Geological Survey of Victoria.

REPORT OF PROGRESS,

BY THE

SECRETARY FOR MINES,

WITH

REPORTS ON THE GEOLOGY, MINERALOGY, AND PHYSICAL STRUCTURE OF VARIOUS PARTS OF THE COLONY,

BY

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REPORT.

Office of Mines,
Melbourne, 31st December 1877.

SIR,

I have the honor to submit to you a further Report of the progress of the geological surveys, together with an account of other work more or less connected with geological and mineral research performed under the direction or supervision of the Mining Department during the past year.

By way of introduction, I may mention that the detailed reports and other statements contributed on this occasion consist of the following :—

1. Report on the Geological Survey of the country about the Thomson River, Aberfeldy River, &c., by Reginald A. F. Murray.
2. Final Report on the Geological Survey of the Creswick Goldfield, by Ferd. M. Krausé.
3. Final Notes on the Geological Survey of the country about Learmonth, by Norman Taylor.
4. Report on the Survey of Granite Areas at Yendon, by Norman Taylor.
5. Report on the Geological Survey of the Clunes Goldfield, by Norman Taylor.
6. Notes on the Geological Survey of Daylesford, by Ferd. M. Krausé.
7. Report on the Geology of Portions of the Dargo and Bogong Districts, by Reginald A. F. Murray (with an Appendix by A. W. Howitt, F.G.S.).
8. Notes on the Devonian Rocks of North Gippsland, by A. W. Howitt, F.G.S.
9. Report on the Mine of the South Extended Sultan Company, Blackwood, by Ferd. M. Krausé.
10. Remarks on the Geology and Mining Resources of the North Waranga Mining Subdivision, by William Nicholas, F.G.S.
11. Schedule of Reports on Fossil Specimens, by Professor McCoy, F.G.S., Hon. F.C.P.S., &c.
12. Laboratory Report, by J. Cosmo Newbery, B.Sc.
13. *Resumé* of the Operations of Prospecting Parties.

Geological maps and other publications issued and in progress.

Fair progress has been made in the preparation and publication of geological maps during the year. In continuation of the statement in the last Report I have to remark that—

The northern sheet of the geological map of the Ararat goldfield has been completed, and both sheets, with accompanying sections, have been published.

The lithographing of the southern sheet of the Stawell goldfield has been completed, and the map is nearly ready for publication.

The four sheets of the geological sketch-map of South-Western Gippsland have been lithographed, and the color-printing is well advanced towards completion.

The sketch geological map of the Bogong and Dargo High Plains and adjacent country has been lithographed and partly printed.

The southern sheet of the geological map of the Creswick goldfield has been lithographed, and proofs have been printed.

Many diagrams have also been lithographed and printed for issue with the publications of the Department.

Geological surveys.

The surveyors, Messrs. Reginald A. F. Murray, F. Krausé, and N. Taylor, have been engaged during the year upon the following work :—

	Square miles.
Creswick.—Completion of the survey and map (referred to in previous Report), (Krausé)	104
Learmonth.—Completion of the survey and map (referred to in previous Report), (Taylor)	84
Gippsland.—Completion of the survey and map (referred to in previous Report), (Murray)	1,360
Portion of Main Dividing Range, Bogong, and Dargo High Plains, &c.—Survey and map completed (Murray) ...	476
Buninyong Granite Areas.—Survey and map completed (Taylor)	41
Clunes.—Outline plotting of map and 17 square miles surveyed in detail (Taylor)	85
Daylesford.—Outline plotting of map and 17¼ square miles surveyed in detail	137

Much time has been occupied in the completion of plans of work commenced in the preceding year; but, notwithstanding this, I am able to report that about 1,210 square miles of country have been examined and geologically surveyed with more or less topographical detail, and that the progress made has been generally satisfactory.

Gippsland.

Sheet No. 2, S.E. Gippsland, surveyed by Mr. Murray, shows about 1,364 square miles of country, and embraces a part of the Main Dividing Range, and several spurs of the Australian Alps, on which are situated—Mount Useful, 4,756 feet; Mount Wellington, 5,363 feet; Ben Cruachan, 2,800 feet; and Mount Kent, 5,129 feet. The area also includes portions of the water-

sheds of the Goulburn, Thomson, and Aberfeldy rivers, and of Donnelly's, Fulton's, Stringer's, and Stony creeks.

About 160 square miles of the survey embraces rocks of Tertiary formation, and the remainder rocks of the Upper and Lower Palæozoic age, with the exception of one small outcrop of granite, which appears from beneath the Upper Palæozoic rocks in the bed of one of the branches of the Avon, about five miles south of Mount Wellington.

Mr. Murray states that the Silurian rocks form the general bases of the country, and that a trough occupied by strata of Upper Devonian age exists in them, extending from the western side of the Macallister to the eastern side of the Wonnongatta River. He identifies the Silurian rocks of the Thomson River as forming a part of the same series as those of the Yarra and Wood's Point districts, which are known to be of Upper Silurian age, while those of the Wonnongatta would appear to be identical with rocks containing Lower Silurian fossils; he assumes, therefore, that there is a line of demarcation between the Upper and Lower Silurian rocks that lie beneath the Devonian rocks previously mentioned as occupying a trough in the Silurian formations.

Mr. Murray discovered no remarkable difference in the Silurian strata as compared with other districts; he notes the strike and dip of rocks observed in various parts of the survey. As a rule, the cleavage and bedding planes of the Silurian rocks coincide, but attention is drawn to some few exceptions.

Limestone but rarely occurs, and in small patches, within the area surveyed. It was found near the copper mine on the north-west side of the Thomson River, on the south side of the same river about seven miles east of the copper mine, and also about six miles easterly from Walhalla on the west side of Duck Creek, a tributary of the Thomson River. In the last-named locality it rests on the upturned edges of the Silurian strata, and on that account it is provisionally classed as of Devonian age. From a small patch of limestone on the north side of Cooper's Creek, similarly resting on Silurian rocks, imperfect fossils were obtained, which Professor McCoy was able to identify as indicative of Devonian rocks.

In referring to the Upper Devonian rocks Mr. Murray alludes to the reasons previously given by Mr. Howitt in favor of the Iguana Creek beds and those of the Freestone Creek in the one direction, and the Snowy Bluff in the other, being regarded as of the same series of Upper Devonian rocks, and states that, from the result of his own observations, he considers, both on stratigraphical and palæontological evidence, that they are so. He shows that about the heads of the Warrigal and Stony creeks (branches of the Macallister) the lowest bed of the Upper Devonian rocks is a very coarse breccio-conglomerate, made up chiefly of large angular fragments of the Silurian rocks; on this rest sandstones, shales, &c., followed by massive porphyritic felsite of great thickness, on which lie the varying sandstones, conglomerates, and shales forming the sedimentary portion of the series.

Mr. Murray illustrates in figures Nos. 6 and 7 the mode of occurrence of the Devonian rocks, and shows the result of a microscopical examination of specimens of the same rocks by Mr. Howitt. A general description is also given of the characteristics of the Devonian rocks extending over the survey, together with interesting sketch-sections.

Mr. Murray mentions that the Macallister River, some distance above Glencairn, trends from a northerly to an easterly direction for several miles, and that it passes through deep gorges and precipitous mountains, walled in by cliffs of mudstones, shales, and sandstones of the Devonian series. Above these gorges are small open, gently undulating plains, covered with "snow grass," through which the river wends, and the surrounding tributary gullies contain moss beds and never-failing springs of water. Mount Tamboritha, whose height above the sea-level is 5,381 feet, appears only as a high hill overlooking this elevated tract of land. Mr. Murray relates that, in following along the summit of the range from Mount Crinoline to Mount Tamboritha, he and his companion, while suffering from severe thirst, determined to descend the mountain side to cascades which they saw in the Macallister River some 1,500 feet below, and that, after scrambling down about half-way, they accidentally discovered a spring of pure ice-cold water issuing from the rock with great velocity, and in a volume equal to two sluice-heads of water, or about 400 gallons per minute. This stream is supposed to have a subterranean communication with the country in which the elevated plains previously referred to are situated.

Mr. Murray alludes to the existence of serpentine and chrome-iron in country west of the range between Mount Hump and Mount Wellington ; he also refers to the occurrence among the Devonian rocks of good beds of sandstone adapted for building purposes. A superior description of hard fissile grit, suitable for flagging, is said to be found at Nicholson's Creek.

No indications of coal were seen in the Devonian rocks, but a little fine gold was found at Nicholson's Creek and a few other places.

Mr. Murray calls attention to patches of Miocene Tertiary at Connor's Plain, on the Dividing Range between the Barkly and Black rivers, at Fullarton's, Spring Hill, and at Mount Useful, all of which underlie basalt, and consist of conglomerates, clays, sands, and gravels, more or less cemented, resting on Silurian rocks. The country under notice bears geological evidence of very extensive denudation ; and as regards the elevated and isolated patches of Miocene Tertiary, it is assumed that, after the Upper Palæozoic (Devonian) rocks had been deposited on the great Silurian and granite rock foundation, they were removed by denuding agencies from all but the deeper hollows and troughs of the Silurian in which they lay. Sections are presented showing the existing rock formations, also ideal sections (Figs. 15 to 18 inclusive), illustrative of the country at various stages during the period of denudation.

An extract is given from Professor Jukes' Manual of Geology, 3rd edition, page 690, describing the denuding agencies that have been in operation in the

Hebrides, in order to show how exactly it appears to describe geological conditions existing in Gippsland. The operation of the agencies described by Professor Jukes, though not so striking in extent and grandeur, are similarly exhibited in other parts of Victoria where Silurian rocks prevail, and particularly so along the valleys of the Loddon and Campaspe, where the lava-flows were originally contracted in width by closely bounding higher country, and where they now stand out in bold relief as elevated plateaux, capping Tertiary deposits, although cut through in many places by denuding agencies.

Mr. Murray furnishes elaborate notes on the quartz mining operations within the tract of country embraced in his survey. In relation to "alluvial" mining, the subject is disposed of in a short paragraph, describing the general exhaustion of the auriferous deposits in the beds of rivers and creeks, or in the terraces along their banks. It is probable that tracts containing these deposits yet remain to be discovered, but it is not considered that they are likely to be of much importance to the miner. Mining operations.

It is upon the development of quartz mining that the main hopes of the future mining prosperity of the district are said to be based. In referring to the seven groups of auriferous quartz veins existing in Victoria, as described in the paper by Mr. Nicholas, F.G.S., published in the Progress Report No. IV., Mr. Murray points out that a portion of the lodes of one of these groups is to be found in the country shown in his sheet. These lodes lie in two separate belts, in one of which occur the reefs at Donnelly's Creek, and in the other those at Aberfeldy and Walhalla. In the former no dykes of any kind have been seen, either in or near the quartz workings, but in the latter the lodes accompany, and are often found in conjunction with, well-defined dykes of felstone and diorite.

Sketch-sections are produced, showing peculiarities in the occurrence of the reefs without dykes at Donnelly's Creek. These reefs vary in thickness from a few inches to several feet, and though very rich in places, the gold is distributed somewhat irregularly in the veins. The mountainous nature of the country favors the working of the lodes by tunnels or adits from the steep sides of the hills. Illustrations are given of some of the adits and of the character of the lodes they intersect. The most valuable vein-stone in the Donnelly's Creek mines is usually well laminated, and contains galena, zincblende, and iron and copper pyrites.

As regards the quartz veins associated with diorite dykes, Mr. Murray supplies sketches (Figs. 31 and 32) and descriptions of the mines on the watershed of the Aberfeldy River.

The reefs at Walhalla are in the same belt as those just referred to, and those known as Cohen's, Longfellow's, Happy-go-Lucky, and Fear-not, are also similarly associated with intrusive dykes. Numerous drawings are given (Figs. 33 to 48) showing details both in longitudinal and cross section of the veins on the Cohen's line, on which the workings of the celebrated Long Tunnel Company and of the Walhalla and North Gippsland companies

are situated. Much gold has been obtained from the former; and in referring to the characteristics of the vein-stone, Mr. Murray says that the presence of arsenical pyrites in the associated dyke is regarded as an unfailing indication of the proximity of good quartz in the lodes. Bournonite, iron pyrites, and galena are said to be plentiful in the vein-stone. Figures 49 to 53, and 56 to 59, contain excellent illustrations of lodes on various lines of reef at Walhalla.

The Walhalla copper mine is described as occurring in a diorite dyke, about four miles distant from Walhalla. The dyke stone contains much hornblende, with copper pyrites disseminated and in veins; the pyrites near the surface has decomposed and become converted into carbonates, sulphates, and oxides of copper, with which is associated brown iron-ore, produced by the decomposition of iron pyrites. The ore-bearing portion of the dyke is about 120 feet long, and about 25 feet wide at the surface. Illustrations and detailed descriptions are given of the mine, and its prospects from a commercial point of view are considered to be of a favorable character.

Prospecting. Mr. Murray offers suggestions for the future prospecting of the country for gold, which may be briefly summed up as follow, viz., that the alluviums in the creeks and gullies intersecting lines of reefs already proven at various points along their courses to be auriferous, should be examined, and that when gold is found careful search should be made in the immediate vicinity for reefs or lodes.

Mr. Murray mentions, as sites offering favorable indications for prospecting operations, the country lying between the Donnelly's Creek reefs and the Boy Reef, the Walhalla belt of reefs, the country on the fall from the Mount Useful range to the Macallister River, and that lying between the Macallister and Thomson rivers, the gravels beneath the basalts of Fullarton's Hill, Connor's Plain, head of Cooper's Creek, &c.

It is remarked that the general appearance of the reefs is greatly in favor of the theory, that veins of quartz and their contained metals and minerals were segregated from the surrounding rocks into fissures and cracks; and it is pointed out that the fissile character of the Silurian rocks admits of fissures of great length along the strike of the uplifted beds.

Creswick. Mr. Krausé has furnished a supplementary report upon his survey of the Creswick goldfield bearing upon the auriferous leads of the Middle Pliocene age, and particularly upon the following known leads and their tributaries:—Sulky Gully, Bald Hill, Cobblers and Diamond Gully, Red Gully, Nuggety Gully, Creswick, Doctor's, Spring Gully, and Separation; the Flat leads lying between Broomfield and Frenchman's gullies, Springhill, Lewers and Hawkins leads. The four latter have been recently opened, and in many instances with highly successful results.

The Sulky Gully Lead, which takes its rise on the south side of the Main Dividing Range, passes under that range into the opposite watershed area, after a course of little over one mile from its source. The ancient Divide in this locality would seem to have been situated to the southward of the one

at present existing, the configuration of the country having been greatly altered by points of volcanic eruption and lava-flows. Such instances of auriferous leads, trending from one watershed area to another, are not uncommon in Victoria, and descriptions of two others will be found in this Report, one by Mr. Krausé, relating to the Wombat Hill Lead, and another by Mr. R. A. F. Murray, in his account of the Dargo High Plains in Gippsland. The latter furnishes evidence of the entire removal of mountains by the sweeping changes effected by denudation.

Many of the leads described by Mr. Krausé have been traced for distances varying from one to nine miles, and their lower portions enter beneath the basaltic tract lying to the north and north-west of Creswick. These latter are much the more costly to work, inasmuch as the hard nature of the basaltic rocks causes the sinking of shafts to be attended with difficulty; another reason is that greater quantities of water are found in the drifts, owing to the low level of the country and its distance from the heads of the watershed. In addition, it may happen that the leads increase in width, and their gravels being more widely distributed contain less gold. Under these circumstances the miners are perhaps unable to continue their operations with profit, and consequently suspend, or altogether abandon work, although, if the leads were traced further along their downward courses, they would likely be found to be again contracted in width, and to be enriched by auriferous tributary gutters, inasmuch as the trend of the main drainage lines of the country is directly conformable to the course of the auriferous belt of reefs, which no doubt extends from Creswick to Clunes, and from which the leads, so far as they have been traced, have received their quartz and gold.

In speaking of the probable direction of the Sulky Gully and Bald Hill leads, from the points where the miners have ceased to work them, it is said that they probably effect a junction immediately north of Mount Hollowback; but the country to the north-west presents for many miles an unbroken sheet of lava, offering no features to indicate the actual position of the lead lying beneath it. Its position can therefore be only determined by boring or sinking.

The further trend downwards of the united course of the Diamond Gully and Long Point leads is supposed to be north-easterly, towards the Red Streak Lead. The principal lead of the goldfield—the Creswick and Black Lead—has been traced a distance of about 8½ miles from the Dividing Range. It receives a number of important tributaries, and its course has been determined a considerable distance beneath the basalt—as far down as the mine of the Australasian Company. Attempts have been made to define the channel of the lead below this part, and a series of bores is said to have proved pretty conclusively that its position may be looked for at a point midway between the No. 1 and No. 2 shafts of the Consols Company. It is generally supposed that the lead then continues in a northerly course across the Glendonald Creek, half a mile west of Swan Hill, and that it

joins the Springhill Lead west of Wheeler's Bridge. Mr. Krausé, however, calls attention to a narrow belt of Upper Pliocene clay drift, lying between smooth Silurian hills, and stretching westward along the Glendonald Creek to Creswick Creek, and considers it of importance that the depth of the deposit should be ascertained, as in the present uncertainty there is no gainsaying the supposition that the Australian Lead may follow the course of the Glendonald Creek to Creswick Creek, and re-enter the basalt under the Racecourse Reserve. I doubt if the onward course of the lead will be found to follow the direction last suggested. I favor the general supposition that it takes a northerly course from the mine of the Australasian Company.

In reference to Doctor's Lead, Mr. Krausé remarks that the tongue of lava occupying the ridge dividing the Adekate from the southern arm of the Back Creek and the narrow outliers west of the first-named stream doubtless cover an old lead valley, the existence of which has hitherto escaped the attention of the miner.

The Flat leads lying between Broomfield's and Frenchman's gullies have been abandoned by the miners for about eighteen months, and their downward courses have yet to be determined. Mr. Krausé thinks that they will eventually be found to unite in one main arm bearing westerly, and then north-westerly towards the Consols Company's ground, joining the Australasian Lead east of their No. 2 shaft.

The consideration of the recently discovered leads underlying the basaltic tract at and near Springhill next calls for attention. Of these, Mr. Krausé mentions that the German Gully and Broomfield leads, after uniting, will probably be found to join with the Trunk (Springhill) Lead in Dyke's freehold.

As regards the Springhill Lead, it is said that in the mine of the Baron Rothschild Company a length of 1,400 feet of the gutter was blocked out in thirteen months—from May 1875 to June 1876—and that the gold obtained amounted to 14,387 oz. 10 dwt. 16 grs., realizing £57,175 1s. 11d., leaving a profit of £38,550, after payment of all working expenses, including machinery and plant. Extensive deposits of gravel drift (reef-wash) exist on the sides of the lead, but they have not been hitherto found to pay the expense of working them.

Fine rolled grains of native copper are rather abundantly distributed through the gravels of the Springhill Lead, but, with the exception of this and some titaniferous iron-sand, the gravels contain few traces of minerals other than gold. The gold is of superior quality, from 23 to 23½ carats fine.

Ryan's Junction Company have at the present time the most advanced workings on the Springhill Lead; there are but few natural features to indicate the course of the auriferous drift beyond their mine; it is, however, considered likely that the lead, joined by the De Murska Lead, will be found east of McDonald's Hill, and that it will thence trend in a northerly direction under the plateau between the Tullaroop and Middle creeks.

Lewers Lead, so far as wrought, extends in a northerly direction from Springhill about 1¾ miles to its junction with Hawkins Lead, about 240 yards north of the Kingston Park shaft. The upper portion of the lead is only from 20 to 30 feet wide; but 250 feet north from the shaft of the Richardson Junction Company it falls rapidly, and expands to a width of 150 feet. At this place large quantities of water were found in the drifts, and a falling-off in the auriferous quality of the gravel, caused the workings to be abandoned, leaving some portions of the gutter untouched.

Hawkins Lead has been traced a distance of about two miles in a northerly and north-westerly direction from Springhill down to the shaft of the De Murska Company, where it is found at a depth of 198 feet beneath the basaltic plain. From this point Mr. Krausé is of opinion that it will probably trend in a north-westerly direction, south of Birch's Bald Hill, and towards the Bullarook Creek, near Wheeler's Bridge. He shows by a diagram and description that there are two distinct flows of lava covering this lead. The gutter varies from 20 to 100 feet in width in the upper, and from 70 to 200 in the lower portion; along its eastern edge terrace drift is found, yielding in some places satisfactory returns.

In addition to the leads already mentioned, it is said that the existence of a deep channel has recently been established by a shaft sunk on the south-eastern slope of Springhill, and it is probable that a lead will be found there bearing northerly for about a mile in the direction of the Kingston Road, and thence north-westerly towards Birch's Bald Hill, in the vicinity of which it may join the Hawkins Lead.

About three-quarters of a mile north-west of the village of Bullarook, in the valley of the Bullarook Creek, a bore was put down to a depth of about 300 feet from the surface to the bed-rock, and specks of gold are said to have been obtained from the bore-meal got from the lower gravel drift. This deep ground is supposed to be a continuation of the Rocky Lead lying to the southward.

Mr. Taylor, in his annual report, describes the work executed by him during the last year, viz., the completion of the Learmonth sheet, the survey and planning of the granite boundaries near Buninyong East (Yendon), the plotting of land surveys within the Clunes sheet, and the geological survey of about 84 square miles of country within the limits of that sheet.

Learmonth.

In the additional notes on the Learmonth survey, referred to in last year's Report, Mr. Taylor has furnished full descriptions of the lithological character of the rocks to which reference numbers are given on his plan.

In describing some bores sunk by Mr. Bath, near the Burrumbeet Creek, north of Tin-pot Hill, he remarks there is a possibility that the auriferous leads found in the mines of the City of Ballarat and Great North-West companies may trend northerly, and nearly follow the course of the Burrumbeet Creek, through the southern portion of the area shown on the Learmonth sheet, and thence pass southerly towards Lakes Burrumbeet and Carngham.

This opinion appears to be based on the fact that the bottoms of the bores sunk by Mr. Bath are about at the same level as the bottom of the shaft of the City of Ballarat Company, but Mr. Taylor makes no allowance for the natural fall of the lead in its downward course. He mentions that, should the lead be found near the site of Mr. Bath's bores, any tributaries coming in from the north and east would not be likely to be auriferous, because the country underlying the basalt in that direction must be of granitic formation, as proved by the ejected masses of granite on all the volcanic points of eruption as far east as Mounts Cavern and Blowhard.

Supplementing his additional notes, Mr. Taylor furnishes descriptions of 167 specimens of rocks obtained from various parts of the Learmonth survey, forwarded to the Office of Mines for reference purposes. Several of the descriptions are from microscopic and other examinations of the specimens made by Messrs. Ulrich and Newbery.

Yendon. In the course of the late prospecting operations at Buninyong, described in another part of this Report, it became apparent that the boundaries of the granite and Silurian rock formations in that locality, as laid down on the Geological Sketch-map of Victoria, required revision; Mr. Taylor was therefore instructed to trace and define the boundaries of the former from the edge of Mr. Murray's previous survey of the Ballarat goldfield, so far as it might be necessary to effect corrections. This work has been satisfactorily accomplished. (*See* Plan and Report annexed.)

Mr. Taylor remarks that the area of granite shown on the plan is part of the same mass as that existing at the Gong Gong reservoir, being merely separated from it superficially by a basaltic overflow from Mount Warrenheip in the north-west. The boundaries of the granite, and also of the basalts in parts of the survey, are much obscured and difficult to define on account of deposits of surface drift.

Little need be said about the basalt-flows: they have their sources at Mount Warrenheip and at the Black and Green hills. The thickness of the basalt disclosed at the Lal Lal Falls is about 130 feet, but this does not represent its actual thickness, as the bottom of this rock is not visible below the Falls.

Lignite. About Lal Lal occurs a basin in which there is a considerable deposit of lignite about 140 feet in thickness, and in the same locality are round swamps surrounded by sand ridges, which present a very coast-like appearance.

Leads. Mr. Taylor says that the drifts to the north of the area surveyed persistently follow the edges of the basalt, and have the appearance of underlying it; also that some leads, fed on the one side by the Ballarat ranges, and on the other by the Egerton and Gordon ranges, most certainly occur under the basalt-flows. He considers that a deep lead probably crosses Ben's Creek, in the narrow gap of 15 chains between the outcrops of Silurian rock (shown on the map which accompanies his report), and that another may pass under the narrow strip of basalt marked 45 on his plan.

In referring to the survey on which he is now engaged, Mr. Taylor remarks that it would be useless to attempt to furnish a full report upon a district of which he at present knows so little; he is, however, of opinion, that the survey will throw a good deal of light upon the trend of the deep auriferous leads beneath the basalts at Clunes. He considers that they are continuations of the leads existing at Creswick, although the general opinion is that they are of local origin. A short description is given of the leads wrought by the New Lothair and Theodora companies, and of the auriferous deposits in what is locally known as the "Paddock," and which he supposes to be "reef-washes" (older drift), derived from the auriferous reefs at Clunes, so long and successfully worked, and to the courses of which they are in close contiguity. Clunes.

The Clunes reefs are stated to be of saddle formation, and they apparently occur along the cap of a ridge forming an anticlinal axis. In the New Lothair mine, of which a section is given, native copper is found, and much of the quartz is discolored by blue and green carbonates of that metal; zincblende, galena, copper pyrites, and cubic and arsenical pyrites are also found sparingly. No dykes have so far been discovered in the reefs.

Mr. Krausé is now engaged in the geological survey of a block of country embracing the Daylesford goldfield, and he has furnished notes on the progress of the work, upon which the following remarks are based. The sheet will comprise a total area of 100 square miles. Parts of the country are rugged and very intricate, both in their geological and topographical features. The rock formations consist chiefly of Lower Silurian, Newer Volcanic, Upper Tertiary, and Post Pliocene drifts. The survey of fifteen square miles of country has been completed. Between the Loddon River and Daylesford the Silurian rocks are said to have a persistent westerly dip, but from the latter place westward the beds are considerably folded and fractured, and are associated with the principal veins of quartz. The flags in these beds consist of light, dark-grey, and almost black shales, and abound in graptolites. Daylesford.

The auriferous quartz veins that have been mostly wrought hitherto are situated in a belt of country less than a mile in width, lying immediately west of Wombat Hill. They have been traced almost uninterruptedly for several miles north and south. Among the principal are Specimen Hill, Colliers, Sandstone, Wombat Hill, Crown, Nuggety, Ajax, St. George, Eugénie, Hepburn, and Mauritius reefs.

Some of the reefs present peculiar features, and notably the Wombat Hill Reef, from 8 to 30 feet in thickness, which is in some places a massive body of quartz, yielding as high as an ounce of gold to the ton, and in others an irregular mass of slate and quartz veins (called a mullock lode). At the 520-foot level in the Cornish mine, on the same reef, the mullock lode terminates abruptly against the basset edges of the slate, although the walls are known to continue downwards. This occurrence is illustrated by a sketch-section. Mr. Krausé also describes other irregularities in the formation of the lode, and their apparent effect upon the yield of gold.

Whatever may have been the influence at work to cause the increased richness of the vein-stone in the instance last described, there can, I think, be little doubt that the irregularities in the occurrence of the lodes, and the existence of small side veins or spurs jutting out from the main lodes, are due to a tendency of the bounding rocks to fracture unevenly when subjected to disturbance; where these rocks are fissile, they cleave regularly, and the walls of the lodes are clean, and are usually conformable to the lines of stratification.

Mr. Krausé furnishes a sketch showing a bifurcation of the Wombat Hill Reef, and a section showing a portion of the Mauritius Reef, both of which contain numerous bands and veins of quartz, accompanied by fractured dark-grey slate full of cubic pyrites.

It may be mentioned that the quartz reefs described are all approximate to points of volcanic disturbance.

Lower Pliocene.

The physical aspect of the country is said to have been changed so much by denudation since the deposition of the Lower Pliocene gravels that there is not sufficient proof to indicate whether these drifts ever occupied widespread beds. Mr. Krausé shows on a sketch a capping of the drift on the summit of a hill at the Wallaby diggings.

Middle Pliocene.

A striking instance is given of the change of a drainage system by the interposition of the lava-streams from Wombat Hill and neighboring points of eruption, as exhibited in the Wombat Hill Lead, which lead has a northeasterly course for a distance of about seven miles in a direction nearly at right angles to the present valleys before it trends to the northward along the course of the Loddon River.

Mr. Krausé furnishes some interesting sketches of portions of the Daylesford leads, and also one showing the edges of a crater as disclosed by mining shafts sunk in search of auriferous gutters. In speaking of the Dead Man's Lead, near Wombat Hill, he expresses an opinion that it forms a portion of the Italian Hill Lead, and says, if this opinion is correct, there remains about 3,000 yards in length of auriferous gutter yet unworked. The continuations of the Fern Hill Lead and the Wombat Hill Lead are also problems that have yet to be solved by the miners.

As an instance of the richness of the Wombat Hill Lead and its feeders at their upper portions, it is mentioned that on the first mile of this lead, from the Haphazard to the White Star mines, 170,000 oz. of gold were obtained, equal to a yield of 32 oz. of gold per lineal foot of its course. The gutter drift of the lead contains more or less rounded quartz gravel and sandstone shingle, and is remarkable as containing fragments of wood and trunks of trees in various degrees of preservation, but nearly always impregnated with, and in some instances replaced by bisulphuret of iron.

The overlying rock varies from a soft ash and tuff to scoriæ and dense basalt, and near the junction of the Concordia and Wombat Hill leads a layer of black clay and sandy mudstone is found full of impressions of reeds and of leaves of eucalypti.

Bogong and Dargo High Plains, &c.

Far up among the dividing ranges of Gippsland, at elevations superior to those of any rocks of similar character in Victoria, are to be found somewhat extensive basaltic plateaux, known as the Bogong and Dargo High Plains. Much speculation has been indulged in respecting these areas, owing to their great elevation, their climatic peculiarities, and from the fact that they were known to contain auriferous drifts. It was therefore determined to prospect the country, and in the month of February last a party was organized for the purpose by Mr. A. W. Howitt, and was placed under the direction of Mr. Murray, who was instructed to make a rough survey of the geological features of the tract to be examined, and when necessary to employ the services of the party in opening any exposures of sub-basaltic gravels that might present favorable indications of gold.

Mr. Murray has now sent in a very exhaustive and interesting account of his labors and observations in this region, together with a sketch-plan of the area provisionally surveyed. (*See* plan with his report.) The plan shows country 28 miles north and south by 17 miles east and west, equal to 476 square miles, and includes Mount Hotham, 6,100 feet, the highest point in Victoria on the Main Divide. (This mountain is exceeded in height by only a few others in the same tract of country, situated on spurs from the principal range, such as Mount Bogong, the highest in Victoria, 6,508 feet; Mount Feathertop, 6,303, &c.)

In describing the physical geography of the region Mr. Murray says that a watershed line running north-easterly from Mount Cope, dividing the Kiewa from the Cobungra and Bundarah rivers, crosses the Bogong High Plains (on the northern side of the Main Divide). On the south side of the Divide, and crossed by the watershed line between the Dargo River and the heads of the Crooked River, are the plateaux known as the Dargo High Plains.

These highlands are from 4,000 to 6,000 feet above the sea-level: they consist of open undulating plains and moors, stony but well grassed, and are interspersed with clumps and belts of "snow" gums. Separated from the larger plains by low saddles, are several smaller ones, from 2,000 to 3,000 feet in height, but which evidently once formed a portion of the former. Below the plains are the valleys of the Dargo and Cobungra rivers, bounded by hills whose steep sides, clothed with timber and scrub, rise abruptly to the plateaux above.

Mr. Murray thus descants upon the features of the country as disclosed to the observer:—"The sharp peaks of Mount Feathertop, the smoother outlines of Mount Hotham and the Bogong Ranges, the rugged granite points of Mount Fainter, and the distant view of the serrated peaks of the Buffalo Mountains, all add grandeur to the beauty of the wide prospects visible in this region, while the verdure, the perpetual springs and clear running streams, give the country an aspect in welcome contrast in summer to the parched appearance of the low country."

As a summer pasture for stock the land would seem to be valuable; but it is subject to severe frosts even during the warm season, and for four months of the winter the snow is said to render it impassable.

Lower Silurian slates and sandstones and metamorphic schists form the bed-rocks of the whole of the area mapped. In parts these rocks are overlaid by gravels, sands, and clays of Miocene or Middle Tertiary age, and these again are capped by flows of lava of varying thickness, which form the high plains of the district. The Palæozoic rocks are to be seen on the highest peaks, and also in the low-lying rivers and creeks which have cut through and separated the plateaux above. In these modern watercourses occur drifts of Tertiary age, resulting from the denudation of the Silurian rocks, the Tertiary beds, and basalts.

It is pointed out that in Middle Tertiary times the beds of the watercourses were at a far higher elevation than those of the present day; that flows of lava took place which filled in the valleys, and that the present rivers then commenced to cut their way, and have since eroded the valleys as they now exist, sometimes parallel with, and sometimes across the ancient river-beds.

Mr. Murray remarks that the unaltered Silurian and metamorphic rocks of the district have no arbitrary line of demarcation, but that as the metamorphic region is approached a regular and gradual transition is observable. The unaltered shales pass into silky micaceous shales, followed by mica schists passing into gneiss and granitoid schists, which in turn pass into granite, that sometimes retains a faintly traceable schistose character.

Middle Tertiary.

Middle Tertiary deposits occur under the areas occupied by basalts, where they seem to lie in well-defined troughs in the bed-rock; but the sites of landslips, and a few places where the gravels have been worked for gold, are the only spots at which the deposits can be observed.

As a result of his observations, Mr. Murray considers that the main river valleys of the Middle Tertiary period were broad and shallow, and distinct from the character of the narrow and steep valleys along the courses of the present mountain streams, and that the lava-flows were confined to the limits of the ancient valleys, except perhaps in some few instances where the dividing ridges were low. He speaks of the more rapid denudation of the softer slates and shales of the dividing ridges as compared with the denudation of the basalts; the former have worn down in many places to lower levels than the latter; he points out that, as the small isolated basaltic patches which now cap hills separated from larger plateaux were once evidently continuous, and formed a portion of the latter, and as these hills at the present time are of little less elevation than the highest peaks of Mounts Feathertop, Hotham, Cope, and others, it is evident that the ranges defining the ancient watershed lines, of which the mountains named are probably remnants, were once hundreds, or perhaps thousands of feet greater in elevation than they are now.

There are no exposures of gravel around the edges of the Bogong High Plain, but on the western margin of the basalt, in a head of the Bundarah Creek, are exposed beds of yellowish-brown laminar clay, containing fossil leaves, among which are *Tæniopteris tenuissime striata* (McCoy)—said to be the first specimen of this fossil found in Tertiary rocks in Australia—*Lastrea Dargoensis* (McCoy), allied to a Miocene species of the Arctic regions, &c.

A small outlier of basalt was discovered capping a hill on the Divide between the Diamantina branch of the Kiewa and the heads of the Cobungra, about two miles N.E. from Mount Hotham, at an elevation of 6,175 feet above the sea-level, and about 74 feet higher than the summit of that mountain; a few more patches of the same rock were found S.S.E. at lower elevations, but were supposed to be portions of a once continuous flow.

Basalt occurs on the east side of Mount Hotham, on the summits of conspicuous hills, known as the Higinbotham Heights, near Mount Hotham, and also for a considerable distance along the Main Divide, at about three miles from that mountain, and at great elevation in some other places.

On a spur north of the Main Dividing Range, between two tributaries of the Cobungra, known as Murphy's and Brandy creeks, is an exposure of gravel from beneath the basalt, now being worked for gold, and known as White's claim. On the slope N.N.W. from Boiler Plain, south of the Main Divide, is another exposure, known as Morris's claim; and near the southern end of the basalt of Mount Tabletop, on the fall westerly into the Dargo, also south of the main range, is another, known as Armour's claim. The bed-rock at White's claim is about 4,800 feet; that at Morris's, the other side of the Main Divide, 4,640 feet; and the summit of the Divide between the two claims is from 5,350 to 5,500 feet above sea-level.

The workings at White's claim prove that the channel trends southerly, towards the Main Divide, in a direction exactly opposite to the modern water-courses; and detached patches of basalt, and their varying levels, also indicate the position and direction of the ancient valley beds, and the great alteration in the physical features of the region. From these, and other indications fully explained in his report, Mr. Murray points out the probable positions of the leads, and says that he has no hesitation in expressing an opinion that the drift deposits at Morris's claim are continuous beneath the basalts on the present Main Divide with those exposed in the land-slips at the head of Brandy Creek, and probably also with those at White's claim, thus showing that the position of the ancient dividing range was different from that of the one at present existing, and that the southern slopes of that range extended *far* back into the present watershed area of the River Murray. As regards the exposure of drift at Armour's claim, it is considered that the gravel is likely to be a vestige of a bend in the main lead from Boiler Plain, and its elevation, which is 400 feet less than the drift at Morse's claim, supports the conjecture.

The next continuation of the Middle Tertiary deposits, and their overlying lava beds, occurs at the Dargo High Plains, a gap of three miles across having been caused by the erosion of the Dargo valley. Along the edges of the basalt in this locality deposits of gravel have been worked for gold, and at a claim known as Synnot's, near the Mayford Spur, a great thickness of gravel is revealed, with some bands of foliated clay, in which were found *Cinnamomum polymorphoides*, identified with fossil flora of Miocene age; and near the same place were found siliceous and ferruginous conglomerates, containing fossil leaves, supposed to represent imperfect lauraceous leaves of undescribed species, also occurring in Miocene Tertiary beds at Bacchus Marsh, together with a specimen of *Salisburia Murrayi* (McCoy), nearly allied to some Miocene forms from the Arctic Regions, but not hitherto found in Australian strata.

Mr. Murray's general conclusions are, that the ancient Dargo of the Miocene epoch headed from the opposite side of the Main Dividing Range near Mount Fainter; that the deposits at White's claim, Boiler Plain, Mount Tabletop, and Mayford Spur, are remnants of its bed, or of some of its branches, and that the intervening parts, and the heads of its tributaries, have been entirely removed during the erosion of the present rivers, and further, that a large main affluent came in from a direction across what are now the courses of the Twentyfive-mile and Thirty-mile creeks. He says that fluviatile and atmospheric action seem to have been the only agencies that have sculptured the country to its present form subsequent to the lava-flows.

The basalts are referred to as Older Volcanic (Miocene period); they are highly magnetic, and their general structure is columnar. Fine specimens of pentagonal columns occur at Mount Hotham and other parts; portions of the surface of the Bogong High Plain have the appearance of being paved with five-sided blocks of stone, and on some of the mountain sides, where land-slips have occurred, acres are covered with five-sided blocks of basalt.

No apparent vents or pipes from which the lava-flows have issued have been yet discovered: it is likely that more than one exists, as the thickness of the basalt is, in some places, equal to 700 feet, and Mr. Murray points out that it is hardly reasonable to suppose that it was poured forth in a single stream.

Auriferous character of drifts.

At White's claim (Bogong Plain), Morris's claim (Boiler Plain), Armour's claim (Mount Tabletop), Synnot's claim (Mayford Spur), also at German Terrace, and on the slopes into the Little Dargo and Pyke's Creek, either coarse or fine gold has been obtained in the gravels coming from beneath the basalts, and many of the creeks and gullies below have yielded good returns where they have cut through the old Miocene gravels. This leads Mr. Murray to the opinion, that the gravels beneath the basalts are auriferous throughout, but that from their great thickness and the general dissemination of the gold they could only be profitably worked by means of an ample water supply for ground sluicing. Where the gravels are under the basalts they would require to be brought to the sluices by means

of adits. Water could be obtained throughout the year at the required levels from springs and the heads of permanent streams, but the construction of long races or channels would be required for its conveyance.

Excluding the Bogong Plain, because little is yet known as to the character of the deposits beneath the basalts in that portion of the country, Mr. Murray estimates that there is a length of about twelve miles of main lead and its principal tributary at the following places :—Cobungra Plateau, Boiler Plain, S.W. side of Tabletop, Mayford Spur, between Pyke's Creek and Little Dargo, and the western branch from the direction of the Thirty-mile Creek. It is considered that fairly remunerative, and in places rich yields of gold would be obtained, but that, owing to the scarcity of quartz reefs in the adjacent country, they would not be equal to the leads of the Western goldfields, which are situated in country traversed by great belts of auriferous quartz reefs.

I believe Mr. Murray's general reasoning to be sound on this point. I am, however, disposed to the opinion, as the result of observations in other parts of Victoria where auriferous quartz reefs are not abundant, that gold in the gravels underlying the basalts would be found to be of a "patchy" character; that is, rich and "coarse" in those parts near to the sites of auriferous reefs that have been extensively denuded and broken up, and poor and "fine" in others.

Mr. Murray recommends, as favorable sites for the operations of a prospecting party, the outcrops of gravels on the falls from the Main Divide into Cobungra and Dargo rivers, and also similar outcrops on the western side of the Dargo. He mentions that operations should be commenced in November, so as to command six months of favorable weather, and also makes suggestions as to the mode in which the work should be carried out.

Devonian rocks, North Gippsland.

Mr. A. W. Howitt, F.G.S., has furnished, as usual, a very valuable contribution to the annual Report, in a series of carefully prepared notes, in continuation of a paper on the Devonian rocks of North Gippsland, which appeared in No. III. "Progress Report."

As a preliminary remark, he calls attention to a foot-note in his previous paper on the Buchan limestones—appended to page 199, Progress Report No. III.—in which he alluded to the marked conglomeratic character of the Snowy River porphyries, &c., as it seems by this clue he was led to continued investigations of these rocks, the results of which are now given as a further contribution to our knowledge of the Upper Palæozoic formations of Gippsland.

Mr. Howitt's previous investigations had induced a belief in his mind that the marine limestones of the Buchan rested upon the Snowy River porphyries, but further examination has caused him to think differently, and he is now of opinion that the purely marine limestones of Buchan form but a moiety of the Middle Devonian formations, with which they are naturally grouped.

Two sketch-sections of country at Butcher's Creek, one from Murendel River to Butcher's Creek, and one at Murendel River, with descriptions of the rocks and their modes of occurrence, are furnished, and it is inferred that the rocks forming the several sections are portions of one series, and that they show a sequence downward from limestones of purely marine origin through calcareous and felsitic tufas, sandstones, breccias, and conglomerates, to what is properly a volcanic series of littoral origin. The total thickness of the group is estimated at about 1,270 feet, of which 270 feet are limestones, and 1,000 feet are tufas, breccias, &c.

Faults in the felsites at Butcher's Creek and the Murendel River, one of which appears to approximate in direction to the course of the latter stream, are illustrated and described. A description is also given of the rocks occurring at the Buchan River, as disclosed in two cross sections illustrated by Mr. Howitt. The marked unconformity of the rocks in these two sections is considered to indicate that a fault exists between the Buchan limestone and the older felsite.

Sketch-sections and descriptions of the rocks at Gellingall then follow, which exhibit the same features as in the sections at the Murendel and Buchan rivers; from this resemblance Mr. Howitt says we may not unfairly consider that at Gellingall a view is obtained of the whole group as it remains, from the underlying granite on which its base rests to the limestones of partly marine origin with which the series terminates, and which, up to the present time, have been here the representatives of Middle Devonian formations.

A provisional estimate is given of the character and thickness of the Devonian formations of North Gippsland, commencing with the Iguana Creek (Upper Devonian), which consist of sedimentary formations, containing plant remains, and passing through the felsites and basalts of the Snowy Bluff beds, the tufas and breccias, &c., of the Lower Buchan beds, down to the felsites, &c., of the Snowy River porphyries (Lower Devonian ?).

Mr. Howitt remarks that the gradual spread of marine conditions over the Buchan and Gellingall areas would suggest previous terrestrial conditions probably to the north and north-west; the Iguana beds show the existence of these conditions unmistakably by the numerous fossil plants alone found in them, and we may conclude that the Devonian age was in North Gippsland a period characterised by the occurrence of vast volcanic manifestations, which were most probably terrestrial.

Lead mines, Buchan.

An interesting description is furnished of the mode of occurrence and origin of the lead-ore and other deposits in the Buchan beds, and of their association with the enclosing rocks. Sketch-sections, taken at Back Creek and at the Murendel River, together with descriptions, are furnished, as affording details of the rock formations at the lead mines opened at those places.

At the Back Creek mine the ore is not found in a true lode, but in irregular bunches and strings in the bedding planes of the limestone, and also disseminated in grains in the calcareous and adjoining felsitic rocks.

The total quantity of ore raised from this mine is estimated at from 180 to 200 tons. About 75 tons were of good quality, and the remainder poor. Fifty tons smelted at the antimony works in Collingwood yielded about 38 per cent. of metal. The mine is now completely abandoned.

At the Murendel mine the ore, as at Back Creek, follows the bedding planes of the limestones, and penetrates crevices in them, or is disseminated in crystalline grains and spangles throughout the mass of rock ; but Mr. Howitt states, from personal examination, that the ore-vein worked in the mine is connected with a fault, and that it has all the appearance of a true lode, the gangue being a limestone breccia, cemented by carbonate of lime and metallic sulphides.

The value of the lode could only be determined by systematic examination and exploration. Up to the present time this has not been done; most of the capital and energy of the company has been expended in erecting smelting and other works, while the actual development of the mine has been neglected. The company has ceased to work, but up to the time of their discontinuing operations 74 tons of ore had been smelted on the ground, which yielded 482 pigs of lead of 112 lbs. each, equal to about 33 per cent. of metal.

In Appendices, Mr. Howitt furnishes remarks based on microscopic examinations of sixteen samples of rocks collected by Mr. Reginald A. F. Murray at the Avon River, Mount Hump and Ben Cruachan creeks, Mount Wellington, &c ; and also notes on the examination of seventeen rock samples, collected at Hughes's Creek, Gap Creek, Gellingall, Buchan, the Murendel River, &c., and intended to illustrate the character of the Buchan beds. Evidence of much care is apparent in the preparation of these notes, and they are of scientific interest.

