when they did get there they found that in the interval since the survey party had seen the formation it had been covered up deeply by creek debris brought down by floods, and no vestige of it could be seen. The task of shifting all this material was too great for the men to undertake at the time, so they restricted their efforts to blasting up some of the larger boulders, in the hope that further floods would clear the debris away and they would be able to see the reef on a subsequent visit. As far as the writer is aware, however, none of the men returned to the spot again, so it is not known what the result of their work was.

Dunn's Creek Reefs.—These are said to offer little promise.

Low's Creek Reef.—This was tested by crushing and panning, also by fire assay, but failed to reveal any gold content.

Freitas Creek Reef.—This reef, which occurs at from one to one and a half miles up the creek mentioned from its junction with Taipo Creek, is described as consisting of several mineralized zones in greywacke and argillite, in only one of which were traces of gold got on assay. Nevertheless the geological surveyors were of opinion that their general appearance was so favourable that they might with advantage be traced and prospected along the line of strike.

Scotty's Creek Reefs.—Numerous lenticular quartz veins are said to have been located in the valley traversed by this creek, but values were not detected in any of them. Highly auriferous quartz fragments are reported, however, to have been found from time to time in the bed of the creek, and the geologists commented that, concealed beneath the vegetation and surface debris, the veins may exist from which they were derived.

Other reefs of the area which attracted the attention of the survey party were those known as the Taipo Gorge reef, Harley's Creek reef, the Hura Creek reefs, and McQuilkin's reef.

Taipo Gorge Reef.—This outcrops in the left side of the gorge, about eight chains below the junction of Rocky Creek with the Taipo River, and has a maximum width of 1 ft. Unlike the reefs just previously referred to, it occurs as a bedded reef in banded schists, a highly quartzose mica-schist forming its western wall, and a more laminated biotite-schist its eastern wall. The vein stands practically vertical, and is described as apparently lensoid both in vertical and horizontal extension. Its chief interest lies in the fact that it was found to contain platinum, an assay of a sample giving a result equal to 1 dwt. platinum and 6 dwt. 13 gr. silver per ton.

Harley's Creek Reef.—This reef occurs in the bed of Harley's Creek, about half a mile up from its junction with the Teremakau River, in country rock consisting of hard shaly phillite, striking north 36° east, and dipping south-eastward at an angle of about 55° , and appeared also to be lenticular in both horizontal and vertical extension. No gold was found in it, but two samples showed on analysis that they contained platinum, respectively at the rate of 3 dwt. 8 gr. and 1 dwt. 2 gr. per ton.

Hura Creek Reefs.—Hura Creek is the next one of any importance entering the Taipo above Dunn's Creek. In one of its headwaters tributaries, at a point above 350 ft. below the Hura Saddle, a fragment of quartz about 5 lb. in weight was found by a member of the survey party, which on one face included a beaten-out ragged streak of gold, in the aggregate amounting to $\frac{1}{2}$ dwt. The quartz is said to have had a striking resemblance to that of the Gold Creek reef, and its discovery was looked upon as important. As it was found so near the cap of the range the geologists considered that the

location of the reef from which it came, by trenching and surface prospecting, should not be a difficult matter, and might be undertaken with advantage.

McQuilkin's Reef.—McQuilkin's Creek is a tributary of the Arahura River, but has its source near the Hura Saddle, on the opposite side from the locality just referred to. At a distance of little more than a mile up from the Arahura River, and at an elevation of about 1,300 ft., in a small head-water stream coming into McQuilkin's Creek from the northern side, occurs what Bell and Fraser describe as one of the best-defined quartz veins in the whole area covered by the survey. As exposed for about 100 ft., it is from 15 in. to 30 in. wide. Its strike is about north 22° east, and its dip westward at about 65° . In some parts it seemed conformable to the bedding of the enclosing greywacke, but in the others evidently cuts it at a very acute angle. The only gold seen in it occurred as a coarse bleb in the quartz in the vicinity of the slaty selvage separating the quartz from the country rock, and the result of one sample assayed was only 1.5 gr. gold per ton; but, in view of the fact that auriferous quartz is found in the debris of the creek, and also free quartz gold very little worn, the geologists were led to the opinion that the neighbourhood well deserved further investigation.

As previously stated, only a negligible amount of prospecting has ever been done in the area within which occur the formations mentioned, and it deserves closer investigation; but it must be said the country is very rugged and difficult of access, and for prospecting purposes is of no use to the small two-or-three-men party, the labour entailed on the individual members of such parties being inordinately heavy, and the loss of time necessitated in travelling to and fro for supplies too great to admit of the men doing justice either to themselves or the possibilities of the locality. To examine such an area to advantage a fairly large party seems needed, well equipped with tools and other requirements; and it would be all the better if it were in charge of a leader with good geological and mineralogical knowledge, who would be able to direct the work and map the country traversed.

JACKSON'S REEFS.

A good deal of prospecting was done some years ago in the ranges south of Jackson's Railway-station, on the Greymouth-Christchurch line, in a reef-bearing run of the country that may be considered the northern extension of the Taipo River belt. As early as 1889 the Teremakau Gold-mining Company is reported to have been investigating an area about a mile and a half from Jackson's, and was said (Mines Repts., 1887, C.-2, p. 52) to have found a quartz lode considered payable for working, and was making arrangements to erect a crushing-battery as soon as a road to their mine (then being constructed with the aid of a Mines Department subsidy) was completed. Apparently this battery was never erected, for there is no further mention of it in the Mines Reports, nor of any further work done on the find.

In 1896 it was reported (Mines Repts., C.-3, p. 104) that four prospecting licenses of 640 acres had been taken up in the same run of country, but evidently not covering the ground on which the old company had worked. A party of men had been prospecting on these areas during the summer of 1895-96, and were said to have got results of an encouraging nature, particularly on the Jackson fall of the range, where a reef 3 ft. in width was said to have been traced for a distance of 60 ft., with gold showing fairly through the stone. Parallel to this reef, and only 20 ft. away, another one had been partially bared and showed gold, but its thickness was not known. On the Taipo River side of the range the party was also reported to have got good results, three distinct lines of reefs having been located, one of which, called

the East Reef, is described as being 3 ft. in width and traceable for several chains. The others were smaller, but well defined, showing fair crushing-prospects.

As in the case of the Teremakau Company's operations, the official publications of the Mines Department are silent as to any subsequent developments on these reefs, and although the writer has sought for reliable information regarding them none has been available. The presumption is that little further work was done on them, the reefs probably turning out on investigation to be merely lenses with no extension worth speaking of in any direction, as proved to be the case with a number of outcrops prospected at Poerua, a mile or two farther north, a few years later.

SOUTH WESTLAND REEFS.

It has long been believed that in the extreme south of Westland Province—that is, in the region between the Waiho River and the southern boundary of the province—good reefing-country exists. Reefs have undoubtedly been located there, some of them auriferous, but such little information as is at hand concerning them does not seem to indicate that search there holds out much promise of success in revealing deposits of economic importance.

One of the most reliable accounts of the region that has been published appears in the Mines Reports for 1890 (pp. 96 and 97), in which a description is given of the results of twenty years' investigation of that part of the West Coast District by Mr. Charles Douglass, an observer of good repute, who was, the writer understands, largely responsible for collecting the fine display of South Westland minerals shown at the Christchurch Exhibition of 1906. In this account Mr. Douglass states that there are within the region several belts of country that contain reefs, and that these all run almost parallel to one another, in a north-east and south-west direction. One of the belts he describes as extending from the Okarito Lagoons, crossing the Waiho River and Totara River, to the Copeland Range. This belt he looked upon as the source of the gold found in the Waiho and Cook's Rivers. He evidently noted a number of outcrops of quartz near the head of the Waikupakupa River, at an elevation of about 4,000 ft. above sea-level, and others in the vicinity of Pike's Peak, three miles farther south. The outcrops are said to have been well defined, but he could see no gold in them, nor even pyrites. Owing to the weather being very bad at the time he was examining this particular belt, Mr. Douglass says that he was unable to find his way along the shoulder of Mount Tasman, where the Torlesse Formation and the mica-schists join, but felt certain had he been able to do so he would have found something of value, as fine gold-quartz and specimens were to be found in the debris on the Balfour Glacier.

A second belt commenced at the Waikohai Bluff and extended in a south-west direction across the Paringa watershed. In this belt he found one small leader of gold-quartz, and several reefs containing minor quantities of galena; also dykes containing antimony with an appreciable show of gold, some large reefs containing arsenical pyrites but not gold, several iron-ore lodes, and a coal-seam 5 ft. in thickness.

A third belt commenced at Bruce Bay and extended parallel with the last mentioned. This belt contained reefs carrying a little galena, but in unpayable quantities. A magnetite lode was also found in it, and some fine quartz reefs outcropped near the granite in the Black River.

The fourth belt is described as commencing at the ocean a little southward of the Paringa River. This belt contained the copper-ore found in the Thomas Range, and outcrops of quartz reefs in the spurs between the Paringa and Blue Rivers. Much of the country in this belt was, however, practically inaccessible.

The fifth belt commenced a little to the northward of Arnott Point, and was believed by Mr. Douglass to be the same as the Shotover belt.

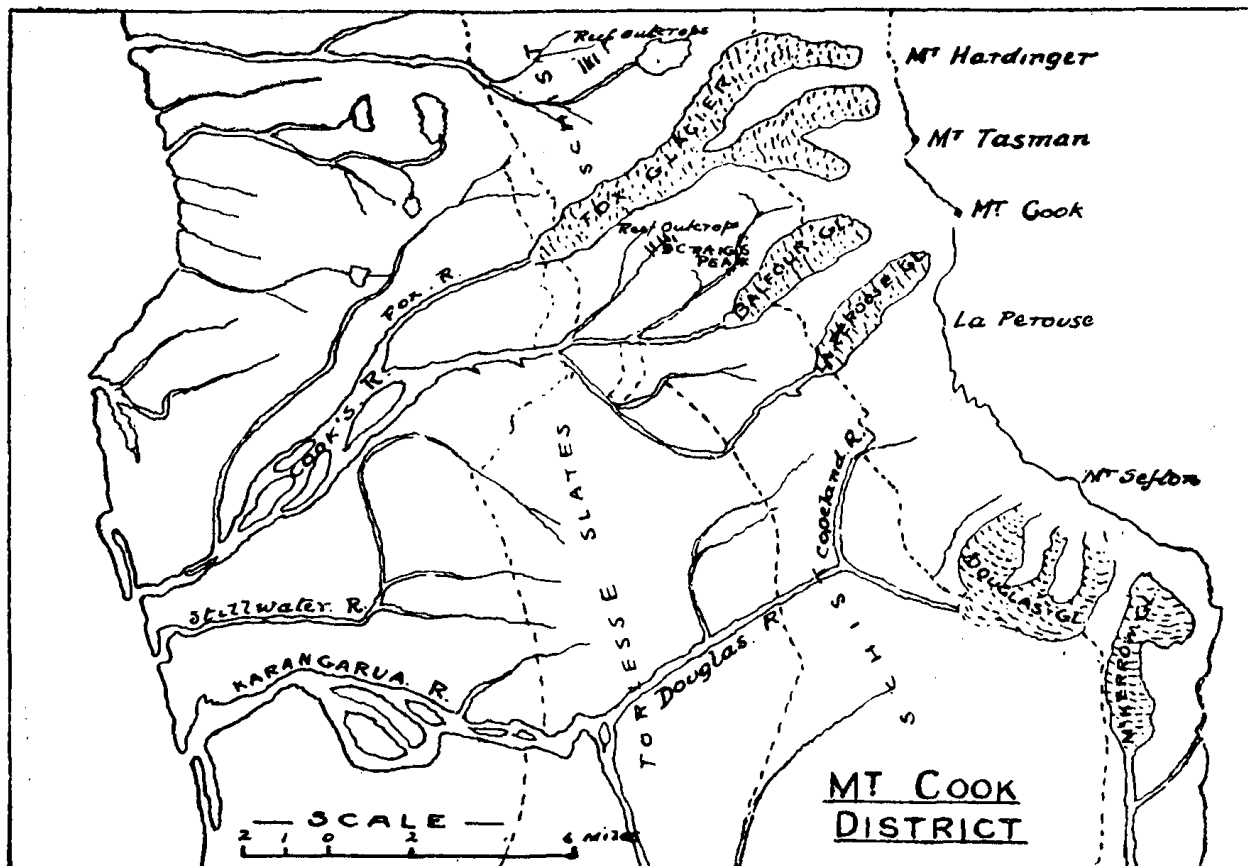


FIG. 3.—SKETCH-MAP OF PART OF SOUTH WESTLAND, SHOWING REEF-BEARING AREAS.

The sketch-map shown in Fig. 3 will serve to show the position of some of the reefs in the second belt described, but there are no plans available indicating the location of the other reefs or lodes mentioned. It may be said, however, that all the belts referred to are in schist country for the main part, and in New Zealand the experience has been that in this class of country reefs have been found not to carry their values to any great depth.

NELSON PROVINCE.

The Nelson Province, stretching from Cook Strait on the north to the Grey River on the south, and from the Tasman Sea to the crown of the dividing-range, has contained all the more important reefing fields in the West Coast District, and quartz deposits have been found scattered widely throughout it, most of the counties comprising it having possessed mines from which fair quantities of gold have been produced.

COLLINGWOOD COUNTY.

In Collingwood County, in the extreme north-west of the province, the principal quartz-mining localities were those known as Bedstead Gully and West Wanganui Inlet.

BEDSTEAD GULLY FIELD.

This field was about seven miles south from the Town of Collingwood, near the eastern boundary of Aorere Survey District. Auriferous reef was first found there by Thomas Adams and party in 1866, in a belt of graphitic phyllites and crystalline schists. This party worked their find for about two years, during which they are said to have won gold to the value of £1,500 merely by breaking up with hammers the gossan forming the outcrop and washing the gold by hand from the crushed material. In 1869 a company known as the Perseverance was formed in Nelson by Mr. James Bennett to work the reef. This company erected a battery in the neighbourhood, and systematically operated the mine till 1876, when it ceased work. No exact figures are available dealing with the tonnage of stone crushed during these years, but it is estimated that about 8,300 oz. of gold were won, and the average value of the ore is said to have been about 10 dwt. gold per ton. Three years later, in 1879, another company, known as the Johnstone's United, was formed to give the property a further trial. This company erected a battery in Wakefield Gully, and worked the mine continuously for the following fifteen years. The data regarding the crushings and yield for this period are, unfortunately, as scanty as for that during which the previous company carried on its operations. It is known, however, that for the years 1893-96 inclusive 14,463 tons were treated for a yield of 2,893 oz. gold. Further figures published in the statement of affairs of mining companies in 1906 show that a total of 10,439 oz. gold had been won by the Johnstone's United Company up to that year. This would mean that during the period 1879-92 the gold recovered must have amounted to 7,546 oz. ; and, as the ore crushed during these years seems to have averaged about 5 dwt. gold per ton, it may be estimated that in order to win this gold about 31,184 tons of quartz must have been crushed. The whole output of the mine, from the time it was first opened till it finally closed down in 1896, may be approximated at 61,259 tons of quartz, which yielded 18,745 oz. gold, valued at about £72,282. The mine was, however, at no time a profitable one, the total dividends paid only amounting to £1,916.

The reef was of lenticular character, and varied in width from 18 in. to 15 ft., the average width being about 3 ft. J. M. Bell* has shown that, as it was followed down, three distinct zones of values were revealed. At the surface, and for a considerable distance down, the reef was a gossan of a rusty-grey, porous nature, portions of which were highly auriferous. Below the gossan was a sulphide zone, containing splashes of granular pyrites, galena, and sphalerite, portions of which were also fairly rich, carrying up to 2 oz. and 3 oz. gold per ton. Below the sulphide zone was a third one in which pyrites occurred, but none of the other sulphides mentioned. This zone was poor in gold values. Near the surface the reef lay in an almost horizontal position, and was worked in a manner resembling long-wall in a coal-mine. The travelling roads were taken in alongside the solid quartz, no filling being used to hold the hanging-wall, consequently the openings, which were up to a chain in width, became very dangerous, and officials of the Mines Department had to insist on better stoping methods being adopted. As depth was attained the reef was at intervals stepped down by more or less vertical faults, and where these steps

* Geol. Bull. No. 3, p. 95.

occurred it is said the gold values always improved. The stepping-down greatly increased the difficulty of working the reef, however, for it necessitated the putting-in of lower and longer levels each time, and this, combined with a gradual falling-off in gold content in the quartz, eventually brought about the cessation of operations.

Several other mines were opened in the locality, amongst which were the Ophir and the Phoenix. The latter was started about the end of 1870. A battery was erected, and a certain amount of stone was crushed in it. No record is available as the quantity treated, nor the results, but the ore was evidently very poor, for the company soon ceased work. This mine is said to have had a reef from 6 ft. to 8 ft. wide, which outcropped on the north-east side of Cole's Gully, traversing amphibole schists close to their contact with the carbonaceous phyllites. The Ophir Mine was on the south side of the same gully, somewhat to the east of the main contact line on which the Johnstone's United reef occurred. The reef in the mine was about 7 ft. in width, but was very irregular. The Ophir Company also erected a small battery, and is said to have recovered about 100 oz. gold from quartz averaging 5 dwt. per ton.

Another mining venture opened in the same locality was the Red Hill Mine, which subsequently achieved some notoriety in the Dominion as probably the worst example of "wild-cat" flotation this country has experienced. The Red Hill was situated about two miles northward of the Johnstone's United. Some small leaders were found in it which are said to have been highly auriferous, but they were only from 2 in. to 4 in. wide. Four of these were followed down from surface for a short distance, and an adit was afterwards driven for 411 ft. about 90 ft. below the surface, from which the leaders were worked out. What gold came from them is not known. A low-level adit was then started about 230 ft. below No. 1 adit, but in this only one of the small veins seems to have been intersected. The property was brought before the notice of capitalists in England, and a so-called mining engineer was sent out to report on it. This engineer, Mr. Price Williams, is said to have reported it as worth £100,000, and a company of £150,000 was formed to work it. Of the capital, no less than £98,000 was given to the promoters in shares, and £2,000 in cash. Another English mining engineer, a Mr. Russel, also evidently visited the property, and in his report, contained in the prospectus of the company, published in the *Mining Journal* of 6th November, 1886, he estimated that 33,250 tons of gold-bearing quartz would be mined, which would yield 229,425 oz. gold, or in value £883,286, and stated that he considered the value of the return to be expected from the mine had almost been placed beyond the region of speculation, and that, with his experience of the gold-mines of New Zealand, he knew of no other having such good prospects.

After the company took the property over a battery was erected, and an expensive water-race partially constructed, and in various ways some £11,764 was actually spent in New Zealand in connection with the operations, but beyond putting in the low level for a short distance practically no mining was done, and not a single ounce of gold appears to have been won. It is not difficult to realize how greatly a flotation of this kind must have injured New Zealand mining interests in the Old World; and with regard to it Gordon remarks,* "It is really a great calamity to the colony to see foreign capital invested in unsuccessful mining ventures like this; but the

* Mines Reps., 1902, p. 51.

London shareholders in this instance have only themselves to blame for acting so rashly on the advice of their supposed mining expert. They could not have found an expert in this colony, outside of those who were directly interested, who would have ever led them astray to such an extent."

It is evident that the Bedstead Gully group of mines was never very remunerative to those interested in the properties. In the early days of the Perseverance Company, when it was operating on the surface gossans, it is possible that a fair amount of profit was made, but the Johnstone's United Company, which later worked the same reef, little more than paid its way. It is therefore very doubtful if any further investigation of the locality is warranted; but Bell* has expressed the opinion that prospecting to the northward, along the line of contact between the graphitic phyllites and the amphibolitic sericitic schists, might lead to the discovery of further rich surface patches such as were got in the Johnstone's United Mine.

WEST WANGANUI INLET FIELD.

This field lies about twelve miles due west of the Town of Collingwood. Alluvial gold was first discovered in the locality about 1868, and auriferous quartz in 1874. Within the twenty years following this last date three small mines are known to have been worked there. One of these was owned by Wilkie and party, and was situated on Friday Creek. A small battery was erected, and a certain amount of crushing done, but no information is now available as to the tonnage of quartz crushed or the yield from it. The stone must, however, have been poor, for work was only carried on for a short time. The other two mines, known as the Morning Star and the Old Golden Ridge, were in the vicinity of Slaty Gorge, south of Mount Baldy. No very definite information is available regarding either of them, but both evidently erected batteries and did some crushing. The Morning Star is said to have returned its owners £1,650 over and above all expenses, while from the Old Golden Ridge gold to the value of £22,000 is reported to have been recovered.

About 1895 an English company known as the Taitapu Gold Estates, Ltd., with a capital set down as £175,000, purchased 85,000 acres of land between West Wanganui Inlet and Big River, and covering the areas within which the mines referred to were located. This company at once set aside three 150-acre sections of its holding as mining reserves, and started prospecting operations for gold. For a time it concentrated its attention on what may be termed the New Golden Ridge Mine, about 15 chains south of the Old Golden Ridge Claim. Gold was got here in cement, and a battery of ten heads of stamps was erected; and from this mine and the Anthill Mine, a little farther south, a considerable amount of the precious metal was won. All the deposits or lodes found were, however, very broken and were soon worked out, with the result that the company had ceased mining operations by 1904. During the intervening period 10,807 tons of stone were treated for a yield of 6,327 oz. 18 dwt. 17 gr. gold worth £25,028.

In the meantime at least two other companies—the Australian Gold Trust and the New Zealand Pioneer Company of London—had made arrangements with the Taitapu Gold Estates to prospect on the latter's ground, with the right to peg off and lease certain-sized areas within the freehold. The former company commenced operations in 1896, and carried on con-

* Geol. Bull. No. 3, p. 95.

tinuous prospecting, pegging off two 50-acre areas, known as Blocks 2 and 3, immediately to the south of the New Golden Ridge Mine. On Block 2, which adjoined the Golden Ridge, a reef was located, on which a winze was sunk for 150 ft. A little later an adit was run in to meet the bottom of the winze, after doing which work operations ceased for a time on that area and the investigation of Block 3 was pushed on with. Winzing and driving on this block soon revealed a fairly large body of quartz. A small trial crushing of 20 tons was taken out and treated at the Taitapu Estates battery for a yield of 65 oz. smelted gold, equal to a return of $3\frac{1}{4}$ oz. gold per ton. In 1898 the company, whose claim was first known as the Pioneer and later as the Aorangi or Golden Blocks, erected for itself a battery of three 250 lb. stamps, which in the following year was increased to eight stamps, and thereafter carried on continuous operations till 1913, when the supplies of stone became practically exhausted and work ceased. During the time it was worked the mine produced 21,326 tons of quartz, which yielded 23,856 oz. 2 dwt. 1 gr. gold, valued at £92,267 11s. 9d. As neither the Taitapu Gold Estates, Ltd., nor the Australian Gold Trust were registered in New Zealand no definite information is known as to what amount was paid in dividends, but the "Mining Handbook" of 1906 shows (p. 87) that up till 1904 the latter company had distributed £18,945.

The mines of the West Wanganui Inlet field may be said to have all been confined to a stretch of country about a mile in length by a few chains in width, all the principal workings being along the same line of lode which traversed them on a strike nearly due north and south. The lode occurred as a series of lenses in rocks consisting of interbedded argillites, greywackes, and quartzites, the argillites being highly graphitic, and appeared to be confined to a narrow band of carbonaceous, sometimes siliceous, argillite never exceeding 20 in. in width. The interbedded rocks were considerably flexed, and the gold-bearing portion had the appearance of being the eastern leg of a syncline. Along the line of the formation the lenses were comparatively short, and towards the northern end in particular they did not live any great distance in any direction. In the upper portion of the Golden Blocks Mine they showed the best development, but even there they did not live downwards continuously. On No. 3 level, which is only about 180 ft. vertically below the outcrop, the quartz found was merely in small isolated blocks. From this level a winze was sunk for 90 ft., and this is said to have bottomed in good stone, but the difficulty of coping with the inflow of water at that depth prevented any attempt to work this quartz.

Outside the principal mines a number of erratic blocks of quartz were found, some of which contained good gold values. One of these was discovered in a branch of Sandhill Creek, three-quarters of a mile to the west of the main line of reef. Another was found in Friday Creek, a branch of Sandhill Creek, from which gold to the value of £2,500 is said to have been got. On the slopes of Conical Hill, some 6 chains or so to the westward of the main line, another erratic was found from which a small quantity of quartz averaging 3 oz. gold per ton was taken.

Although there are indications, as before mentioned, that the ore-shoots in the Golden Blocks Mine live down below No. 3 level, it seems apparent that, as far as the main line of lode is concerned, its possibilities of further profitable working are negligible, but farther to the south there is still a chance that close search might reveal ore-bodies that would pay to work. J. M. Bell* remarks that a possible continuation of the principal reef-system

* Geol. Bull. No. 3, p. 94.

was found, by officers engaged with him on the geological survey of the district, near the head of a small right-hand branch of the Anatori River, about a quarter of a mile below the junction of the latter with Independent Creek. Here a reef 4 ft. 6 in. was located, but samples taken from it gave only very low results. The geologist mentioned states that outcrops of quartz also occur in the low-lying country south-west of the Golden Ridge and falling within the Paturau and Wakamarama Survey Districts, the truncated edges of the strata on the more flat-lying portion of the syncline being exposed in the stream-valleys, and the reef-system is distinctly traceable, following the contour of the country in a southerly direction, for miles. Below these outcrops the stream-gravels have frequently been found to be highly auriferous, thus apparently showing the continued gold-bearing nature of the reef-system in this direction. In places the vein material itself, occasionally carrying good values, has been found, but has not been continuous for any great distance. Within the area under consideration some good alluvial gold has been found near the head of Malone Creek, just below the stratum of quartzitic greywacke which overlies the reef-system. Careful search along the base of this stratum may therefore reveal the presence of auriferous quartz. In Dr. Bell's opinion it would seem that the area within which further prospecting may be warranted is bounded to the eastward by a line running a little east of south from the Golden Blocks Mine; and he points out that the flexures of the strata enclosing the vein formation and the rough topography of portions of the area may afford outcrops in the more densely wooded and consequently little explored country lying westward from the main-lode line.

REEFS OF THE QUARTZ RANGES.

Throughout Collingwood County many other outcrops of quartz veins were located, especially in Aorere Survey District. To give particulars of all these here would serve no useful purpose, for in but few cases were they found to have any gold content, and even in these the values were extremely low. Any reader desirous of learning more regarding their location is referred to Dr. J. M. Bell's Geological Bulletin of the Parapara Subdivision (No. 3, New Series). Mention may be made, however, of the fact that about 1881 or 1882 a Collingwood company spent a good deal of money in prospecting some small veins at the Quartz Ranges at a low saddle at the head of Finnie's Creek. The country consisted of banded grey and black slates and grey sandstones, striking east and west, and dipping north at an angle of 45°. Several veins of hard blue-coloured quartz occurred, the outcrops of which sometimes showed gold. Apart from the gold-bearing veins there were also several other larger veins crossing the line of the others, but these were barren. On one of the gold-bearing veins an inclined shaft, known as Smith's shaft, was sunk to a depth of 20 ft., following the underlie of the vein, and at a vertical depth of 90 ft. below the outcrop an adit was driven for a length of between 300 ft. and 400 ft. In this adit the veins were not intersected, and the company suspended operations.

In 1888 another company, undeterred by the failure of its predecessor, made an attempt to develop the veins. A lot of surface trenching was done, and Smith's shaft was cleaned out and sunk to 56 ft. A small vein lived down to the bottom, but it was never more than a few inches in width, and was evidently of low value in gold. The slates in the shaft were said, however, to contain quantities of pyrite and mispickel, both of which

yielded appreciable quantities of gold. Park, who visited the prospect in 1889, expressed the opinion (Reps. Geol. Expl., 1888-89, p. 68) that it was hardly probably, in view of the evidence afforded by the shaft and old drive, that the anticipations of the shareholders would ever be realized. Evidently little work was subsequently done on the veins, and it is questionable if they at any time showed sufficient promise to justify the expenditure entailed in prospecting them.

WAIMEA COUNTY.

There is no record of any gold being recovered from quartz in Waimea County, but reefs have been found in the county containing more or less of the precious metal, in nearly all cases in conjunction with other minerals such as galena, copper, and zinc. In the basin of the Wangapeka River much prospecting was carried out on reefs of this kind. They appear to have been first discovered about 1870, at the junction of sandstone and limestone on the tributary of the Wangapeka River known as Rolling River, on the northern slopes of Mount Owen. A Nelson company was formed about that time to investigate them. Several open-cuts on the hillside above Blue Creek, at a spot about a mile and a half above the confluence of the creek with Rolling River, revealed the existence of a number of small veins, up to 14 in. in width, carrying a good deal of pyrites and nests of galena; but the results of the work could not have been looked upon as satisfactory, for no more than the making of the shallow open-cuts was done on them at the time.

About 1887 two prospectors named Doran and Culford opened up several bedded segregations or veins of the same character in the locality, but they apparently met with no more success than the old company.

About 1911 George Van Belle and party, prospecting in the spur between Blue Creek and Nuggety Creek, found two reefs outcropping on the fall to the latter, but a crosscut adit put in to intersect them showed that the two reefs were parts of the same reef that had been folded. The reef or reefs contained galena, iron-pyrites, and copper-pyrites, but the total mineral content was probably not more than 10 per cent. of the whole. The adit was driven for about 150 ft. A Government subsidy was granted to extend the adit, but instead of using it for the purpose the party directed their attention to several other formations in the neighbourhood, on which a good deal of work was done without satisfactory result.

During the same year the Blue Creek Development Syndicate was prospecting a reef or lode found about one mile and a half south-west of Van Belle's reef, which showed greater promise, having a much higher mineral content; but, as with Van Belle and party's efforts, the work of development was not persisted with, and for some years the locality was neglected.

In 1917 Phillip O'Malley did some prospecting there and discovered a reef showing gold in the quartz, and a little later the Colossus Gold-mining Development Company was formed to open it up. In the winter of the year mentioned this company drove an adit on the reef for a distance of 210 ft., put up a rise on it for 30 ft., and sank a winze for 20 ft. Samples were taken at every 5 ft., and sent to the Waihi School of Mines for assay, the result being that a shoot of what is described as pay-ore, 60 ft. to 70 ft. in length, was shown to exist. A bulk sample from this shoot

treated at the Waihi School of Mines is said to have yielded gold at the rate of 3 oz. 7 dwt. per ton, and silver 2 oz. 1 dwt., equal to a value of £13 12s. 1d. per ton.

Several other parallel reefs, known as Andy's reef and McCarthy's reef, a short distance to the south of O'Malley's reef, were also prospected, the former being up to 5 ft. in width and showing a little gold by panning. The

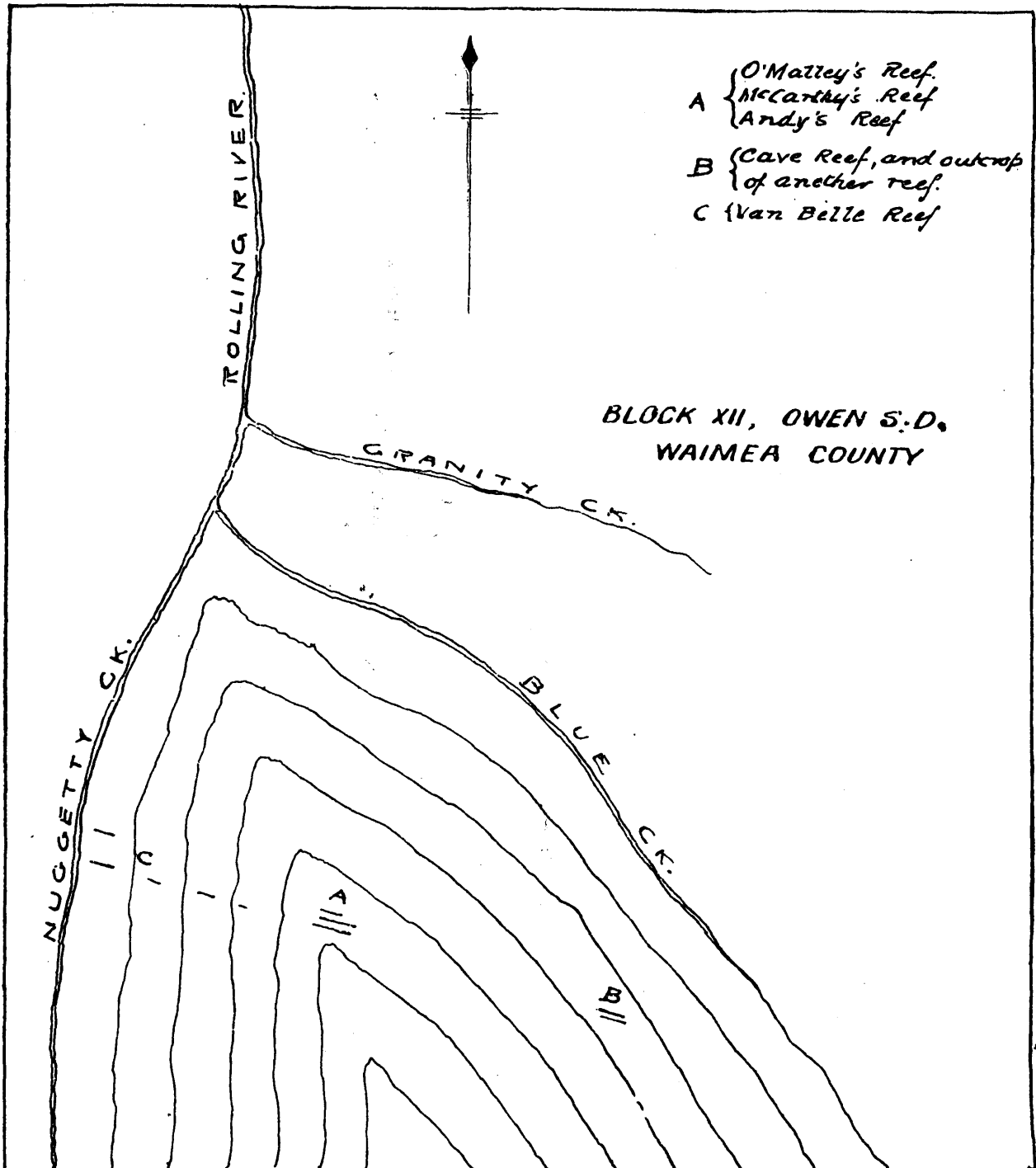


FIG. 4.—SKETCH-MAP OF LOCALITY OF WANGAPEKA REEFS.

company also came into possession of the area containing the reef prospected by Van Belle, and did some little work on other reefs to the eastward of the O'Malley reef outcrop. One of these was named the Cave Reef. As a matter of fact, all the outcrops were along the same north-westerly-striking line, and the Van Belle reef was probably the north-western extension of O'Malley's reef, or one of the parallel reefs near the latter, and the Cave Reef the south-eastern extension. The sketch-plan shown in Fig. 4 will serve to illustrate the position.

No more work appears to have been done either on O'Malley's or Van Belle's reef, but on another reef on the Nuggety Creek side of the spur an adit was put in for 250 ft. This reef was named the Surprise, and was probably identical with McCarthy's reef. In 1919 Mr. A. H. V. Morgan, Director of the Waihi School of Mines, visited the locality and advised that another adit should be driven on this reef 100 ft. higher than the one first driven, and that the two adits should be connected by rising or winzing. The second adit referred to was subsequently driven for 130 ft., the ore met with in the first 50 ft. being similar in character to that of the lower level, but at that distance from the portal the drive passed into disturbed country and the reef was lost. The assay results of eleven samples taken at regular intervals from 195 ft. to 250 ft. in the lower adit, and tested at the Waihi School of Mines, showed the average value for all the mineral content to be £2 15s. 4d. per ton. The results of six samples from the upper level gave an average value of £2 13s. 6d. per ton. The average proportion of the different minerals in the samples was as follows:—

—			Gold.	Silver.	Lead.	Zinc.
			Oz. dwt. gr.	Oz. dwt. gr.	Per Cent.	Per Cent.
Lower adit	..	..	0 2 16	6 10 7	6·8	1·0
Upper adit	..	..	0 0 22	7 15 16	8·6	..

A small battery was brought on the field, mainly for the purpose of treating the gold-bearing ore of O'Malley's reef, but it was not erected, and, as the company was not in a sufficiently good financial position to erect the costly plant necessary to deal with the more complex ores of the other reefs, no further work was done on the property. An application was made to the Mines Department for a substantial loan under the provisions of Part X of the Mining Act, but, in view of grave doubt as to the general values of the ore being as high as shown by the assays mentioned, and the difficulty of extracting the mineral content profitably even if the values were as shown, the application was declined.

There would have been some justification for testing the lodes at greater depth, and it is to be regretted this was not done, for deposits of this nature, containing base metals, frequently become denser in mineral content, and hence carry better values, as they go down.

MURCHISON COUNTY.

In Murchison County no reefs of any importance have been discovered. The finding of auriferous quartz at the Owen River in 1886 by Messrs. Bryne and Bulmer led for a time to high hopes that a valuable mining-field had been located in the county, but such hopes were very short-lived. The discovery was made from seven to ten miles up the Owen River from its junction with the Buller River. A number of claims, such as the Enterprise, Wakatu, Zealandia, Golden Crown, Bulmer Creek, Comstock, Better Times, and Great Eastern, were pegged out, a township was laid out, and quite a large settlement sprang into being. Within a year a two-storied fifteen-roomed hotel was built at a cost of £2,000, and a number of other large buildings had either been erected or were in course of construction.

On nearly all the claims, reef-outcrops varying from 3 ft. to 20 ft. or more in width were located, and from the surface stone fair prospects could be got everywhere by crushing and panning. A company with a capital of £6,000 was formed to provide the field with a battery of twenty heads of stamps, and one of the mining companies, the Enterprise, also built a battery of ten stamps.

The Enterprise company went in for a vigorous development policy. The company's ground was situated on the western side of the Owen River, about seven miles up from its junction with the Buller River, and the reef outcrop was found about 250 ft. above the level of the former river. Where first found the reef is said to have been 30 ft. wide, but consisted of alternating bands of quartz and country rock. H. A. Gordon* states that he estimated the stone he saw at the surface would go from 6 dwt. to 10 dwt. gold per ton. A shallow adit was put in along the formation for 65 ft., after which a second adit was driven 54 ft. lower. In this lower adit the reef was intersected at 171 ft., and was driven on for 50 ft., when it averaged 40 in. in width. A winze was then sunk on the stone for 80 ft. from No. 2 adit, and No. 3 adit was driven at that depth to meet it. As a result of this work the company was so well satisfied with the prospects of its mine that it erected the battery previously mentioned. This plant was completed, and crushing was commenced towards the end of 1887 or early in 1888. The results of the crushing were not, however, at all satisfactory. Instead of yielding the anticipated 6 dwt. to 10 dwt. gold per ton, the clean-up from 720 tons crushed only gave 72 oz. gold, equal to about 2 dwt. per ton. The facilities for handling the quartz economically were so exceptional that it was considered a recovery of even 4 dwt. per ton would have shown a profit, but a 2 dwt. recovery was not payable; and as it was evident that, whatever the actual values in the stone might be, it was impossible to save a higher proportion than this with the treatment plant available, the company seems to have made a further effort to carry on.

In the meantime the Wakatu Company, whose claim was situated about half a mile up Bulmer Creek, and two miles farther up the Owen River than the Enterprise, was busy at proving its ground. Three lodes were found in the claim, only a few feet apart. On the surface they were similar to the reef in the Enterprise Company's claim, carrying fair gold; but the putting-in of several adits served to show that at a comparatively shallow depth they either pinched out altogether or became very poor. The company crushed several hundred tons of stone in the battery erected by the public crushing company, but no data is available either as to the exact quantity or the yield of gold. It has been stated, however, that the return was less than 4 dwt. gold per ton.

The Zealandia Company's workings were in a blind gully on the range northwards of the main branch of the Owen River, and about half-way between the Wakatu and Enterprise Companies' areas. The reef was discovered outcropping in the gully, and some fair specimen stone is said to have been taken from it at surface. An adit driven at a depth of 80 ft. under the outcrop failed, however, to locate any quartz.

The Golden Crown Claim was on the opposite side of the main branch of the Owen River to the other claims mentioned. A reef was discovered outcropping on it at a high elevation, which is said to have shown promising

* Mines Repts., 1888, p. 33.

prospects at the surface, but a low-level adit driven below the outcrop failed to pick reef up.

In the Bulmer Claim, which adjoined the Wakatu to the north, the same promising kind of reef was found outcropping as in the other claims, but 900 ft. of adit level failed to locate any solid stone below the surface.

On the Comstock, Better Times, and other claims little more than surface prospecting was attempted, the owners evidently taking the line of waiting to see the issue of the development carried out by the Enterprise and Wakatu Companies. The result was that when these two companies ceased operations, which they did very shortly after their first crushings, all the other claims were abandoned forthwith, and by 1890 the field was almost entirely deserted. Towards the end of 1889 another company, known as the Wellington and Silverstream Gold and Silver Mining Company, was formed to take over a number of the old claims, but this company, instead of doing any further work on the reefs, directed its attention to some galena discoveries that had been made in the locality. Samples of the mineral showed on assay fairly high silver values, but the galena only occurred in small and scattered pockets, and the attempt to work them was no more successful than that of working the quartz reefs.

The Owen River reefs were segregated veins following the bedding of a belt of greywacke, but the country was extremely badly broken and the reefs had no continuity in any direction. In practically all cases the outcrops prospected by the various companies proved to be moved by faulting from their original positions. Only in the Enterprise Mine did the stone live down to the lowest workings opened, and these were less than 200 ft. below the outcrop. In all cases the quartz was heavily charged with arsenical pyrites, which remained unaltered to within a short distance from the surface, and whatever gold was in the stone was evidently in close association or combination with the pyrites. At the surface, oxidation had taken place, freeing the gold, hence the fair prospects that were got by crushing and panning samples from the outcrops. When the pyrite zone was reached, only the very poorest prospects could be obtained from samples treated in the same primitive way; but even had good values been found to occur in it it may be readily understood they could not have been recovered by the ordinary battery process of treatment then so generally followed. That fairly good values existed in at least parts of the ore in the various mines is shown by the assay results (Reps. Geol. Expl., 1887-88, pp. xxiii, xxiv) of many samples taken by Sir J. Hector on one of his visits to the field, and tested at the Colonial Laboratory.