Mine of the South Extended Sultan Company, Blackwood.

In May last Mr. Krausé furnished a careful and interesting report, with plan and sections, of the mine of the South Extended Sultan Company at Blackwood, containing many suggestions of a practical nature. His report is reproduced herewith for general information.

Mr. Wm. Nicholas has furnished an interesting paper, containing remarks on the geology and mineral resources of the goldfield in and about Rushworth and Whroo, in which he calls attention to an outcrop of granite not previously noted, lying between Sandy Creek and the Goulburn River, south of Coy's Diggings. The exposure is small in area, and is apparently caused by the denudation of overlying Upper Silurian rocks. Mount Black and the Sugar-loaf Hill, two eminences on either side of the valley in which the granite occurs, and also other hills in the vicinity, rest upon granite, and are capped by Upper Silurian rocks.

In referring to the Upper Silurian strata, which extend over nearly the whole area under observation, Mr. Nicholas points out that, unlike other portions of Victoria, there is a great want of uniformity in the bearing of their strike, inasmuch as, within short distances, it varies from directions nearly north and south to east and west; and further that the strata generally have been much disturbed, and tilted nearly to the perpendicular.

The creeks running to the northward in this district are either absorbed in the sandy soils of the Murray plain, or in swamp depressions. They display the same characteristics in this respect as several in other parts of Victoria within the Murray basin, and there can, I think, be little doubt that a large proportion of the rainfall which drains from this basin finds its way to the sea by percolation through gravel drifts, forming older drainage beds that lie beneath the surface and at a much lower level than the modern streams.

Alluvial gold workings.

Mr. Nicholas furnishes an account of the alluvial gold workings at and near Rushworth, Whroo, and Coy's Diggings. All these are shallow in depth. Deposits of cemented gravel, more or less auriferous, cover large portions of the country about Rushworth, Whroo, Nine-mile, and Fontainbleau. Very few nuggets of gold exceeding five ounces weight are known to have been found in the goldfield. It is considered that the country lying between Good Friday Creek and Redcastle, and that between the ranges north-east of Coy's Diggings, in a south-easterly direction towards the Goulburn, present good fields for prospecting operations.

Quartz reefs.

Near Rushworth most of the quartz reefs have an east and west strike, conformable in direction to the strike of the Silurian rocks in which they occur ; but while the underlie of the latter is nearly vertical, the reefs dip at a high angle to the north and across the lines of stratification. The lodes are often much faulted, and they vary in thickness from 6 inches to 6 feet. Many of them have proved very rich in gold, but very few have as yet been tested below the water-level. At Coy's Diggings the strike of the quartz reefs conforms generally to the direction of the meridian.

Some interesting information is given from notes furnished by Mr. T. Benbow, who was formerly in charge of a local branch bank, as to the quality of the gold obtained from reefs in the district under review, showing the purity of the metal in many instances to have been remarkable.

Mr. Nicholas furnishes tabulated particulars relating to the strike, dip, and thickness of many of the reefs, and extracts are furnished from reports by Messrs. Ulrich and Lewis respectively on the Balaclava mine. This mine is shown to contain several veins of quartz, yielding gold of vafying qualities. A description, with diagram, is also given of the workings on an antimony and gold-bearing lode known as the Albert Reef, together with general descriptions of other mines in the district.

Palæontology.

Professor McCoy has furnished another of his admirable decades (No. V.) of the Prodromus of the Palæontology of Victoria, containing numerous figures and descriptions of fossils of Tertiary and Upper and Lower Silurian formations, an outline of which is given in the following remarks.

The first and second plates contain illustrations of the skull and teeth of a new extinct species of Eared Seal, *Arctocephalus Williamsi*, obtained from Tertiary calcareous beds at Queenscliff. This seal is described as nearly related to the *Otaria* and *Arctocephalus* of our South Seas, and most nearly approaching the Australian Eared Seal, the *Arctocephalus lobatus*.

The third plate contains excellent drawings of *Waldheimia Corioensis* (McCoy) and *Waldheimia macropora*, mollusca illustrating characteristic Brachiopoda of the Tertiary age. The former is described as the largest of our Tertiary Brachiopoda, and unlike any living forms at present known. It is abundant in the Tertiary sands of Corio Bay, at the Bird Rock, and in similar beds at Jan Juc. The latter is, with the exception of the coarser punctation of its surface, in all respects similar to the living *W. flavescens* of Hobson's Bay. It is very common in the older Pliocene Tertiary strata of Flemington, and less common in Oligocene beds between Mount Eliza and Mount Martha.

The fourth plate illustrates two Tertiary species of *Cardium*, *C. pseudo-magnum* (McCoy) and *C. (Protocardium) anti-semigranulatum*. The first is said to be very abundant in the Miocene Tertiary sandy beds at Bird Rock Bluff, near Geelong. The second, which is closely related to *Cardium (Protocardium) semigranulatum* (Sowerby) of the Upper Eocene or Oligocene strata of the Hampshire coasts. The fossil is described as rare in Lower Miocene Tertiary of Moorabool.

The fifth plate furnishes further illustrations of the *Spondylus gæderopoides* (McCoy), and also an additional Victorian smaller and rarer extinct species *Spondylus pseudo-radula* (McCoy). The former is the representative of the European Tertiary and recent *Spondylus gæderopus*. As regards the latter, Professor McCoy says there are no recent species very nearly allied to it, and of fossil species the nearest is *S. rarispina* and *S. radula* of the Older French Tertiaries. The species is remarkable in the thinness of the valves. In most localities it is only about 1½ inches in length. It occurs in the Oligocene Tertiary clays and limestones near Mount Martha, in the clay beds of Muddy Creek, in the sandy Tertiaries of Fyansford, in the sands and limestones of Miocene Tertiary age at Bairnsdale, and in the Older Pliocene sandy clays of Mordialloc.

The sixth and seventh plates contain figures of species of the more abundant forms characteristic of the Upper Silurian Mollusca not illustrated in previous decades, and intended by Professor McCoy to facilitate the recognition of strata of the Upper Silurian age by the field geologists now engaged in their examination. The sixth plate shows *Leptæna (Leptagonia) rhomboidalis*, common in the Upper Silurian rocks in Wenlock shale at Yering, Upper Yarra; *Trematospira liopleura* (McCoy) and *Trematospira formosa*, more or less common in "May Hill" sandstone, at the hills near Mount Disappointment; *Spirifera plicatella* (Lin.), var. *Macropleura* (Conrad), identical with the *S. macropleura* of the "Lower Helderberg" rocks of New York, and common in Wenlock shale, near Kilmore; and *Spirifera sulcata* (His.), common in the Wenlock shale of Yering.

Professor McCoy says that the much greater size of the Australian specimens of this fossil than those found in Europe is the only difference he can perceive between them.

The seventh plate illustrates *Spirigerina reticularis* (Lin. sp.), common in the Silurian and Devonian formations of Australia and Europe; *Rhynchonella* (*hemithyris*) *decemplicata* (Sow.), common in the May Hill sandstone, near porphyry dyke, west of Mount Disappointment, and in similar sandstone in England, which is known as the true base of the Upper Silurian system; *Nucleospira Australis* (McCoy), almost identical with the Wenlock shale *Atrypa compressa* of Wales, and with the *Nucleospira ventricosa* of the Lower Helderberg beds of New York; also common in the May Hill sandstone of hills west of Mount Disappointment; *Pentamerus Australis* (McCoy). The Professor says this may be regarded as an Australian representative of *P. oblongus* of exactly the same geological horizon at the base of the Upper Silurian, which it strongly resembles in size, shape, and surface. Abundant in May Hill sandstone, section 12, parish of Yering.

The eighth plate shows a new spheroidal Tertiary species of sponge, *Tethya Newberyi* (McCoy), the fine hair-like or asbestiform hollow silicious spicules of which exactly accord with those of sponges of the recent European genus, *Tethya*. It occurs in the cream-colored Miocene Tertiary strata of Boggy Creek, near Sale.

The same plate also contains an illustration of *Graphularia Robinæ* (McCoy), described as a remarkable extinct gigantic species of sea-pen, allied to *Graphularia* of the European London clay formation, and also closely allied to the sea-pen now living in Hobson's Bay (*Sarcoptilon*), but four times the size of the living types. The fossil exists in the Miocene Tertiary strata at Waurn Ponds and at Bird Rock Bluff.

The ninth plate contains illustrations of *Cypræa* (*Luponia*) *leptorhyncha* (McCoy), slightly allied to *C. Haveri*, found in the Oligocene Tertiary clays of Mount Eliza and Mount Martha, Mornington; *Cypræa* (*Aricia*) *consobrina* (McCoy), related to *C. eximia* and *C. platypyga*, said to be very rare in the lower Miocene or Oligocene Tertiary strata of Moorabool River; and *Cypræa* (*Luponia*) *contusa* (McCoy). Professor McCoy remarks that this common little species is curiously distinguished by its surface seeming to be covered with little bruises or indentations of irregular size and shape, resembling a minutely shrivelled fruit. It is not nearly allied to any living or extinct form with which he is acquainted. It occurs in the Oligocene Tertiary clays and limestones of Mount Eliza and Mount Martha.

The tenth plate has further illustrations of the Graptolites of our goldfield slates, including *Graptolites* (*Didymograpsus*) *Thureaui*, named after the discoverer, Mr. Thureau, of Sandhurst, and *Graptolites* (*Didymograpsus*) *Headi* (Hall). The first is said to be rare in the black and red slates of Llandeilo flag age of the Sandhurst goldfield, and the second in flags of the same age, section 16, parish of Darriwil, Sutherland Creek, together with *D. Logani*, *D. pristis*, and *D. bryonoides*, as in Canada.

Fossils. The fossils briefly referred to in the following description have been received by the Department during the year, and reported upon.

Mr. J. V. Bartlett, of Colac, while prospecting in the vicinity of the Love's River, near to its junction with the Gellibrand, found some fossils and other specimens, which were sent to the Department for examination. The fossils proved to be a new species of *Echinolampas* of the Miocene Tertiary age.

Some fossils obtained by Mr. William Nicholas from a range of hills about midway between Whroo and Coy's Diggings were stated by Professor McCoy to be articular surfaces of crinoid stems of the *Actinocrinus* type, and fragments of the Upper Silurian variety of the *Orthis calligramma*.

At Coleraine a shaft was sunk in search of coal, and rock was pierced containing fossils. Some of the specimens collected and sent to the Department by Mr. Paramor were examined by Professor McCoy, and were described by him as belonging to various parts of the *Tæniopteris Daintreei* (McCoy), with the exception of a new species of *Zingophyllites*. The former are common in the Cape Patterson coal-seams. The fossils "indicate closely the Mesozoic age of rocks."

Mr. J. A. Panton, P.M., forwarded a collection of fossils gathered at Shelford, and near Petteval, Waurn Ponds. Those obtained at the former place contained *Fusus centrifugus* (McCoy), and a new species of *Murex*, both of which occur in the Mount Martha beds, and indicate strata of Upper Oligocene age. The remaining specimens consisted of *Cetotolites*, or ear bones and other portions of extinct whales of three species; teeth of the European Miocene Tertiary shark, *Oxyrhina Desori* (Ag.); *Turitella*, a new species, also found in the Mount Martha beds; *Terebratula Corioensis* (McCoy); *Cellepora*, one new species; *Cidaris*, spines of three undescribed species; and *Graphularia Robinæ* (McCoy), axes of the gigantic extinct sea-pen.

Several specimens of the fossil flora, found in clays beneath the basalts of the Dargo and Bogong High Plains, were forwarded by Mr. Reginald A. F. Murray. They contained a new species of *Tæniopteris—T. tenuissime striata* (McCoy); *Lastrea—L. Dargoensis* (McCoy); and a few fragments of dicotyledonous leaves, and also imperfect lauraceous leaves, and an interesting specimen of a species of *Salisburia*, *S. Murrayi* (McCoy).

Mr. Murray subsequently forwarded sixteen plant impressions from Freestone Creek; one contained an obscure impression of *Cordaites Australis;* the others were too fragmentary and imperfect to render them determinable. Further remarks on these fossils will be found in connection with Mr. Murray's report herewith.

Fossil fruits.

Baron F. von Mueller has again kindly added to the list of new vegetable fossils of the auriferous drifts published by the Department by a revised description of a fossil fruit, *Wilkinsonia bilaminata*, from the Black Lead, Gulgong, New South Wales, 140 to 175 feet in depth, and obtained through the efforts of the Government Geologist, Mr. C. J. Wilkinson, F.G.S.

It is remarked that the fossil may perhaps have belonged to the order *Sapindaceæ*. It has not yet been discovered in Victoria, but as it proves to

be coeval to the series already described and found within the colony, a full description and illustration of the specimen has been published with the Mining Surveyors and Registrars' Reports for the quarter ending 30th September 1877.

Maps and sections.

Among the presentations to the Department, I desire to refer to an excellently executed map of a geological section of the shaft of the City of Ballarat Company, prepared by the manager, Mr. T. W. Thompson. This shaft was pierced to a great depth through several distinct flows of basalt; the Silurian rock was struck at 409 feet from the surface, but before reaching this depth a very strong flow of water, estimated at 3,000 gallons per minute, was encountered, issuing from a "honeycombed" (vesicular) layer of volcanic rock, which rendered the prosecution of the latter portion of the work very costly and tedious.

Mineral specimens.

Noteworthy among the mineral specimens presented to the Department may be mentioned a collection of very fine felspar crystals forwarded by Mr. Harris, legal manager of the Rocky Mountain Tunnelling and Sluicing Company, Beechworth. They were found in quantity in hard granite, at a distance of 720 feet from the mouth of a tunnel, now being cut as a tail race, under a portion of the town of Beechworth, and they occurred in a small patch about 6 feet in length horizontally, and about 9 inches in depth.

Mention may be also made of a sample of granite containing gold, obtained by Mr. Henry Davidson, Mining Surveyor, from a prospecting claim at Sandy Creek, in the county of Benambra. The analyst of the Department describes this rock as a true granitic quartz, surrounded by felspar. Several pounds weight of the mineral were crushed, mixed, and assayed, and reported to contain gold equal to 19 dwt. 14 grs. per ton (report 4835).

Laboratory work.

Mr. Cosmo Newbery, B.Sc., the analyst to the Department, has furnished another of his interesting reports relating to or connected with the work upon which he has been engaged during the past year.

Rocks containing phosphates.

As a matter of interest to agriculturists, Mr. Newbery alludes to the almost constant presence of phosphates of lime, alumina, and iron in the brown iron-ores of South Gippsland. From some specimens of these rocks and their accompanying soils, obtained at Brandy Creek, he found phosphates in notable quantity, and the rock—a yellow-grey soft earthy sandstone—further contained soluble silicates and salts of potash, soda, and ammonia. Mr. Newbery considers that the yellow and grey soils derived from these rocks, which have been hitherto despised by agriculturists, are likely to be of considerable value for cultivation, and he states that, in some instances where they have been tried, they have given excellent results.

Lignite.

Numerous specimens of lignite, from country near the Gippsland Railway, have been examined, and it is considered they are likely to be of commercial value as furnace fuel. One sample received from the Honorable John

Woods readily produced gas of a high illuminating power ; others, however, were not so good in this respect.

Several samples of guano, from the recently opened Skipton caves, have been analysed by Mr. Newbery, and found to contain phosphates of some rarity. Guano.

Allusion is made to the continued examinations of sandstones, with the view of determining their adaptability for building purposes, and favorable mention is made of a sample obtained from Walker's quarry at Stawell, and of other samples from Briagolong and Mansfield. Sandstones.

Interesting accounts are given of microscopic and other examinations by Mr. G. H. F. Ulrich, F.G.S., of basaltic rocks forwarded from Learmonth by Mr. Norman Taylor. Basaltic rocks.

The finding of gold in true granite at Sandy Creek (Benambra) is mentioned as the most notable discovery of the year. Referring to the auriferous and cupriferous ores of Bethanga in the same part of the colony, the discovery of which was noted in the last Progress Report, Mr. Newbery points out, for the information of miners, that the copper and magnetic pyrites they contain are almost free from gold, and that the metal is found in the iron and arsenical pyrites. He considers it would be advisable, before reducing these ores, to separate them by mechanical dressing whenever the mixture of copper pyrites with the auriferous arsenical and iron pyrites is not too intimate. He is of opinion that the more preferable process by which to treat the ores would be to prepare them for amalgamation, remove the gold, and then, if desired, to smelt the waste for copper ; or perhaps a still cheaper method would be found in an adaptation of Hunt and Douglass', Henderson's, or Gipps' processes, thereby taking the copper and silver out as chlorides, and leaving the gold with the oxide of iron, so that it could easily be obtained by amalgamation. Auriferous ores.

As showing the satisfactory result of the well-known process adopted by the Port Phillip Company, Clunes, for the treatment of quartzose ores associated with only iron and arsenical pyrites, Mr. Newbery refers to the examination of some samples of pyrites sands from the works of this company, after they had been roasted in a reverberatory furnace, and amalgamated for the extraction of gold.

He also calls attention to a new process devised by Mr. H. Rosales, of Walhalla, for the treatment of auriferous pyritous sands, by which they are ground to a fine slime, and amalgamated without roasting. It is claimed that the cost of grinding is less than that of roasting, and that there is no increase in the loss of mercury.

Plutner's chlorine process is said to have been adopted by Messrs. Chapman and Edwards with excellent results in the treatment of the ordinary pyrites of Sandhurst.

In referring to a process devised some time ago for the treatment of auriferous ores containing sulphide of antimony, by fusing the sulphide with a portion of metallic antimony, and using the same metal with fresh charges

of the ore until it becomes rich in gold, and then separating the two metals by the oxidation of the antimony, Mr. Newbery says that this process, although suitable to rich antimony ores, will not answer with those containing less than 30 per cent. of the sulphide of antimony, as they are too silicious to fuse. He explains the difficulty hitherto experienced in successfully dealing with these poorer ores, and states that for some time past he has been experimenting, with a view of finding a process by which the gold and antimony in these ores might be saved, and has now devised a method which seems to answer well. The ore from the mine, or the scoria from the furnaces, is placed in a close furnace or kiln, with an amount of salt or other chloride, and is brought up to a dull red heat; steam is then forced through the charge, until the whole, or nearly the whole of the antimony, is got rid of by conversion into chloride of antimony.

Mr. Newbery explains in detail the effect of the above process, and says that trial lots of 5, 8, and 15 tons have been treated with perfect success.

Mention is also made of the revolving furnaces for roasting antimonial quartz tailings, devised by Mr. H. Herrenschmidt and Mr. Borthwick respectively, and erected at Costerfield and South Costerfield, which are intended to save the antimony, and to treat from 20 to 50 tons per diem. Vast heaps of these sands or tailings, the accumulation of many years, are lying at the Costerfield mines, and if the new methods of treatment be attended with success, a very large amount of antimony is likely to be produced during the current year.

The newly devised processes of treatment are likely to have a most important bearing upon the profitable realization of our poorer antimony ores. At present it is said that some of our auriferous antimonial mines do not yield half the gold contained in the ores, and when worked for gold do not return any antimony.

Mr. Newbery is still continuing his experiments on the mode of the deposition of gold, but the results are not yet ready for publication. He says that he has as yet found no proof of the condition in which the gold-carrier exists in the waters. The interesting nature of the problem is referred to in connection with the association of gold with antimony and copper.

Water. The examinations of water conducted last year are still being continued. An account is given of the analyses for ammonia and nitrogenous bodies of twenty-seven samples of water obtained from wells at Kyneton, from the Port Phillip mine at Clunes, from the Yan Yean and Geelong water supply works, from Sandhurst, rain-water from tanks and from the Observatory rain gauge, and also collected at the Laboratory, Melbourne. The greatest amount of ammonia was found in samples of rain-water collected in Melbourne immediately after a drought. In the mine-waters from Clunes silica in solution was found to the extent of about 1 in 100,000.

Underground surveys, Sandhurst. Satisfactory progress has been made during the year with the underground surveys of quartz mines on Garden Gully line of reef at Sandhurst. Mr.

Thomas has completed the surveys and plans of the following mines, embracing a length of about 1 mile and 31 chains along the courses of the lodes :—The Garden Gully United, South Garden Gully Tribute, Garden Gully Freehold, Miller's Tribute, Ladies' Tribute, Sea, Horwood's, Burrowes, Golden Stream, Londonderry, Gordon's Garden Gully Tribute, Londonderry Tribute, Cosmopolitan, Ulster and South Ulster, and the Garden Gully Railway.

Mr. Thomas has furnished copious notes referring to the characteristics of the lodes, which are principally of value for comparison with his plans and sections. I have not therefore considered it advisable to reproduce them with this Report : it is proposed to publish them in a separate form.

Stawell.

Mr. Bate, an officer engaged from time to time as opportunities offer (when not employed in his routine duties of District Mining Surveyor) in the underground survey of the cross and flat reefs at Stawell, reports that the workings of the following companies have now been surveyed by him, viz., Prince Patrick, Prince Alfred, Magdala, Moonlight, Pleasant Creek, Great Northern, Crown Cross United, No. 2 Crown Cross, Nos. 8 and 9 Crown Cross, and a portion of the Scotchmans United.

The plans and sections of the above work are in a progressive state, and the entire survey, it is expected, will be completed in about six months.

Cutting tracks in unexplored areas.

The work of track-cutting through the densely timbered and scrubbed portions of the Gippsland district has been continued under the direction and supervision of Mr. O. P. Whitelaw, Mining Surveyor. Practicable means of access have been afforded to the miner to many portions of the territory hitherto difficult to reach, and valuable lines of communication have been opened.

During the past year a track, 42 miles in length, has been cut and cleared between Mount Useful and the Moroka River ; and also one of 35 miles in length between Howittville and Harrietville. The surveys and plans of the routes, and the reports upon the geological features of the country, have not yet been completed ; remarks upon these will therefore be reserved for the next Progress Report.

Gold in deep mines.

In the last Report reference was made to the satisfactory yields of gold obtained from the Stawell quartz mines—which are the deepest in Victoria. As a matter of scientific interest it may be mentioned that at the still greater depths from which quartz has been obtained at Stawell during the past year the yields continue to show no falling-off. For instance, it is reported that 2,599 tons of quartz, from 1,060 to 1,120 feet in depth, averaged 2 oz. 6 dwt. of gold to the ton ; and 4,212 tons, obtained at 800 and 951 feet from the surface, gave 1 oz. 8 dwt. 13 grs. per ton ; and 1,924 tons, got at a depth of 850 feet, produced 2 oz. 3 dwt. 1 gr. per ton.

In the Sandhurst and Ballarat districts the yields from the deeper mines appear upon the whole to bear favorable comparison with those obtained at lesser depths.

Prospecting operations.

A vote of £10,000 having been passed by the Legislature for expenditure during the year in prospecting for new goldfields, numerous parties were organized to examine country in many parts of Victoria considered likely to contain auriferous veins and deposits. As an inducement to unremitting and diligent search, arrangements were made that the agreements with the prospectors should cease and determine on the discovery of gold in sufficient quantities to be remunerative, and that the prospectors should then be at liberty to mark off and take possession of mining claims, and work them on their own account, so as to be able to reap the benefit of their discoveries.

The following is a brief outline of the results of the prospecting operations undertaken in the several mining districts. Further details will be found in the statement at end of this volume.

In the Ararat Mining District eight parties, consisting of thirty-five men, were employed in prospecting country about Moyston, Armstrongs, Cathcart, Stawell, Great Western, Landsborough, and Raglan.

The Moyston party (five men) are reported to have sunk twenty-four shafts to depths varying from 11 to 45 feet in depth, exclusive of others of lesser depth, and to have done a large amount of driving, but no success attended their efforts.

The Armstrong party (five men) sank upwards of thirty-eight shafts, of the aggregate depth of 578 feet, and further explored by driving 267 feet on the bottom rock, but no more than the "color" of gold is said to have been obtained.

The Cathcart party (six men) sank forty-two shafts of various depths. Gold in small quantities was obtained in a gully about one mile south from the "Port Curtis" Lead. One load of dirt is said to have yielded 3½ dwt.

The Stawell party (five men) sank a number of shafts up to 76 feet in depth. Small quantities of gold were obtained, but nothing of importance.

The Great Western party (four men) sank twelve shafts, from 5 to 82 feet in depth, and drove upwards of 80 feet. They discovered gold only in small quantities.

The Landsborough party (five men) sank about thirty-five shafts, ranging from 33 to 67 feet in depth, but only found traces of gold.

The Raglan party (five men) sank eighty shafts, from 5 to 55 feet in depth, but with no encouraging results.

In the Ballarat Mining District, four parties, consisting of twenty-three men, were employed, their centres of operation being Blackwood, Steiglitz, Smythe's Creek, and Buninyong.

The Blackwood party (five men) examined an extensive area of comparatively untried country, and during their researches a nugget of gold of 14

dwt. was found at the mouth of a blind gully near Doctor's Creek, but no ground of a remunerative character for mining operations was found near the site of the discovery.

The Steiglitz party sank many shafts, varying from 10 to 38 feet in depth, but were unsuccessful in finding gold.

The Smythe's Creek party (six men) sank shafts from 16 to 96 feet in depth, equal to 530 feet of sinking, exclusive of 266 feet of drives, and were also unsuccessful in their search for gold.

The Buninyong party (six men) sank about eighty shafts, from 3 to 23 feet deep, in various parts of the district allotted to them, and found small quantities of gold, but none of any value. They subsequently commenced a rock tunnel at the foot of the Devonshire Range, and after driving 225 feet, cut an auriferous quartz vein, which yielded such fair prospects that the prospectors, at the termination of their engagement, continued to work the mine on their own account.

In the Beechworth Mining District two parties of five men each were employed, who examined country near Murmungee and Alexandra.

The Murmungee party confined their operations to the Buckland Gap, as offering the most favorable field for such work as they, with their limited appliances, were able to explore. Two shafts were sunk from 40 to 87 feet in depth, and 180 feet of driving was accomplished. Fair prospects of gold were found in places, so that the party continued to work some time after the termination of the period for which they were engaged, and other miners also took up claims near the same place, but no important discovery followed.

The Alexandra party examined a good deal of country at the heads of creeks in the Dividing Range, and found only traces of gold.

In the Castlemaine Mining District three parties, including thirteen men, were engaged: their centres of operation were Daylesford, Steel's Creek, and Hoddle's Creek.

The Daylesford party examined much country about Reedy, Wombat, and Werribee creeks, and about one mile south of Bullarto found a little fine gold in the washdirt; at other places only traces of gold were found.

The Steel's Creek party examined much rough country in the Main Dividing Range and its spurs, and found only traces of gold.

The Hoddle's Creek party (Upper Yarra) also tested country towards the heads of several tributaries of the Yarra. Their only noteworthy discovery was at a place known as Derlan's Flat, where gold in small quantities was traced through a depth of 30 feet of washdirt.

In the Gippsland Mining District three parties of five men each were engaged to examine country in East and South Gippsland, and in the high lands of the Omeo district.

The first was started with pack horses from Bairnsdale to explore the densely wooded and little known country in the watersheds of the Broadbent, Brodribb, and Goongreah rivers. Many banks and terraces on these rivers

and their tributaries were examined, and gold in small quantities frequently found, but nothing of importance.

The party engaged for South Gippsland examined much rough auriferous country at and near Turton's Creek, and in the Hoddle Ranges, but without effecting any noteworthy discovery.

The Omeo party, under the direction of Mr. R. A. F. Murray, a geological surveyor of the Department, examined the elevated country on either side of the Main Dividing Range, at the heads of the Cobungra and Bundarah rivers, and the edges of the basaltic high plain, from the latter to "White's claim," and also on several tributaries of the Kiewa, and at the head of Brandy Creek. The party then crossed to the south side of the Divide, and prospected the edges of the Dargo High Plain (basaltic), where encouraging prospects of gold were obtained, Shafts were also sunk at the Pic-Nic Creek and Little Dargo River. (*See* account of Mr. Murray's survey of this country.)

In the Maryborough Mining District eight parties, comprising forty-four men, were engaged for Amherst, Avoca, Inglewood, Wedderburn, Charlotte Plains, Orville, Maryborough, and St. Arnaud. Much country was explored by the several parties, but the only discoveries worthy of note were made by the prospectors from Amherst and St. Arnaud ; the former found small quantities of gold some distance south of Glenmona station, and at the expiration of the term for which they were engaged they worked out a block of ground 15 feet by 12 feet, and obtained a yield of 2¼ dwt. to the load of washdirt. A small rush of miners set in to the place, but from the difficulty of obtaining water for their operations the claims were soon abandoned.

The St. Arnaud party found gold yielding 2 dwt. to the load of washdirt from one of the cement hills, about six miles north-east of St. Arnaud.

In the Sandhurst District four parties, containing twenty-two men, were respectively employed near Reedy Creek, Heathcote, Homebush, and Rushworth. None were successful in their search for gold ; but the operations at the last-named place led to the discovery of a new run of gold at the lower end of the old lead, about two miles and a half east of Rushworth ; and some time after the party ceased to be employed by the Government, as many as 700 miners were working on the ground ; in some of the claims satisfactory yields were said to have been obtained.

In compliance with a request from the Commissioners for Victoria for the Paris Exhibition, a collection of minerals, rocks, fossils, &c., illustrative of the geology and mineral resources of Victoria was obtained and classified for exhibition at Paris, and a carefully compiled catalogue descriptive of the specimens was prepared by Messrs. G. H. F. Ulrich and W. Nicholas to accompany them. Although little time was afforded in which to obtain the collection, I am pleased to relate that, by the energy of the surveyors, registrars, and others who assisted in the work, and also by the timely and generous presentation of valuable minerals by Messrs. Lansell, Field,

and other gentlemen connected with mining, no less than 1,500 specimens were prepared for the Commissioners (exclusive of other exhibits) as classed in the descriptions hereunder :—

Older Igneous or Plutonic rocks	140
Newer Igneous or Volcanic rocks	193
Lower Silurian rocks	221
Upper Silurian rocks	71
Devonian rocks	13
Upper Palæozoic rocks	21
Mesozoic rocks	33
Tertiary rocks	139
Mineral specimens	327
Economic collection :—	
Auriferous quartz	171
Auriferous alluviums	77
Minerals	71
Facsimiles of nuggets	23
Total	1,500

In addition to the above, a special collection of quartz and other specimens was forwarded from the mine of the Pandora Company, Garden Gully Reef, Sandhurst, together with a plan of a cross section of the workings, showing those portions of the mine from which the specimens were obtained. Also—

1 case containing native bread,
1 case containing fossil fruits,
1 case containing maps,
1 case containing models.

Before concluding these remarks, I desire to thankfully acknowledge the cheerful assistance rendered to the Department by the following gentlemen, who have either contributed valuable information or collections of geological or mineralogical specimens :—Commandatore Felice Giordano, Italy ; Professor McCoy ; Baron Ferd. von Mueller, C.M.G., &c. ; P. Wright, Esq., M.P. ; A. W. Howitt, Esq., F.G.S., P.M. ; G. H. F. Ulrich, Esq., F.G.S. ; J. C. Newbery, Esq., B.Sc. ; T. E. Rawlinson, Esq., C.E., Melbourne ; G. Gordon, Esq., C.E. ; R. G. Ford, Esq., C.E. ; J. A. Panton, Esq., P.M. ; J. Hornsby, Esq., Maldon ; E. Field, Esq., Costerfield ; R. H. Bland, Esq., Clunes ; R. M. Sarjeant, Esq., Ballarat ; H. Y. L. Brown, Esq., Costerfield ; E. H. Dunn, Esq., Beechworth ; W. H. Higman, Esq., Hay, N.S.W. ; W. Vale, Esq., Coleraine ; W. Paramor, Esq., Coleraine ; R. Jones, Esq., Bethanga ; Joseph Harris, Esq., Bethanga ; W. Rhodes, Bethanga ; W. Thompson, Esq., Bethanga ; J. K. Bickerton, Esq., Melbourne ; R. A. F. Murray, Esq., Geological Surveyor ; F. M. Krausé, Esq., Geological Surveyor ; Norman Taylor, Esq., Geological Surveyor ; Wm. Nicholas, Esq.,

F.G.S.; H. B. Nicholas, Esq., Inspector of Mines; W. Grainger, Esq., Inspector of Mines; J. V. Bartlett, Esq., Surveyor, Colac; G. Smellie, Esq., Melbourne; W. J. Meek, Esq., Coleraine; G. H. F. Ellen, Esq., Castlemaine; O. R. Rule, Esq., Richmond; T. McBurnie, Esq., Melbourne; R. D. Duncan, Esq., Melbourne; also the Mining Surveyors and Registrars who aided in procuring specimens for the Geological and Mineralogical Collection sent by this Department to the Paris Exhibition (1878).

Appendices. The Appendices to this Report contain the usual information relating to the cost of the geological survey during the past year; the publications printed and issued; the geological and mineralogical collections received, and the collections of specimens furnished or presented by the Department; the donation of books to the library; and a list and other particulars respecting gold nuggets found in Victoria.

I have the honor to be, Sir,

Your most obedient servant,

THOS. COUCHMAN,

Secretary for Mines.

Major

The Honorable

W. Collard Smith, M.P.,

Minister of Mines,

&c., &c., &c.

APPENDICES.

GEOLOGICAL SURVEYS, TOPOGRAPHICAL SURVEYS, PRINTING AND PUBLISHING MAPS, ETC.

STATEMENT OF EXPENDITURE FROM 1ST OCTOBER 1876 TO 30TH SEPTEMBER 1877.

	£	s.	d.
Geological Surveys	1,681	18	4
Printing and Publishing Maps, both Mining and Geological, and including Engravings of Fossil Plants, Maps, and Sections to illustrate Progress Report No. 4, Plates of Fossils, &c. ...	1,461	18	0
Cutting Tracks	1,016	17	7
Analysis of Minerals	200	0	0
Underground Surveys of Mines	474	17	3

MAPS, REPORTS, AND PAPERS

PUBLISHED BY THE MINING DEPARTMENT DURING THE YEAR 1876-7.

Mineral Statistics of Victoria, 1876.—No. 6. 1877.

Reports of the Mining Surveyors and Registrars :—

Quarter ended 31st December 1876.—No. 2. 1877.

Ditto 31st March 1877.—No. 10. 1877.

Ditto 30th June 1877.—No. 43. 1877.

Ditto 30th September 1877.—No. 68. 1877.

Report of the Chief Inspector of Mines, 1876.—No. 1. 1877.

Summary of Particulars furnished by Mining Registrars respecting the number of miners employed during the quarter ended 31st December 1876, in mining for Metals and Minerals other than Gold. Mining Surveyors and Registrars' Reports, 1876.—No. 2. 1877.

Report of Progress of the Geological Survey of Victoria.—No. 4.

Report of Progress of the Geological Survey of a part of Gippsland. By Reginald A. F. Murray, Mining and Geological Surveyor. Report of Progress of the Geological Survey of Victoria.—No. 4.

Progress Report on the Geological Structure of portion of country between the Thomson and Wonnangatta rivers, North Gippsland. By Reginald A. F. Murray, Mining and Geological Surveyor. Report of Progress of the Geological Survey of Victoria.—No. 4.

Report on the Geological Character of portion of the Cape Otway District. By Reginald A. F. Murray, Mining and Geological Surveyor. Report of Progress of the Geological Survey of Victoria.—No. 4.

Notes on the Geological Survey of Creswick. By Ferd. M. Krausé, Mining and Geological Surveyor. Report of Progress of the Geological Survey of Victoria.—No. 4.

Report on the Geological Survey of Learmonth. By Norman Taylor, Geological Surveyor. Report of Progress of the Geological Survey of Victoria.—No. 4.

Notes on the Geological Structure of North Gippsland. By A. W. Howitt, Esq., F.G.S. Report of Progress of the Geological Survey of Victoria.—No. 4.

Notes on the Geology of part of the Mitchell River Division of the Mining District of Gippsland. By A. W. Howitt, Esq., F.G.S.

Report on Site of proposed Prospecting Operations at Chilwell, Geelong. By Ferd. M. Krausé, Mining and Geological Surveyor. Report of Progress of the Geological Survey of Victoria.—No. 4.

Report on Site of proposed Prospecting Operations near Warburton. By Ferd. M. Krausé, Mining and Geological Surveyor. Report of Progress of the Geological Survey of Victoria.—No. 4.

Report on the Hope Company's Mine, Running Creek, Ovens River. By Ferd. M. Krausé, Mining and Geological Surveyor. Report of Progress of the Geological Survey of Victoria.—No. 4.

Notes on some Characteristics of Auriferous Quartz Reefs or Veins. By William Nicholas, F.G.S. Report of Progress of the Geological Survey of Victoria.—No. 4.

Schedule of Reports on Fossil Specimens. By Frederick McCoy, F.G.S. Report of Progress of the Geological Survey of Victoria.—No. 4.

Laboratory Report. By J. Cosmo Newbery, B.Sc., Analyst. Report of Progress of the Geological Survey of Victoria.—No. 4.

Resumé of Prospecting Parties' Operations :—Buninyong Prospecting Party, Mount Buller Prospecting Party, Upper Yarra Prospecting Party, Colac Prospecting Party, Moyston Prospecting Party, South Gippsland No. 1 Prospecting Party, South Gippsland No. 2 Prospecting Party, North Gippsland No. 1 Prospecting Party, North Gippsland No. 2 Prospecting Party. Report of Progress of the Geological Survey of Victoria.—No. 4.

Prodromus of the Palæontology of Victoria; or Figures and Descriptions of Victorian Organic Remains. Decade IV. By Frederick McCoy, F.G.S., &c.

Descriptive Catalogue of Rocks, Minerals, and Fossils, illustrative of the Geology, Mineralogy, and Mining Resources of Victoria, exhibited at the Paris Exhibition, 1878.

LIST OF MAPS, PLANS, ETC.,

PRINTED AT THE LITHOGRAPHIC BRANCH, GOVERNMENT PRINTING OFFICE, FROM 1ST OCTOBER 1876 TO THE 30TH SEPTEMBER 1877.

Geological Sketch-map of Gippsland.—Sheet No. 1.

Geological Map of the Ararat Goldfield.

Plan showing coast line from Cape Howe to Wilson's Promontory (lithograph).

Cross-section North Garden Gully United Company's main shaft, Garden Gully Reef, Sandhurst.

Section showing fall of Ovens Valley, from Bright to Myrtleford.
Section showing bores in the Ovens Valley at Eurobin (lithograph).
Section showing bores near Ararat.
Sections of Gift Reef, Bethanga.
Sketch-section of Tertiaries of Glenmaggie.—Fig. 1.
Geological Map of portion of parish of Glenmaggie, Gippsland (lithograph).
Sketch-sections (ideal) near Glenmaggie.—Figs. 2, 3, 4, 5.
Sketch-sections near Glenmaggie.—Figs. 6, 7, 8, 9.
Sketch-section showing Upper Tertiaries west of Armagh Reef, Creswick.
Sketch-section showing lava flows north of Spring Hill.
Sketch-section showing lava flows along Lewers Lead.
Sketch-section showing Newer Middle and Older Middle Pliocene Gold Drifts.
Sketch-plan showing Middle Pliocene Gold Drifts at Ryrie's Creek.
Sketch-section showing Pliocene Gold Drifts, Mopoke.
Sketch-section showing railway cutting at Snake Hill.
Sketch-section of Working Miners' Reef.
Vertical section of Humbug Reef, at ninety-five feet below the surface.
Sketch-section of Towler's Reef and other veins.
Sketch-section Snowy Bluff to Upper Dargo River.
Cliff at Wongungarra River (lithograph).
Sketch-section of the Snowy Bluff.
Cliff, Snowy Bluff (lithograph).
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Plan showing area prospected by the South Gippsland Prospecting Party No. 1 (lithograph).
Plan showing area prospected by the South Gippsland Prospecting Party No. 2 (lithograph).
Plan showing area prospected by the North Gippsland Prospecting Party No. 1 (lithograph).
Plan showing area prospected by the North Gippsland Prospecting Party No. 2 (lithograph).

DONATIONS TO THE LIBRARY OF THE DEPARTMENT OF MINES DURING THE YEAR 1877.

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GEOLOGICAL AND MINERALOGICAL COLLECTIONS,

PRESENTED TO THE DEPARTMENT OF MINES AS DONATIONS, OR IN EXCHANGE FOR VICTORIAN SPECIMENS.

*(Duplicates of the Specimens have been forwarded with the exception of those marked *.)*

Specimens of Lava Dyke Stones, from the Pandora Claim, Garden Gully Reef, Sandhurst. Arthur Everett, Esq., Mining Department, Melbourne.

Collection of Samples of Copper, Iron, and Arsenical Pyrites, from the New-Year's-Gift Claim line of reef, Bethanga. Wm. Rhodes, Esq., Bethanga.

* Lignite, from a seam in a shaft sunk in the neighborhood of Coleraine. W. J. Meek, Esq., Coleraine.

Samples of Granite, Quartz, Mica, Diorite, and Clay Slate, from the Camm, Bulda, and Genoa rivers. North Gippsland Prospecting Party.

* Specimen of Stibnite, from New Zealand. W. Crowson, Esq., Fitzroy.

* Specimen of Pholerite, said to have been obtained from a Copper vein near Granite Flat, Snowy Creek. Allan Hodder, Esq., Snowy Creek.

Samples of Stream Tin Sand with Iron Ores, Zircons, &c., from 'Possum Hill, Orville. W. G. Couchman, Esq., Mining Surveyor, Dunolly.

* Specimen of Ironstone Grit, from Nunawading. Dr. L. L. Smith, M.P., Collins street east, Melbourne.

Specimens of Freshwater Limestone, from the side drain, Asylum road, Ararat. James Galbraith, Esq., Ararat.

* Specimen of Concretionary Brown Iron Ore, from South-west of Traralgon. Chas. Denis, Esq., Mining Registrar, Traralgon.

Specimen of Mundic, from the Indicator Reef, Ballarat East. David Christy, Esq., Mining Registrar, Ballarat.

Lignite with Iron Pyrites, from Coleraine. W. Paramor, Esq., Coleraine.

Stream Tin Ore, from the Upper La Trobe River. W. Grainger, Esq., Melbourne.

Specimen of Slate, from Malmsbury. Castlemaine Flagging Company, Castlemaine.

Specimen of Stibnite, from a reef on the northern bank of the Lerderderg River. J. F. Hansen, Esq., Mining Registrar, Blackwood.

Collection of Carbonaceous Shales, from twelve miles south of Colac. J. V. Bartlett, Esq., Colac.

* Specimen of Trap Rock, from Lilydale. F. M. Krausé, Esq., Geological Surveyor, Creswick.

Specimen of Granite, from the Gong Gong Reservoir. F. M. Krausé, Esq., Geological Surveyor, Creswick.

Specimen of Calcspar, from Running Creek. F. M. Krausé, Esq., Geological Surveyor, Creswick.

Collection of Fossil Specimens, from Coleraine. William Paramor, Esq., Coleraine.

Specimen of Shale, from Coleraine. Wm. Vale, Esq., Coleraine.

Collection of Fossil Specimens, from Freestone and Cooper's creeks and the Avon and Thomson rivers, Gippsland. R. A. F. Murray, Esq., Geological Surveyor, Sale.

Pyrites Sand with Amalgam, from Rob Roy Reef, Swift's Creek. A. W. Howitt, Esq., Bairnsdale.

Specimens of Brown Iron Ore and Quartzose Sand, from Granite Flat, Snowy Creek, Gippsland. A. Hodder, Esq., Snowy Creek.

Specimen of Micaceous Iron Ore, from West of Grampian Mountains. H. C. Bate, Esq., Mining Surveyor, Stawell.

Specimen of Brown Iron Ore, from Blue Mountain, Blackwood. M. Trewhella, Esq., Blackwood.

Specimens of Massive Brown Iron Ore, from Dandenong. W. Turner, Esq., Elizabeth street, Melbourne.

Sample of Coal, from Gippsland. Dr. L. L. Smith, M.P., Melbourne.

Samples of Tin Ore, Black and Ruby Sand with Zircons, from Tin Creek, near Mount Fatigue, Gippsland. G. R. Murphy, Esq., Mining Registrar, Foster.

Samples of Coal, from the head of Mosquito Creek, Gippsland. R. A. F. Murray, Esq., Geological Surveyor, Sale.

Samples of Carbonaceous Clay, from same locality and donor.

Sample of Secondary Pyrites, from the reef wash in the Working Miners' Gold Mining Company, Homebush. T. Tomkins, Esq., Maryborough.

Volcanic Scoriæ, from near Smeaton. Thos. Spinks, Esq., Campbelltown.

Molybdenum, from a reef at McIntyre's, near Berlin. J. C. H. Ogier, Esq., Inglewood.

Samples of Lignite, from near the junction of the Tyers and La Trobe rivers. Robert Vincent, Esq., Traralgon.

Samples of Sulphide of Iron and Lead, from the Lord Raglan and St. Arnaud Company's Mine, St. Arnaud. J. K. Bickerton, Esq., Legal Manager, Melbourne.

Rocks and Minerals, from the Morwell and Tarwin rivers. South Gippsland Prospecting Party.

Sample of Tin Sand, from the Bunyip Creek, Upper Yarra. Robt. Clarke, Esq., Melbourne.

Earthy Manganese Ore, from the neighborhood of Costerfield. S. G. Leonard, Esq., Heathcote.

Slate with Iron Pyrites, from the Bald Hill, Daylesford. T. Hale, Esq., Mining Registrar, Daylesford.

Fossil Specimen. Sent by E. Gladman, Esq., foreman of the Reedy Creek Prospecting Party.

Samples of Titaniferous Iron Sand, Tin, and Zircon Sand, &c., from Kiewa and Bundarah rivers. Omeo Prospecting Party.

Encrustations, taken from the condenser, Port Phillip Company, Clunes. R. H. Bland, Esq., Clunes.

Bore Meal, from the Bright Bore. Honorable G. V. Smith, Melbourne.

Sample of Bore Meal, from the No. 2 Bore, Porepunkah. J. Darbyshire, Esq., Mining Surveyor, Bright.

Sample of Lignite, from the Coleraine Coal Mining Company's Mine, Coleraine. W. J. Meek, Esq., Manager, Coleraine.

Specimens of Micaceous Iron, from the Western Water Shed of the Grampian Range. A. B. Clemes, Esq., Stawell.

A very valuable collection, numbering over one hundred specimens, illustrative of the Geological and Mineralogical resources of Italy. Presented by Commandatore Felice Giordano, Italy.

Lignite, found on the north-west side of the Aire River, Cape Otway District. J. V. Bartlett, Esq., Colac.

Sample of Fire Clay, from Little Moe, Gippsland. Edwin Patterson, Esq., Brandy Creek.

Fossils from the Dargo and Bogong High Plains and the head of the Wentworth River. R. A. F. Murray, Esq., Geological Surveyor.

Samples of Bore Meal, from Porepunkah, Ovens Valley.

Specimens of Granite and Brown Iron Ore, forwarded by R. M. Harvey, Esq., Mining Surveyor, Buninyong.

A collection of Rocks and Minerals, illustrative of the Geological Survey of Learmonth. By Norman Taylor, Esq., Geological Surveyor, &c., Learmonth.

A collection of Specimens of Lava Dyke, Slate, Quartz, Sandstone, &c., principally from the land held by the City of Sandhurst, Hustler's Royal Reserve, Great Extended Hustler's Tribute, Hustler's Mine, and Hustler's Reef companies. Collected by A. F. Walker, Esq., Mining Surveyor, while engaged in the underground survey of mines at Sandhurst.

Sample of Infusorial Earth, from the West Melbourne Swamp. G. Smellie, Esq., Victorian Water Supply Department.

Sample of Galena and Arsenical Pyrites, from Mount Birregun, North Gippsland. A. W. Howitt, Esq., F.G.S., Warden, Bairnsdale.

Samples of Bore Meal, from Porepunkah. J. C. Darbyshire, Esq., Bright.

Specimen of Hematite with Quartz, from Snowy Creek. A. Alderdice, Esq., Warden's Clerk, Beechworth.

Samples of Copper Ore and Gypsum, forwarded by A. G. Miller, Esq., Munday street, Sandhurst.

Samples of Rutile, from near Kingower. Inglewood Prospecting Party.

Fossils from Shelford and Petteral, near Geelong. J. A. Panton, Esq., Warden, Geelong.

Specimen of Brown Coal with Iron Pyrites, from Coleraine. W. Paramor, Esq., Coleraine.

Sample of Copper Ore, found near Heathcote. The Honorable Duncan Gillies, M.P.

Sample of Chrome Ochre, stated to have been obtained near Heathcote. George Harwood, Heathcote.

Sample of Micaceous Iron Ore, found near Stawell. A. Flegellante, Esq., Stawell.

Calcareous Earth, from Cape Woolomai. A. L. Edgar, Esq.

Specimen of Kaolin. Same locality and donor.

Copper and Arsenical Pyrites, from the Gift Reef, Bethanga. Messrs. Durant and Rogers, Castlemaine.

Specimen of Sulphide with Oxide of Antimony, from the U. and F. Antimony Company, Whroo.

Specimens of Auriferous Granite, from the wall of the Pioneer Reef, Sandy Creek. Henry Davidson, Esq., Mining Surveyor, Beechworth.

Samples of Secondary Iron Pyrites and Brown and Yellow Clay, from James McDonald, Esq., Warrigal.

Fossils, from Port Fairy Bay. Thomas E. Rawlinson, Esq., Melbourne.

Silicate of Alumina, found between the sandstone strata in the Grampian Tunnel. The Rev. William Matthews, Stawell.

Sample of Magnetic Oxide of Iron, said to have been found near Blackwood. J. T. Taylor, Esq., Hotham.

Fossil. Sent by F. M. Krausé, Esq., Geological Surveyor, Creswick.

Specimen of Quartz, from the Victory Company's Mine, Garden Gully Reef, Sandhurst. H. B. Nicholas, Esq., Inspector of Mines, Sandhurst.

A collection of Specimens of Shales and Lignites, from Coleraine. Sent by Wm. Paramor, Esq., Coleraine.

Specimens of Metamorphic Slate and Ferruginous Conglomerate, from the Darling River, New South Wales. W. H. Higman, Esq., Hay, New South Wales.

Rock Specimen, from Rocky Mountain Tunnel, Beechworth. R. G. Ford, Esq., Victorian Railways.

Sample of Guano, from Gippsland. Dr. L. L. Smith, M.P., Melbourne.

Quartz and Pyrites. Sent by R. Jones, Esq., Bethanga.

Fossils, collected by the foreman of the Omeo Prospecting Party.

Specimens of Rocks and Fossils, collected by the foreman of the North Gippsland Prospecting Party.

Samples of Tin Sand, from Gippsland. Dr. Macartney, M.P., Melbourne.

Sample of Gold obtained from Granite, and Specimens of Auriferous Granite. Hy. Davidson, Esq., Mining Surveyor, Beechworth.

Samples of Brown Tourmaline Sand. Sent by A. G. Miller, Esq., Bethanga.

Sample of Tin Sand, from the La Trobe River, Gippsland. J. E. Usher, Esq., Melbourne.

Specimens of Iron Ore, from Lal Lal. F. M. Krausé, Esq., Geological Surveyor, Daylesford.

Specimens of Quartz and Iron Pyrites, from Kangaroo Creek. Alexandra Prospecting Party.

Specimens of Quartz from the Gift Reef, Bethanga. P. Wright, Esq., M.P., Yackandandah.

Pebbles, found in the bed of a creek by the Blackwood Prospecting Party.

Sample of Titaniferous Iron Sand. Forwarded by the Homebush Prospecting Party.

Samples of Magnetic, Arsenical, and Copper Pyrites, from the Flagstaff Hill, Bethanga. Joseph Harris, Esq., Bethanga.

Specimens of Hematite, from Cooper's Creek, Gippsland. R. A. F. Murray, Esq., Geological Surveyor, Sale.

Samples of Kaolin Clay, from Pottery Flat, Epsom. N. G. Stephens, Esq., Mining Registrar, Sandhurst.

* Specimen of Quartz with Iron and Copper, from Mountain Creek, Snowy River. A. W. Howitt, Esq., Warden, Bairnsdale.

Fossil, from Range north-east of Redcastle. H. B. Nicholas, Esq., Inspector of Mines, Sandhurst.

Samples of Raw and Roasted Pyrites and Specimens of Quartz, from the Port Phillip Company's Mine, Clunes. R. H. Bland, Esq., Clunes.

* Double Pyramidal Crystal of Quartz, from Burrowes' Freehold, South Victoria Reef (?). C. Thomas, Esq., Mining Surveyor, Sandhurst.

* Sample of Felspathic Clay, from a Dyke at Daylesford. F. M. Krausé, Esq., Geological Surveyor, Daylesford.

Samples of Copper, Iron, Magnetic, and Arsenical Pyrites, from the Flagstaff Hill, Bethanga. Wm. Thompson and Co., Bethanga.

Specimen of Galena, said to have been obtained at Percydale. J. C. H. Ogier, Esq., Warden, Inglewood.

Specimen of Sub-angular Quartz and Clay Slate, cemented by Clay, obtained from the City of Ballarat Company's Shaft; and Samples of Auriferous Washdirt, from Winter's Freehold Company, Ballarat. D. Christy, Esq., Mining Registrar, Ballarat.

LIST OF GOLD NUGGETS FOUND IN VICTORIA FROM 1ST OCTOBER 1876 TO 30TH SEPTEMBER 1877.

(Showing the localities where found, the date of discovery, the name of the discoverer, the weight, and the depth at which each nugget was obtained.)

Locality, and by whom found.	Date of Discovery.	Gross Weight (troy).	Depth at which found.
		lb. oz. dwt. gr.	ft. in.
*Found at Eames' Gully, Sandhurst, by Samuel Nicholas	28th September 1876	2 4 19 10	3 0
Found at Homebush, by a Chinaman ...	3rd October 1876 ...	0 15 19 0	Not stated.
Found at Foster in the Prospectors' Tribute Claim	8th November 1876	3 4 5 0	50 0
Found at Eames' Gully, Sandhurst, by Samuel Nicholas	21st November 1876	0 6 0 0	3 0
Found at Tarr's Gully, Campbell's Creek, Castlemaine, by J. Arkistal and P. Shean	November 1876 ...	0 8 1 0	3 6
Found in Parade Company's Mine, Ballarat	8th December 1876	20 5 9 0	310 0
Found at Kangaroo Gully, near Amherst, by a German, name unknown	Not given ...	22 1 0 0	20 0
Found at Chinaman's Flat, Maryborough, by the Band of Hope G. M. Company ...	1st February 1877 ...	4 2 19 0	200 0
Found in the vicinity of White Horse Reef, Amherst, by Henry Ball	About Easter, 1877	6 10 1 0	46 0
Found at Wedderburn, by J. Anderson ...	30th May 1877 ...	0 14 16 0	7 0
Found at Chinaman's Flat, Maryborough, by William Brown and Samuel Keen ...	28th August 1877 ...	0 12 14 15	9 0

* The information respecting this nugget was received too late to be inserted in the list published in the last Report.

REPORTS.

GEOLOGICAL SKETCH-MAP, SHEET No. 2, SOUTH-EAST GIPPSLAND.—REPORT.

Description of sheet boundaries.

SHEET No. 2, south-east of the geological survey of Gippsland, represents an area of about 1,364¼ square miles, within the following boundaries, viz.:—Commencing at the intersection of the 147th meridian of longitude and the 38th parallel of latitude; thence west along the latter 34 miles; thence north 40 miles; thence east 34 miles 17 chains to the 147th meridian of longitude; and thence south along the meridian to the commencing point.

Physical outlines.

The Main Dividing Range of the colony enters the sheet on the northern boundary near the north-west corner, and after trending some distance south-easterly turns to the west and passes out of the sheet, the bend thus formed including on its western fall the heads of the Black River, a tributary to the Goulburn. A leading spur (on which Mount Useful is a conspicuous point), starting from this bend in the main range, extends down to the flat country near Seaton, and forms the divide between the Macallister River on the east and the Thomson on the west. Included in the south-west portion of the sheet are part of the Thomson River and its eastern affluents — the Aberfeldy, Donnelly's Creek, Fulton's Creek, Stringer's Creek, Deep Creek, and Stony Creek—all heading from the range last described. Close to the Main Divide, on its eastern fall, run the two branches of the Barkly River, which, after meeting one another, join the Macallister River heading from the north; and the Macallister, fed by the Wellington River from the east, and the Serpentine, Glenmaggie and other creeks from the west, traverses the block in a south-easterly direction, passing out near the south-east corner close to Maffra. A great leading spur between the Macallister and the Wonnangatta, leaving the Main Divide at Mount Howitt, passes into the sheet on the northern boundary, and about six miles south thereof forms the lofty Mount Wellington Range, whose highest point at the trigonometrical station is 5,363 feet above sea level. From the saddle immediately north of the trigonometrical station, head on one side the Wellington River, running into the Macallister, and on the other a branch of the Moroka River, running into the Wonnangatta.

The Mount Wellington Range terminates seven miles southerly from the trigonometrical station at Mount Wellington proper, a huge bluff forming a conspicuous feature in the mountains; and from here a range at lower elevation continues southerly, and forms the watershed line between the Macallister and the Avon, running out in numerous broken spurs on the flat country of Upper Maffra and Wa-de-lock. On one of these spurs in the Avon watershed is Ben Cruachan, another very conspicuous mountain, approaching 2,800 feet in elevation. The Avon River, heading from the northern extremity of the Mount Wellington Range, and fed in its course by several large tributaries on either side, flows southerly, and passes out of the

VIEW ACROSS THE MITCHELL RIVER VALLEY FROM NEAR GRANT

eastern boundary of the sheet in the flat country near Boisdale. From the Mount Wellington trigonometrical station the leading range extends easterly for a few miles, and then divides; one spur, running south, separates the Avon and Valencia Creek down to their junction near Wa-de-lock; the other, running east, passes out of the sheet, and, turning to the south at Castle Hill, continues as the western watershed line of the Wonnangatta. A spur running from Castle Hill north-westerly re-enters the sheet boundary near the north-east corner, where Mount Kent is its highest point, and it thence descends to the junction of the Moroka and the Wonnangatta, ending in the Snowy Bluff, a place of great geological interest, which, though outside the limits of the sheet, will be hereafter described. The range from Mount Wellington, by Castle Hill, round to Mount Kent, partly encloses the picturesque valley of the Moroka, a broad open strath, forming the gathering-ground of numerous small streams from the surrounding mountains.

General geological description.

With the exception of about 160 square miles in the south-eastern corner of the sheet, occupied by Tertiary formations, and a few outliers of the same in the mountains, the whole of the country described consists of Lower and Upper Palæozoic rocks. Subjoined is a list of the various formations in their order of superposition, with the localities in which they occur, or are most developed.

Post-Tertiary.

Most Recent.—Low flats of rivers, creeks, and gullies, both completed and in progress.

Recent.—Wide plains of Heyfield, Maffra, &c., and raised flats.

Tertiary.

Upper Tertiary (Pliocene).—Gravels and conglomerates, between Seaton and Glenmaggie, Upper Maffra, and Wa-de-lock.

Middle Tertiary (Miocene).—Silicious conglomerates and gravels of Glenmaggie, Seaton, Connor's Plains, Mount Useful, &c. Older Volcanic overlying the above in the same localities.

Upper Palæozoic.

Upper Devonian.—Sandstones and conglomerates, with interbedded lavas and porphyries, shales and mudstones. Avon River watershed; Wellington, Macallister, and Moroka rivers.

(?) *Devonian.*—Limestones. Thomson River and Deep Creek.

Lower Palæozoic.

Upper Silurian.—Country between Macallister and Thomson rivers.

Granite.—Head of a branch of the Avon.

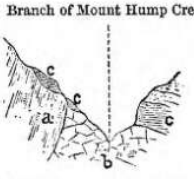
Granite.

Only one small outcrop of granite occurs within the sheet, and that is situated in the bed of one of the branches of the Avon, five miles south from Mount Wellington. As only a margin of the outcrop appears from beneath Upper Palæozoic rocks, it is impossible to say how far it may extend eastward as their foundation. On the western side the Silurian abuts on it, and the creek, which follows the

junction of the Upper and Lower Palæozoic for a short distance, has laid bare the granite, as illustrated in the sketch-section (Fig. 1). The granite appears to be intrusive as regards the Silurian, but certainly is not so as regards the Upper Devonian conglomerates, which rest on it undisturbed, and have at one time covered it completely, as shown by the outliers on the Silurian side of the creek. Coarse and fine varieties of texture are met with in this granite, and Mr. A. W. Howitt, who kindly examined for me a sample of the latter under the microscope, described it as a crystalline granular compound, consisting almost entirely of quartz and orthoclase, neither being well crystallized, plagioclase being nearly absent, and biatite mica equally rare with plagioclase.

FIG. 1.

Sketch-section illustrating relations of Granite, Silurian, and Upper Devonian rocks, Mount Hump Creek, branch of Avon River.



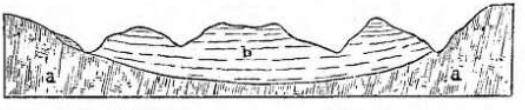
a Silurian. *b* Granite.
c Upper Devonian.

SILURIAN.

The Silurian rocks form the general basis of the whole country under notice, for though the Upper Devonian rocks occupy all the eastern portion, the Silurian appears from beneath them again, to the east of the sheet, in the Wonnangatta valley. There exists, therefore, in the Silurian rocks a great trough occupied by strata of Upper Devonian age, and this trough lies between the Silurian rocks west of the Macallister and those east of the Wonnangatta, as illustrated in the accompanying sketch-section (Fig. 2).

FIG. 2.

Sketch-section illustrating relations of Silurian and Upper Devonian rocks between the Barkly and Wonnangatta Rivers.



a Silurian. *b* Devonian.

The Silurian rocks of the Thomson River are clearly part of the same series as those of the Yarra and Wood's Point districts, known from palæontological evidence to be Upper Silurian; and those of the Wonnangatta are referred to the Lower Silurian, on account of their apparently belonging to the same series with strata containing Lower Silurian fossils.*

Assuming the classification of the Wonnangatta Silurian as Lower to be correct, there must be somewhere between the Thomson and the Wonnangatta a line of demarcation between the Upper and Lower Silurian. Having failed hitherto to discover any palæontological evidence on the subject, this line of demarcation is assumed to be concealed by the Upper Devonian rocks which occupy the great trough above described between the Macallister and the Wonnangatta; and the Silurian rocks exposed within the sheet are all provisionally classed as Upper Silurian, pending the acquirement of further testimony. There is no noticeable

* Papers by Mr. A. W. Howitt. "Progess Report" No. III., p. 186; No. IV., p. 119.

difference between the Silurian strata of this and other districts; the same highly inclined sandstones, shales, and slates prevail throughout; the general strike being north-westerly, and the dips varying north-easterly or south-westerly, according to the flexures of the bands. The following are the principal of the observations noted in various localities.

Thomson River, above the copper mine: alternate bands of bluish-grey hard silicious grit and fissile indurated clay-slate, dipping N. 40° to 45° E. at 59°. West branch of Stringer's Creek, about a mile and a half from Walhalla: blue slates and coarse sandstones, dipping E.N.E. at 58°.

Crossing of Aberfeldy, on Mount Look-out road: hard fissile greyish-blue schists, dipping W.S.W. at 55°. Aberfeldy River, below Mount Lookout: hard slates and sandstones, anticlinal, S.W. at 65° and N.E. at 62°. A similar anticlinal appears in the workings of the Lily Mine, near the same place.

Upper portions of Donnelly's Creek: slates and shales, with hard thick sandstone bands; strike N.N.W. synclinal and anticlinal folds.

Along the track from Seaton to the Springs, near Donnelly's: slates, with thick bands of sandstone. At the Springs: curly purple and grey vertical clay-slates, striking N. 40° W.; near Mount Useful, strike N.W.; on track from Mount Useful to the Black River, strike N.W., dip S.W.

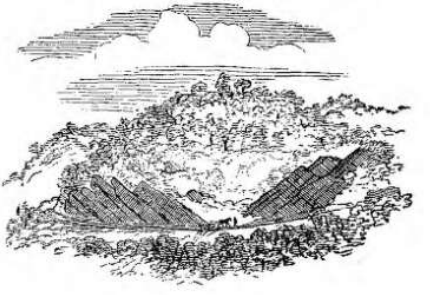
In the Serpentine Creek: slates, shales, and thick-bedded sandstones, striking from N.N.E. to N.N.W., the most reliable observation being a strike N.N.W. and a dip W.S.W. at 34°. In the Glenmaggie Creek, north from Seaton: whitish-grey fissile, jointed sandstone, and thin bands of shale, dipping S. 35° W. at 81°. In Macallister River, near Glenmaggie: slates, shales, and sandstones, dipping at one spot N. 55° E. at 33°, and at another W.S.W. at 28°. In upper portion of Ben Cruachan Creek: bluish-grey hard grits and indurated shales, bands of hard silicious sandstone, and blue and grey clay-slates; dip nearly vertical, but, if anything, inclined to the E.N.E; strike N.N.W. The Silurian rocks appearing at the base of the Snowy Bluff, north from the N.E. corner of the sheet, are slates and sandstones, dipping E.N.E. at 42°.

Near Cooper's Creek there is one small band containing very imperfect fossils, such as I have seen in the Alexandra district; and near this is a singular band of brown granular schist, containing nodules of intensely hard black silicious stone, resembling some described in a previous report as occurring near Turton's Creek, in South Gippsland.

As a rule, the cleavage and bedding of the Silurian rocks in this district coincide, but one notable exception, near Walhalla, was pointed out to me by Mr. H. Rosales. A section occurs beside a tramway along the spur of "Little Joe," showing a distinct synclinal fold, in which the bedding and cleavage planes are nearly at

FIG. 3.

Sketch showing synclinal fold with non-parallel bedding and cleavage planes, "Little Joe" spur, near Walhalla.



right angles to one another. This I have endeavored to illustrate in the accompanying drawing (Fig. 3). An anticlinal fold more to the eastward, in the bed of Little Joe Creek, exhibits similar features.

Limestones.

The few occurrences of limestone within the sheet are of Palæozoic age, but whether Upper or Lower has not yet been determined on palæontological evidence, the fossils obtained not being perfect enough to enable Professor McCoy to determine absolutely whether they were indicative of Upper Silurian or Devonian age. The stratigraphical evidence, however, is in favor of the latter, as will presently be shown, and these limestones are therefore here provisionally classed as Devonian.

In a report on South-Western Gippsland, in Progress Report No. III., the strike of some limestone near the Tyers River, which is clearly Silurian, being interbedded with Silurian slates, was described as being in the direction of the limestone near the Thomson River copper mine; but further examination of the latter has shown that this is a mere coincidence.

The three localities where the limestones now under notice have as yet been found to occur are—1st. On the north-western side of the Thomson River, near the copper mine; 2nd. On the south side of the Thomson, about seven miles east from the copper mine; and 3rd. About six miles easterly from Walhalla, on the west side of the Deep Creek, a tributary to the Thomson.

The limestone in these localities occurs only in patches of limited extent, and has not the appearance of forming bands in the Silurian strata, but, in the last-named locality especially, rests *on* the upturned edges of the latter, and on this account it is here classed as Devonian.

Near the Thomson River copper mine the limestone occupies a portion of the sideling along which the Melbourne road has been cut, and here the excavations for lime-burning expose blocks of hard bluish-grey limestone, resting apparently on the brown granular schist, referred to at page 46 in the description of the Silurian rocks. Down in the river the normal Upper Silurian rocks occur, but their interstices are filled with calcareous matter, as if infiltrated from the limestone above.

Another limestone patch of small extent, and showing similar relations to the Silurian rocks, occurs on the north side of Cooper's Creek: from both places lime of very superior quality is burned for local use. Professor McCoy supplies the following note on the fossil specimens obtained here:—"The specimens from this locality are so exceedingly imperfect and ill-preserved as not to admit of exact determination, with the exception of a mass of the *Favosites Goldfusi* indicative of Devonian rocks, with which are traces of a lamelliferous coral closely allied to Diplophyllum cœspitosum, and small branching forms allied to *Trematopora ostiolata* and *Cladopora fibrosa;* also one Beyrichia closely allied to *B. lata,* and a few crinoid stems of the *Actinocrinus* type. The general facies of these imperfect remains is as nearly indicative of Upper Silurian as of Devonian, and I would draw your attention to the necessity and importance of a larger collection of specimens being obtained from this locality." I have subsequently made further search, but could obtain nothing more satisfactory than those described.

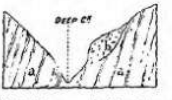
The second patch referred to also appears simply to be an outlier, as the Silurian rocks in the adjacent gully and on the Thomson River do not show any interbedded limestone. Close to the limestone, calcareous matter from it seems to have impreg-

nated the Silurian rocks, but unfortunately no good section could be obtained. The limestone, which may also be termed an encrinital marble, is dark bluish-grey, polishing nearly black, with white markings of the contained fossils. It would be a valuable ornamental stone if in a more accessible place and in greater quantity. Concerning specimens from here, Professor McCoy says:—"This limestone contains abundance of large crinoid stems of the *Actinocrinus* type, and some traces of *Gasteropoda*, apparently of the genus *Acroculia*, too imperfect to render determination possible, and a fragment of Bellerophon. It is impossible to determine the precise age of this rock for want of more perfect specimens, but I have no doubt it is identical with that of Cooper's Creek."

The Deep Creek limestone forms a bluff, and, as clearly as can be seen under the circumstances, rests on the upturned edges of the Silurian. Wombat burrows at the base of the limestone cliff have gone under it for a considerable distance, and the material brought out consists of fragments of Silurian shale and slate, which are visible *in situ* in the creek below. The sketch-section (Fig. 4) represents this occurrence—the best evidence at present available as to the relation of the limestone to the Silurian rocks. On specimens from here Professor McCoy remarks:—"In the small portion of this limestone forwarded there are only indeterminable fragments of crinoid stems and the coral allied to Trematopora ostiolata found in the Cooper's Creek limestone, with which the stratum is no doubt identical."

FIG. 4.

Sketch-section illustrating apparent relations of Limestone (? Devonian) and Silurian, Deep Creek, branch of Thomson River.



a Silurian. *b* Limestone.

Even with the imperfect fossils obtained, Professor McCoy is enabled to express an opinion that these three patches of limestone are identical in their geological age, whatever that may be, and the stratigraphical evidence so far fully justifies their being classified as they are. They may therefore be regarded as vestiges of a once more extensive area of limestone denuded during the Upper Devonian, Mesozoic, and Tertiary periods, till only the portions occupying the deeper hollows in the Silurian were left.

The fact of the limestone resting on the upturned edges of the Silurian rocks would show that the foldings of the latter, however effected, took place prior to the deposit of the limestones.

UPPER DEVONIAN.

Before giving my own observations, reference must be made to the work accomplished by Mr. A. W. Howitt in the investigation of the Upper Devonian rocks of North Gippsland.

In that gentleman's paper in Progress Report No. III. he gives very valid reasons for regarding the Iguana Creek beds—referred on palæontological evidence by Professor McCoy to the Upper Devonian—as of the same series, and continuous with those of Freestone Creek in one direction and the Snowy Bluff in another.

Mr. Howitt shows how they are seen lying on the upturned edges of older strata, and how they contain, interbedded with the shales, sandstones, and conglomerates, certain layers of felstone porphyry and basalt, which appear to have been the lava-flows of Upper Devonian times, subsequently altered by chemical

action from their original condition. Having myself examined the Iguana Creek beds, I traced them round to Freestone Creek, and found in the latter locality fossil flora, among specimens of which Professor McCoy recognised *Cordaites Australis*—a characteristic fossil of the Iguana Creek strata, and indicative of Upper Devonian age, so that both on stratigraphical and palæontological evidence the rocks of Iguana and Freestone creeks may be regarded as identical. Having accompanied Mr. Howitt on a visit to the Snowy Bluff, and having with him taken notes of the section thereof given by him in Progress Report No. IV., page 77, I reproduce it here from my own notes, as it will be necessary for comparison with others observed subsequently (Fig. 5).

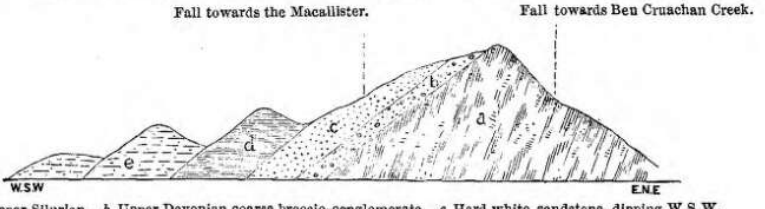
In following from Freestone Creek northward the margin of the Upper Devonian rocks, where they rest unconformably on older strata, it was found that the felstones, porphyries, &c., continue among the lower beds of the series as far as explored in that direction, to about Valencia Creek, ten miles south from Castle Hill. To absolutely establish their identity with the Snowy Bluff beds it would be necessary to trace them round by Castle Hill and Mount Kent outside the limits of the present sheet; this has not yet been done, but probably will be soon, and in the meantime their continuity may be safely assumed. The Barkly and Macallister rivers form approximately the boundary between the Silurian and Upper Devonian from the northern edge of the sheet down to Hickey's Creek; from here the boundary between the two formations turns north-easterly along the Divide between the Macallister and Avon, keeping the slope towards the former to a point on the range between Mount Hump and Mount Wellington, whence it turns back southerly into the Avon watershed, and, passing to the west of Ben Cruachan, recrosses the Divide between the Macallister and Avon, and runs down to the former river at a point nearly opposite the junction of Glenmaggie Creek.

Thus the upper portions of Ben Cruachan Creek and another branch of the Avon heading from Mount Hump, which I have called Mount Hump Creek, are in country consisting of Silurian rocks which form a tongue jutting into the Upper Devonian area, whose lower beds lean against and dip from it on either side.

From Hickey's Creek, crossing the heads of Warrigal and Snowy creeks (branches of the Macallister) towards the west of Mount Hump, the lowest bed of the Upper Devonian is a very coarse breccio-conglomerate, consisting principally of large angular fragments of the harder portions of the Silurian rocks; on this rest sandstones, shales, &c., followed by massive porphyritic felsite of great thickness, on which lie the varying sandstones, conglomerates, and shales comprising the sedimentary portion of the series. The sketch-section (Fig. 6) was

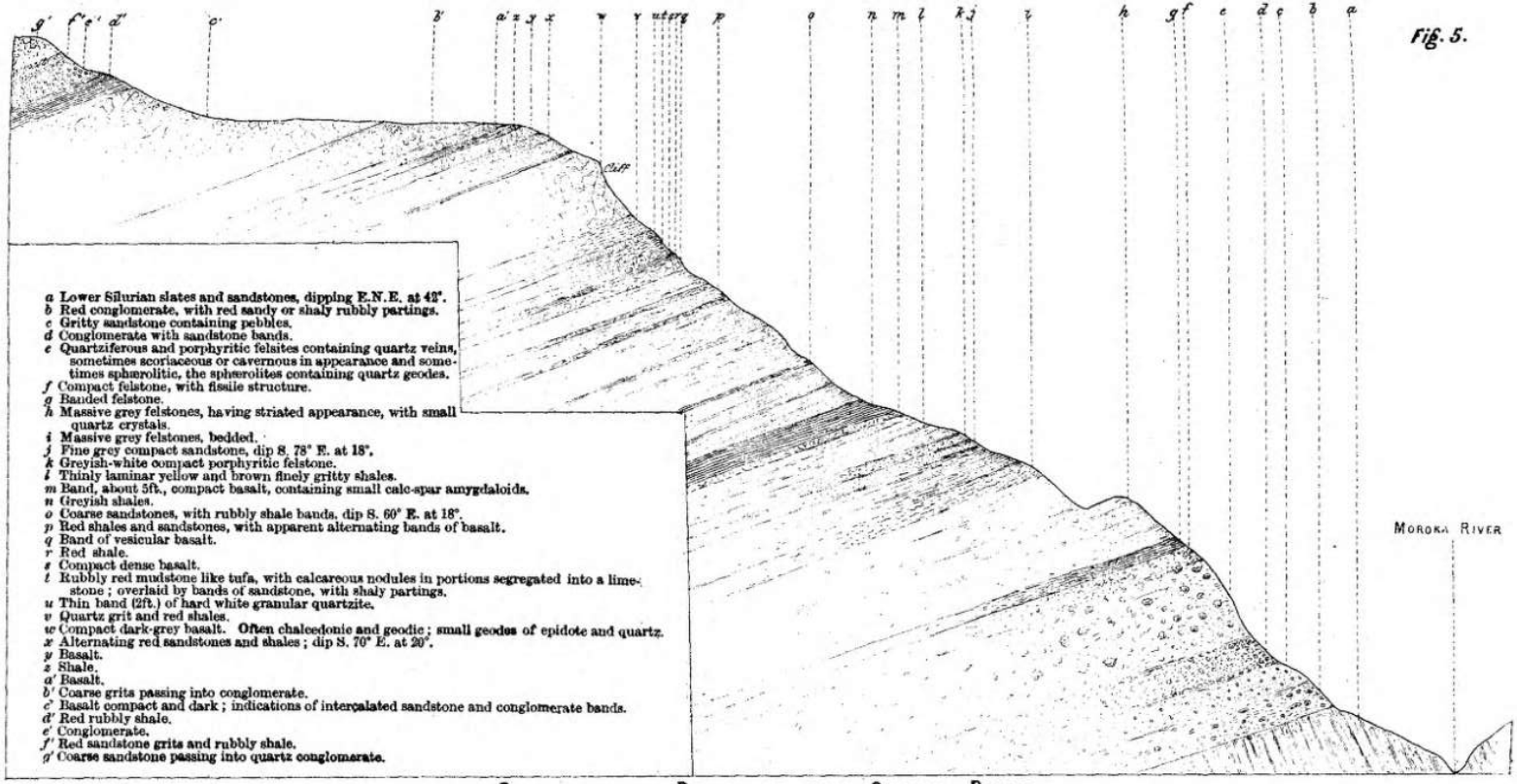
FIG. 6.

Sketch-section on Divide between the Macallister and Ben Cruachan Creek.



a Upper Silurian. *b* Upper Devonian coarse breccio-conglomerate. *c* Hard white sandstone, dipping W.S.W. *d* Massive felstone porphyry. *e* Sandstone and red rubbly shales.

Fig. 5.



a Lower Silurian slates and sandstones, dipping E.N.E. at 42°.
b Red conglomerate, with red sandy or shaly rubbly partings.
c Gritty sandstone containing pebbles.
d Conglomerate with sandstone bands.
e Quartziferous and porphyritic felsites containing quartz veins, sometimes scoriaceous or cavernous in appearance and sometimes spherolitic, the spherolites containing quartz geodes.
f Compact felstone, with fissile structure.
g Banded felstone.
h Massive grey felstones, having striated appearance, with small quartz crystals.
i Massive grey felstones, bedded.
j Fine grey compact sandstone, dip S. 78° E. at 18°.
k Greyish-white compact porphyritic felstone.
l Thinly laminar yellow and brown finely gritty shales.
m Band, about 5ft., compact basalt, containing small calc-spar amygdaloids.
n Greyish shales.
o Coarse sandstones, with rubbly shale bands, dip S. 60° E. at 18°.
p Red shales and sandstones, with apparent alternating bands of basalt.
q Band of vesicular basalt.
r Red shale.
s Compact dense basalt.
t Rubbly red mudstone like tufa, with calcareous nodules in portions segregated into a limestone; overlaid by bands of sandstone, with shaly partings.
u Thin band (2ft.) of hard white granular quartzite.
v Quartz grit and red shales.
w Compact dark-grey basalt. Often chalcedonic and geodic; small geodes of epidote and quartz.
x Alternating red sandstones and shales; dip S. 70° E. at 20°.
y Basalt.
z Shale.
a' Basalt.
b' Coarse grits passing into conglomerate.
c' Basalt compact and dark; indications of interçalated sandstone and conglomerate bands.
d' Red rubbly shale.
e' Conglomerate.
f' Red sandstone grits and rubbly shale.
g' Coarse sandstone passing into quartz conglomerate.

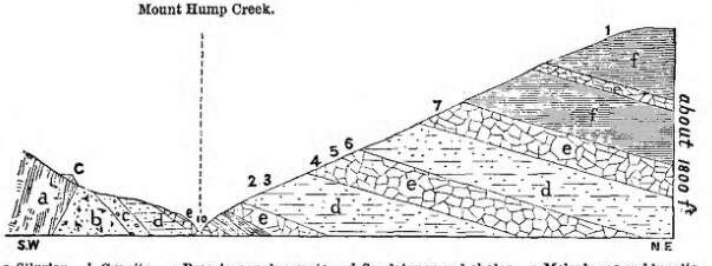
SECTION OF BEDS AT THE SNOWY BLUFF

noted on the Divide between the Macallister and Ben Cruachan Creek, near the head of Stony Creek.

Near the small outcrop of granite S.E. from Mount Hump the same breccio-conglomerate rests on the Silurian and granite, but between it and the felsite are many layers of basalts and melaphyres, with intervening sedimentary bands. The section (Fig. 7) was noted along a spur rising from the bed of Mount Hump Creek

FIG. 7.

Section showing apparent sequence of beds in head of branch of the Avon River S.E. from Mount Hump.



a Silurian. *b* Granite. *c* Breccio-conglomerate. *d* Sandstones and shales. *e* Melaphyres and basalts. *f* Porphyry-felsite. 1, 2, 3, and Nos. of specimens examined microscopically by Mr. A. W. Howitt.

towards Mount Wellington, and Mr. A. W. Howitt has kindly supplied notes of his microscopical examination of some specimens from the various bands which I sent to him. It must be stated, however, that the conditions here were by no means favorable for obtaining an accurate section, on account of the great quantity of scrub, soil, and loose masses of rock. In the following general description of the rocks numbered in the section, and others in the vicinity, are embodied notes given me by Mr. A. W. Howitt, who has also promised to furnish a detailed account of the results of his examination of them. The numbers are those attached to the specimens sent, and appear in the section at the points where they were obtained.

No. 1.—A dark porphyritic felsite, similar to some at the Snowy Bluff.

No. 2.—A light greenish-grey rock, melaphyre, consists of a mass of concretions, mostly containing quartz as a centre.

No. 3.—A hard dark-grey rock, melaphyre, basaltic in character, and containing some concretions as in No. 2.

No. 4.—Hard, fine, olive-colored rock. Compact melaphyre of a basaltic character.

No. 5.—Exceedingly hard and compact; light olive-green in color. Compact felsite (felstone).

No. 6.—Light drab-colored, hard fine-grained felsite.

No. 7.—Quartz felsite, fine-grained base, with a few crystalline products of quartz.

No. 8.—(From loose piece in creek.) Melaphyre, apparently a completely altered basaltic rock; the concretions are of some mineral at present undetermined, resembling epidote.

No. 9.—Mixed light-grey and purple rock from waterfall in Mount Hump Creek, a mile above the point shown in the section. Apparently a portion of highly altered rock, probably melaphyre; the rock is very silicious.

No. 10.—Dark slate-colored fine dense rock, containing many concretionary quartz geodes. Microcrystalline melaphyre, resembling some of the varieties of basalt of the Snowy Bluff.

The great porphyritic felsite mass forming the summit of the section extends to and forms the southern and south-eastern portion of the base of Mount Wellington; it has not yet been followed to the western side, though it probably extends there, and thence to the Snowy Bluff; it nowhere appears in the bed of the Main Avon, being covered by sedimentary rocks.

Resting on the porphyry, and forming the cap of Mount Wellington proper, is a hard glassy greyish-white melaphyre. Northward from Mount Wellington, conglomerates, thick-bedded, reddish-brown, and whitish sandstones and shale bands, dipping E.S.E. at about 30°, continue to the trigonometrical station, and thence round the Divide between the Avon and the Moroka valley. The Divide extending from the Moroka valley, between the Avon and Valencia Creek down to Little Plain, consists entirely of sedimentary rocks, sandstones of various colors and textures, conglomerates and rubbly red mudstones being the prevailing forms.

Returning to the S.E. of Mount Hump, and following thence the Silurian and Upper Devonian boundary southward, the same general phenomena are met with to the base of Ben Cruachan, viz., immediately on the Silurian coarse conglomerate or breccio-conglomerate, then melaphyres and felsites, and then the bulk of the sedimentary sandstones, shales, and conglomerates. The continuity of particular bands is not always distinctly traceable, and their relations in wide apart localities are sometimes obscure, but the general features are the same. The felstone porphyry resting on and overlaid by conglomerates is traceable along the Silurian boundary from the north of Ben Cruachan to the Macallister River east of the Glenfalloch pre-emptive right. There is an exposure in the bed of the Macallister, at the west end of the Glenfalloch pre-emptive right, of very decomposed basalt, which may either be the Tertiary Older Volcanic or a decomposed Devonian melaphyre; it has been colored as the former, which it most resembles, but there is no positive evidence as to which it is.

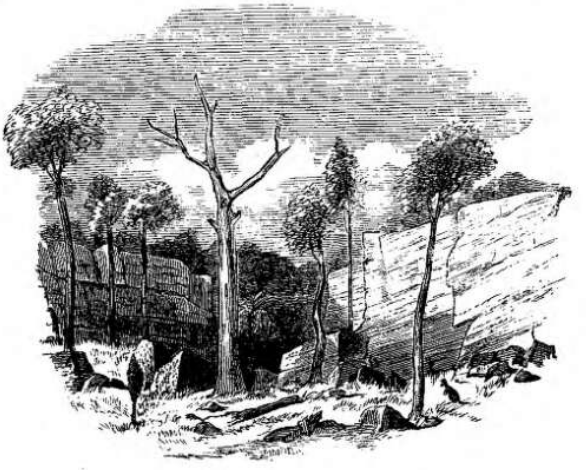
The most south-westerly exposure of the Upper Devonian rocks in the sheet or in Gippsland is at a spot called Alick's Downfall, on the south side of the Macallister, a few miles below Glenmaggie Creek, and here they consist of coarse silicious conglomeritic sandstones, forming cliffs towards the river, and sloping back under the Tertiary gravels by which they are hidden. From here along the foot of the ranges to the Avon, and back from that line to the summit of Ben Cruachan, none of the felsite or melaphyre bands have been met with; various conglomerates, sandstones, and red rubbly shale bands being the prevailing rocks. The sketch (Fig. 8) represents a small but rather picturesque gorge in Nicholson's Creek, between the Avon and Macallister; the rocks are coarse silicious conglomerates, with intervening sandstone bands dipping south-easterly.

The examination of the rocks of the Avon River and its tributaries was more exhaustive than in any other part of the sheet, and the principal features noted are

here given, starting from the lowest point of exposure, at the junction of Valencia Creek. At this point an anticlinical occurs, of which the accompanying is a

FIG. 8.

Gorge in Upper Devonian conglomeritic silicious sandstones, Nicholson's Creek.



sketch (Fig. 9). The base of the section is a purple fine-grained rubbly shale, over which are irregularly bedded layers of conglomerate, shale, and sandstone. Two or three miles further up the Avon, near Mount Angus Creek, are thick-bedded yellowish-brown micaceous sandstones, fissile, purple-brown and dark-red fine sandstone, and the rubbly purple mudstone, bands of which are very frequent throughout the series: the dip here is S. 74° W. at 48°.

FIG. 9.

a Surface soil. *b* Fine rubbly sandstone. *c* Shales. *d* Jointed sandstone. *e* Fine rubbly sandstone. *f* Yellowish shales. *g* Conglomerate. *h* Fissile shale. *i* Purple fine-grained rubbly shale.

FIG. 10.

Avon River, top of Little Plain.

a Fissile whitish and yellowish-brown micaceous sandstone, containing bands of coarse grit with a few small pebbles. *b* Hard light-brown jointed grit. *c* Coarse fissile brown micaceous sandstone. *d* Red rubbly shale.

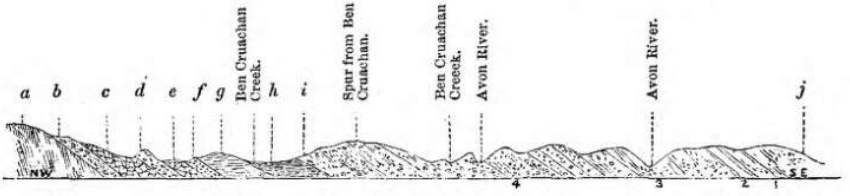
At the upper end of the alluvial flat of Little Plain is the locality where the specimen of lepidodendron, figured in Professor McCoy's Decade No. I., is stated to have been found, but further specimens of which I was unable, during long search, to discover. The sketch (Fig. 10) shows the section observed at this spot; near here are also shown, in the river bed, sandstones containing both rounded pebbles and veins of quartz, a feature to which further notice will be hereafter given.

From here along the Main Avon, to a point east from Mount Wellington, conglomerates, sandstones, and rubbly shales prevail; the dips generally are south-easterly, though they become more north of east abreast of Mount Wellington; the

angle of dip rarely exceeds 30°. I did not follow up the last few miles of the head of the Avon, as it was evident from the character of the washed fragments that there was no change. To the principal eastern head branch of the Avon I have given the name of Turton's River, running parallel as it does with the track cut by Mr. W. Turton while engaged on the geodetic survey. In exploring portions of this river nothing except the three above-mentioned forms of rock was met with, nor were any rolled pieces of others seen. In following up Ben Cruachan Creek from its junction with the Avon, no change from the above forms occurs until reaching a point north-east from Ben Cruachan, where the conglomerate, in addition to the usual constituents, contains boulders of melaphyre such as occur further up the creek; under this conglomerate are hard dark greyish-blue gritty shales resting on porphyry. Apparently under the porphyry are hard sandstone grits, and beneath them dark greenish-grey melaphyre, resting on hard dense sandstone and conglomerate. Other bands of melaphyre and porphyry, with intervening sandstones and conglomerates, are met with up to the Silurian boundary, on which lies coarse grey conglomerate. The sketch-section (Fig. 11) along the line of dip of the beds, from the Silurian boundary to near Little Plain, illustrates the sequence of the layers.

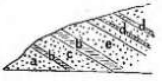
FIG. 11.

Sketch-section showing general sequence of Upper Devonian rocks along line of dip from the Silurian boundary, north-west of Ben Cruachan to near upper end of Little Plain.



a Silurian. *b* Upper Devonian conglomerate. *c* Melaphyres. *d* Conglomerate (containing melaphyre boulders). *e* Melaphyre. *f* Coarse sandstone. *g* Porphyry. *h* Hard fissile gritty shales. *i* to *j* Alternating conglomerates, thick and thin bedded.

Enlarged sections illustrative of rocks between *i* and *j* in above section.



1.

a Thick-bedded coarse-jointed micaceous sandstone.
bb Soft purple shale bands.
c Hard fine purple-brown micaceous sandstone.
e Fissile brown micaceous sandstone; part of the band ferruginous and full of cavities.
d Alternate bands of purple rubbly shale and hard purple-brown micaceous sandstone.

2.

aa Thick-bedded hard fine brown sandstone.
bb Finely gritty purple-brown rubbly shales.
c Light bluish-grey finely gritty shale.
d Hard brown sandstone.
e Thick-bedded light bluish-grey coarse silicious sandstone.

3.

a Rubbly purple-brown shale.
b Hard coarse silicious sandstone with fine-grained brown layer.
c Fine hard rubbly silicious grit.
d Hard fine purple-brown sandstone, much jointed.
e Hard rubbly bluish-grey shale.
f Hard fine grey silicious sandstone with fissile bands.