Of thirty-nine samples from the Enterprise Mine there were only four that did not give a trace of gold. Six samples contained under 3 dwt. per ton, the lowest being 12 gr. The other twenty gave good results, one containing 19 oz. 13 dwt. 6 gr. gold per ton, and the remainder from 6 oz. down, the average being about 5 oz.

From the Wakatu Claim seventeen samples were analysed, but the results were not so good. Only one proved to have no gold, and the rest had little more than traces, the best specimen giving 1 oz. 19 dwt.

Five specimens from the Bulmer Creek Claim gave an average of 11½ dwt. gold per ton, the best result being 1 oz. 15 dwt.

From the Golden Crown four specimens were taken, the highest result being 1 oz. 15 dwt. 16 gr. gold per ton.

Three specimens from the Zealandia gave an average of 9 dwt. gold per ton.

Unfortunately, there is nothing to show what parts of the mines these samples or specimens came from ; but, as the reef in the Enterprise had been opened at the time down to No. 3 level, the presumption is that they were taken from all parts of the workings. It is highly probable, however, that the greater number of them, particularly those containing good values, came from the upper or oxidized zone.

In view of the values shown, especially in the samples from the Enterprise Mine, it may be thought that the field did not get as thorough a try-out as it deserved. The poor recoveries obtained in the batteries is accounted for by the fact that bismuth was present in the ore, and this had the effect of sickening the mercury, making the ordinary battery treatment useless for saving the gold. The close association of the gold with the pyrites also brought about conditions tending to cause serious loss of gold, the decomposition of the sulphides and arsenides of iron finding its way to the plates, and also sickening the mercury. If the difficulty of saving the gold was, however, the only one to be overcome it is quite possible that modern metallurgical science could conquer it ; but the fact is that insufficient sampling of the deposits was carried out, and insufficient practical testing of the ore done, to definitely determine what the actual values in the lodes were. Park, who visited the field in the early part of 1888, pointed out (Reps. Geol. Expl., 1887-88, p. 87) that careful tests should be made of large samples of the stone to ascertain if it contained payable gold, and that steps should afterwards be taken, by actual experiment, to find out the process best suited to extract the gold. He further suggested that, instead of the companies wasting their capital in individual efforts, they should unite their resources and thoroughly test the claim offering the best prospects and greatest facilities for working. These suggestions were not acted on by the claimholders, consequently some doubt remains as to the real values, but the probability is largely that on the whole the deposits would not have been found to be rich enough in gold to pay for working.

Even had the values been actually much better than those recovered, there was a further obstacle to the success of the field in the lack of continuity in the reefs. Most of the stone found was practically on the surface, and in all the deposits it was much broken. There can be no doubt all of it was faulted from its original position, and, as the whole area had been extremely badly disturbed, the probability is that further investigation would not reveal *in situ* the ore-bodies from which the stone was derived, but would show that, in fact, no bodies of any extent would be found in any part of it.

BULLER COUNTY:

In Buller County auriferous reefs were located in at least three areas—Lyell Creek, Mokihinui River, and Waimangaroa—from each of which considerable quantities of gold were won.

Lyell Creek Reefs.—The reefs discovered in this locality were the most important found in the county. Alluvial gold was first discovered at the Lyell as early as 1862, but it was not until about 1870 that quartz-mining began there. The United Alpine Company, registered in 1874, was the first to be formed to work the reefs, and it started operations on a reef discovered on a high ridge on the south side of Lyell Creek, about two and a half miles up that stream from its confluence with the Buller River, where it succeeded in opening up what proved to be one of the most profitable mines in the Nelson Province, and one which continued to yield fair quantities

of gold right up till 1912, or for a period of thirty-seven years. No detailed information is now available as to the tonnage of quartz crushed or the amount of gold won up to the year 1887, but it is known that the value of the precious metal recovered up till that date was £120,000 and that £35,666 13s. 4d. was paid in dividends to the shareholders. The total subscribed capital up to the same time was less than £20,000. The company as originally formed carried on very profitably after this date, and up till 1896, when, owing to some of the more important blocks of stone being lost and the breaking-up of the lode into smaller and poorer blocks as depth was attained, dividend-paying came to an end.

Down to No. 7 level the United Alpine Company worked its mine by means of adits, but from this adit an inclined shaft was sunk from which Nos. 8 and 9 levels were opened. Such blocks of reef as were living down, however, in this part of the mine were fast making on their pitch into an adjoining claim held by the Lyell Creek Extended Company, which had for thirteen years been engaged in driving a long adit to catch the downward extension of the reef, which it eventually intersected at 3,700 ft. in. When the reef-line was cut, however, very little solid stone was met with; some reef was found going underfoot, but there was none in the backs. Two winzes were sunk from the adit to depths of 125 ft. and 150 ft. respectively, but the prospects got in them were not very encouraging. In 1897 the two companies amalgamated under the title of the Alpine Extended Gold-mining Company. The long adit of the Lyell Creek Extended then became No. 10 level of the Alpine Mine, and a vertical underground shaft was sunk from it, from which four more levels were opened. The Alpine Extended Company carried on till 1905, when, owing to scarcity and poverty of quartz, it ceased operations, and the mine lay idle for about two years. Another reconstruction then took place, resulting in the formation of the New Alpine Gold-mining Company, Ltd., and a further attempt was made to work the property to advantage, but success did not crown the undertaking, and in 1912 the mine was finally abandoned. No dividends were paid by either the Alpine Extended or New Alpine Companies, but the Alpine United Company paid £74,266 13s. 4d. to its shareholders. The exact tonnage crushed during the lifetime of the mine is not definitely known, owing to the detailed figures for the period 1875 to 1885 not being available, and the same applies to the yield of gold; but if the missing figures are calculated from general data that are at hand the results show that approximately a total of 146,640 tons of quartz were crushed, for a yield of 80,510 oz. gold, valued at £315,402.

In the upper levels of the mine two shoots of stone, known respectively as the North and South Blocks, were worked, the former being by far the more important. It was from this North block that most of the stone was won during the mine's dividend-paying days, the block being of high average values and up to 50 ft. in width. This block was lost, however, about 120 ft. below No. 6 level, and was never subsequently picked up, and from the time of its disappearance the mine did little further good. In No. 7 level, which was driven about 800 ft. below the outcrop, and 290 ft. below No. 6, very little ore was developed, and in each succeeding level downward the quantity became less, only isolated blocks being found that did not live far in any direction. The section of the mine shown in Fig. 5, which has been compiled by the writer from the very incomplete plans of the mine that are available, will serve to show the position. It is clear from this that below No. 6 level the lode was seriously disturbed by

faulting, but from the meagre information at hand it is difficult to form any idea as to the exact nature of the fault movement. The general opinion of the old miners seems to have been that the worked portion of the block had been normally faulted with a downthrow to the eastward, and that thus the lost part should be found to the westward of No. 7 level. This theory of the occurrence was probably correct, but only very half-hearted attempts were made to prospect for the lode in this direction. Three crosscuts were run out westerly from No. 7 level, but none of them was carried nearly far enough to effect the desired purpose. If the work done in the three had been done in one, good might have resulted. Years

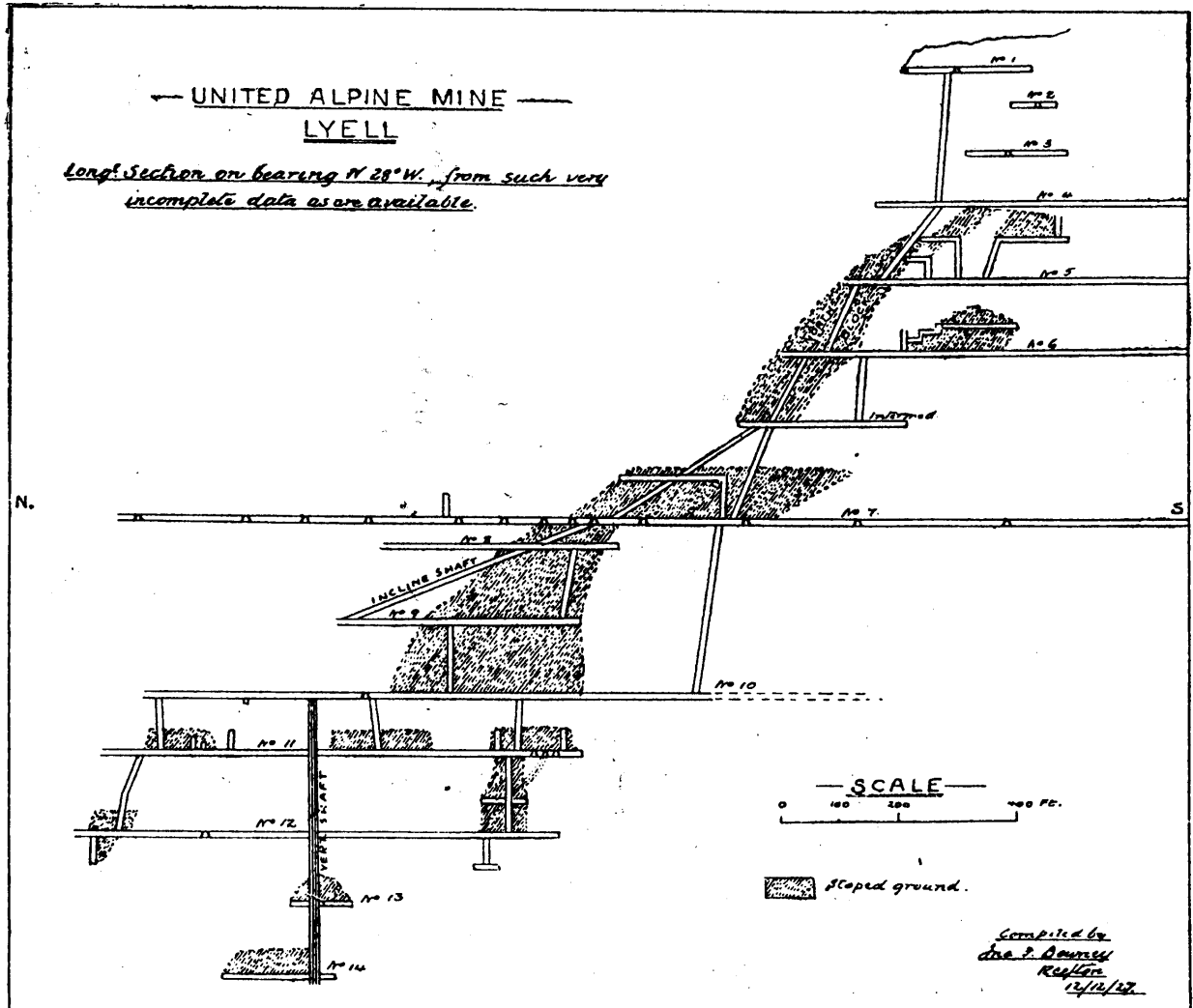


FIG. 5.—LONGITUDINAL SECTION OF UNITED ALPINE MINE, LYELL.

later the New Alpine Company extended a drive from the end of the most southerly of the crosscuts, which came to a point vertically under the spot where the block cut out, but no indication of reef was noted. It is to be regretted that more vigorous search was not made for the lost portion of this block, as its rediscovery would have given the mine a much longer and more profitable life.

A number of other companies, among them the Break of Day, the Tyrconnell, the Cræsus, and the United Italy operated mines in the vicinity of the United Alpine, but in practically all cases they merely worked small rich leaders, some of which were only 2 in. to 3 in. wide, no considerable body of quartz being found in any of them.

Regarding the Break of Day little is known except that it crushed 872 tons of quartz for a yielded 4,610 oz. gold, equal to 5 oz. 5 dwt. per ton, and paid in dividends £10,000.

The Cræsus Company was formed about 1885 to work a claim facing Lyell Creek, to the north of the United Alpine Claim, in which a reef was found that for a time promised good returns. A battery was erected and crushing was carried on for some time, but the values recovered were not up to expectations, and the company soon suspended operations. The ground lay idle till about 1892, when the claim and battery were purchased by the Tyrconnel Company. Work was continued in the Cræsus, however, by a party of tributors, who carried on for about eight years, during which period they crushed 2,818 tons of stone, which yielded 1,890 oz. 2 dwt. 16 gr. gold, valued at £7,785 11s. 8d. There are no records dealing with the earlier crushings by the original company.

The Tyrconnel Company was formed in 1882 to work the ground previously held by the Break of Day Company, and up till 1887 had won a fair amount of gold, one crushing alone of 46 tons yielding 685 oz. In 1893 the mine was let to tributors, who worked it till 1898. As far as is now known, the total stone crushed from the mine, exclusive of the old Break of Day figures, amounted to 198 tons, which yielded 1,658 oz. 14 dwt. gold, valued at £6,346 18s.

The United Italy Company was formed in March, 1882, to work a reef from which great things were expected, but the results did not come up to expectations, and after struggling along till 1889 the claim was let to tributors, who worked it until 1897. During its working-life this company's claim produced approximately 505 tons of stone, which yielded 2,230 oz. gold, valued at £8,655, and dividends to the amount of £1,200 are believed to have been paid.

It may be mentioned that the Lyell Creek Extended Company, before amalgamation with the United Alpine, crushed 133 tons of stone for 454 oz. 6 dwt. gold, valued at £1,787 1s. 2d.

About 1915 a new company known as the Lyell Consols was formed to take up most of the ground formerly held by the various small companies just previously referred to, north of the United Alpine claims, and, with the help of Government subsidy, a crosscut was driven for about 553 ft. with the intention of intersecting the line of the Alpine reef about 1,500 ft. north of the old workings of the Alpine Mine. In the first 200 ft. this crosscut is said to have intersected five gold-bearing leaders, and at about 406 ft. in the reef-line sought for was intersected and driven on for 147 ft. Such quartz as was found along the line was, however, very broken. It contained gold, but only occurred in small boulders which would not pay to work. A start was then made to put another tunnel 250 ft. lower than the other, with a view to seeing if at this depth the reef would prove more solid and continuous. This second adit had its portal about 1,200 ft. north of the old tunnel, and was driven on what was believed to be the reef-line, only a short crosscut of 112 ft. being necessary to reach the line from the portal. Almost from the time the reef-line was met, small bunches of quartz were met with, and these continued for many feet. At 241 ft. in a solid block of stone was encountered and was driven on for 62 ft. It was evidently only the cap of a large block, for it did not at any point reach up to the back of the drive. Underfoot the stone was the width of the drive, but it was not of much value, the best result of several assays only showing 6 dwt. gold per ton. The tunnel was eventually

carried in to about 1,500 ft., but no more solid stone was met. In 1921 the company ceased operations.

New Creek Reefs.—It was known in 1886 that auriferous quartz reefs occurred in New Creek, about two miles north of the United Alpine Mine, but owing to the inaccessibility of the locality nothing could be done with them at the time. A pack-track was made, however, a year or two later, and shortly afterwards a company known as the Victory was formed to work one of the outcropping reefs. This company drove two adits, the upper about 70 ft. and the lower 220 ft. below the outcrop. A short shoot of stone was picked up in both levels, but with the exception of a small portion of it close under the outcrop it appears to have contained poor values. No record is available as to the tonnage crushed or the gold recovered, but the fact that the company abandoned its claim is sufficient evidence that the stone was not payable. Some years later, about 1911, another company known by the same name made an attempt to work the property. A winze was sunk for about 50 ft. from No. 2 adit, and a drive was put out from it for 40 ft. on a small reef that is said to have assayed well. This company then proposed to put in a third adit, about 230 ft. below No. 2, to test the ground at that depth, but although Government subsidy was promised to assist in carrying out this work the adit was not gone on with, and the company ceased operations. In 1919 a third company, the New Creek Prospecting and Developing Company, was formed to give the mine still another trial. This company commenced the driving of the lower adit proposed by its predecessor, and this was carried in about 500 ft. without meeting the reef-line, but at about 170 ft. from daylight a small reef averaging a little over 1 ft. in width was cut and driven on for 83 ft. It was found to carry values equal to 8 dwt. gold per ton, but was in very hard country. This reef may have represented the downward continuation of the shoot on which the winze from No. 2 adit was sunk, but if so the underlie of the reef would have had to change from easterly to westerly between the two levels. The probability is that the stone was on a parallel line to that worked by the original company. In such a locality and in such hard country 8 dwt. gold would not pay. The company's money being exhausted by the time this driving was done, it ceased operations, and the claim has lain idle up to the present date. It cannot be said there was much to justify the expenditure by either of the last two companies, and the work done makes it clearly evident that no further attempt to work the property would be warranted.

Numerous other reefs are known to occur in the Lyell district, from some of which samples have occasionally given encouraging values by assay, but very little work has been done on any of them. Unfortunately, no geological survey of the locality has yet been made available, consequently its possibilities are not well known; but there is a belt of greywacke and argillite stretching northward from New Creek to the Mokihinui River within which vigorous prospecting might reveal deposits of economic importance.

Mokihinui River Reefs.—Towards the head of the Mokihinui River auriferous reefs were first found about 1875, and a company known as the Halcyon appears to have been formed shortly after that date to work some of them. A battery was erected, but although the quartz crushed is said to have averaged 1 oz. gold to the ton, operations were not successful, and after expending about £10,000 the company abandoned its holdings. About 1884 some further discoveries of reef were made, close to the old Halcyon ground, and this led to a revival of mining at the place, at least six com-

panies—the Red Queen, South Pacific, Mokihinui, Southern Light, Lady Agnes, and Guiding Star—being formed to develop different finds.

The Red Queen Mine was on the southern bank of the river, and was the only one to meet with any measure of success, and it only earned a very moderate profit. During the years 1885 and 1886 this mine crushed 1,560 tons of quartz for a yield of 2,263 oz. gold, valued at £8,999 9s., and paid in dividends £2,400. The reef was small, ranging from 6 in. to 18 in. wide; and as the country was extremely hard the cost of mining as the stone was followed down increased rapidly, so much so that after working out the reef in sight about the end of the last-mentioned year the only development carried out was of a desultory character, and it was not till 1902 the mine began to produce gold again. This time operations were, in a small way, carried on steadily till 1910, during which period a further 648 tons of quartz were crushed for 842 oz. 2 dwt. 12 gr. gold, valued at £3,256 16s. 4d., but no more dividends were paid. This made the total output of quartz from the mine during its working-life 2,208 tons, which yielded 3,104 oz. 2 dwt. 12 gr. gold, valued at £12,248 5s. 4d. Since 1910 no attempt has been made to reopen the old workings.

The Southern Light Mine was on the same reef-line as the Red Queen, but higher up the range. A good deal of work was done on the outcrop of a reef in the claim, and it is on record that in 1887 a quantity of stone was ready for crushing. The writer can find no data showing that this stone was actually treated, but as tramway connection had been made with the Mokihinui Company's battery it is probable it was crushed at that plant. If this were so, the returns must have been unsatisfactory, for the company only carried on for a very short time afterwards.

The Mokihinui Company appears to have done little mining on its own account, but it owned the only battery on the field and did all the crushing for the other companies.

The Guiding Star Company's ground was in such a position that to reach the reef-line a very long adit was necessary, but the company was not sufficiently strong financially to carry the work out unaided, and, as the other companies that would have been benefited would not co-operate, very little other than surface prospecting was done on the property.

The South Pacific Company put in a low-level adit for 445 ft., but found nothing of any value.

In 1888 an effort was made to float in London a large company to work the whole of these claims, a Mr. Hay Dickson undertaking the formation of it. In the meantime, all work on the field was suspended. The proposed flotation was not effected, and evidently its failure was not unexpected in well-informed quarters. In his report for 1889, Inspector of Mines Gow, who was in charge of the district, remarks, "It is to be hoped English capitalists will satisfy themselves as to the value of these properties before embarking their capital."

Between the time of this attempt at a London flotation and the reopening of the Red Queen Mine in 1902 the only prospecting of any note carried out in the locality was in the Lady Agnes Claim. Several drives, only a few feet one below the other, were run in there on a solid reef about 4 ft. in width, and two small crushings were taken out, one of 75 tons and the other of 80 tons of quartz, from which a total of 22 oz. 1 dwt. 12 gr. gold was obtained, equal to less than 3 dwt. gold per ton.

After ceasing crushing operations in 1910 the Red Queen Company did some surface prospecting with apparently encouraging results on a massive

quartz outcrop that had previously been neglected, and a new company known as the Swastika was formed, which carried out a certain amount of development work on this outcrop and on several smaller ones in the vicinity. The new company met with no success, however. Some small crushings, totalling 118 tons of quartz, were taken from the various formations, but on treatment they only yielded 29 oz. 15 dwt. 8 gr. gold, valued at £116 5s. 7d., equal to a return of only a trifle over 5 dwt. per ton. By the end of 1914 all work once more ceased on the field, and there has been no resumption up to the present.

H. A. Gordon describes the quartz veins of the Mokihinui district as being for the most part small lenticular veins conforming to the bedding of the country.

Waimangaroa Reefs. — Gold-bearing quartz appears to have been first discovered in this locality, near the head of Stony Creek, and at an elevation of about 2,000 ft. above sea-level, in 1875, and a company was formed to work there. A battery was erected, but the enterprise soon failed, and nothing more in the nature of mining seems to have been done till about 1885, when some good stone was found on an area held by the Great Republic Company, which was formed in 1882. Operations were carried on by this company till 1890, but no solid reef was at any time got, the quartz being all mined from loose blocks that were evidently brought down by slips from higher country. No plans of the workings exist, but for the main part they consisted of short drives or crosscuts put into the loose material lying on the hillside. The only considerable working was a low-level adit which was put in for 215 ft. in 1890 in the hope of striking solid reef behind the slip country, but no reef was met with in it. Information at hand regarding the quantity of stone crushed, yield of gold, &c., is very scanty, all that is known being that prior to 1887 some 1,500 tons of quartz were crushed which yielded 1 oz. gold per ton, and that dividends amounting to £1,900 were paid out. A good deal more stone was crushed during the following years up to 1889, but there are no records as to the tonnage and yield. It is known, however, that a further £1,900 was paid in dividends, making altogether £3,800 disbursed. The Mines Reports of 1890 show that the total value of the gold won was £12,000.

After the cessation of operations in 1890 by the Great Republic Company no further quartz-mining seems to have been done on the field till the Britannia Gold-mining Company was formed to work some new outcrops that had been discovered close to the old Republic ground. This company had much the same experience as the other, inasmuch as all the reef found was badly broken, and occurred in small blocks with no defined strike or dip. A two-stamp battery was erected and a small cyanide plant, and in a modest way work was carried on till 1910, during which period 3,847 tons of stone were treated for a yield of 3,534 oz. 13 dwt. 21 gr. gold, valued at £13,330 2s. 3d., and dividends to the amount of £3,242 were paid. No plan of the mine-workings is available, but no less than seven levels were driven, the longest being No. 7, which intersected the reef-line at 143 ft. All the workings were in badly crushed ground. Other outcrops on the claim were also tried, one of them, discovered near the north-eastern corner, yielding at the rate of 10 dwt. gold per ton from a crushing of 48 tons, but when the reef was driven on the values fell away.

In 1902 the old Republic ground was taken up by a local syndicate known as the Stony Creek Gold-mining Company, for the purpose of working a new outcrop that had been located on the area. A crushing of 200 tons

was mined from this, but on being treated it only yielded 32 oz. 1 dwt. 10 gr. gold, equal to about $3\frac{1}{2}$ dwt. per ton, which was far from being payable that the company closed down forthwith and went into liquidation.

Within the past few years the ground formerly hold by these old companies has been taken up again under prospecting licenses, and some further attention had been given to examining them. A new adit was put in on the old Britannia ground, and some gold-bearing quartz located, but the stone did not extend any distance in any direction. One of the Stony Creek Company's adits was also put in repair and extended for about 150 ft., with the result that another short shoot of gold-bearing stone was found in it. It is very questionable, however, if the quantity of stone that is likely to be available would be sufficient to warrant the expenditure of the very considerable sum of money the erection of a battery to treat it would entail.

As far as the writer can see, the only hope of prospectors doing any good now in this part of the district is by close investigation of the country higher up than any of the old workings, as there is just a chance of finding there *in situ* the reefs from which the stone so far worked has been derived. It may be said, however, that prospecting of this kind would be most arduous, for the country is extremely steep and difficult of access.

Beaconsfield Mine.—The only other part of the Waimangaroa district to which any special reference need be made, by reason of the discovery of auriferous quartz, is a small run of slate in the Waimangaroa River about a quarter of a mile south of the Denniston incline. Here a small reef was found about 1890 in the bed of the river. A drive was put in on it a few feet under the outcrop, and fair values are said to have been got. A company known as the Beaconsfield was formed to work it, and a shaft was put down for 118 ft. on the north bank of the river, from which a cross-cut was extended under the river-bed, which intersected the vein at 100 ft., when a drive followed the stone for about 70 ft. A rise was made from the drive for 54 ft., where the vein was from 1 ft. to 2 ft. 6 in. wide, and in driving from the rise to connect with a winze sunk from the outcrop some very good gold-bearing stone was said to have been met with. Owing to the want of a battery to crush it, no stone was, however, taken out by the company, which abandoned the prospect in 1892. About 1899 the property seems to have been taken up by an English syndicate, which worked it for a short time under the name of the Twins Mine. This syndicate equipped it with a ten-head battery and a water-driven winding plant. The old workings were repaired and extended, but no development of consequence was made, and in the following year the plant was sold to the Despatch Foundry, Greymouth, and the ground was once more abandoned. A certain amount of stone seems to have been taken out and crushed, but no records concerning it are now available.

It may be mentioned that in the Waimangaroa and other streams in the locality heavy gold has been got in the alluvial deposits, and fine specimens of gold-bearing quartz, leading to the belief that somewhere thereabout rich reefs occur. The slate country in the neighbourhood is overlain, however, by coal-measures, leaving only small exposures of it here and there, and, as these have been greatly disturbed and masked by slips, the likelihood of the reefs from which the gold has come being discovered is remote.

GREY COUNTY.

In Grey County the principal localities in which gold-bearing reefs have been discovered are those known as Langdon's, Blackball Creek, Croesus Knob, Roaring Meg Creek, and Moonlight, all of which are situated along the Paparoa Range, but no finds of first importance were made in any of them.

Langdon's Reefs.—A little westward of Stillwater Junction, on the Grey-mouth-Christchurch Railway, a narrow exposure of greywackes and argillites occurs in the mass of coal-measures forming the surface in the locality. This exposure crosses the Grey River and extends to the south of it for perhaps a mile, but northward from the river it may be traced for probably twice that distance. As far back as about 1870 it seems to have been known that auriferous reefs occurred in it, but it was not till the discovery in 1879 of what was subsequently known as Langdon's Antimony Vein that serious attention was drawn to them. A number of claims were pegged out. The finding of rich specimen stone in Langdon's Creek led to a certain amount of prospecting which resulted in the discovery of the antimony vein referred to, which outcropped in a gully at the head of the creek, about 1,440 ft. above sea-level. Sir James Hector*, reporting on the lode in 1879, stated that it consisted of five distinct bands, as follows:—

No. 1, next the foot-wall, was quartz containing stibnite	Ft.	in.
in irregular masses	2	0
No. 2, compact stibnite	2	0
No. 3, stibnite, including quartz in the form of nodules	3	0
No. 4, fine-grained mixture of quartz and stibnite ..	0	4
No. 5, breccia of slate (argillite) ..	1	8
	9	0

Apparently when first found the lode contained high, if patchy, values. Hector states that assays of the first specimens forwarded gave results equal to 84 oz. gold and 36 oz. silver per ton, and that a sample taken by himself from the compact stibnite band yielded gold at the rate of 32 oz. per ton, other samples giving by assay from nil to 5 oz. 16 dwt. 16 gr. gold per ton.

It seems evident that the lode could not have lived far to the width mentioned by the geologist referred to, for when, a few years later, the locality was visited by Alexander McKay he found that the wide part of the lode had been worked out and the excavation filled by a slip, but an outcrop 3 ft. wide was showing on the western side of the slip. In March, 1904, the reef was visited by P. G. Morgan, who states† that a lode 2 ft. wide, which appeared to be a bedded vein enclosed in argillite and greywacke, was showing in the west side of the slip, striking about 322° and dipping to the south-west at 75°. A sample taken by him from the spot yielded on assay only 5 dwt. 16 gr. gold and 1 dwt. 21 gr. silver per ton.

Some time in the early "eighties" a parcel of 10 tons of ore from this lode appears to have been shipped away for treatment, but no records are available as to the results. It is probable that this was the only ore won

* Progress Report on Repts. Geol. Survey, Vol. 12, 1879, p. 20.
No. 13, p. 84.

† Geol. Bull.

from the lode, and the return could not have been satisfactory, for no further work was done at the time.

On the Langdon's Extended Claim, on which the antimony lode occurred, another formation known as Langdon's Reef was found at about the same time, but outcropping 400 ft. lower down the hillside. This reef was described by Hector* as showing a solid ledge of white quartz 3 ft. to 11 ft. wide, a sample from which, assayed by Skey†, yielded gold at the rate of 69 oz. 3 dwt. 12 gr. per ton. In 1883 Alexander McKay‡, who visited the reefs in that year, reported that samples from this reef yielded on assay at the rate of 19 dwt. 12 gr. gold per ton. No more work seems to have been done on the reef than on the antimony lode, and the prospects could not have been very encouraging, for nothing in the way of active mining was done on the field till 1894, when the Curtis brothers took a tribute over Langdon's Extended Claim, known by this time as the Julian Claim. While excavating for a tram-line they proposed laying down, to carry stone from the Julian Claim to a small one-head battery they had erected, they discovered a boulder of quartz showing good gold. From the appearance of the shoad it had not travelled far, so a search was at once started to trace its place of origin, with the result that in a short time the party found a lode a short distance up the hill and outside the Julian ground. The Curtis brothers at once pegged out a claim (since known as the Victory) covering the find. Surface prospecting soon showed that the reef ran nearly east and west across the lower part of the claim. An adit was started, which cut the reef at 70 ft. in. When driven on the stone varied from 1 ft. 6 in. to 3 ft. in width, and at one point, where several leaders had junctioned with it, is said to have reached a width of 4 ft. Three tons of stone were taken out, and treated in the one-stamp battery previously mentioned, with the result that 44 oz. gold were obtained. This encouraging yield led the owners to at once improve on their crushing plant, and a five-stamp battery was purchased from the Specimen Hill Company at Reefton, and transported to the mine, where it was erected in Langdon's Creek.

In 1895 and 1896 an attempt was made to float the Julian, Victory, and several other claims adjoining into one big company in London, but the promotor found when in England that he would have to modify the offers he had made to the property-holders, and as the new terms were unacceptable to the Curtis brothers the flotation fell through.

In the meantime, development work on the Victory showed that in No. 1 adit the shoot of gold-bearing stone was about 134 ft. long, averaging between 18 in. and 24 in. in width. From the adit a winze was sunk to a depth of 93 ft., and No. 2 adit was driven to meet it. The reef was then all stoped out from No. 2 level to the surface, some 609 tons being mined and crushed for a yield of 1,159 oz. 7 dwt. gold, valued at £5,564 11s. 3d. In 1898, the stone having been practically exhausted, an amalgamation of the Julian and Victory Companies was arranged, under the title of the Julian Gold-mining Company; and as the water was said to be too heavy to permit of sinking below No. 2 level a start was made to put in a third adit about 200 ft. below the latter. This adit was carried in about 200 ft. when the work was abandoned owing to the company's funds being used up.

* Progress Report on Repts. Geol. Survey, Vol. 12, 1879, p. 19. † 14th Annual
 Rep. Colonial Museum and Laboratory, 1879, p. 35. ‡ Rep. Geol. Survey,
 Vol. 15, 1883, p. 84.

An application was made for Government assistance for the extension of the adit; but, as the Inspector of Mines reported that the shoot underfoot in No. 2 level was only about 40 ft. in length and was of poor grade, this application was declined, and in 1899 all operations ceased. Before stopping work, however, a further 77 tons of stone were mined from the Victory, which on treatment yielded 82 oz. 19 dwt. gold, valued at £331 16s. 4d., and 110 tons from the Julian, which yielded 129 oz. 19 dwt. gold, valued at £519 16s. As the Julian, prior to the amalgamation, had crushed $12\frac{1}{2}$ tons for 15 oz. 18 dwt. 18 gr. gold, valued at £60, this gave the whole known output from the mines as 811 tons, yielding 1,388 oz. 3 dwt. 18 gr. gold, worth £6,476 3s. 3d.

Nothing further appears to have been done on the field till 1917, when the Victory Mines Syndicate was formed in Greymouth to give it another trial. This syndicate erected a new battery, and did some mining on the old antimony lode. A crushing of about 100 tons was taken out, but the return was poor, only a little over 20 oz. gold being recovered. As assays showed the stone to be fairly rich, there can be no doubt that the greater part of the gold was lost through the antimony preventing effective amalgamation. Following on this disappointing return, the syndicate abandoned further work on that part of the property and directed its attention to the Victory section, where a new adit was run in about 105 ft. under the old No. 2 adit. This new adit was extended for about 455 ft., but the only stone met with consisted of a small barren reef intersected near the end of the drive. Owing to there being some uncertainty as to the position, by reason of doubt as to the accuracy of such old plans as were available, the syndicate drilled upward from the new level in an effort to discover where the shoot of stone going underfoot in No. 2 level had got to, and at a point estimated to be 25 ft. under the old level the bore is said to have passed through 3 ft. of quartz, an assay of which showed it to contain gold to the extent of 19 dwt. 17 gr. per ton. All effort failed, however, to pick up the downward continuation of this stone on the new level, and work on the property was once more discontinued.

On the Julian Claim several adits were also put in, of which no plans or adequate description are now available, but it is known that nothing of value was found in them.

Beyond the fact that in this report of 1883 Alexander McKay mentions that reefs were found in the Albion Claim, south of Langdon's Extended, and in Wilson's lease to the north of it, nothing is known regarding the results of prospecting on the many other claims taken up in the locality. A sample from a 2 ft. reef in the last-mentioned claim is said to have yielded by assay at the rate of 3 dwt. 6 gr. gold per ton.

There can be no doubt that the area within which the Langdon's reefs occur, lying as it does along the powerful Roa fault, has been subjected to considerable disturbance, and in view of this it is questionable if any further prospecting there is justifiable. There is a possibility that careful prospecting by trenching along the lines of the Antimony lode and the Victory lode might reveal valuable surface shoots, but anything found would almost inevitably be badly broken up by earth-movements.

Blackball Creek Reefs.—For a number of years prior to 1889 it was known that quartz reefs occurred in the gorge of Blackball Creek, but it was not till that year that any of them were found to be auriferous, when a little of the precious metal was discovered in a large formation outcropping on the western bank of the creek about half a mile above its confluence with

Smoke-oh Creek. At first the values in the stone were not considered payable, but a little later the reef was traced to the eastern bank of the creek, where some work was done on it, with the result that the gold values seemed to show material improvement, and the Minerva Gold-mining Company was formed in 1890 to further test the discovery. This company drove an adit level on the stone on the eastern bank for a considerable distance, and from the adit put down a winze for 40 ft. at which depth water prevented further sinking. The stone from the winze was estimated by the owners to be worth 10 dwt. gold per ton. From the foot of the winze a crosscut was made in the reef for 22 ft. without finding the other wall. In 1891, the battery of the William Tell Company at Ross was purchased and re-erected by the side of Blackball Creek, a short distance below where the reef was found, and crushing was commenced and continued from time to time up till 1894, during which period 2,460 tons of quartz were crushed from the mine for a yield of 771 oz. gold, valued at £2,987 12s. 6d. The reef was about 5 ft. in width, and a large quantity of stone was available, but the average return of only a little over 6 dwt. per ton left no margin of profit, and in 1896 the company suspended operations. As far as can be gathered, all the stone crushed came from the sides of the adit, and there is nothing in the records to indicate that any was taken from the winze, where better values seemed to obtain, nor from any point below the adit. Evidently the company was working on a very limited capital and became discouraged by the results of the crushing; but in view of the fact that in sinking the grade of the stone appeared to improve, and the further fact that the cyanide treatment was but little known in the Dominion in those days, it seems to the writer that this old mine might deserve further investigation in the future.

Cræsus Knob Reefs.—Auriferous quartz was first found in this locality, near the head-waters of Ten-mile Creek, by Harry Neilson in 1897. This prospector traced shoad stone up the bed of the creek mentioned, and located what was subsequently known as the Cræsus Reef on the crest of the mountain-range. The outcrop was traced on the surface for about 700 ft., and trenches cut across it at short intervals for 400 ft. showed that it contained payable gold. The Cræsus Gold-mining Company was formed to work the find, and an adit (No. 1) was driven in 100 ft. below the outcrop. At 130 ft. from daylight this adit intersected the reef, which was then driven on for over 400 ft., and a rise was put up to surface for ventilation. In 1899 a battery was erected and crushing operations went on until the end of 1902, during which time 4,757 tons of quartz were crushed for a yield of 2,655 oz. 10 dwt. 3 gr. gold, valued at £10,785 16s. 8d.

During the years crushing was in progress the development of the mine was carried on steadily, Nos. 2 and 3 levels being opened on reef. A fourth level, 284 ft. below No. 3, was also put in and driven about 924 ft., but no reef was cut in it. There is some room for doubt, however, if sufficient work was done on this level to definitely determine whether or not the reef lived down to this depth. The level was certainly carried far enough north to meet the downward continuation of the shoot of stone, but more extensive crosscutting would appear to have been justified. However, the records concerning the mine, in common with those of most of the mines operated about that period, are very incomplete, only the scantiest information being available as to the appearance of the level, so any opinion expressed regarding the point referred to can be looked on as merely speculative. Moreover, it is in any case doubtful if the vein would have been payable at that depth, even if it had been picked up. The lowest

point to which quartz was traced in the mine was in a winze sunk to the depth of 27 ft. below No. 3 level, where gold was said to still show in it, but it is evident that from No. 2 adit downwards the values fell rapidly. The last crushings, totalling 1,000 tons, put through the battery in 1903, obviously came from the lower horizon in the workings, and only yielded an average of 4.84 dwt. gold per ton, whereas the average of previous crushings was 12.85 dwt. Dr. J. Henderson mentions* that he was informed by Mr. T. O. Bishop, Inspector of Mines, that above No. 2 adit a rich leader occurring about 2 ft. in the hanging-wall was mined with the main ore-body, but that this leader was lost below that level. The fact that such a leader was worked has further confirmation in a remark in the Mines Report for 1897, p. 117, to the effect that on No. 1 level a drive was put in about 8 ft. to the eastward and a rich leader struck showing gold freely. The distance of this leader in the hanging-wall is greater than that mentioned by Mr. Bishop, but the probability is that the formation referred to in both cases was identical, and if the leader was lost below No. 2 level that would account for the falling-off of the gold values in the lower part of the mine, the best gold being evidently in it. There seems also to have been a decided shortening of the shoot from level to level, for whereas it was nearly 400 ft. long on No. 1 level it was only about 100 ft. in length on No. 3 level.

In 1902 the company was reconstructed as the Mount Paparoa Gold-mining Company, but the new company did no good, and in 1904 the battery and other plant was sold to the Garden Gully Gold-mining Company, which transferred it to the valley of Roaring Meg Creek.

At least seven or eight other reefs were found to outcrop in the vicinity of the Croesus, all of them having the same north-and-south strike and easterly underlay. In common with most of the reefs of the district, they were bedded veins occurring in the greywacke and argillite country with which most of the West Coast mines are associated. A good deal of prospecting was done on some of them. In the Croesus property itself a crosscut was put in about 1889 to intersect one of them 160 ft. below the outcrop. This reef at surface was 2 ft. in width, and was said to show favourable prospects, but no record exists as to what were the results of the work, from which lack of information the conclusion may be safely drawn that the reef was either not picked up in the workings, or else was found to be too poor to pay for mining. In the Homeward Bound Claim, a small leader carrying gold is said to have been intersected in an adit driven 60 ft. into the hill. Other ore-shoots carrying more or less gold were got in such claims as the Sunlight, Poneke, and Corrie's Reward, but although much work was done on the two first-mentioned of these the claims never reached the producing stage. Apart from the Croesus, the only other claim on the field from which any crushings were taken was the Taffy. In this claim several small veins or leaders were found, one of them said to be 3 ft. wide at the surface, but the area on which the claim was situated was subsequently found to be very badly broken by faulting, and none of the veins could be traced down more than a few feet. The formation from which the gold was won from the claim consisted of a band of country rock carrying numerous minute stringers and veinlets of quartz, which was worked by open-cut method. The company put up a light five-head battery and for a time worked the open-cut on wages,

* Geol. Bull. No. 18, p. 175.

but this plan of operating was not found to pay, and the property was handed over to a tribute party which worked it subsequently for several years. During the time the mine operated 2,751 tons of material were crushed for a yield of 981 oz. 14 dwt. 9 gr. gold, valued at £3,956 1s. 6d., making it evident that, considering the amount of waste rock that had to be taken with the quartz, the stringers themselves must have been fairly rich.

Roaring Meg Creek Reefs.—About 1896 a run of reef-bearing country was located in Dug-out Creek, a headwater tributary of Roaring Meg Creek, and at a spot not far from the headwaters of Blackball Creek, and a claim was taken up, to work which the Garden Gully Gold-mining Company was subsequently formed. Three auriferous reefs having a north-and-south trend outcropped on the claim, parallel to and within 600 ft. of one another. The company did quite a lot of work on these various reefs, and removed the Cræsus battery to the locality to treat the stone, but the results of its operations were unsatisfactory. Large reefs were shown to exist and to live down to some depth, but they were of too low grade to pay for working. On what was termed the main reef an adit was driven at a depth of 240 ft. below the outcrop, which intersected stone at 532 ft. This stone when driven on proved to be from 9 ft. to 11 ft. wide. It is said that gold could be seen in it at times, but on the whole it did not carry payable values. Some small crushings, totalling 14 tons, were put through the battery in 1903–4 for a yield of a trifle over 10 dwt. gold per ton, and in the early part of 1906 a crushing of 33 tons was reported to give 1 oz. per ton; but there is nothing to show where the stone came from, and the fact that the company did so little crushing and abandoned its holding during the last-mentioned year is sufficient indication that the general prospects could not have been encouraging.