4.

a Conglomerate.
b Coarse sandstone, showing false bedding and containing patches and bands of conglomerate.
c Dark-red rubbly fine sandstone and gritty shale.
d Coarse sandstone.

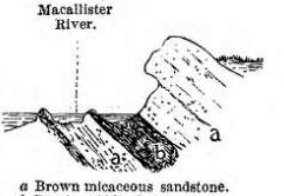
In the upper portion of McColl's Creek, which enters the Avon above Ben Cruachan Creek, the hard greyish-blue shales above mentioned again occur, and these are the only two places where they have been met with in the Avon watershed; they are more horizontal than the superincumbent beds, and resemble some (to be hereafter described) which occur in the Macallister. They appear in some cases to fill in hollows and undulations in the porphyry; one section observed would lead to the belief that the latter was intrusive, were it not for further evidence as to the porphyry being an intercalated layer.

A lofty hill between the heads of McColl's Creek and the eastern branch of Ben Cruachan Creek shows a band of porphyry whose outcrop forms as it were a belt round it, sandstones and conglomerates appearing both above and below. Ben Cruachan consists of alternating red rubbly mudstones, sandstones, and red sandy conglomerates, the latter composing its summit.

In the country watered by the Macallister, the Wellington, and the Barkly, it is noticeable that the conglomerate layers, though by no means absent, are fewer than within the Avon watershed, and that the porphyries and melaphyres do not appear at all, as far as the country has been examined, to the north-west of a line drawn from about the junction of the Serpentine Creek and the Macallister towards the northernmost bend of the Moroka River.

Nothing is, however, yet definitely known about the country north of the present sheet extending from between the Barkly and Wonnangatta northward to the Main Divide; and beyond giving an account of the rocks noted, it will not be here attempted to show their relation to those of the Avon except by the statement that the stratigraphical evidence obtained so far and the general character of the beds indicate that they are of the same series. Following up the Macallister from Glenfalloch, brown micaceous sandstones with purple rubbly mudstones prevail to the junction of the Wellington, where a small section illustrative of the character of the beds occurs as shown in Fig. 12; and no special change of character occurs as far as the Macallister and Barkly rivers were followed towards the sheet line. The dip at the junction of the two branches of the Barkly is S.E. at 8° in hard, gritty flags, overlaid by sandstones and red rubbly shales. Some of the sandstones along the Barkly are very thick-bedded, and form perpendicular cliffs overhanging the river. In Glencairn Creek, near its junction with the Barkly, are hard grey laminar gritty shales, resembling those described in Ben Cruachan Creek, dipping S. 40° W. at 13°; and further up towards the Glencairn homestead are alternate hard sandstones and red mudstones, with the same direction of dip. In the Macallister, east of Glencairn homestead, are red rubbly mudstones and shales resting on coarse fissile yellowish-brown sandstone dipping S. 60° W. at 38°. Higher up the river is another well-defined dip in similar rocks of S. 73° W. at 41°.

FIG. 12.



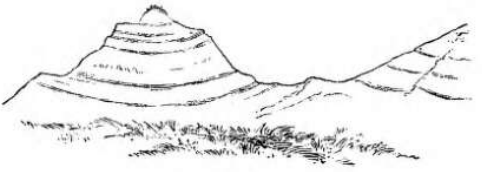
a Brown micaceous sandstone.
b Purple rubbly shales.

With a few variations in character, and some fine conglomerate bands, the same descriptions of rock are met with up to the summit of the Crinoline, a very conspicuous hill, about 4,500 feet in elevation, on the range between the Macallister and the Wellington. The rocks here are nearly horizontal, and the outcrops of the

harder beds on either side of the hill form a succession of cliffs, with steep grassy slopes between, which give the hill the appearance whence its name is derived (Fig. 13).

Fig. 13.—"The Crinoline."

From Glencairn.



From the North-east.

From the summit of this hill the same appearances are visible in the ranges on either side of the Macallister and Wellington as far as the eye can discern, cliffs and buttresses of the harder rocks forming broken contour lines round the spurs of the mountains.

In following up the Macallister from Glencairn the river holds at first a course from the north, and then the main stream turns sharply, inside the sheet boundary, and has a course from the east for several miles through deep gorges and precipitous mountains walled with cliffs of the above-described rocks. Above the gorges are small, open, gently-undulating plains covered with snow-grass, through which the river winds, the surrounding tributary gullies containing moss beds and unfailing springs of water.

A high hill overlooking these plains, and on the Divide between the Macallister and Wellington, is named on the map Mount Tamboritha, as it appears to be the one so named on the Government map of the colony. The summit consists of sandstone, sometimes passing into conglomerate; and from here down to the Wellington River are the prevailing sandstones and red rubbly shales. While following the range from the Crinoline to Mount Tamboritha my companion and myself began to suffer so severely from thirst that we decided to descend a mountain side of about 1,500 feet to the cascades which we could see in the Macallister below. After scrambling down about half way we accidentally discovered a magnificent spring of pure ice-cold water issuing from the solid rock with a velocity and volume equal to about two sluice-heads of water.

The position of this spring is shown approximately on the map, and it indicates that there must be some subterranean passage by which the water comes from higher country, probably that in which the plains are situated.

The portions of most interest to be yet examined in the southern part of the Upper Devonian area are its eastern margin, from Freestone Creek to Castle Hill,

Mount Kent, and the Snowy Bluff, and a small tract lying immediately west of the range between Mount Hump and the Mount Wellington trigonometrical station. The first is nearly certain to afford geological features of interest bearing on the relations of the Snowy Bluff beds with those of Freestone and Iguana creeks. In the second locality I have lately learned on good authority that serpentine has been found, and that the samples of chrome iron mentioned in Progress Report No. III., page 172, came from the same place. I had proposed making the above investigations before sending in this report, but being occupied in the Dargo and Bogong country during the latter part of the autumn I was unable to carry out the intention before the winter set in. I trust that I may yet be able to do so in time to furnish the result in the form of an appendix hereto.

Among the Devonian sandstones are beds of good description for building purposes; the sandstone from the Freestone Creek quarries is used throughout the district, and will probably be more extensively employed when railway communication is established with Melbourne.

A very good description of hard fissile grit, suitable for flagging, occurs in Nicholson's Creek, below the gorge, and at other places along the foot of the ranges between Nicholson's and Freestone creeks, are sandstones which, from their appearance, would yield good building stones if properly opened into.

Nowhere have I met with the least indication of coal in these rocks, and I could hardly have escaped seeing it if it existed at all. A little fine gold is reported to have been found in Nicholson's Creek and a few other places, but in no case could I hear of anything approaching a payable prospect being obtained.

In conclusion, it may be remarked that the evidence obtained leaves no doubt as to the rocks of Freestone and Iguana creeks and those of the Avon belonging to the same series; the former have been shown on palæontological evidence to be of Upper Devonian age, and therefore the latter must be Upper Devonian also. At the same time it may be stated that the rocks where the lepidodendron—indicative of Lower Carboniferous age—was said to have been found are among the uppermost exposed beds of the series, and the presence of lepidodendron may indicate the proximity of the line of demarcation between Upper Devonian and Lower Carboniferous rocks, which latter, if they ever existed in this part of the country, have been entirely removed, unless portions remain under the Tertiary country between the foot of the ranges and the seacoast.

Middle Tertiary (Miocene).

The northernmost and most elevated occurrence of deposits of this age within the present sheet is at Connor's Plain, on the Main Dividing Range, between the Barkly and Black rivers. Here, at an elevation of between 5,000 and 6,000 feet above sea-level, is a basaltic plateau about half a square mile in extent, under which are beds of hard silicious rock and conglomerate, clays, sands, and gravels, resting on the Silurian bed-rock.

A tunnel is said to have been driven into the gravel and fine gold obtained; but, having no one acquainted with the locality with me when there, I failed to discover it.

A few miles south, at the point where the Main Divide turns to the west, and at a somewhat lower elevation, is Fullarton's Spring Hill, a similar basaltic plateau underlaid by the same deposits. The next occurrence, though of smaller area, is

Mount Useful, on the Divide between the Macallister and Aberfeldy rivers, where there are beneath the basaltic cap of the mount beds of intensely hard conglomerate, consisting of quartz pebbles and sand cemented with yellowish-grey silicious matter. The sketch-section (Fig. 14) represents the mode of occurrence in the three instances, and it is noticeable that in all of them the Silurian bed-rock rises higher on the eastern than on the western side, showing these remaining vestiges to be portions of the eastern margin of a Miocene valley, the main bed of which has been removed by denudation.

Fig. 14.

Sketch-section of Connor's Plain.

a Older volcanic. *b* Silicious conglomerates, clays, gravels, and (Miocene) *c* Silurian.

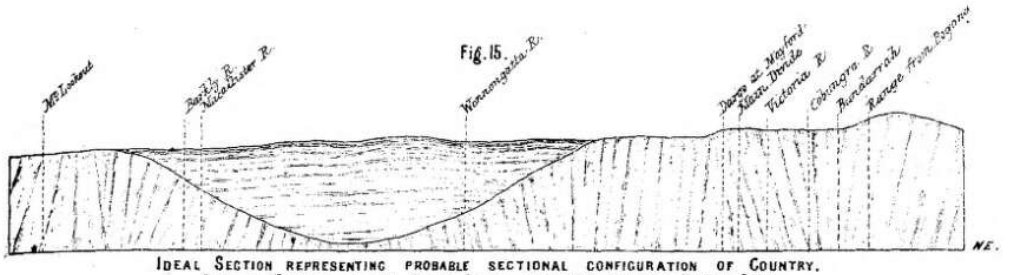
Though no palæontological evidence has been found, I have no hesitation in classing these gravels as Miocene; their elevation and general character leave no room for doubt as to their being of the same age as, and formed under similar conditions to, those of the Dargo and Bogong High Plains, where fossil flora, described by Professor McCoy as Miocene, are of plentiful occurrence. Outside the western boundary of the sheet is Mount Lookout, resembling geologically the points last described, and along the spur between the Aberfeldy and the Thomson rivers, at gradually descending elevations, are several small patches and outliers of basalt and silicious conglomerate, evidently portions of a once continuous and extensive formation.

There are no evidences of the Mesozoic rocks having once covered the country under notice, though it is possible that they did so. Leaving that an open question, the outline geological history, applicable to this and other parts of the colony, is that, after the Upper Palæozoic (Devonian) rocks had been deposited on the great Silurian and granite rock foundation, ensuing denudation (probably during Mesozoic times) removed them again from all but the deeper hollows and troughs in the Silurian which they occupied, so that the section across the country from Mount Lookout to the Bogong Ranges would probably have been, at the commencement of the Tertiary epoch, as represented in the ideal sketch (Fig. 15).

The rivers of the Lower and Middle Tertiary periods taking their courses approximately along the boundary lines between the Lower and Upper Palæozoic altered the sectional configuration to that represented in Figure 16, and deposited their gravels, sands, and clays in the beds of the valleys they had scooped out. Then came volcanic eruptions, which poured streams of lava down the valleys, partly, and in some places wholly, filling them, covering the deposits in their beds, and forming basaltic plateaux with intervening ridges of the Palæozoic rocks. The section was then as represented in Figure 17, and subsequent denudation, from the cessation of the lava-flows till now, has more or less altered the surface configuration of the whole country, reducing the general level of, and cutting deep valleys into, the Palæozoic rocks, removing large areas of the Miocene, Tertiary, and Volcanic formations, and leaving portions of the basaltic flows, once filling valleys, in the position of high plateaux on the watershed lines of the present day.

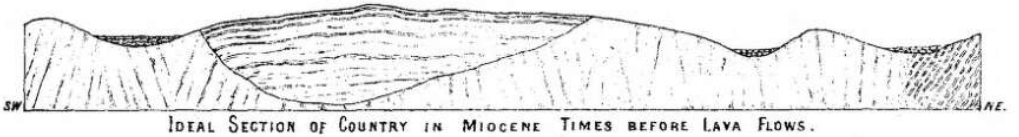
This present condition is illustrated in the sketch-section (Fig. 18) from Connor's Plain across the bight in the Main Divide, past the Snowy Bluff to another portion of the Main Divide above Mayford, on the Dargo; and the section could, I understand, be extended, showing similar conditions round into New South Wales.

Fig. 15.



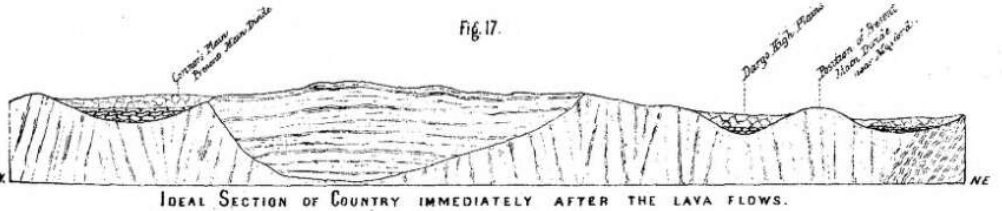
IDEAL SECTION REPRESENTING PROBABLE SECTIONAL CONFIGURATION OF COUNTRY.
BETWEEN Mt LOOKOUT AND THE BOGONG RANGES IMMEDIATELY PRIOR TO THE TERTIARY PERIOD.

Fig. 16.



IDEAL SECTION OF COUNTRY IN MIOCENE TIMES BEFORE LAVA FLOWS.

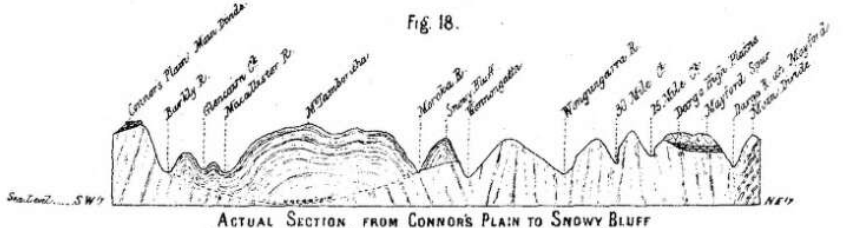
Fig. 17.



IDEAL SECTION OF COUNTRY IMMEDIATELY AFTER THE LAVA FLOWS.

Scale for Ideal Sections 16 Miles to the Inch

Fig. 18.



ACTUAL SECTION FROM CONNOR'S PLAIN TO SNOWY BLUFF
AND THENCE IN MAIN DIVIDE NEAR MAYFORD ON THE DARGO.

SCALE { Horizontal 18 Miles / Vertical 12000 Feet } to the Inch

Silurian | Metamorphic | Upper Devonian | Miocene | Volcanic

An extract from Professor Juke's Manual of Geology, third edition, page 690, has been brought under my notice by Mr. A. W. Howitt. As far as denuding agencies and the period of their activity are concerned, the instance noted in the Hebrides is analogous to what has been described above, and the extract is copied here as affording a parallel in another part of the world of what was taking place in this country during the same geological period :—"Another and striking piece of evidence (*i.e.*, as to the long continuance of volcanic action during Miocene times among the Hebrides) is given by the well-known Scúr of Eigg. That island consists of nearly horizontal sheets of basaltic rocks, like those of Mull, resting unconformably upon oolitic rocks. After their eruption they must have been long exposed to the wasting agencies of the atmosphere. A valley was cut out of them, and its bottom was watered by a river which brought down shingle and sand from the distant Cambrian mountains of the north-west. These changes must have demanded a lengthened lapse of time, yet they took place during an interval in the volcanic history of the island. The igneous force which had been long dormant broke out anew, and poured several successive ***coulées*** of vitreous lava (pitch-stone) down the river bed. In this way the channel of the stream came to be sealed up, but the same forces of waste which had scooped out the channel continued their operations. The hills which had bounded the valley crumbled away, and the lava currents that filled the river bed being much harder than the surrounding rock were enabled in a great measure to resist the degradation. Hence the singular result now appears that the former hills have been levelled down into slopes and valleys, while the ancient valley occupies the highest ground in the neighborhood, and its lava current stands up as the well-known precipitous ridge of the Scúr of Eigg. The gravel and drift-wood of the old river-bed are still to be seen under the rocks of the Scúr."

On the west side of the Thomson River, at the head of Cooper's Creek, is an area of Older Volcanic, beneath which are heavy deposits of gravel and silicious conglomerate, to all appearance the continuation of those from Connor's Plain, Mount Useful, and Mount Lookout, the intervening portions having been removed during the erosion of the Thomson and Aberfeldy valleys. I believe that future investigations during preparation of the next geological sheet will show that these are also portions of a lead similar to that which passes through Tangil, and runs under the Upper Tertiaries at the Haunted Hill, as described in the report on South-Western Gippsland, Progress Report No. III.

Having nothing to add as to the Tertiaries of Glenmaggie, I here reproduce the notes and sketches thereof already published in Progress Report No. IV.

Tertiaries of Glenmaggie.

The various sedimentary and volcanic Tertiary formations of Gippsland, being well represented at Glenmaggie, permission was obtained from Major Couchman, Acting Secretary for Mines, to make a detailed survey on a scale of 40 chains to 1 inch of a small area in that locality. The map is sufficiently complete to accompany and illustrate the present report, but is not in all respects a reliable delineation of the geology of the district, because in its preparation I have been guided by surface indications alone, and these are too frequently of a vague and unsatisfactory character. As the Glenmaggie district is one presenting auriferous

indications, it is to be hoped that my application to be allowed to prospect it will be granted, and the double object gained of testing the locality for gold and ascertaining the relations of the formations.

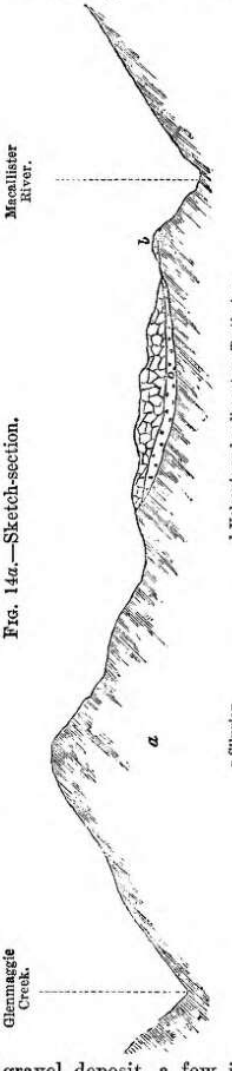


FIG. 14*a*.—Sketch-section.

The range of hills dividing the Macallister River from Glenmaggie Creek is, for a few miles up from their junction, comparatively low, and consists of Silurian rocks overlaid by volcanic and sedimentary Tertiaries. A rough section drawn across from the upper portion of the Glenmaggie Creek to its junction with the Macallister, would be that in the attached sketch (No. 14*a*).

As followed northward, the base of these Tertiary deposits rises far above the existing river level, while to the south they can be followed till they pass beneath the bed of the Glenmaggie Creek, and are lost to the south thereof under the wide expanse of Upper Tertiary deposits which flank the foot of the ranges. There are rocks and gravels of apparently Middle Tertiary or Miocene age: a lava-flow resembling in character the older volcanic, and gravels and ferruginous cement beds to all appearance overlying, and more recent than, the volcanic. These last, described on the map as Upper Tertiary, appear to be identical with those termed Pliocene on the geological map of South-Western Gippsland—such as the gravels of "The Ridge," near Rosedale, Tom's Cap, and other places.

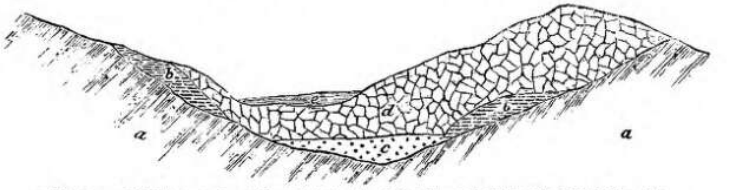
There are distinct indications of an old river-course or lead, now filled in by basalt, from the Stony Creek down to and through the Glenmaggie pre-emptive right; its northern extension beyond Stony Creek is not yet ascertained, but the basalt is visible in place in or near the bed of a tributary of the Glenmaggie Creek, down to and through the pre-emptive right, and again in the bed of a creek to the south-east thereof. In the natural sections exposed the basalt rests occasionally directly on the Silurian, but in other places separated from it by thick beds of intensely hard cherty silicious rock, and conglomerate precisely similar to that described in the report on the geology of South-Western Gippsland. The silicious rock thins out as the Silurian rocks rise on either side of the old channel, and does not appear to occupy its bed, which apparently contains a gravel deposit, a few indications of which are here and there met with. This gravel would therefore appear to be somewhat more recent than the silicious rock, and the section, if exposed, would probably be as indicated on the ideal sketch-section (No. 14*b*).

The actual sections observed are illustrated in sketches Nos. 14*c*, 14*d*, 14*e*.

Rolled boulders of the silicious rock, polished like glass, are frequent on the low spurs in Glenmaggie pre-emptive right, and associated with them are pieces of

highly silicified wood, apparently once embedded in the rock itself. There is a deposit of gravel forming hills above the level of the volcanic, but traceable to

FIG. 14*b*.—Sketch-section (ideal).



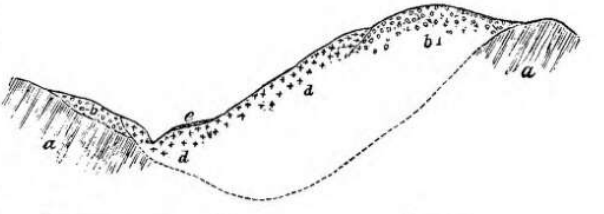
a Silurian. *b* Silicious rock. *c* Gravels in lead. *d* Basalt. *e* Most recent alluvial deposits.

lower elevations and beneath it. This gravel may be of the same age as the silicious rock beds, or the gravel in the old channel, but the evidences are too obscure to admit of an opinion being expressed until some holes are sunk to prospect the gravels and ascertain their relations to other deposits.

FIG. 14*c*.

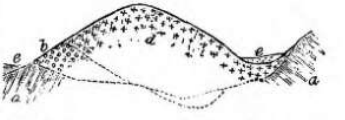
The modes of occurrence of the gravel referred to and the silicious rock, together with the doubtful character of their relations is illustrated in sketch-section No. 14*d*.

FIG. 14*d*.



The volcanic rock, where solid, is a dense, hard, dark basalt, but is usually much decomposed, and resembles the true older more than the newer volcanic; it appears to be of the same age as the basalt covering the lead at Tangil, and fills in the old river bed above mentioned, spreading over some of the adjoining hills; that it once covered a more extensive area is shown by the outlying patches left unremoved by the denuding agencies which formed the existing creeks and gullies.

FIG. 14*e*.



a Silurian.
b Silicious rock, and
*b*1 Gravel of apparently the same age.
c Gravel in lead.
d Basalt.
e Alluvial deposits.

To the south of the Glenmaggie Creek are tracts of country consisting of quartz gravel and ferruginous cement, somewhat higher than the basaltic hills in the pre-emptive right, and sloping southwards towards the plains; they sometimes rest on the Silurian and are visible in one place resting on the Middle Tertiary silicious rock. At the boundary with the basalt, however, the surface indications so blend the characteristics of both formations that it cannot be seen whether the gravels rest on the basalt or the basalt on them; these two possible modes of relation are indicated in sketches Nos. 14*f* and 14*g*.

FIG. 14*f*.

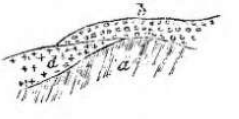
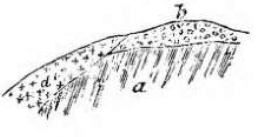
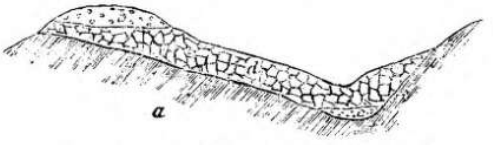


FIG. 14*g*.



The former view, as shown in No. 14*f*, is here adopted, because a few miles distant, near Seaton, a clear section is found of similar gravels overlying basalt, which is again underlaid by other gravels (sketch No. 14*h*).

FIG. 14*h*.



a Silurian. *b* Gravel on hills. *c* Gravel in lead. *d* Basalt.

A few holes would solve this problem and also test the auriferous quality of the gravel.

The deposits classed as "Recent" are those of the age of the Sale and Heyfield plains, consisting of soil, loam, clay, and occasionally sand or gravel; they are of a higher elevation than, and usually divided by a distinct line of demarcation from, the most recent deposits of river and creek flats, morasses, &c., an abrupt bank, as in sketch-section 14*i*, showing the boundary.

FIG. 14*i*.

GOLD WORKINGS.

Alluvial.

The alluvial workings in this sheet are confined to the beds or terraces on the banks of creeks and rivers. A few men still earn a livelihood on Donnelly's Creek and the Aberfeldy, and some of the terrace drifts along the Thomson are being remuneratively worked; but rich alluvial yields for a large population are now things of the past as regards the area under notice, and though there are no doubt creeks and gullies still unprospected which would afford temporary employment to a small number, the main hopes of future mining prosperity are centred in quartz mining.

Quartz.

In his excellent paper published in Progress Report No. IV., Mr. William Nicholas points out the existence, in this colony, of seven main groups of auriferous quartz reefs, and one of these includes the reefs of Stockyard Creek, Russell's Creek, Walhalla, Jericho, Donnelly's Creek, Wood's Point, Gaffney's Creek, Jamieson, Big River, and Alexandra.

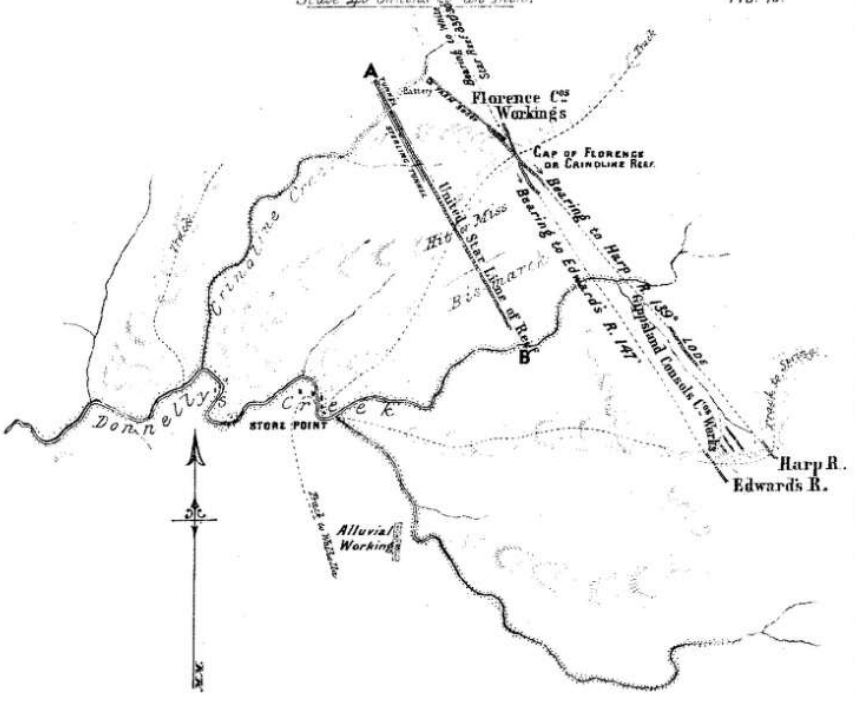
The portions of this group included in the present sheet are the reefs of Donnelly's Creek and those of Aberfeldy and Walhalla, occurring in two separate belts, 5 miles apart, between which the most marked distinction of character is that, in the first—the Donnelly's Creek belt—no dykes of any kind have yet been found in or near the quartz workings, while, in the Walhalla and Aberfeldy belt, the quartz lodes accompany large well-defined dykes of felstone and diorite.

Plan of the

DONNELLY'S CREEK GOLD WORKINGS

Scale 40 Chains to an Inch.

FIG. 18.



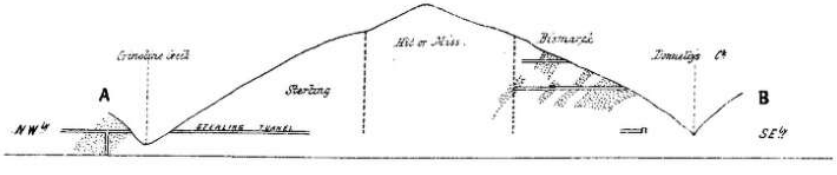
Sketch Longitudinal Section on Line A.B.

or

UNITED STAR LINE OF REEF.

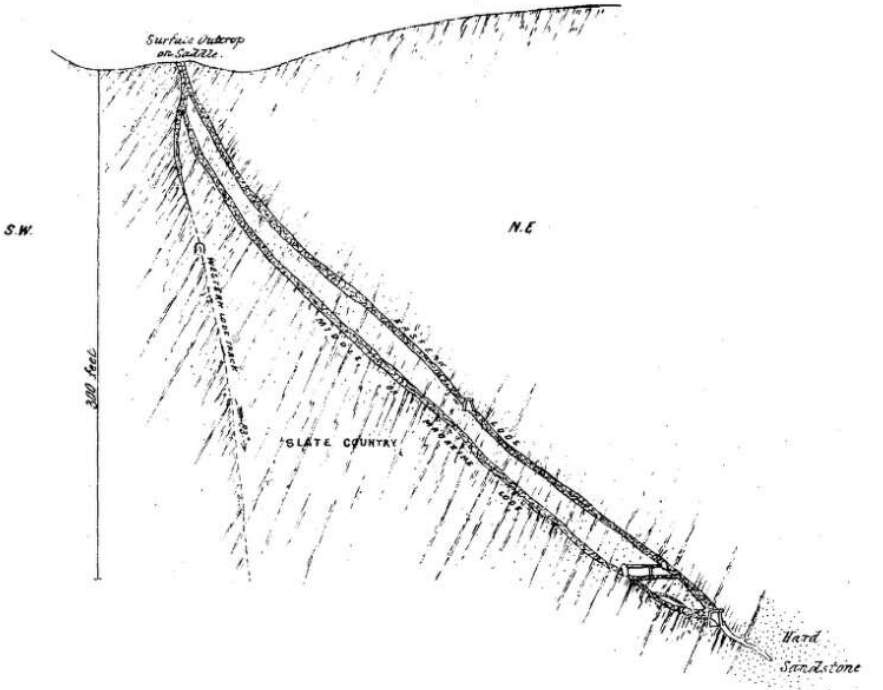
Showing Shoots

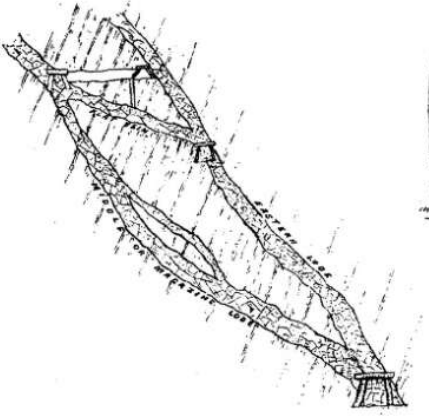
FIG. 26.



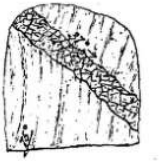
Sketch Section of Crinoline Reef
FLORENCE Co

FIG. 20.





Section of Junction
OF EASTERN AND MAGAZINE LODES



Section of face
IN DRIVE IN MAGAZINE LODE.

FIG. 21

EDWARD'S AND HARP REEFS
GIPPSLAND CONSOLS GMCº

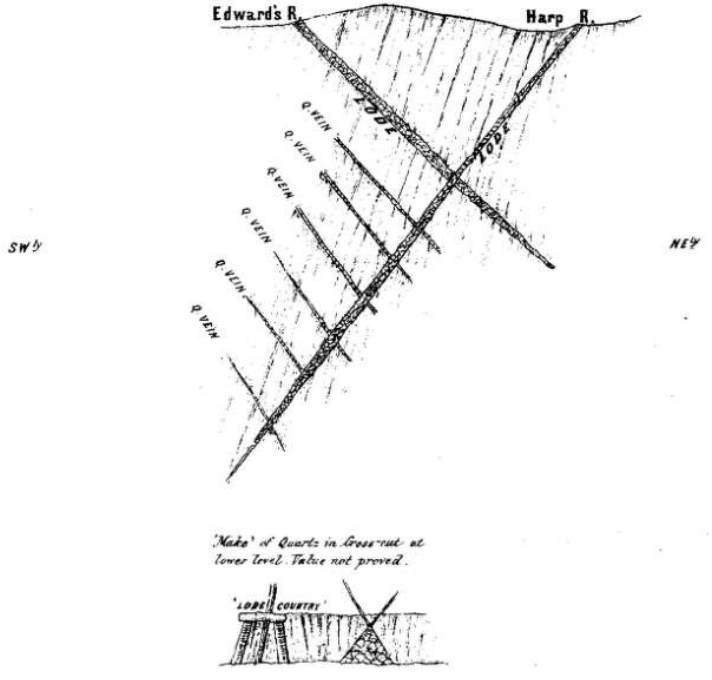
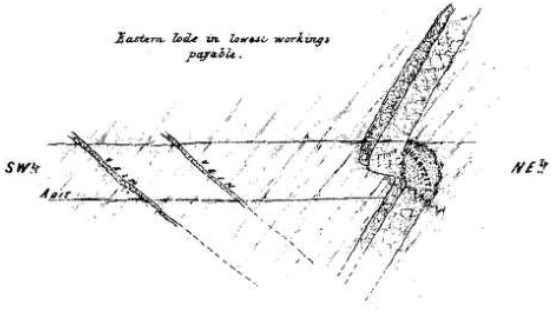


FIG. 22.



Donnelly's Creek belt of reefs.

The Donnelly's Creek belt consists, as far as is yet known, of two main lines of reef about 600 feet apart. The eastern is known at its northern portion—worked by the Florence Gold Mining Company—as the Florence or Crinoline Reef; at the southern, worked by the Gippsland Consols Company, as Edwards' Reef. It is clearly, however, the same line of reef, though there are several different veins and varieties in their modes of occurrence. As may be seen by reference to the accompanying plan of Donnelly's Creek (Fig. 19), the cap of the Florence Reef crosses a saddle in a lofty range separating Crinoline Creek, one of the northern heads of Donnelly's, from the main creek. At this point it appears at surface as a single reef about a foot thick, but below divides into three, as shown in diagram (Fig. 20). The eastern and middle or magazine lodes at first diverge downwards and then join again at about 300 feet below the cap. The western lode, though its "track" only remains at that depth, continues to diverge from the others as far as yet followed.

On their strikes, in both directions from the cap on the saddle, the lodes diverge.

The shoots of gold in this reef do not appear to have been found continuous, though they have been very rich in patches, and better stone than worked for some time has lately been struck in a deeper adit. The lodes vary in thickness from a few inches to several feet. The eastern and magazine lodes, after joining, pass away into a hard sandstone belt, in which they have not as yet proved remunerative.

The old surface workings on the Harp and Edwards' reefs, and those of the Gippsland Consols Company at deeper levels, show the two lodes to underlie towards and across one another, the continuation of the eastern reef below the intersection being also cut by a number of minor veins; these points of intersection appear, in many cases, to have been the richest. The sketch-section (Fig. 21) conveys a general idea of their mode of occurrence; but so numerous are the veins and intricate the various old workings that it is impossible, without a detailed survey, to give an accurate delineation.

On the eastern side of the gully, trending northerly from the outcrop of the Harp and Edwards' reefs, a lode has lately been struck which is apparently the lower continuation of the Harp reef. It is here 4 feet in thickness at the deepest level, carrying payable gold, principally on the walls, and has the appearance, as indicated in the diagram (Fig. 22), of two distinct veins in contact with one another. A singular twist which occurs is also represented in the diagram, as well as two veins which show in the adit as if going to join the main lode below. Between the Gippsland Consols and Florence workings the character of the lodes is as yet unknown, but they appear to be the same line of reef, notwithstanding local variations, and will probably be more developed at no distant period.

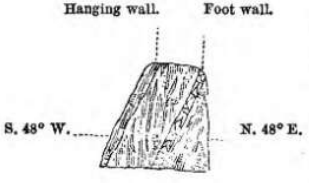
The main western Donnelly's Creek line of reef is the United Star line, a single lode, worked at present by the Sterling, Hit-or-Miss, and Bismarck companies.

The general bearing is from N. 30° W. to N. 40° W.; its underlay is south-westerly, usually at from 75° to 85°, though in one place as low as 36°; the auriferous quartz occurs in successive shoots, which dip northerly, the "track" and walls of the lode between the "shoots" being clearly defined even where quartz is absent. In workings, at present idle through litigation, on the north side of Crinoline Creek, a shoot which yielded richly has passed under foot and will have

to be recovered by sinking. (*See* Fig. 26.) The section in the north end of the tunnel is as shown in the diagram (Fig. 23). This line has not been further explored to the north, and it is uncertain whether the White Star line towards Mount Useful, now abandoned, is a continuation of this or the Crinoline Reef.

FIG. 23.

Face in end of tunnel on the United Star Reef, looking north-westerly.



On the south side of Crinoline Creek the Sterling Company have driven a tunnel for a distance of over 1,000 feet along the clearly defined "track" of the lode; except occasional small veins indicating the possibility of shoots of stone above or below, the tunnel has not met with any defined quartz lode whatever, though in some of the veins, galena, pyrites, and zinc-blende were abundant, and these minerals are regarded as almost unfailing accompaniments or indications of the proximity of auriferous quartz.

The diagrams (Figs. 24 and 25) show sections of the face of the Sterling tunnel at various stages. South of the Sterling, and occupying the crown of the range, is the claim of the Hit-or-Miss Company, whose ground is at present untouched, though, as will be shown presently, its development is being rapidly proceeded with. To the south of the Hit-or-Miss is the ground of the Bismarck Company, from which very rich yields have been and are likely to be again obtained.

There are several shoots of auriferous stone in this ground, all of them dipping north-westerly along the strike. The southernmost, which is the principal shoot yet worked, is about 70 feet in length, and has been worked down from its outcrop 360 feet; to reach it at a lower level an adit of about 1,000 feet has been put in, and, having intersected the "track" of the lode, is being driven north-westerly along it for the continuation of the shoot (Fig. 26). The thickness of stone in this shoot was 3 feet 6 inches to 4 feet, of which about 6 inches on the footwall was good, the rest being poor. Some of the good stone yielded as much as 20 oz. per ton. Here is also an appearance of a double reef like that described in the Gippsland Consols workings, a well-defined line of parting being visible between the two portions (Fig. 27). The lowest tunnel (excepting the adit now being driven), after passing through the main shoot, struck some smaller ones and then came to a break in the lode, where it was thrown slightly to the west by a cross-course bearing 240° and dipping S.S.E.; its course was recovered again and followed to about 70 feet from the Hit-or-Miss boundary with slightly improving aspect. In an underlay shaft from this tunnel, on the main shoot, the walls of the lode from about 9 feet apart came nearly together, the golden stone adhering to the footwall to the point of meeting and turning back along it when the walls resumed their normal course (Fig. 28). An upper tunnel followed a shoot till it broke off, forming a remarkable curve, which is represented in the diagram (Fig. 29). Beyond the curve, on the line of the lode, a "dig" was followed a short distance, and at the end of the drive the walls are wider apart and show a little quartz.

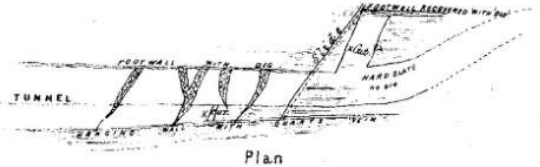
The Hit-or-Miss Company having arranged with the Bismarck Company for the use of the tunnel, mentioned as being 70 feet from their boundary, pushed it forward, and at about 20 feet from the boundary came upon a splendid shoot of stone, on which they are now driving at or near the boundary line. I saw the commencement of

STERLING TUNNEL

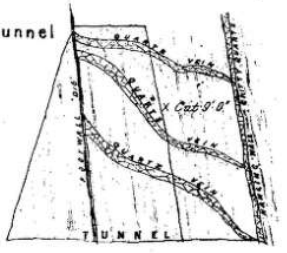
Fig. 25.

Plan and Section of part of Sterling Tunnel between 900 and 1000 feet.

Supplied by Mr. R. H. Bake Manager.



Plan



Section.
LOOKING S.E.

Face at 670 feet.
LOOKING S.E.

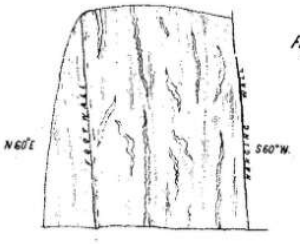


Fig. 24.

Section of Reef.

Fig. 27.

Section of Reef

Fig. 28.

Plan of Break in Reef.

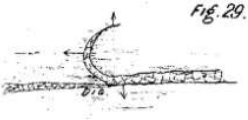
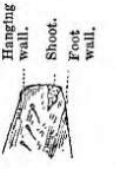


Fig. 29.

the shoot in the drive, and it then only appeared at the top of the face in a wedge shape, as shown in diagram (Fig. 30), but has since, I learn, extended down the whole face to a width of 2 feet, carrying excellent gold.

FIG. 30.

First appearance of "shoot" struck by Hit-or-Miss Company in Bismarck Company's tunnel.



This shoot, like the others, dips north-westerly and underlies south-westerly; its length is as yet unproved, and it is supposed to be a continuation of the shoot in the upper workings of the Bismarck which was found to be broken.

The good stone in the Donnelly's Creek mines is usually well laminated, and both between the laminæ and in the solid stone are galena, zinc-blende, iron and copper pyrites, associated with the gold. On the track from Seaton to Donnelly's are quartz workings known as the Boy's Reef. Being abandoned at the time of my visits, I could not examine them, but I hear that the formation consists of a succession of leaders with indications of ultimately forming into a good solid auriferous lode. This is in the general line of strike of the Donnelly's Creek reefs; and in the country between the two places on that line there is every likelihood of other "makes" of stone being found.

To the east of the Florence line are the old workings of the London and Excelsior companies on two thick parallel bands of hard bluish-grey sandstone, containing nearly flat veins of quartz. They were worked under the mistaken impression that they were dykes like those of the Wood's Point district, but proved unremunerative. The bands strike N. 30° W. and dip N. 60° E.

As the alluvial workings of Donnelly's Creek and its branches start principally from the Florence and Edwards' Reef line, and very little gold appears to have been found above, it would appear that there were no auriferous reefs of any importance to the eastward within that watershed.

A number of reefs do exist, not only there, but in the Macallister watershed as far as the Silurian rocks extend, but none of the trials yet made by prospectors have proved successful. It may therefore be one of those barren belts known to intervene between auriferous ones.

I may take this opportunity of acknowledging the information and assistance courteously rendered by Mr. R. H. Bake, manager of the Florence, Sterling, and Hit-or-Miss mines; Mr. E. Keelan, of the Gippsland Consols; and Mr. Grant, of the Bismarck.

Quartz mines in which dykes occur.

The northernmost mine on the second belt of quartz reefs, that in which the quartz veins are associated with dykes, is the Lily mine, principally owned and managed by Mr. John A. Wilson, who showed me the workings.

The general bearing of the line of reef is N. 40° W., and there are two lodes—an eastern and western—which bifurcate from a single lode immediately below where the latter intersects a diorite dyke. The western vein keeps along the dyke which forms the hanging wall; and the eastern vein, after underlying to the north-east, turns and underlies south-westerly. This is shown in the diagram (Fig. 31). The lodes vary from a few inches to 12 feet in thickness along their course, and the gold does not seem to be established in a well-defined shoot, but irregularly, some portions being good and others poor. The strata in the mine show several

singular contortions, a drive easterly exhibiting on its wall curves in the strata as represented in the sketch (Fig. 32).

FIG. 31.

Lodes and dyke near surface, Lily Mine.

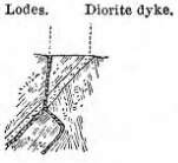


FIG. 32.

Contortions of strata on wall of drive, Lily Mine.

In this mine an adit is being put in which will afford more information, and as the boundary of the sheet to be next surveyed passes close to it I will probably be able to add as an appendix hereto a more detailed account.

In the Aberfeldy mine, south-east from the Lily on the opposite side of the Aberfeldy River, the reef has a bearing of from N. 30° W. to N. 40° W. with a south-easterly underlay, and a diorite dyke runs parallel with it to the eastward. In the mine adjoining on the south-east (late Stratford and Avon Company), the reef is similar, but it is said that the auriferous shoots in the Aberfeldy mine dip south-east, while in the Stratford and Avon they dip north-west, along the strike of the lode. Both these mines appear likely to yield good returns if properly worked, and the former has been improving since it came into the possession of the present proprietor, Mr. J. Rice. Very rich stone has been worked here, and will doubtless be found to continue at deeper levels, for which a shaft would be required. The Stratford and Avon mine could be easily prospected on the surface for shoots below those already worked on the crown of the range. Several hundred feet of vertical height intervene between the lowest workings and the creek bed at the southern end of the ground, so that if, as stated, the shoots dip north-westerly, the outcrops of any others that exist below would certainly be found on the side of the hill. Both these mines need further development before a reliable detailed account can be given of the modes of occurrence of the lodes.

The Dream and Mountaineer mines, approximately on the same line as those last mentioned, were not being worked when I was in the vicinity, so I did not visit them. They are reported to have dykes along with the quartz veins.

Walhalla reefs.

The principal lines of reef near Walhalla are Cohen's Reef, Longfellow's Reef, Happy-go-Lucky Reef, and that worked by the Fear-not Company.

Cohen's Reef.

Taken as a whole the line of Cohen's Reef has a strike N.N.W., and an underlay W.S.W. There are two principal quartz lodes, known as the eastern and western lodes, and in the Walhalla mine a third, known as the first eastern vein, which branches from the eastern lode and diverges northward.

The eastern and western lodes meet in an apex above, and join again below, both lines of meeting dipping N.N.W.'ly along the strike, and the intermediate space being occupied by a felstone dyke. There are portions of the line of lode where the dyke stone alone is met with ; others where the western lode alone occurs, and others where both dyke stone and quartz are absent, but the walls of the lode remain distinctly apparent, being either close together or slightly separated with jumbled and decomposed slate filling the intervening space. The lodes sometimes occur in the body of the dyke, but more usually on either wall, the dyke occupying the intermediate space. The main shoot thus consists of the dyke and the two lodes ; their apex dipping N.N.W.'ly in the line of strike at an angle of about 32° ; auriferous quartz, however, continues for some distance both above the apex and below the lower junction of the two lodes. The diagrams given will

Fig. 33

Longitudinal Section

SHOWING AURIFEROUS SHOOT IN THE WALHALLA AND LONG TUNNEL Cos MINE

COHEN'S REEF WALHALLA.

Scale 160ft to the Inch.

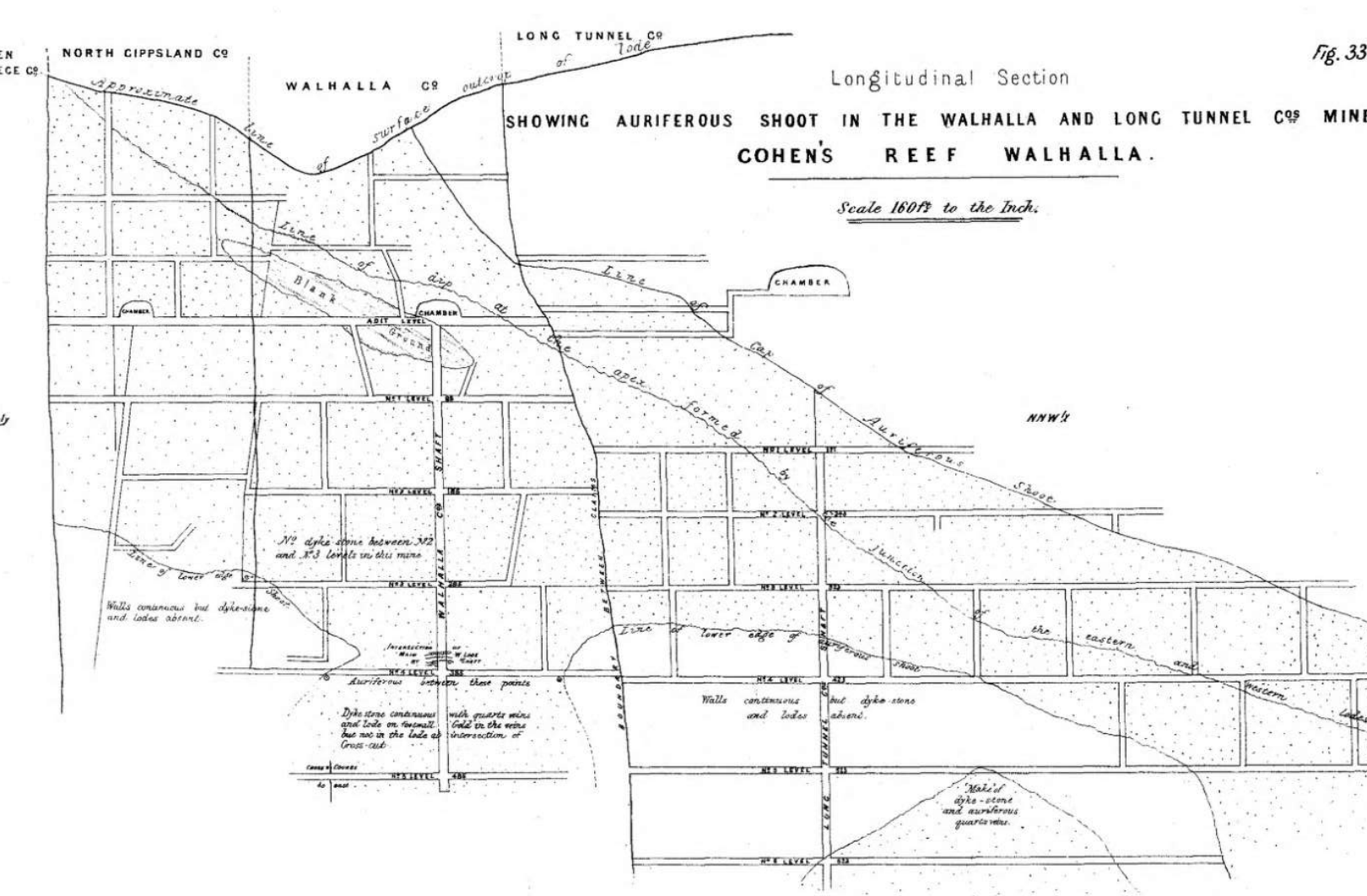
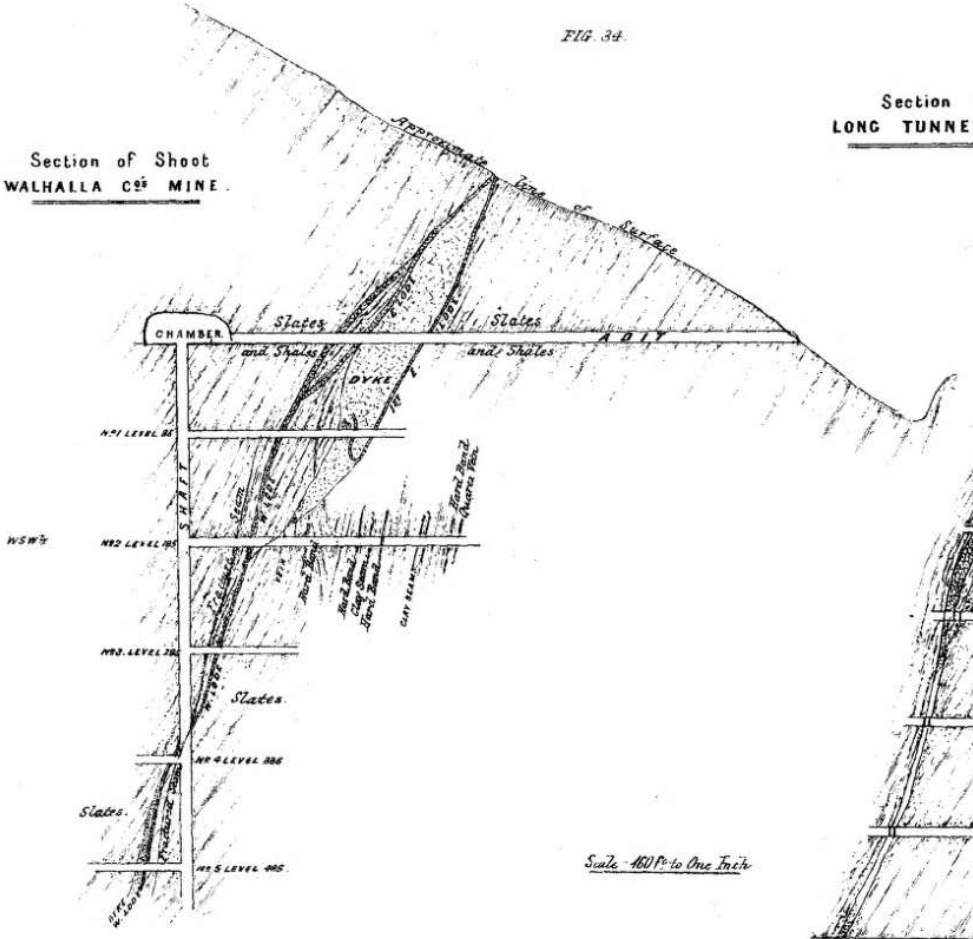


FIG. 34.

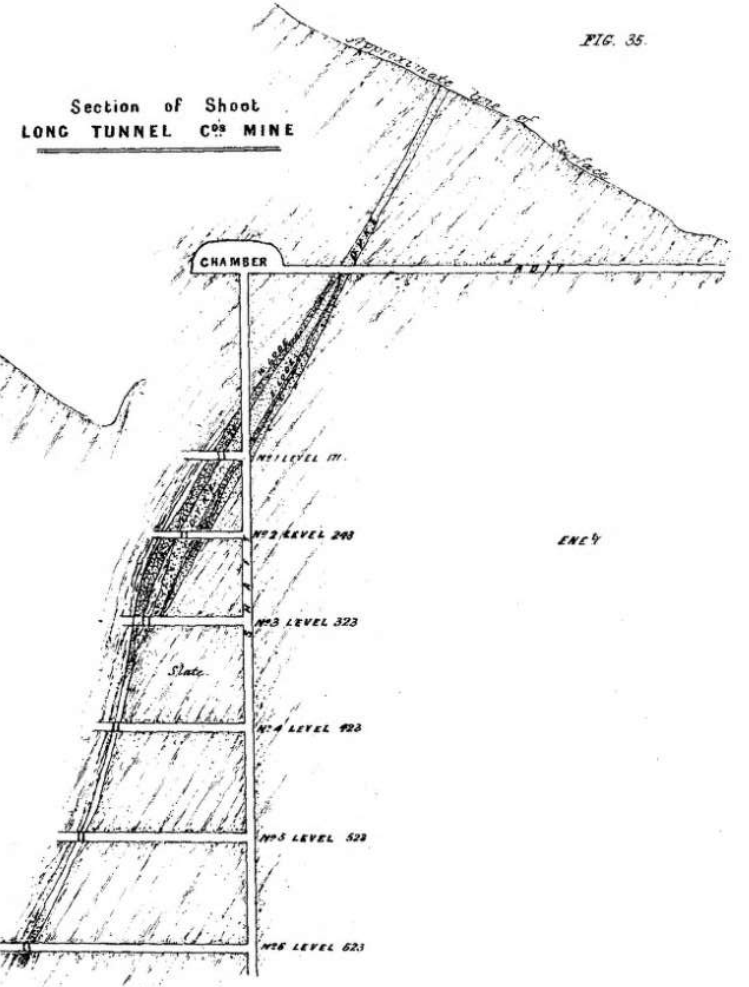
Section of Shoot
WALHALLA Cos MINE.



Scale 160 Ft to One Inch

FIG. 35.

Section of Shoot
LONG TUNNEL Cos MINE



Walhalla Co.

Sketch Plan of Shoot about adit Level

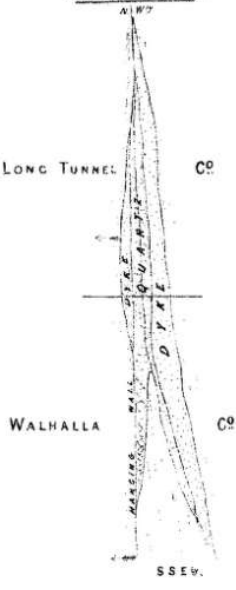


Fig. 36.

Sketch Section of Upper (southern) part of Shoot in Adit Level

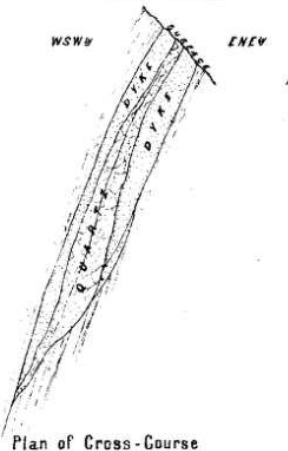


Fig. 37.

Plan of Cross-Course in Adit Level

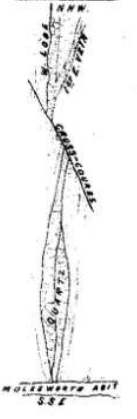


Fig. 39.

Section in Slope No. 3 Level

Fig. 38.

No. 5 Level

N. Face 110 feet from Cross-Cut

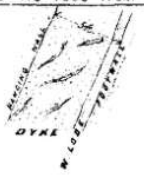


Fig. 40.

S. Face 130 feet from Cross-Cut

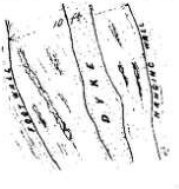
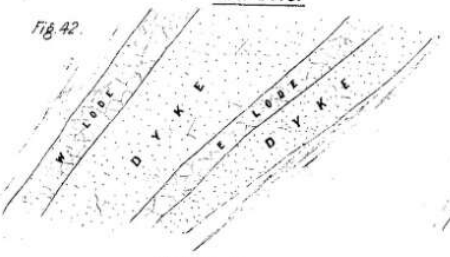


Fig. 41

Long Tunnel Mine

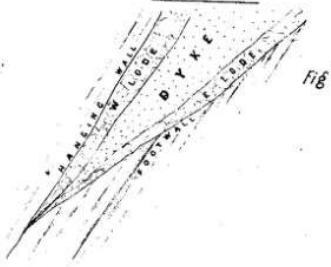
Section in Stopes
No 2 Level

Fig. 42.



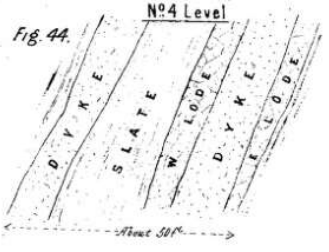
Section Lower Edge of Shoot
No 3 Level

Fig. 43



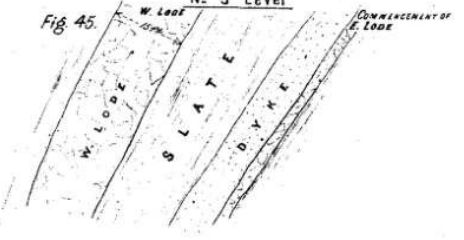
Section in
No 4 Level

Fig. 44.



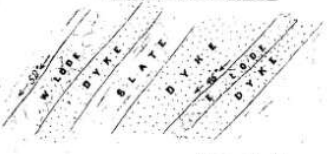
Section at N. End
No 5 Level

Fig. 45.



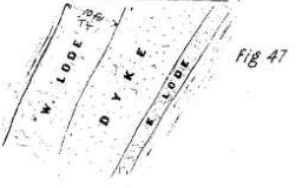
Section in Stopes between
No 3 & No 4 Levels

Fig. 46.



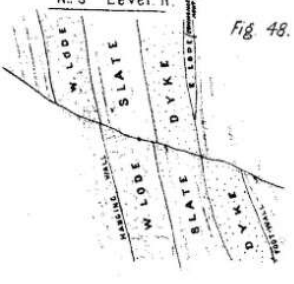
Section in Stopes
No 5 Level (S. portion)

Fig. 47



Plan of Cross Course
No 5 Level N.

Fig. 48.

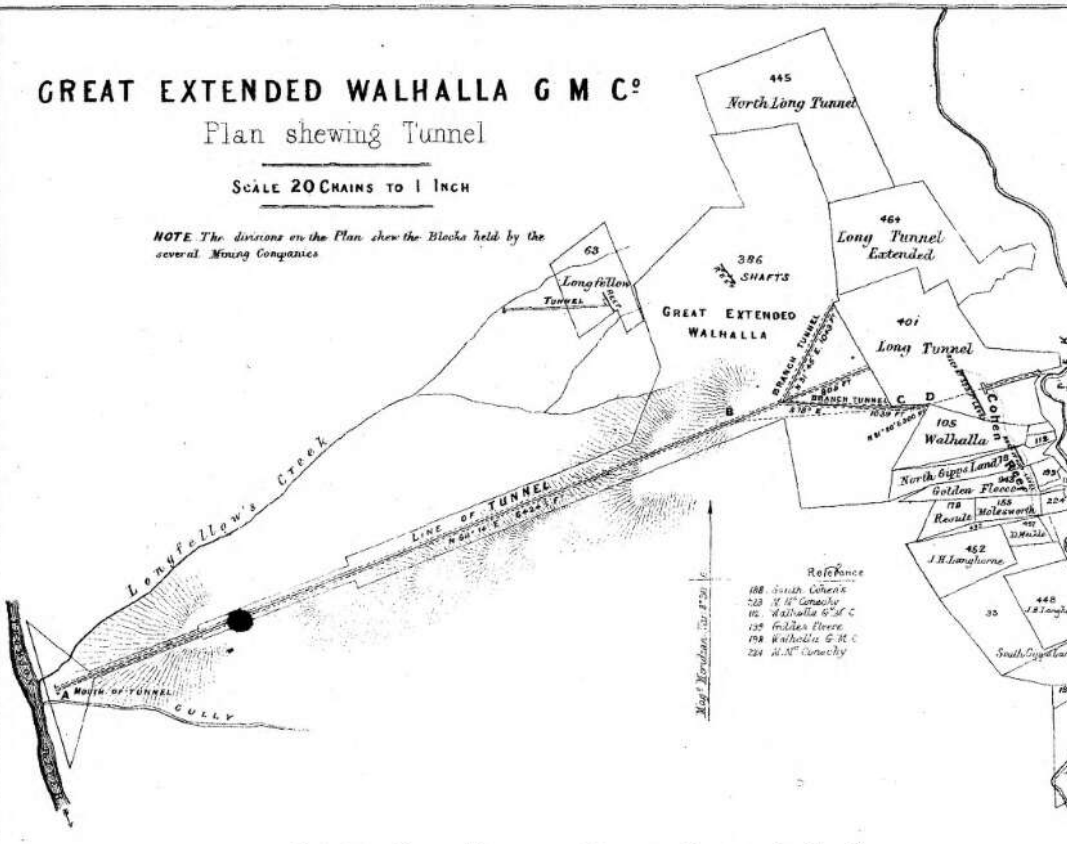


GREAT EXTENDED WALHALLA G M Co

Plan shewing Tunnel

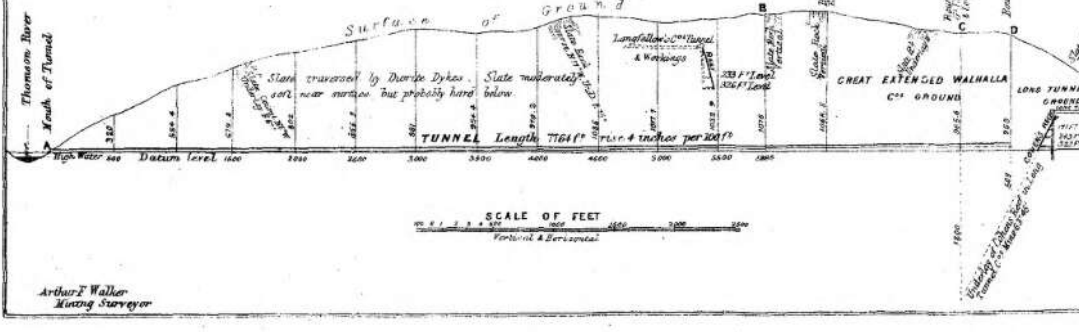
SCALE 20 CHAINS TO 1 INCH

NOTE The divisions on the Plan shew the Blocks held by the several Mining Companies



Section from Thomson River to Stringer's Creek

on line A B C D

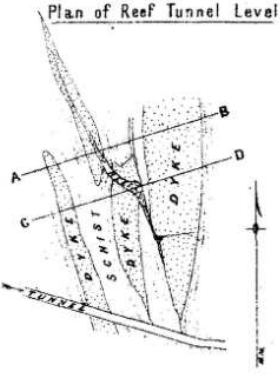


Arthur F Walker
Mining Surveyor

LONGFELLOW'S REEF

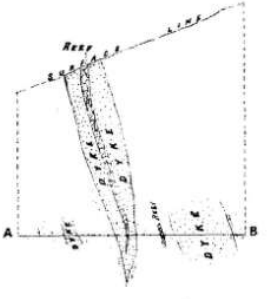
Plan of Reef Tunnel Level.

Fig. 51.



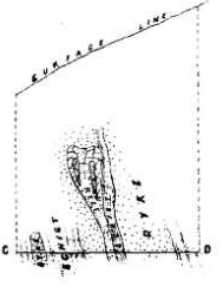
Section on Line A B.

Fig. 52.



Section on Line C D.

Fig. 53.



Reduced from drawings by Mr Arthur F. Walker

Scale 100 Ft to 1 Inch

afford a clearer idea than any written description of the features of this line. The longitudinal section (Fig. 33) shows the shoot as found in the North Gippsland, Walhalla, and Long Tunnel mines; the downward continuation of the main shoot in the Walhalla, and the new "make" in the No. 5 and No. 6 levels of the Long Tunnel, the discovery of which goes to substantiate an opinion expressed in a former report as to the occurrence of other shoots below the main one. Figs. 34 and 35 give a general idea of the cross-sections of the line of lode near the shafts of the two mines. Figs. 36 to 41, and 42 to 48, show various modes of occurrence of the dyke and lodes in the two mines. The lodes vary in thickness from a few inches to 12 feet in the eastern and 22 feet in the western lode. The presence of arsenical pyrites in the dyke is regarded as an unfailing indication of the proximity of good quartz in the lodes; besides, arsenical pyrites, bournonite, iron-pyrites, and galena are of plentiful occurrence.

Mr. H. Rosales, manager of the Walhalla mine, in addition to giving me every assistance in examining the workings, was kind enough to revise some of my drawings, and to allow me the use of his own. Without this help no information could have been given as to the upper workings, which had been stoped and filled up prior to my visits. Mr. Ramsay Thomson, manager of the Long Tunnel mine, and Mr. Symons, underground manager, were most courteous in showing me all points of interest in the workings. In some of the mines south of the Walhalla claim other shoots of auriferous quartz have been partly worked, and in all cases have been found to dip northerly along the strike: their continuance will probably be found at a greater depth in the northern mines.

The Long Tunnel Extended Company will also meet with the shoot now being worked by the Long Tunnel Company, though at a considerable depth, probably 900 feet.

A plan and section, Figs. 49 and 50, by Mr. A. F. Walker, mining surveyor, are here given as excellent general illustrations of Cohen's and other lines of reef. Figs. 51, 52, and 53 are copies of drawings by the same gentleman, illustrating the Longfellow's Reef, a line approximately parallel with, and half a mile to the west of Cohen's line, but having an easterly underlay. This reef is also accompanied by a diorite dyke.

Fear-not.

Supposed to be on the same line as the Longfellow's, but considerably to the northward, is the reef now being worked for by the Fear-not Company. In the old workings the upper tunnel was driven along a reef bearing about N. 15° W. and underlying E. 15° N. at 53°. A soft decomposed diorite dyke, 4 feet thick, occurs to the east of the sandstone hanging wall. In this level the reef thins out northward to a small vein, but the shoot of auriferous stone dips under foot southerly (Fig. 54).

In the lower tunnel a reef was cut just where the survey made by Mr. O. P. Whitelaw showed it as likely to be from the data obtained in the upper tunnel; this reef is auriferous, but no crushings have been made.* No dyke stone has been met with; so either this is not the same as the reef worked above, or else the dyke is absent from the portion intersected. Further working can alone decide this question. Sketch Fig. 55 shows the appearance of the face in the drive along the lower level.

* Trial crushings made since have proved payable auriferous quartz to exist.

Happy-go-Lucky.

Southward from Walhalla is the Happy-go-Lucky Reef, not being worked at present. From inspection of the old workings and information given me by Mr. Archer, manager of the South Cohen's mine, I was enabled to make the drawings (Figs. 56 to 59) illustrating what is known of the reef. Its strike is N. 15° to 20° E., and it has a very low underlay, N. 70° to 75° W. No dyke has been found associated with the quartz, but one is visible to the eastward.

The workings on the Girl's Reef, on the eastern branch of Stringer's Creek, have been idle for some years, but from what I saw of them the existence of large bodies of diorite dyke-stone in association with the veins was evident.

Walhalla Copper Mine.

The Walhalla copper mine is situated on the eastern side of the Thomson River, opposite the junction of Cooper's Creek, and about five miles from Walhalla. At the outcrop, 250 to 300 feet above the river, is a diorite dyke containing much hornblende, with copper pyrites disseminated and in veins. These are decomposed near the surface and converted into carbonates, sulphates, and oxides of copper, with which is associated brown iron-ore, probably a similarly produced result from the decomposition of iron-pyrites. The ore occurs as a "shoot," the general strike of which is N. 15° W., with a dip in the same direction, and an underlay easterly at a high angle. The ore-bearing portion of the dyke is about 120 feet long at the surface, with a total thickness in parts of 25 feet. In the upper tunnel the shoot is only about 60 feet long, but the ore is here a solid vein, from a few inches up to 4 feet in thickness. In the lower tunnel the lode was struck at 376 feet; its bearing here is N. 12° W., and its thickness 1 foot 6 inches, thinning out at 100 feet in the north drive from end of tunnel, and widening in the south drive to 21 feet at 150 feet from tunnel, where it abruptly stopped as if faulted.

The foot-wall of this part of the lode is soft, dark slate, and the eastern or hanging wall a fine hard silicious quartzite, apparently also calcareous ; no diorite appears in this level, and the lode at its thickest portion is a solid mass of yellow ore. Winzes sunk from the north and south drives passed through and away from the ore, which has probably gone eastward on its underlay. The diagrams (Figs. 60, 61, and 62) show the mode of occurrence of the ore.

The prospects of this mine may now be regarded as promising, there being a large amount of ore in sight, both in the newly opened and in the old workings ; the general indications are in favor of its further improvement at depth, and if the company succeed in getting a tramway to the railway line, and can utilize the lignite deposits of the La Trobe valley for smelting purposes, the probabilities of success will be greatly enhanced.

Remarks on Prospecting, etc.

In offering suggestions for the further prospecting of this portion of Gippsland it must be pointed out that, as regards shallow alluvial workings, the best and most extensive have already been found and worked out, and any future alluvial discoveries sufficient to benefit a large number cannot reasonably be expected, though there is still hope for small parties to prospect with a fair chance of success.

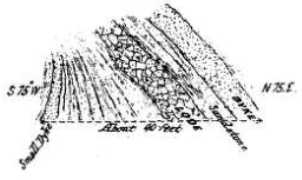
Whether undertaken at Government expense or by private enterprise, prospecting operations require to be more directed to specialities than they have been hitherto.

FEAR NOT MINE

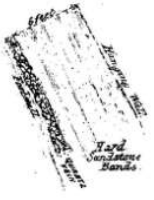
FIG. 55

FIG. 54

Section in Upper Tunnel



Section in Cross Cut from Lower Tunnel



HAPPY GO LUCKY REEF

FIG. 56

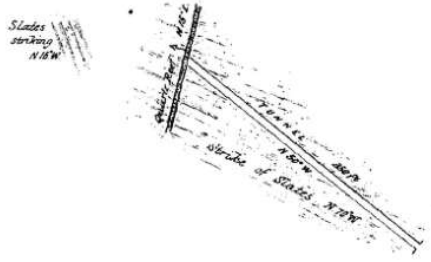


FIG. 57

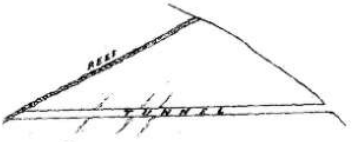


FIG. 58

General Sketch Section of Reef

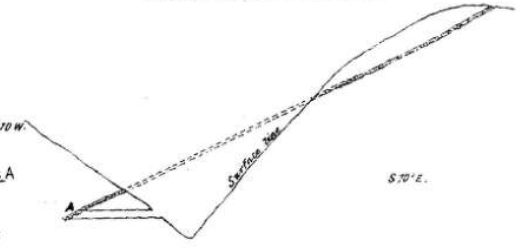


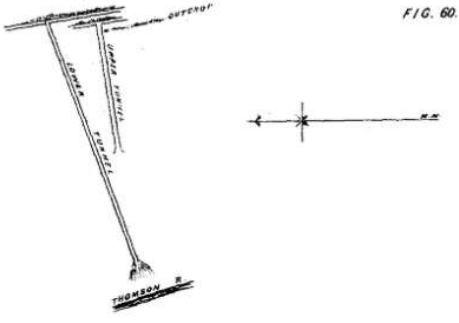
FIG. 59.

Surface Outcrop

Section in face at A

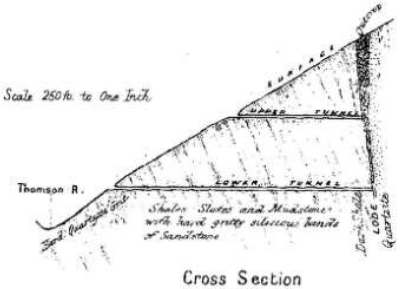
Walhalla Copper Mine
THOMSON RIVER.

FIG. 60.



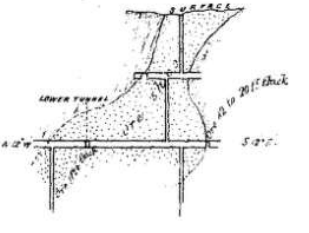
Plan

FIG 61.



Cross Section

FIG 62.



LONGITUDINAL SECTION

Taking into consideration the fact that the gold in quartz reefs occurs in shoots, with frequently long barren intervals between, it is easy to understand that, of several gullies or creeks crossing a line of reef, one only may have cut through the portion containing a shoot, and therefore the non-discovery of gold in one should not be a discouragement to prospecting others. Certain lines of reef have been proved auriferous at various points, and taking such lines as guides, the creeks and gullies intersecting them should be systematically tested a short distance below. The discovery of alluvial gold would thus be likely to lead to that of the matrix whence it was derived; and in cases where alluvial gold occurs I would strongly urge the advisability of careful search for the reef or lode, which is nearly certain to outcrop near where the gold commences.

Generally the discovery of alluvial gold has led to that of the reefs; there have been cases in which the former was inferior and the latter very rich, and *vice versâ*. Such instances can be accounted for by the position and trend of creeks, gullies, or leads, with respect to lines of quartz reef, and the position and extent therein of the auriferous shoots.

The line of country between the Donnelly's Creek reefs and the Boy's Reef, and the extension of that line south-easterly to the low country and north-westerly to the Main Divide, should be prospected in the manner suggested. It is worthy of note that the Royal Standard Reef, on Stander's Creek, just outside the western boundary of the sheet, is approximately in the line of strike of the Donnelly's Creek reefs. The line of the Walhalla belt and its extensions north-westerly and south-easterly should also be prospected in a similar way.

As before indicated, the country eastward of the Donnelly's Creek belt of reefs may be one of those barren tracts in which gold does not occur; but this cannot be proved except by proper trial. The country on the fall from the Mount Useful Range into the Macallister has been, to all appearance, very little tested. Gold is said to have been found in the Serpentine Creek and the western branch of the Barkly, but the few holes I saw in those creeks were a very insufficient test. The Glenmaggie Creek and its many branches hardly appear to have been tried at all. The southern portion of the sheet, from the Macallister to the Thomson, presents all the usual geological indications of being auriferous, and is almost untouched by prospectors. The gravels beneath the basalt of Fullarton's Hill and Connor's Plain are similar to those of the Dargo High Plains, and are worthy of a trial. The heavy gravels underlying the basalt at the head of Cooper's Creek, west of the Thomson, should be tested, as the currents which deposited them evidently crossed the country containing auriferous belts.

The country occupied by Devonian rocks, eastward from the Barkly and Macallister, cannot be recommended as likely to be auriferous, though a small expenditure to test whether gold does or does not exist in that formation would be advisable.

Besides the mines in work there is a wide field for enterprise in the numerous reefs once proved auriferous, but at present lying untouched.

The usual story attached to these reefs, among which are the Happy-go-Lucky, the Girl's Reef, the Dream, the Mountaineer, and the Stratford and Avon, is that good stone was found at the surface or for some distance down, and that it ran out or was cut off by a fault, or the owners had not sufficient capital. The abandonment of the reefs, being a good reason for regarding them as worthless, deterred

others from venturing time or money on them. It seems a very unlikely thing that a shoot of auriferous stone should be absolutely solitary ; that where the track of a lode continues after the stone has run out, there should be no more "makes" of stone either at a depth or along the line of reef ; at any rate this is not the experience obtained in most energetically worked and well developed mines. Failing, therefore, the discovery of fresh lines of reef, there is good reason for the opinion that those partly worked and now idle would, if their development was proceeded with in an intelligent manner, again produce remunerative yields. Every lode or vein has its peculiar features, and it is only by careful study thereof that the miner can direct his operations so as to have a fair chance of success.

The general appearance of the reefs of this district is greatly in favor of the theory that the veins of quartz and its contained metals and minerals were segregated from the surrounding rocks into fissures and cracks ; where these fissures follow the strike and bedding of the strata, they would naturally be expected to be more persistent than where they cross them, and general experience bears out this opinion. The laminated character of the Silurian rocks admits of fissures of great length occurring along the strike of the uptilted beds. In the Devonian rocks, where the strata are less fissile, and also, from their more horizontal character, less liable to be fissured, quartz occurs in small irregular veins, and occasionally large bunches, one of which, in the Avon River, is 20 feet in thickness. Flat lenticular veins occur isolated in some of the sandstones. The occurrence in these rocks of quartz veins in cracks and joints of conglomerates containing quartz pebbles shows that the formation of quartz veins is not confined to the Silurian rocks. Where quartz veins accompany dykes in the Walhalla and Aberfeldy district, the evidence is invariably to the effect that the igneous dyke-stone was injected into the fissures first, and the quartz veins formed afterwards. In the Walhalla and Donnelly's Creek mines the laminated quartz is usually the richest in gold and minerals. May not the laminated structure betoken a slow process of formation of the quartz, and consequently more opportunity for the segregation of the rarer minerals ?

In Mr. J. Cosmo Newbery's laboratory report (Progress Report No. IV.), he mentions the action of acid carbonate of ammonia on silica, and the progress of his experiments in that direction may throw great light on the question of the chemical conditions under which quartz veins were formed and the associated minerals deposited.

REGINALD A. F. MURRAY,
Geological Surveyor.

NOTES ON THE AURIFEROUS LEADS OF MIDDLE PLIOCENE AGE ON THE CRESWICK GOLDFIELD.

SUPPLEMENTARY to the report already furnished on the general geological conditions of the country in the neighborhood of the Creswick goldfield, it is proposed to give in the following paper an account of the drainage system of Middle Pliocene age, as far as it has been disclosed by the operations of the miner, with the addition of some speculative observations on its probable extension and trend. For the proper understanding of the physical description herein given it will be of assistance to refer to the geological map of the district, forwarded to the Office of Mines in March last.

The order of the leads enumerated below is taken by commencing on the west boundary of the survey (long. 143° 50′), and proceeding in an easterly direction to the east boundary of the sheet (long. 144°).

1. *The Sulky Gully Lead* takes its rise on the south, or seaward, side of the Main Dividing Range, crosses the latter after a north-westerly course of a little over a mile, and, assuming a westward direction, passes under the basalt near the Bible Christian Church. Only one shaft, 130 feet deep, has been sunk through the basalt. The lead then resumes its north-westerly course between the main range on the west and Sulky Gully on the east, and trends towards a probable junction with the Bald Hill Lead, immediately north of Mount Hollowback.

On its whole course, so far described, this lead runs parallel with, and nowhere more than a mile from, the Main Dividing Range. From Mount Pisgal westward this range consists of a series of volcanic points of eruption which have greatly modified the former surface configuration. The pre-Pliocene axis seems to have been considerably to the south, deviating from the present watershed at a point near the head of Petticoat Creek (*vide* Ballarat geological sheet), running first nearly west by Mount Rowan, then west-north-westerly to the site of Lake Learmonth, and thence to the granite range north of Ercildoun.

2. *The Bald Hill Lead* comprises several arms which spring in the Silurian ranges west and south-west of Fiddler's Gully. These ranges are abundantly traversed by reefs and veins of quartz, and in one or two places capped by thin layers of richly auriferous gravel, probably the redistributed remnants of Lower Pliocene (the oldest) drift. The different branches unite west of the Bald Hill schoolhouse, and the main lead has been worked thence westward to Sulky Gully. The gutter, which has been in parts extremely rich in nuggety gold, lies from 135 to 160 feet under the basaltic plateau. Several broad quartz reefs, from which auriferous specimens were freely obtained, intersect the bed of the lead channel on the last 500 yards of its worked course, and it may be fairly assumed tend to contribute towards the productiveness of the gutter drift for some further distance west. Owing principally, it is stated, to the costly labor of subduing a considerable influx of mine water, operations on this lead have not been carried on for more than 60 chains from the point of immergence under the basalt.

From the banks of the Sulky Gully the country to the north-west presents for many miles an unbroken sheet of lava, offering no features to indicate the position of the lead beneath it, to ascertain which must therefore be left to actual boring or sinking.

3. *The Cobbler's and Diamond Gully leads.*—The country drained by these leads and their numerous affluents is situate from one to two miles south-west of the township of Creswick, and consists of high Silurian ranges rather deficient in quartz veins. The courses of the leads are often identical with those of the modern valleys which frequently cut through and for considerable distances entirely supplant them. Below the junction of the two branches the main lead enters under the basalt west of Shicer Hill, and is again effaced by the broad valley of Creswick Creek. After uniting with the Long Point Lead it is traced under the basalt on the right bank of Creswick Creek, a short distance below Long Point. The course of the gutter thence is probably north-easterly towards the Red Streak Lead.

4. *The Red Gully Lead* has its source at the northern base of the Snake Hill ridge, and passing by the Hard Hill it is worked opposite Clarke's Hill under the name of White Flat Lead. The sinking is from 20 to 40 feet through clay and gravel, and the material of the gutter, being chiefly derived from the contiguous Lower Pliocene hills, is a well-rounded quartz boulder drift. It then receives the Pollard Gully Lead, and enters the basalt south-east of Union Hill. Thence it runs under the latter, crosses the Creswick Creek, and joins the Black Lead at the Quarry Hill.

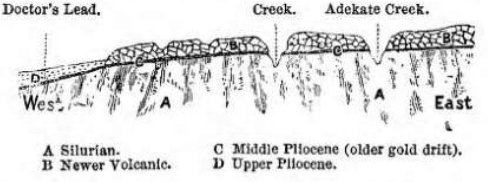
5. *The Nuggety Gully Lead* receives its auriferous gravels principally from Dutchman's Hill, Church Hill, and Hard Hill, and joins the Creswick Lead immediately east of the railway station in the township of Creswick.

6. *The Creswick Lead.*—This lead has been traced from the Dividing Range, where its sources are covered by the lava flow from Wombat Hill, Bungaree (*vide* Ballarat sheet), in a north-westerly direction for a distance of eight and a half miles. It evidently formed, in Middle Pliocene times, one of the main drainage channels, in the same way as the Creswick Creek of to-day is the principal watercourse of an extensive district. On the first four or five miles of its course the lead, greatly denuded and frequently cut through by the modern streams, runs generally within a few hundred feet of the banks of the Slaty Creek. Receiving the Long Gully Lead on the right, and the Milkman's Flat Lead on the left, it is capped at the Cabbage-tree Hill by a small outlier of basalt, and then sinks beneath the alluvial flat of Slaty Creek, under which it runs as far as Portuguese Flat, where it is joined by the Lincoln Lead. Passing in a straight north-westerly course of over a mile in length through the township it enters the basalt (under the name of Black Lead) at the base of Clarke's Hill, crosses the Creswick Creek some 130 yards above the railway viaduct, runs in a westerly course beneath the Slaughteryard Hill, then northward under Quarry Hill, and has been worked as the Red Streak Lead for upwards of a mile further north. A great deal of prospecting has been conducted to define the lead north of the Australasia Company's ground, and a series of bores have proved pretty conclusively that its position may be looked for some 150 yards west of the Consols No. 1 shaft, and an equal distance east of No. 2 shaft. The Cosmopolitan Company worked a tributary gutter (possibly the Long Point Lead) trending in a north-easterly direction towards a junction with the main lead, probably some 20 chains due north of the Consols No. 2 shaft. Beyond this point there is little guidance for further conjecture. It is generally accepted that the lead persists in its northerly course across the Glendonald Creek, half a mile west of the Green

Hill, and seeks a confluence with the Spring Hill Lead west of Wheeler's Bridge. Mr. Patterson, the late manager of the Cosmopolitan Company, who, from his observations at the most advanced point of the search operations has had the best opportunity of acquiring a clear perception of the surrounding features, is of opinion that the course of the gutter is a north-easterly one, leaving the Green Hill some hundreds of yards to the west. This is, comparatively speaking, a matter of detail, and its determination must be simply and solely left to the results of actual sinking. Before leaving this subject it is, however, well to mention one circumstance which has been hitherto altogether overlooked. From the western margin of the basalt, near the crossing of the Clunes road, a narrow belt of Upper Pliocene clay drift, betwixt smooth Silurian hills, stretches westward along the Glendonald Creek to the Creswick Creek. It is of considerable importance to know the depth of this deposit, for under the present uncertainty there is no gainsaying the supposition that the Australasian Lead may follow the course of the Glendonald Creek to its confluence with the Creswick Creek, and re-enter the basalt under the Racecourse Reserve. About three-quarters of a mile south of this point it has been ascertained by sinking that a wet lead, 120 feet deep, underlies the alluvial flat of the Creswick Creek. Owing to the narrowness of the Upper Pliocene deposit, immediately west of the Clunes road, it is possible that a single bore may suffice to determine its thickness; and, considering the importance of the problem, it is desirable that this work should be done in order to remove all doubts as to the direction of the main trunk lead.

7. *Doctor's Lead.*—The tongue of lava occupying the ridge which divides the Adekate Creek from the southern arm of the Back Creek no doubt covers, together with the two narrow basaltic outliers west of the first-named stream, an old lead valley, the existence of which has so far escaped the attention of the miner. Where the valley of the Adekate Creek and that of another watercourse, some 20 chains to the west, have cut through the basalt specks of drift gold and washed quartz pebbles have been unearthed by the ploughshare. The basalt terminates about a

Sketch-section showing probable eastern extension of Doctor's Lead.



A Silurian. B Newer Volcanic. C Middle Pliocene (older gold drift). D Upper Pliocene.

mile below the junction of the Adekate and Back creeks, and immediately to the west of it extensive goldworkings have laid bare the rich gutter drift of Doctor's Lead. The latter follows the southern bank of Back Creek, and, receiving on the north a tributary from Jackass Gully, has been worked uninterruptedly for a distance of somewhat over a mile to Lincoln Bridge, where its course is cut through by the Lincoln Gully. At this point a small portion of the lead, about 200 feet in length, still remains on the west bank of Lincoln Gully, just above its confluence with the Back Creek, after which it has been for a considerable extent entirely removed by the erosion of the present valley of Back Creek, in the sides and bed of which the Palæozoic rocks are everywhere exposed. At a distance of a little over half a mile

below Lincoln Bridge the lead drift re-appears in the left bank of the creek, and has been wrought thence under the name of George's Diggings, as far as Portuguese Flat, where it unites with the Lincoln Lead, and finally joins the Creswick Lead.

8. *Spring Gully Lead.*—This lead, under the name of Red Lead, takes its rise in many tributaries under the basalt on the southern slope of Spring Hill, and follows the valley of Spring Gully, gradually rising to an elevation of from 40 to 60 feet above the present creek bed. It receives the Surface Gully, Sawpit Gully, and Watson's Gully Lead on the left, while the southern declivity of the Silurian range on the right is now entirely denuded of any older drift which may have previously existed. On its lower course the lead becomes more and more denuded, and intersected by the modern valley; Shicer Hill, Turkey Hill, and Eastern Hill are detached portions of this lead. A junction with the Creswick Lead no doubt existed at one time, but it is now completely obliterated by modifications in the surface form brought about by later denudation.

9. *Separation Lead.*—The two branches of this lead, the Frenchman's and Mosquito Gully leads, spring at the western slope of Quartz Hill, and follow closely the course of the modern valleys to their junction, after which the main lead bears somewhat north of the present gully. The sinking here is through from 80 to 90 feet of gravel and clay drift. After crossing the site of the Clunes road the lead enters under the basalt, and joins the Black Lead at the Slaughteryard Hill, some 200 yards north of the railway viaduct.

10. The Upper Pliocene area, lying between Broomfield and Frenchman's gullies, and extending from the foot of the Armagh Reef Hill westward for about a mile, covers three or four flat leads which have been worked upon with varying results. The sinking on the eastern or higher portion is quite dry, and through 80 to 90 feet of sandy mottled clay with ironstone pebbles, over a bed two feet thick of auriferous quartz gravel. Further west a layer of basalt intervenes between the upper clay and the lead gravel; the sinking exceeds 110 feet, and from the large amount of water the ground is difficult to work, or at all events, conditions more adequate appliances than those hitherto used in this particular locality. The mines here have ceased to be in operation for more than 18 months without determining the downward course of the main gutter. The various lead branches no doubt unite into one main arm which, judging by the contour of the Silurian boundary, seems to bear first westward as far as the visible margin of the basalt, and then north-westerly towards the Consols Company's ground, joining the Australasian Lead probably east of their No. 2 shaft.

11. *The Spring Hill Lead.*—The source of this lead has been traced to the north-west slope of Spring Hill. Its material in quartz and gold seems to have been chiefly derived from the denuded caps of Armagh Reef and several quartz veins known to traverse the bed-rock beneath the lava of Spring Hill. Several rich feeders join the main lead from the Armagh Reef ridge. The first coming from the northern slope of Quartz Hill joins the main lead in the Western Lewer's Company's ground. The second descending in a rapidly-deepening course from the crown of the Armagh Reef Hill is traced to its junction in Robinson's Freehold. A third tributary, the Dan Ryan's Lead, springs from the northern extension of the Armagh Reef, and has its upper course denuded by the erosion of Broomfield Gully. It unites with the main lead in the Baron Rothschild Company's mine, close to its

southern boundary. Three or four branches worked by the Ryrie's Freehold and Carter's Freehold companies join the main gutter in Cameron's Freehold, but the various points of coalescence have not yet been clearly defined. The German Gully and Broomfield leads, after uniting in the Nelson Company's ground, probably have their junction with the trunk lead in Dyke's Freehold. On the north boundary of the Ryan's Junction Company's leasehold the basalt projects north-easterly some distance up the valley of a shallow watercourse. This projection is no doubt caused by the lava flowing into an existing *embouchure*, and it is probable that this channel, running in a south-westerly direction, may unite with the trunk lead at or near the south-west angle of the above company's leasehold. This company's workings are up to the present time the most advanced on the Spring Hill Lead. Beyond this point there are no artificial sections, and but few natural features to assist in indicating the onward course of the gutter. It is, however, likely that the Spring Hill Lead, joined by the De Murska Lead, will be found east of McDonald's Hill, and thence trend in a northerly direction under the plateau between the Toolaroop and Middle creeks.