Moonlight Creek Reefs.—In upper Moonlight Creek auriferous quartz was found at a very early period in New Zealand mining history, and a battery—probably the first to be provided on a mine in the South Island—was erected there in 1868, the parts having been transported up the bed of the creek with immense labour and cost. Prior to this date rich alluvial had been won from the creek, much of the gold having quartz adhering to it, and in Caples Creek some good shoad stone was picked up. The old company erected its battery in this latter creek, and evidently made an effort to trace the reef from which this shoad was derived, but its search could not have been rewarded, for it soon ceased operations. The field was then neglected for many years. The next mention made of the locality in the mining records is to the effect that in 1877 some prospecting was going on on the Prophet and Deering's Wonder Claims. The former of these covered the area on which the old battery had been erected nearly thirty years previously. On this occasion a discovery was said to have been made on the claim of a formation of slate and quartz, 6 ft. in width, carrying a little gold, and on the other claim, which adjoined it to the south, a reef 2 ft. wide is said to have been found in which gold was showing. Adits were driven on both claims with a view to cutting the deposits at depth, but either no reef was met with or it was too poor to pay for working, for mining effort at both places soon ceased again.

During subsequent years, under the auspices of the Blackball Prospecting Association, assisted by subsidies granted by the Mines Department, much further prospecting was carried out in this vicinity, but although many reefs were found none was of a payable character. In 1925, after prospecting had been abandoned for some years, a party led by J. Rasmussen again made

a search in the locality and, within a stonethrow of the old battery, found a large block of quartz which carried gold. The writer visited this find and took two samples from it, one of which yielded on assay gold at the rate of over 1 oz. per ton, the other being barren. Samples were also taken at the same time from several other reefs outcropping a short distance higher up the range, but none of them when assayed revealed any gold content. Two short adits were driven a little later under the block of stone found by Rasmussen, with the result that it was found to be merely a boulder contained in a large slip that had come down from a higher level.

In view of the specimen gold got in such quantity in Moonlight Creek and its upper tributaries, it would appear that somewhere in the area drained by the creek rich gold-bearing reef must once have existed, and probably still exists and will some day reward the efforts of the prospector; but the country is rugged, heavily timbered, and very difficult to get about in, and few men are now willing to face the extreme hardship the investigation of such places entails.

Poerua Reefs.—The only other area in Grey County calling for particular mention as having revealed auriferous quartz is one lying on the extreme east of the county, in Block I, Otira Survey District, about two miles north of Jackson's Station on the Greymouth-Christchurch Railway. About 1910 the Poerua Gold-mining Company was formed to work some reefs that had been discovered there, near the head of Peter's and Homestead Creeks. Quite a number of outcrops were located, amongst them those known as the South lode, Peter's lode; Blind Gully lode, Homestead lode, and Farmer's lode, and a certain amount of prospecting was done on each of them. The lodes occurred in mica-schist country, and had on the surface a nearly east-and-west strike, with an apparent underlie to the south at an angle of about 30°.

The most extensive exploration was done on Peter's lode, on which two adits, 80 ft. apart measured on the dip of the lode, but only 40 ft. vertically, were driven, the lower of which (No. 2) followed the course of the lode for 700 ft. A winze was also put down from No. 2 adit to a depth of 200 ft. on the dip of the lode, from which, at 90 ft. down, another level was started. The result of all this work was to show that, while small pockets of reef carrying fair values existed, the value of the reef as a whole was extremely low. Acting on ill-considered advice, however, the company erected a ten-stamp battery, equipped with Fraser pans, agitation tanks, cyanide plant, &c., at considerable expense, and crushed 600 tons of lode-material from between No. 1 and No. 2 adits for the poor yield of 23 oz. 11 dwt. 5 gr. gold, valued at £88 1s. 6d. This yield was only equal to a trifle over 9 gr. gold per ton.

P. G. Morgan, Director of Geological Survey, visited the mine in 1912, when the two adits had been driven and the winze from No. 2 adit sunk 110 ft., and his report (*Mines Repts.*, 1912, C.-2, p. 128) was to the effect that up to that time the result of the mining operations was to show the existence of a block or shoot of ore with a possible average width or thickness of 2 ft., 100 ft. to 120 ft. in length at the most, and apparently pitching to the westward on its downward course, the average value of which probably did not exceed £1 per short ton of 2,000 lb.

The winze was, as previously mentioned, subsequently sunk to 200 ft. on the dip of the lode, but in the further sinking no more satisfactory values were revealed, and the information at hand indicates that the mineral-bearing part of the formation had narrowed to a few inches in width.

Mr. Morgan seemed to think, when reporting, that Peter's lode ought to be further prospected by extending the level at 90 ft. down the winze, or continuing the winze to 200 ft. in depth. The writer has not been able to find out whether or not the level referred to was driven any further, but the winze was sunk to the depth mentioned, with results that left no doubt the mine had no prospect of meeting with success.

It is to be regretted that the costly treatment plant was put up, the appearance of the mine at the time by no means warranting its erection; but the provision of it can only, as Mr. Morgan remarks, be looked upon as one more example of the foolishness of imagining that the building of a battery converts a prospect into a dividend-paying mine.

Following the treatment of the 600 tons of ore previously mentioned the company in 1912 approached the Mines Department for a loan of considerable size, to be devoted to sinking to a much greater depth than had been reached; but owing to the poor promise of success in such a venture the application was refused, and the company forthwith ceased operations. No work has since been done on the property.

INANGAHUA COUNTY.

Of all the various divisions of Nelson Province, Inangahua County has been by far the most prolific producer of gold from quartz-mining, the mines of that county having, to the end of 1926, as near as can now be estimated, crushed 3,076,246 tons of quartz, for a yield of 1,619,173 oz. 16 dwt. 5 gr. gold, valued at £6,257,268 15s. 1d., and paid in dividends £1,612,109 8s. 9d.

The genesis and character of the reefs have been fully and ably described by Dr. Henderson (Geol. Bull. No. 18, New Series), to which publication the reader desirous of further information regarding these points is referred. It will suffice to say here that the reefs occur in a strip of greywackes and argillites lying along the edge of the Grey-Inangahua rift-valley. In practically all cases they conform closely to the bedding of the country rock, but there are a few instances where they appear to cross the strata at small angles. In a general way it may be said that they occur along two lines, striking about 20° east of north, and extending for upwards of twenty miles through Waitahu and Reefton Survey Districts. In only a few cases are the reefs continuous for any great distance in the horizontal direction, but occur rather as lenses of limited length at intervals along the main lines of fissure. Some of the lenses have, however, been traced down to considerable depths, as in the Wealth of Nations Mine, where they have been worked down to No. 13 level, 2,270 ft. below the outcrop. If anything approaching what may be termed normal conditions had prevailed—that is, had the veins remained undisturbed to any great extent after their formation—the Inangahua field would have been a most important gold-producer and had a long life before it; but, unfortunately, the whole area covered by it has been subjected to intense faulting, with the result that the ore-shoots have been broken up in a way that has been disastrous to mining effort. Amongst the scores of mines that were opened up, it is safe to say there has scarcely been one that, sooner or later, has not entered into a zone of serious earth-movement. In some cases, after the shoots had been dislocated by these movements, their downward continuations have been picked up again, as in the Wealth of Nations and Big River Mines—in the former it was only after about

sixteen years of groping—but in most instances they were never located. A striking instance is that of the Progress Mines, in which large ore-bodies occurred which produced gold to the value of £1,652,204, and paid over £395,000 in dividends. In this mine the stone that was mined all came from a huge earth-block that had been moved from the position it occupied at the time the lodes were deposited, and all effort failed to trace the lost portion, although an immense sum of money was spent in the search for it. Much the same experience was the fate of such mines as the Caledonian, Golden Fleece, Cumberland, Inkerman West, and Kirwan's Reward. The faulting seems to have been mainly of the normal order, hence the lost parts of the various lodes should have been rediscoverable had the search been carried out vigorously and in the right way, but in some cases the post-mineral movements had undoubtedly entered the original fissures themselves, shattering the reefs up hopelessly to probably great depths, while in others the movements were so complicated that it was extremely difficult to know just what the nature of the disturbance had been. It may be said, however, that the mines were chiefly held by small local companies working on very limited capital, with the inevitable consequence that when trouble of this kind was met with there were no funds available for the prospecting and deadwork necessary to relocate the broken ore-shoots, and little effort was made in this direction. Apart from that, the conduct of mining operations was usually in the hands of men who, while good practical miners, had no special training in geological observation, and were thus ill equipped for the carrying-out of the search to advantage.

In preparing the following descriptions of the various mines of the district, the writer, for the sake of convenience, has dealt with them by lode-series according to the classification made by Dr. Henderson in Geological Bulletin No. 18 (New Series).

AJAX GROUP.—KELLY'S LODGE-SERIES.

This group of auriferous lodes occurred between the Inangahua and Waitahu Rivers, and northward of the headwaters of Murray Creek. The discovery of gold-bearing stone on this series was made in 1870, and was probably the first of its kind to be made in the Reefton locality, the credit of making it being given to a prospector named Patrick Kelly. Another prospector, Frederick Westfield, lodged the first application for a claim on the field, but the honour of being the original discoverer of gold in this neighbourhood is generally accorded to Kelly. The find was made on part of what was later the Golden Treasure Claim.

Within a very short time after the first discovery was made, the claims known as the Perseverance, Band of Hope, Comstock, Westland, Golden Treasure, Victoria, Phoenix, and Inglewood were pegged out along the line.

Perseverance Mine.—The Perseverance lay somewhat to the west of Kelly's line, at its southern end, but the position of the reef in it was probably due to displacement, the locality having been subjected to the action of several powerful faults. An adit was put in, which picked the reef up at 160 ft. in and 100 ft. below the outcrop. The reef was driven on in a northerly direction for about 100 ft., and was up to 8 ft. wide, but the values were evidently low. In 1877 and 1880 two small crushings, totalling 57 tons, appear to have been taken from it, which yielded 19 oz. gold. In the last-mentioned year the claim was abandoned, and lay idle till

about 1910, when the Consolidated Goldfields, Ltd., cleaned up the old adit and extended it about 200 ft. in a southerly direction, proving a run of stone about 3 ft. wide which carried much better values than that in the north end. No. 2 adit, 150 ft. below No. 1, was then started, but had not been carried in to the reef when work was stopped by the outbreak of the World War in 1914, so many men enlisting from the district that only enough were left to man the more important mines. Since then the claim has come into the hands of Robert Bros., who put the adits in repair, but for want of sufficient capital they have not been able to carry out any fresh development work on it.

Band of Hope Mine.—This mine may be said to be the most southerly of those directly on Kelly's line. It was opened up very soon after the first discovery in the locality, for a crushing from it in October, 1872, is amongst the very earliest recorded in the district. The mine has, however, never done any good. The original company ceased to exist in 1877, when the claim became the property of the Golden Treasure Company. Two adits were driven on the claim, 190 ft. apart vertically, the upper being 170 ft. below the collar of the Golden Fleece shaft and 60 ft. below the outcrop of the reef. A winze connected these two levels, from which several intermediates were opened out. About 700 ft. in from the mouth of No. 2 adit another winze was sunk for about 150 ft., and two levels were driven from it, one at 70 ft. below the adit and the other at the bottom. Only very incomplete plans of these workings are available, but the records show that a shoot of ore existed in the mine, about 200 ft. in length with an average width of about 6 ft., and that it was followed down from surface for a distance of approximately 400 ft. Some patches of fair-grade ore appear to have occurred in it, but the quartz on the whole was poor. Small parcels of stone were mined and treated by the original company, but of these no record exists showing quantity or value. It is known, however, that in 1910 a party of tributers took out a crushing of 390 tons which only yielded 25 oz. gold, a return which was far from payable.

Golden Treasure Mine.—The original Golden Treasure Company was formed in 1875 to work an area adjoining the Band of Hope. Until 1886 this company worked steadily, and managed to pay £3,400 in dividends, but the output was comparatively small, the total amount of quartz mined and crushed during the period being 7,671 tons, which yielded 4,820 oz. gold, valued at £18,703 18s. 6d. The principal reason accounting for the small tonnage extracted was the fact that the lode contained a considerable quantity of antimony, and it was found impossible to separate the gold from it, consequently only the cleanest quartz could be taken. In 1886 the original company ceased operations and the ground lay idle till 1889, when it was purchased by a syndicate of which Mr. J. B. Beeche was manager, and a new company known as the Golden Treasure Extended was formed, which for a time carried on very active prospecting both in the old Golden Treasure and in the Band of Hope, in the latter of which the winze from No. 2 adit was sunk.

Apart from the Band of Hope shoot, there were three others found in the claim. The most northerly of these was what was known as the Westland Block, which was worked in a small way in 1875-76, but did not prove payable. It is stated to have been 4 ft. in width, but nothing is known as to its length. South of this was the Golden Treasure North block, 100 ft. in length and from 2 ft. to 5 ft. in width, from which the original company had crushings which yielded 2 oz. gold per ton. Somewhat south again of

this block, and partially overlapping it, was what was termed the Antimony Block, about 180 ft. in length. The mine-workings proper of the Golden Treasure consisted mainly of three levels. Two of these were adits, and the third was driven from the bottom of a vertical shaft 308 ft. in depth, the collar of which was 50 ft. above the upper or main adit. In the latter adit the old Golden Treasure Company worked both the North and Antimony blocks, and these appear also to have been picked up in the lower adit, but in the shaft level neither of them was met with. H. A. Gordon* mentions, however, that no prospecting was done for them on that level, owing to want of funds.

The Golden Treasure Extended Company made a determined effort to bring the mine to a payable position, and actually succeeded in paying £900 in dividends; but the great amount of antimony present in the stone and the difficulty of treating it proved too great a handicap. Various records serve to show that the antimony sulphide contained on an average about $1\frac{1}{2}$ oz. gold to the ton, and gold could be seen in it, and there were evidently parts of the mine where the gold value was much higher. In the Mines Reports for 1896 (p. 116) it is stated that a parcel of 5 tons sent for treatment to Freiberg, in Germany, gave a return of £23 per ton. The company itself made an effort to treat this antimonial ore by crushing and running the pulp over blankets, but only succeeded in recovering about 5 dwt. gold per ton from it. The lodes varied from 2 ft. to 10 ft. in width, and it is mentioned by Inspector of Mines Gow that in places they consisted of a little quartz and a large body of antimony-ore, much of the latter having to be mined to get out the quartz. The antimony-ore, which contained from 30 to 50 per cent. pure antimony, was stowed away in the workings in the hope of some day finding a buyer for it.

The Golden Treasure Extended Company carried on till 1892, when it ceased operations. In the following year the mine was let on tribute, and for several years a little work was done without satisfactory results. In 1898 the Anglo-Continental Gold-mining Syndicate took the property over, and reopened some of the workings, but the results of its operations were not encouraging, for it soon ceased work, and in 1901 the claims passed into the hands of the Consolidated Goldfields, Ltd., which removed the winding-engine to the Energetic Mine. In 1906 the claim was surrendered, but was taken up by the Wellington Mines Syndicate, which did a little further prospecting without success, and eventually, in 1911, the claim passed to the Murray Creek Mines. The latter company did no work on it, and it has practically lain idle ever since.

During the full period that mining was carried on, the total ore crushed amounted, as far as can now be estimated, to 9,423 tons, which yielded 5,696 oz. gold, worth approximately £23,042 18s. 8d., and paid in dividends £4,300.

Westland Mine.—Northward of the principal workings of the Golden Treasure were those of the Westland Claim, from which one of the earliest parcels of ore crushed in the district was taken. The old Westland Company erected a small battery in Murray Creek in the early part of 1872, and in July of the same year crushed its first quartz, 80 tons, which yielded 60 oz. gold. In 1875 the claim became part of the Golden Treasure holding, and the shoot of stone in it was again worked for a short time, but the results were not payable.

* Mines Repts., 1896, C.-3, p. 116.

Victoria Mine.—The claim of the old Victoria Gold-mining Company was next in succession to the northward from the Westland. It was on this claim that Fred Westfield is said to have found auriferous quartz at about the same time as Kelly found it on the Golden Treasure. From the time of its discovery the shoot of stone was energetically worked. The original company drove three adit levels on it, which proved the shoot to be about 200 ft. long and up to 6 ft. in width. The first crushing from it was, like all the others from the locality, put through the Westland Company's battery. This was in 1872; and mining and crushing were carried on regularly till 1879, during which period 2,027 tons were treated for a return of 1,279 oz. gold, an average of 12·6 dwt. per ton. A further 342 oz. gold were recovered in 1880, but, as the tonnage crushed for that year is not definitely known, this has not been taken into consideration in arriving at the average values. The stone above No. 3 adit having been by this time exhausted, the mine was practically abandoned, and little was done on it till 1894, when Messrs. Knight and party, who held the claim on tribute from that year till 1896, reopened the old levels, and also drove an adit at a higher level than the Victoria No. 1, in which they located a block of stone. This party, during the time it worked the ground, mined 925 tons of quartz, which was crushed for a yield of 473 oz. gold, an average of 10·22 dwt. per ton. From the termination of this tribute the claim lay idle again till 1903, when Mr. P. N. Kingswell, who had acquired it a year or so previously, extended the No. 4 Inglewood adit (originally driven by the Phoenix Gold-mining Company) into the Victoria ground. This adit was only 40 ft. below the old No. 3 Victoria adit, but it enabled a further quantity of stone to be mined from the Victoria shoot between 1903 and 1907. What the exact amount of this stone was is, however, not now ascertainable, the figures being lumped in the returns with those dealing with the Phoenix and Inglewood shoots, which were both operated on by Mr. Kingswell during those years, but the developments are said not to have been satisfactory. In 1908 the claim, together with that held by the other companies mentioned, came into the hands of a Reef-ton syndicate, which disposed of it to the Wellington Mines Syndicate, which merged in the following year into the New Murray Creek Gold-mining Company. This latter company thereafter pursued a vigorous policy of development, pushing the No. 5 Inglewood adit (otherwise known as the Battery level), the first portion of which was driven conjointly by the Inglewood and Phoenix Companies, into the Victoria shoot, and sinking a three-compartment main working-shaft. This shaft, which was sunk to a depth of 540 ft., had its collar on the same level as the portal of No. 4 Inglewood adit. At the depth of 220 ft. it was connected with the battery level, and two further levels, Nos. 6 and 7, were opened from it at 400 ft. and 540 ft. respectively from the shaft-collar. Between Nos. 4 and 5 levels the shoot was broken up by faulting, but on Nos. 6 and 7 levels being extended to the Victoria ground the shoot was picked up in both of them and was found to be about 200 ft. longer than it appeared to be in the surface adits. On these lower levels it was about 400 ft. in length. The company started crushing operations in 1914, and continued them till about the end of 1919, during which time 30,631 tons of quartz were treated for a yield of 19,072 oz. 8 dwt. gold, an average of 12·45 dwt. per ton. The value of the gold was £75,850 16s. 4d. As neither the Inglewood nor Phoenix shoots had been picked up on Nos. 6 or 7 levels, the whole of this quartz came from the Victoria shoot, and the bulk of it from

between the two levels mentioned. Notwithstanding the large amount of gold won by the company it was unable to carry on—the expense of working more than swallowing up the whole revenue; and in 1920 an

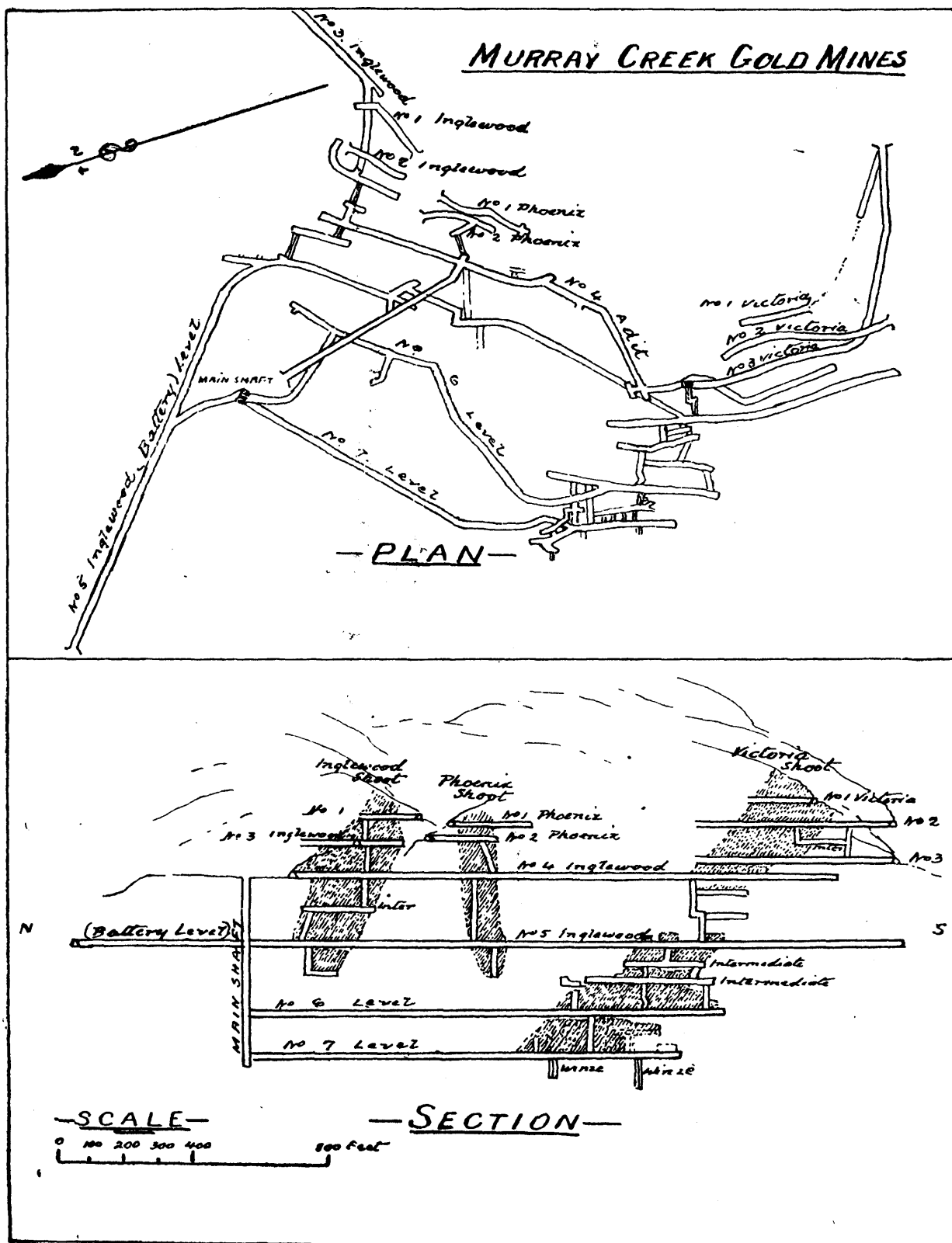


FIG. 6.—PLAN AND SECTION OF MURRAY CREEK MINES, REEFTON.

application was made for a Government loan of £10,000 to enable operations to be continued, the chief feature of the proposal being that the money would be mainly spent in putting out a tunnel from the shaft at No. 7 level to daylight on the fall of the range to the Waitahu River, and

removing the battery to a new site there where water-power could be used for driving the mill in place of steam-power. In view, however, of the costliness of the proposed adit, which would have had to be about 3,300 ft. in length, and of the further cost of sinking the shaft and developing the shoot on lower levels, combined with the fact that under No. 7 level two winzes had shown the shoot to be again broken up by faulting, the application was not entertained. The company then went into liquidation and the mine and plant were disposed of to a small syndicate, which in turn sold it to a new company, which, the writer understands, intends making an effort to succeed where its predecessors failed. During the time the property was held by the syndicate referred to, a tribute party of four men, led by G. Kremmer, opened out on some stone left by the former company under No. 4 adit, and crushed 161 tons for 111 oz. 6 dwt. 4 gr. gold, valued at £425 2s. 8d. Including this crushing, the quartz which it is definitely known came from the Victoria shoot since the start of operations amounted to 33,744 tons, which yielded 20,935 oz. 14 dwt. 4 gr. gold, valued at £83,284, but the only dividend paid was the small distribution of £600 in 1880.

Phoenix Mine.—The old Phoenix Claim was next to the Victoria in a northerly direction, and gold-bearing reef was found in it very shortly after the discovery of reef in the latter. The first stone from it was crushed at the Westland Company's battery in 1874, and during that and the following year some good returns were got. The block of ore in the claim was only about 120 ft. in length, with an average width of 3 ft. In exploiting it four adits were driven, the lowest known as the Inglewood No. 4, being driven conjointly by the Phoenix and Inglewood Companies. The last-mentioned level was about 400 ft. below the reef outcrop, and the company mined all the stone down to it. No detailed account of the crushings is available, but it is known that up till March, 1886, the company sent to the battery 2,190 tons of quartz, which yielded 2,918 oz. gold, valued at £11,272 11s. 10d., out of which £4,533 6s. was paid in dividends. This would serve to show that the stone averaged over 26 dwt. gold per ton. Very little, if any, quartz appears to have been mined from the claim for some years after 1886, but in 1887 the company joined with the Inglewood Company in driving No. 5 adit, which in the following year had reached the Inglewood shoot. The adit was not, however, carried far enough to reach the Phoenix shoot, and in 1889 the Phoenix Company merged with the other, thereby losing its identity. The Inglewood Company continued to stope the quartz from its own shoot, but for some inexplicable reason seems to have made no effort to locate the Phoenix shoot on that level, and when it had exhausted the stone from the Inglewood shoot did little work. In 1901 Mr. P. N. Kingswell purchased the Victoria, Phoenix, and Inglewood Claims, and extended No. 5 adit to the Phoenix shoot, which he subsequently stoped up to No. 4 adit. He also sank a winze on the shoot for about 80 ft. below No. 5 adit, at which depth stone pinched out. The quartz showing the winze was then taken out up to No. 5 level. What tonnage was won from the shoot on this occasion there is now no means of telling definitely. During the six or seven years that he held the properties the records show that Mr. Kingswell mined and crushed 6,184 tons for a yield of 4,815 oz. gold, but it is known that some small portion of this tonnage came from the Victoria shoot on Nos. 2 and 4 adits; the figures relating to output from the different parts of the property having been lumped together, the respective quotas cannot now be determined. It is certain, however, that as far down as the Phoenix shoot was mined

it carried very good values. In common with the other two shoots referred to, the Phoenix in 1908 became the property of the local syndicate, from whom it passed first to the Wellington Mines and then to the Murray Creek Gold-mines. The latter company, when driving No. 6 level from its shaft, carried the working well out towards the lode-line in the endeavour to pick up the Phoenix shoot, but failed to find reef. A track that was supposed to represent the downward continuation of the shoot was met with and driven on for a considerable distance, but no solid stone was found along it. When No. 7 level was opened up it was extended in the most direct line towards the Victoria shoot, no attempt being made to locate either the Inglewood or Phoenix shoots by means of it. Evidently the former was looked upon as too poor to be worth the expense the deviation of the drive would entail, and the experience on No. 6 must have led the management to the conclusion that the other shoot had disappeared for good.

Inglewood Mine.—The Inglewood shoot, the most northerly on Kelly's lode series, was, like the Victoria, discovered in 1870, and the Inglewood Gold-mining Company was formed to work it. The first stone was crushed from it in 1872. The original company drove two adits on it, which proved the shoot to be about 200 ft. in length, with an average width of from 3 ft. to 4 ft., and the available records serve to show that it mined and treated 1,005 tons of quartz for a yield of 561 oz. gold, equal to 11·15 dwt. per ton. In 1879 the company absorbed the North Star Claim, which adjoined it to the north-east, and became the Inglewood and North Star Company. This company put in a third adit, known as the No. 3 Inglewood and North Star adit, and carried on operations till 1885, during which time, with the help of the Phoenix Company, it drove No. 4 Inglewood adit. Within this period 1,591 tons of stone were crushed for a return of 821 oz. gold, an average of 10·3 dwt. per ton. In the last year mentioned another reconstruction evidently took place, and the company became known as the Inglewood Extended, which name it retained till the conclusion of its operations about 1896. In 1887–88 this company, with the help again of the Phoenix Company, drove the No. 5 (battery level) in to its shoot of stone, and in the following year absorbed the latter company. What amount of quartz the company mined during these years cannot now be definitely ascertained, but a statistical record of all quartz crushed and gold won from Reefton mines, published by the Inangahua County Council, shows that up to March, 1887, the Inglewood Extended Company crushed 4,233 tons for a yield of 2,886 oz. gold, valued at £16,058, and paid in dividends £1,500. During the years 1888–96, in which latter year the company practically ceased operations, a further 5,120 tons were crushed for a yield of 2,867 oz. gold, and, as there is no reason to believe that the Phoenix shoot was operated on during the period, this output may also be credited to the Inglewood shoot. This would mean that during the working-life of the mine 11,949 tons of quartz were crushed from this shoot for a return of 7,135 oz. gold, an average of 11·86 dwt. per ton, and dividends to the amount of £2,700 were paid.

The shoot was worked down to a total depth of about 500 ft. below the outcrop. It was picked up in No. 5 adit, where it was much the same length as in the upper levels, but evidently in this lower part of the mine the values were such as to leave but the barest margin of profit. Referring to the stoping above No. 5 adit, Warden Bird* mentions that the work was being done on day labour, but, owing to the expense incurred, did not pay; but when

* Mines Reps., 1889, C.-2, p. 115.

the company let a contract for mining and raising the stone a small profit was shown. The tributers were paid £1 per cubic yard for stone delivered to the paddock, finding all tools, explosives, &c., themselves.

The stone was going underfoot on No. 5 adit, but the company did not consider it worth while to follow it down. A party of tributers was allowed to do so. This party sank a winze about 50 ft., where the stone became very broken and eventually pinched out. A short level was then projected from the foot of the winze, and the stone was stoped out up to the adit. The last crushing from the mine, 250 tons, which yielded 70 oz. gold, evidently came from this part, and if that is so the values were unpayable.

It may be mentioned that in the Inglewood Claim a second vein of about the same length and width occurred parallel to the Inglewood Block and about 6 ft. to 8 ft. in the hanging-wall from it, and contained within a diabase dyke that forms the hanging-wall of the Phoenix and Inglewood shoots. This parallel shoot was traced down to No. 5 adit, but probably cut out below that level in the same way as the other shoot. As far as the writer can learn, both shoots carried similar values.

From a geological viewpoint Dr. Henderson considered (Bull. No. 18, p. 146) it probable that the Phoenix, Inglewood, and North Star shoots originally formed part of the Victoria shoot, and represented fragments displaced from the latter by faulting, an occurrence that could be explained by an east-north-east-striking normal fault, with an angle of dip less than that of the pitch of the shoot cutting off its upper part. There can be no doubt that the three first-mentioned shoots have been faulted, and it is quite likely that the movement was of the nature indicated by Dr. Henderson. It is also highly probable that the vertical pitch of the Phoenix and Inglewood shoots is to be accounted for by twisting or warping of the country due to this faulting.

North Star Mine.—Little is known of this mine beyond the fact that for a short time in the "seventies" a shoot of stone was worked in it on the same line as, and north of, the Inglewood shoot. This was the most northerly stone found on Kelly's line; but what the length of the shoot was or how far it was followed down are not recorded. It is known, however, that the stone cut out when sunk on, and the depth at which it disappeared must have been very shallow. A small crushing of 215 tons was put through in 1875 for 114 oz. gold, and in 1877 there was a crushing of 100 tons for 76 oz., showing that the stone was not of high grade. In 1879 the company was absorbed by the Inglewood Company, and, except that the No. 4 Inglewood adit was driven through the North Star ground, no further work was ever done on the claim.

Summarizing regarding the various ore-shoots along Kelly's lode-series, it may be said that the Band of Hope end offers no promise of yielding any satisfactory results to future investigation. There is a strong shoot of stone in the claim of that name, but it has been followed down for 400 ft. below the outcrop without any payable values being revealed. The advance of modern metallurgical knowledge may make it possible for the antimonial ores of the Golden Treasure section to be treated now profitably, but, unfortunately, the data regarding the quantities of this ore available is painfully meagre. It seems evident that there is in the claim a fairly large amount of this ore carrying gold values, but any attempt to estimate the quantity would be merely guessing. It is known that on No. 3 level of the mine the lode was not picked up, but H. A. Gordon's remark, previously quoted, that no prospecting was done to find it, owing to lack

of funds, seems to be borne out by such plans as are in existence. In all possibility further work on this level would have shown the antimony lode to live down to it. In view, however, of the uncertainty of the position it cannot well be said that an attempt to reopen the mine in order to better determine its possibilities would be justifiable.

In the Murray Creek Mines area, comprising the Victoria, Phoenix, and Inglewood shoots, it is known that on the first-mentioned shoot gold-bearing ore is going underfoot on the bottom level of the mine, which fact, combined with slight possibilities of getting quartz in other parts of the property, is an ever-present temptation to mining-men to try their luck again, in an effort to work it profitably. Despite the fact that a previous company took over £70,000 worth of gold out of the mine, and put besides a good deal of fresh capital into working it, only to find itself unable to meet expenses and compelled to end up in liquidation, a new company has, the writer understands, been floated to give the property another trial. The promise of success for the new venture cannot be said to be bright. There is a certain amount of stone left above the fault between Nos. 4 and 5 levels, on which prospecting is now in progress, but this stone is small, irregular, and in very limited quantity. The previous company knew of its existence, but went to little trouble to mine it. A connection was made on the shoot between Nos. 4 and 5 levels, and a small portion of the stone was stoped out, but the results could not have been satisfactory, for the company soon ceased work there, and nothing more was done in that part of the mine till Kremmer's tribute party in 1925 drove an intermediate south on the shoot, 50 ft. below No. 4 adit. From this working and the leading stope over it the party took out 161 tons of stone, which yielded 111 oz. 6 dwt. 4 gr. gold. The run of solid stone was only about 60 ft. in length. The present company has advanced another intermediate in the same direction at 120 ft. below No. 4 adit. For the first 60 ft. to 70 ft. there was no stone underfoot, but a little was showing in the back, and it was plain that faulting had taken place.

As to the stone going underfoot on No. 7 level, there is no sufficient reason for thinking otherwise than that this will live down to another level, and possibly much deeper; but the two winzes sunk to 49 ft. and 97 ft. respectively from the level show that it will be much broken, a series of step-faults that came in just above the level evidently continuing down as far as the winzes went. The gold contents in the shoot may also be of much the same tenor as those recovered from above No. 7 level during the past two years or more that the reef was worked—namely, from 9 dwt. to 10 dwt. per ton. The point is, however, as to whether, in view of the fact that the Murray Creek Mines could not mine and treat the stone from above No. 7 level at a profit, it is possible to deal any more successfully with quartz from below that level. In the writer's opinion the chance of doing so is remote.

AJAX GROUP.—WALSHE'S LODGE-SERIES.

This line, which outcrops about 20 chains westerly of Kelly's line, has the same general strike. Along it were discovered the various shoots known as the Ajax, Golden Fleece, Royal, and Venus. The latter shoot is somewhat to the westward of the others, but was considered by Dr. Henderson to be genetically related to them. The lode-series is otherwise known as Shiel's line, after Richard Shiel, one of the discoverers, but Dr. Henderson

has named it after George Walshe, who was Shiel's mate, and is credited with being the actual discoverer of the Ajax shoot, the first to be located.

Ajax Mine.—The finding of the outcrop of the Ajax shoot was made in November, 1870, at an elevation of something over 2,000 ft. above sea-level, in very rugged country which, in those days when Inangahua County was practically roadless, presented tremendous difficulties to the miners in bringing in equipment. A steam-driven fifteen-stamp battery was placed on the claim in the following year. It is said that the boiler and other heavy parts had all to be brought in barges up the Buller and Inangahua Rivers to the Landing, whence they were drawn by horses up the bed of the latter river to Black's Point. From there they were taken up the steep hillside to the mine by means of blocks and tackle; and none save those who are familiar with the locality can realize what immense toil, hardship, and expense all this entailed. The company started crushing in 1872, in which year 2,603 tons of quartz were treated for 3,444 oz. gold, equal to nearly 26½ dwt. per ton. The claim was vigorously prospected by means of adits, and by sinking a vertical shaft from which several levels were projected, but the best of the stone was soon found to make, on its pitch, into the adjoining Golden Fleece Company's ground, and this led, in 1876, to the two companies merging under the title of the Golden Fleece Extended. Prior to this amalgamation the Ajax Company had treated 6,890 tons of quartz from its mine for a yield of 6,441 oz. gold, valued at £24,958 17s. 6d., out of which it paid for all its plant and distributed £2,504 in dividends. It is said of the company that it was the only one in the Reefton district that made no call whatever on its shareholders, the money for the early working of the mine and for its equipment having been borrowed, and paid back out of profits.

Golden Fleece Mine.—The Golden Fleece shoot was found by Patrick Hunt very shortly after the discovery of the Ajax shoot. Up to the time of the amalgamation with the Ajax Company in 1876, the company that had been formed to work it did not do much good, although it raised a fair tonnage of quartz, but after the merger the Golden Fleece Extended Company operated with great success for a number of years. Between 1876 and 1884 it crushed 24,877 tons of stone for a yield of 31,371 oz. gold, valued at £121,542 12s. 9d., out of which £55,000 was paid in dividends. In the latter year a re-formation of the company seems to have taken place, the name being altered to the Golden Fleece United; but after this the company did no good. By this time the Ajax shaft, from which all work was carried on, had been sunk to a depth of 742 ft., and six levels were opened from it. Of the two shoots of stone then known to occur in the joint claims, the southern, or Ajax, shoot was mined down to the bottom level, but the northern or Golden Fleece shoot, which was the richer and larger, cut out between Nos. 4 and 5 levels, and was not subsequently found. For four years following 1886 the mine was practically abandoned. In that year, or early in 1887, a large slip came down which did great damage to the winding plant, nearly all the working-parts of the machinery being broken. By the end of the latter year the plant had been largely renewed or repaired, but evidently no resumption of underground operations took place till about 1891, when a few men were put on to pick up the old No. 5 level. In 1892 some parties of tributers retimbered No. 1 level, and generally reconditioned the shaft, and stoped out some quartz left by the old company in the upper levels. By this time the Golden Fleece United Company had evidently ceased to exist, the claims having passed into the

hands of Mr. F. Hamilton. For some years following a party of tributers who had taken the whole mine over worked certain parts of it, but mainly directed their attention to the working-out of a large block of the Ajax shoot the company had left as unpayable over No. 5 level. This block the party stoped up for 120 ft. above the level. It was only about 18 in. wide, and averaged from 6 dwt. to 8 dwt. gold per ton; but the men were satisfied with the return, although they paid a 10-per-cent. royalty on the gross yield in addition to the working-expenses of crushing and 6d. per ton for the use of the battery. During the time the tributers worked the mine they appear to have crushed 1,426 tons of quartz, for a return of 1,271 oz. gold.

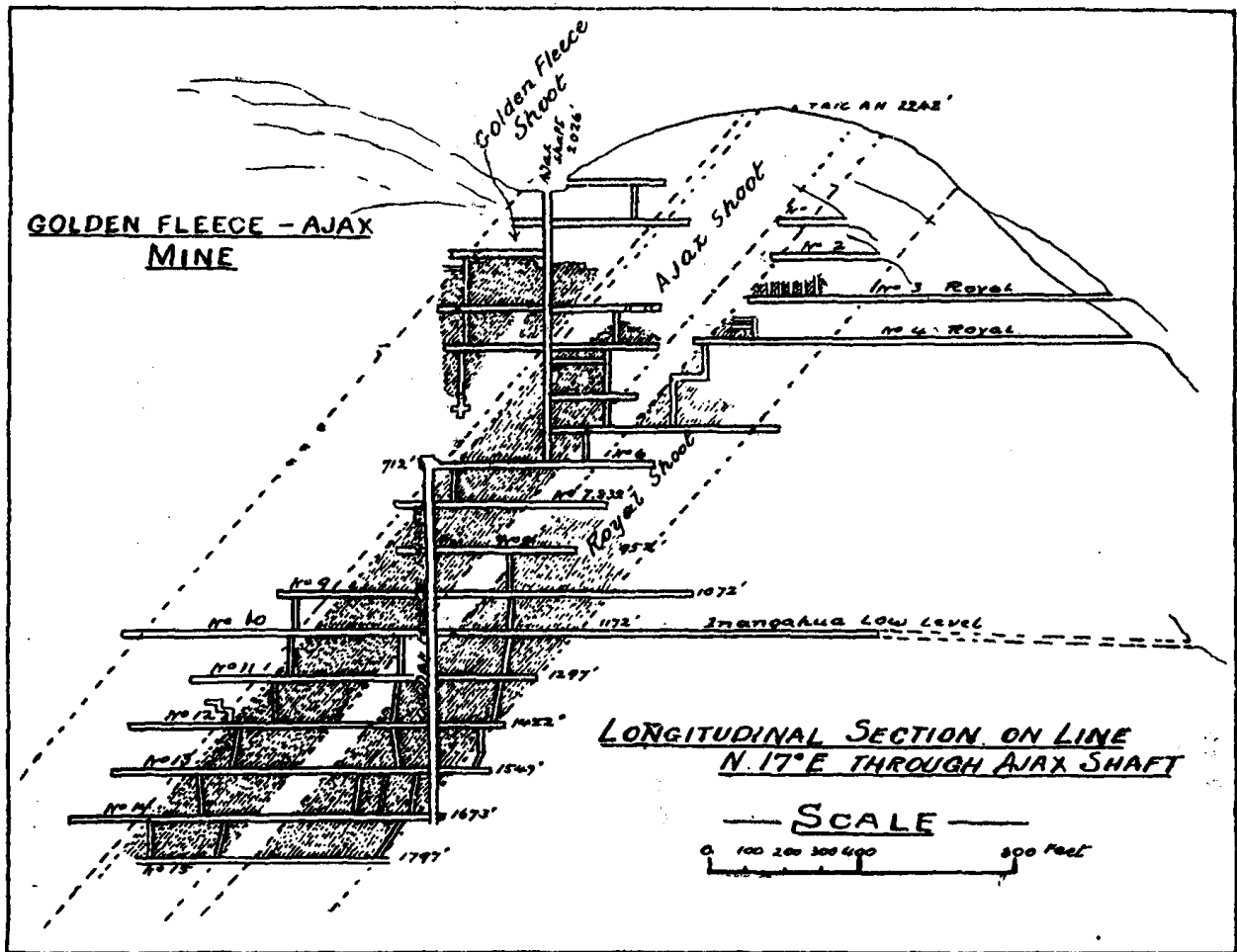


FIG. 7.—PLAN AND SECTION OF GOLDEN FLEECE MINE, REEFTON.