Most of the quartz veins in the upper watershed of the Spring Hill Lead are cupriferous, and we find in consequence that fine, rolled grains of native copper are rather abundantly distributed through the lead gravels. With the exception of this and some titaniferous iron sand the Spring Hill and neighboring leads present a singular paucity of mineral adjuncts. The gold is of superior fineness, being generally over 23 carats; and in the Baron Rothschild mine it rises as high as 23⅓ carats, and brought 83s. per ounce in the market. The lead, as far as it has been wrought, has been extremely productive, although the layer of pay-gravel is confined within narrow banks. As an example of successful mining enterprise it may be stated that the length of the lead in the Baron Rothschild Company's leasehold is 1,400 feet, the whole of which was blocked-out in thirteen months, viz., from May 1875 until the middle of June 1876. During this period the produce of gold amounted to 14,387 oz. 10 dwt. 16 gr., realizing £57,175 1s. 11d.; out of which £12,910 11s. 1d. was expended in the purchase of engine and plant and the working of the mine, while £38,550, or £6 8s. 6d. per share was returned in dividends, besides £5,714 10s. 10d. paid in royalty to the landowner.

The depth of the gutter under the basaltic plains increases from 120 feet at the First Chance shaft (on the north-west slope of Spring Hill) to 270 feet at Dyke's Freehold. At the Baron Rothschild it is 181 feet; the section of the shaft, which lies 100 feet west of the gutter, is as follows :—

	Feet.
Surface soil	2
First rock	31
Burnt clay	8
Second rock	25
Yellow clay	24
Third rock	59
Total thickness of basalt	149
Black clay	18
Schist rock	48
Total depth of shaft	215

The gradient of the bottom of the lead becomes less rapid with the increasing distance from the source. In the Cumming's Freehold mine the bed of the gutter

has been levelled for a distance of 800 feet, and the fall observed is 20 inches in 100 feet, or 1 in 60. The banks of the lead are nearly throughout capped with gravel drift ("reef-wash") both older and newer than the lead gravels. An example of the older drift has been given in a previous report as occurring in the Carter's Freehold mine. In the Baron Rothschild ground there is a reef-wash on both sides of the gutter from 2 to 4 feet thick, extending in one place where a prospecting drive was put in on the the east 130 feet from the lead channel. Numerous trial washings were made from the deposit, but in no case was the yield of gold sufficient to defray the working expenses, and the work, therefore, was not persevered with. In the Ryrie's Freehold shaft, which lies some 500 feet south of the gutter, a non-productive reef-wash of considerable thickness was struck at 118 feet. In the Ryan's Junction shaft, beneath 145 feet of basalt, a similar wash, 23 feet thick, occurs. It is a white quartz pebble drift, the finer particles angular, the coarser sub-angular with a few rounded boulders up to 12 inches in diameter. This drift is completely barren, and lies 113 feet above the bed of the gutter. In the two last-mentioned instances there is little doubt that the gravel beds belong to the oldest (Lower Pliocene) drift.

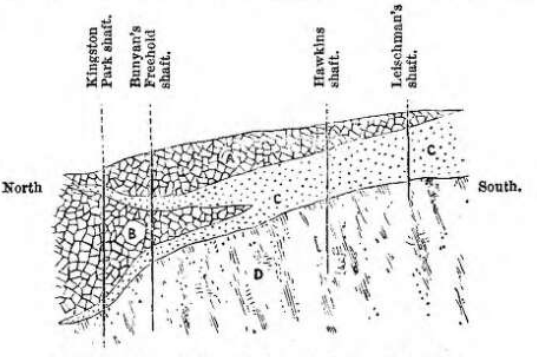
12. *Lewer's Lead.*—The sources of this lead have been traced along the northern slope of Spring Hill to within less than half a mile from its summit. Two branches, sunk upon by the Westcott Freehold and Royal Mint companies, proved the depth to be 115 and 100 feet respectively. The lead bears in a north-westerly course for 45 chains to Lewer's Freehold No. 1 shaft, then northerly 65 chains to the west boundary of Bunyan's Freehold, and finally north-east 30 chains to its confluence with the Hawkins Lead, some 240 yards north-west of the Kingston Park shaft—making the total length of this lead one and three-quarter miles. The fall of the gutter bed on the first 92 chains is nearly the same as that of the present surface, the average depth of sinking being 110 feet. The lead channel on this distance is from 20 to 30 feet wide, confined within steep walls, and holds a thickness of from 4 to 7 feet of auriferous gravel. At the Richardson's Junction mine, the lower half of the gravel stratum is cemented. At a distance of 250 feet north of this company's shaft the bed of the gutter begins to fall rapidly at the rate of 3 feet in 100. A black clay overlies the drift, which changes its former appearance of a clean white quartz gravel to a dark-colored compound of quartz and black sandy clay, while the lead suddenly expands to a width of 150 feet. Simultaneously with these changes a greatly increasing amount of drift-water was observed, while the productiveness of the gravel diminished in a manner that it was considered expedient to abandon the mine, leaving some portions of the gutter untouched. Subsequently the lead was worked upwards by the Kingston Park and Bunyan's Freehold companies. The changes noticed in the Richardson's Junction mine are probably due to the conflux of one or more tributaries which, however, cannot command any great watershed. At the confluence with Hawkins Lead the gutter is about 180 feet deep, while the level of the surface differs but slightly from that of the Richardson Junction shaft, where the depth of the gutter is 112 feet.

13. *Hawkins Lead.*—This lead is first met with on the north-east slope of Spring Hill, at a depth of 120 feet, and trends in a direction slightly west of north through the mines of the Costello Freehold and Leischman's Reserve companies, where it is joined on the left by a branch lead worked by the Sovereign Company. The depth of sinking here is 108 feet. Continuing its northerly course the lead is

successfully wrought by the Clark's, Hawkins, and Bunyan's Freehold companies, at depths varying from 130 to 185 feet below the surface ; after which it assumes a north-west direction through the Kingston Park mine, where it absorbs the Lewer's Lead, and has recently been touched upon by the De Murska Company, about 300 feet south-west of their shaft, the depth being 198 feet beneath the basaltic plain. From here the lead probably trends north-westerly, south of Birch's Bald Hill, towards the Bullarook Creek, near Wheeler's Bridge.

The lava covering this lead occurs in two sheets, the southern extent of which

Sketch-section showing occurrence of Lava Streams at Hawkins Lead.



A First rock. B Second rock. C Clay. D Schist.
Scale { Horizontal 40 chains to the inch. Vertical 200 feet to the inch.

has been ascertained in the several shafts as shown on the annexed section. The gutter in the southern part of the Bunyan's Freehold mine varies from 20 to 60 feet in width, and is bound within steep banks. The depth of washdirt is from 5 to 8 feet. Near the north boundary of the freehold the width increases to over 100 feet. Along the east side occurs a terrace on an average 7 feet above the gutter, capped by an auriferous reef-wash, 2 feet thick, the working of which has yielded satisfactory returns. On the west side numerous small tributary channels join the main lead, but the gold they contain proved insufficient to pay working expenses. In the Kingston Park mine the eastern bank of the gutter is generally steep and bare, while on the flat western bank rests a gravel capping 20 to 30 inches thick, with a lateral extent of upwards of 200 feet. This reef-wash is not remuneratively auriferous. The width of the gutter in this mine averages 100 feet, and varies from 70 to 200 feet. In the De Murska mine a similar reef-wash, 2 to 3 feet in thickness, occurs at a depth of 163 feet in the shaft, and is again met with at a distance of 220 feet south of the shaft, at a 36-feet lower level, whence it has been followed for 180 feet westward. Gold has been freely observed throughout, but as the mine is not yet in a sufficiently advanced condition an estimate of the value of this deposit would be premature.

14. The existence of a deep channel has recently been established by the Bank of England Company's shaft, sunk on the south-east slope of Spring Hill. There is a probability that this lead will bear northerly for about a mile in the direction of the Kingston road, and thence north-westerly towards Birch's Bald Hill in the neighborhood of which it is likely to join the Hawkins Lead. The fact of deep ground having been struck in the eastern prospecting drive, off the Colthard's

Company's shaft (half a mile south-west of Kingston), lends strength to this supposition.

15. About three-quarters of a mile north-west of the village of Bullarook, in the valley of the Bullarook Creek, a bore was sunk in the year 1865, of which Mr. Gore supplies the following particulars :—

	Feet.
Three courses of basalt (the last an extremely dense rock), separated by layers of clay	200
Black and light-blue clay, with fragments of quartz	10
Quartz gravel, with large boulders of quartz	8
Bottomed on sandstone at	218

Four specks of gold were obtained out of the bore-meal, from the lower gravel drift. The flow of water was very strong, and rose with a considerable pressure several feet above the natural surface. The cost of the work was £400.

The banks of the creek are from 80 to 100 feet above the surface of the bore ; the thickness of basalt, therefore, cannot be less than 300 feet at this place.

It is generally assumed that the deep ground discovered here is a continuation of the Rocky Lead. The Geological Survey not having extended to that locality, there are no present means of examining into the correctness of this view.

FERDINAND M. KRAUSÉ,
Geological Surveyor.

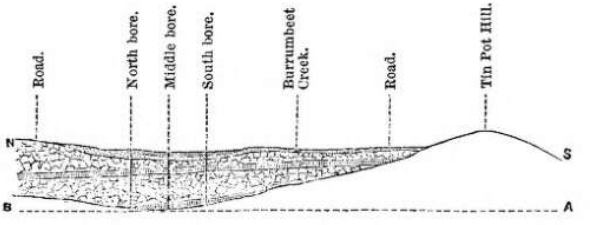
Daylesford, April 1877.

GEOLOGICAL SURVEY OF LEARMONTH.*

Supplementary Notes by Norman Taylor.

Particulars of Bores Sunk by Mr. Bath.

North Bore.	ft.	in.	*Middle Bore.*	ft.	in.	*South Bore.*
Alluvial, &c. ...	15	0	Alluvial, &c. ...	20	9	Depth 113 feet 2 inches.
Basalt	22	8	Basalt	16	0	No particulars.
Clay, &c.	16	6	Alluvial, &c. ...	17	3	
Basalt	72	6	Basalt	66	2	
Reef	0	7	Alluvial, &c. ...	10	4	
	127	3		130	6	



There is a probability that the leads of the City of Ballarat and Great North-West companies may trend north-westerly, and nearly follow the course of the

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* *Vide* Report of Progress of Geological Survey of Victoria, No. IV.

Burrumbeet Creek, through the southern portion of the sheet; thence passing southerly towards Lake Burrumbeet and Carngham, where an accession of gold would be obtained from the Silurian ranges passed through in that locality. The Burrumbeet Creek is about 250 feet below the level of the top of the City of Ballarat Company's shaft. This is, I believe, about 400 feet deep, leaving 150 feet to reach the bottom, which, in the absence of true levels, is very nearly the depth of Mr. Bath's bores. The lead would most likely be found a little to the north of these bores. Tributaries would come in from the north and east, but the former would not be auriferous, for the whole country in that direction below the basalt must be granite, as proved by the ejected masses of granite on all the volcanic points of eruption as far east as Mounts Cavern and Blowhard.

CATALOGUE OF ROCKS AND MINERALS COLLECTED WITHIN THE AREA OF THE GEOLOGICAL SURVEY OF LEARMONTH, BY NORMAN TAYLOR.

No.			
4611.	R.	1.	Fine-grained Ternary granite.
4612.	R.	2.	Dense dark-colored basalt, enclosing oligoclase. Some parts are scoriaceous, and enclose microscopic crystals.
4613.	R.	3.	Quartz, from reef under Mount Bolton West (E. of), with a steatitic clay.
4614.	R.	4.	Light-brown fine-grained Ternary granite, from a hill south of Mount Bolton West.
4615.	R.	5.	Quartz, from Middle Reef, Mount Bolton West, arranged in thin plates intersecting one another, like false bedding, and having a porcelain-like appearance. Quartz crystals occur in lenticular cavities.
4616.	R.	6.	Quartz, from Eastern Reef, Mount Bolton West, showing the structural planes of growth. The crystals have their apices pointing towards the centre of the vein.
4617.	R.	7.	Quartz, from reef near Bald Hill, showing same as above. The crystals have a radiated structure.
4618.	R.	8.	Basalt, from Bald Hill, hackly fracture, mottled light-grey and slate-colored, enclosing green olivine, slightly magnetic.
4619.	R.	8A.	Basalt, from Bald Hill, scoriaceous, enclosing olivine and a decomposed felspar.
4620.	R.	9.	Basalt, from north-west of Bald Hill, finely scoriaceous, enclosing olivine and oligoclase.
4621.	R.	10.	Dyke in granite; a dense dark-colored hackly fractured tough felspathic basalt, slightly magnetic.
4622.	R.	11.	Nodule of concretionary basalt from Mount Beckworth Creek, Amherst road. Several occur in the same concretion.
4623.	R.	12.	Basalt, highly felspathic, porphyritic; encloses olivine, and in the cavities aragonite; from creek under granite hill, on north sheet line.
4624.	M.	13.	Minerals from volcanic ash, on hill in north-east corner of survey, consisting of crystalline fragments of hornblende, oligoclase, and basaltic glass.
4625.	R.	14.	Dolerite, occurring as thick horizontal beds, Creswick Creek; vesicular, and contains hornblende and plates of specular iron.
4626.	R.	14A.	Subcrystalline, grey felspathic basalt, from Creswick Creek.
4627.	R.	15.	Basalt, from lowest visible flow on a tributary of Creswick Creek, containing agatiform ferro calcite, like the Barfold (Campaspe) basalt.
4628.	R.	16.	Dense grey felspathic (porphyritic) basalt, polar magnetic, from east side of Coghill's Creek.
4629.	R.	17.	Grey porphyritic basalt, with oligoclase and zircon (in red ring), slightly magnetic, from south-west of Coghill's Creek village.

4630. M. 18. Calcite, or aragonite, from west of Coghill's Creek P. R.
4631. R. 19. Tertiary grit, ferruginous, with granite detritus of quartz and felspar, from three-quarters of a mile south-west of Coghill's Creek village.
4632. R. 20. Scoriaceous basalt, with hyalite and dense anamesite, with olivine, from road north-east of Tinkler's Hill and south-east of village.
4633. R. 21. Red volcanic ash, with imbedded scoria, from One-mile Hill.
4634. R. 21A. Anamesite, with olivine, from One-mile Hill.
4635. M. 21B. Scoriaceous basalt, with minute crystals (in red rings), from One-mile Hill.
4636. R. 22. Ejected granite, from south-east of Vaughan's Hill.
4637. R 23. Porphyritic basalt, with olivine, from south-east of Vaughan's Hill and Tinkler's Hill.
4638. R. 24. Obsidian (?), from Vaughan's Hill.
4639. R. 24A. Olivine (?), from Vaughan's Hill.
4640. R. 25. Flesh-colored fine-grained Ternary granite, from Mount Bolton East.
4641. R. 26. Quartz, with pholeritic mineral, from reef under (south of) Mount Bolton.
4642. R. 27. Grit, with granite detritus, and wood, from road north of Webster's Hill.
4643. R. 28. Volcanic ash, from Webster's Hill.
4644. R. 28A. Vesicular basalt, with oligoclase, from Webster's Hill.
4645. R. 28B. Ejected granite, from Webster's Hill.
4646. R. 28C. Porphyritic basalt, slightly polar magnetic, from Webster's Hill.
4647. R. 28D. Finely scoriaceous basalt, showing lines of flow, from Webster's Hill.
4648. R. 29. Ejected granite, enclosed in basalt, from near 16-mile post on Avoca road.
4649. R. 30. Grit formed of mixture of volcanic and granite detritus, from Lexton road, near Addington Hotel.
4650. M. 31. Orthoclase, from granite outcrop in Ercildoun range.
4651. M. 31A. Schorl, felspar crystals, and hexagonal mica, from same locality as 4650.
4652. R. 22. Finely scoriaceous grey basalt, with hyalite, and slightly magnetic, from south-east foot of a hill in Ercildoun range.
4653. R. 33. Fine-grained conchoidal fractured grey basalt ; the flat pieces show numerous minute prismatic crystals of felspar (?), all running in one direction.
4654. R. 34. Dense grey slaty and porphyritic basalt, from south end of Ercildoun range.
4655. M. 34A. Basalt, with aragonite, hyalite, hornblende, and ferro calcite.
4656. R. 35. Earthy ferruginous conglomerate, from flat east of Lady Mount.
4657. R. 36. Smoky crystallized quartz, from scattered blocks of granite, from Lady Mount.
4658. R. 36A. Portions of rounded tabular pieces of hard indurated sandstone, from Lady Mount.
4659. M. 37. Orthoclase, from dyke in road cutting north-west of Stony Rises.
4660. R. 38. Fine-grained basalt with conchoidal fracture ; shows numerous minute prismatic crystals of felspar (?), all running in one direction ; from west of Stony Rises.
4661. R. 39. Large-grained coarsely crystallized granite, nearly all felspar, with a little quartz and large oblong flat plates of black mica, from Stony Rises.
4662. R. 39A. Crystallized quartz and felspar, from Stony Rises.
4663. M. 39B. Schorl, felspar, and quartz crystals, from Stony Rises.
4664. M. 39C. Granite, coated with hyalite, from Stony Rises.
4665. R. 40. Epidotic vein in granite, from north of Stony Rises.
4666. R. 41. Ferruginous mammillated coating of oxide of iron, common everywhere on the drift cement boulders.
4667. R. 42. Volcanic ash, enclosing scoriæ, &c., from a cutting in road near Brown's Hill.
4668. R. 43. Angular and rounded drift quartz and sandstone, resting everywhere on basalt from high to low.
4669. R. 44. Grey vesicular basalt, very polar magnetic, from Bawkins Hill.
4670. R. 45. Fragments of rounded and angular quartz of various colors, transparent, red, and white ; cement, jetty basalt, and an apparently recent marsupial tooth ; from Sandy Beach, on north shore of Lake Learmonth.
4671. R. 46. Coarse grit, cemented by lime, occurring in banks of Lake Learmonth.
4672. R. 47. Rounded quartz pebbles, occurring on the basalt east of Bawkins Hill.

4673. R. 48. Portion of sandstone pebbles.
4674. R. 49. Finely vesicular basalt in layers, from east side of Sharp's Swamp.
4675. R. 50. Very vesicular basalt, rich in olivine ; part of the olivine is enclosed in oligoclase ; from road west of Mount Cavern.
4676. R. 51. Very vesicular basalt, with olivine, oligoclase, and hyalite, from road south-east of Mount Cavern.
4677. R. 51A. Very vesicular basalt, with oligoclase, from Mount Cavern.
4678. R. 51B. Fragments of probably granite, from Mount Cavern.
4679. R. 51C. Basalt, with enclosed mineral, from Mount Cavern.
4680. R. 52. Clayey and ferruginous brecciated quartz conglomerate, with semi-angular quartz.
4681. R. 53. Red shale, Creswick road.
4682. R. 54. Ferruginous clayey volcanic conglomerate, containing round quartz and fragments of ash and scoriæ. Some specimens on basalt are strongly magnetic, with or without polarity, whilst others are not magnetic. Ascot.
4683. R. 55. Scoriaceous basalt, from top of Mount Pisgal ; portions more like volcanic ash enclose olivine, oligoclase, and hyalite.
4684. R. 56. Dense grey polar magnetic basalt. Wall of Mount Blowhard crater.
4685. M. 56A. Hyalite. Wall of Mount Blowhard crater.
4686. R. 56B. Earthy basalt, with felspar and red spots.
4687. R. 57. Scoria, enclosing granite and another mineral, from road west of Mount Blowhard.
4688. R. 58. Ejected granite from Mount Blowhard, used for road metal on road south of Ascot Mill.
4689. R. 59. Ferruginous conglomerate, enclosing quartz, and resting on basalt, from three miles down Ballarat road.
4690. R. 60. Dense fine-grained basalt, from south-east of Bath's selection.
4691. R. 61. Quartz and ironstone clayey conglomerate, from three-quarters of a mile north-east of Burrumbeet Station.
4692. R. 62. Scoria, from Mount Weatherboard.
4693. R. 62A. Volcanic bomb (?), from Mount Weatherboard.

REPORT ON SPECIMENS Nos. 4637, 4629 (4).

Since my report on the Learmonth specimens Mr. Ulrich has made a microscopic examination of thin sections of the above numbers, and has given me the following description :—

No. 4637 (R. 23), black dense basalt of rather dull aspect, rendered porphyritic by opaque regular and irregular crystalline grains of felspar, a few glassy quartz grains, and greenish grains of olivine. The reactions of the rock, when examined under the microscope, prove it to consist mainly of an isotropic brown glass base, in part dentrified, and full of microlites of plagioclase, small grains of olivine, and crystals of magnetite (titaniferous iron ?), showing in arrangement fluidal structure. The glassy particles porphyritically distributed prove to be quartz ; the opaque (felspathic) have an entire absence of twin striations and colored bands in polarized light, which points to their belonging to a monoclinic or orthoclastic system ; and this result is confirmed by an examination of the mineral by flame reactions, according to the method of Professor Szabo, which unmistakably proves it to be potash felspar, either orthoclase or sanidine : its opaqueness and general aspect point to the former. As orthoclastic felspar is extremely rare in basalt, and when found has been identified as sanidine, the occurrence of true orthoclase in this instance

must appear more strange and interesting ; but, considering that Mr. Norman Taylor states in his report that this basalt comes from a point of eruption which has broken through a deposit of granite detritus, and taking this into consideration with the association of the felspar with quartz grains, the probability is that both were taken up by the fluid lava on its passage through the detritus, though their uniform porphyritic distribution would remain an unexplained and very curious fact.

No. 4629 (4) (R. 17), light bluish-grey anamesite, rendered slightly porphyritic by irregular colorless transparent patches of striated felspar and of yellowish-green olivine. The rock inclines in aspect more to the trachytic than the basaltic series. An examination of thin sections by the microscope proves the felspar to be, without exception, plagioclase, and that there is a great deal of isotropic clear glass base present in larger or smaller portions of irregular outline between the crystalline minerals. Olivine is present in quantity, occasionally in nearly perfect, though much fractured, crystals ; magnetite, or titaniferous iron, sometimes in octahedral crystals, but mostly of irregular outline ; augite very scarce, in light-brown irregular crystals ; an examination by flame reactions proved the felspar to be labradorite.

J. COSMO NEWBERY, Analyst.

REPORT ON AN OUTCROP OF GRANITE, EAST OF BUNINYONG.

SIR,

In accordance with your instructions, received on the 31st March, to follow out the granite boundary at Buninyong in its continuation eastwards from Mr. Murray's Ballarat goldfield map, I proceeded to Yendon (late Buninyong East) on the 5th April, and commenced the work. I soon saw the impossibility of making anything like a sketch-map of the country on the half-inch to a mile scale, on account of two or three surveys not appearing on the county map, and the country itself being of too complicated a character to record any facts worth observing on so small a scale; I accordingly did the geological work on the two inches to a mile scale, after obtaining all the requisite surveys from the Ballarat Survey Office, omitting, as I at the time informed you, all mere topographical work not absolutely necessary to the correct delineation of the boundaries of the rock masses themselves. The time of the year selected for working in a wet district like Buninyong was unfortunate, as it has been almost incessantly wet, and the country flooded. The field work was finished on 1st June, and the remaining time has been occupied in plotting it.

I have now the honor to forward the finished plan with indices to the notes not on the map, and the few rock specimens collected. As I was not informed for what purpose this work was intended, I am rather at a loss as to what is required to be reported upon, or if, indeed, any report is needed. A few observations, however, in addition to the facts shown on the map may not be out of place.

The granite appears to have occupied a large basin in the Silurian rocks, formed by the prolongation of the Buninyong and Clarendon ranges on the west and south-west, and the Mount Egerton ranges—through which Ben's or Woolan Creek

and the Moorabool River have cut their way—on the east. This lower (in regard to the Silurian) granitic area was subsequently overflowed by lava streams, some of which *apparently* have not taken the lowest levels. This is to be accounted for by the granite—which now remains uncovered, and was, at the time of the flow, at a higher level—having, from its easy decomposibility, suffered greater denudation than the harder basalt, and been reduced to a lower level. Some of the present exposed granite areas have no doubt also once been covered by the basalt (as proved by several outliers), which has since been entirely swept away. The area of granite shown on the map is evidently a part of the same mass as that at the Gong Gong reservoir, being merely separated from it superficially by the basalt overflows from Mount Warrenheip to the north-west. Some further extension of the granite may possibly occur farther north, towards Bungaree and the Great Dividing Range.

The granite boundary on the north flank of the range to the south-west is quite an arbitrary one, having been only approximately determined by the contour of the Silurian hills. With the exception of the two spots marked "granite" on the map, there is no other sign of it in its massive state, the surface drift being the only indication of its presence, and that consisting more of a reef detritus than of a granitic one. No granite is visible east of Smith's Hill. The surface on the flanks of this basaltic hill is covered with blocks of hard ferruginous grit and silicious cement, and it is most likely that the flow does not end abruptly, as shown by Mr. Murray, but that it underlies this Tertiary deposit, outcrops again in Yendon, and thence flows down and under the large Tertiary flats to a junction with the south-east flow from Mount Warrenheip, which has caused the sudden right-angular bend of the Lal Lal Creek. I believe that the area which I have colored as granite and dotted with Tertiary, in the south-west corner of the township of Yendon (to assimilate it with Mr. Murray's sheet) would be found to be, were there any wells to show it, basalt overlaid by drift. The same holds with the south-east foot of Smith's Hill in Mr. Murray's sheet. In all the remaining portions of the district the granite is well developed, forming either low or tolerably high ranges among the basalt flows. The granite boundary along the courses of the Moorabool River, and the Black and Ben's creeks is much obscured by the talus from the basalt escarpments. Here and there, on the Black Creek especially, landslips have exposed the underlying granite. The banks of these two creeks, which stretch backwards on the eastern in a long—but on the western sides in a steep—slope to the basalt plains, are covered by drift sand, utterly destroying any evidence of what lies below. This has been caused by the sudden turn of the river to the south, and the consequent rush of water against the eastern banks, during the first period of its channel-cutting.

Little need be said about the basalt flows, the courses of which will be seen on the map. They have their source in Mount Warrenheip and the Black and Green Hills. I believe that the basalt fills the valley running south-east from Yendon, and now covered by Upper Pliocene deposits, up to or near the boundary of the latter, as shown on the map, and of course overlying the granite. The height of the plains at the junction of the Lal Lal Creek and the Moorabool River is about 250 feet above the bed of the river, and between this and the Moorabool Falls, and below the smaller granite falls, it is possible that the basalt crosses the river; but the precipices are so abrupt that I was unable to determine the question. The height of the Lal Lal Falls is 110 feet, to which must be added about 30 feet

above them to the top of the cliff. The bottom of the basalt is not visible under the falls, and from this great thickness of lava it is hardly probable that it ends so abruptly as it appears to do. It must underlie the swamps and flats towards Lal Lal, but any evidence in that direction I could not obtain.

In Mr. Ulrich's Descriptive Catalogue of the Rocks of Victoria, 1875, p. 106, the Lal Lal lignite is described as being 115 feet thick, above which is about 73 feet of alternating sand, clay, and gravel (the lower three feet fire-clay).

In the Descriptive Catalogue of Rocks, &c., in the Mining Department, 1875, p. 67., the lignite shaft is described as being sunk 200 feet—60 feet surface (what, is not mentioned), 128 feet of lignite, 5 feet of clay, 8 feet of lignite, and another seam below, unprospected.

In Mr. Selwyn's Exhibition Essay, p. 79, the lignite is stated by Mr. Ulrich to occur "in the Miocene Tertiary formation of Lal Lal," his opinion being based apparently on the occurrence of coniferæ, but their age has not as yet, I believe, been decided.

In none of these instances is there any mention of a bottom rock; and I could obtain no information on the spot, as the works were closed, and the shaft half full of water, with only a man in charge.

Now, considering that the basalt at the falls is of the thickness stated, and apparently flowing southerly, as indicated by the fall of the country, and nothing but a level swampy country intervenes between it and Lal Lal, what has become of this basalt flow, and also of that coming down the valley from Yendon? They could hardly dip rapidly enough (it would require, by calculation, a fall of 94 feet in a mile) in so short a distance as to underlie the lignite; and if they did, and supposing the flows to be newer basalt, then the lignite cannot be Miocene.

In the geological sketch-maps of the colony by Mr. Selwyn and Mr. Smyth the basalt is shown all round Lal Lal and for some distance to the south. In Mr. Selwyn's sketch-section he says :—"Near Lal Lal Falls the Tertiary sands are at the surface. Several shafts have been sunk through sand and clay and through a bed of lignite 120 feet thick. Gold-bearing drifts would very likely be found under the lignite in this basin. * * * * The age of the lignite is at present (1866) uncertain; if Miocene, and the same age as the 'Golden River's' basin, gold deposits will not probably underlie it."

Under the circumstances it seems more than probable that the Yendon and south-east Warrenheip flows, becoming narrowed to about a mile in width, have turned north-easterly, and crossing between the two falls have turned easterly, and gradually round to the south, after joining other flows from the north-west, and then down the east side of the Moorabool Valley. The apparent fall from north to south between the Moorabool and Lal Lal falls is probably due to the scour of the Lal Lal Creek while cutting its passage. At note 14 is probably the outlet of the underlying lead, and notes 12 and 18 are possibly portions of the same.

The depth of the sinking at Lal Lal still requires explanation, and if the above solution of the course of the basalt flow be the correct one, there must be a sandstone bar or ridge running across between the basalt and the basin containing the lignite.

The elevation of the basalt plains above the river and creeks to the east is about 150 feet in their upper, and from 250 feet to 300 feet in the lower part of their course.

The drifts colored yellow on the map may very likely require modification. Those round Yendon are at a slightly higher elevation than the Newer Pliocene down the valley, but otherwise there is nothing to show their relation to the other rocks. In other places to the north where they occur, they persistently follow the basalt edge and have the appearance of underlying it. Those at notes 14 and 18 on the map—one of which is cut through by a road—I think will certainly be found to underlie the basalt.

Some leads must certainly occur under the basalt flows, fed on the one side by the Ballarat ranges, and on the other by the Egerton and Gordon ranges. A very likely-looking surface wash of rounded quartz pebbles occurs at Note 40. A deep lead probably crosses Ben's Creek in the narrow gap of 15 chains between the outcrop of Silurian, and another may pass under the narrow strip of basalt near note 45. The whole of the land, however, is purchased property.

The large round swamps about Lal Lal are surrounded by sand ridges, generally covered with brake-fern and present a very coast-like appearance.

In conclusion, I may state that the greater part of the boundaries had to be traversed on account of a large portion of the country being held by Messrs. Fiskin and Bacchus in large blocks, and none of the survey lines being fenced.

I have the honor to be, Sir,
Your most obedient servant,
NORMAN TAYLOR,
Geological Surveyor.

Thos. Couchman, Esq.,
Secretary for Mines, &c., Melbourne.

CLUNES GOLDFIELD.

Sir, Clunes, 31st October 1877.

I have the honor to forward the annexed report on the progress of the geological surveys under my charge for the year ending the 30th September 1877.

I have the honor to be, Sir,
Your most obedient servant,
NORMAN TAYLOR.

Thomas Couchman, Esq.,
Secretary for Mines, &c., Melbourne.

REPORT.

On the 20th October 1876 I sent in my report of progress for the year ending the 30th September 1876. I was then engaged in finishing the field work of the Learmonth sheet. On the 24th February 1877 I finished and sent in the map of that sheet with some additional remarks, the report having been previously sent down for publication in conjunction with the progress report. On the 26th February I forwarded a collection of rocks and minerals, with full descriptive indices; and

on the 27th commenced plotting the Clunes sheet, which I had been instructed to survey geologically. On the 31st March I received a letter with instructions to survey the granite boundary in the neighborhood of Buninyong East (Yendon), and on the 5th April I proceeded to Yendon to carry out these instructions. On the 2nd June I had finished the field work there, and on the 4th July sent down the map and report. On the 16th and 17th July I was occupied in moving to Clunes, since which time I have been partly engaged in continuing the plotting of the Clunes sheet, which has been a work of considerable difficulty, as, owing to the very insufficient data at my command, I had in many instances to examine the surveys on the ground ; and have finished the field work of about one-sixth of the area of the sheet (84·267 square miles).

It would be useless for me to attempt to report upon a district of which, at present, I know so little, and have been for so short a time engaged upon ; but I think it is highly probable that the survey here will throw a good deal of light upon the trend of the deep leads, about which there is much speculation. That they are continuations of the Creswick leads I have little doubt, although the general opinion here is that they are entirely local. The very much rounded or waterworn character of the quartz, however, precludes the latter idea.

The lead worked in the New Lothair Company's Lease has been long since abandoned, and the only workings now are almost too poor to be continued with any profitable result, averaging only from ¾ dwt. to 1 dwt. per load. The lead is supposed to come from the north-west, as the Theodora Company, 13 chains north-west of the New Lothair shaft, reached bottom at 233 feet, while the latter company bottomed at 242 feet, and the lead bottom, to the east of the shaft, is about 256 feet. If this should be the case, and it is the exact reverse of the trend of the existing watercourses, it will be merely a tributary of the main leads from Creswick, which must underlie the plains to the eastward. The lead is very flat and of variable width, with a high bar on its eastern side. Nuggets of native copper and concretionary masses of oxide of manganese occur, the latter in considerable quantities, as also fine copper dust. I cannot help thinking that the above measurements and levels are not reliable, and that, were an accurate survey made, it might be found that the lead went in the contrary direction.

Another lead, with drift of the same character as the New Lothair, was touched at 1,000 feet east of the old Oriental Company's shaft, long since abandoned, under about 170 feet of basalt.

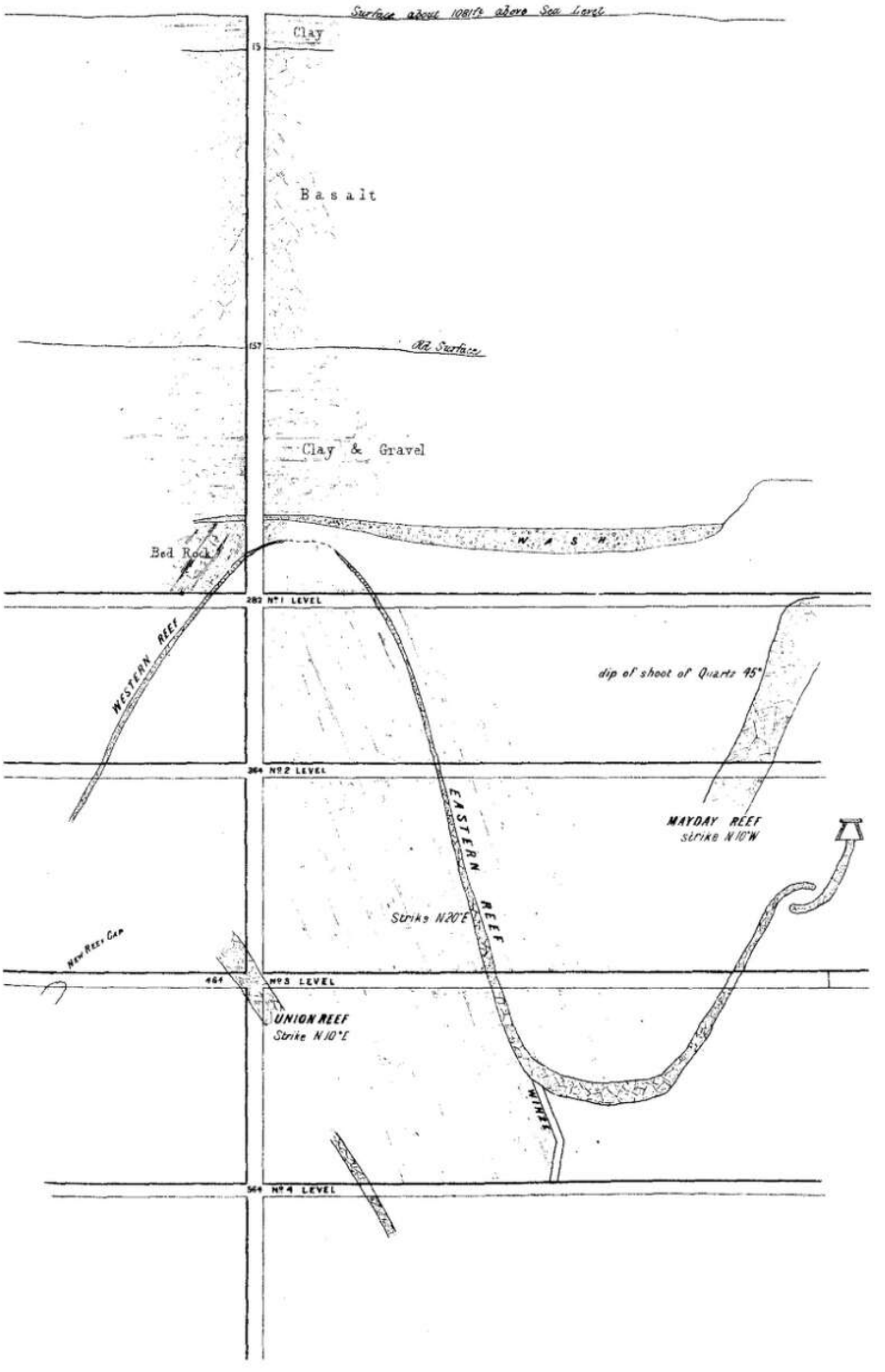
The so-called leads in the pre-emptive section, or the "paddock," are merely local reef-washes, old "surfacing" in fact, now covered by basalt.

The basalt, as taking the lowest levels, will, to some extent, indicate the course of the leads, and until that boundary is accurately mapped it would be useless to speculate on the subject. In some places where the basalt is narrowed to a width of about half a mile, as between the cemetery and the pre-emptive right, and again on the edge of the Mount Beckworth granite, it would be decidedly advantageous to bore ; but it would be extremely difficult and expensive to find (except accidentally) the lead or leads which must underlie the widely extended basaltic plains to the east of Clunes.

The reefs are all "saddle reefs," and the accompanying section, reduced from a plan kindly lent by Mr. J. Bryant, the manager, shows their mode of occurrence in the New Lothair Company's mine. The reefs occur apparently along the cap of a

Section of the **NEW LOTHAIR G.M.C^os** workings looking North

Scale 80ft to One Inch



ridge forming an anticlinal axis, with a synclinal to the eastward, in which the deep lead is shown. Further sections will be given in my full report on the sheet when finished. Native copper (moss copper) occurs in the above-mentioned mine, and much of the quartz is discolored by blue and green carbonates. Zinc blende, galena, copper pyrites, and cubic and arsenical pyrites, occur sparingly.

The "country" consists generally of thin-bedded aluminous sandy beds with cubic pyrites, shales, and mudstones, with occasional hard bands of slate and metamorphic schists.

No dykes occur in the reefs, either granitic (elvan) or basaltic (lava streak).

NORMAN TAYLOR,
Geological Surveyor.

NOTES ON THE GEOLOGICAL SURVEY OF DAYLESFORD.

Progress of Survey.

The area comprised within the survey is about 140 square miles. It lies to the east of the 144th meridian, and includes the parishes of Bullarto and Wombat, and a great portion of the parishes of Glenlyon, Holcombe, Franklin, Bullarook, and Korweinguboora, in the counties of Talbot, Bourke, and Grant. Nearly one-half of the area of the sheet is in unsurveyed country, and this is for the most part extremely rugged and thickly wooded. It would have been impracticable to carry on the survey over so large a tract without the aid of some fixed lines as bases, and to meet this deficiency I have provisionally surveyed somewhat over five miles of connecting lines between Wombat and Bullarook. The survey is divided into two parts: the northern half-sheet being at present in progress, and the skeleton map for field purposes has been compiled. In addition to numerous traverse surveys and preliminary examinations I have filled in the details of four square miles in the parish of Bullarook, and fifteen square miles in the parishes of Wombat, Glenlyon, and Bullarto. The latter area presents both geologically and topographically some of the most intricate features I am acquainted with on any of the goldfields. Owing to the natural obstacles offered in the ruggedness of the locality, and the difficulty of obtaining precise and trustworthy information respecting important features uncovered by former—now abandoned—mine operations, the progress of the survey in the part completed has been necessarily slow. Less difficulty, at least with regard to the last point, is anticipated in the future, as a mass of mining information has been collected over a considerable portion of the sheet.

The rock formations represented in the area under survey are principally Lower Silurian, Newer Volcanic, the Upper Tertiary gold drifts, and Post-Pliocene.

Palæozoic Rocks.

It is apparent from the persistent westerly dip of the Lower Silurian rocks in the country between the Loddon and Daylesford that the uppermost beds are exhibited on or in proximity to the meridional range, of which Wombat Hill forms a conspicuous point. The beds thence westward become considerably folded and

fractured (*vide* Fig. 1), and with them the principal auriferous quartz veins are associated. The flags in these upper beds, consisting of light and dark grey, almost black, shales, abound in graptolites (chiefly *Graptolites fruticosus* and *Phyllograptus folium*). The finely-granular, greyish-yellow, sandstone in the neighborhood of Daylesford is being occasionally used as a building stone for rubble work. An indurated sandstone, almost passing into quartzite, is met with near the basalt boundary at Leitch's Creek. On the left bank of the lower part of Wallaby Creek occurs a coarse brown quartz grit (R 1), lithologically resembling the Tertiary conglomerates in other localities. The general strike of the beds in the latitude of

FIG. 1.

Sketch-section showing Lower Silurian Strata, Wombat.

Wombat Hill is from 16° to 22° west of north, approaching further north more and more to the magnetic meridian.

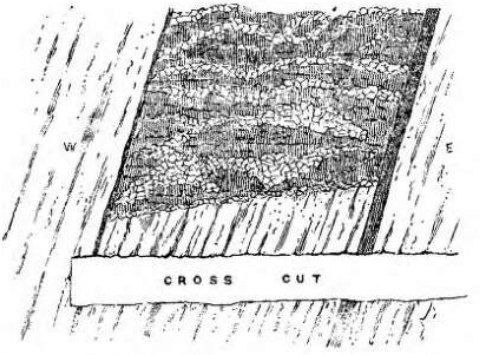
QUARTZ VEINS.

The auriferous quartz veins on which mine work has been most extensively carried on in this district occur in a belt, less than a mile wide, passing immediately west of Wombat Hill, and have been thence traced, almost uninterruptedly, for several miles both north and south. This group of veins lies in the flexured beds at A, shown on Figure 1, and includes the Specimen Hill, Colliers, Sandstone, Wombat Hill, Crown, Nuggety, Ajax, St. George, Eugenie, Hepburn, and Mauritius reefs. Among them the most noteworthy, both from an economic and scientific aspect, are the so-called "mullock loads," *i.e.*, bodies of slate in fractured and contorted layers, with bands, veins, and lenticular masses of quartz, contained within regular walls of the bounding slate and sandstone country. Reefs of this character, opening out to a thickness of 30, 50, and even 100 feet, yielding more or less productive stone, occur in the immediate neighborhood of Daylesford. The Wombat Hill Reef (Cornish Lode, Red Lode, Mullock Reef, Black Lode) offers many features of interest. The lode, from 8 to 30 feet in thickness, underlying W. 21° S. 62°, is in places a massive body of quartz, yielding as high as an ounce of gold per ton, while in others the space between the walls is filled with an indeterminate mass of slate and quartz veins. At the 520 feet level in the Cornish mine the lode terminates vertically against the bassets of the slate beds, the floor thus formed dipping southward 22°. The walls of the lode still continue downwards, as was ascertained by a cross-cut driven beneath the floor (*vide* Fig. 2). The entire body of stone between the walls is treated under the mill, it having been found that the free gold is contained chiefly, if not solely, in the slate, or possibly in the pyrites with which the slate is thickly studded. The average yield of gold at this spot is 3 dwt. per ton. The nature of the bordering rock plays here, as elsewhere, an important part in the distribution of gold in the veinstone. Where the wall of the vein and the bedding planes of the country are coalescent, a smooth black argillaceous band, or a layer of crystalline indurated sandstone (as shown in section)

encases the lode, and the stone in such parts is invariably poor. On the other hand, where the angles of dip or strike of the vein are somewhat different to those of the schist beds the faces of the lode are "ragged," the casing is absent, and small

FIG. 2.

Cross-section of Wombat Hill Reef at 520 feet level of the Cornish Company's Mine.



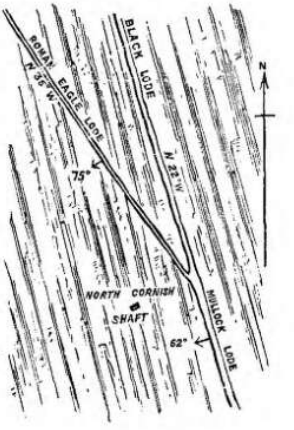
Hanging wall black clay, band 3 inches thick. Footwall crystalline sandstone, 2 feet thick. Underlay of lode 62° W. Shoot 22° S.
Scale 20 feet to the inch.

veins of quartz jut out from the main body and enter the country under various angles. It is noticed, however, that these veins frequently present a regular southerly dip, corresponding to that of the main shoot of quartz ; the miner speaks of them as "feeders," and the occurrence is generally accompanied by an increased richness of stone.

A singular feature is exhibited in the strike of the Wombat Hill Reef, opposite (east of) the North Cornish Company's shaft. The reef in the Cornish Company's mine bears 20° to 22° west of north. The eastern wall still continues in the same strike; so does the western wall after a break of 40 to 50 feet, and the lode has thence been worked as the Black Reef for over 200 yards northward to beneath the basalt cover of Wombat Hill. At the point where the break occurs in the hanging wall a strong vein, defined but with less distinct walls, branches off to the left under a bearing of N. 36° W., and a westerly underlay of 75°. This lode is being worked under the name of Roman Eagle Reef, at a distance of 370 yards north of the point of divergence (Fig. 3).

FIG. 3.

Sketch-plan showing bifurcation of the Wombat Hill Reef.

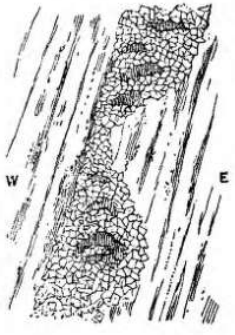


Similar in character to the Wombat Hill Reef is the Mauritius Reef, distant about a mile north-west of Wombat Hill. This is a body from 2 to 12 feet in thickness of fractured dark-grey slate, full of cubic pyrites, with numerous irregular

bands and veins of quartz, underlying 65° to 85° westerly. The western or hanging wall is smooth and well defined, while the dead rock in the footwall frequently encroaches upon the lode, pinching it into a narrow space of only a few inches in thickness. The south level in the Union Company's adit exposes such a contraction of the lode. The thickest part of the lode in this place is 4 feet 4 inches, which serves as a scale for the other dimensions in the annexed section (Fig. 4). The whole mass of stone between the walls is crushed, and yields from 3 to 7 dwt. of gold per ton. The gold is always associated with the mullock; it is never seen in the quartz, neither in the bands and patches within the lode walls, nor in the separate veins which are to be found in close proximity. The Hepburn Reef, *e.g.*, in the same mine, is a vein 55 feet west of the Mauritius Reef, and a true quartz reef 12 to 30 inches thick; but although the adit opened out upon it, the stone never yielded profitable returns, and the workings were abandoned

FIG. 4.

Sketch-section of Mauritius Reef in the south stope of Union Company's adit.



NEWER VOLCANIC.

The result of volcanic activity and subsequent extensive denudation is strikingly exemplified in the Daylesford district. The principal points of eruption are Wombat Hill, Fern Hill, Lightwood Hill, Snake Hill, Kangaroo Hill (Glenlyon), Bald Hill, and Mount Franklin, lying to the east of Deep Creek ; and Kangaroo Hill (Bullarook), Eastern Hill, Mount Bullarook, and Smeaton Hill, on the west. The lava flow around the site of the township of Daylesford appears to have taken place during two distinct periods. The older flow emanated from one or more points north of Wombat Hill ; the latter and less wide-spread flow came from Wombat Hill itself, and its border is well defined along a contour some 140 feet below the crown of the hill. A thick deposit of ash and scoriæ, with grains of obsidian, fills a great part of the depression between Wombat Hill and Fern Hill. At Italian Hill a layer of greyish-white tuff occupies the lowest part of an old lead valley. The cellular lava north of Wombat Hill is rich in carbonate of lime. The basalt between Daylesford and Glenlyon contains hornblende and large tabular pieces of transparent oligoclase, with coatings of carbonate of iron and calcite ; olivine is rare. The rock is coarsely-granular, and, although affording a good road metal, is ill-adapted for dressing as a building stone.

LOWER PLIOCENE (OLDEST DRIFT).

Since the deposition of the Lower Pliocene gravels the physical aspect of the country has been so thoroughly changed by powerful and protracted denudation that the few remnants now represented in the vicinity of Daylesford do not offer sufficient proof to show whether the oldest drift occupied at any time wide-spread beds or not. At the Wallaby Diggings, two miles north-east of Daylesford, the drift

is clearly identifiable, occupying the crown of a Silurian hill, flanked on two sides by a lava sheet. A section at B on Figure 5 gives—

Brown volcanic soil	3 to 4	feet
Red, yellow, and grey clay, with loose quartz pebbles ...	3 to 8	„
Well-rounded quartz gravel, from 1 to 12 inches in diameter	4 to 12	„
	10 to 24	feet

on white Silurian slate.

The deposit is auriferous, and has been advantageously worked upon.

Middle Pliocene (older drift).

The trend of the main channels of Middle Pliocene age, from the Dividing Range northwards, shows on the whole but little divergence from that of the modern drainage system. An exceptionally large deviation exists in the Wombat Hill Lead, caused by the interposition of the lava stream from Wombat Hill and neighboring points of eruption. The course of this lead, once no doubt the main arm of the River Loddon, runs for a distance of seven miles in a north-easterly direction, nearly under right angles to the present valleys, before it assumes the northerly bearing along the modern stream beyond the township of Glenlyon. The lead takes its rise at an elevation of 2,050 feet above sea-level, immediately south of Wombat Hill, where it is covered by 110 feet of lava. The original surface, west of Wombat Hill, presents a narrow ridge running in a north-north-westerly direction, and dividing the Wombat Hill Lead from the Doctor's Gully (Township) Lead (*vide* Fig. 6). The gold in the lead drift is evidently derived from the denuded caps of several quartz veins which traverse the dividing ridge, and have, subsequent to the discovery of the leads, been mined upon. For a distance of 300 yards the Wombat Hill Lead runs parallel with this ridge, and then suddenly turns under an elbow bend of 60° to the east, beneath the crown of the hill, where the overlying mass of volcanic rock cannot be less than 350 feet in thickness. Just below (east of) the elbow a dyke, some 50 feet thick, cuts across the lead

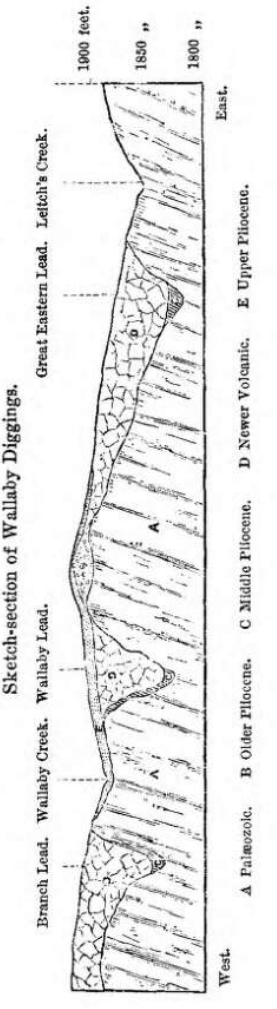
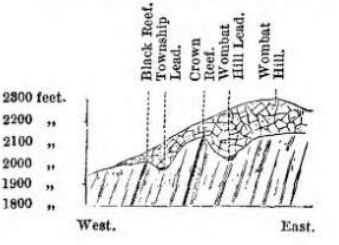


Fig. 5.
Sketch-section of Wallaby Diggings.

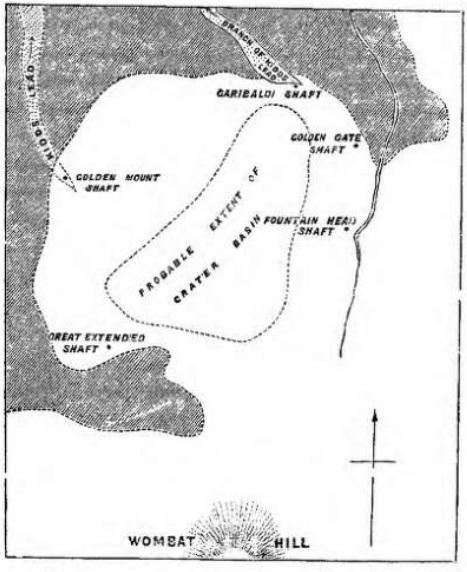
Fig. 6.
Sketch-section showing the sources of Wombat Hill and Township Leads.



valley without affecting either the level or direction of the latter. Miners look upon this as the pipe of the crater, but judging by the unaltered condition of the original surface contiguous to the dyke, and from the character of the dyke stone, resembling in places tuff rather than basalt, the probability is that it is a fissure filled from above by the overspreading sheet of volcanic matter, while the vent of the intrusive lava, lying some distance to the south-east, has never been touched upon by the mine workings. The lead channel, which is from 20 to 50 feet wide, falls rapidly for a distance of a little over a mile, when it opens out to a width of over 100 feet, with a decreasing gradient. At 250 yards below this point the lead is joined on the left by the Concordia gutter, a tributary which bifurcates at a distance of 330 yards from the junction. Both branches have proved exceedingly rich in gold. The head of the northern branch emerges from under the edge of the volcanic, on the south side of Spring Creek, near its confluence with Blind Creek. The southern branch was worked to Blind Creek ; and with the view of tracing its supposed source westward a series of costly shafts were sunk through the basalt, on the left side of the last-named watercourse. The work, although practically a failure, is so far of interest, as it discloses the existence of a crater basin at a distance of half a mile north of Wombat Hill. The position of this crater is approximately defined by the sinking of four or five shafts (*vide* Fig. 7). The Golden Gate shaft was sunk 350 feet in dense basalt without bottoming. The Garibaldi shaft descended 200 feet, and drove south 200 feet against the rock, sunk again 90 feet and drove 60 feet, finally went down 12 feet, and discontinued at a total depth of 302 feet (*see* Fig. 8). The Fountain Head shaft was sunk to a depth of 400 feet, driving at intervals westerly against the barrier of basalt. A fourth shaft, sunk by the Great Extended Company on the southern border of the basalt, bottomed at 200 feet, and then followed the wall-like, almost vertical, face of the rock downwards for a considerable depth, with the same fruitless object of searching for a lead at a level

FIG. 7.

Plan showing position of Crater Basin north of Wombat Hill.



The shaded part shows the Palæozoic rocks, the unshaded part the Volcanic rock.
Scale 4 inches to a mile.

FIG. 8.

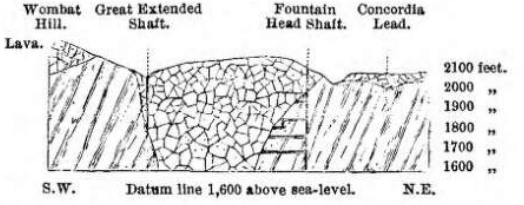
Section of Garibaldi Shaft.

Scale 400 feet to the inch.

deeper, by several hundred feet, than any channel of Middle Pliocene age in the neighborhood (Fig. 9). It was, on the contrary, apparent at the outset that the inclination of the lead beds was away from the hill, as the sources of the Kidd's Gully Lead were traced in two branches under the basalt, the one to the Garibaldi shaft, the other to the Golden Mount shaft (*vide* plan, Fig. 7). A similar feature,

FIG. 9.

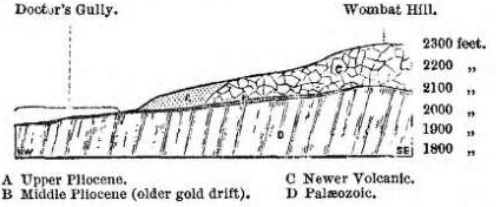
Sketch-section of Crater north of Wombat Hill.



well calculated to have served the local miner as a precedent, is presented by the Township Lead, which, after a sub-basaltic course of half a mile, emerges at the head of Doctor's Gully, and follows the direction of the latter, where it is partly, and in places wholly, removed by the erosion of the modern valley (Fig. 10).

FIG. 10.

Sketch longitudinal section of Township Lead.



A Upper Pliocene.
B Middle Pliocene (older gold drift).
C Newer Volcanic.
D Palæozoic.

Returning to the Wombat Hill Lead we find, at a distance of 700 yards below the confluence of the Concordia Lead with the main channel, a branch falling in on the right. This branch, known as the Dead Man's Lead, has been traced from the Astley No. 2 shaft southward for 1,200 feet. Many adverse opinions notwithstanding, facts so far observed induce me to think that this is the Italian Hill Lead; and, if so, there are fully 3,000 yards of workable gutter untouched, in addition to the tributary leads, which there is evidence to show must coalesce with it: one coming from the head of Smith's Creek, trending east towards the California shaft, the other from the Copenhagen Company's shaft, west of Lightwood Hill, passing northward by the Florence Nightingale shaft. The search operations of the Long Tunnel Company promise to remove some of the uncertainty at present felt with regard to the older drainage system south-east and east of Daylesford.

In the neighborhood of the Astley No. 2 shaft the lead is 150 feet wide; on the next quarter of a mile the width is increased to upwards of 400 feet, accompanied by a corresponding decrease in gold. It is at this distance that a junction of the O'Hara Bourke Lead, probably running beneath the cemetery, may be looked for. At the Astley No. 3 shaft the Pig-and-Whistle Lead, a narrow gutter with steep gradients, joins on the right. This lead has been traced beneath a contracted

tongue of lava, about three-quarters of a mile, to its source, and is quite worked out. Immediately above the Astley No. 3 shaft the main lead, under a lava covering of 160 feet, spreads with a northerly sweep into a wide flat, extending across the site of the Malmsbury road. The northern border of the drift has been but imperfectly explored, and it is possible that this is an *embouchure* formed by the Fern Hill Lead, the position of which has been ineffectually looked for some 25 chains further east. The head of the Fern Hill Lead protrudes from under the lava at a spot three-quarters of a mile north of Fern Hill, and its course has thence been followed for about 600 yards, the washing of the drift being hardly remunerative at the farthest part worked. Between that point and the probable junction, a distance of nearly a mile, two shafts (the Cosmopolitan No. 2 and the Newton No. 2 shafts) have been sunk, bottoming at 150 and 137 feet respectively on bare bed-rock. As already stated, the course of the gutter probably lies further west, perhaps from 10 to 25 chains.

At a distance of 4,600 yards from its source the Wombat Hill Lead arrives under the eastern branch of Wallaby Creek, where it receives on the south a feeder which, at 300 yards, splits up into two branches of but limited extent. The main lead has not been traced beyond the Coomoora shaft, on the right bank of the Wallaby Creek, but the boundaries of the old valley are pretty clearly defined by the, albeit somewhat intricate, outlines of the lava sheet ; and it seems surprising that so much desultory work should have been done by miners, while even now opinions are still far from settled. The approximate course of the lead may be gathered from the following observations :—A shaft was started and abandoned by the Confluence Company, 45 chains east of the Coomoora shaft, in a position well chosen to secure the junction of the main and Great Eastern leads. The latter runs under the belt of basalt on the left side of Leitch's Creek coming from Lightwood Hill, and has been worked principally by the Daylesford Company. On the further side of the Confluence shaft the main lead must pass by the shaft commenced by the Creavy Company, on Leitch's Creek. Somewhat less than half a mile further west the Duke of Cornwall Company worked a gutter 200 to 400 feet wide. This is either the main lead or the lower part of a tributary, starting west of Snake Hill from the tongue of lava on the east side of Leitch's Creek (opposite the Daylesford Company's shaft), where the older drift is seen dipping beneath the basalt. The trunk lead then trends more northerly, towards the Lyon Bank Company's shaft, whence it resumes its north-easterly course, passes north of Kangaroo Hill to the township of Glenlyon, crosses the Loddon below Babington's homestead, and follows along the course of the river, through Holcombe P. R. to Fryers (*vide* geological quarter sheets 10 N.W. and 9 S.W.). From Glenlyon downwards the overlying basalt is frequently cut through and exposes the lead, with a considerable depth of the Silurian rock in natural sections.

The Wombat Hill Lead and its ramifications have been exceedingly rich in gold at their upper courses. It has been estimated, for instance, that on the first mile, viz., from the Haphazard to the White Star mines, the Wombat Hill Lead has produced 170,000 oz. of gold, being equal to 32 oz. of gold for every lineal foot of its course. With the paucity, however, of auriferous quartz veins, the absence of oldest drift deposits in the drainage area beyond the Wallaby Creek Lead, and the increasing width and depth of the drift over the expanding gutter bed, the contents of gold declines *pari passu*. The material of the gutter drift is a

more or less well-rounded quartz gravel, with a shingle of sandstone, containing fragments of wood and trunks of trees in various states of preservation, but nearly always impregnated with, or wholly changed into, bi-sulphuret of iron. The overlying rock varies from a soft ash and tuff to scoriæ and dense basalt. Where the Concordia Lead merges into the main channel, and for some distance below that point, a layer of black clay and sandy mudshale intervenes between the gravel and tuff. This layer is full of impressions of reeds and eucalypti leaves.

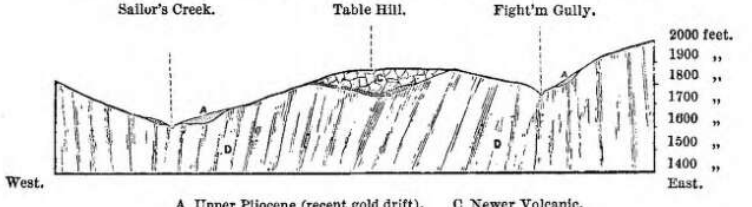
Upper Pliocene (recent drift).

As usual, in the neighborhood of volcanic centres, the greatest extent of the latest Tertiary deposit occurs in places upon and around the basalt boundaries where the clay drift fills up the inequalities in the surface caused by the lava flows. An example has already been given *ante*, in the sketch section (Fig. 10) relating to the Township Lead at the head of Doctor's Gully, where the thickness of the recent deposit is upwards of 100 feet.

In most of the watercourses which are scooped out on, or adjacent to, the sites of Middle Pliocene leads we find Upper Pliocene "drift banks," consisting in great part of the re-distributed material of the denuded older drift. Red, brown, blue, and mottled clays, with angular quartz fragments, form the matrix, with which are mixed up well-worn pebbles and boulders of quartz, and shingle of slate and sandstone. In many places, notably at Sailor's Creek and Stony Creek, where a layer of lava has been intersected by later erosion, pebbles and larger masses of completely rounded basalt form a not inconsiderable adjunct in the drift (*vide* Fig. 11).

Fig. 11.

Sketch-section showing Pliocene Gold Drifts south-west of Daylesford.



A Upper Pliocene (recent gold drift). C Newer Volcanic.
B Middle Pliocene (older gold drift). D Palæozoic.

At Leitch's Creek and other places, where denudation has removed the capping of basalt either wholly or in part without interfering with the sub-lying bed-rock, the flanks of the hills are frequently covered by a ferruginous precipitate in the form of layers and nodules of brown iron ore. Fragments of this ore, either sub-angular or in pisolitic pebbles, also occur to a limited extent distributed both as "local" drift and as cappings in some of the swampy depressions between Wombat Hill and Lightwood Hill.

FERDINAND M. KRAUSÉ,
Geological Surveyor.

Daylesford, 1st October 1877.

REPORT ON THE GEOLOGICAL SURVEY OF PORTIONS OF DARGO AND BOGONG.

Description of area.

THE area geologically illustrated by the accompanying sketch-map embraces the lofty basaltic plateaux known as the Dargo and Bogong High Plains, to which attention has been directed, not only on account of the scientific interest attached to the geology of the country, but also on account of the existence, beneath the basalt of the plateaux, of auriferous gravels, the successful development of which would largely augment the mining importance of the district.

NOTES.

1.

This patch of basalt is apparently a vestige of the western edge of a flow covering a lead from the north now obliterated by denudation. See Note 2.

2.

In these two gullies, which have been worked for gold, are numerous water-worn blocks of basalt and much heavy quartz gravel, evidently derived from a now obliterated lead.

3.

Only a few slight indications of sedimentary deposits between the basalt and the bed-rock are visible, but this is probably owing to their being concealed by slipped and fallen débris.

4.

Layers of yellowish-brown foliated clay containing fossil-leaf impressions.

5.

These patches of basalt appear to be remnants of a flow or flows from the N.W., and to have been once continuous with the larger basaltic area to the S.E.

6.

Clays, sand, and lignite exposed by land-slips, and probably overlying gravels which join those of White's claim beneath the basalt.

7.

Beds of clay, sand, and lignite similar to and probably continuous with those referred to in Note 6.

8.

Beds of clay, sand, and auriferous gravel, forming a well-defined lead, portion if not all of whose heads were from the N.W. It is possible that the lead at White's may be one of its heads, and that a "high reef" passing under Paw Paw Plain divides White's Lead from the deposits referred to in Notes 6 and 7.

a 8.—The basalt is here low enough to admit of the outlet of White's Lead being on this fall, but the quantity of slipped material is so great that no positive indications can be seen.

9.

There is every indication of this being the outlet of Morris's Lead from beneath Boiler Plain, and that a junction with the deposits described in Note 7 took place between here and Mount Tabletop.

10.

Heavy deposits of gravel (auriferous) presenting the appearance of being the eastern margin of a bend in the main lead from Boiler Plain.

a 10.—A small branch "run" of gravel here passes under the basalt, and apparently is tributary to the lead at Armour's.

11.

Heavy auriferous gravels, with sand, clay, and conglomerates. Among the fossil leaves discovered was *Cinnamomum polymorphoides* of the Middle Tertiary or Miocene era.

12.

Heavy deposits of coarse gravel, which appear likely to extend eastward under the basalt, and join the main lead from Synnott's.

13.

The gold in this creek has been traced nearly to the basalt boundary, and has probably been derived from the denudation of portion of the eastern extension of the gravel described in Note 12, though any outcrop of gravel which may exist is here concealed by fallen basalt and other débris.

14.

Heavy auriferous gravel, apparently coming from the westward, and a continuation of that at *a* 14 and *b* 14.

15.

These ranges consist of gneiss and granite; the latter in places still retains indications of a formerly schistose character.

16.

This patch of basalt appears to be in no way connected with that of the S.W., but is apparently a vestige of a flow from the north, which went in a south-easterly direction over what is now the valley of the Big River.

17.

Open plain, consisting of mica schist; the ranges to the north, south, and east consist of granite, exhibiting faintly a schistose character.

18.

The basalt of these plains, as also that of the various small outliers, is generally hard, dark, and dense, exhibiting in many places the columnar structure (large pentagonal prisms) in a very marked degree.

19.

This basaltic area has not been well examined, and though underlying drift deposits are not shown, it is likely that they exist, and that this is portion of a flow approximating in course to the direction of the Cobungra Valley.

20.

The bed-rock appears high up under the basalt on the N.E., and low down the S.W. side of Mount Battery; indicating this as the north-eastern margin of the lava-flow referred to in Note 19.

21.

Drifts and hard conglomerates; stated to have been prospected, but without finding payable gold. From a point about north from here downwards the Cobungra River has been profitably worked, and the gold has probably been derived from the denuded auriferous portions of the Middle Tertiary drifts.

22.

The rocks along the Victoria valley consist principally of mica schist, sometimes contorted and passing into gneiss.

23.

A fine illustration is here observable of the gradual passage from unaltered to altered rock, which is noticeable all along the Silurian and metamorphic boundary. The unaltered clay-slates, shales, &c., pass into silky micaceous shale, which passes into mica schist, and the latter in turn is altered into gneiss and schistose granite.

ically surveyed under the instructions of Thos Couchman Esq. Secretary for Mines by R. A. F. Murray

Mining Department, Melbourne.

OLDER VOLCANIC 13 | MIDDLE TERTIARY (Miocene) 5 | LOWER SILURIAN 9? | METAMORPHIC 10

of leads beneath volcanic ——— Where uncertain, or obliterated - - - - - Dips ⁂ Note references ⁂1 Heights above sea-level 4010

are impassable on account of the snow, and although the soil is in many places very rich the irregularity of the seasons and the frequency of sudden and severe frosts, even during summer, would be very prejudicial to agriculture.

General geological description.

The geological formations in the district mapped are few in number and their stratigraphical relations simple and easily understood.

Lower Silurian slates, shales, and sandstones, and metamorphic schists and granites form the bed-rock of the whole; this bed-rock is overlaid in parts by gravels, sands, and clays, whose fossil flora indicate them to be of Miocene or Middle Tertiary age, and, wherever found, these are covered by varying thicknesses of lava, forming the plateaux or high plains already referred to. The highest peaks consist of the Palæozoic rocks, which are also plainly exposed in all the deeper rivers and creeks that intersect the plateaux and separate them from one another; these watercourses contain drifts and gravels of Post-Tertiary age, made up of the materials denuded from the bed-rock, the Middle Tertiary beds, and the basalts.

The geological history of the district, deduced from the above data, is that in Middle Tertiary times the beds of the ancient watercourses were at a far higher relative elevation than those of the present day; that flows of lava took place which filled in the valleys of the period, and that the present rivers then commenced to cut their way, and have, during long ages, eroded their valleys as they now exist, sometimes parallel with and sometimes across the ancient river beds.

The changes of watershed and the deviations of the drainage channels caused by the lava-flows will be more particularly described hereafter.

Palæozoic rocks.

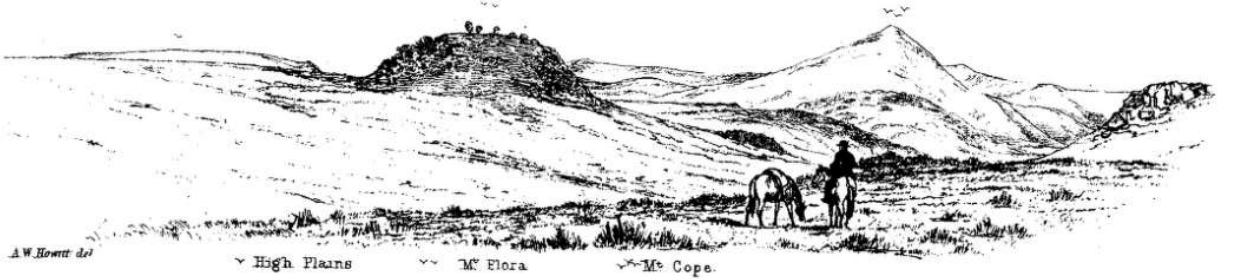
As before stated, the Palæozoic bed-rock of the district consists of Lower Silurian and metamorphic rocks, and it is observable that between these there is no arbitrary line of demarcation, though the general line of boundary between the two may be roughly described as running in a north-westerly direction from between Mounts Birregon and Phipps along the eastern side of the Dargo to Mayford; thence across the Main Divide into the Cobungra; thence along the western side of the main Cobungra to a very low saddle between it and the Kiewa; and thence northerly along the western side of the Kiewa.

The unaltered Silurian rocks consist of the usual sandstones, shales, and clay slates, but as the metamorphic region is approached a gradual and regular transition is observable. The unaltered shales, &c., pass into silky micaceous shales, followed by mica schist, passing into gneiss and granitoid schists, which in turn pass into a granite that sometimes retains a faintly traceable schistose character. This gradual passage was specially pointed out to me by Mr. A. W. Howitt, during a journey taken in his company in 1873, while descending into the Dargo, at Mayford, from the Omeo side.

On the road from Omeo to Mayford the highly metamorphosed rocks are found to prevail along the Victoria valley to the Main Divide; they consist of mica schists, sometimes contorted, passing into gneiss, and the strikes observed were from N. 75° W. to N. 85° W. On the spur from the Main Divide down to Mayford, known as King's Spur, the strike is N. 80° W. and the dip N. 10° E. at 85°, and on this spur is clearly visible the gradual passage from gneiss to mica schist, thence to silky micaceous shale, and thence to the unaltered slates and sandstones. Leptynite schist containing decomposed garnets occurs here, and also a band resembling a greenstone dyke of quartz and green hornblende.

A.W. Howitt del. — McHotham

SOURCES OF THE DARGO RIVER
from the High Plains

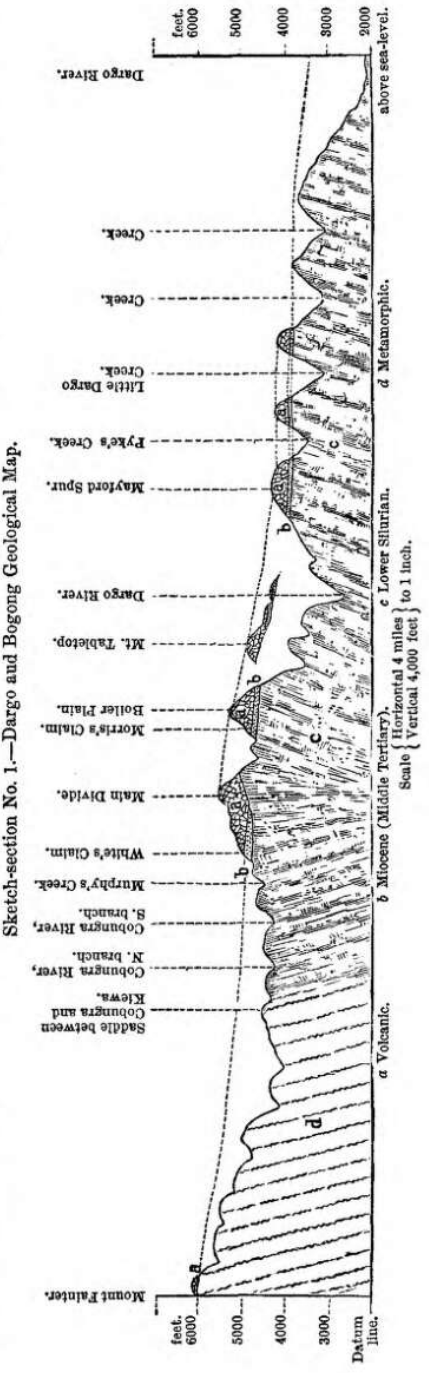


BOGONG HIGH PLAINS AND SOURCES OF THE BUNDARRAH RIVER

Along the spur the strikes observed varied from N. 20° W. to N. 80° W., and the dips correspondingly from N. 70° E. to N. 10° E. at from 65° to 85°. The unaltered rocks in the Dargo River dip N. 40° E. at 80° and strike N. 50° W.; at the Eighteen-mile Creek, between Mayford and Grant, the dip observed was N.E. at 73°.

The same general north-westerly direction of strike prevails on the Cobungra fall of the Main Divide, but the dip is south-westerly, indicating a synclinal fold between the Dargo and the Cobungra.—(*See* Section 1.) One dip near Mount Hotham is S.W. at 58°, and several other observations gave nearly the same result —a north-westerly strike and a south-westerly dip.

The metamorphic rocks show in their strikes a general parallelism to the unaltered strata, and the inference drawn from this, as well as the fact of the gradual passage between them, is that the metamorphic rocks were once part of the Silurian system, and have been changed, by whatever metamorphic agencies, from the conditions of slate, shale, and sandstone, to those of mica schist, gneiss, and granite; the extent of the alteration varying according to the intensity or proximity of the metamorphic agencies. The transition above described coincides with that treated of by Bernhard von Cotta in his "Rocks Classified and Arranged," and he strongly suggests hydroplutonic action, or the combined agencies of heat generated by pressure, and permeating waters, as the cause which produced the metamorphism of sedimentary rocks into crystalline schists. The granite in this part of the country, being clearly a metamorphic and not an intrusive granite, is not distinguished



by color on the map from the metamorphic schists which surround and pass into it.

Middle Tertiary.

The Middle Tertiary deposits, being covered with basalt, are only exposed on the slopes into creeks and rivers which have cut through them into the bed-rock, and consist, where visible, of gravels, conglomerates, clays, sands, and occasionally impure lignites. The heavy gravels usually lie on the bed-rock, and above them are alternating clays, sands, and finer gravels, with bands of silicious or ferruginous conglomerate, the uppermost beds consisting of the finer clays, sands, and lignites. These deposits occupy well-defined troughs in the bed-rock, and although much intersected and divided into separate areas by the existing more deeply eroded valleys, their former connection may be traced with tolerable certainty, and an idea presented to the mind of the conditions of the country during that epoch. The few places where the gravels have been worked for gold, and the small sections afforded by land-slips, are the only spots where the deposits can be observed, as great masses of mixed débris brought down by land-slips usually prevent the relations and total thickness of the beds from being ascertained with accuracy. In tracing the line of contact of the bed-rock with the superimposed deposits, it is noticeable that the surface of the former slopes far less abruptly than do the steep inclines walling the present rivers; and this, coupled with the palustral aspect of some of the Middle Tertiary beds, would lead to the inference that the main river valleys of that period were broad and shallow, though their minor tributaries may have resembled those of the present mountain streams. As suggested to me by Mr. A. W. Howitt, they probably resembled some of the mountain straths of the present day, such as Delegete Plain, a long level flat of marshy deposits covering gravels through which the present river winds.

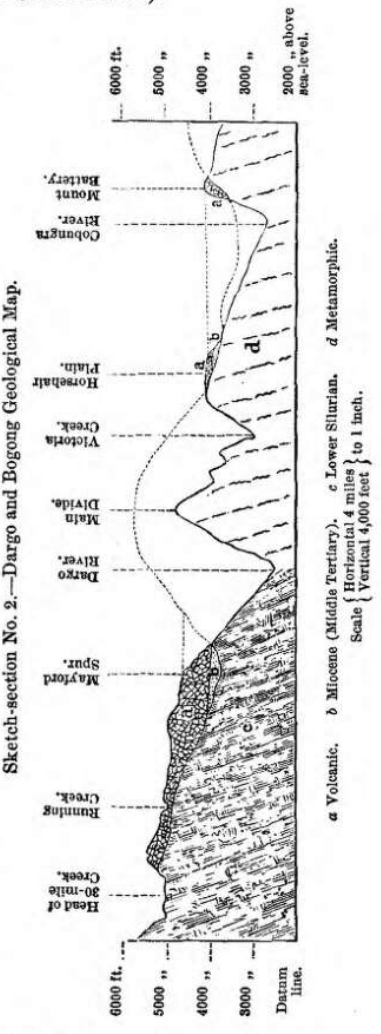
While the incline of the ancient river beds was steep the deposits would consist principally of gravels, but as these accumulated in the lower portions, and the bed-rock became more deeply eroded towards the heads of the streams, the incline would become more horizontal, and, as a natural consequence, the finer sediments only would continue to be carried down, and, overspreading the gravels, form wide marshy flats. This view is well borne out by the character and the fossil flora of the Middle Tertiary beds. As the small isolated basaltic patches which cap hills separated from the larger plateaux were once evidently continuous with the latter, and on or near the courses of former streams, and at the same time of little less elevation than the highest peaks of Mounts Feathertop, Hotham, Cope, and others, it is clear that the ranges forming the ancient watershed lines, of which the mountains named are probably remnants, were once of far greater elevation than they are now, and have been reduced by denudation hundreds, perhaps thousands, of feet during the time that the same action has taken to erode the deep valleys at their bases.

This suggests that the lava-flows did not form the widespread sheets they have been supposed to have done, but that they followed the valleys, were confined to them, and separated from one another by their dividing ridges, except in a few cases where the latter were comparatively low. The denuding influences subsequent to the lava-flows met with less resistance from the slates and shales of the dividing ridges than from the hard basalts, and consequently the surface of the

former, once far higher, has been worn down in many places to a lower level than that of the latter (indicated by dotted lines in Section No. 2).*

As the isolated patches of basalt are here the principal evidences on which to base any theory as to the ancient water-shed lines, their position will now be described, starting from the supposed former Main Divide, which in this portion of the country appears to have been further north, anterior to the lava-flows, than at present.

The Mount Fainter range, starting from the basaltic plateau between the Kiewa and the Bundarrah, or Bogong High Plains, runs N.N.W. between the two main branches of the Kiewa, and attains its highest elevation (about 6,160 feet) at Mount Fainter, four miles north-easterly from Mount Feathertop. The summit of Mount Fainter is a basaltic patch of about half an acre, resting on the metamorphic granite without apparent intervention of drift, and is the most northerly occurrence of basalt in the area surveyed. From Mount Fainter to the nearest tongue of basalt from the Bogong High Plain the distance is three miles, along a rugged granite range devoid of any Tertiary or basaltic capping whatever, but in some gullies worked for gold, on the eastern fall of this range, are numerous water-worn blocks of basalt, large well-rounded quartz boulders, and gravel of materials foreign to the neighboring bed-rock, evidently the re-distribution of the gravels and overlying basalt of a former lead. This points to a previous connection between the large plateau and the basalt on Mount Fainter, which is apparently a mere vestige left on what was the western side of the old stream; the bed-rock beneath the basalt rising higher on the western than on the eastern side of the hill.



Sketch-section No. 2.—Dargo and Bogong Geological Map.

The highest point of the Bogong plain is 200 feet lower than Mount Fainter, so that the fall of the ancient stream was in an opposite direction to that of the Kiewa River, which has cut back to its present head. Another patch of basalt, three miles N.N.E. from Mount Cope, on the divide between the Kiewa and the Big River, has no apparent relation to the large plateau to the south-west, its

* See extract from Professor Jukes' Manual quoted in Report on the Macallister Geological Survey, page 59.

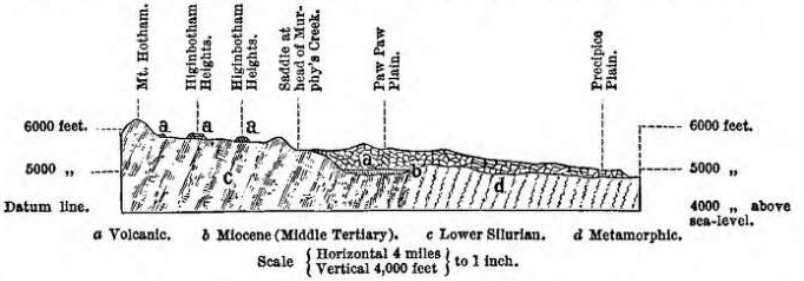
elevation being 400 feet less, and the higher intervening granite range showing no patch of basalt or opening indicating a former connection between them. The appearance of this patch of basalt indicates the course of the valley which it once occupied as from N.W. to S.E. The basaltic portion of the Bogong High Plain has an extreme length N. and S. of four miles by a width of three miles, containing an area of about seven square miles. Around the edges of the basalt no distinct outcrops of gravel are visible, a few scattered quartz pebbles and fragments of cement being the only visible indications on the slopes into the Cobungra and the Kiewa of any deposits intervening between the lava and the bed-rock. That they do exist, however, is nearly certain, but they are concealed by slipped and fallen débris, and can only be exposed by labor. In a head of the Bundarrah, on the south-western margin of the basalt, are exposed beds of yellowish-brown laminar clay containing fossil leaves, on specimens of which, forwarded by me to the Department of Mines, Professor McCoy remarks as follows :—"The specimens from this locality are of great interest, from containing a new species of *Tæniopteris, T. tenuissime striata* (McCoy), the first example of this in Tertiary rocks in Australia, although well known in rocks of this age in other parts of the world. There is also a *Lastrea, L. Dargoensis* (McCoy), allied to a Miocene species from the Arctic regions. With these are a few fragments of dicotyledonous leaves, apparently identical with some from Bacchus Marsh, but too imperfect for precise identification."

Fossil flora

Only a small exposure is visible, and no data were obtainable as to the thickness of the beds. A hole sunk below them by the Government prospecting party to a depth of nine feet passed through what resembled decomposed basalt containing calcite. As the fossiliferous beds are clearly overlaid by basalt, the presence of the same below them points to the existence of two separate lava-flows, with intervening sedimentary beds. No gravel was found, but it is nearly certain to exist somewhere beneath the basalt, though only to be discovered by sinking or tunnelling. That the sedimentary beds beneath this plateau were deposited by waters flowing from the direction of Mount Fainter is tolerably certain, but the consideration of their connection with those south of the Cobungra will be deferred until the latter have been described.

On the Divide between the Diamantina branch of the Kiewa and the heads of the Cobungra, about two miles N.E. from Mount Hotham, is a small basaltic outlier

Sketch-section No. 3.—Section along Main Divide, Dargo and Bogong Geological Map.



capping a hill 6,175 feet, or about 74 feet higher than Mount Hotham, above sea-level. In a direction S.S.E. from this hill are a few more small basalt patches of

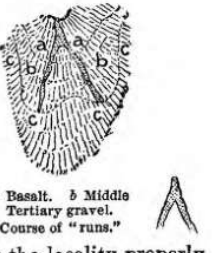
less elevation, but once continuous with it, and also with the basalt south of the Cobungra, the intervening portions having been removed during the erosion of that river and its branches. There is no basalt on the summit of Mount Hotham ; but on its eastern side, by the Omeo and Harrietville road, is a very small outlier ; further south-easterly, along the road, are two separate outliers, forming conspicuous hills, known as Higinbotham Heights ; and about three miles from Mount Hotham commences an area of basalt which occupies the Main Divide from that point to one north-easterly from Mayford, and also extends for a short distance along the divide between the Cobungra and the Victoria.—(*See* Section No. 3.)

On leading spurs from the Main Divide into the Dargo are two detached basaltic plateaux of little less elevation than the main range, and connected with it by saddles, on which the bed-rock appears at the surface. The western of these is known as Boiler Plain, the eastern as Mount Tabletop, and they are both of importance in connection with the sub-basaltic leads. On a spur into the Cobungra, between two of its tributaries, called Murphy's and Brandy creeks, is an exposure of gravel beneath the basalt, which is being worked for gold, and is known as White's claim. On the slope, W.N.W. from Boiler Plain, into the Dargo, is another worked exposure of sub-basaltic gravel known as Morris's claim ; and near the southern end of the basalt of Mount Tabletop, on the fall westerly into the Dargo, is another known as Armour's claim. The bed-rock of the gravel lead at White's is about 4,800 feet ; that at Morris's claim, on the other side of the Main Divide, 4,640 feet ; and Paw Paw Plain, on the summit of the Main Divide, between the two claims, 5,350 to 5,500 feet above sea-level. The gravel at White's claim is about 15 feet in thickness, with a few hard ferruginous bands ; it is coarse on the bed-rock, becoming somewhat finer upwards, and consists of boulders and pebbles of quartz and the harder portions of the metamorphic and Silurian rocks intermixed with sand and clay. Above the gravel are beds of white clay and sand, but the actual section from the bed-rock to the basalt is not known, though the total thickness may be estimated at 130 feet.

There are two "runs" of gravel, one on each side of the spur, with a rise in the bed-rock between them, indicating two leads, which meet under the basalt, as represented in the sketch (Fig. 4).

FIG. 4.

Sketch illustrating junction of two auriferous "runs" in gravel at White's claim.



a Basalt. *b* Middle Tertiary gravel. Course of "runs."

The workings prove that the channel trends towards the Main Divide, as the bed inclines gradually in that direction. South-east from White's claim, on the opposite side of Brandy Creek, and between the heads thereof, are land-slips along the basalt boundary, in which are exposed beds of sand, lignite, and clay, containing fossil lauraceous leaves and other plant remains. An attempt was made under my advice by the prospecting party to sink here for auriferous gravel, but was desisted from on finding that the time required to test the locality properly would, on account of the immense quantity of slipped material, be too long to admit of their likewise prospecting, within the period of their engagement, other more easily tried places requiring attention.

As the basalt boundary is followed easterly from here along the Cobungra slope, the bed-rock is found to rise gradually to an elevation considerably above that of

White's claim, and westerly from White's claim along the slope into Murphy's Creek the bed-rock rises similarly, until it forms the surface rock of the Main Divide at the head of Murphy's Creek, whence it again falls to a low level, in the direction of Boiler Plain, along the slope into the Dargo. As regards the connection of the deposits of the Bogong plateau with those at White's claim, it can only be said that there is nothing to justify a decided opinion as to whether the former represent the upper continuation of the latter, or of an old channel which approximated in course to that of the present Cobungra. On the range between the Cobungra and the Bundarrah, and on that between the Cobungra and the Victoria, there are small basaltic plateaux, and it is noticeable that, where absent on one side, they occur on the opposite one, indicating that the present Cobungra has followed approximately the course of an old river, cutting its way first on one side and then on the other of the lava which had filled it in. Mount Battery, on the spur between the Cobungra and the Bundarrah, is the last occurrence of basalt in this direction, and the basalt here descends low down the slope towards the Cobungra, while the bed-rock rises nearly to the summit of the hill on the opposite fall. Under the basalt of Horsehair Plain, on the opposite side of the Cobungra to Mount Battery, are deposits of gravel and cement, but they have not yet been properly examined.—(*See* Section No. 2.) As the country falls considerably towards the Big River, the continuation of the basalt and underlying deposits beyond Mount Battery has been entirely removed, but there is no doubt that the trend was towards the Mitta Mitta valley. The predominance of granite and metamorphic pebbles in the drift at White's claim show that it must have mainly come from a direction not further west than between Mount Feathertop and Mount Fainter; and the very low saddle between the Kiewa and the Cobungra, shown in the accompanying sketch by Mr. A. W. Howitt, suggests that that was its course. It remains an open question, therefore, whether the deposits beneath the Bogong plateau represent the upper continuation of those at White's claim or of those in the direction of Mount Battery. If the first hypothesis be correct, the Main Divide of the Miocene era must have deviated from its present course at some point near the head of the Victoria, and extended to Mount Cope; thence around the north of Mount Fainter and back to the south-west; if the second, it must have held its course from about the same point of deviation, rather more to the westward, in the direction of Mount Fainter.

As before stated, Boiler Plain is a detached basaltic table-land, on a spur from the Main Divide into the Dargo; between it and the Main Divide is a saddle, on which the bed-rock is at the surface, and from either side of this saddle head creeks running into the Dargo. On the fall from Boiler Plain, towards the junction of the western creek with the Dargo, and at a lower level than the saddle referred to, is the exposure of gravel opened and worked by Mr. Saul Morris, who first found and worked out a highly payable patch of auriferous gravel on a little saddle from which the basalt had been apparently denuded, not far from, and slightly above the level of the sub-basaltic exposure; and then, prospecting the latter, traced gold down the western "rim rock," or boundary reef of the gravel lead. The workings (now abandoned) expose a considerable thickness of gravel, with sandy and clayey layers. The deepest part of the gravel has been lately reached by a tunnel put in at Government expense, and the bed is found to pitch to the south-east. Land-slips in the vicinity expose beds of clay and impure lignite appearing from beneath the basalt above the level of the gravel.

A.W.Hewitt del.

~ Mt Jeanbertop ~~ Mt Painter ~~ Bogong High Plains

SOURCES OF THE COBUNGRA RIVER.

from near White's claim.