In 1895 the property was purchased by the Consolidated Goldfields of New Zealand, together with the Royal Mint, Venus, and Royal claims. At the same time this company also took over the ownership of the Inangahua Low-level Tunnel, which had originally been started with a view to cutting the whole of the country in which Anderson's, Walshe's, and Kelly's lode-series occurred. The new owners began vigorously to prospect and exploit the claims from a number of points. Connection was made by rises and winzes between No. 4 level of the Royal and No. 6 level of the Golden Fleece, and the stoping of such stone as was left in the Royal shoot was pushed on with. Simultaneously a winze was started from No. 6 level on the Royal shoot, which was subsequently connected with No. 9 level. The driving of the Low-level Tunnel towards the Golden Fleece ground was also resumed, and this long adit, which later became No. 10 level of the

mine, was extended to a point directly under the old No. 6 level, and a vertical shaft was raised through from one level to the other, a distance of 460 ft. This shaft was completed in 1900. During the progress of raising it, chambers were cut for Nos. 7, 8, and 9 levels, and drives were rapidly put out from these, stoping being started in this lower part of the mines in November of the same year. In the following year, 1901, the shaft was sunk from No. 10 to No. 11 level, and each succeeding year a further level was opened till No. 14 was reached. In all these levels the Ajax and Royal shoots were worked, but as the stone was not wide it was soon beaten out from level to level. No. 14 level, 1,673 ft. below the collar of the Ajax shaft, did not open out at all well, comparatively little stone being met with; but it was driven to the northern end of the Ajax shoot, from which point an incline shaft was sunk, and No. 15 level, the lowest in the mine, opened from it. This level did not show much more quartz than No. 14; and in August, 1907, the company decided to let the whole mine on tribute to a party consisting of Nicholas Lawn, John Oats, and others. This party then worked the mine till 1910, stoping out both shoots of stone from Nos. 14 and 15 levels, and mining a small tonnage from other parts of the workings. In all they crushed 7,856 tons for a yield of 6,543 oz. 6 dwt. gold. For the entire period during which the Consolidated Goldfields Company operated the mine it crushed approximately 92,287 tons of quartz for a return of 46,425 oz. 6 dwt. gold, valued at £183,079 17s. 7d.; but the amount paid in dividends is not available. At the same time the company operated the mine it also worked the Energetic - Wealth of Nations Mine, and during the period paid £178,214 14s. 6d. in dividends. A goodly part of this may have come from the Golden Fleece property, but what the proportion was there is now no means of telling.

For the whole period the group of mines comprising the Ajax, Royal, and Golden Fleece were worked the stone crushed amounted, as closely as can now be determined, to 134,477 tons, which yielded 89,639 oz. 15 dwt. 19 gr. gold, valued at £369,215 1s. 6d., out of which, apart from any dividends that the Consolidated Company may have paid, the sum of £57,785 15s. 5d. was distributed to shareholders. Of this amount the Ajax Company paid £2,504, the Royal £231 15s. 5d., and the Golden Fleece Extended Company £55,000.

Gold-bearing quartz was still going underfoot on No. 15 level when work ceased, but the cost of sinking the shaft further in order to work it was considered too great to permit of following it down.

Royal Mine.—This mine adjoined the Ajax on the south. A very large amount of work was done on it, including the driving of four adits; but the results were unsatisfactory. The shoot was located on each of the levels, but it was broken, narrow, and poor. All the stone in sight above the No. 4 adit was stoped out prior to 1895, either by the company or tributers, and the Consolidated Goldfields Company subsequently removed what little there was in the Royal ground from that level down. Very little definite information is available as to crushings or yields, and the figures relating to them cannot be segregated from those dealing with the Golden Fleece. It may be mentioned that the Royal Claim was first held by a company known as the Victory, formed in 1878, to which the Result and Royal Companies succeeded.

Venus Mine.—As previously stated, the shoot of ore in this mine lay somewhat to the west of those in the other claims referred to on Walshe's line, but a study of the position convinced Dr. Henderson that it was

related to them. Auriferous stone seems to have been first found in it as early as 1875, and a small crushing of 12 tons was evidently taken out shortly after that date, which yielded 10 oz. gold. The ground was only worked intermittently, however, for a good many years, such bodies of stone as were found being of no great extent. In 1885 a new company, the Venus Extended, was formed to work the claim, and met with a fair measure of success. The old company had driven an adit, No. 1, into the hill for 800 ft. without finding any reef of value. This adit the new company extended for 22 ft., when a shoot of stone 20 in. wide was struck, showing gold freely. This shoot was subsequently stoped from No. 1 adit to the surface, and was traced down to Nos. 2 and 3 adits, the values being maintained throughout; but whereas it was about 350 ft. in length on the two upper adits, it shortened considerably on No. 3. Below No. 3 adit a winze was sunk for 115 ft. It was expected that the shoot would be struck in this at 25 ft. down, but the winze was carried down to 70 ft. without meeting stone. A crosscut was then run out to the east, which met the stone at 28 ft. A winze was then sunk on the stone for 40 ft., after which the first winze was continued to 115 ft., and connection made between the two workings. Below this point the shoot was not seen again. Another adit was started, to come in below the winzes, but no stone was got in it. It seems certain that this shoot was cut off by faulting; but even if it had lived down to No. 4 adit it is somewhat doubtful if the latter was carried in far enough to reach it. About the time the last of the stone in the shoot was being exhausted, another block, about 100 ft. long, was located in No. 1 adit. This was traced down to No. 2 adit, where it was apparently about 150 ft. south and somewhat to the west of the older workings. In the absence of plans it is difficult to tell precisely, but the reports of the Inspectors of Mines seem to indicate that this stone was also got on No. 3 level, but it was evidently irregular and of low grade. About the end of 1894 or early in 1895 the mine ceased operations, and in 1896 it passed into the hands of the Consolidated Goldfields Company, since which time nothing has been done by way of further prospecting it.

During the time the mine worked, 10,871 tons of quartz were crushed, for a yield of 7,043 oz. gold, valued at £27,404 16s. 2d., and dividends amounting to £3,300 were paid.

Dealing generally with this lode series, it may be said that some of the old-time miners who still remain in the district have a firm belief that the stone worked in the Venus Mine would have been found to live at a greater depth than it was traced, but Dr. Henderson's opinion is that the stone probably formed the original cap of the Royal shoot, from which it was carried by faulting to the position in which it was found. This theory may be, and in all likelihood, is correct, but its reliability as accounting for the disappearance of the shoot in the lower levels can be only definitely proved by further prospecting. This much is known, that when the Inangahua Low-level Tunnel was being driven it entered badly crushed country some 10 chains before the lode country of the Venus was to be expected, and continued for 20 chains through similar material, thus showing that a powerful fault-movement had occurred there, and, as the Geologist says, it will well be that this crushed country represents the fracture-filling of the fault that displaced the Venus lode. Dr. Henderson further points out that the chaotic occurrence of the outcrops in this portion of the Murray Creek area may also be taken as evidence of faulting, the exact nature of which cannot

be defined. Be this as it may, it can be said that there was little in the history of the mine to lead to the belief that the property is one in any case for the further prospecting of which any considerable expense would be justified. It would have been a good thing if, when the Low-level Tunnel was open, some lateral prospecting had been done from it to determine the point. An amalgamation of the Venus and Low-level Companies had been arranged with this end in view, but when the privileges held by them passed to the Consolidated Goldfields that company was intent only on pushing the tunnel in to the Golden Fleece shoot, and did not trouble about any other work, and it is questionable if the great cost of reopening the tunnel now for the purpose would be warranted.

As far as the Royal section of the line is concerned there is no reason whatever for thinking that any further development on it would yield any better results than were obtained, and the Ajax shoot was worked out down to 1,800 ft. The chance of locating the lost portion of the Golden Fleece shoot may perhaps justify some prospecting effort. Considering that the two adjoining shoots, the Ajax and Royal, lived down to 1,800 ft., and were still going underfoot, there seems no good reason for thinking otherwise than that the Golden Fleece shoot would also live down in a similar manner, and, as the shoot was longer and richer than the others, some far better effort to locate it was justified than was apparently made in the past. It is on record that the Golden Fleece Extended Company brought a diamond drill from Australia for the purpose of using it in the search for the downward continuation of the shoot, but there is no record available as to what work was done with it in this direction. Local tradition has it that the crown of the drill was lost in the first hole and could not be recovered, and the assumption is that no further use was made of the plant. Any drill-hole that was put in would be between the surface at the Ajax shaft and No. 6 level, and was in all likelihood started from No. 4 or No. 5 level. In any case, such literature as there is dealing with the history of the mine at the time leads the writer to the conclusion that the hole was directed westerly from the old workings, in which case it may well have been advanced to any distance without finding the reef sought for. Referring to the cutting-off of the shoot, H. A. Gordon, Inspecting Engineer of Mines, mentions that "at the north side of the shaft a dislocation took place which caused a considerable throw in the lode, and it has not been picked up again on the north side of the dislocation or fault. Very good stone was got up to the fault, and there are indications that this lode will be again found to the northward of the fault and to the westward of the ground worked." In view of this statement, the theory that the lost part of the shoot lay to the westward was probably the generally accepted explanation of the position at the time, consequently any work that was done by the way of searching for the lost reef would have been carried out in that direction. In a study of the mine made at a later date, however, Dr. Henderson came to the conclusion that the greater probability was that the lost portion of the shoot might be expected to lie to the eastward of the old workings. He points out that in the upper levels more than 1,000 ft. of lode-channel was ore-bearing, but the length below No. 6 level was reduced to about 700 ft., from which fact it was probable that three rather ill-defined ore-shoots were worked in the upper levels, the most northern of which was cut off by a fault of which the angle of dip was slightly steeper than the pitch of the shoots. A fault of this nature would have a northerly dip and an east-north-east strike, and the fact that each of the three bottom levels in the mine turned eastward following a pronounced fissure leaves little doubt

as to the correctness of Dr. Henderson's theory. If any of these bottom levels, Nos. 12, 13, or 14, had been continued on in the easterly direction the probability is that the lost part of the shoot would have been rediscovered. Should any attempt be made now to locate the shoot it cannot be made from the lower part of the mine, but must be made from the upper part. The vertical height of the downthrow of the worked portion of the shoot cannot now be estimated, but it was probably no great distance, therefore any such attempt would perhaps be more wisely undertaken from the horizon of No. 4 or No. 5 level than from any other part of the old workings.

AJAX GROUP.—ANDERSON'S LODGE-SERIES.

This series lies about 45 chains westerly of Walshe's line. Auriferous stone was first found in it by James Anderson in November, 1870, and two companies, the Anderson's Creek and the Invincible, took up claims on it, and worked, for a time anyhow, independently of one another. The former company erected a fifteen-stamp battery at Black's Point, and commenced crushing in December, 1872, while the Invincible started to crush in the following January. No full plans of the old workings are to be found, but it is evident that both companies worked parts of the one ore-shoot, which was developed by means of three adit levels. The shoot was about 300 ft. in length, with an average width of 3 ft., but, as far as can be learned, it was rather badly broken. No definite information is available as to the depth to which it was traced down from the outcrop, but it could not have been far, for by 1875 all the stone in sight had been worked out, and after some unsuccessful prospecting to find its downward continuation the companies collapsed in 1876. The stone is said to have cut out in the bottom workings against a slickensided wall, beyond which it could not be found. In 1878 the mines were reopened and desultory prospecting was carried on till about 1884, but no success was met with. During the times the mines worked, the Anderson's Creek Company crushed 6,791 tons of quartz for 5,363 oz. gold, valued at £20,781 12s. 6d., and paid £475 in dividends; while the Invincible crushed 564 tons for 675 oz., valued at £2,525, and paid £1,050 in dividends.

The shoot dipped to the eastward—that is, in the opposite direction to most others in the Murray Creek area—and at the bottom is said to have turned upward. There can be no question but that it had been displaced from its original position by faulting, and as the powerful Black's Point fault is only a short distance away Dr. Henderson was of opinion that this dislocation had probably been caused by one of its subsidiary fault movements. In the present writer's belief the available evidence seems to indicate the probability that the shoot as originally situated conformed to the general westerly dip of the other shoots of the locality, the easterly dip revealed in the old workings being accounted for by distortion of the earth-block containing the stone that was worked, due to the faulting. In this case the fault would have been normal, a theory that seems to be confirmed by the upward turning of the shoot where it cut out, and the downward continuation of the stone should therefore have been discoverable to the eastward of the old workings. In later years several attempts were made without success to pick it up at greater depth. The Consolidated Goldfields Company, for instance, in 1898 or 1899 put out a crosscut from the Inangahua low-level adit for about 1,300 ft. to come under the Anderson's Creek workings, without locating

any sign of lode. It may be, of course, that the shoot does not live down below the point to which it was followed, but if it be taken that the theory of normal faulting as applied to it is to be relied on it is questionable if the crosscut mentioned was carried quite far enough to meet the shoot. At the best, according to such plans as are available, the working only seems to have penetrated to a point about $1\frac{1}{2}$ chains eastward of No. 3 adit, which was scarcely sufficient to prove definitely the non-existence of the shoot on that horizon. Still later, about 1912, the Willis brothers started an adit at an even lower level than the Low-level Tunnel with a view to making a further search for this shoot. This work was subsequently taken over by the Consolidated Goldfields, and the adit was driven a distance considered sufficient to pick up the shoot if it had lived down. Several tracks containing broken quartz were met with and driven on for short distances, but nothing of value was located. If the pitch of the shoot had been to the south, which is improbable, the general pitch of all others in the area being northerly, it is possible that this adit was driven far enough to meet it, but if the pitch was to the north the distance driven was not sufficient to effect its purpose. Again, if the worked part of the shoot was normally faulted, the same doubt suggests itself as in the case of the crosscut from the low level, as to whether the working was sufficiently to the eastward to find the downward continuation of the stone.

CRUSHINGTON GROUP.—SMITH'S LODE-SERIES.

This important series has been named after the prospector who first found gold-bearing quartz on what was subsequently the Wealth of Nations Claim, in 1870. Within a very short time after the discovery a number of claims were pegged out along the line, amongst which were the South Wealth of Nations, the Pandora, No. 2 South Keep-it-Dark, Nil Desperandum, Golden Ledge, Vulcan, Independent, Wealth of Nations, Energetic, Dauntless, and Macedonian.

South Wealth of Nations Mine.—This was the most southerly claim on the line. A company was formed to work it in 1886, and joined with the Pandora and No. 2 South Keep-it-Dark companies to sink a shaft to 280 ft. on the joint boundary of the claims held by the two latter, but no stone was ever found in the claim, and the company ceased work in 1890; and in 1894 its ground was purchased by the No. 2 South Keep-it-Dark Company, and eventually was absorbed, in common with the claims of the other two companies mentioned, by the Keep-it-Dark Company.

Pandora Mine.—This mine adjoined the South Wealth of Nations on the east and the No. 2 South Keep-it-Dark on the South. The company was also registered in 1886. A shoot of stone was found outcropping on the claim, the discovery being made when cutting the Keep-it-Dark water-race. The outcrop was close to the boundary of the No. 2 South Keep-it-Dark Company's ground, and a winze was sunk on it for 176 ft., 100 ft. of which was on reef averaging 16 in. in width. In 1887 the company joined with the two adjoining companies in putting down the shaft before mentioned and opening a level from it at 280 ft. from surface. This work served to show that very little of the shoot was in the Pandora ground, and in 1890 the company, after taking out such stone as there was, and doing some fruitless prospecting by way of extending the 280 ft. level for several hundred feet into its own ground, ceased operating, and was sold in 1894 to the No. 2 South Keep-it-Dark Company.

The total quartz crushed from the claim amounted to 699 tons, which yielded 664 oz. gold, valued at £2,611.

No. 2 South Keep-it-Dark Mine.—The original company formed to work this claim was formed in 1882, but it did no good until after the shaft already several times referred to was sunk. In driving the 280 ft. level from it, a shoot of stone averaging 3 ft. in width was driven on for 50 ft. This stone was subsequently stoped out to surface, and proved of fair quality, enabling the company to pay a small amount in dividends. The level was then pushed on in a northerly direction, but although boulders of stone were met with frequently—a feature of this ore-channel for the 2,000 or more feet it has been driven on in the various claims—no solid stone was met with till a distance of 563 ft. from the shaft had been reached. At this point a body of quartz averaging about 4 ft. in width was encountered, which was subsequently driven on for 129 ft. This reef was stoped up for 200 ft. towards the surface, when for a time all trace of it was lost. An intermediate level driven to the southward from the top of the stope located it again, however, and from this level the remaining 100 ft. to surface was stoped out. Below the 280-ft. or No. 2 level a winze was sunk on the shoot for 90 ft., but at 35 ft. down the stone cut out, and as only a short length of the claim intervened between the winze and the boundary of the Nil Desperandum (Hercules) Claim the small quantity of quartz in sight in the winze was taken out, and that end of the mine was abandoned. In 1893 an inclined shaft was sunk from the 280 ft. level for 175 ft., not far from the foot of the vertical shaft, and No. 3 level was opened up, with a view to picking up at that depth the southern shoot of stone. This level was extended, however, for a distance of upwards of 190 ft. in a northerly direction without any reef being met with. The level was then extended into the Pandora ground in the hope that some stone that was going underfoot 200 ft. south of the shaft on No. 2 level might have made into a workable ore-body as it went down, but here again disappointment was experienced, nothing but track carrying occasional boulders of quartz being found. In a final effort to make something of its property the company now ran a crosscut out to the west from No. 2 level from near the foot of the vertical shaft in search of the lode-channel in which the western shoot of the Keep-it-Dark mine occurred. This working was extended to a total distance of 516 ft. and cut several reef-tracks, but nothing of any value was got in it, and in 1899 the company ceased operations. Later on the claim came into possession of the Keep-it-Dark Company, but no further work was done on it. During its productive life the mine crushed 8,829 tons of quartz for a yield of 6,024 oz. gold, valued at £23,942, and paid in dividends £8,600.

Nil Desperandum (Hercules) Mine.—The ground immediately north of the No. 2 South Keep-it-Dark appears to have been taken up as the Hercules Claim in 1875, but the company evidently did no good, for only two years later another company known as the Nil Desperandum held the property. The first company evidently did some work in the way of putting in adits to a shallow depth below the outcrop of a shoot of stone that had been discovered, and for some years the second company showed little activity, for by 1885 the deepest workings on the claim had not penetrated below No. 3 level, approximately 150 ft. below the surface. About 1886 a more vigorous policy seems to have been adopted, and the sinking of a vertical underground or "monkey" shaft was started at a point about 300 ft. in from the portal of No. 3 adit. This shaft was pushed down

fairly rapidly to No. 5 level, and a certain amount of quartz seems to have been won from Nos. 4 and 5 levels. Only the scantiest information is now available as to the actual development, especially on reef, but a study of such old plans as have been preserved serves to show that a short shoot of stone was apparently worked north of the shaft—probably the southern end of the shoot afterwards worked to some extent in the Golden Ledge Claim adjoining. Whatever stone was mined must, however, have been of poor grade. In 1887 the shaft was sunk 100 ft. further, and No. 6 level was opened out. A crosscut to the west cut a reef track which, on being driven on northerly for 70 ft., was found to carry a shoot of quartz 90 ft. in length and about 3 ft. in width. This stone was, however, also poor, for very little work was done on it, and a return was made to No. 3 level, which was extended to the south, where a number of small detached blocks of stone were located and mined. In 1889 another company took the mine over under the old name, Hercules, and at once drove No. 6 level to the south, where, at about 200 ft. from the crosscut, a block of stone of good quality was met with, a first crushing of $31\frac{1}{2}$ tons from it giving 58 oz. gold. The stone was found, however, to live only a short way above the level, and the sinking of the shaft to No. 7 level was hurried on with. Towards the end of 1890 this lift was completed, and the level was being extended north and south. In the south end, at 170 ft. from the crosscut, the reef was met, but it was just as broken as in No. 6, and the level was then pushed on towards the northern boundary of the No. 2 Keep-it-Dark. At about 600 ft. in from the crosscut the downward continuation of the shoot worked in the north end of the latter mine was picked up, but the stone was apparently only about 2 ft. in width and of low grade, and, like all the other blocks found in the mine, this was broken and erratic. The company struggled on for a few years longer, during which it opened up Nos. 8 and 9 levels, the latter 713 ft. below the surface, without meeting with any success, and in 1899 it ceased operations. The claim later became the property of the Keep-it-Dark Company, which still holds it, but no further work has been done on it.

Under its various managements the mine produced, as near as can be estimated, 12,601 tons of quartz, which yielded 6,809 oz. gold, valued at approximately £27,233, and paid in dividends £3,744.

Golden Ledge Mine.—The original Golden Ledge Company, which held a small claim to the north of the Hercules, appears to have been formed about 1877. Very little is on record regarding its operations, but it put in two adits on a shoot of stone outcropping close to its southern boundary. The upper adit was about 100 ft. below the highest point of the outcrop, with No. 2 about 50 ft. still lower. The top adit was driven wholly on reef for about 200 ft., the stone averaging apparently from 2 ft. to 3 ft. in width. In the lower adit about 230 ft. of crosscut had to be put in before the shoot was met, but the latter maintained its length and width. Most of the quartz between the two levels was stoped out, but it was of low grade, 1,831 tons only yielding 552 oz. gold, equal to about 6 dwt. per ton. The company carried on operations a short time only, and its claim became part of the Keep-it-Dark property. As in the case of the neighbouring companies—the Hercules, No. 2 Keep-it-Dark, and Pandora—the Golden Ledge Company did not erect its own battery, but had its crushing done at either the Keep-it-Dark or Wealth of Nations mills. For nearly forty years the ground lay idle till about two years ago, when what is known as the Keep-it-Dark Tribute Party cleaned out the two old adits, and extended the lower

for a distance of 390 ft., eventually making connection on the reef-line with a two-compartment vertical "monkey" shaft, sunk very many years previously from what is known as the "Old Dark" tunnel, in which, it may be remarked, the timber was found as sound almost as when first put in. During the extension of this adit four short shoots of quartz were met with at 300 ft., 450 ft., 550 ft., and 585 ft. respectively from the crosscut: the first was 45 ft. in length and 1 ft. wide; the second was 50 ft. in length and about 2 ft. in width; the third and fourth were each only 20 ft. long, but opened out to about 4 ft. in width. Three parcels of quartz, totalling 225 tons, were crushed from the drive and from a small stope on the second shoot, for a yield of gold valued at £595 15s. 1d., equal to £2 13s. per ton, while a parcel of 70 tons won when driving on the third and fourth shoots yielded 31 oz. 13 dwt., valued at £126 4s. 1d. When the drive had reached the old shaft referred to the conduct of operations was taken over by the Hercules Mines Syndicate, a subsidiary organization of the recently floated Southern Mines Corporation. This syndicate has since cleaned up and repaired the old battery level of the Keep-it-Dark Mine, 103 ft. below the No. 2 Golden Ledge adit, and purposes crosscutting from it at a point about 300 ft. in from the portal to Smith's line, a distance of approximately 380 ft.

Wealth of Nations Mine.—Portion of the Keep-it-Dark Mine, that known as the "Old Dark" shoot, was on Smith's line, north of the Golden Ledge workings, and Dr. Henderson has evidently included the east shoot of the mine as belonging to this lode-series; but, partly because there is some little reason for doubting the correctness of this classification and partly for the sake of convenience, the present writer has preferred to deal with the Keep-it-Dark as a whole when describing the western line of the Crushington Group. The next claim of importance north of the Keep-it-Dark was the Wealth of Nations. In the early days another small claim, the Vulcan, intervened, but comparatively little work was ever done on it, and it was in a very short time absorbed by the Wealth of Nations Company. At least one adit was driven on it, and a shoot of stone was located, but it evidently cut out at shallow depth. Crushings totalling 919 tons were, however, taken out, which yielded 586 oz. gold, valued at £2,077, out of which £400 was paid in dividends. Another company held ground adjoining the Wealth of Nations on the west, but was also absorbed by the latter company at an early stage. This was the Independent, which drove a long adit to one of the shoots subsequently worked in the Wealth of Nations, from which it mined 2,345 tons, which yielded 1,179 oz. gold, worth £4,568 12s. 6d.

As previously mentioned, it was on the Wealth of Nations Claim that Adam Smith found the first gold-bearing stone on the line in 1870. The shoot on which this discovery was made was vigorously developed by means of four adits. No plans or other records are available showing the length or width of the shoot, but it is known that it was followed down to 300 ft. from the outcrop, down to which depth it yielded about 28,000 oz. gold, valued at £110,267 2s. 5d., out of which dividends amounting to £35,100 were distributed among the shareholders. At this point the shoot became very broken and finally was lost. A fissure containing a mixture of quartz and country went down, however, and was followed for 500 ft., when solid stone again came in. The tracing-down of this shoot was a remarkable example of persistent and plucky prospecting. From the time the shoot was lost in 1881 the search went on till about 1893, and was only made possible by

the foresight of the manager, Thomas Watson, in stacking the tailings from the early crushings. At all the other mines the tailings were allowed to pass direct into the streams, the cyanide process of treatment not then being known; but Mr. Watson evidently had some vision of the future, for all the tailings of this company's battery were carefully saved. Subsequently they were all reground, and the additional gold recovery in this way practically kept the mine going during the long interval of prospecting. The search was mainly conducted from the No. 4 (battery) level. At a point about 800 ft. from the portal a vertical shaft was put down to a depth of 200 ft., and from the bottom a drive was extended north for 540 ft., when a body of stone was met with. This stone was very broken, but after following it for 150 ft. solid stone came in, 5 ft. wide. The quartz only averaged, however, from 5 dwt. to 6 dwt. gold per ton. From the 200 ft. level the shoot was then followed down a further 150 ft. by an inclined shaft, from the foot of which another level was put out north in which two shoots of quartz were located, but they were too poor for working. An intermediate level was then opened out from 50 ft. down in the inclined shaft, and there stone was found that was payable. A little later a winze was sunk on one of the two shoots found in the drive from the bottom of the inclined shaft, and was carried down to 115 ft. on quartz averaging 7 ft. in width. At first the stone was very low-grade, but it gradually improved in value as sunk on. For a year or so after this the company battled along, mining and crushing the stone that had been developed, and continuing the regrinding of the tailings, when in 1895 Mr. David Ziman bought the mine, together with the adjoining Energetic Claim, on behalf of the Consolidated Goldfields of New Zealand. This company at once started to develop the claims vigorously, and in a short time an inclined shaft was sunk from the No. 4 level in the Wealth of Nations to a depth of 624 ft. and a number of levels were opened from it. The Energetic shaft was also enlarged and sunk deeper, and subsequently most of the development of the joint mines was carried out from it.

Energetic Mine.—The plans of the upper portion of this mine, like those of the old Wealth of Nations, are not now available, but it is known that reef was found outcropping on the surface near Murray Creek, and was followed down by means of two adits and a shaft to about 300 ft., where, as in the case of the adjoining mine, it became broken up and finally cut out. The discovery of the outcrop was made in 1870, shortly after Smith made his find, and by March, 1872, the company had erected a battery of ten-stamps (afterwards increased to twenty-five), and started crushing. As the stone was of good width and value, the company enjoyed a prosperous run until the shoot was lost in the early "eighties," some 59,080 tons of quartz being crushed for a yield of 30,811 oz. gold, valued at £119,322 7s. 8d., out of which dividends amounting to £21,900 were paid. In 1887 the mine was sold to Mr. R. J. Tonks, of Greymouth, who let it on tribute to a party of working-miners, who worked it under the name of the Energy. This party started to take out stone that had been left in the upper levels as unpayable. A trial crushing of 260 tons was first taken out and crushed at the Venus battery with satisfactory results, whereon stoping was continued on the stone, and continued up till 1895, during which time the party crushed 4,766 tons for a return of 2,375 oz. gold, valued at £9,193 2s. 6d. The Consolidated Goldfields Company on taking over the property the following year resumed the sinking of the shaft, which it eventually carried down to No. 12 level, 2,300 ft. below the surface. Down to this level the mine produced a large tonnage of

quartz, but before it was reached faulting of the shoots of ore again made itself evident, especially in the north end of the mine, with the result that below No. 11 level several shoots cut out and have not since been picked out. In 1918 all the surface plant round the shaft was destroyed by fire, and it was not restored or replaced till about 1922. When the plant was restored the company found itself unable to resume mining operations owing to want of the necessary funds, and the property was disposed of to a locally formed company, known as the Wealth of Nations Mines, Ltd. During the control of the Wealth of Nations and Energetic Claims by the Consolidated Goldfields Company the quartz crushed from them amounted to 300,230 tons, which yielded 127,651 oz. 12 dwt. 20 gr. gold, valued at £493,098 10s. 7d.

The new company, with the aid of Government assistance, sank the main shaft to No. 13 level, and drove about 400 ft. south to pick up a shoot of stone that had been driven and winzed on in No. 12 level. Good values were found in this stone on No. 12 level, and in the 70 ft. for which the winze was sunk, but, as bad luck would have it, when it was met with on the new level the values had died out, and it was not until stoping was carried up nearly to the foot of the old winze that stone of payable grade came in. The company has been unfortunate in other respects also, for last year the upper part of the shaft collapsed, necessitating very costly repairs. Operations have been practically confined to working out the shoot referred to, but a certain amount of quartz was won from two stopes in the north end of No. 11 level. Up to the end of 1926 this company crushed 18,502 tons for a return of 8,278 oz. 2 dwt. gold, valued at £32,902 15s. 4d. Including the figures for the Independent Claim, the total output for the two mines since they were first opened up, as nearly as can now be estimated, was 437,531 tons of quartz, which yielded 203,784 oz. 14 dwt. gold, valued at £788,438 5s. 3d. The only dividends definitely known to have been paid were those distributed by the original companies—namely, £67,000. This does not represent, however, the whole amount paid by the mines, for the Consolidated Goldfields Company paid £240,878 10s. 6d., a large portion of which—probably £80,000—must have been profits made from the working of these mines.

Taking Smith's lode-series as a whole, it cannot be said that any part of it deserves much further attention from a prospecting point of view. That section of it from the "Old Dark" workings to the Pandora was very disappointing. The reef-line here is one of the most persistent and regular in the district, having been driven on for nearly 2,000 ft., but solid reef only occurred in it at long intervals, and such shoots as were found were very broken. Along the whole section, boulders of stone, many of them smooth and rounded as if water-worn, were found in numbers between the different shoots, leading to many conjectures as to how they came to be in the positions in which they were found, but probably the entrance of faults into the original fissure accounted for their occurrence. Between the "Old Dark" and the Wealth of Nations there is a stretch of virgin country in which driving on the lode-line might reveal the presence of unknown shoots, but it is likely that the company now operating on the Golden Ledge section of the Keep-it-Dark Mine will exploit this ground. As far as the Wealth of Nations and Energetic end of the line is concerned, the extensive workings of these mines have demonstrated that the chances of further payable ore-bodies being found there are slight.

It may be mentioned that on the north of the Energetic Claim two other companies, the Dauntless and the Macedonian, worked areas in the early

days. Reef-tracks were found in each company's ground, and a lot of work in the nature of tunnelling and shaft-sinking was done, but no solid stone was ever located. The Macedonian Claim was absorbed by the Energetic Company in 1879, but the Dauntless, which, by the way, was known for a time as the Undaunted, struggled on for some years longer, and was finally abandoned.

CRUSHINGTON GROUP.—WESTERN LODGE-SERIES.

On this line, which is only a few hundred feet west of Smith's lode-series, Dr. Henderson has placed the Heather Bell and Eclipse Mines, and what is known as the western shoot of the Keep-it-Dark Mine. Regarding the first-mentioned, which lay to the north of the Keep-it-Dark and west of the Independent, very little information is available. No stone was apparently ever won from it, and no record is available as to any work done on it. Much the same applies to the Heather Bell. There is a record of a crushing of 60 tons from which it yielded only 10 oz. gold, but that is all the information at hand concerning it. Probably reef-tracks were found in each claim, but the prospects were not encouraging, and little actual mining was done.

Keep-it-Dark Mine.—This mine was an important producer. In it there were at least three shoots of quartz known as the "Old Dark," the eastern, and the western. In his "Geological Survey of the Reefton District" Dr. Henderson has placed the eastern shoot on Smith's lode-series, but, for reasons already stated, the present writer has preferred to deal with all the shoots in the one general description of the mine. The "Old Dark" shoot was undoubtedly on Smith's line, and was probably the first stone worked on the claim. The first Keep-it-Dark Company was registered on the 2nd March, 1874, but there is reason to believe that before that date work had been done on the claim, and this would almost surely have been on this shoot, and perhaps partly in some of the upper adits on the eastern shoot. The "Old Dark" shoot was about 100 ft. in length, but its width is not known. It had an underlie to the eastward, whereas all the other shoots of the vicinity dipped to the westward, showing that it had been involved in a fault movement. A tunnel put in 120 ft. below the outcrop evidently picked the shoot up, but it must have cut out at that point. It was worked out to the surface, but no work was done on it lower down. A vertical "monkey" shaft was sunk from the tunnel, in which the country came back to the general westerly dip—there must have been some indication of the change on the horizon of the tunnel, as otherwise it is difficult to understand why the shaft was sunk vertically—but no stone was got in it. In the Golden Ledge No. 2 adit there was, however, a little reef a short distance to the south, and this may have represented the downward continuation of the shoot. No records are available as to any crushings from this shoot, but it may safely be assumed that the stone was not of high value, for it is known that the earlier working of the mine gave no satisfactory return to its owners.

The eastern shoot was the most profitable in the claim. Its outcrop was apparently from 5 to 6 chains easterly of the "Old Dark" shoot, and for a time it was worked by several adits, the lowest of which, however, gave only about 180 ft. of backs, and a vertical haulage shaft was soon started from the level of this lowest adit. By 1887 three levels had been opened from this shaft. Plans of these various workings are in existence,

but, unfortunately, little can be gathered from them as to the precise way in which the ore-bodies occurred. Reports by the officials of the Mines Department make it clear, however, that throughout the entire workings the stone occurred in disconnected blocks, most of which were of considerable size. The richest ore-body was one known as the North Block, which is said to have been up to 29 ft. in width. Another is described as having been 350 ft. long and 8 ft. wide. This first ten years of the company's operations were very successful, gold to the value of £180,464 being won, out of which the sum of £87,083 was paid in dividends, equal to £4 2s. 2d. per share.

No. 2 level seems to have produced a large tonnage of high-grade quartz, but from it down each succeeding level showed a falling-away both in quantity and value. In No. 3 level a block of stone of great size was picked up, from which a first crushing of 300 tons yielded at the rate of 14 dwt. gold per ton; but when stoping was started on it the values fell rapidly below what was payable. A little later, however, the North block was intersected on the level, and the position was improved again.

In 1888 a beginning was made with the sinking of a "monkey" shaft from No. 3 level at a point 522 ft. in from the main shaft. This was subsequently carried down to a depth of about 500 ft., four further levels being opened from it at 120 ft., 245 ft., 370 ft., and 480 ft. respectively. Development on No. 4 level was even less satisfactory than on No. 3. The North block was not found on it, and only one other block was met with, which was too poor to pay for working. On No. 5 level the block of stone met on No. 4 was picked up, as was also another block lying to the westward. Both blocks were of considerable size, but their values were as low as that of the stone on the upper level. In driving out in a northerly direction a third block was met, which had payable content but was small. A winze was sunk on this last block, but at 35 ft. down the stone cut out. No. 6 level was more satisfactory. Here a block was met with, about 60 ft. in length and 30 ft. wide, containing payable gold values. This block was stoped out up to No. 5, and found to yield on an average between 11 dwt. and 12 dwt. gold per ton. On No. 7 level developments were disappointing. A large block of stone was met, but it was only found to be worth about 4 dwt. gold per ton, and very little work was done on it. In 1898, discouraged by the results obtained from these workings, the company practically discontinued work from the "monkey" shaft, and turned its attention to further prospecting in the upper levels on the eastern shoot and to investigating the country to the west of the main shaft. In both these directions very gratifying measures of success rewarded its efforts. On No. 1 level on the eastern shoot a new block carrying good values was found, which was upward of 40 ft. in length and 13 ft. in width, and on the western shoot payable stone was quickly located on Nos. 1, 2, and 3 levels. After this nearly all the operations in the mine were confined to the western shoot. The main shaft was sunk a further 887 ft., making a total depth of 1,360 ft. below the brace, and new levels were opened out as follows: No. 4 at 624 ft., No. 5 at 773 ft., No. 6 at 923 ft., No. 7 at 1,024 ft., No. 8 at 1,145 ft., and No. 9 at 1,345 ft. respectively.

Very little stone was broken out from No. 1 level, the reef being left *in situ* to prevent an undue influx of water to the mine, but Nos. 2 and 3 yielded a good deal of ore, two shoots being located on each, 185 ft. and 50 ft. in length respectively on the former level and 220 ft. and 40 ft. on the latter. The stone on No. 2 level averaged about 9 ft. in width, and that on No. 3

about 7 ft. On Nos. 4 and 5 levels the shoots were found still living down, but they were broken and displaced. No. 6 level produced a lot of quartz, the shoots there being respectively 270 ft. long by 6 ft. wide, and 180 ft. by 5 ft. As depth was attained, however, the stone grew more and more patchy in value, and generally much poorer than in the upper levels, with the result that while fairly large quantities of quartz showed on Nos. 7, 8, and 9 levels most of it was too low-grade to pay for extraction. On No. 8 level no stoping was done. The company did very well, nevertheless, till 1908, up to which year it paid dividends, but its long period of prosperity then came to an end, and after struggling along for several years more it went into liquidation in 1911, and was reconstructed under the name of the Keep-it-Dark Mines, Ltd. During the thirty-seven years of its operation the Keep-it-Dark Quartz-mining Company produced, as nearly as can now be determined, 253,441 tons of stone, which yielded 115,547 oz. gold, valued at £443,509, and paid in dividends £158,666 13s. 4d., equal to £7 13s. 8d. per share. The total paid-up capital was £8,708 6s. 8d.

The Keep-it-Dark Mines, Ltd., carried on till the early part of 1917, when another reconstruction took place under the title of the New Keep-it-Dark Mines, Ltd. During this period some 54,866 tons of quartz were crushed for a return of 16,841 oz. 8 dwt. 23 gr. gold, valued at £63,261 7s. 1d., but no dividends were paid. The New Keep-it-Dark Mines, Ltd., found a lot of fresh working capital, and made an effort to put the mine on to a paying basis again, but it so completely failed in its purpose that it went into voluntary liquidation in October, 1922. While the company operated it raised and crushed 13,943 tons of quartz for a yield of 2,801 oz. 5 dwt. 15 gr. gold, valued at £10,507. In the following year the mine was let on tribute to a party of working-miners, who removed the block of ore left by the original company over No. 1 level, taking out from it 3,429 tons, which have a yield of 1,963 oz. 7 dwt. gold, valued at £8,062 12s. 3d. The removal of this stone was completed in the early part of 1924, since when no work has been done in the mine.

The total output of the mine since it was first opened would thus appear to be approximately 325,679 tons of quartz, from which 137,153 oz. gold were won, worth £525,339 19s. 4d., while the dividends, as before mentioned, were £158,666 13s. 4d.

It is clear that both the principal shoots in the mine were strongly affected by faulting, and that the eastern shoot had been badly shattered by it, but the available data is much too scanty to admit of any but the vaguest theorizing as to its exact nature. It is probable that both the eastern and western shoots were originally continuous shoots, having a general north-and-south strike, which were distorted and broken by east-and-west faulting. This faulting must, however, have been of a local character, for while there is no sufficient information at hand to show how far the faulting that tossed the eastern shoot about extended in this east-and-west direction, it is known that the movement that affected the western shoot did not cross the Hercules (Smith's) line. The effect of whatever movement occurred in this western shoot seemed to have been to bend it into the shape of a V, splitting it into two sections, which may be described as eastern and western legs or branches. Fig. 8, which shows the position of each of these sections on some of the lower levels from the main shaft, will serve to explain what is meant. As depth was attained the two sections were separated by greater distances at each level, making them more and more difficult to locate. The eastern leg was not worked on Nos. 6, 7, or 8 levels, but a little mining was done on it on No. 9.

Regarding the eastern shoot very little can be said, but it would appear as if a somewhat similar twisting of the original ore-body occurred. The whole country there was, however, so badly distorted, and the discovered

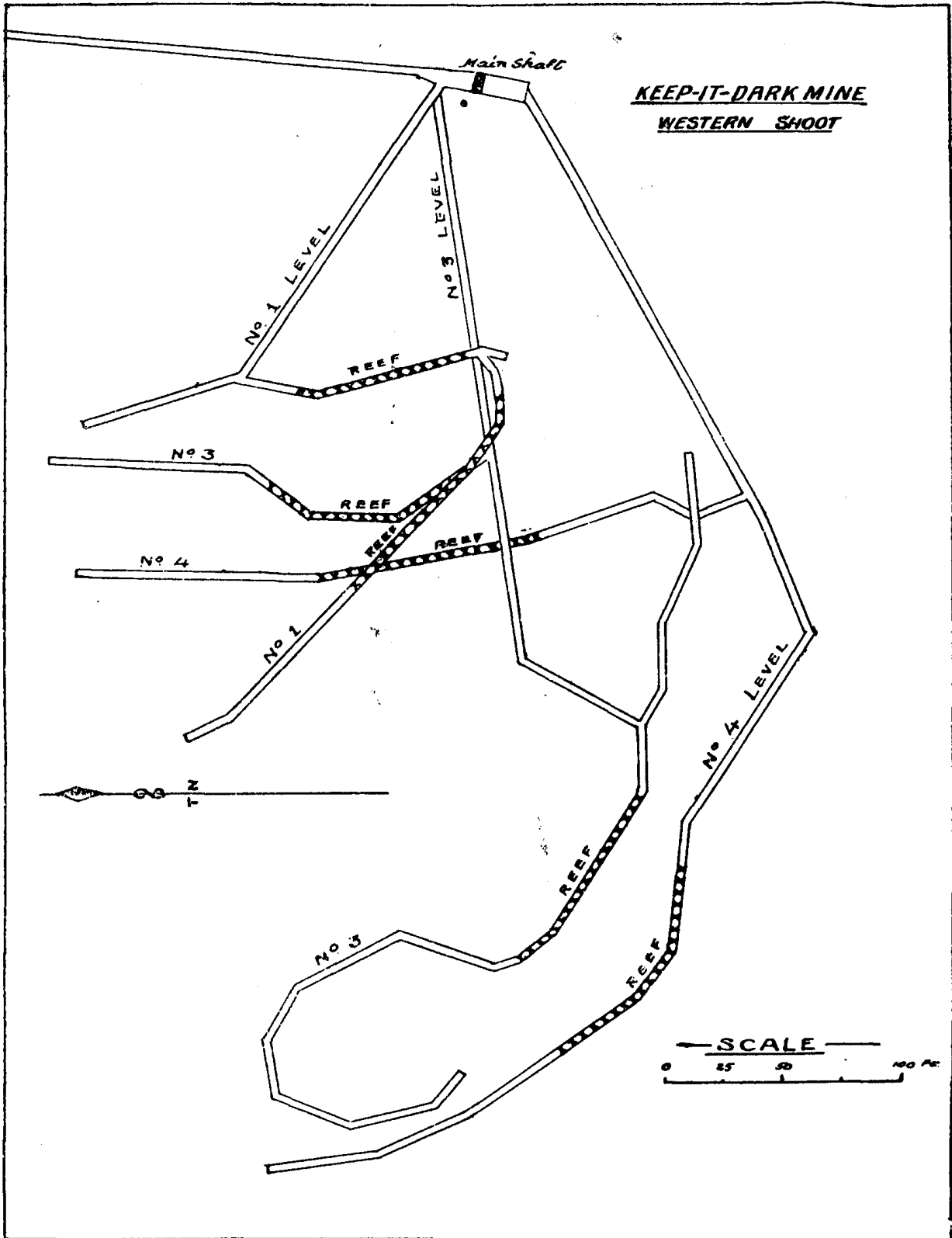


FIG. 8.—PLAN OF PORTION OF NOS. 1, 3, AND 4 LEVELS, WESTERN SHOOT, KEEP-IT-DARK MINE, REEFTON.

blocks of stone lay at such varied orientations, that no definite conclusion can be arrived at on this point. There is some probability, however, that the stone worked in the lower levels of the "monkey" shaft represented the

western section of this shoot, and what was known as the North block the eastern. The North block was apparently not traced below No. 3 level, and there has been much speculation as to what became of it below that horizon. The first company did much prospecting for it on Nos. 4 and 5 levels without avail, and the adjoining Wealth of Nations Company extended its No. 7 level about 1,000 ft. out to within a short distance of the Keep-it-Dark boundary, and put out diamond-drill holes there for considerable distances east and west in search of it, but found nothing of value. If the downward continuation of this block could be located a rich reward might await the finder, and it is possible it may still be discoverable; but, in view of the little reliable data there is to serve as a guide in prospecting for it, any attempt to do so would have in it so much of the blind-stabbing element that no experienced miner could recommend it. The proper time to have made the search was when the old workings were open: a very moderate amount of diamond-drilling might then have yielded the desired result. It may be mentioned that in 1909 the old Keep-it-Dark Company extended its No. 7 level from the main shaft out under the "monkey" shaft workings, and did a good deal of prospecting there, but found nothing of consequence.

As to the western shoot, while there is still fairly large reef underfoot on the bottom level, carrying a little gold, the unsatisfactory results of the work from No. 6 level down offers no inducement to searching at still greater depth.

GLOBE-PROGRESS GROUP.—GLOBE-PROGRESS LODGE-SERIES.

The two principal mines on this series were the Globe and the Progress, but the ground they worked had previously been held by other companies, such as the Union and the Oriental. On what is known as Globe Hill the existence of quartz reefs was evidently first noted about 1876, when a block was found outcropping by a party of miners when constructing a dam for use in connection with their alluvial claim at Soldier's Creek. Two companies, the Union and the Oriental, were soon afterwards formed to develop the locality. In 1878 the former erected a ten-head stamper battery in Devil's Creek, and in the following year crushed 600 tons of ore, which, however, only yielded the small return of 64 oz. gold, which was so discouraging that the company seems to have made no further effort, and in 1881 it sold the battery to the Oriental Company. In 1882 the Globe Company, which seems to have been a re-formation of the old Union Company, came into existence, and proceeded to work a new outcrop discovered that year on the claim. Some extensive ore-bodies were opened up, and a twenty-stamp battery was erected near the Inangahua River, about one and a half miles away. An aerial tramway was also provided to carry the ore to it. Work on the ore-bodies referred to was continued for about three years, but the stone proved too low-grade to pay, and in 1886 the company was compelled to cease operations, and was considering the question of going into liquidation. Shares were being sold for whatever they would bring—one parcel of a thousand is said to have been disposed of for 1s. the lot—and in some cases they were being given away. Two men were, however, kept on at prospecting, and in September of the same year they made a discovery of reef near the western boundary of the claim and about 1,000 ft. westward of the earlier workings which completely altered the position both in regard to the company and mining generally in the locality. The new reef was 10 ft. in width. A trial

crushing was soon taken out of 86 tons, which yielded gold to the value of £688 5s. 6d., equal to 2 oz. gold per ton; and further prospecting showed the reef to extend at least 700 ft. in an east-and-west direction. An adit was then put in to cut the formation 130 ft. below the outcrop. At this depth it proved to be 13 ft. wide. Within a very short time the sinking of the Globe, or "A," shaft was started, and by means of this the stone was followed down to 825 ft., the depth of No. 6 level. The winding in this shaft, it is worthy of mention, was done by an overshot water-wheel erected near the battery, the power being communicated to winding-gear at the shaft, one and a half miles distant, by a steel rope. Down to No. 5 level the stone maintained good size and value, but on No. 6 level it was much broken and poorer. During the course of operations another block was also discovered, which yielded a large tonnage of quartz. In 1896 the mine was sold to the Consolidated Goldfields of New Zealand, which company also purchased the adjoining Progress Mine and a number of contiguous claims. During the period 1882-96, during which it worked its property, the Globe Company crushed 73,428 tons of quartz for a yield of 38,844 oz. gold, valued at £138,283, and paid in dividends £40,000.

The claim subsequently known as the Progress was originally worked by the Oriental Company, which was formed in 1876, and, like its neighbour, the Globe Company, worked some large low-grade ore-bodies without success. In 1881 it purchased the battery of the Union Company, and did a certain amount of crushing, but in 1886 it went into liquidation, only a short time before the discovery of the east-and-west reef in the Globe ground, and the mine and plant were sold to Mr. Gerald Perotti for the small sum of £320. The purchaser tried to get a few friends to join him in forming a syndicate to get the mine going again, but no one could be induced to put money into the venture. When the discovery in the Globe was made in September a company of 24,000 shares at 2s. each was formed, however, in a few hours, Mr. Perotti retaining a large interest. This new company was named the Progress. A little prospecting soon served to show that some stone that had previously been worked by the Oriental Company, and left as unpayable, really represented the continuance of the Globe reef in the Progress ground. Driving on the stone was resumed, and in a few feet the reef, which was 9 ft. in width, was found to show material improvement in value. One sixpenny call was made on the shareholders, and this enabled 310 tons to be taken out as a trial crushing. On being put through the battery this parcel gave the very satisfactory return of 400 oz. gold, from the sale of which the company was able to pay a dividend of 1s. per share, absorbing £1,200. From that time work continued steadily with varying degrees of success. Stopping was started from No. 1 level, but as the stone approached the surface it was found to be much broken, and poorer than on the level. The following of the stone with winzes from No. 1 adit showed, however, that good values lived down, and a second adit was started from near the battery in Devil's Creek, which it was estimated would have to be driven 1,200 ft. to meet the reef. In the meantime, prospecting revealed the fact that there were in the claim two other blocks or shoots of quartz, both of which were picked up in the lower adit. The company also sank what was known as the "Old Progress" underground shaft, with which the adits were connected. Up to the time of the sale of the property to the Consolidated Goldfields, practically all the stone above No. 2 adit had been stoped out, and the shaft had been sunk a further lift and connected with a winze from

No. 2, but no stone had been taken from this lower horizon. During the course of its operations the Progress Gold-mining Company mined and crushed 60,235 tons of quartz for a yield of 28,185 oz. gold, valued at £98,482, and paid in dividends £17,400.

A new company, the Progress Mines, Ltd., a subsidiary of the Consolidated Goldfields, was formed, with a capital of £250,000, to work the various claims acquired, and a vigorous development policy was at once instituted. A large new shaft, the Progress or "B" shaft, was started, and a powerful winding plant was installed. A new battery of forty stamps (afterwards increased to sixty-five) was also erected, and supplemented with chlorinating and cyaniding units for the treatment of the auriferous concentrates and tailings.

Crushing started in May, 1898, and, except for a short stoppage in 1912, continued until 1920, during which period 911,562 tons of quartz were crushed for a yield of 356,286 oz. 9 dwt. 7 gr. gold, valued at £1,399,972 16s., to which must be added 3,062 oz. 2 dwt. 10 gr. gold, valued at £10,980 16s. 8d., recovered from treatment of tailings between 1920 and 1926, after crushing operations had ceased; and dividends to the amount of £326,562 10s. were paid. The output of the group of mines since they were first opened up, and to the end of 1926, may thus be estimated at 1,044,913 tons of quartz, which yielded 416,377 oz. gold, valued at £1,645,302, out of which £384,062 10s. was paid in dividends.

The Progress Mines, Ltd., opened several further levels from the Globe, or "A," shaft, but concentrated its efforts mainly in pushing down the "B" shaft, which was eventually sunk to No. 11 level, 1,416 ft. below the shaft-collar. In the Globe section, several of the blocks lying towards the western side of the claim united above No. 6 level to form one large ore-body, which lived down to No. 8 level, where it was broken up. The various blocks mined in the combined claims were followed without much difficulty to the horizon of No. 8 level, but below that depth they became badly broken, and were found shattered into fragments lying at all orientations and inclinations. No. 9 level yielded a large tonnage of ore, but No. 10 was not nearly so productive, and on No. 11 the only block of any importance found was the Pioneer block, which was, however, of great size. This block dipped flatly under the level, then turned upward again and died out against a fault; and, as it was the last known payable ore-body in the mine, its exhaustion brought about a cessation of mining operations.

There is no room for doubt that the various ore-bodies worked in the mine owed their erratic occurrence to earth-movements, and that they were all eventually cut off by a powerful fault. What the exact nature of this faulting was, however, evidently puzzled the management to know. With a view to solving the problem, a start was made to construct a complete model of the ore-bodies, but the model was not finished, and was long ago dismantled. Certain mining operations carried out seem to indicate that at different times both normal and reversed faulting were accepted as accounting for the disturbed nature of the country containing the ore-bodies, and there is not lacking evidence that, for a short period, anyhow, a system of synclinal and anticlinal folding was held to have been responsible for it. It must be said that a study of the position in the lower levels is greatly complicated by minor faulting; but the opinion now generally held by experienced mining-men familiar with the mine is that the cutting-off of the various ore-shoots was effected by a normal fault

having a strike about north-north-west and a north-easterly dip, and that the lode in its original position had a westerly underlie, but was cut across by the fault mentioned, with the result that the earth-block containing those portions of the lode already worked was thrown down to the north-eastward, the downward movement causing the changes in orientation noted in the different blocks of quartz. This was the opinion arrived at by Dr. J. Henderson when making a study of the mine during the preparation of his "Geological Survey of the Reefton District," published in 1913; and in a report furnished to his Department in 1921, after a further examination of the property, plans, and such geological data as were available, he stated that he saw no reason to alter it in any essential. In view of the fact that the fault is well displayed on No. 10 level, and that the dragstone was followed up by means of rises from No. 11 level to about the horizon of No. 7 level, there can be little doubt as to the correctness of this assumption, and if the theory is accepted it should be possible to locate the downward continuation of the shoots by prospecting to the south-west of the old workings.

The presence of a strong east-and-west fault crossing the main fault towards the southern end of the workings somewhat complicates the position when a study of the mine is being made, especially when an attempt is ventured at determining at what point the picking-up of the lost lode might be most readily achieved. The positions of the main and cross faults on several of the levels are shown in Fig. 9, as well as their approximate surface positions. Whether or not these faults occurred at different times is not determined, but the probability is greatly that they occurred simultaneously; but in any case it seems practically certain that the downward movement of the earth-block containing the worked portions of the lode was in the direction marked by the junctioning of the faults—that is, north-easterly—which would mean that the downward continuation of the lode must be looked for south-westerly of the worked ground. When the mine was open a good point from which to prospect would have been the south end of No. 9 level. A crosscut was put in there to the westward some years ago, and was the only development in the mine in which timber was not needed, a fact that served to show that the working was in settled country beyond the fault, and might well, if continued, have encountered the reef in its original position. Now that water has been allowed to accumulate in the old workings, underground search for the lode is no longer possible, and any prospecting done must be from the surface. It may not be out of place to mention that, while the mine was still working and the levels maintained, the Mines Department, realizing that search for the lode could be most effectively and satisfactorily prosecuted from an underground base, offered very generous financial assistance towards carrying it out on the condition that the company contributed an equal amount; but the latter could not meet the condition, and the proposal fell through. The best way to undertake now the necessary prospecting would seem to be by putting down diamond-drill holes at approximately the positions marked by small circles in Fig. 9, parallel with the main fault, and radiating so as to thoroughly explore the country west of it and above the points where the shoots or blocks were cut off. A lot of drilling done in the mine in past years served to show that it was practically impossible to get a core, but the work was done mainly in ground that had been moved and crushed, and it is quite reasonable to expect that in the solid country west of the fault much better results may be got in this regard. Drilling in the posi-

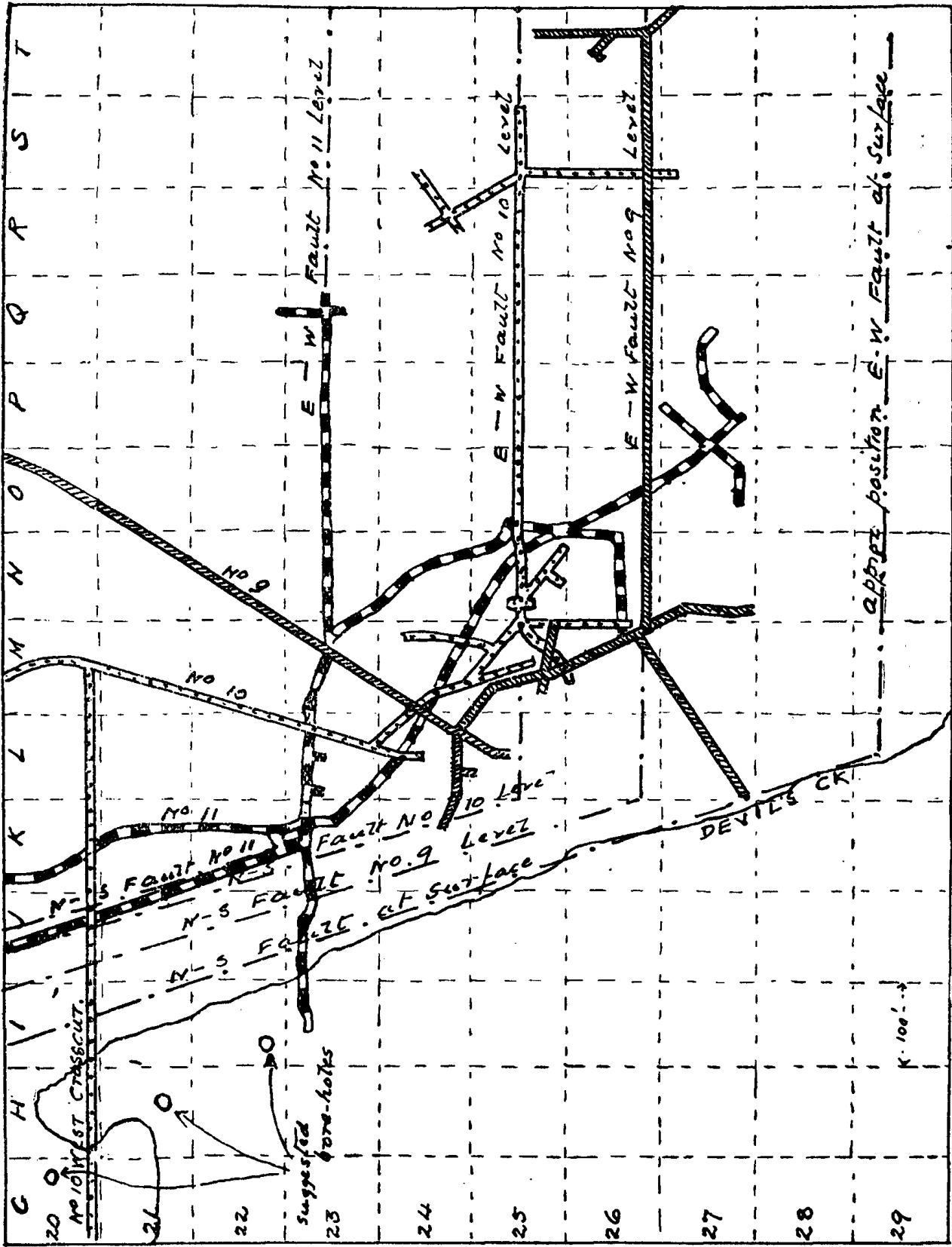


FIG. 9.—PLAN OF POSITIONS OF NOS. 9, 10, AND 11 LEVELS, PROGRESS MINE, SHOWING POSITION OF MAIN AND CROSS FAULTS ON EACH LEVEL.

tions indicated should not need to be very deep to reach the reef-line, as the point of fracture of the original line was evidently between No. 7 level and the present bed of Devil's Creek in its upper part, and the total distance vertically between these two horizons may be approximated at only about 400 ft.

The lode, if located beyond the fault, would doubtless be in the usual lensoid form, but the lenses would be more regular than in the shattered worked portion of the mine; nevertheless any bores put down would need to be placed in such a way that at no point would they be more than 200 ft. apart, to ensure that they would not miss the lenses.

Most of the blocks of ore worked carried fair gold down to where they disappeared against the fault, so it is not unreasonable to think that if their downward extensions were located the stone would continue to have much the same values.

Although the Progress Mines, Ltd., held several large claims to the south of the main workings, comparatively little prospecting seems to have been done on them, particularly along what may be considered the strike of the main fault, the surface indication of which is the gorge of the upper part of Devil's Creek and of Fossicker's Creek. Misled by the east-and-west strike of the principal ore-bodies at the surface, the opinion for years seems to have been that if any extension of the lode-line was to be picked up it would be in a direction varying from east to south-east of those ore-bodies, hence whatever search was made was in that general line. In view, however, of the information furnished by the lower levels of the mine it is possible that the original strike of the lode was much more nearly north and south, consequently a certain amount of close surface investigation may even now be justified in the very rough country in a more direct southerly line from "B" shaft.

AULD CREEK GROUP.—RANFT'S LODE-SERIES.

The line, so named by Dr. Henderson after Theodor Ranft, who, with William Falla, first prospected it in the early "seventies," lies to the northward of the Globe-Progress series, and may be the continuation of it in that direction. Several claims were pegged out on it, among them the Fraternal and the Bonanza, but the latter is the only one calling for any special mention. Very little work was done on any of the claims for some years after the first discovery, but about 1882 the existence of a fair market for antimony, of which the outcrops contained a large percentage, led to some active work being done on some of them. The antimony was not, however, in sufficient quantity, nor was the gold content high enough, to warrant the erection of treatment plant, and operations ceased again. In 1908 some further work was done, this time mainly on the Bonanza. A prospecting-shaft (locally "winze") was sunk on a reef averaging about 8 ft. in width to a depth of 90 ft., for which distance the gold values in the ore are said to have averaged 15 dwt. per ton. A drive appears also to have been put in on the reef for 200 ft. at a depth of 400 ft. below the outcrop. The owners are reported, however, to have been greatly hampered at the time by litigation, and also by regulations restricting mining on the area, which was within the reserve from which the domestic supply of water for Reefton township is drawn, with the result that prospecting operations were once more suspended. About 1914 another attempt was made to do something with the claim. The old 200 ft. drive was repaired and extended a further

similar distance. Only rather indefinite information regarding the results of this work is available, but reports on the files of the Mines Department at Reefton seem to indicate that the drive followed a reef averaging about 14 dwt. gold per ton, but very narrow and broken. The prospects were evidently not considered encouraging, for nothing more was done, and the claim has lain idle ever since.

MERRIJIGS GROUP.—LEE'S LODGE-SERIES.

This series, on which the mines known as the Happy Valley, Sir Francis Drake, Gallant, Scotia, Cumberland, Exchange, Inkerman South, and Inkerman West were opened up, has been named after Robert Lee, who found auriferous stone on it in 1887. Actually, the first discovery of gold-bearing stone on the line was made by the McGee brothers in 1882, on what was afterwards the Happy Valley Claim, but Dr. Henderson has preferred to name the next lode-series to the south after those pioneers.

Happy Valley Mine.—An east-and-west lode was found on this claim by the McGees, as well as a number of leaders with a north-and-south strike. A considerable amount of prospecting was done on the claim, a winze or prospecting-shaft 60 ft. in depth having been sunk on a large reef near the head of Slab Hut Creek, and a lot of trenching and driving on other formations. The claim did no good, however, the ore proving everywhere unpayable. Only one crushing is recorded, 127 tons of quartz, in 1889, which yielded 28 oz. 12 dwt. gold, equal to only a little over $4\frac{1}{2}$ dwt. per ton.

Sir Francis Drake Mine.—It was on this claim that Lee made his discovery, and great expectations were formed regarding its possibilities. On the surface the reef was traceable for about 250 ft., and showed a width of up to 5 ft. An adit driven at 45 ft. under the outcrop cut the reef at 60 ft. from daylight, where it was from 8 ft. to 9 ft. wide, and a second adit, 115 ft. lower still, struck it at 260 ft., where it varied in width from 2 ft. to 9 ft. In 1888 a fifteen-stamp battery was erected at a cost of about £4,000. Although very good prospects of gold were said to have been got throughout the prospecting, the crushing did not come up to expectations, a total of 3,980 tons of quartz taken from above No. 2 adit only yielding 820 oz. gold, valued at £2,972 12s. 9d., an average of 15s. 10d. per ton. It may be said, however, that the gold was very fine, and an appreciable amount of it escaped during treatment owing to a small quantity of base metals being associated with it. The tailings from these crushings, when put through the cyanide process some years later, yielded very good returns; but even if these recoveries be added to the figures given it is questionable if the stone could have been considered payable.

By 1891 all the stone in sight had been stoped out, and a start was made to sink a main shaft the collar of which was on the level of No. 2 adit. From the shaft a level, No. 3, was opened out at 190 ft. down, in which three blocks or shoots of stone were met, two of them being 80 ft. in length each, and the third 70 ft. Stoping on this level did not pay the company. In 1893, 1,911 tons of quartz were mined and crushed for a return of 393 oz. gold, valued at £1,482; but, to meet the expense of working, calls to the amount of £1,800 had to be made. In 1894 the company went into liquidation, and the claim and plant were disposed of to a party of working-miners, who made a sturdy effort for some time to work the property to advantage. In 1895 and 1896 they mined 2,195 tons of quartz, all of which came evidently from No. 3 level. From this tonnage

781 oz. gold were recovered, an average of 7.1 dwt. per ton. Despite the unsatisfactory yield, the party in 1897 continued the sinking of the shaft, and opened out No. 4 level at 330 ft. below the collar. On this level only one of the three blocks found on No. 3 level was picked up, and this was stoped out up to No. 3; but the gold values continued below pay-line, and towards the end of 1899 the claim, together with the Gallant and Scotia Claims, passed into the ownership of a Reefton syndicate, which started to operate them under the title of the New Scotia Gold-mining Company. The new company carried on till 1905, during which time it did very well, mainly from the treatment by the cyanide process of the accumulated tailings. The company did a lot of development work, continuing No. 3 level and connecting it by means of winzes and rises with the Gallant adit, but no reef of any value was found, and the boiler and winding-engine were removed for use in sinking a prospecting-shaft, known as "Martin's Winze," on the Scotia Claim.

As near as can be estimated, the Sir Francis Drake Mine during its period of production crushed 16,987 tons of quartz for a yield of 5,810 oz. 16 dwt. 6 gr. gold (including the results from cyanide treatment), valued at £20,632 5s. 2d., equal to £1 4s. per ton.

In 1912 the claim passed into the hands of the Consolidated Goldfields, Ltd., which re-equipped the shaft with winding plant and began to sink it to greater depth. As far as the writer can learn, the objective on this occasion was not so much to test the Sir Francis Drake lode at deeper levels, but to put out a drive at 600 ft. below the shaft-collar to test the country between that mine and the Cumberland Mine, about 2,400 ft. to the southward. Whatever the intention was, however, it was not proceeded far with. With the coming of the World War in 1914, which resulted quickly in a great falling-off in the supply of suitable labour, an abrupt stoppage was put to the sinking when the shaft had reached a depth of 553 ft., and not long afterwards the property was forfeited on suit in the Warden's Court and passed into the hands of Joseph Gardner. Practically nothing more was done with it till about 1923, when the Scotia Prospecting and Development Syndicate was formed to give it another trial. This syndicate opened out a new level (No. 5) from the shaft, and picked up a short shoot of stone—or, rather, a formation consisting of numerous small leaders of quartz banded with country rock—but it contained little more than traces of gold, and after spending about £4,000 the syndicate abandoned operations, and the mine has since been idle.

Gallant Mine.—This claim, adjoining the Sir Francis Drake on the north, was taken up in 1888, and a company was at once formed to work it. A reef about 3 ft. in width, and said to show very fair gold prospects, was traced on the surface for nearly 1,000 ft., or practically right through the claim. A shaft was sunk on the outcrop for a depth of 150 ft., about 5 chains from the northern boundary, and an adit level was driven to meet it. This adit met the reef at 250 ft. in, and 175 ft. north of the shaft. Where first intersected in the adit the stone was 18 in. wide, but at the foot of the shaft it was 3 ft. 6 in. This adit was later extended to over 800 ft., on lode said to average about 4 ft. in width, but the values throughout were evidently low. Crushing was started towards the end of 1889, but with the exception of a short period on 1891, when a small pocket of fairly good stone was mined, the returns were not payable. In 1893 a party of tributers tried the reef, but did not carry on long, the yield from the crushing taken out being unsatisfactory, and early in 1894 the claim was abandoned. Nothing further was done on

the ground till 1901, when the New Scotia Gold-mining Company cleaned up the adit and sank a winze from it. An intermediate level driven from this winze is said to have been for a time on stone up to 16 ft. in width. No data is available as to the depth of this intermediate below the adit, nor as to the value of the reef found in it, but it is obvious that the quartz was of poor grade, for the company soon ceased operations there and turned its attention to sinking what is known as Martin's Winze on another reef lying several hundred feet to the westward of the Gallant reef. This winze was sunk to a depth of 200 ft., and two levels were driven from it—one at 111 ft. from the surface and the other from the shaft-bottom. The lower level was driven for 70 ft. on reef averaging about 3 ft. in width, but some trial crushings showed the stone to be unpayable, and the mine was once more abandoned.

In all, from 1899 to 1894, 2,340 tons of stone were mined and crushed for a yield of 759 oz. gold, equal to 6.4 dwt. per ton. Despite the generally low values, the patch of good ore previously mentioned enabled the sum of £600 to be paid in dividends.

Scotia Mine.—The Scotia Claim adjoined the Gallant on the north, and was taken up at about the same time. Rich stone was found on the surface by Robert Robin early in 1887, and gold-bearing shoad occurred along the line for nearly the full width of the claim. A winze (prospecting shaft) was sunk on the outcrop, about 30 ft. from the southern boundary, to a depth of 84 ft., and at 170 ft. farther north a second winze was put down to a depth of 70 ft., in both of which stone of good grade was got. An adit was then driven, which at 320 ft. from daylight connected with the south winze, from which point it was extended for 67 ft. on reef averaging 2 ft. in width. The adit was subsequently driven northward a further 400 ft., and also southward for 70 ft., 50 ft. of which were in the Gallant ground, but this shoot, 67 ft. in length, was the only reef discovered. From the adit a winze was sunk on the shoot, but at 25 ft. down the stone cut out. The winze was contained to 140 ft., and several crosscuts were driven from it on the footwall side. In one of these, 45 ft. below the adit, a reef 12 in. wide was located, but in another at 75 ft. down no sign of quartz was met with. The small shoot thus disclosed was stoped up to the surface. Only 594 tons were mined from it, but they yielded 1,284 oz. gold, valued at approximately £5,155, of which £3,000 was distributed in dividends. Much surface prospecting was carried out in the hope of locating along the line some further shoots, but, though loose auriferous stone was to be found for almost the width of the claim, no solid reef was discovered, and the company abandoned the ground in 1903.

Inkerman South Mine.—In 1890 some rich stone was found on this claim not far from the north boundary of the Scotia, 90 tons of which, taken from the surface, is said to have been crushed for a yield of 3 oz. gold per ton, but although a considerable amount of prospecting was done no solid reef was ever located.

Inkerman West Mine.—This claim was the most northerly taken up on Lee's line. Auriferous quartz was found in it by Henry Evans in March, 1888, and a reef was traced on the surface for about 350 ft. For a time the claim promised well. A winze sunk on the reef to the depth of about 70 ft. carried good values all the way, as did also a drive put out for some distance from the bottom of it. A vertical shaft was then started, which was eventually sunk to 423 ft., four levels being opened from it. No. 1 level, 68 ft. from surface, connected with the drive from the winze, and was extended

for 330 ft. on reef varying from 1 ft. 6 in. to 5 ft. in width, with an average width of 3 ft. The length of the shoot shortened rapidly, however, as depth was attained. In No. 2 level, 218 ft. from surface, a run of only 220 ft. of stone was found, varying from 1 ft. to 7 ft. in width. An intermediate level, 45 ft. below No. 2, showed the length to be 107 ft., while on No. 3 level, 318 ft. from surface, it was only 50 ft. From No. 3 level a winze was sunk for 60 ft., in which the reef consisted merely of small boulders; while on No. 4 level, 423 ft. from the shaft-collar, no reef was found, but a strong track striking nearly north and south was driven on for several hundred feet. This latter level formed part of a long low-level adit driven by the Inkerman Combined Mines from Rainy Creek.

Although Dr. Henderson has placed the shoot of ore in the mine as belonging to Lee's lode-series, he points out that its strike differs from that of the shoots in the other mines along the line, being about 50° east of north, instead of a little north of west as in the Scotia, Gallant, and Sir Francis Drake. In the upper two levels, moreover, the dip was to the eastward, instead of to the westward as in the other mines mentioned. In No. 3 level, however, the dip changed to the westward. Regarding these features the Geologist expresses the opinion that these changes in dip and strike were probably brought about by faulting, which had displaced that portion of the shoot that had been worked. He found evidence for this in the change of dip between Nos. 2 and 3 levels, in the fault-dragged stone in No. 3 level and in the winze below it, in the flaky nature of the walls in No. 2 and lower levels, and in the peculiar topography and depressed position of the Miocene rocks lying to the west of the shaft. Dr. Henderson seemed to consider, however, that in this case the reef-track followed on No. 4 level could not be the fault cutting off the shoot in No. 3, but probably corresponded to a track driven on from a crosscut pushed for a short distance towards the original Inkerman lode on the latter level, and, arguing from these premises, he held that the lower lost portion of the shoot should be found in the eastern side of the zone of displacement, and northward of any of the old underground workings.

When the ore opened up in the various workings of which mention had been made was stoped out, little more was done on the claim, which was virtually abandoned in 1893.

During the time it was worked the mine produced 7,282 tons of quartz, which yielded 6,035 oz. gold (equal to $16\frac{1}{2}$ dwt. per ton), valued at £22,714 19s. 6d., and paid £4,000 in dividends.

Exchange Mine.—This claim was south of the Sir Francis Drake, portion of the Happy Valley Claim intervening between them. It was at no time worked profitably, such quartz as was found in it being broken and of low grade. The reef chiefly prospected in it lay somewhat to the east of the others, on Lee's line. Two adits, 60 ft. apart, were driven, in the upper of which the stone averaged about 3 ft. in width but was badly shattered. In the lower adit the reef was only about half this width, and below it no stone was got, although the ground was subsequently prospected from the adjoining claim, the Cumberland. From No. 2 adit a long crosscut was also run out to within 4 or 5 chains of the western boundary, in the hope of cutting the Cumberland reef, but at that depth the latter was not found to extend into the Exchange ground. In 1898 the Exchange amalgamated with the Cumberland, and a little prospecting was done from Nos. 3 and 4 levels of the latter in the Exchange ground without anything of value being found. In 1905 another company, known as the Industry,

took up the Exchange Claim, and did some further work on it, putting in several adits and sinking a winze to 50 ft., but nothing was found beyond reef-tracks. This company took out, however, the small amount of quartz that had been developed in the claim by the former owners, 511 tons being mined and treated at the Sir Francis Drake battery for 259 oz. gold, valued at £945 0s. 6d.

Cumberland Mine.—This was the most southern mine opened on Lee's lode-series, and the most successful of all the claims along it. In 1890, while prospecting for the northward continuation of the Golden Lead line of reef, Robert Lee, the original discoverer of the Sir Francis Drake shoot, found, near the eastern boundary of the claim, a block of quartz lying in a horizontal position. An adit was put in 30 ft. below the outcrop, which cut the lode at 130 ft. in from the portal, and followed it for about 250 ft., in which the width varied from 1 ft. to 10 ft. No. 2 adit was then put in, 133 ft. below No. 1. This adit was driven for 450 ft. without meeting any stone. A reef-track was struck, however, at 280 ft. in, which was driven on for 140 ft., but was only found to contain small boulders of quartz. A winze was then sunk from No. 1 adit on the shoot revealed there, and a rise was put up from No. 2 to meet it. At 50 ft. down the winze a crosscut was put out to the west, and in this at 20 ft. the reef was intersected and an intermediate level was driven on it, which developed a splendid body of stone 100 ft. in length and averaging about 5 ft. in width. Following this discovery, No. 2 adit was advanced in a north-westerly direction for a further 150 ft., where it picked up the lode, which was found to be about the same length as in the intermediate, but averaging about 11 ft. in width. An inclined shaft was next sunk from No. 2 adit for 86 ft. (measured on the incline). At the bottom of this shaft the lode became badly broken, but a drive put out from it in a southerly direction located much more solid reef at 40 ft. in. This stone apparently was not correlated to the shoot worked in the upper levels, but it was driven on for 110 ft. and found to average about 18 in. in width. A winze was also sunk on it for 45 ft., for which depth it averaged 2 ft. in width. It may be here mentioned that down to No. 2 level the dip of the stone was easterly, but on No. 3 the small reef referred to dipped to the west. A vertical "monkey" shaft was then sunk at a point about 500 ft. in from the portal of No. 2 adit to a depth of 220 ft., and at 200 ft. No. 4 level was opened out. On this level much prospecting was done without satisfactory result. The level was extended north into the Exchange ground, but nothing was found but a track containing quartz fragments and much pug. In an extension of 300 ft. to the south, however, a large body of quartz was met with, but it was of very low grade. Two crosscuts were run out to the westward, one for 60 ft. and the other for 80 ft., and a winze was also sunk for some distance below the level, but nowhere was any payable reef found. The last stone of any value got in the mine was in an intermediate level 100 ft. above No. 4. By the end of 1900 the company had exhausted all the ore in sight and ceased operations. During the period of working, some 13,896 tons of quartz were crushed for a yield of 13,631 oz. 10 dwt. gold, valued at £53,734 16s. 4d., and dividends to the amount of £13,800 were paid out.

Whether or not further prospecting along this lode-series is warranted is a question not readily answered. It is plain that from end to end the line has been greatly affected by faulting, and the blocks of stone found have been of no great length or depth; but, in view of the richness of

some of the stone and of the information furnished by the work already done, it is possible that the locality may deserve some little further investigation.

As far as the Cumberland and West Inkerman shoots are concerned, such evidence as is at hand seems to indicate that they were both cut off by normal faults, consequently it is highly probable that the downward continuation of each could be located again if the necessary prospecting-work were carried out in the right way. Unfortunately, owing to no sufficient data having been preserved as to the exact position underground, any opinion expressed as to the precise nature of the earth-movements that dislocated the shoots can only be of a purely speculative character, but from a study of such information as could be adduced at the time he made the geological survey of the district Dr. Henderson has drawn very reasonable conclusions as to what happened with each shoot. Regarding the Cumberland shoot he was of the opinion that the fault that dislocated the worked portion had a general north-and-south strike and an easterly dip—or, in other words, that the earth-movements affecting it were similar to those that occurred in the Progress Mine. In this case the lost portion of the shoot might be located either by rising up along the fault-plane disclosed in the bottom level or by crosscutting westward from it. As to the Inkerman West shoot, the Geologist's opinion was that the fault displacing it had a westerly dip, and that the downward continuation would be found to the eastward, and perhaps a little northward, of the old workings. In both cases, if the necessary work had been done in the directions indicated, good results might well have accrued, but the work should have been done when the mines were open, as it would then have entailed only a reasonable expenditure. Whether it would be justified now is another question, and one regarding which only a doubtful answer can be given. To reopen the mines now, and re-equip them with the necessary winding and pumping plant, would cost a lot of money, and the writer would certainly hesitate to recommend the adoption of such a course. This much may be said, however, that even under existing conditions the attempt to locate either of the shoots mentioned would have been as well justified as a number of other prospecting efforts upon which large sums of money have been wasted in the district of late years.

Between the Cumberland Mine and the Sir Francis Drake is a stretch of upwards of 2,400 ft. of virgin country that may have possibilities. It has been well examined superficially in the past—the old-time miner of the district could be safely trusted to look out for that—but there is nothing to show that any trenching, tunnelling, or shaft-sinking has been done on it. If the Consolidated Goldfields' intention of testing it at depth from the Sir Francis Drake shaft had been carried into effect it would have been the best way, even if a rather costly one, of testing the ground; but, in lieu of it, surface trenching and the driving of shallow crosscut adits might give good results.

Between the Scotia workings and those of the Inkerman West there is another stretch of about 1,600 ft. of lode-line that may deserve further examination. Auriferous shoad stone is said to have been found nearly the whole way along it, and from one spot, on the Inkerman South claim, 90 tons of loose stone were gathered, as before mentioned, which on treatment yielded 3 oz. gold per ton. It is difficult to believe that this shoad came from purely superficial deposits, and, although a number of good prospectors have searched the locality, it is possible that one or more shoots of stone still await discovery there.

MERRIJIGS GROUP.—ADAMS LODGE-SERIES.

This series occurs between Lee's and the Globe-Progress series, and a little eastward of either. The principal mines opened on it were the Rainey Creek, Supreme, and Inkerman; but there were several claims towards its northern end, such as Hustler's and the General Gordon, in which more or less auriferous stone was found.

Rainey Creek Mine.—In 1872 the Adams brothers located an immense blow of quartz in this claim. It was of very low grade, but it was thought it might be treated payably, and a company was formed to work it. The mine being in a position difficult to access at the time, there was some delay in starting active operations, but in 1876 a fifteen-stamp battery was erected at a cost of £6,000, and crushing was begun. The quartz proved, however, even poorer than had been expected, some 1,632 tons yielding only 167 oz. gold, equal to just over 2 dwt. per ton. The company soon suspended operations, and disposed of its mine and plant to Messrs. Graham and Allen, who continued to work the deposit intermittently for several years without getting any better results. The quartz-blow was about 100 ft. wide on the surface and 150 ft. in length, and it stood up 30 ft. above the surrounding surface. Exactly what development was done on it is not now known, no plans or other definite information being available. The earlier owners of the claim evidently took their crushings from the surface, but it is known that in 1893 the Inkerman Company, which then held the property, sank a winze on the blow and crushed some stone taken from it with unsatisfactory results, and the mass of quartz is said to have cut out in a rounded surface resembling the hull of a ship. Years later, however, another company, the Inkerman Combined Mines, is reported to have located at depth some large bodies of quartz that evidently represented the downward continuation of the "big blow," but they were, like the surface stone, of extremely low grade, and there is no evidence that any crushings were taken from them.

Supreme Mine.—The original company that held this property, the Supreme Gold-mining Company, was registered in September, 1888. The ground was immediately north of the Rainey Creek Company's holding. In the year mentioned some fairly good reef was found outcropping on the claim near its western boundary, on which a winze was sunk to a depth of 40 ft. An adit was also driven to meet the stone at a depth of 180 ft. below the outcrop. Practically no information is now available as to the results of this latter work, but it is recorded that in 1892 a party of tributers gave the mine a trial and took out, evidently from this adit, 400 tons of quartz, which yielded at the battery only 17 oz. gold, so it would look as if the shoot at this horizon was very poor.

In 1897 the Inkerman Combined Mines (later reconstructed as the New Inkerman Mines, Ltd.), took over all the claims in the vicinity from the original holders and commenced prospecting on them in a large way. An adit known as No. 2 was driven from the Lady Louisa Claim westward into the Supreme ground, and in a branch drive from it in a southerly direction a large ore-body was located from which a considerable quantity of quartz was subsequently mined: this stone was evidently not correlated to the outcrop previously mentioned as having been found near the western boundary of the claim. A little later the same company drove a second adit, also from the Lady Louisa, nearly due west to come under the big blow on the Rainey Creek Claim, but nothing of value seems to have

been located in it. Still later the same company drove a very long low-level adit, also from the same side as the other two adits, for the purpose of prospecting from it both the Supreme ground and that previously held by the old Inkerman Gold-mining Company. A little over 1,000 ft. from the portal of this adit a crosscut, known as No. 5 south drive, was projected in a southerly direction, and in it the Supreme lode (evidently the downward continuation of the shoot previously referred to as having been struck in the south branch of No. 2 adit) was picked up. At this depth the lode was up to 45 ft. in width, but was mixed with country rock and was about 400 ft. in length, but, like all the other ore in the claim, it was of low gold content. From the low level this shoot was followed down by means of an incline shaft to a further vertical depth of 200 ft., two levels being opened from the shaft, one at 100 ft. down and the other at the bottom. In these levels the shoot is said to have been up to 57 ft. in width, and of about the same length as on the low level. A good deal of this stone was mined and crushed, but it barely paid working-expenses, and was certainly too poor to encourage development of the ore-body at any deeper zone.

As nearly as can now be estimated, the quantity of stone crushed from the Rainy Creek—Supreme Claims was 22,214, tons, which yielded 5,268 oz. gold, equal to 4.7 dwt. per ton.

Inkerman Mine.—This mine was not directly on Adam's line, but lay a little to the west of it, and about half-way between it and Lee's line. Auriferous stone was first found on it in 1876 by Joseph Potter, one of the discoverers of the Caledonian reef, and a company was registered in February of that year to work the property. By means of three adits the ore-shoot was developed down to 300 ft. below the outcrop, and was found to be 200 ft. in length, with an average width of about 8 ft. Below No. 3 adit a winze was also sunk to a depth of 40 ft. Throughout the workings the stone was consistently of low grade, some 21,020 tons crushed only yielding 6,102 oz. gold, equal to 5.8 dwt. per ton. The Inkerman Company at an early stage acquired the Rainy Creek and Supreme Companies' holdings, and did a good deal of prospecting on them without satisfactory result. It also worked the Inkerman West Mine, on Lee's line, and this was the only part of its property that gave any profit. The same company also held the Inkerman South Claim, on Lee's line, when in 1890 some rich stone was found on the surface, 90 tons of which was crushed for a return of 3 oz. gold per ton, but it does not appear to have done much prospecting on this claim. In 1896 the Inkerman Combined Mines took all the Inkerman Gold-mining Company's claims over, repaired No. 3 adit of the Inkerman Mine, and drove it a further 800 ft., but got no solid reef. It also put out a drive southerly from the low-level adit, to come under the old Inkerman workings, with which connection was made by rising, but no reef was found; and after 1899, in which year the company was reconstructed as the New Inkerman Mines, Ltd., no further work was done on the claim.

Lady Louisa Mine.—This mine lay to the east of the Supreme. Some outcrops of quartz were found on it, but when they were tested by means of several shallow drives they were found to carry gold to the extent of about 3 dwt. per ton only.

As to Hustler's (Souvenir) and the General Gordon Claims, along the northern portion of the lode-series, there is little to be said. Some outcrops were noted on them, and a certain amount of prospecting was done, but in all cases the stone found was extremely poor. On one of the Souvenir

claims a small antimonious reef was discovered, but this was somewhat to the west of Adam's line, and probably represented the continuation in a southerly direction of the Globe-Progress series.

It is evident that the country in which the various ore-bodies were found on Adam's line of reef was much broken and distorted by earth-movements. In the Rainy Creek and Supreme sections the strike of the shoots varied from 15° to 50° east of north, and their dip was south-easterly, while the Inkerman lode was east and west with a southerly dip. The shoots of stone, with the exception of the Supreme shoot, were broken, and evidently did not continue for any great distance in any direction; and, in view of the general poverty of the stone throughout the workings, the locality may be said to have received all the investigation it deserved.

MAORI GULLY GROUP.

The Maori Gully Group occurs about a mile and a half westward of the Globe-Progress group. A number of claims were taken up on it, including, amongst others, the Kohinoor, Golden Hope, Merrie England, Morning Star, and Golden Point, in all of which auriferous outcrops were found, but the two last mentioned were the only mines in which any important work was carried out, and none of them proved to contain a payable shoot.

Morning Star Mine.—Gold-bearing stone seems to have been first discovered on this claim by William Harvey in the early "eighties," in the form of a very small but rich leader, which, however, on being prospected, did not open up well, and the ground was abandoned. In 1912 the ground was taken up again and renamed the New Discovery; and the owner, after doing some further prospecting on the leader, erected a small battery. A crushing of 9 tons put through the battery in the same year gave a return of 16 oz. 15 dwt. gold, but another crushing of 20 tons in the following year yielded only 2 oz. 0 dwt. 4 gr. gold, equal to about 2 dwt. per ton, and work was suspended. Some years later, about the end of 1922, the mine passed into the hands of the New Discovery Gold-mining Syndicate, which in the following year transferred it to the New Discovery Mines, Ltd. These companies spent a lot of money in driving a low-level adit about 150 ft. below the deepest of the old workings, with a view to striking the leader-bearing country on that horizon. This adit was carried in for 1,253 ft. At 80 ft. back from the face a reef-track was driven on for 47 ft. north and 25 ft. south. In the north drive boulders of quartz were met with, but they continued only negligible values. In the south drive only the merest track was followed. Later, a rise was put up from the north drive for over 90 ft., but nowhere was any sign of payable reef noted.

Golden Point Mine.—Auriferous quartz was probably first revealed in this claim by alluvial miners working in the vicinity in the "seventies." In 1882 a company consisting of 20,000 shares of £1 each was formed to develop the claim, and £7,000 is said to have been actually spent. Near the surface at least three reefs or leaders were prospected, one of which, described as a well-defined reef up to 4 ft. wide, was followed by an adit for 200 ft. and showed fair prospects. A ten-stamp battery was erected, and some crushing done, but the results were not payable. Prior to the formation of the company a parcel of 2 tons of quartz, evidently from one of the leaders, was crushed for a yield of 25 oz. gold, but the company itself in 1884 crushed 1,000 tons for a yield of 307 oz., equal to only 6.14 dwt. per ton. In 1885 the claim and plant became the sole property of Mr. Gerald Perotti, the prin-

cipal shareholder in the company, who for a number of years subsequently spent a considerable sum in prospecting it. In 1894 a parcel of 155 tons of quartz was crushed for a yield of 44 oz. gold, and in 1907 another of 100 tons was treated for a return of 18 oz. 13 dwt. 2 gr., while in the following year a further 100 tons, taken from a 3 ft. reef, gave 16 oz. 5 dwt. gold. None of these crushings were payable.

For the purpose of testing the reefs at greater depth a shaft was sunk in 1912 and 1913 to 250 ft., and a crosscut was put out to the west from the bottom for a distance of 500 ft. At least two reef-tracks were cut in this crosscut, one at 320 ft. from the shaft and the other near the end, but they contained no stone worth mining, and operations were suspended. Nothing has since been done on the claim.

GOLDEN LEAD GROUP—MCGEE'S LODGE-SERIES.

This series lies a little south of Lee's line, and auriferous stone was first found on it shortly after the discovery of the Sir Francis Drake shoot in 1888. No reef of any size was located, the find consisting of a belt of country in which numerous stringers, leaders, and veinlets of quartz occurred banded with sandstone. On the O.K. Claim, this belt was about 60 ft. wide on the surface, and in No. 1 adit of the Golden Lead it is said to have been 80 ft. in width, but its average width was very much less. Along the line it was picked up at spots nearly 3,000 ft. apart. So numerous were the veinlets, and so rich did the gold in them appear to be, that it was thought the whole formation would pay to crush; but this expectation was not realized, bulk parcels of the material yielding only from 3 dwt. to 4½ dwt. gold per ton, and the leaders were too small of themselves to be worked profitably. Nevertheless, work was carried on for about fourteen years on the field, mainly on the Golden Lead, A1, and Merrijigs Claims.

Golden Lead Mine.—The original claim of this name lay immediately to the west of the Cumberland Claim. The leader formation was first found on the O.K. Claim, near the Merrijigs Claim boundary, at a point about 20 chains south-westerly from the Golden Lead, but it was soon traced north-easterly into the latter, and south-westerly into the A1. In 1890, when the Golden Lead Gold-mining Company was formed, it absorbed the O.K. and Northumberland Claims, and during subsequent years carried out much active prospecting on them. Prior to the formation of the company a tunnel had been put in on the Golden Lead Claim, about 70 ft. below the outcrop. In this the leader formation was said to have been 80 ft. wide, but other reports seem to indicate that this width included a 30 ft. horse of mullock. The adit was driven over 400 ft. By way of trying out the average value of the formation in it, 100 tons of material taken from the ore-dump at the mouth of the adit were crushed, but the yield was only 4½ dwt. gold per ton. After the amalgamation, another crushing of 52 tons, from which as much as possible of the sandstone was picked out, was put through the battery for a yield of 25 dwt. per ton. In 1891 the Golden Lead Company erected a ten-stamp battery, and a second adit was driven for 700 ft., at a depth of 150 ft. below No. 1. Subsequently, two other levels—No. 3, 120 ft. below No. 2, and No. 4, 250 ft. below No. 3—were put in. In neither of the latter workings was anything of value found. No. 3 was a crosscut for the first 150 ft., then it followed the leader zone for a further 200 ft., but the formation at this part was not payable for working. No. 4 adit was started in 1902, and

carried in for about 600 ft., but owing to lack of funds the company had then to suspend work in it for several years. It was, however, eventually extended to about 1,800 ft. Small quartz veins were cut in it at 300 ft. and 360 ft. respectively from the portal, but they did not carry payable values. At 1,400 ft. the adit is reported to have entered good reefing-country, and followed it for about 300 ft., but there was evidently no encouraging show of quartz in it. Some small amount of stone was crushed from the adit, but it was not found rich enough to pay expenses. The No. 2 adit was therefore the lowest point to which any formation approaching a payable character was traced, and on this level the ground worked consisted of two very narrow stockwork bands separated by about 12 ft. of hard sandstone, which converged as they neared the surface till they were 30 ft. apart.

During the whole time the Golden Lead property was worked the total material mined and treated, as far as can now be estimated, amounted to 11,379 tons, which yielded 2,645 oz. 7 dwt. 22 gr. gold, valued at £10,602 11s. 8d., the average recovery per ton being about 4.6 dwt. gold.

A1 Mine.—This claim adjoined the O.K. on the south. The formation was traced into it, but such work as was done on it was mainly confined to following a small foot-wall leader which was only from $\frac{1}{2}$ in. to 1 in. wide, but carried values up to 20 oz. gold per ton. Two adits were driven on this, and for about fourteen years the mine was worked in a small way, chiefly by tributers. Up till 1905, when the claim was finally abandoned, 1,361 tons of quartz were crushed for a yield of 2,497 oz. 10 dwt. 12 gr. gold, valued at £8,770. For some years towards the end Messrs. Morris and Fleming worked part of the A1 Claim as the Last Chance, and won a good deal of gold, the figures being included in the foregoing totals.

Merrijigs Mine.—This claim lay on the west of the O.K. and A1 Claims. Much work was done on it without satisfactory result. Two winzes were sunk to 45 ft. and 84 ft. respectively, and an adit was driven for 700 ft., which cut the formation 280 ft. below the outcrop. Where met with in the tunnel the formation is said to have been 38 ft. wide, but only the foot-wall leader was mined, and this, though larger than in the A1, was much poorer. As far as can be learned, only 259 tons in all were crushed from the property, which only yielded 84 oz. gold, valued at £325 10s.

BIG RIVER GROUP.—SUNDERLAND'S LODGE-SERIES.

This series occurs between the Big River and Blackwater groups, and a number of claims, chief of which were the St. George and the South Big River, were taken up along it.

St. George Mine.—Auriferous stone was first found on the line in this claim by James Sunderland in 1891, and for several years following the discovery the ground was fairly well prospected. A five-stamp battery was erected, and from an adit driven at a depth of 50 ft. below the first-located outcrop 30 tons of quartz were taken out, which on being crushed yielded 70 oz. gold. Three lines of reef, known as the eastern, central, and western, were found on the claim, but although one formation was up to 12 ft. in width, and a small crushing of 16 tons from another gave a return of 2 oz. 7 dwt. gold per ton, development on all the reefs proved so disappoint-

ing that in 1895 the claim was abandoned and the plant disposed of. In 1898, and again in 1904, some little further prospecting was done on the ground, which, however, gave no better results than the previous work. In 1908, following the success attained by the Big River Mine, the St. George and all the other claims along the line were taken up again, and the St. George Gold-mining Company was formed to work the St. George and Matthias Claims. An adit was started on the Snowy River fall in the latter claim in 1909, to give from 270 ft. to 500 ft. of backs on the three known lines of reef, and this was subsequently extended northerly for upwards of 1,800 ft., but the driving throughout was on a fault with well slickensided walls, which carried occasional boulders or bunches of quartz but no solid stone. Crosscuts were run out to east and west. The westerly crosscut was extended for 180 ft. from the main drive, and at 106 ft. in what was believed to be the western reef was struck, and was driven on for a considerable distance, but nothing of value was found. In 1911 this long adit was extended into the South Big River Claim, still without satisfactory result, and in 1912 all work by the company was discontinued, and nothing has since been done on the areas it held.

South Big River Mine.—This adjoined the St. George on the north, and was about two miles south of the Big River Mine. It seems to have been first prospected about 1908 by the South Big River Gold-mining Syndicate, and afterwards by the Big River South Gold-mines, Ltd. Two winzes were sunk on the outcrop, and three adits were driven at 15 ft., 70 ft., and 185 ft. respectively below the outcrop; but, although some gold-bearing stone was got in the upper workings, the results of the work were unsatisfactory, and in 1914 the ground was abandoned. In the lower levels a strong reef-track was followed, but it contained no payable stone. In 1921 the claim was again taken up, this time by William Rodden, and prospecting was resumed. No. 2 adit was repaired and extended, and some gold-bearing stone was found near the most northerly of the old winzes, but the reef was very broken, and the quartz in small quantity. A little later the claim was taken over by the South Big River Mines, Ltd., a subsidiary of Reefton Mines, Ltd., and for a time prospecting was pushed along vigorously, particularly in No. 3 adit, which was driven a further considerable distance on a reef-track up to 4 ft. or more wide, consisting mainly of pug with splashes of much-crushed quartz. Altogether, this adit was extended to 900 ft. from the portal, of which the last 400 ft. were on reef-track of the character mentioned. From a point about 160 ft. from the end a crosscut was also put out to the west for approximately 460 ft., with a view to picking up a supposed parallel line of reef. At 290 ft. from the main adit a formation in the nature of a stockwork, consisting of a mixture of quartz and country-rock was met, and was driven on for 75 ft. north and 50 ft. south. This formation was about 4 ft. in width, and carried a little gold, but in quite unpayable amount. The company also connected Nos. 2 and 3 adits by means of a rise.

The appearance of the mine indicated that in all probability at one time a reef-line having several short shoots of stone existed, but that later post-mineral faulting had occurred, resulting in the reopening of the original fissure and the crushing of its contents and walls. In Dr. Henderson's opinion the fissure followed in the workings was probably the same as that in which so much driving had been done in the St. George Mine.

At the present time the mine is idle, and there is little to justify the expenditure of further money in prospecting it.

BIG RIVER GROUP.—DOOGAN'S LODE-SERIES.

This series was next in a southerly direction from McGee's series, about sixteen miles by road from Reefton and eight miles in a direct line. Gold-bearing quartz was first found on it by H. F. Doogan in 1880. In 1882 the Big River Gold-mining Company was formed to work the discovery, but for some time, owing to the inaccessibility of the locality, no very active development was carried out. By 1886 a road sufficiently graded to enable machinery to be carted out was completed, and in the following year a ten-stamp battery was erected. By the time this plant was ready to start crushing, about 200 tons of stone were at grass, which was estimated to be worth fully 2 oz. gold per ton, but when it was crushed the ore did not come up to expectations. In the same year, 1887, another shoot of stone was struck, however, which gave better promise, with the result that by the end of the year 510 tons had been put through the mill for a return of 645 oz. gold, equal to about 25 dwt. per ton.

The first active mining-work took the form of putting in two adits, with their portals only a short distance one from another, one of which was driven north-eastward towards the outcrop first discovered, and the other north-westward and then eastward to a point where it made connection with a shaft sunk from the crown of the spur in which the lode occurred. This later working was known as No. 1 level of the mine, and was 220 ft. below the shaft-collar. Several isolated blocks of stone of no great size were met with in these adits. The fact that they did not live far above the level is shown by the small amount of quartz won from them, the total crushings up to the end of 1890 amounting to only 1,210 tons, which yielded 995 oz. gold, valued at £3,893 6s. 8d. During the same period £7,450 had been called up. No. 2 level, 420 ft. from surface, gave more ore, and evidently ore of better value, for during the year ending 31st March, 1892, it is reported that 1,625 tons were crushed for a yield of 3,704 oz. gold, valued at £14,807. Half of the expense of sinking the shaft from No. 2 to No. 3 level was borne by the adjoining company, the Lord Edward, and most of the work done on the latter level appears to have been carried out in the Lord Edward ground. That company did not succeed, however, in finding, either on that level or in any part of its property, any quantity of payable stone. A small parcel of 32 tons was crushed for 34 oz. gold in 1893, but this seems to have been the only quartz produced from the mine. On No. 3 level the Big River Company located one block 100 ft. in length and up to 12 ft. in width. Thereafter, for some years, the company continued operations with varying fortunes. Nos. 4 and 5 levels appear to have been fairly productive, but No. 6 was a poor level, only one very small block being found on it.

About the end of 1890 the Lord Edward and Big River Companies merged under the title of the Big River Extended Gold-mining Company, but after the amalgamation the company evidently did not do much good. It continued the sinking of the shaft down to No. 9 level (1,375 ft.), but such blocks of stone as were found on the different levels opened out were scattered and small in extent. In 1907 another reconstruction took place, and the company became known as the New Big River Gold-mining Company, Ltd. This new company met with almost instant success. It consisted of 24,000 shares of 5s. each. Only one call of 6d. per share was made, and on this no less than £4 15s. per share was paid in dividends during the following years. Almost immediately after the reconstruction good stone was struck in No. 9 level, and the level proved a most productive one, large

ore-bodies being traced from it up to No. 8 level. No. 10 level was nearly as good as No. 9, and the stopes over No. 11 level (1,775 ft.) also produced large quantities of stone of good grade. Between Nos. 8 and 11 levels the country was much broken, and the blocks of stone found lay in all sorts of situations and at all orientations, making it evident that the greatly increased amount of ore found in that part of the mine resulted from faulting of the lode, the quartz of an upper portion having been thrown down and massed up with that of another portion in which the blocks were less disturbed. A wide ore-channel existed, in which the blocks of stone occurred most erratically. On No. 11 level the appearance of the mine began to alter again. The wide ore-channel closed in, and such ore as was located on the level or below it was apparently confined to what may be considered the original fissure, and this ore was in much less quantity than on the two preceding levels. On No. 12 level (1,925 ft.) practically no stone was located, and there was a very limited tonnage developed between it and No. 11.

Up to the end of 1926 the total amount of quartz crushed from the mine was 107,113 tons, which yielded 123,515 oz. 7 dwt. 3 gr. gold, valued at £501,360 13s., and the sum of £145,098 was paid in dividends.

Owing to the erratic disposition of the blocks of quartz through the mine it was not found possible to prepare any satisfactory longitudinal or transverse sections of the workings, but a study of the plan seems to indicate that originally there were two main shoots, with an easterly dip and a northerly pitch. These were shattered by faulting, so much so that it is difficult to correlate any of the ore-bodies in the lower part of the mine with those of the upper part, but from No. 8 level down there was sufficient connection between the blocks to enable a very fair idea of their pre-fault occurrence to be arrived at.

Owing to the unsatisfactory nature of the developments in the bottom level the mine is now closed down, and it is questionable if further prospecting in it is justifiable. Referring to the mine in 1913, Dr. Henderson says (Geol. Bull. No. 18, p. 171): "The ore-bodies developed in No. 2 to No. 9 levels are more or less connected, and the same may be said of the double blocks occurring in No. 7 to No. 10 levels. It is probable that the northerly blocks of the lower levels may be correlated with the ore-bodies so far developed in the upper levels, except in the case of that in No. 2 level. The southerly ore-bodies of the lower levels would then correspond with the original Big River block that was located in No. 2. In this case two original ore-shoots would be indicated, and further prospecting towards the south-east in No. 3 to No. 6 levels is advisable." There seems to be some probability that search eastward from the shaft on these upper levels may reveal stone. The one ore-body in No. 2 level referred to by Dr. Henderson as not being correlated to the northern blocks in the bottom levels was only traced a short distance below that level, and may form portion of a third shoot not elsewhere seen, but which might be located by prospecting. It is doubtful, however, if prospecting in any other direction from these upper levels would yield any useful result. Small blocks of stone belonging to the southern shoot may exist there, but the probability is greatly that any stone that may have originally been there ~~has been~~ carried down by the fault movement to a lower horizon. It is also possible that between Nos. 6 and 11 levels stray blocks of ore may have been missed or left behind. For instance, on No. 10 level a strong block of quartz,

known as the south-east block, was stoped up for some distance towards No. 9 level. It was going underfoot on No. 10, and a winze was sunk for a few feet on it, and when the winze was discontinued the stone was still going down, but nothing more was ever done by way of prospecting lower down for this stone. The intention of the management had been to search for it by means of an intermediate level between Nos. 10 and 11, but, although an intermediate was carried in towards the block at 90 ft. above No. 11, it was never extended sufficiently far to reach the stone. Portion of this block therefore remains undeveloped, and there may be other blocks or portions of blocks left in the same way, but the expense that would now have to be incurred in picking up the old levels to get into the parts of the mine where they are likely to be would be too great to warrant search for them being made under existing conditions. As to further prospecting on No. 12 level, or at greater depth below it, it must be said there seems little to justify it. The most work there the writer could recommend would be the putting-in of two short crosscuts, with a view to determining definitely whether or not the downward continuation of the shoots worked higher up have been missed on the level.

North Big River Mine.—This mine adjoined the Big River on the north. In 1909 William Kirwan located on it the outcrop of a reef which was subsequently traced by trenching for about 500 ft. along the surface. It was from a few inches up to 3 ft. in width, and was said to prospect fairly well. Shortly after the discovery an adit was put in, at a point about half a mile from the Big River shaft, to cut the vein about 50 ft. below the outcrop and 150 ft. from daylight. In this adit several reef-tracks were cut, one of which, met at 70 ft. from the portal, carried small boulders of gold-bearing quartz in very wet and broken country. Subsequently the prospecting party put in another adit, known as No. 2, at a depth of 150 ft. below No. 1, which, with the assistance of Government subsidy, they drove for 497 ft. At 250 ft. from the portal a small reef-track was met with, but it contained no gold, and for the last 150 ft. the driving was on a small reef that carried gold, but not in payable quantity. The party also started a third adit, 163 ft. below No. 2, but after driving this for about 100 ft. work was suspended. In 1919 a company known as the North Big River Mines, Ltd., was formed to give the property another trial. This company extended No. 3 adit about 600 ft. farther to the south, to come under the old surface workings, and also did hundreds of feet of crosscutting from it, but nothing was found except small reef-tracks carrying occasional boulders or blebs of poor quartz. The company also put in another adit, known as No. 1 Intermediate, 40 ft. below No. 1 adit, and connected Nos. 1 and 2 adits by rises and winzes, but in these workings no better results were met with than in No. 3 adit. A further work carried out by the company was the putting-in of what was termed No. 4 adit on another reef to the westward of that on which the other adits mentioned were driven. This adit was only very few feet under the surface, on the course of a reef about 3 ft. in width, but the stone was found so poor that, after going 100 ft. on it, operations were abandoned.

National Mine.—It is somewhat doubtful if this claim was on Doogan's line, but it deserves passing mention. A small reef was found outcropping on it by John Gill in 1891, and a drive was put in on it for 150 ft., but the reef was very broken. A parcel of 66 tons of stone taken from it was crushed, but it yielded only 12 oz. gold, or, say, 3·8 dwt. per ton.

BLACKWATER GROUP.—MARTIN'S LODE-SERIES.

This lode-series is the most southerly in the western section of the Reefton auriferous belt on which any development of importance has occurred. The field is situated about twenty-five miles south from Reefton by road, but in a direct line it is only half that distance.

Snowy Creek Mine.—The first discovery of gold-bearing stone on the line was made in the "nineties" close to Snowy Creek, where a reef averaging 2 ft. wide was found outcropping. A company known as the Snowy Creek United was formed to develop the find in 1898, and a winze was sunk from the outcrop to a depth of 118 ft. In the following year a party of tributers took the property over, and drove a level from this winze, erected a three-stamp battery, and crushed some small parcels of quartz, but the yield was unsatisfactory. In 1900 the company took over the claim again, and did some further prospecting with no better results, and the property was soon afterwards abandoned. During the time the claim was held by the company 159 tons of stone were crushed for a yield of 50 oz. gold, equal to 6.22 dwt. per ton. Some years later the ground came into the hands of the Blackwater Mines, Ltd., which did some further prospecting on it, but the only stone found was narrow and very broken, and did not carry payable values.

Blackwater Mine.—In November, 1905, a party prospecting in the locality with the aid of Government subsidy discovered the outcrop of a small gold-bearing reef in Greek's Creek, about three-fourths of a mile northerly from the Snowy Creek Company's workings. Very shortly after making this find the party, which consisted of four men, disposed of their interest in it to Mr. P. N. Kingswell, who, in turn, after doing a little work on it, sold it to the Consolidated Goldfields of New Zealand and the Progress Mines, Ltd. The price paid to the prospectors is said to have been £2,000, and that paid to Mr. Kingswell £30,000. After acquiring the property the two companies mentioned formed the Blackwater Mines, Ltd., a company of 250,000 shares of £1 each, to work it. The sinking of a haulage shaft was started not far from the site of the first discovery, and about 200 ft. on the hanging-wall side of the reef, and two levels, No. 1 at 150 ft. from surface, and No. 2 (Joker level) at 305 ft., were rapidly pushed out, showing that a long run of stone existed. The erection of a thirty-stamp battery, equipped with tube mills, concentrating and cyaniding plants, was also quickly proceeded with, and crushing was begun in July, 1908, from which time up till the present it has been continued with a great measure of success.

The sinking of the shaft was steadily gone on with, and eight further levels were opened—No. 3 at 430 ft., No. 4 at 615 ft., No. 5 at 765 ft., No. 6 at 915 ft., No. 7 at 1,064 ft., No. 8 at 1,214 ft., No. 9 at 1,364 ft., and No. 10 at 1,514 ft., respectively from the shaft-collar. The shaft has also been sunk another lift, and a chamber cut for No. 11 level at 1,664 ft.

The workings have served to show that in common with the others occurring in the district, the reef consists of a series of lenses, but the blanks between them are short, and in places one lens practically joins up with another. The reef has a westerly dip of about 80° and strikes about N. 30° E. It consists of four main lenses, which pitch to the north at an angle of about 38°. The stone varies in width up to 8 ft., but the average width is only about 2 ft. The most southerly lens is about 400 ft. in length, the next in northerly succession 800 ft., the next 1,400 ft., and the most northerly about 300 ft.

For the whole depth so far reached, the lenses, although more or less broken by minor displacements, live down fairly uniformly, and down to No. 9 level carried fairly regular values. On No. 10 level the development work showed values up to the usual standard, but when stoping was started above the level the gold content of the stone seriously decreased. As payable values are, however, going underfoot, this falling off is probably nothing to be concerned about. It has been a feature of several of the Reefton mines that zones of poor values would occur, only to be succeeded at depth by others of better values.

In the north end of the mine the pitch of the shoots or lenses was carrying them rapidly into the adjoining ground held by the North Blackwater Mines, Ltd., the small northern shoot entering the latter at about the horizon of the Blackwater No. 3 level, and the next shoot at the horizon of No. 5 level. To ensure its own mine a longer life the Blackwater Company has, within the current year (1927) purchased the North Blackwater Company's property, and is now busily engaged in pushing its Nos. 6 to 9 levels into the latter. These workings are, however, nearly 2,000 ft. from the company's haulage shaft, and to reach them a tremendous outlay is entailed in maintaining levels and meeting increased costs of underground transport, so that in the future it would seem that the North Blackwater shaft will have to be used as a main winding-shaft for the property. This shaft is only about 500 ft. from the boundary of the claims, but up to the present it has only been sunk to about 50 ft. below the Blackwater No. 6 level, and would, of course, have to be carried down much deeper to be of any service for haulage purposes.

Since the battery started crushing in 1908 there has been only one break in its operations, labour troubles having caused a stoppage for six months in 1912, and up to the end of 1926 the quartz crushed amounted to 690,309 tons, which yielded 329,012 oz. 12 dwt. 7 gr. gold, valued at £1,330,895 1s. 3d. and dividends to the amount of £193,742 18s. were paid out.

The mine promises to have still a good many years of productive life ahead of it, but, owing to the increasing depth of the workings and to the even more serious handicap imposed by the materially heavier costs of labour and mining supplies that followed the World War, it is not to be expected that operations can be as profitable as formerly; indeed, it is questionable if the future earnings will ever do much more than pay working-expenses.

North Blackwater Mine.—To the immediate north of the Blackwater Mine a number of claims, among which were Scott's Special Claim, the Lord Reading, and Mills's and Fry's Claims, were pegged out shortly after the first discovery of the reef in Greek's Creek. No outcrops of any importance were ever found in these areas, nor did prospecting reveal any reef. About 1907 several of these claims amalgamated, and a syndicate known as Fry's Prospecting Syndicate drove a long crosscut adit through them westerly from Coorang Creek. This adit reached a total length of about 1,120 ft., and at least six reef-tracks were cut in it, but none of them carried any solid stone. The Blackwater Mines Company also extended their No. 2 level for about 565 ft. in to the same claims without finding anything but mere reef-tracks. In both of the workings mentioned the country was much crushed. It was known, however, that the shoots of ore being developed in the Blackwater Mine were pitching into these northern areas, and would be located in them at depth, and this led, later on, to the amalgamation of all the northern claims and the formation of the North Blackwater Mines, Ltd., to provide the money for sinking a shaft to reach the shoots. It was planned at first to sink the shaft direct to at least 1,650 ft., as at that

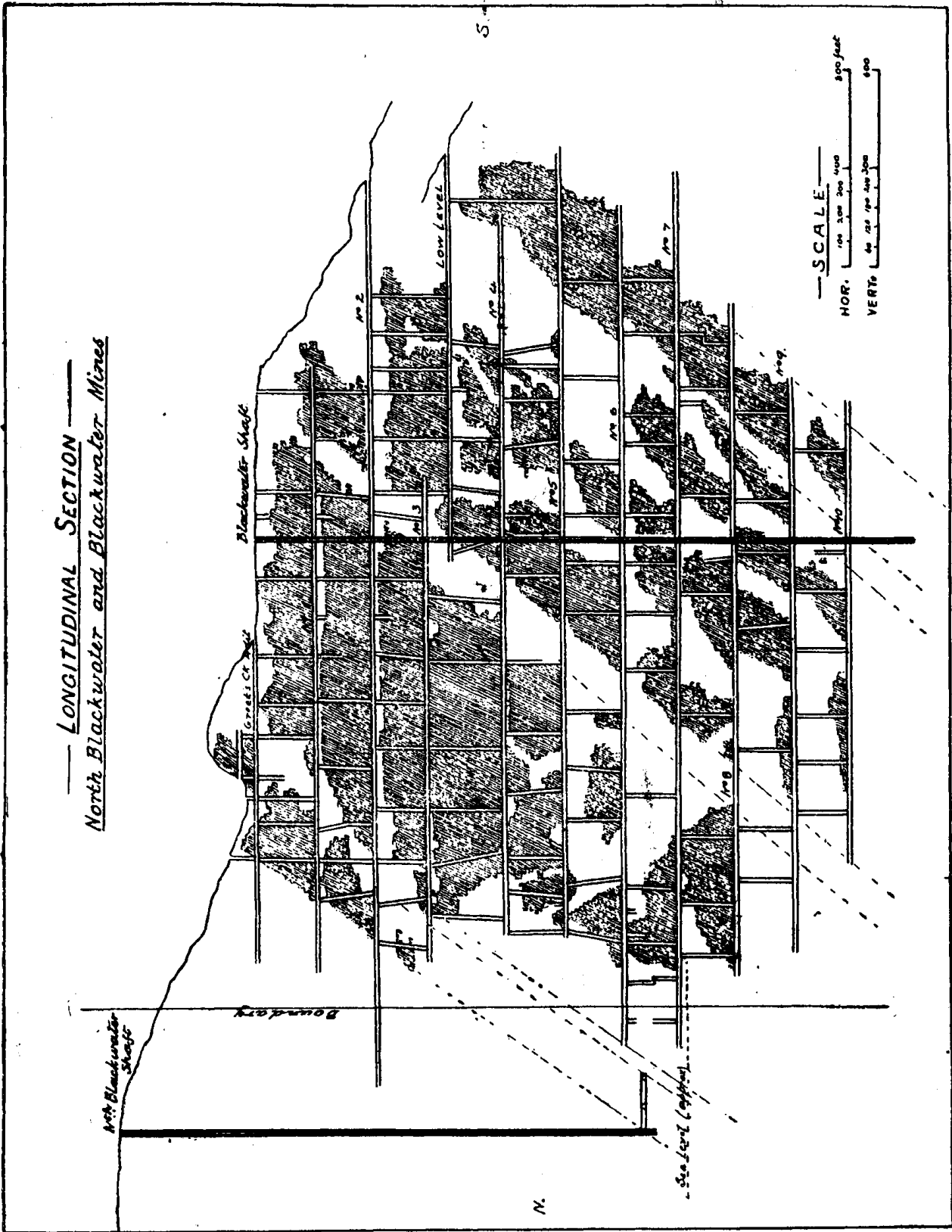


FIG. 10.—LONGITUDINAL SECTION OF BLACKWATER AND NORTH BLACKWATER MINES.

depth it was considered sufficient of the shoots would be in the new company's ground to admit of several levels being opened on stone. Despite the fact, however, that the Government assisted the project by a grant of £10,000 as subsidy, it became evident that the available finances would not allow of sinking to the depth proposed, consequently a level was opened out at 1,350 ft. and a crosscut driven east for 305 ft. in which what appeared to be parallel reefs were cut at 18 ft., 120 ft., and 220 ft. from the shaft. The first-mentioned of these was only about 8 in. wide, but carried good gold values. The second reef was about 20 in. wide, and the third 15 in., and both also showed good prospects of gold. Later investigation left little doubt, however, that, although the small reef first struck might be one not previously cut in any of the local workings, the other two reefs were parts of the Birthday or Blackwater reef, the parallel occurrence being due to faulting. It may be mentioned that in the Blackwater Mine no prospecting whatever has been done west from Birthday reef to see if any other reef occurred in that direction. The reef at 120 ft. in the North Blackwater crosscut was driven on north for 10 ft., when it cut out, and for 112 ft. south, where it also disappeared, while that at 220 ft. cut out at 70 ft. north and 21 ft. south. Another level was then opened out at 1,200 ft. in the shaft, and a crosscut put out, also to the east. In this the reefs met at 18 ft. and 220 ft. in the lower crosscut were met with, but no reef corresponding with that at 120 ft. was intersected. The company's funds having been exhausted by the time these mining operations were carried out, work was suspended, and the mine lay idle until it was purchased by the Blackwater Mines, Ltd.

It is as certain as anything can be that all the shoots located in the Blackwater Mine will eventually make into the North Blackwater ground, hence gold-bearing stone may possibly be got for many hundreds of feet in the latter below the present bottom of the shaft, but the depth to which it will pay to work under modern conditions is another question. There seems no good reason, however, for thinking otherwise than that stone of fair grade should live down for at least another 1,000 ft.

South Blackwater Mine.—South of the Blackwater Mine a number of claims are held by the South Blackwater Mines, Ltd., which is understood to be a subsidiary of an incorporation known as Reefton Mines, Ltd.. In these claims the Birthday, or Blackwater, reef is believed to occur, and there are a number of other parallel outcrops known as the Snowy, Empire, Kathleen, and Imperial reefs. On what is thought to be the continuation of the Birthday reef a drive was extended some years ago for a distance of nearly 300 ft., but such stone as was found in it was very broken. On the Empire reef two adits were driven on a shoot of stone about 115 ft. in length and 16 in. wide, averaging 8 dwt. gold per ton. On the Kathleen reef a shaft was sunk to a depth of a little over 20 ft. The reef in the bottom was about 4 ft. wide, but was extremely poor. The Snowy and Imperial outcrops have had only a small amount of surface examination.

During 1926 a start was made to put down a large haulage shaft on the property, at a site about 5,500 ft. south of the Blackwater shaft and 4,500 ft. south of any known payable ore-body in the Blackwater Mine. At the present time (November, 1927) this shaft is down a little over 300 ft., and work is suspended. The intention of the company was to sink it to 600 ft., and crosscut at that depth for the various reef-lines to which mention has been made. To intersect the whole of the lines, approximately 2,640 ft. of crosscut would be needed. It is considered that the

Birthday reef should be about 3 to 4 chains west of the shaft, and the Kathleen about 12 chains, while to the east the Snowy line should be 12 chains, the Empire 16 chains, and the Imperial 32 chains. If the proposed work were looked upon purely as prospecting it might have something to recommend it, but in view of the great distance it is from any known payable reef, and the comparatively poor results of all the testing so far done in the company holdings, there seems little to justify the immense expenditure the carrying of it out would entail.

BLACKWATER GROUP.—HURLEY'S LODE-SERIES.

This lode-series lies about 30 chains eastward of the Birthday, or Blackwater, line. In 1906 a very rich leader was found on it by James Hurley, a short distance north-east of Trig. M, which on being followed down was found to be cut off by faulting at a shallow depth, and could not subsequently be picked up again. In 1914 the Blackwater Mines, Ltd., put out a crosscut for 800 ft. to the east on No. 3 level, with a view to prospecting the country towards the leader, but the work was not carried far enough to reach the latter, even if it lived down to that horizon. Several other small leaders were cut, however, in this crosscut, but only one of them had any gold values, and this was much too poor to pay for working.

The Empire and Imperial outcrops in the South Blackwater Company's ground are thought to be probably on the same line.

Eastward of Hurley's leader, and also to the north of the North Blackwater Mine, much prospecting has been done for miles, and many outcrops were located, all of which either barren or contained merely the barest traces of gold.

MILLERTON GROUP.—DANK'S LODE-SERIES.

This series is about two miles westward of the Blackwater (Martin's) line. A gold-bearing reef is said to have been exposed there many years ago by alluvial miners working in Snowy Creek. In 1911 a syndicate composed mainly of men employed at the Millerton Coal-mine at Westport sent two prospectors named Danks and Morgan to examine the locality. These men soon found an auriferous outcrop on the north bank of the creek. With the assistance of Government subsidy an adit was driven into the rising ground immediately above the outcrop, which followed reef for about 180 ft. For the first 30 ft. the stone was of fairly good grade, and up to 3 ft. in width, but for the rest of the way it became much narrower and poorer. At 180 ft. in the reef pinched to a mere track, and continued so for a further 70 ft., when it widened again to about 3 ft. and carried values estimated to go from 20 dwt. to 25 dwt. gold per ton. At 300 ft. from daylight the adit passed into alluvial drift and was discontinued.

Shortly after this, the Millerton Gold-mining Company, Ltd., of a nominal capital of £62,000 in 62,000 shares of £1 each, was formed to work the property. Of the capital, £12,000 cash was to be paid the vendors, £2,000 went in flotation expenses, and £14,000 was to be provided for working-expenses. A start was made to sink a vertical shaft about 450 ft. north of the original discovery, and this was subsequently carried down to a depth of 390 ft., three levels being opened from it, at 115 ft., 240 ft., and 415 ft. respectively below the shaft-collar. No. 1 level connected with the

adit already referred to; No. 2 level was driven upwards of 200 ft. north and about 400 ft. south; No. 3 level was driven 550 ft. north and 400 ft. south. In these last two workings gold-bearing shoots corresponding with those met with in the adit were located. On both levels, however, the northern shoot was found too short and poor to pay for working, but the southern shoot was stoped up to the adit. Occasional splashes of rich quartz were met, but on the whole the stone was very low grade. In all some 4,483 tons of quartz were crushed, for a yield of 1,675 oz. 8 dwt gold, valued at £7,504 13s. 4d., an average of 7.46 dwt. or £1 11s. 3d per ton.

All this work was not done by the Millerton Gold-mining Company. That company had exhausted its capital by 1914, when it suspended operations, and the claims lay idle till 1920, when they passed to the New Millerton Mines, Ltd., a subsidiary of Reefton Gold-mines, Ltd. This company did most of the development on No. 3 level, erected the battery and did all the crushing; but, as it could not work the mine profitably it also ceased work in 1924. Since then a little fruitless prospecting has been done on what is known as the Anzac section of the property, immediately south of Snowy Creek, but no attempt has been made to reopen the main workings.

In the present writer's opinion the mine is not worthy of any further trial. At the time Dr. Henderson inspected the mine, when preparing his geological survey of the district, the adit previously referred to and a shaft sunk on the outcrop, from which a drive had been put out to the lode represented all the mining done; but he noted then that the reef-track in the latter was strongly suggestive of a lode faulted along its strike. The work done on Nos. 2 and 3 levels from the main shaft showed that this judgment was well founded, as the whole appearance of the lode for the full length of these workings was that of a lode faulted in the way mentioned. More or less quartz was to be found all along the levels, but it was mixed with pug and was all badly crushed. Near the north end of No. 3 level a cross-fault cut the track off, and it was not located again.

Northward of the New Millerton Company's areas, and along the same general lode-line, indications of reef were got in several prospecting claims notably Saraty's and O'Connor's, but in both of them the stone was much crushed and the shoots did not seem to live far in any direction. On some of these areas further investigation may, however, be justified.

PAINKILLER GROUP.—WESTERN LODGE-SERIES.

This series lay to the north of Anderson's series, and between it and the Boatman's Groups, a short distance northerly from Reefton. At least four claims on it—the Gladstone, Sir Charles Russell, Dillon, and Ulster—were found to contain auriferous outcrops, but, although much work was done on them, the results were in all cases unsatisfactory.

Gladstone—Sir Charles Russell Mine.—Gold-bearing quartz appears to have been discovered in the Painkiller locality probably as early as the "seventies," and a certain amount of prospecting was done about that period, but nothing of an encouraging nature was evidently found. In the early "eighties" a company known as the Gladstone took up one of the old prospected areas and did some further work on it, evidently with no better result, and in 1886 the company became defunct. Three years later an outcrop not seen by previous prospectors was located just outside the

Gladstone Claim, and a new company, the Sir Charles Russell, was formed in 1890, which took up the new find as well as part of the old Gladstone ground. An adit was driven from the south side of the hill on which Trig. E1 is situated, which crosscut the country for 50 ft. before intersecting the reef, and then followed the latter for 200 ft. The stone is said to have averaged 2 ft. in width, but to have been very bunched and irregular. A second adit was driven 170 ft. below No. 1, with its portal on the northern side of the hill. This adit crossed the country for 700 ft. before it reached the reef-channel, along which it was subsequently extended for 1,600 ft., 400 ft. of which was in the adjoining Dillon Claim. A winze was also sunk on the stone for 96 ft. from No. 1 adit, and at this depth an intermediate level was opened out, from which a connection was made to No. 2 adit. The reef is said to have had a north-north-west strike and a steep westerly dip. On the intermediate level, which was evidently the lowest point to which the reef was traced, it is reported that it was 18 in. wide. In 1893 the company purchased a ten-stamp battery formerly used at the Supreme Mine, and re-erected it on the south bank of the Waitahu River, about 35 chains from the mine, connecting it to the latter by means of an aerial tramway. The stone above the intermediate was stoped to surface, but did not amount to more than 881 tons, which yielded 597 oz. gold, valued at £2,368 5s. 7d.

Beyond the extension of the No. 2 adit into the Dillon Claim, nothing more was done on the Sir Charles Russell till 1912, when it was taken up again as the Pride of Reefton; and some further prospecting was done on it, without, however, any more satisfactory result being met with.

Dillon Mine.—This adjoined the Sir Charles Russell on the south, and was on the same ore-channel as the latter mine. The original Dillon Gold-mining Company was registered in October, 1891. An adit was driven into the claim from the opposite side of the gully from the portal of the Sir Charles Russell No. 1 adit. This cut the ore-channel at 75 ft. in, and followed it for some distance, but the lode was found so broken and poor that work was abandoned. The company then sank a winze about 7 ft. from its northern boundary to a depth of 106 ft., the upper 50 ft. of which was on stone said to have shown gold freely. In 1896 the Sir Charles Russell and Dillon Companies merged under the title of the Dillon Extended, and the No. 2 adit of the former was advanced to come under the Dillon winze, with which connection was made by rising. No plans of these workings exist, and for lack of them it is difficult to say what the precise extent or nature of the development work carried out by the reconstructed company amounted to; but it seems fairly certain that, as far as the Dillon Claim is concerned, no other work than that described was done on it, and the only record there is of any crushing from the claim is that of a parcel of 90 tons, treated in 1897, which yielded 52 oz. gold, valued at £201 10s. This quartz was taken from the upper part of the winze sunk near the northern boundary. All the old official reports regarding the claim being very incomplete and somewhat contradictory, it is impossible to determine whether or not any stone was found other than that in the winze; but the Mines Reports of 1898 (C.-3A, p. 16) seem to indicate that in extending the No. 2 Sir Charles Russell adit one short shoot, from 2 ft. to 3 ft. in width and 30 ft. long, was struck; but the quartz must have been poor, for no stoping was evidently done on it. The claim has been idle since 1899, and it cannot be said that there was anything in the early work done to justify further prospecting on it.

Ulster Mine.—The early history of this mine seems to be shrouded in some mystery. It appears to have been known as the "Ulster" in the early "nineties," and to have been prospected then by William McCloy. In 1896 it was visited by Professor Black, of the Otago School of Mines, who reported on it on behalf of Messrs. Forsyth and Masters, of Reefton. He describes the prospecting-work done up to that time as consisting mainly of two surface trenches 500 ft. apart, a winze 50 ft. deep, and an adit a short distance below the outcrop, which cut the reef at 40 ft. in from the portal. In one of the trenches he gives the width of the reef as 2 ft. 6 in., and in the other as 6 ft. 6 in., while in the adit it was 7 ft. wide, consisting of 2 ft. 6 in. of solid quartz on the hanging-wall and 1 ft. 6 in. on the foot-wall, with 3 ft. of mixed quartz and country between. As the winze had a lot of water in it he could not see what the width of the stone was in it, but a pile of quartz on the surface indicated that it had been sunk on rich reef. General samples were carefully taken from the stone in the trenches and the adit, also from the heap at the top of the winze, all of which on being assayed showed high gold values. A sample from the first-mentioned trench gave 13 dwt. 1 gr. per ton, and that from the other, taken right across the 6 ft. 6 in. of formation, gave 2 oz. gold per ton. Two samples from the heap of quartz at the winze gave 5 oz. 3 dwt. 6 gr. and 5 oz. 0 dwt. 15 gr. respectively, while a mixed sample from across the 7 ft. of formation in the adit gave 3 oz. 14 dwt. 15 gr. gold per ton. He estimated the average width of the stone throughout to be 3 ft. In the face of these high results it seems strange that for ten years afterwards no active move was made to develop the property.

In 1906 the claim was evidently held by a party of Reefton mining-men known as the Phoenix Syndicate. This party erected a five-stamp battery which was driven by an 8-horse-power oil-engine, and commenced crushing. Operations seem to have been mainly confined to stoping on such ore as was in sight above the upper adit, and within the following two years 247 tons were mined and crushed for a yield of 200 oz. 12 dwt. gold, valued at £736 12s. This return was only equal to a yield of 16 dwt. 6 gr. per ton, which was very much below the values obtained by Professor Black.

In 1908 the property passed to the New Ulster Gold-mining Company, which drove a second adit, supposed to be about 30 ft. under No. 1. This adit was driven for 1,200 ft., all of which, with the exception of 100 ft., was on the ore-channel. The whole of the country passed through is described as being crushed and broken, with only occasional stringers or bunches of quartz of low grade. Owing to an error in levelling, the adit, instead of being 30 ft. under No. 1, was, the writer has been informed by a prominent shareholder, directly under it, the timbers of the old adit having actually been picked up for part of the way, hence it proved the ground to no greater depth than the earlier working. This, however, is a matter of no importance, for it is clear that No. 2 adit was throughout on a fault. Having met with no success with this work, the company then ran out a crosscut due east from a point in the adit 212 ft. from the portal. This crosscut was eventually extended to 170 ft., making a total of 382 ft. from the mouth of the adit, and at 24 ft. from the end a drive was put out north from it for 26 ft. on a reef-track. No solid stone was met with, and work was then suspended. The company asked for the assistance of a pound-for-pound subsidy to enable the crosscut to be advanced a further 500 ft., but in view of the nature of the development elsewhere in the mine, and the fact that no reef is known to outcrop to the east, the application was not entertained. In 1912 the company ceased operations, but during its working-

period it crushed 380 tons of quartz, for an even smaller average return than the Phoenix Syndicate had secured, the yield only being 241 oz. 2 dwt. gold, valued at £883 13s. 1d.

In 1919 the property was taken over by the Ready Bullion Mining Company, Ltd., which put in the third adit 250 ft. below No. 2. This adit was carried in for 600 ft., and at its end a crosscut was put out east for 200 ft. in which reef-tracks, containing only fragments of valueless quartz, were intersected at 100 ft., 143 ft., and 175 ft. respectively from the drive. It is doubtful, even had any shoots of stone lived down to this depth, if the adit was carried in far enough to meet it; but it is unlikely that further driving would have brought any better result, and, indeed, bearing in mind the extremely unsatisfactory character of the development in No. 2 adit, it is difficult to find justification for the carrying-out of such work as was done in it. Mining of this kind can scarcely be considered as other than of the "wild-cat" order, and it is to be regretted that well-intentioned supporters of mining effort should be induced to spend their money on it.

The Ready Bullion Mining Company was dissolved in 1926, but no work had been done on the property for several years prior to that date.

CAPLESTON GROUP.—TOPFER'S LODE-SERIES.

The lode-series so named occurs in the Boatman's locality, about four miles and a half north-easterly from Reefton. It was originally prospected by Alexander Topfer in 1872, the first discovery having been made on what was afterwards the Just-in-Time Claim. In common with the other formations of the district, the lode consisted of blocks or lenses of quartz separated one from another by stretches of barren country. A number of claims were pegged out along the line very shortly after the first find, some of which were among the most successful to be opened in the Inangahua County.

Just-in-Time Mine.—This mine, which was towards the southern end of the lode-series, was one of the first to be developed systematically. In 1873 the company owning it joined with the Fiery Cross Company in erecting a fifteen-stamp battery, in which a parcel from the Just-in-Time, of 308 tons of quartz, was the first to be crushed. The yield from this crushing was 1,631 oz. gold, equal to a little over 5½ oz. per ton. Thereafter for a considerable number of years the mine continued to be a regular producer. Portions of two lenses were found to occur in it, the first to be worked being what was known as the western block. The eastern block, otherwise known as the Walhalla was near the boundary of the Fiery Cross Claim, and pitching into it. This block was not found till 1874, when no time was lost in developing it, and most of the best stone taken from the mine was won from it. When it passed into the Fiery Cross ground at the 200 ft. level of the Just-in-Time, the latter company collapsed, and for some years its claims lay idle. The western shoot, which was on the boundary between the Just-in-Time and Reform Claims, only lived down a short distance. About 1896 the areas held previously by the company passed into the hands of the Consolidated Goldfields of New Zealand, which company sank the Just-in-Time shaft, otherwise known as the Imperial-Reform shaft, a further 200 ft., making a total depth of 400 ft. from the collar, and did a lot of prospecting from a level opened out at that depth without finding anything of value. About the end of 1900 the mine was taken over by a party of tributers, who repaired the old 200 ft. (Reform) level, and did much prospecting from it, also without satisfactory result. In 1907 the property

passed to J. Coghlan and party, who carried out some fruitless prospecting in the upper levels, and in the following year Walker and party seem to have taken it over. Another company was then formed, which replaced a winding plant on the shaft, repaired the latter to the 400 ft. level, and carried out further extensive prospecting east and west from that level. A crosscut to the east cut two reef-tracks, which were driven on for considerable distances without anything but odd boulders of quartz being met with. A crosscut was also run out for some hundreds of feet to the west without finding anything of value. This company carried on till 1913. In 1914 the Boatman's Consolidated Company became the owners of the claim and of all the others on the field; but it did no work on the Just-in-Time, confining itself to the sinking of the Fiery Cross shaft to a depth of 1,000 ft. to test the whole area at that horizon.

During its years of production the Just-in-Time crushed, as nearly as can now be estimated, 13,537 tons of quartz for a yield of 17,173 oz. gold, valued at approximately £67,829 3s., and paid in dividends £17,166. These figures include small yields from the Walhalla and Boatman's Creek Claims, which for a time held part of the ground.

Fiery Cross Mine.—This mine adjoined the Just-in-Time on the north, and started crushing in the same year as the latter (1873), but the stone from it was not so rich as from the other mine. Work was at first confined to the Fiery Cross shoot. A three-compartment shaft was sunk, which eventually reached a depth of 450 ft., and three levels were opened from it, at 191 ft., 300 ft., and 450 ft. respectively. From these levels much quartz was won. Below the 450 ft. level the Fiery Cross shoot was followed down by a skip-winze (inclined shaft) a further distance of about 160 ft., two levels being opened from it, one at 103 ft. below the 450 ft. level and the other at the bottom. From this latter a winze was started, but after it had been sunk only a few feet the stone cut out. All the quartz in the shoot having been stoped out, attention was directed to the southern end of the mine, where, on the 450 ft. level, the Just-in-Time eastern shoot was found. To follow this shoot down, a "monkey" shaft was started from the level at a point 200 ft. south of the main shaft. This underground shaft was subsequently sunk to a vertical depth of 360 ft., and three levels were opened from it, from which a good deal of stone was won. Just below the bottom level the stone cut out in much the same way as in the Fiery Cross shoot. These workings having exhausted all the known ore, active work ceased about 1896, and little more was done on the claim till 1914, when the Boatman's Consolidated Mines took it over. This company reopened and enlarged the old 450 ft. shaft and sank it to a depth of 1,000 ft., where a level was opened out and a crosscut driven for 800 ft. to the eastward. To enable this work to be carried out, a Government subsidy of £10,000 was granted. It may be said that the leading technical officers of the Mines Department were averse to the granting of this assistance, as they saw no chance of the work yielding satisfactory results, nevertheless the grant was made and the whole of the money was expended. In the crosscut, three reef-tracks were intersected, and a good deal of lateral prospecting was carried out, but no reef was anywhere found. The company's funds having all been used up, work ceased about 1921 and the company went into liquidation. Before closing down, however, a good deal of fruitless prospecting was done in several of the upper levels. From 1873 to 1895, the period of its productive life, the mine yielded 24,561 tons of quartz, from which 27,958 oz. 10 dwt. gold were recovered, valued at £110,679, and the

sum of £24,168 was paid in dividends. These figures include a crushing of 304 tons from the Alexandra, which yielded 168 oz. gold. The Alexandra was absorbed by the Fiery Cross Company at a very early stage in the history of the field.

Hopeful Mine.—This mine was next, in northerly succession to the Fiery Cross. Auriferous stone seems to have been found in it in 1872 by Ryan brothers. The quartz discovered formed part of what was later and more widely known as the Welcome shoot. This shoot soon passed out on its northerly pitch into the Welcome Company's ground, but during the time (about ten years) the Hopeful Company worked that portion of it lying in its own claim the operations were very successful, some 12,798 tons of stone having been crushed for a yield of 20,954 oz. gold, valued at £121,542 12s., out of which £55,000 was paid in dividends.

Welcome Mine.—The Welcome Company was registered in 1873, the year following the registration of the Hopeful Company, and it started to work the same shoot as the latter. The shoot eventually passed wholly into the Welcome ground, and was followed down by that company to a depth of about 1,000 ft. below the outcrop. Down to No. 6 level the mine was worked from adits, but from that level, at its northern end, a vertical underground shaft was sunk from which three more levels were opened. On No. 9 level very little stone was found, the shoot at that horizon having been shattered by faulting. The last solid stone was got in an intermediate level about 50 ft. above No. 9. By about 1888 the known ore in the mine was exhausted, and negotiations were being made for an amalgamation with the Homeward Bound Company, which held the next claim to the north. This merger was evidently not brought about at the time, and after doing some desultory prospecting the Welcome Company suspended operations and the claim lay idle for several years. In 1892 the Welcome, Homeward Bound, and Eureka Companies amalgamated under the title of the Welcome United, for the purpose of trying to connect the Eureka inclined tunnel with the No. 9 Welcome level, and sinking a shaft from that level to a depth of 250 ft., at which depth it was proposed to put out a level in the hope of relocating the Welcome shoot on the Homeward Bound boundary. The Eureka incline was unwatered, and the level at its foot cleaned up and retimbered. A crosscut was then run out under the No. 9 Welcome level, and from this a "monkey" shaft was sunk to 240 ft., at which depth a drive was extended 540 ft. northerly without finding any reef. Simultaneously with the pushing-on of this prospecting from the Eureka incline the company also reopened the old No. 5 adit and extended it for several hundred feet, thus locating what was known as the Welcome North Block. Only a comparatively small amount of stone was won from this block, which proved to be narrow and considerably broken. The block was traced down to about the horizon of No. 9 level, or perhaps a little below it. By the end of 1904 the company found itself unable to carry on any longer. The mine was then let on tribute to O'Leary and party for three years, but the tribute was abandoned within a year. The company then resumed prospecting for a brief period, and in 1905 McKenzie and party took the property on tribute. During the following two or three years much prospecting was carried out near the surface, with a view to picking up there the cap of the Welcome North Block, but, although several promising reef-tracks were found, no solid reef was located. About 1908 a new company was formed to take over the areas, with the intention of reopening the Boatman's low-level tunnel and prospecting from it for the block mentioned, but no work appears to have been done, and in

1910 the property had passed into the hands of Morris and party. To this party the then Minister of Mines promised a subsidy of £10,000 to enable the ground to be prospected at depth, but the holders were not able to find their proportion of the cost and did no work, with the consequence that a cancellation suit against them in the Warden's Court was successful. Several years later the claims, together with the Fiery Cross and Just-in-Time claims, again came into the hands of the same party, and this time the Boatman's Consolidated Company was formed to carry out the deep-level testing. This company received the £10,000 previously promised as subsidy, and sank the Fiery Cross shaft to 1,000 ft., but no further work was done on the Welcome Claim.

During the time it was actively worked the Welcome Mine produced 31,360 tons of quartz, which yielded 67,676 oz. 19 dwt. gold, valued at £261,155 18s. 2d., and paid in dividends £110,250. As the shareholders in the old company subscribed the small sum of £3,500 only, the claim was thus one of the most payable in the whole district.

Homeward Bound Mine.—This claim, as already stated, was next on the north to the Welcome. The first company formed to work it was registered in 1883, but although it spent a considerable amount of money it met with no success. The principal work carried out was the driving of a long crosscut adit from Boatman's Creek towards the Specimen Hill Claim, and sinking from it, at a distance of about 2,300 ft. from daylight, a vertical shaft to a depth of 300 ft. This adit was known locally by the varied names of the Boatman's low-level tunnel, the Homeward Bound tunnel, and the Specimen Hill tunnel. Seven companies—the Occidental, Welcome No. 2, Homeward Bound, Specimen Hill, Comstock, North Cleopatra, and the Great Eastern—holding claims on or near its line, contributed for a start to the cost of its construction, but long before the work was finished all but the Homeward Bound and Specimen Hill Companies had ceased to exist, and these two completed it. The object in driving the adit and sinking the shaft was to pick up the Welcome shoot at depth, but no sign of it was ever seen in the workings, and a glance at the longitudinal section of the mines now shows that the shaft would have had to reach a much greater depth before there was any chance of meeting it. The work mentioned was completed about the end of 1887, and thereafter for some years little appears to have been done in the way of mining. In 1893 the company merged with the Welcome and Eureka Companies to form the Welcome United—or, as it is termed in some of the old reports, the New Welcome Company. No further prospecting was done, however, in the Homeward Bound ground till 1898, when the company repaired the old adit, and from a point in it about 1,500 ft. from the portal drove out southerly for a distance of 1,153 ft. to come under the old Welcome workings, with which connection was made. The purpose of this work was to try and find the downward continuation of the Welcome shoot itself below the No. 9 Welcome level, but no success rewarded the effort. About 1909 or 1910 another attempt to locate something of value in the claim seems to have been made, but after repairing the adit once more for a good part of its length the party carrying out the work had to give up. Eventually the claim became the property of the Boatman's Consolidated Mines, Ltd., but no further work was done on it.

Reform Mine.—Turning to the southern end of the lode-series, the Reform Company worked a claim adjoining the Just-in-Time. The ground had previously been held by the Imperial Company, which in 1883, in conjunction with the Just-in-Time, sank a shaft to 200 ft. on their joint boundary. It

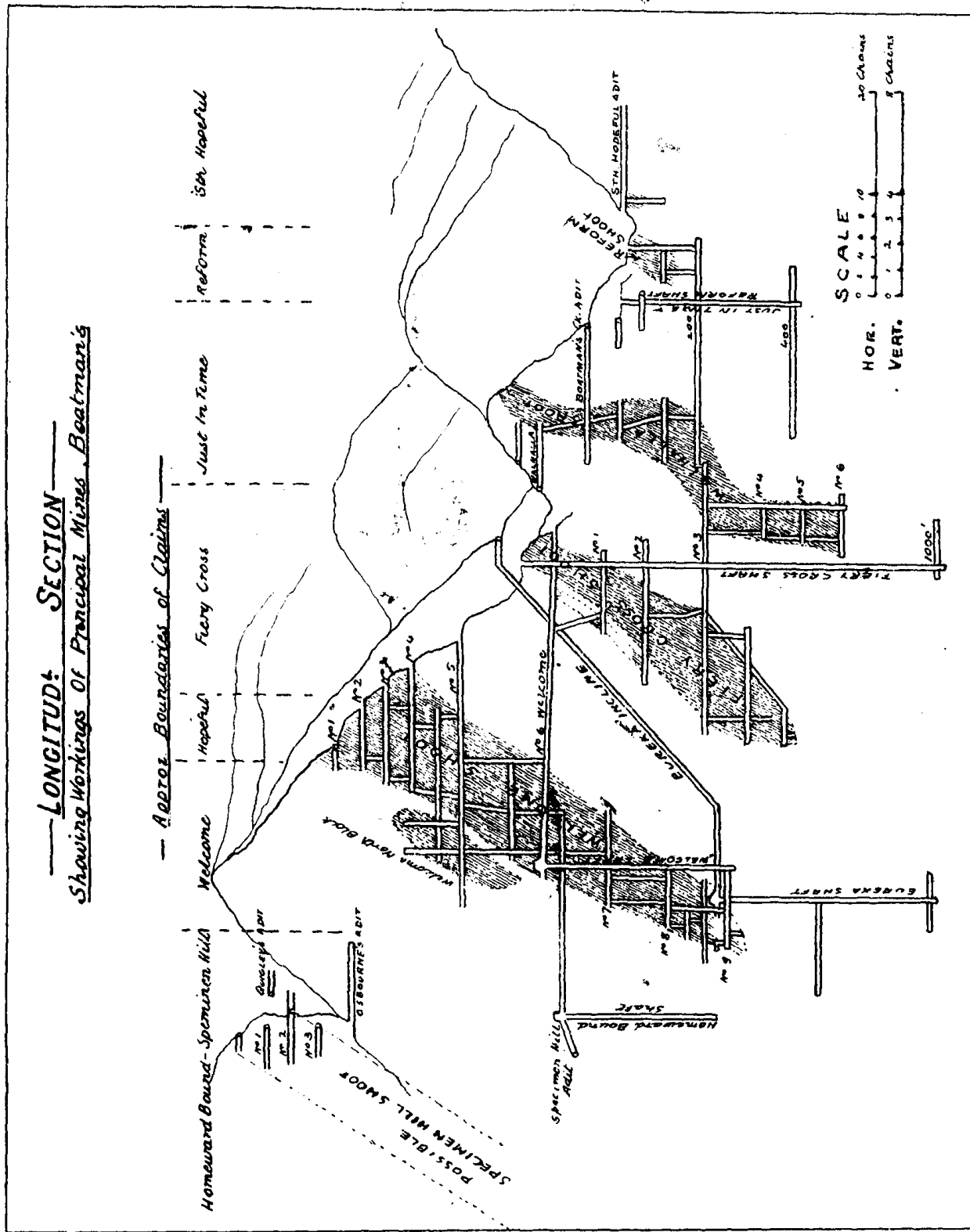


FIG. 11.—LONGITUDINAL SECTION OF BOATMAN'S MINES.

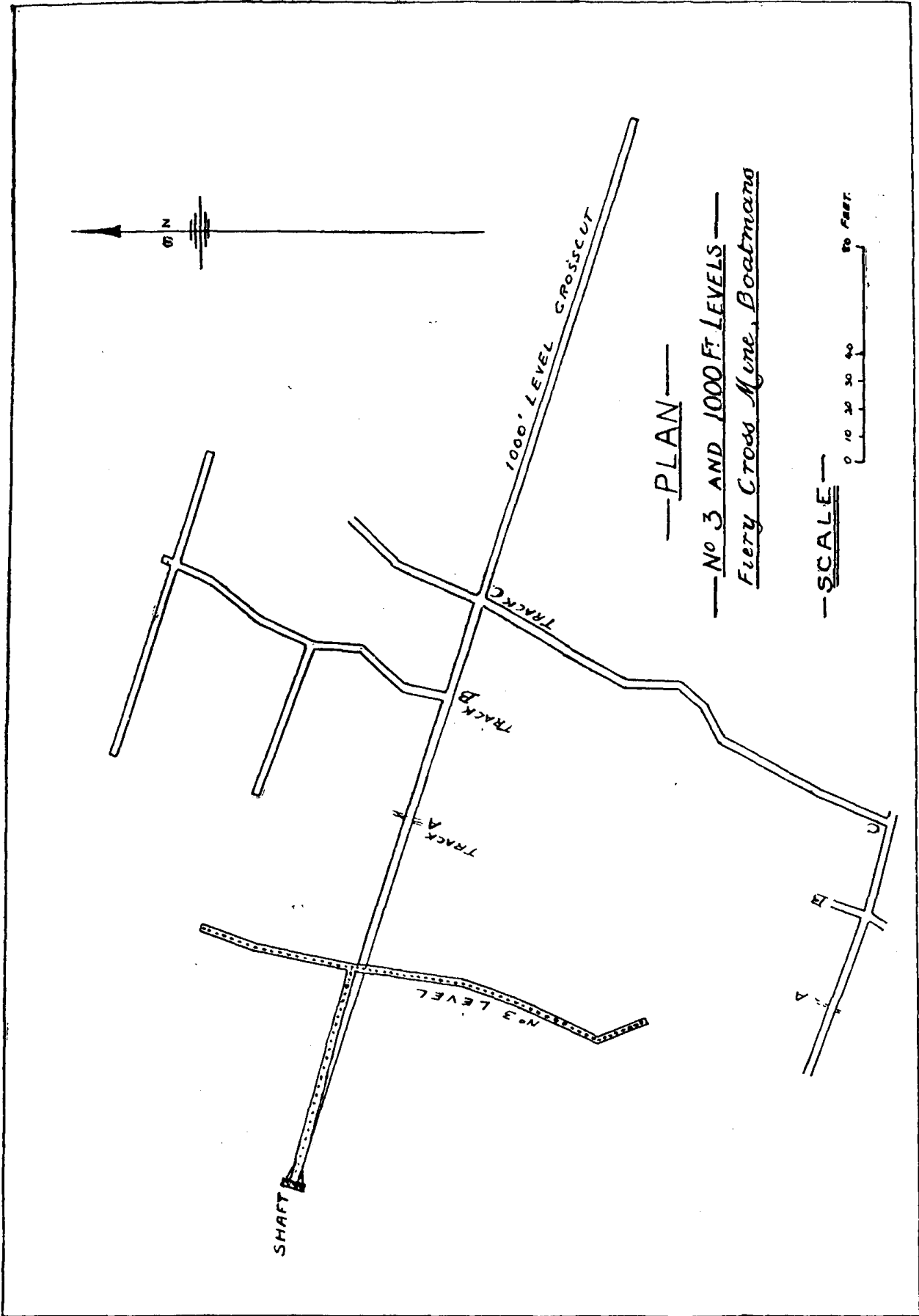


FIG. 12.—PLAN OF 1,000 FT. LEVEL, FIERY CROSS SHAFT, BOATMAN'S.

may be mentioned that the Imperial Company had itself been preceded by two other companies, the Alhambra and the Rose of Lancaster, in the ownership of the claim. From the bottom of the shaft referred to a level was driven north for a considerable distance. This level served the Just-in-Time Company to work its eastern shoot to a depth corresponding nearly with the 450 ft. level of the Fiery Cross shaft. The Reform, or Imperial, shoot was not, however, traced down to it. About 1896 the Consolidated Goldfields Company deepened the shaft to 400 ft. and prospected from it at that depth for the shoot without success. In 1910 another company repaired the shaft, and did some further prospecting both on the 200 ft. and 400 ft. levels, but having no better fortune than its predecessors it soon went into liquidation.

The total ore crushed from the claim amounted to 1,672 tons, which yielded 1,072 oz. gold, approximate value £4,133 10s. The greater portion of this stone seems to have come from quite close to the surface.

South Hopeful Mine.—This claim was next south to the Reform. A company was formed in 1877 to work it, and an adit was driven south for 600 ft. without meeting any stone. In 1887, however, some quartz was found a few feet to one side of the old adit and 30 ft. in from the portal. On this a winze was sunk for some distance, but the stone turned out to be narrow and very broken. There is no record of any crushing from the mine.

Lone Star Mine.—This mine was some distance south of the South Hopeful, and separated from it by claims known as the Chicago, Multum in Parvo, and Orient. It was the most southerly in which auriferous quartz was got on Topfer's lode-series. There were two outcrops of reef on the claim, about 350 ft. apart. On the northern outcrop a winze was sunk to 67 ft. on reef, at which depth a level driven on the shoot proved it to be 160 ft. in length, with an average width of 1 ft. 6 in., but it was badly broken. An adit was then driven to cut the reef 103 ft. below the drive just mentioned, or 170 ft. below the outcrop, but in this no trace of the shoot was met with. The southern outcrop was about 200 ft. long on the surface, and a trial crushing of 20 tons taken from it is reported to have yielded 35 dwt. gold per ton. Two adits were driven, however, in search of the shoot without locating any solid reef. Some small parcels of stone, totalling 220 tons, chiefly from the north outcrop, were treated for a yield of 75 oz. gold, which was not payable.

Eureka Mine.—Though no reef was at any time found in this claim it adjoined the Fiery Cross, Hopeful, and Welcome Claims on the east, and, as the very extensive prospecting-work carried out in it had for its main objective the location at depth of the Welcome shoot, it may be deemed as being on Topfer's line. During the number of years mining operations were in progress on it various owners controlled the property. The first company, formed in 1883, sank an incline at a grade of one in three for a distance of 1,800 ft., and from the foot of this extended a level north 600 ft., at a cost of £18,000. In 1892 the claim was amalgamated with the Welcome and Home-ward Bound, and thereafter for about five years practically all the prospecting-work being done on the lode-series was directed from it. The operations carried out from it by the Welcome United Company have already been described and need not be recapitulated. It will suffice to say that they were not successful in achieving their purpose. Afterwards, when the claim passed into the hands of the Consolidated Goldfields of New Zealand, that company continued the sinking of the "monkey" shaft to 533 ft., and opened out a level at that depth, from which much prospecting was done with equally satisfactory results.

CAPLESTON GROUP.—GAFFNEY'S LODE-SERIES.

According to Dr. Henderson's classification, another lode-series lies a little to the east of Topfer's line. On this he placed such mines as the Specimen Hill, Pactolus, Lady of the Lake, and Argus. Regarding the three last-mentioned of these comparatively little is known. Some auriferous quartz was got in each of them. The Pactolus, which lay to the east of the South Hopeful, had in 1878 a crushing of 88 tons, which gave the handsome return of 436 oz. gold, and enabled £1,000 to be distributed amongst the owners. The Lady of the Lake had a crushing of 10 tons in the same year, which yielded 3 oz. gold, and the Argus had two small crushings in 1889 and 1893, totalling 82 tons, which yielded 90 oz. The claims never passed the prospecting stage, and such information regarding them as is at hand serves to show that in each of them the country was very wet and broken, clearly indicating that they had been traversed by a powerful fault.

Specimen Hill Mine.—The claim was on the east of the Homeward Bound. A large amount of prospecting was done on it, no less than five adits, several of them of considerable length, having been driven. Quantities of richly auriferous quartz were found scattered on the hillside forming the surface. The first discovery was made on it in 1872, and prospecting was carried on for many years. A number of reef-tracks were located in the workings, in which boulders and small bunches of good stone were frequently found, but no extent of solid reef was ever located. In 1881 it was thought a strong reef had been picked up and a battery was erected, but when development was pushed on the reef soon cut out, and after struggling along for some few more years the claim was eventually abandoned in 1893. In 1896 the claim, together with several others adjoining, was taken up by the Cadman Syndicate, but this party did little if any work in it, and the ground was soon abandoned again. About 1906 a small party of working-miners did some further driving on it, with the aid of Government subsidy, but found nothing of any value. This party gave up its effort in the following year, and since then no work of any kind has been done on the area.

As nearly as can now be estimated, 2,265 tons of quartz were crushed from the claim for a recovery of 1,205 oz. gold, valued at approximately £4,412 15s. 9d.

Regarding these two lode-series, there is still a strong belief among old hands who have worked more or less in the various mines along them that they yet have possibilities, but there seems little on which to base it. As far as Topfer's line is concerned, it is evident that all the principal shoots on it were cut off at a comparatively shallow depth, below which all effort to trace them has failed. There can be no doubt that the disappearance of the shoots was due to faulting, but, owing to lack of data, nothing definite is known as to the exact nature of the movements. Dr. Henderson has pointed out (Geol. Bull. No. 18, p. 139) that to the northward of the old workings an important fault occurs, which brought about the crushing of the Specimen Hill ore-shoot. This fault had a north-north-easterly strike and a south-south-westerly dip; but as far as the Welcome, Fiery Cross, and Just-in-Time eastern shoots are concerned, the belief may be said to have been unanimous among all mining-men who have had occasion to study the position that they were cut off by a fault (or series of faults) having an easterly or north-easterly dip, which has thrown the lost portions of the

shoots down to the eastward. It was undoubtedly this belief that led to the carrying-out of the extensive prospecting done for the Welcome shoot from the Eureka workings, and the prospecting to the east on the 1,000 ft. level of the Fiery Cross was prompted by the same conviction. Regarding the first-mentioned of these efforts to locate the shoots at depth, it is recorded that a number of reef-tracks were met with, and driven on. In the 1,000 ft. level of the Fiery Cross similar tracks were met, notably at 270-320 ft., 370-390 ft., and 440-455 ft. from the shaft. Two such prominent geologists as P. G. Morgan and Dr. J. Henderson, who examined this working, were agreed that one of these tracks—in all probability that at 370-390 ft.—actually represented the fault that cut off the Just-in-Time eastern (Walhalla) shoot, and possibly the Fiery Cross shoot also, and that if there was any chance of picking up the downward continuation of the former it would be either on this track or on that at 270-320 ft. The track at 440-455 ft. was driven on in a southerly direction for 300 ft. without finding anything but very occasional small pockets of barren quartz. The other two tracks were not driven on in that direction, but a crosscut was put out westerly from the end of the 300 ft. drive which intersected them. At the points of intersection no reef was found. There was room between the two crosscuts for the Walhalla shoot on either of these two tracks, but there was little to justify further search for it by driving on them. From all the evidence afforded by the work done on this level, and also from that done from the Eureka Claim, the writer is satisfied that, assuming the shoots were downthrown as believed, the downthrow was to a depth greater than any of the workings so far opened on the lode-series, and consequently that any further search for the downward continuation of the various shoots, if it is to succeed, must be made below the 1,000 ft. level of the Fiery Cross; and, when the wholly problematical question is considered as to the depth at which the stone may "make" again, there is little to induce any thoughtful mining engineer to recommend such search being made.

Whatever chance there may now be of finding further payable reef in the locality would appear to be towards the northern end of the field. The long drive put in by the Welcome United Company from the Boatman's low level to connect with the old Welcome workings could not have picked up along its course the downward continuation of the Welcome North Block, but, granting that the block lived down, a crosscut from the drive put out to the east from a point about 600 ft. from the junction of the drive with the low level would have struck it, and it is rather difficult to understand why such a crosscut was not made. It is said that a party began the repairing of the low-level tunnel in 1910 with a view to doing this work, but owing to certain mining difficulties had to abandon the effort after spending a good deal of money. It is also rather hard to know why, when the low-level adit was first driven, or when it was later reopened by the Welcome United, an attempt was not made to prospect from it to the north or north-east, with a view to picking up at depth the Specimen Hill shoot. There seems no reason to think otherwise than that this shoot would live down to as great a depth, anyhow, as the Fiery Cross and Welcome shoots. Its upper portion has been badly shattered by faulting, but the earth-movements may not have affected it to any great depth. If Dr. Henderson's theory is correct—that the shoot belongs to a lode-series lying to the east of Topfer's line, and has been affected by a south-south-easterly dipping fault—any work done to find it from the horizon of the low-level tunnel would have had to be extended well to the east; but it

would have been just as well justified as the sinking of the 300 ft. of shaft at the end of the adit. Although prospecting of this nature may have been advisable when the level was open, it is very questionable, however, if it could be recommended now : present-day mining costs are too high to justify ventures having in them such a large element of chance.

ITALIAN GULLY GROUP.—WALKER'S LODGE-SERIES.

This series occurs about two miles northerly from the Capleston groups, and was discovered in 1872 by Francis Walker. Only two mines calling for any mention were opened on it, the Italian Gully and the Garibaldi.

Italian Gully Mine.—Prospecting by means of four adits showed that in this property there was a shoot of stone about 500 ft. in length but of narrow width. In one place it opened out to 3 ft., but it only averaged from 6 in. to 8 in. The Italian Gully Gold-mining Company was formed, shortly after the discovery, to work the find. For several years only prospecting was done, but in 1876 the company erected a five-stamp battery and commenced crushing. Small parcels of quartz were treated thereafter for some years, but the returns were not satisfactory, and in 1878 another company, the Golden Arch, purchased the claim. During the time the original company operated the mine 897 tons of stone were crushed, for a yield of 512 oz. gold, valued at £1,984. The new company carried on prospecting and crushing intermittently till 1883, when it let the mine on tribute. During its tenure as owner the Golden Arch Company appears to have crushed 149 tons of quartz, for a yield of 139 oz. gold, but there is no record available as to the amount of stone mined and treated by the tribute party. In 1884 the ground was abandoned, and, although a little prospecting seems to have been continued in the locality in the intervening period, no further attempt was made to work the mine till 1905, when Knight and party (afterwards known as the Buller United Syndicate) reopened the old No. 4 adit and re-equipped the mine with another five-stamp battery, which they erected near the mouth of the adit (the previous battery was on Raglan Creek). It may be mentioned that the three upper adits had been driven wholly on the reef, but No. 4 crossed the country for several hundred feet before reaching the vein. About 100 ft. south of where the crosscut intersected the reef the latter had been cut off by a fault. Knight and party, in 1907, ran a crosscut out near this fault and located the reef again, 100 ft. to the westward. Following the reef southward from where it was picked up, other displacements were found to occur, shifting the stone each time to the west, and the large amount of deadwork necessitated by these breaks, combined with the smallness of the reef and the hardness of the walls, made it difficult to operate the mine at a profit. In 1908 the Buller United Syndicate disposed of the claim to a new Golden Arch Company, which erected a ten-stamp battery, as well as a cyanide plant, and carried out some further prospecting; but, although reef was going underfoot in the adit and was showing in both ends of No. 4, it was found impossible to work profitably, and the property was again let to tributers, who operated it for several years with a moderate degree of success.

From the time when Knight and party took over the claim in 1905 until the second Golden Arch Company went into liquidation in 1911 a further 576 tons of quartz were crushed, for a yield of 433 oz. 19 dwt. 6 gr. gold, valued at £1,632. Another small crushing of 22 tons was reported in 1913, which yielded 7 oz. 19 dwt. gold, valued at £31 2s. 6d. Thus the total quartz

mined and treated from the claim during the whole time it was worked was apparently 1,644 tons, which yielded 1,092 oz. 18 dwt. 6 gr. gold, valued at £4,185 15s. One small dividend, totalling £104, is said to have been paid by the first Golden Arch Company.

Garibaldi Mine. — This mine was situated immediately south of the claim just described, and it is reported that in "it, in the "nineties," the brothers J. and P. Coghlan proved an ore-shoot of much the same length, width, and value as that in the adjoining claim, but very little effort seems to have been ever made to develop it.

Although reef of a value of about £2 10s. per ton for gold was left underfoot in both these mines, further prospecting on the shoots is not justified. The stone is too narrow and the rock-walls too hard to admit of profitable working, and there is small likelihood of the reef widening at depth, it being a feature of the bedded veins of the Inangahua district that they rarely alter much in width as they are followed down.

CALEDONIAN GROUP.—POTTERS LODGE-SERIES.

This lode-series, situate about eight miles north-north-east from Reefton and about four miles and a half up Larry's Creek from its confluence with Inangahua River, was the most northerly on which any important work was done in the Reefton auriferous area. The first discovery of gold-bearing quartz there was made in 1872 by Joseph Potter and Thomas Bateman, on what was afterwards the Caledonian Claim. A company was formed shortly after the find was made for the purpose of developing it, and a shaft was sunk on the south bank of Larry's Creek close to the outcrop. This shaft subsequently attained the depth of 183 ft., and four levels were opened from it, the first level being 70 ft. below the shaft-collar, and the others at intervals of less than 40 ft. under it. The shoot of stone dipped easterly at a high angle and had a northerly pitch of about 30°. It is said to have had an average width of 3 ft., with a length on Nos. 1 and 2 levels of 180 ft. On No. 3 level very little stone was got, and on No. 4 none was met with. In 1874 crushing was commenced at a ten-stamp battery erected in the locality by No. 2 South Larry's Company, which held the adjoining ground to the south. The first parcels of quartz treated proved very rich, returning about 9 oz. gold per ton, but as the stone was sunk on the values fell away, with the result that the average of all the quartz crushed was about 4 oz. per ton. By 1879 all the stone in sight was worked out, and the Caledonian Company merged with the No. 2 South Larry's to form the Caledonian Extended Company, which continued prospecting on the areas for several years and then abandoned the ground. In 1894 Messrs. B. and R. Duffy formed a party which took the claims up again, erected a five-stamp battery, and took out and crushed a small quantity of quartz the old company had left to protect the shaft. They also crushed about 900 tons of stone from the old dump, but the return from this, 90 oz. gold, was far from payable.

In 1896 the claims were purchased by David Ziman and transferred to the Consolidated Goldfields of New Zealand. This company meditated the sinking of a new main shaft, but later decided against this course, and, after spending a good deal of money in cleaning up and retimbering the old workings, abandoned the property in 1900.

In 1906 the Duffy brothers again took up the ground and arranged for the formation of the New Caledonian Gold-mining Company, which began the sinking of a new shaft on the north bank of the creek. Much difficulty

was experienced in sinking, owing to the great quantity of water that found its way into the shaft, but eventually a depth of 285 ft. was reached, and a level was opened out there about 40 ft. under the No. 4 level of the old shaft. At about 230 ft. west from the shaft a slickensided plane was met, along which a drive was extended for 400 ft. in a south-easterly direction, and two crosscuts were put out from it to the west to come under the old workings. These crosscuts intersected a track that had been driven on in No. 4 level from the original shaft, but no reef was found, and in 1910 the company ceased operations. No work has since been done on the claim.

It is evident that the shoot of quartz worked in the upper levels of the old shaft was cut off by a fault, and Dr. Henderson has given it as his opinion (Geol. Bull. No. 18, p. 131) that it must be considered the upper portion of a shoot of which the downward extension lies to the north-eastward of the fault-plane explored from the new shaft, in which case he considered it should not have been difficult to locate from that shaft if work had been carried out in the right direction.

During the few years the Caledonian Mine was productive the total stone crushed, including the 900 tons from the old dump, amounted to 1,406 tons, which yielded 2,162 oz. gold, valued at £8,364, and £2,250 was paid in dividends.

No. 2 South Larry's Mine.—The reef in this mine was discovered very shortly after the discovery of the Caledonian reef. An adit 600 ft. in length was driven, which cut the reef 100 ft. below the outcrop. Where intersected the stone was 12 ft. in width, but was not solid, consisting of stringers of quartz interspersed with slate and sandstone, and it is said to have had very ill-defined walls. The quartz stringers carried visible gold. The company erected a ten-stamp battery and commenced crushing in the same year as the Caledonian, 1874. In the adit mentioned the lode-channel was driven on for about 70 ft. north and 260 ft. south, in which distance three lenses of quartz are said to have been met with. A small first crushing from the adit is reported to have yielded 18 dwt. gold per ton, but when stoping was started the values decreased. By the end of 1877 all the stone above the adit had been stoped to surface, 7,514 tons being crushed for a return of 4,129 oz. gold, valued at £13,999 17s. 6d. The average yield was thus 10 dwt. 11 gr. per ton.

In 1883–84 the long Argyle tunnel, the lowest level in the mine, was driven to the reef, 40 ft. below the first adit. In this working the stone is said to have been much more compact than in the upper level, but it proved to be very poor, yielding only 3 dwt. gold per ton at the battery, and, as this grade was not payable to work, mining operations were suspended.

After lying idle for a number of years the claim, as previously stated, was given some attention by the Consolidated Goldfields Company in the "nineties." The old adits were repaired and a certain amount of prospecting done, but the prospects could not have been encouraging, for the ground was soon abandoned again, and nothing in the way of mining has since been done on it.

Apart from the fact that the values in the reef fell away in the lower workings, it is evident that the reef was disturbed by earth-movement, for whereas the dip was to the eastward in No. 1 adit it was to the westward in the Argyle tunnel. It is probable that the impoverishment of the quartz below the upper level was not permanent, but there seems to have been little in the appearance of the mine to induce prospecting effort at any greater depth.

No. 1 Larry's Mine.—Another claim known by this name had a limited amount of prospecting done on it, immediately to the north of the No. 2 South Larry's and on the same reef-line. A shoot of stone was found in it, but it was much too poor in gold to pay for working.

KIRWAN'S HILL LODE-SERIES.

Prospecting from Boatman's towards the eastern extremity of the wide belt of greywackes and argillites within which the Reefton auriferous areas are contained, William Kirwan, in December, 1896, located a mass of loose gold-bearing quartz at a spot about eight miles east of Reefton Township, and at an elevation of about 3,350 ft. above sea-level on the southern slopes of a peak subsequently named after him, "Kirwan's Hill." This discovery caused a considerable stir in the district, and within a very short time the country north and south of it was pegged out for miles. A special claim, known as the Lord Brassey, and three licensed holdings—the Earl Brassey, Lady Brassey, and Kirwan's Reward—were granted to the discoverer, and much prospecting was done on them as well as on a number of adjoining claims. Numerous reefs were found outcropping, from 3 ft. to 6 ft. in width, but in none of them was the quartz similar to that of the original find on the Lord Brassey Claim, and none of them carried payable gold. Shortly after the discovery was made, an option was given over the four claims mentioned to the Anglo-Continental Gold Syndicate, of London, for which company H. A. Gordon (previously Inspecting Engineer of Mines for the New Zealand Government) was local representative. The terms of the option were that £1,000 was to be paid in cash, and £200 per month expended in prospecting the areas for a year. If at the end of that period the syndicate availed itself of the option, a company of £280,000 in £1 shares was to be formed, the vendors to get £32,000 in cash and a similar value in shares. Working capital to the amount of £30,000 was to be provided, and 30,000 shares held in reserve.

The loose auriferous quartz on the surface was scattered over an area, roughly 11 chains long and 4 to 5 chains wide, and as some of the boulders were up to 2 and 3 tons in weight it evidently came from a large reef. The great bulk of the material was, however, in small pieces of a few pounds weight. With a view to locating the formation from which it was derived, the option-holders at once instituted a vigorous prospecting scheme of tunneling under the loose surface material, and sinking shafts in it. Two of the tunnels were each driven a distance of about 250 ft., one of them at a depth of 130 ft. and the other at 205 ft. below the surface, but neither in these nor in any other of the test workings was any solid reef found. At the end of the year for which it held the option the Anglo-Continental Syndicate surrendered the latter, owing to the unsatisfactory developments, but it continued to hold an interest in the property as a shareholder to the extent of one-third of the shares in the Kirwan's Reward Gold-mining Company, which proceeded to erect a ten-stamp battery (an additional five-stamps were added in 1902) in Kirwan's Creek for the purpose of treating the large quantity of loose quartz lying on the surface. Crushing was continued till about the middle of 1906, during which period 21,967 tons were put through the plant for a yield of 10,984 oz. 10 dwt. gold, valued at £43,798 5s. 9d., out of which £11,200 was distributed as dividends. At first it was thought that all the quartz was on the surface, but later it was found to be mixed with the crushed country down to a depth of about 120 ft. All the stone crushed was mined by open-cut.

In 1907 the property was sold to Mr. P. N. Kingswell, who carried out some further prospecting on it, but without satisfactory result, and in turn disposed of it to Messrs. G. Pettigrew and party in 1909. In 1908 an additional 230 tons of ore were crushed from the deposit, making the total crushings 22,197 tons, and the total yield of gold 11,013 oz., valued at £43,943 19s. 8d.

Throughout the whole course of the mining operations on the property the opinion seemed to be general, both amongst those in charge of the working and such outside mining-men who visited it, that the loose quartz lying on the surface of the Lord Brassey Claim could not have come from any great distance, nor from any other locality than the western side of that claim. As far as the various holders of the claims are concerned, the existence of this belief was clearly indicated by the fact that nearly all the tunnels were driven in the direction of the western side, and a number of shafts were put down on that side. Visiting mining engineers and geologists also show in various reports that they held the same belief. For instance, Inspecting Engineer G. Wilson states* that "the work done clearly shows that a large slip has at one time taken place from the western side eastward," and Alexander McKay, the well-known geologist, who examined the mine in 1897, came to the same conclusion. H. A. Gordon, previously Inspecting Engineer of Mines for the New Zealand Government, would also appear to have been in accord with it. In a special report† dealing with the field, McKay writes as follows:—

"The discovery on the northern slope of Kirwan's Hill of a considerable area over which are strewn a covering of loose blocks of auriferous quartz has led during the past season to a great amount of prospecting there, in the vicinity and surrounding district. The result has been the discovery of numerous reefs of quartz within the area lying between the upper part of Larry's Creek and the upper part of the Waitahu River, or North Branch of the Inangahua River. Of the reefs found, none of them as yet afford prospects of gold equal to what are to be obtained from the loose quartz on the slopes of Kirwan's Hill. This loose quartz appears in blocks of sizes up to masses of 2 to 3 tons in weight, and thickly covers the surface over an area 10 or 12 chains in length, with an average breadth of 4 to 5 chains. The quartz is chiefly, if not wholly, confined to the surface, although masses of the wrecked hill-slope do here and there show portions of reefs held within walls of sandstone and slate rocks identical with the general formation of Kirwan's Hill and the country eastward to Capleston. Towards the lower end of the quartz covered, and where the stone was richest in gold, a tunnel has been driven west into the hill, in the hope that by this means solid ground might be entered, and the lode from which the richer quartz has been derived thus discovered. At a distance of 150 ft. from where started the tunnel driven west into the hill failed to reach solid rock, and no reef was discovered; yet, more remarkable, scarcely a fragment of quartz was found more than 3 ft. below the surface in the tunnel workings. At the present time, at the opposite northern end of the field of quartz, a shaft is being sunk to prove the depth to the solid rock, and this shows the same remarkable absence of quartz from all but the debris-covered mountain-slope. This shaft, when visited, had reached a depth of 35 ft. and had not passed through the broken angular material met with in the tunnel lower down the spur. On the north-eastern part of Kirwan's Hill, and in the ridge going thence east and north-east to con-

* Mines Repts., 1898, p. 84.

† Mines Repts., 1898, p. 94.

nect with Trig. Hill, there are numerous reefs that strike south-south-east and dip east-north-east at high angles, and thus should pass but a little to the eastward of the field of loose quartz on the northern slope of Kirwan's Hill. It must, however, be noted that in the north and north-north-west higher part of the hill no notable discovery of quartz has been made (none was reported to me), and westward, along the road leading to the upper part of Boatman's Creek and Capleston, in the side cuttings of the road rarely is a piece of quartz to be seen. All the lodes of quartz found are in gold compared with the richer of the loose blocks of the quartz-covered surface of Kirwan's Hill, and some would seek to refer the latter to a distant source, and consider that the lodes and the field of loose quartz on the surface are only in accidental juxtaposition. After due consideration of this matter I have come to the conclusion that the loose quartz is derived from lodes in the immediate vicinity; and the evidence in support of this conclusion fully bears out the decision arrived at. Wherever matrix adheres to the quartz, this, as forming part of the foot- or hanging-walls of the original lode, is of the same character as the foot- or hanging-walls of the lodes that have been discovered. The quartz also closely agrees with that of the lodes found, and the correspondence is complete in all except the amount of gold which is contained in the loose and solid stone. All the rocks of Kirwan's Hill and the adjacent ranges to the north and north-east are slates and sandstones belonging to the Maitai series of the New Zealand Geological Survey classification. Outside there are the Victoria Mountains to the east. The rocks are granites and crystalline schists, and, from the absence of a trace of these in Kirwan's Hill, it is not possible that the loose quartz of the northern slope of Kirwan's Hill could have come from these mountains, nor from an eastward direction; nor could the material of the quartz-field have come from the west without at the same time being accompanied by granite from the lower beds of the coal-measures and dark hornblendic diorite from a heavy band of that rock that outcrops on the slope from the higher part of Kirwan's Hill to the source of Boatman's Creek. The rich quartz that is found on the surface of the Lord Brassey Claim has therefore, in all probability, been derived from a lode not now seen at the surface, and which probably will be found running along the western part of the claim mentioned. More to the westward for a considerable distance there is little indication of the presence of quartz reefs. The whole belongs to the eastern system of quartz lodes found in connection with the Maitai slates that stretch along the east side of the Inangahua and Little Grey valleys, from the source of the Blackwater in the south to the gorge of Larry's Creek in the north. The slate between the Waitahu and Larry's Creek extends considerably east of the boundary hitherto assigned it, and towards the upper part of Larry's Creek there is a large area over which prospecting might be carried on with a fair show of success."

In several places in the foregoing report where reference is made to the loose deposit of quartz being on the northern slope of Kirwan's Hill, the description should have been the "southern" slope. The word "eastward" is also used in one place instead of "westward"; but these are probably typographical errors, and are in any case of little consequence. The important facts in connection with the report are that the geologist had arrived at the following conclusions: (1) That the strike of the reefs found *in situ* in the locality was in general N.N.W. and S.S.E.; (2) that the loose stone came from the immediate vicinity; (3) that the

probability was it was derived from a lode running along the western side of the Lord Brassey Claim.

Seeing that no trace of the original reef was found in this westerly direction, although much work was done in search of it after McKay's visit, it is not to be wondered at that those in charge of the property were completely puzzled, and that the origin of the loose quartz was then, and has been ever since, a source of unlimited theorizing and conjecture to the mining-men of the district.

Only one geologist of undoubted standing, Dr. J. Henderson, has visited the locality since the Kirwan's Reward Company ceased operations, and, it is worthy of careful note, he arrived at quite different conclusions as to the derivation of the broken quartz to those expressed by previous observers. When carrying out the geological survey of the Reefton Subdivision in 1912-13 Dr. Henderson made a very careful study of the Kirwan's Hill field, with the result that, instead of the reefs in the locality having a south-south-east strike, he states (Geol. Bull. No. 18, p. 135) his observation was that where they were unaffected by faulting the strike was east of north, but that several powerful faults striking west of north traversed the region, near which the orientation of the outcropping lodes conformed more or less with their strike. From these facts he premised that the loose quartz on the Lord Brassey Claim originated from a large auriferous lode striking east of north, with an easterly dip and a northerly pitch, which became involved in the shatter-zone of a powerful dislocation striking north-west and dipping south-west, and that the downward continuation of the lode should therefore exist to the north-eastward, and would probably cross portions of the Mark Twain and Kirwan's Reward Claims into the Earl Brassey and Newhaven Claims. Dr. Henderson points out, in this connection, it is significant that the only reefs found in this direction not absolutely barren traverse the claims mentioned, and that it is hence not unreasonable to consider them shoots of poorer ore on the same lode-channel as that carrying the shoot which furnished the rich ore of the loose deposit on the Lord Brassey, and which, in all probability, would nowhere reach the surface in the other claims.

Very little information is available as to the nature or extent of the prospecting-work done on the other claims referred to, but it is known that in the Earl Brassey a tunnel of considerable length was driven on a track traceable on the surface for some hundreds of feet, and which carried a little gold. As to reef in the Newhaven Claim, the only mention on record seems to be a brief note in the Mines Reports of 1898 to the effect that a winze was sunk for 30 ft. on a leader which carried gold all the way, and that in the bottom of the winze the stone opened out into a fine body about 5 ft. wide, from which gold could be got by pounding and panning. The writer is unable to find out with any certainty whether or not any further work was done on this formation, but some 350 ft. of driving reported to have been done in 1911 by the Hit-or-Miss Syndicate without satisfactory result may have been on it. In some claims held by the Boatman's Exploration Syndicate on the east of Kirwan's Reward a certain amount of prospecting in the nature of shaft-sinking was done on a loose formation of slate containing small fragments of quartz, and another company started a tunnel from near the headwaters of Larry's Creek, which was driven easterly for about 530 ft. through the Colonial Claim, with the idea of picking up at depth a reef found outcropping in that direction. After going this distance, however, it was found that, owing to a surveying mistake, the distance to

be driven to meet the reef had been underestimated by some hundreds of feet, and as the company was not prepared to find the money to do the extra work operations were suspended.

Regarding the many other claims that were pegged out in the vicinity, it may be said little more than the most superficial prospecting was done on any of them. Outcrops of quartz were found on some, but they were of so hungry an appearance as to give little encouragement for closer investigation, and no doubt there was, as there always is in such cases, a disposition on the part of the holders to sit back and await the outcome of development on the principal claims.

It is rather strange that, although Dr. Henderson's well-considered opinion as a mining geologist was expressed as far back as 1913, no attempt has been made to investigate the locality in the direction along which he thought satisfactory results might be got. The only work of any importance done on the field in the interval was the extension by G. Pettigrew and party of a low-level adit driven westward from Kirwan's Creek—that is, towards the western boundary of the Lord Brassey Claim, where Alexander McKay considered the lost lode should be found. This adit was in about 1,400 ft. at the time of Dr. Henderson's visit, and he describes it as being for the whole distance in very wet and broken country. The working was subsequently extended to 2,600 ft., passing through the Mutual Claim, formerly held by the Boatman's Exploration Syndicate, and reaching the centre of the Lord Brassey Claim immediately under the old open-cut workings. Beyond the 1,400 ft. mark the ground passed through is said to have been more solid, but nothing of value was met with. Some small quartz veins were intersected, but only one of them, at about 800 ft. from the portal, carried any gold, and this was only about $2\frac{1}{2}$ dwt. per ton. At the time of his visit Dr. Henderson pointed out, with regard to this work, that if his conclusions concerning the locality were correct, the party would not achieve its object by going on with it, and his opinion seemed to be justified by the results.

ALEXANDER RIVER REEFS.

With the reefs of Kirwan's Hill, those of the Alexander River are the only two lode-series so far discovered on the eastern side of the Reefton (Inangahua) auriferous belt, the latter series being about five miles due east from the Blackwater line. The first discovery of gold-bearing stone in the locality was made by James Hurley and Loftus McVicar, working with the aid of Government subsidy, who found shoad stone in the Alexander River in 1920. It took about a year for the prospectors to trace this stone to its source, but eventually, by following the shoad up the spurs, they located a mass of solid quartz early in 1921 at an elevation of about 1,500 ft. above the river. This find was named the Bull reef, and in places it showed gold freely. Although it was traced on the surface only, by trenching for a length of 2 chains the massive nature of the reef—it was up to 6 ft. wide—led at first to the belief that it was in settled country and would live both in length and depth. Shortly after the discovery was made public an option was granted over the claims taken up by the prospecting-party to a syndicate of Auckland and Reefton mining speculators, which immediately started to put in an adit 80 ft. below the outcrop, which was expected to cut the reef at 140 ft. in. The adit was carried in, however, for 170 ft. without meeting any quartz. At a point 25 ft. from the end of the adit a branch drive was then put out at a right angle to the strike of the reef, and was extended for 115 ft.,

making 260 ft. in all from the portal, but still no stone was intersected. Discouraged by the unsatisfactory result of this work, the syndicate abandoned its option. The prospectors then formed the Alexander Gold-mining Syndicate, and resumed active prospecting. A shaft was sunk from the outcrop, alongside the reef, in which it was found that the stone went down almost vertically for 35 ft. and then cut out, the dip of the country at the same time altering from the vertical to nearly a horizontal direction. In the adit the same almost horizontal dip of the strata was noted, making it clearly evident that the country had been moved and badly crushed, and that the Bull reef was merely a floater. Nevertheless the syndicate put in another adit, 130 ft. below No. 1, and drove it for 400 ft. in a south-south-easterly direction, then crosscut from it, at a point 325 ft. from the portal, towards the west—that is, across the strike of the quartz on the surface, for a little over 200 ft. From near the end of the drive a branch drive was also put in almost due south for 100 ft., but in none of these workings was any reef found. In this adit the strata straightened up somewhat, with a flat dip to the eastward, but all the ground penetrated was still evidently moved and crushed. A No. 3 adit was also started, 300 ft. below No. 2, and about a similar distance northerly from the mouth of the latter, on a small outcrop of quartz; but this adit was not persevered with far, owing to the quartz cutting out. Realizing now that it was useless to seek further in this immediate vicinity for the downward continuation of the Bull reef, the syndicate directed attention to investigation of the surface to the east and north-east of the original find, and in 1923 located an outcrop about 20 chains in the latter direction. This outcrop was traceable on the surface for about 3 chains, and the quartz from all parts of it prospected well, but it was lying horizontally. In order to test it, a drive was put in easterly under the flatly-disposed stone, and when this had been extended for 20 ft. it was found that the reef, which was 5 ft. wide, turned over and went down nearly vertically. An adit was next started to cut the reef at 130 ft. below the outcrop, but, as in the case of the Bull reef, it failed to locate the reef, although it was extended a much greater distance than should have been necessary to intersect it. To better determine what had happened to the reef, a return was made to the outcrop, and a winze was sunk inside the first short upper adit, which made connection with the lower (No. 2) adit and served to show that the reef lived down to within about 9 ft. of the back of the adit. The conclusion then formed was that the quartz was in the form of a lens with a flat northerly pitch. An intermediate level was then opened on the stone, about 40 ft. above No. 2 adit, which, when driven north-east and south-west, showed the lens at this depth to be 140 ft. in length. A five-stamp battery was erected, well up the face of the hill and about 200 ft. below the mouth of No. 2 adit, and crushing was commenced towards the end of 1924. For driving this plant electric power was used, the current being generated by a small hydro installation on the Alexander River. The first clean-up yielded 121 oz. 17 dwt. gold, by amalgamation only, from 60 tons of quartz. Crushing was then carried on intermittently till the end of February, 1926; but owing to many breakdowns in the plant, especially in the electrical part, the total quartz crushed only amounted to 659 tons, which, however, yielded 1,646 oz. gold, equal to nearly $2\frac{1}{2}$ oz. per ton, all recovered by amalgamation only. In the meantime a drive had been put in northerly from No. 2 adit to try and pick up the lens on its pitch to the north. It was expected that very few feet of driving would effect this purpose, but the drive had to be extended 80 ft. before the stone was met,

thus making it evident that the lens was making very rapidly away to the north.

In the first half of 1926 a company known as the Alexander Mines, Ltd., was formed to provide the necessary funds to enable the mine to be opened up more actively. This company was of 75,000 shares of £1 each, 25,000 of which, together with £12,000 in cash, was to go to the vendors, the Alexander Gold-mining Syndicate. The company continued the driving of No. 2 adit on the reef, which, it may be mentioned, was named the McVicar, and found the lens here to be about 158 ft. in length, with an average width of nearly 5 ft.; but at this distance the drive came out to daylight again, the reef having cut through a narrow spur. Another adit (No. 3) was also put in about 100 ft. below No. 2, with a view to picking up the reef at that depth, but although several reef-tracks were met with the reef was not picked up. A winze was then started on No. 2 level, at a point about 160 ft. in from the crosscut, and a branch drive was put out from No. 3 adit, in a southerly direction, to come under it. In this branch drive reef was met with, but it was apparently not the same as worked higher up, having a different appearance and being much poorer in gold. The winze was connected by a rise with No. 3 adit, and it was found that the McVicar block lived down in it for only 40 ft. below No. 2 adit. At 50 ft. down an intermediate level, No. 2A, was driven north from the winze for over 80 ft., but no stone was got in it. Two short rises put up from the intermediate level showed the stone, however, at 9 ft. and 15 ft. up respectively. Despite the fact that the stone cut out, a strong reef-track, consisting of pug and quartz fragments, lived down on the same dip the stone had shown, and this seemed to indicate that faulting had taken place in the ore-channel itself and the stone had been carried down. It was most unfortunate, but quite in keeping with the experience of other mines in the district, that the rich quartz should have cut out in this way, and there is nothing now for the company but to follow the track down persistently if the shoot is to be picked up again. Already No. 4 adit has been started, 100 ft. below No. 3, in the effort to locate it, but insufficient work has yet been done on this level to show whether or not it will locate the stone. In the meantime, while prospecting for the downward continuation of this shoot is in progress, the company is carrying on operations on the Downey reef at Mullocky Creek, about 2,500 ft. north of the McVicar and 700 ft. to 800 ft. lower. A drive has been put in on this reef, which for 41 ft. showed a width of about 18 in. of stone carrying fair values. The reef then closed in to a mere track, and, although the drive has now been extended 150 ft., no more solid quartz has been found. Several other outcrops known to be gold-bearing occur in the company's property, but no development has yet been done on them.

3 When the company took over the mine it installed a petrol-engine to drive the battery, in place of the electrical power previously used, and continued crushing in a small way, putting through up to the end of last year a further 352 tons of stone, which yielded by amalgamation 675 oz. 5 dwt. gold, valued at £2,685 Os. 2d. A cyanide plant was also provided, in which the sands accumulated from previous crushings, as well as those from the company's own crushings, were treated, yielding 134 oz. 10 dwt. 2 gr. gold, valued at £422 Os. 9d. The total crushings to the end of 1926 were thus 1,011 tons, which yielded 2,455 oz. 16 dwt. gold, valued at £9,747 ls. 5d., an average of 2 oz. 8 dwt. 14 gr. per ton. The Alexander

Gold-mining Syndicate, prior to disposing of its property to the company, reported one dividend, absorbing £300.

Following the discovery of the Alexander reefs, prospecting licenses covering nearly 4,000 acres were taken up in the locality, and a good deal of surface investigation was carried out on them; but although a number of reefs, some of which were of large size, were found, nothing of any value has been so far located outside the company's areas.

Summarizing briefly regarding the Inangahua auriferous quartz area, it may be said that such mines as the North Blackwater and the Blackwater may have some years of productive life ahead of them; the mines at the Alexander River also have possibilities that vigorous prospecting, well directed, may yet lead to important developments; but of the other mines at present working it is doubtful if any offer promise of better days in the future. In some of the old mines now closed down, such as the Globe-Progress, Golden Fleece, Cumberland, Caledonian, and perhaps the Inkerman West, there is some reason for thinking that quartz bodies of fair grade still await discovery, but the tracing of these would in all cases be a costly business under present-day conditions. Apart from the possibility of finding these ore-bodies, the only hope of a more prosperous future for quartz-mining in the county depends on the discovery, by surface prospecting, of new reefs; but, in view of the very large amount of investigation already carried out in the likely areas by competent and energetic men, the chances of finding such reefs do not look bright. Nevertheless, the discovery within recent years of auriferous stone at the Alexander River shows that there is at least some small probability that further close search may reveal payable deposits in other parts. Practically all the country in which reefs are likely to occur has been gone over by the prospector, but it must be remembered that all the reef-bearing areas of the district are heavily timbered and deeply covered with mosses and forest rubbish, and in country such as this reefs may easily have been missed.

The most promising places for new finds would undoubtedly be along the general lines of the eastern and western reef-systems occurring within the Reefton auriferous belt on which all the mines so far opened up have been located.

On the eastern system the only two mines opened up to the present are those of the Kirwan's Reward and Alexander River Companies, and they are about twelve miles apart. In between them, and for some distance to the north of Kirwan's Reward, there stretches a belt of greywackes (slate) in which new finds of quartz are possible.

On the western system the country between the different lode-series has been well examined in the past. In that stretch between the Blackwater and Big River groups of mines many reefs have been found, some of them of large size, but so far none of them has been shown to have sufficient gold to pay for working. Much the same may be said of the stretch north of Boatman's towards Dunphy Creek. Nevertheless, within these areas, and those between the other lode-series, can future prospecting effort alone be recommended, and in them there are still possibilities of undiscovered ore-shoots occurring.

APPENDIX.

TABLE COVERING ALL PRODUCTIVE QUARTZ-MINES OF THE WEST COAST DISTRICT,
NEW ZEALAND, SHOWING TONNAGE OF QUARTZ CRUSHED, GOLD WON,
VALUE OF GOLD, AND DIVIDENDS PAID.

Name of Mine.	Tons of Quartz.	Yield of Gold.			Value of Gold.			Dividends paid.		
		Oz.	dwt.	gr.	£	s.	d.	£	s.	d.
MARLBOROUGH.										
Dominion Consolidated ..	104,694	16,839	9	7	66,525	0	0	3,750	0	0
Jubilee	3,673	1,187	0	17	4,182	19	2	..	..	..
Ravenswood	975	126	10	0	490	3	9	..	..	..
WESTLAND.										
Mount Greenland	1,940	2,034	16	5	8,122	19	4	500	0	0
Donnelly's Creek	299	160	0	0	620	0	0	..	..	..
Osmer's	432	616	0	0	2,377	0	0	..	..	..
Poerua Reefs	600	23	11	5	88	19	6	..	..	..
NELSON.										
Johnson's United	61,259	18,745	0	0	72,282	0	0	1,916	0	0
Ophir	400	100	0	0	387	10	0	..	..	..
Old Golden Ridge .. .. .	..	5,677	0	0	22,000	0	0	..	..	..
New Golden Ridge	10,807	6,327	18	17	25,028	0	0	..	..	..
Golden Blocks	21,326	23,856	2	1	92,267	11	9	18,945	0	0
Enterprise	720	72	0	0	290	0	0	..	..	..
Alpine United	146,640	80,510	0	0	315,402	0	0	74,266	13	4
Break of Day	872	4,610	0	0	17,863	15	0	10,000	0	0
Croesus (Lyell)	2,818	1,890	2	16	7,785	11	8	..	..	..
Tyrconnell	198	1,658	14	0	6,346	18	0	..	..	..
United Italy	505	2,230	0	0	8,655	0	0	1,200	0	0
Lyell Creek Extended	133	454	6	0	1,787	1	2	..	..	..
Red Queen	2,208	3,104	2	12	12,248	5	4	2,400	0	0
Swastika	118	29	15	8	116	5	7	..	..	..
Great Republic	3,097	3,097	0	0	12,000	0	0	3,800	0	0
Britannia	3,847	3,534	13	21	13,330	2	3	3,242	0	0
Julian-Victory	811	1,388	3	18	6,476	3	3	..	..	..
Minerva	2,460	771	0	0	2,987	12	6	..	..	..
Croesus (Paparaoas)	4,757	2,655	10	3	10,785	16	8	..	..	..
Taffy	2,751	981	14	9	3,956	1	6	..	..	..
Garden Gully	14	7	0	0	27	2	6	..	..	..
Perseverance	57	19	0	0	73	2	6	..	..	..
Band of Hope	390	25	0	0	96	17	6	..	..	..
Golden Treasure	9,423	5,696	0	0	23,042	18	3	4,300	0	0
Westland	80	60	0	0	236	10	0	..	..	..
Murray Creek (Victoria, Phoenix, and Inglewood)	51,491	33,707	4	21	126,715	5	0	7,833	0	0
Ajax, Golden Fleece, and Royal Venus	134,477	89,639	15	19	369,215	1	6	57,785	15	5
Anderson's Creek	10,871	7,043	0	0	27,404	16	2	3,300	0	0
Invincible	6,791	5,363	0	0	20,781	12	6	475	0	0
.. .. .	564	657	0	0	2,525	0	0	1,050	0	0

APPENDIX—continued.

TABLE COVERING ALL PRODUCTIVE QUARTZ-MINES OF THE WEST COAST DISTRICT,
NEW ZEALAND, SHOWING TONNAGE OF QUARTZ CRUSHED, GOLD WON,
VALUE OF GOLD, AND DIVIDENDS PAID—continued.

Name of Mine.	Tons of Quartz.	Yield of Gold.				Value of Gold.			Dividends paid.		
		Oz.	dwt.	gr.		£	s.	d.	£	s.	d.
Pandora	699	664	0	0	2,611	0	0	..	..	..
No. 2 South Keep-it-Dark ..	8,829	6,024	0	0	23,942	0	0	8,600	0	0	
Nil Desperandum (Hercules) ..	12,601	6,809	0	0	27,233	0	0	3,744	0	0	
Golden Ledge	2,241	751	0	0	2,848	4	1	..	..	..
Keep-it-Dark	328,508	182,617	19	3	520,031	2	4	251,916	0	0	
Wealth of Nations and Energetic (Energy)	437,531	203,784	14	20	788,438	5	3	67,000	0	0	
Consolidated Goldfields .. .. .	..	..	..	..	..	..	..	240,878	10	6
Vulcan	919	586	0	0	2,097	0	0	400	0	0	
Independent	2,345	1,179	0	0	4,568	12	6	..	..	..
Heather Bell	60	10	0	0	38	15	0	..	..	..
Globe-Progress	1,044,913	416,377	0	0	1,645,302	0	0	384,062	10	0	
Happy Valley	127	28	12	0	111	0	0	..	..	..
Sir Francis Drake	16,987	5,810	16	6	20,632	5	2	..	..	..
Gallant	2,340	759	0	0	2,974	3	5	600	0	0	
Scotia	594	1,284	0	0	5,155	0	0	3,000	0	0	
Inkerman South	90	270	0	0	946	5	0	..	..	..
Inkerman West	7,282	6,035	0	0	22,714	19	6	4,000	0	0	
Exchange	511	259	0	0	945	0	6	..	..	..
Cumberland	13,896	13,631	10	0	53,734	16	4	13,800	0	0	
Rainy Creek and Supreme	22,214	5,268	0	0	20,287	6	4	..	..	..
Inkerman	21,020	6,102	0	0	23,821	12	11	..	..	..
Morning Star (New Discovery)	29	18	15	4	72	0	0	..	..	..
Golden Point	1,157	394	13	2	1,535	16	10	189	14	10	
Big River	107,113	123,515	7	3	501,360	13	0	145,098	0	0	
National	66	12	0	0	38	15	0	..	..	..
Lord Edward	32	34	0	0	133	12	2	..	..	..
Blackwater	690,309	329,012	12	7	1,330,895	1	3	193,742	18	0	
Snowy Creek	159	50	0	0	193	15	0	..	..	..
Millerton	4,483	1,675	8	0	7,504	13	4	..	..	..
Sir Charles Russell	881	597	0	0	2,368	5	7	..	..	..
Dillon	90	52	0	0	201	10	0	..	..	..
Ulster	627	441	14	0	1,620	5	1	..	..	..
Just in Time	13,537	17,173	0	0	67,829	3	0	17,166	0	0	
Fiery Cross	24,561	27,958	10	0	110,679	0	0	24,168	0	0	
Hopeful	12,798	20,954	0	0	121,542	12	0	55,000	0	0	
Welcome	31,360	67,676	19	0	261,155	18	2	110,250	0	0	
Imperial-Reform	1,672	1,072	0	0	4,133	10	0	..	..	..
Lone Star	240	110	0	0	426	5	0	..	..	..
Specimen Hill	2,265	1,205	0	0	4,412	15	9	..	..	..
Pactolus	108	498	0	0	1,929	15	0	..	..	..
Lady of the Lake	10	3	0	0	11	2	6	..	..	..
Argus	82	90	0	0	346	10	0	..	..	..
Golden Arch	1,644	1,092	18	6	4,185	15	0	..	..	..
Caledonian	1,406	2,162	0	0	8,364	0	0	2,250	0	0	
No. 2 South Larry's	7,514	4,129	0	0	13,999	17	6	..	..	..
Kirwan's Reward	22,197	11,013	0	0	43,943	19	8	11,200	0	0	
Golden Lead	11,379	2,645	7	22	10,602	11	8	..	..	..
AI (Last Chance)	1,361	2,479	10	12	8,770	0	0	..	..	..
Merrijigs	259	84	0	0	325	10	0	..	..	..
St. George	46	107	12	0	416	9	6	..	..	..
Alexander Rées	1,011	2,455	16	0	9,747	1	5	300	0	0	
	3,454,600	1,801,861	7	0	6,971,698	14	0	1,732,129	2	1	

APPENDIX—continued.

QUARTZ PRODUCED, AND YIELD OF GOLD, FROM THE VARIOUS MINING COUNTIES IN THE WEST COAST DISTRICT TO 31ST DECEMBER, 1926.

County.	Tons of Quartz.	Yield of Gold.			Value of Gold.			Dividends.		
		Oz.	dwt.	gr.	£	s.	d.	£	s.	d.
Inangahua ..	3,076,246	1,619,173	16	5	6,257,268	15	1	1,612,109	8	9
Marlborough ..	107,342	18,153	0	0	71,198	2	11	3,750	0	0
Collingwood ..	93,792	54,706	0	18	211,965	1	9	20,861	0	0
Westland ..	2,671	2,810	16	5	11,119	19	4	500	0	0
Grey ..	11,393	5,826	19	11	24,321	15	11	..	..	..
Buller ..	160,436	101,118	14	9	395,534	19	0	94,908	13	4
Murchison ..	720	72	0	0	290	0	0	..	..	..
	3,454,600	1,801,861	7	0	6,971,698	14	0	1,732,129	2	1

NOTE.—In preparing the foregoing tables it has been necessary in some cases to calculate the figures given. This was owing to the absence of detailed information regarding the crushings put through during certain periods, especially prior to 1887. There has, however, in practically all instances been indirect data available enabling the missing returns to be estimated, so that the figures set out may be taken as sufficiently accurate for all ordinary purposes.

DEPTHS OF LEVELS IN PRINCIPAL SHAFTS, REEFTON DISTRICT.

BLACKWATER SHAFT:—

Height of collar above sea-level, 1,400 ft. (approx.).

Depth of levels below collar of shaft: No. 1, 150 ft.; No. 2, 305 ft.; No. 3, 430 ft.; No. 4, 615 ft.; No. 5, 765 ft.; No. 6, 915 ft.; No. 7, 1,064 ft.; No. 8, 1,214 ft.; No. 9, 1,364 ft.; No. 10, 1,514 ft.; No. 11, 1,664 ft.; low level, 490 ft.

NORTH BLACKWATER SHAFT:—

Height of collar above sea-level, 1,801 ft. (approx.).

Depth of levels below collar of shaft: No. 6, 1,200 ft.; No. 7, 1,350 ft.

BIG RIVER SHAFT:—

Height of collar above sea-level, ?

Depth of levels below collar of shaft: No. 1, 200 ft.; No. 2, 420 ft.; No. 3, 539 ft.; No. 4, 659 ft.; No. 5, 776 ft.; No. 6, 925 ft.; No. 7, 1,075 ft.; No. 8, 1,225 ft.; No. 9, 1,375 ft.; No. 10, 1,575 ft.; No. 11, 1,775 ft.; No. 12, 1,925 ft.

FIERY CROSS SHAFT:—

Height of collar above sea-level, ?

Depth of levels below collar of shaft: No. 1, 191 ft.; No. 2, 300 ft.; No. 3, 450 ft.; No. 4, 1,000 ft.

ENERGETIC SHAFT:—

Height of collar above sea-level, 1,187 ft.

Depth of levels below collar of shaft: No. 4, 427 ft.; No. 5, 1,174 ft.; No. 6, 1,234 ft.; No. 7, 1,360 ft.; No. 8, 1,485 ft.; No. 9, 1,611 ft.; No. 10, 1,736 ft.; No. 11, 1,918 ft.; No. 12, 2,120 ft.; No. 13, 2,270 ft.

APPENDIX—*continued.*DEPTHS OF LEVELS IN PRINCIPAL SHAFTS, REEFTON DISTRICT—*continued.*

KEEP-IT-DARK SHAFT :—

Height of collar above sea-level, 740 ft. (approx.).

Depth of levels below collar of shaft : No. 1, 152 ft. ; No. 2, 372 ft. ; No. 3, 493 ft. ,
No. 4, 624 ft. ; No. 5, 733 ft. ; No. 6, 923 ft. ; No. 7, 1,073 ft. ; No. 8 ;
1,223 ft. ; No. 9, 1,373 ft.

KEEP-IT-DARK UNDERGROUND SHAFT FROM NO. 3 LEVEL :—

Height of collar above sea-level, 247 ft.

Depth of levels below collar of shaft : No. 4, 125 ft. ; No. 5, 245 ft. ; No. 6, 370 ft. ;
No. 7, 480 ft.

GOLDEN FLEECE SHAFT :—

Height of collar above sea-level, 2,026 ft.

Depth of levels below collar of shaft : No. 1, 66 ft. ; No. 2, 130 ft. ; No. 3,
296 ft. ; No. 4, 396 ft. ; No. 5, 611 ft. ; No. 6, 712 ft.

GOLDEN FLEECE UNDERGROUND SHAFT FROM NO. 6 LEVEL :—

Height of collar above sea-level, 1,314 ft.

Depth of levels below collar of shaft : No. 7, 120 ft. ; No. 8, 240 ft. ; No. 9,
360 ft. ; No. 10, 460 ft. ; No. 11, 585 ft. ; No. 12, 710 ft. ; No. 13, 835 ft. ;
No. 14, 961 ft. ; No. 15 (incline from No. 14), 1,085 ft.

MURRAY CREEK SHAFT :—

Height of collar above sea-level, ?

Depth of levels below collar of shaft : No. 5, 220 ft. ; No. 6, 400 ft. ; No. 7, 540 ft. ;
(NOTE.—Nos. 1, 2, 3, and 4 levels are adits.)

NEW MILLERTON SHAFT :—

Height of collar above sea-level, ?

Depth of levels below collar of shaft : No. 1, 115 ft. ; No. 2, 240 ft. ; No. 3, 365 ft.

GOLDEN POINT SHAFT :—

Height of collar above sea-level, ?

Depth of levels below collar of shaft : No. 1, 250 ft.

GLOBE OR " A " SHAFT :—

Height of collar above sea-level, 1,691 ft.

Depth of levels below collar of shaft : No. 1, 125 ft. ; No. 2, 250 ft. ; No. 3,
367 ft. ; No. 4, 490 ft. ; No. 5, 615 ft. ; No. 6, 816 ft.

PROGRESS OR " B " SHAFT :—

Height of collar above sea-level, 1,690 ft.

Depth of levels below collar of shaft : No. 4, 489 ft. ; No. 6, 816 ft. ; No. 7,
916 ft. ; No. 8, 1,016 ft. ; No. 9, 1,116 ft. ; No. 10, 1,266 ft. ; No. 11, 1,416 ft.

NO. 2 SOUTH KEEP-IT-DARK SHAFT :—

Height of collar above sea-level, (?)

Depth of levels below collar of shaft : No. 1, 180 ft. ; No. 2, 280 ft. ; No. 3,
450 ft.

SIR FRANCIS DRAKE SHAFT :—

Depth of levels below collar of shaft : No. 3, 194 ft. ; No. 4, 330 ft. ; No. 5,
480 ft. (NOTE.—Nos. 1 and 2 levels are adits.)

INKERMAN WEST SHAFT :—

Depth of levels below collar of shaft : No. 1, 62 ft. ; No. 2, 218 ft. ; No. 3,
318 ft. ; No. 4, 423 ft.

SOUTH BLACKWATER SHAFT :—

Sunk 315 ft. No levels opened.

JUST-IN-TIME SHAFT :—

Depth of levels below collar of shaft : No. 1, 200 ft. ; No. 2, 400 ft.

HERCULES SHAFT :—

Height above sea-level at collar of shaft, 781 ft.

Depth of levels below collar of shaft at No. 3 level : No. 4, 100 ft. ; No. 5, 200 ft. ;
No. 6, 290 ft. ; No. 7, 414 ft. ; No. 8, 564 ft. ; No. 9, 713 ft.

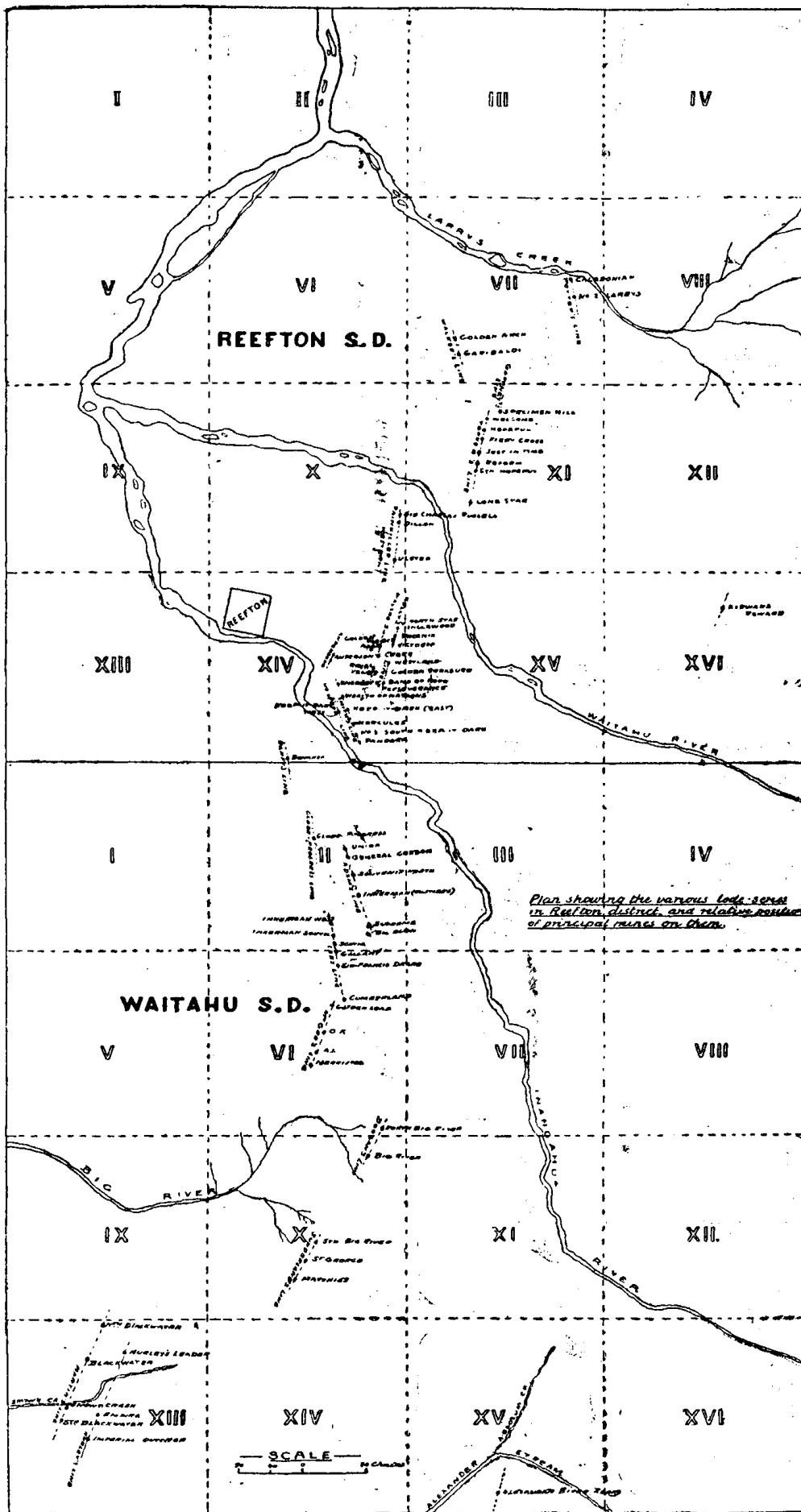


FIG. 13.—MAP SHOWING RELATIVE POSITION OF THE VARIOUS LODGE-SERIES OF THE INANGAHUA DISTRICT, AND THAT OF THE PRINCIPAL MINES ON THEM.

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