At the southern point of the basalt of Boiler Plain the bed-rock is high and far above the level of Morris's claim, but on the south-eastern fall from the plain the basalt goes down to a level as low as, if not lower than, that of the claim. Only faint signs of wash from beneath this basalt were detected by me during the examination made, but the great amount of fallen basalt and other débris rendered superficial search useless. We have thus the "high reef" at the north-eastern and southern extremities of Boiler Plain; a proved deposit of gravels, &c., passing under the basalt on the north side, and indications of an apparent outlet of the same on the south-east side. East from the saddle between Boiler Plain and the Main Divide, the bed-rock again descends, and in a race on a level with the saddle along the slope are exposed beds of laminated clay, lignite, and sand; below this the ground is again found so broken and covered with fallen masses that nothing definite can be ascertained, but at the same time the general indications are that the bed-rock descends to a level below that of White's claim on the other side of the Main Divide; and I have no hesitation in expressing an opinion that these deposits are continuous beneath the basalt with those exposed in the landslips at the heads of Brandy Creek, and probably also with those at White's claim.

It is possible that the lead at White's claim may have taken a more westerly course and be the upper continuation of that at Morris's claim, but the usual difficulties in the shape of fallen rock prevented my ascertaining the existence of gravels beneath the basalt on the fall from the Main Divide opposite the latter; the basalt, however, appears to be low enough to admit of such being the case.

It is also highly probable that some of the heads of the Boiler Plain lead came from the direction of the present heads of the Dargo, and that the basaltic patches near Mount Hotham mark the vicinity of the course of one of the former tributaries. There appears no doubt that the deposits beneath Boiler Plain, and those described as appearing in the race east of the saddle, once joined, but their junction and south-easterly extension have been removed by denudation.

The bed-rock in the saddle connecting Mount Tabletop with the Main Divide rises to a level above the sedimentary deposits between it and Boiler Plain, and at a lower level, to the eastward at the N.E. extremity of the Tabletop basalt, there is a deposit of sand and gravel which apparently runs in under the plateau, and is a tributary to the lead worked at Armour's claim. The contact of the bed-rock with the basalt continues high from this point along the eastern side of Mount Tabletop, but on the south-western side the basalt is lower, and there is beneath it a heavy deposit of gravel traceable for some distance. The information afforded by Mr. Armour's workings leads to the belief that this gravel is the vestige of a bend in the main lead from Boiler Plain with which that passing under Mount Tabletop has joined, and its elevation, which is about 400 feet less than Morris's claim, supports the conjecture.—(*See* Section No. 1.)

The basalt extends along the Main Divide to a point eastward from Tabletop on the opposite side of Tabletop Creek, and also down the divide between the Victoria and the Cobungra, but there were no indications observed in the form of exposures of gravel, or low levels of the contact of the bed-rock and basalt, which would lead to the opinion that the outlet of the Middle Tertiary deposits of White's claim and Boiler Plain was in any other direction than by the way of what is now the western slope of Mount Tabletop.

The next continuation of the Middle Tertiary deposits and their overlying lava is that of the Dargo High Plains, a gap of about three miles across having been caused by the erosion of the Dargo valley. The track from Mayford to Grant ascends a spur from the Dargo known as the Mayford spur, and from the summit of the spur the basaltic plateau extends westerly to near the head of the Thirty-mile Creek and southerly to the Eighteen-mile Creek ; a large creek called the Little Dargo heads from the Grant track on the table-land, about four miles from Mayford, and runs into the main Dargo, opposite Mount Birregon, a spur fourteen miles long, capped with basalt for a part of its length, separating the two streams. The heads of other creeks also cause the margin of the plateau to be divided into spurs and tongues of table-land, consisting of basalt on top and Silurian below, with occasional intervening gravels, &c.—(*See* Section No. 1.)

On the Mayford spur the Silurian and Tertiary boundary is about 3,950 feet, and the point of the table-land about 4,700 feet above sea-level, or 1,400 and 2,150 feet respectively above the level of the Dargo at Mayford. On following this boundary westerly from the spur the Silurian bed-rock is found for a very short distance to fall slightly, and then rise, a large deposit of heavy gravel occupying the depression and passing beneath the basalt : this has been partially worked for gold with more or less success, but is at present abandoned. Further to the west the bed-rock gradually rises, until, on the range between the Dargo and the Thirty-mile Creek, at the western extremity of the basaltic plateau, it is found at an altitude of 5,200 feet above sea-level.—(*See* Section No. 2.) A quarter of a mile south-easterly from the workings on Mayford spur, along the slope towards the Dargo, are other workings also abandoned, known as Synnot's claim, where several extensive excavations have been made into the side of the hill, revealing a great thickness of gravel with some bands of foliated sandy clay, in which Mr. A. W. Howitt found *Cinnamomum polymorphoides*, identified and figured by Professor McCoy, in his Decade No. IV., as belonging to a fossil flora of Miocene age. Synnot's party drove a tunnel through the "rim-rock" about 100 feet westerly into the hill, but after following the surface of the bed-rock to near the end of the tunnel it was found to dip inwards too much to admit of the tunnel being profitably worked further, showing that the main channel was further in beneath the hill, and running nearly parallel with its external slope. At a height of 300 feet above the tunnel there are exposed by land-slips fragments of clays and impure lignites, but whether the whole thickness from these to the gravel at the tunnel consists of sedimentary deposits, or whether there is an intervening layer of basalt, is uncertain. From Synnot's claim the gravels, &c., pass beneath a high basaltic point, on the eastern side of which, towards the Dargo, the bed-rock is seen above the level of the tunnel : on the fall from this point, over into Pyke's Creek, are clear indications of the outlet of the gravels from Synnot's claim, and slightly below the level thereof, the bed-rock rising both to the east and west : here also are silicious conglomerates and ferruginous bands containing fossil leaves, on specimens of which, forwarded by me to the Department of Mines, Professor McCoy remarks as follows :—"From this locality there are several imperfect lauraceous leaves of undescribed species occurring also in the Miocene Tertiary beds of Bacchus Marsh ; with these is a most interesting specimen of a species of *Salisburia*, *S. Murrayi* (McCoy), nearly allied to some Miocene forms from the Arctic regions, but not hitherto found in the Australian strata."

On the south side of Pyke's Creek, at a still descending elevation, the above described gravels are again found passing beneath the long spur of table-land separating that creek from the Little Dargo, and out again on the fall into the latter, the rising boundary reefs east and west being still traceable. From the Little Dargo around the eastern fall from the plateau, as far as the Eighteen-mile Creek, are numerous indications of gravel from beneath the basalt, but the course of the main lead from Synnot's tunnel has not been traced southward with certainty beyond the slope north of the Little Dargo. At a place called German terrace, on the fall into the Dargo, two miles from the head of the Eighteen-mile Creek, is a very heavy gravel, the fallen débris from which on the hill side has been worked for gold; this is apparently a tributary coming from the S.W., as there are abundant indications of gravel and conglomerate passing in under the basalt near the Eighteen-mile Creek, at a higher elevation than German terrace. At one of the western points of the Dargo plateau, south-west from the Harrietville track, on the divide between the Twenty-five-mile and Thirty-mile creeks, is a very heavy gravel passing in under the basalt at high elevation, and this, I think, represents a large tributary from the west to the main lead, and its course will be found to extend beneath the basalt near the head of the Twenty-five-mile, and either join the main lead or pass out from beneath the basalt on the fall towards the Dargo. Other small basaltic outliers covering gravels are stated to occur in the mountains to the westward, but whether those were connected with the Dargo formations or belong to a separate system cannot be ascertained until the country has been further examined.

From the Eighteen-mile Creek downwards the Dargo valley itself seems to follow at a lower level the course of the old lead, every vestige of basalt and underlying drifts having been swept away. Mount Ewen, on the range to the west, and Mount Birregon, on that to the east of the Dargo, both high points consisting of Silurian rocks, may be regarded as portions of the ancient, as they are of the present, watershed line of the Dargo River.

General conclusions.

The general conclusions are, that this ancient river—the Dargo of the Miocene epoch—headed from near Mount Fainter; that the deposits at White's claim, Boiler Plain, Mount Tabletop, and Mayford spur, are remnants of its bed, or those of its branches; that the intervening parts, and the heads of most of the tributaries, have been entirely removed during the deeper erosion of present rivers; that a large western affluent came in from a direction across what are now the courses of the Twenty-five-mile and Thirty-mile creeks, the two main heads of the Crooked River; and that the southern extension of the ancient system, from the Eighteen-mile Creek downwards, has been utterly obliterated, though the ancient river probably joined the sea of the Miocene epoch near where the Mitchell valley now emerges from the ranges.

The lava-flows, by filling in the old drainage channels, caused those which formed afterwards to deviate from the original beds; and while we find evidences of ancient streams, corresponding to the present Dargo and Cobungra rivers, separated by a main divide which had partly the same and partly a different course from the present one, we find that the deviations caused by the lava-flows have resulted in the changes of watershed by which the heads of the Cobungra River and those of the Crooked River now occupy respectively the country once drained by the northern and western heads of the ancient Dargo.

It does not appear that glacial action took any part in the denudation of the country since Miocene times, as there are no signs of it in the Dargo and Cobungra valleys: fluviatile and atmospheric action, the former perhaps once more potent than now, seem to have been the only agencies that sculptured the country to its present form subsequent to the lava-flows.

Volcanic.

The basalt or lava forming the high plains is here referred to the Older Volcanic (Miocene) period, immediately overlying, as it does, sedimentary deposits, shown by their fossil flora to be of Miocene or Middle Tertiary age. Objection may be taken to this classification on the ground that the fact of basalt overlying Miocene deposits does not necessarily prove it to belong to that epoch, but the evidences here are to the effect that the Miocene beds were still in actual progress of deposition when the lava poured over them.

The general structure of the basalt is columnar, fine specimens of the large pentagonal columns occurring near Mount Hotham and elsewhere.

Portions of the surface of the Bogong High Plains have the appearance of being paved with five-sided blocks of stone, and on some of the mountain sides, where land-slips have taken place, are acres covered with jumbled heaps of five-sided logs of basalt.

The basalt throughout this country is highly magnetic, so much so that, when taking compass bearings, I have had to ascend trees and observe from the elevation so attained, to escape the influence of the rock on the instrument. In an appendix by Mr. A. W. Howitt will be found detailed mineralogical descriptions and results of microscopic examination of the principal varieties found. As before pointed out, there may have been more than one flow of lava, and indeed it is hardly reasonable to suppose that the entire thickness of basalt, amounting, as before shown, in some places to 700 feet in thickness, could have been poured out in a single stream. No apparent vents, or pipes, whence the lava-flows issued, have been discovered, but they probably exist in the country to the north and north-west, and being, as such usually are, of small extent, have not yet been noticed.

Having so far described the geological aspect of the Bogong and Dargo plateaux, it remains to be considered whether these plateaux are likely to afford extensive and remunerative employment to miners, and, if so, what is the best way to develop their resources.

Auriferous Character of the Drifts.

At White's claim the gold was first found around the edge of the gravel, at its contact with the Silurian, and, as might be expected from the natural sluicing operations in force during the denudation of the country, the gold was here richer in quantity than it was found to be subsequently while working the gravel *in situ*. At the same time, the party now working the claim find a well-defined "run," or lead, about 20 feet wide, yielding moderately payable gold, and evidently continuing under the basalt in a southerly direction. At Morris's claim, below Boiler Plain, the richest gold was got in the little isolated remnant of gravel first found, and the gold was here heavy and coarse: at the workings, where the tunnel advised to be driven by Mr. R. Brough Smyth was put in along the bed of the lead, the gold was

found coarse and of a good sample on the high reef on the western slope of the gutter. Previous to the contractors' commencing the tunnel, the Government prospecting party, under my advice, commenced a shaft which would probably have reached the deepest ground within 20 feet of the surface, but on arrangements being completed to drive the tunnel to test the same ground, and on finding the tools they then had were insufficient to get through the hard cement reached at 10 feet, they desisted from further sinking. The last 6 feet of the shaft passed through coarse heavy gravel, and in every dish tried from twenty to fifty specks of fine gold were obtained, and the last, from the cement, was of somewhat heavier character than that washed from the stuff above. The prospects since obtained by the men who drove the tunnel show a still further improvement, though not equal to the prospects reported from the higher reef; this, however, is by no means uncommon in mining experience, as it is frequent both in deep and shallow alluvial mining to find the richest deposits of gold on points and slopes of the bed-rock, as well as in the deepest portions of the bed.

At Mr. Armour's claim, at the southern end of Mount Tabletop, the proprietors have made fair wages, though much time has been lost through scarcity of water: the gold is here fine, but weighs well. No certain information was obtained as to the gold obtained in the workings at Mayford spur, but the general account is that it was payable, or nearly so, while water remained plentiful: most of the gold here is fine, but a piece of 14 dwt. is reported to have been obtained from a blind shaft sunk in the end of Synnot's tunnel. Gold was also obtained by the Government prospecting party during the little prospecting they were able to accomplish in the gravels on the falls into the Little Dargo and Pyke's Creek. Payable gold is also reported in the gravel worked at German terrace, though the workings there are merely in the mixed débris on the side of the hill, and have not been carried into the wash *in situ*.

Many of the creeks and gullies draining the plateaux, though patchy, have yielded good returns below where they have cut through the courses of the old gravels; the Twenty-five-mile Creek, in particular, is stated to have been best close up to the junction of the Silurian and basalt, and was worked until the number and size of the fallen blocks of the latter prevented the diggers from going further: this indicates the proximity of the gravel of the great western affluent previously referred to. The general information obtained all leads to the conclusion that the gravels are auriferous throughout, but that, from their great thickness and the dissemination of the gold through a great portion of that thickness, they can only be profitably worked on a large scale, and by means of an ample water supply for ground sluicing or hydraulic mining. The latter method will only be available within certain limits near the exposures of the gravels on the hill sides; for as they are worked in towards the hills, the enormous thickness of overlying clays and sands, with the basalt above, will be too much even for the Californian hose to compete with effectively. Ultimately, therefore, the working of the gravel will have to be accomplished by means of tunnels, near the entrances of which water will have to be conducted in sufficient volume to form powerful sluices, into which the washdirt can be tipped as brought out. Even with the short races now in use an over abundant supply of water is available during the wet season, but this runs short during the dry months, so that, to enable regular work to be carried on, races of great length tapping springs and the heads of constantly running streams would

be necessary to ensure a supply during the whole year. Those who have hitherto worked the places described have been men of limited means working for speedy returns, and neither possessing at the commencement, nor winning subsequently from the ground, sufficient to enable them to extend their races as they saw was requisite, and no capitalists have yet turned their attention towards developing this branch of mining in the Dargo and Bogong district.

Estimated extent of available ground.

Subjoined is an estimate of the lengths of the portions of the main lead and its principal western tributary which remain undenuded south of the Cobungra, too little being known of the deposits under the basalt of the Bogong plateau to admit of their being included;—Cobungra plateau, 3 miles; Boiler Plain, 1 mile; south-west side of Tabletop, ½ mile; Mayford spur, 1½ mile; between Pyke's Creek and Little Dargo, 1 mile; western branch from direction of Thirty-mile Creek, 5 miles—total, 12 miles. Other small leads concealed beneath the basalt might possibly increase the actual length of workable ground to 20 miles. The width and thickness of workable gravel will of course vary greatly, but may be estimated at from 20 to 100 feet for the former, and 2 to 10 feet for the latter. I consider that there is good reason for the opinion that fairly remunerative, and in places rich yields, are likely to be obtained, but that, owing to the scarcity of quartz reefs in the adjacent country, there are no grounds for expecting that they will approach in value the returns from the leads of the western goldfields, which are situated in country traversed by great belts of auriferous quartz reefs. Assuming the gravel included in the above estimate to afford a fair margin of profit over working expenses, there is certainly a great field open to the enterprise of the mining public.

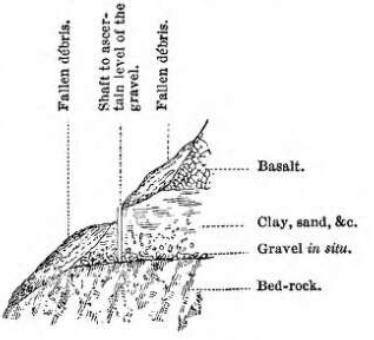
Suggestions for Government Prospecting.

I beg to suggest that a moderate outlay on the part of the Government is advisable for the purpose of ascertaining and informing the public of the value of the gravels of the Dargo plateaux. The labors of the Omeo prospecting party were, during the first portion of their engagement, directed to shallow ground at the heads of the Cobungra, the Bundarrah, and the Kiewa, but it was intended that they should also prospect the sub-basaltic gravels of the high plains. Unfortunately they were not sent out until three of the most favorable months of the year—November, December, and January—had passed, and the period of their engagement expired with the close of the financial year, 30th June 1877. After they had prospected the shallow ground, which they did well and thoroughly, though unsuccessfully, they were unable, on account of the setting in of the wet and snowy season, to do more than superficially try a few places where indications of the outcrop of gravel were visible. I would therefore recommend that a small party be fitted out solely for the purpose of prospecting the gravels appearing from beneath the basalt on the falls from the Main Divide into the Cobungra and Dargo rivers, and also on the western side of the Dargo: the operations of the party should be under competent supervision, and be commenced in November, so as to have six months of favorable weather before them. As already pointed out, a number of places are now ascertained where the inlet or outlet of gravels beneath the basalt are to be found in natural section, but the immense quantity of surface débris prevents the exact level at which to drive into the gravel from being immediately ascertained. To find the contact of the gravel and bed-rock *in situ* in the

deepest part of the channel should be the first object, and this can only be done by experimental cuttings and shafts, sites for which would have to be selected according to the circumstances of the appearance of the ground, the exposed occurrence of the clay and sand beds above the gravel, &c. The difficulties alluded to and method of dealing with them are illustrated in the accompanying sketch (Fig. 5).

FIG. 5.

Sketch illustrating difficulties opposed by fallen débris to discovery of contact of gravel *in situ* with bed-rock.



Once the actual bed of the lead is thus found, the prospecting thereof by driving along and across its course will be an easy matter, and it should be tried across and up the boundary reefs as far as gravel continues, notes being taken of the amount and thickness above the bed-rock of the stuff washed, the width of auriferous gravel, the yield, and all other points bearing on the economy of mining. To test only one or two places thoroughly in the manner suggested would be of more practical utility than to try superficially every gravel exposure in the district.

Prospecting by boring.

To prospect by boring has nothing to recommend it whatever; however useful to discover the trend of a lead in such country as that near Ballarat, it would possess no advantages here, where the general courses of leads, from one point of exposure to another, can be readily judged from surface examination. The expense of boring 500 to 1,000 feet, principally through basalt, would be very great, and as a means of testing the auriferous quality of the gravels boring would be useless.

REGINALD A. F. MURRAY,
Geological Surveyor.

Sale, 17th July 1877.

APPENDIX.

EXAMINATION OF ROCK SAMPLES COLLECTED BY REGINALD A. F. MURRAY AND A. W. HOWITT AT THE BOGONG AND DARGO HIGH PLAINS.

Twenty-five thin slices of these rocks were prepared, from which the following have been selected as illustrative of the rocks of the district.

No. 1.—Junction of Brandy Creek with the Cobungra River.

A fine-grained gneissose schist. An examination of the locality shows that the Silurian slates and sandstones of the Upper Dargo become metamorphosed on the eastern side of that river.

The changes observable in proceeding eastward are—1. Mica schist; 2. Gneiss; 3. Granite.

This sample may represent those schists which stand between 1 and 2.

A thin slice of this sample was prepared perpendicular to the foliations.

It consists of alternate foliations of mica and quartz with a little felspar. The foliations are of irregular thickness and uncertain distance apart, the separation being made by narrow folia of mica. The mica is most probably biotite. It is brownish-yellow in color, and is strongly dichroic, changing in color, on rotation over the polarizing nicol, from brown-yellow to nearly black. The quartz predominates much. It is not found in distinct grains, but in what may be termed granulations, and of the kind usually seen in metamorphic schist. With it is a little felspar, mostly monoclinic, but more rarely showing the triclinic striations. It is nowhere well crystallized. Very few, if any, inclusions are to be observed, and these of indefinite character.

A mica schist rich in quartz with a little subordinate felspar.

No. 2.—Source of the Kiewa River, Camp 4 of the Omeo Prospecting Party.

In tracing the metamorphic crystalline schists further to the eastward their structure becomes coarser, and, finally, they are represented by rocks which might either be termed coarse-grained gneiss or granite having a gneissic structure. An examination of the district leads to the belief that these rocks represent the most completely metamorphosed of the Silurian sediments.

The sample here chosen was an extreme form, in which the gneissic structure was completely wanting. It represents a rather coarse, grey, ternary granite. The rock occurs in weathered rounded masses protruding from the thick alpine sward of the Bogong table-land.

In preparing a thin slice I found this rock to be one of the hardest and toughest of the granite rocks which I had examined. Under the microscope it proved to be a crystalline granular compound of—

(1.) Plagioclase. This triclinic felspar predominates in the structure and occurs in two forms—(*a.*) Small well-crystallized prisms of the character often met with in some granites, *e.g.*, those of Beechworth and of Genoa Peak. (*b.*) Some few larger crystals of remarkable polysynthetic structure. The interior of one of these crystals, which was very distinctly shown in the slice, consists of two portions, each of which is again compounded of numerous laminæ. These are probably compounded—first, according to the law "axis of rotation normal to i$\breve{1}$"; second, according to the law "axis of rotation parallel to i$\breve{1}$." The exterior part of the crystal consists of a rather wide margin, or shell, mostly homogeneous in character, but showing plainly concentric growth, whilst, in places, the striations of the internal halves extend into or across the external shell.

(2.) Of quartz grains of the character usual in granites. These fill in spaces between the felspars. Fine hair-like bodies, and more rarely stout colorless prisms, suggestive of apatite, are the only inclusions observable. Minute fluid cavities are exceedingly numerous, but in only two or three cases could I detect in them what seemed to be minute bubbles.

(3.) Of ill-formed crystals of monoclinic felspar. In many of these are portions which show triclinic striæ, indicating inter-growth of the two classes of felspars. These orthoclase felspars are quite subordinate.

(4.) Of yellow-brown mica, in flakes lying between the other constituents. They are strongly dichroic, yellow-brown, changing on being rotated to almost black. A portion of the rock was roughly broken. Pieces of

felspar were picked out as free as possible from quartz or mica. These were powdered, and digested for several days with concentrated hydrochloric acid. Partial decomposition took place, and the solution gave a decided lime precipitate, with oxalate of ammonia. This reaction was stronger than I have observed with oligoclase, but not by any means so strong as that with the lime felspars of Swift's Creek. The mica is rather brittle, and in irregular flakes of a shining black. Before the blowpipe it fuses without much difficulty to a black magnetic mass. It is somewhat strongly acted upon by hydrochloric acid, and thus approaches in these characters to lepidomelane.

Assuming that the determination of this granitic rock, as being an extreme example of the metamorphic crystalline schist of the district, is correct, some interesting points arise. An examination of a mass in the field would show that it strongly resembles, in its structure, the true intrusive granites. A microscopic examination of a thin slice would indicate it as being a quartz mica diorite, while its connection by intermediate gradations with the gneisses of the Cobungra River would show that it, like them, is the result of the metamorphism of sediments. A series of analyses of the various rocks, commencing with the normal slates of the Dargo, and ending with the plagioclase granite of the Bogong Plains, would be of the highest interest.

No. 3.—Mount Fainter.

This is a basalt, having a microporphyritic structure.

The ground mass consists of interlacing minute plagioclase prisms, grains of augite and olivine, and some magnetite.

In this are, porphyritically—

(1.) Imperfect crystals of augite.

(2.) A few large augite grains.

No. 4.—High Point between Cobungra and Kiewa Rivers.

This basalt has a microporphyritic structure.

The ground mass is microcrystalline, consisting of minute plagioclase prisms and grains of augite, olivine, and magnetite. In this are numerous imperfect olivine crystals and granules.

The olivine crystals and granules are traversed by numerous irregular flaws, along which alteration has set in, the result being a yellowish-brown or dark-greenish serpentinous substance. The only inclusions in the olivine are opaque octahedral crystals, magnetite, and a few less regularly formed, which are dark-brown, and which may perhaps be picotite. But I was unable to confirm this.

No. 5.—Bogong Plains.

A basalt, having a microporphyritic structure. The ground mass is composed of rather long prisms of plagioclase, between which, besides some small amount of devitrified base, are very numerous pale-brown augite granules and some magnetite.

In this are :—

(1.) Olivine, as in No. 4.

(2.) Compound irregular masses of augite granules. One of these masses is composed of augite and olivine granules.

No. 6.—Divide between Cobungra and Bundarrah Rivers.

Basalt. The structure of the ground mass is semi-crystalline, or even granular. Besides portions of devitrified base are grains of—

(1.) Augite of pale-brown color.
(2.) Small prisms of plagioclase scattered among the augite grains.
(3.) Magnetite and titanic iron, their respective rectangular and hexagonal outlines being clearly distinguishable.

In this ground mass are—

(1.) Imperfectly formed olivine crystals, as in No. 4.
(2.) Masses of augite grains, arranged closely together, to the exclusion of the other constituents. The augite includes magnetite.

No. 7.—Brandy Creek, Cobungra River.

This is a porphyritic dolerite. The ground mass is composed of—

(1.) Plagioclase prisms, aggregated together in groups.
(2.) Purplish-brown granules and imperfect crystals of augite.
(3.) Magnetite.

In this are porphyritic crystals of augite, about ·1 inch diameter. Polarized light proves them to be clusters of more or less perfect crystals, which nearly all show traces of twin structure. This augite is pale-brown yellow, and in places purplish. Where the latter color occurs the augite is decidedly dichroic, and this remark holds equally as to the small grains. Mr. Allport makes a similar remark as to the augite of dolerites from Necropolis Hill, Glasgow.*

Among the other constituents is a yellowish-brown colored material filling in irregular spaces, and having much the appearance of a secondary product. It is, however, crossed in various directions by numerous short stout hexagonal prisms. These are externally yellowish-brown, but internally colorless, as is shown by their cross-sections. These behave exactly like apatite, when examined between crossed nicols, and have the structure and appearance of that mineral.

No. 8.—Brandy Creek, Cobungra River.

A porphyritic dolerite. The ground mass is as described in No. 7, but the triclinic felspars are smaller in size. The porphyritic augite is remarkable for its size, and its beautifully developed examples of twin structure.

The ground mass, as well as the various crystals, are permeated in places by a dark-yellow secondary substance, which seems to be the result of decomposition of perhaps olivine grains.

No. 9.—Bogong High Plains.

The mineral was observed to occur in rough fibrous-looking masses, about ·5 inch diameter, in basalt, near the source of the Bundarrah River. In a thin slice it is almost colorless, having only a faint trace of brown. It has a strongly marked but not very regular cleavage (prismatic?) in one direction. These cleavage planes are, in places, lined by a black or dark-brown substance. A second cleavage of far less marked character crosses the former at an angle of about 62° 30′, which was the

* On the Microscopic Structure and Composition of British Carboniferous Dolerites. L. Allport, Esq., F.G.S. Quarterly Journal of the Geological Society, No. 120, Dec. 31, 1874, p. 534.

mean of several measurements. Rows of minute black specks mark this latter cleavage. These are also very numerous along the direction of the strong cleavage, and, under a high power, prove to have, in many cases, a central clear spot surrounded by a dark margin, and are probably air or gas cavities.

The application of polarized light showed that the optical properties of this mineral are those of augite.

No. 10.—Battery Hill, Cobungra River.

This basalt has a microporphyritic structure. The ground mass is granular. Together with portions of devitrified base are—

(1.) Augite granules.
(2.) A few small prisms of plagioclase.
(3.) Magnetite.

In this are larger porphyritic crystals of olivine.

No. 11.—Mayford Spur, Dargo River.

The basalt has a microcrystalline ground mass, consisting of—

(1.) Plagioclase prisms.
(2.) Augite grains, which in places are aggregated together, including prisms of the triclinic felspars. These masses become wholly dark, as regards the augite, when rotated between crossed nicols.

In this ground mass are more or less imperfect crystals of olivine.

No. 12.—Dargo High Plains.

This is a porphyritic dolerite, in which the porphyritic mineral is oligoclase, in crystals. An example cut from one of the porphyritic crystals showed that it consisted of beautifully compounded triclinic felspars, displaying the twin structure very distinctly. The crystals are, however, not well formed, but have mutually interfered with each other, thus producing a crystalline granular structure. Among the well-characterized triclinic felspars are others without any striations, and which, otherwise, much resemble orthoclase.

No. 13.—Eighteen-mile Creek, Dargo High Plains.

The structure of this basalt is microporphyritic. The ground mass consists of—

(1.) A small portion of devitrified base.
(2.) Very numerous narrow plagioclase prisms aggregated in groups, their longer diameters being generally accordant in direction. In the neighborhood of porphyritic crystals they conform to the outlines of the latter, but beyond them resume their general direction.
(3.) Numerous exceedingly minute light-brown granules of augite.
(4.) Magnetite.

In this ground mass are numerous porphyritic grains and well-formed crystals of olivine. This mineral is all more or less attacked along the irregular flaws traversing it. The result is the production of a yellowish to dark-greenish serpentinous substance. In the slice the process of alteration may be well followed, from mere stains to the complete destruction of the olivine.

Assuming that the age of the Dargo and Bogong basalt is that indicated by the fossil flora of the streams which it overflowed and sealed up, it is manifestly of interest to ascertain, if possible, whether it can be distinguished by any reliable characters from those more recent basalts which occur elsewhere in Victoria—in other words, the Newer Volcanic. For this purpose, I carefully examined the examples which I already had prepared from near Melbourne, and, in addition, completed a series collected from various parts of the Western district. I found the structure and composition of both series, the older and the newer, to substantially agree, the only distinction to be drawn being that in some of the Bogong and Dargo rocks their porphyritic character and the prevalence, indeed preponderance, of augite was marked. Considering, however, that the examples of newer basalts from western Victoria were collected from more superficial and often very vesicular or scoriaceous flows, while those from North Gippsland were taken from sheets of basalt which represent only the deeper-seated portions of the sheets, this distinction may be said to have little or indeed no weight. So far it may be said, therefore, that my examination has shown no good distinction to exist in the structure and composition of the newer and older basalt of Victoria.

In respect to these Gippsland basalts, I may notice, finally, that, where olivine occurs as porphyritic crystals, augite retreats into microscopic dimensions, and *vice versâ*.

No. 14.—Dyke near Battery Hill, Cobungra River.

This traverses the metamorphic crystalline schists. It consists of plagioclase, augite, magnetite, and chlorite. It is, therefore, a diabase, and its whole aspect microscopically conforms to this definition.

No. 15.—Dyke, White's Claim, Brandy Creek, Cobungra River.

This rock has, under the microscope, a dark-colored finely-granular base, in which are indistinct outlines of felspar crystals. Some few still retain striations. Two irregular patches of dark-green chlorite (viridite) suggest former hornblende crystals. This was probably a hornblende porphyrite.

No. 16.—Dyke, White's Claim, Brandy Creek, Cobungra River.

Under the microscope this rock is seen to have a felsitic base, in which are grey opaque patches resembling those resulting from the alteration of felspars. The outlines are scarcely to be defined, owing to the general alteration which has taken place. In the general mass are stout green and brownish hornblende prisms. Apatite can be recognised in long narrow needles. A few quartz grains in interstices suggest that they are secondary products derived from the alteration of the felspars.

This is probably a hornblende porphyrite, approaching a diorite in character, and between which classes intermediate forms occur.

Nos. 15 and 16 traverse the Silurian strata near the metamorphic boundary.

No. 17.—Mount Flora, Bogong High Plains.

This mineral occurs among the decomposed basalt, at one of the sources of the Bundarrah River. It is found in infiltrated masses, filling or incrusting cavities.

H. over 5; sp. gr., 3·04; color, yellow-brown; streak, white.

A quantitative examination gave me—

$FeO.CO_2$	6·37
$CaO.CO_2$	91·50
$MgO.CO_2$	2·71
	100·58

A small percentage of $MnO.CO_2$ has not been determined, except qualitatively before the blowpipe. Taking "ferro-calcite" to include those indefinitely mixed carbonates occurring under such conditions as those above stated, it may be held to merge on the one hand into calcite and on the other into spherosiderite. This mineral would be thus included.

I give, as a comparison, the two following analyses:—

Ferro-calcite—	$CaO.CO_2$	$FeO.CO_2$	$MgO.CO_2$			Sp. grav.
* Hunt ...	93·90 ...	4·64 ...	1·59	=	100·13 ...	2·715
† Newbery ...	72·43 ...	20·65	5·00	=	100·00 ...	2·860
		$MnO.CO_2$ 1·92				
Howitt ...	91·50 ...	$FeO.CO_2$ 6·37 ...	2·71	=	100·58 ...	3·049

In the Mount Flora example the hardness and density are both unusually high, and are evidently connected with the toughness of the mineral, as experienced in preparing a thin slice. This, examined under the microscope, shows that the internal structure of this mineral agrees with the view that "ferro-calcite" is no definite mineral species. One portion of the slice is certainly a crystal, being wholly obscured at the same time between crossed nicols. It also polarizes with far more color than usually does calcite, and it is traversed by a well-marked rhombic cleavage. The remainder polarizes merely as an aggregate of doubly refracting particles, without color. In this portion are specially included some black flocks, which are probably impurities derived from the decomposing basalt.

This mineral is therefore, it seems, a mixture of the carbonates, and not a definite compound.

A. W. HOWITT.

NOTES ON THE DEVONIAN ROCKS OF NORTH GIPPSLAND.‡

By A. W. Howitt, F.G.S.

The Buchan Limestones.

In a footnote appended to page 199 of my former paper on this subject I stated that at Butcher's Creek I had found that the Snowy River porphyries consisted of beds of over 1,000 feet in thickness, of the usual fragmental character, with interbedded sheets of felstone, and that I had noticed that some of the beds had a marked conglomeratic character, and that nearly all of them included very numerous fragments of slate, sandstone, and quartzite, of the character of the Lower Silurian of the district.

Following out the clue thus obtained, I have since that time worked out more in detail those facts which are observable in the neighborhood of Buchan as bearing

* Dana. System of Mineralogy, p. 680.

† Physical Geography, Geology, and Mineralogy of Victoria. Exhibition Essays, 1866, p. 75.

‡ Continued from the Report of Progress of the Geological Survey of Victoria, No. III., p. 181.

upon this subject. The results of those continued investigations I now propose to record as a further contribution to our knowledge of the Upper Palæozoic formations of North Gippsland.

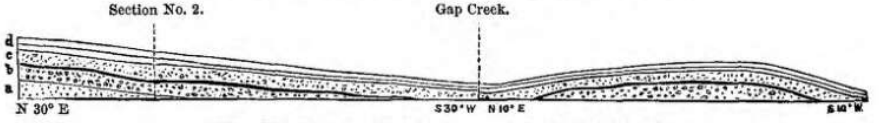
My previous investigations had led me to believe that the marine limestones of Buchan rested directly upon the Snowy River porphyries.* I observed, however, that there seemed to be a small thickness of beds at the base which were not wholly calcareous, and which, to me, had a littoral character. In tracing out the clue obtained at the Butcher's Creek, these views have become greatly altered, and it will be seen from the succeeding statements that the purely marine limestones of Buchan form but a moiety of the formation with which they are naturally grouped, and which they serve to identify as of Middle Devonian age.

BUTCHER'S CREEK AND MURENDEL RIVER.

These two streams rise at no great distance apart on the Gelantipy table-land. They flow southwards in deep valleys and join at Murendel, afterwards forming a junction with the Buchan River.

Commencing with the Butcher's Creek, the following statements may be made:— In tracing this stream up or down from the mouth of Gap Creek, the actual base of the group is not well determinable. This is partly owing to the slight angle of dip of the beds, the course of the creek being approximately along the strike. It is, however, probable, as I have shown in the subjoined sketch, that it rests upon the worn surface of much older felsitic rocks, in fact upon the porphyries of the Snowy River.

No. 1.—Sketch-section along the course of Butcher's Creek.



Scale.—Horizontal, 40 chains to 1 inch; vertical, 2,000 feet to 1 inch.

"*a*." Massive, rather harsh textured, quartz felsites.

"*b*." A thick mass, without stratification, of rounded or sub-angular felsite blocks, associated with smaller fragments of all sizes. The whole is in some places completely massed together, so that structure is almost obliterated. These felsite fragments narrowly resemble the massive quartz felsites of the district, as at Black Mountain or Gellingall.

Between "*b*" and "*c*" are beds from 3 to 4 inches in thickness, resembling sandstones or grits. The materials forming them are, however, derived from felsitic rocks, and are either minute grains forming sandstones, or more generally angular fragments, forming trappean breccias. These beds are clearly aqueously deposited, and, from the peculiarity of their structure and their constituent materials, strongly suggest that they are altered tufas.†

* This term is not quite satisfactory to me; but it may serve provisionally to describe a marked feature in the massive felsites of the Snowy River. These rocks, which are perhaps the most prominent of the group, contain as a rule free quartz in crystals or crystalline grains. Thus the term is justified. The remainder of the group consists either of fragmental or compact felsites.

† I use the terms "tufa" and "breccia" as indicating volcanic materials which have fallen into and been re-arranged by water; ash and agglomerate are similar materials which have fallen upon land.

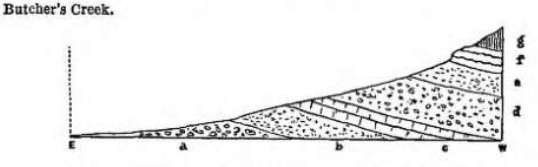
"*c*." Breccias containing numerous fragments of slates, and becoming conglomeratic in places.

At one place where I observed them forming the base of a cliff they were about 30 feet in thickness; the upper part of the cliff, for about 50 feet, being rudely stratified breccias, again followed as it seemed by sandstones more thickly bedded than those at the base.

"*d*." Yellow and grey compact felsitic beds. In places where these beds have the appearance of being compact felsites (felstones), the appearances suggest that there may have been more than one flow, alternating with very finely fragmental beds (*see* lithograph plate No. 2, Fig. 7).

We may therefore picture to ourselves that this group rests upon the older felsitic rocks of the Snowy River, and that it is commenced by a coarse deposit of large boulders, and angular fragments of felsites of various, but yet always of highly acid character. These are followed by an alternation of aqueously arranged sandstones and breccias, composed almost entirely of volcanic materials, some tufas, and probably one or more sheets of compact felsite. It seems from my observations that the greater percentage of fragments of sedimentary rocks occur in the breccias above and not below the sandstones separating "*b*" and "*c*."

No. 2.—Sketch-section at Butcher's Creek.



Scale.—Horizontal, 8 chains to 1 inch; vertical, 500 feet to 1 inch.

"*a*." Coarse conglomerate, containing some few rough angular fragments. It consists mainly of felsites, with fragments of slates and sandstones, resembling those of the Lower Palæozoic formations.

"*b*." Thick-bedded breccias, composed of small felsite and slate fragments.

"*c*." Thick-bedded felsitic sandstones and grits.

"*d*." Felsite breccia-conglomerate of rather coarse materials, but with distinct signs of bedding.

"*e*." Fine breccia-conglomerates similar to "*d*."

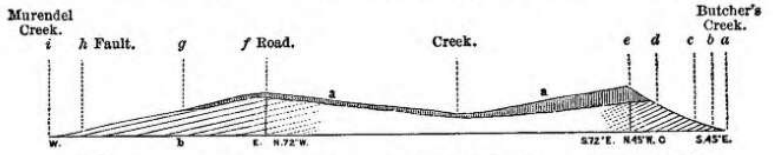
"*f*." Compact yellow or reddish felsite. It seems to be composed of several sheets, some of which are only separated from each other by an irregular contact. The base where visible is very uneven, and conforms to the rises and hollows of the underlying breccias. I observed in one place that the lower face was vesicular; the upper surface is nowhere visible, being covered by

"*g*." Basalt.

"*a*" and "*c*" in Section No. 2 may be taken as equivalent to "*b*" and "*d*" in Section No 1.

The second section which I obtained at Butcher's Creek was from about one mile above the junction of Gap Creek. (*See* Sketch-section No. 1.)

No. 3.—Sketch-section from Murendel Creek to Butcher's Creek.



a Basalt. *b* Upper Buchan beds. *c* Lower Buchan beds. *d* Massive felsites.

Scale.—Horizontal, 40 chains to 1 inch; vertical, 2,400 feet 1 to inch.

The above section crosses the Maneroo road about a mile north of Murendel Hill. Commencing at the Butcher's Creek, the following description may be given :—

"*a*." Junction of Butcher's and Gap creeks : Yellow compact or granular felsitic beds ; these are equivalents of "*c*" of Section No. 1 and "*d*" of Section No. 2.

"*b*." Coarse breccia-conglomerates without much trace of bedding, and consisting, beside the usual felsite fragments, of very numerous rounded or subangular pieces of slates and sandstones, to all appearance derived from the Lower Palæozoic (Silurian) formation of the neighborhood.

"*c*." Similar rocks, but of finer texture, extending to "*d*," where they are distinctly bedded. The beds are from 6 inches to several feet in thickness, and dip N. 65° W. at 7° to 10°. The uppermost beds are of a fine texture—resembling a fine-grained sandstone. In descending order they become coarser, passing into the breccias and breccia-conglomorate as at "*e*." They consist mainly of felsitic grains, of which most are rounded, but a certain percentage is angular. Overlying these bedded rocks at "*d*" is the basalt sheet of the Butcher's Ridges. The lowest part of the sheet which may be seen resting upon the felsitic sandstones is formed of rough masses, including numerous scoriaceous and glassy fragments. This basalt is probably of Middle or Lower-Upper Tertiary age.

"*f*." From this point the section crosses to the Maneroo road near the "*W*" tree, no other rocks being met with than basalt of the ordinary compact or vesicular character of the district.

"*g*." In descending into the valley of the Murendel the basalt sheet ceases nearly at the same level at which it was found to commence in the ascent from Butcher's Creek. It is immediately succeeded by limestones, having, among other numerous marine fossils, the usual and characteristic Spirifera lævicostata of the Buchan beds.

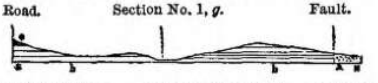
The sequence of this group is as follows :—Compact blue limestones of moderate thickness are followed by thin-bedded limestones, some of which contain a large percentage of angular felsite fragments, which, in the weathering of the calcareous beds, stand out in relief. They are deposited either irregularly or in bands.

Underlying these are thick yellow beds, which are in all probability either decomposed felsites or consolidated felsitic mud. That they are the former, at least in part, is shown by a slice examined under the microscope, in which the ordinary structure and composition of a quartz-bearing felsite could be clearly made out. These rest upon limestones, which are abruptly but conformably succeeded by thick red beds resembling sandstones. These extend down to

"*h*," where they suddenly cease at harsh granular felsites without bedding or any visible fragmental structure. These felsites are massive, but traversed irregularly by two sets of joints, one dipping east at 45°, the second running east and west, and being vertical.

A cross-section at "*g*" is now given, as showing that the limestones extend some distance north and south, and there end, as delineated, against the massive harsh felsite common at the Murendel River. The limestones wherever seen maintain their low angle of dip. Other faults than that shown in Section No. 3 are indicated here.

No. 4.—Sketch-section at Murendel River.



a Quartz felsites. *b* Buchan limestones. *c* Basalt.
Scale.—Horizontal, 20 chains to 1 inch; vertical, 1,200 feet to 1 inch.

In tracing up and down the Murendel River, from the western end of Section No. 3, no other rocks were to be observed than the ordinary harsh massive felsites, with the exception at one spot of compact felsites, which I regarded as forming part of an intrusive mass.

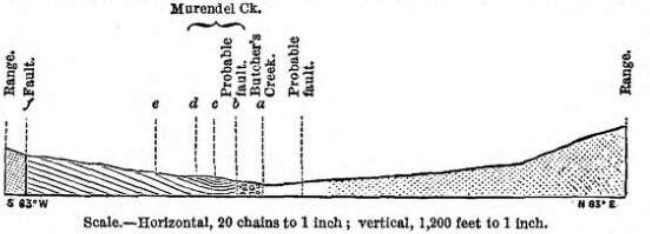
After carefully examining and considering the beds just described, I conclude that those at Butcher's Creek, as their dips indicate, are inferior in position, and that both portions form part of one series, and as such I have treated them.

We should in that case have here a sequence downwards from limestones of purely marine origin, through calcareous and felsitic tufas, sandstones, breccias, and conglomerates, to what is probably a volcanic series of littoral origin.

The total thickness of the group, assuming it to be continuous and that no portion reappears in each part, might approximately be estimated as follows :—

	Feet.
Limestones	270
Tufas, breccias, &c.	1,000
Total thickness	1,270

No. 5.—Sketch-section crossing junction of Murendel and Butcher's Creeks.



Scale.—Horizontal, 20 chains to 1 inch; vertical, 1,200 feet to 1 inch.

The above section I found at the junction of the Butcher's Creek with the Murendel River.

"*a*." Coarse dark-red breccia, or breccia-conglomerate, some few of the fragments being rounded, consisting mainly of compact felsite, but some fragments appearing to be indurated slate and sandstone, with quartz. No bedding visible; in the west side of the stream red sandstones seem to rest upon or even pass down into the breccia.

"*b*." Buff-colored calcareous beds, dipping N. 55° W. at 20°.

"*c*." Bluish limestones, showing numerous lines of small felsite fragments, dipping S.E. at about 15°.

"*d*." Buff-colored calcareous beds, such as those at "*b*." They rise up from beneath "*c*," and are thin-bedded, dipping S. 80° E. at 10°. These beds are very full of small felsite fragments, lying in the mass without any definite direction.

"*e*." Grey crystalline limestone, the dip uncertain but small.

"*f*." Ordinary Buchan limestone, commencing near "*e*." The dip probably E., at a low angle. The limestones end abruptly at "*f*," lying at a low angle against the ordinary harsh quartz felsites of the district, which to the westward rise up into high hills. In ascending the eastern side of the valley from "*a*" the only rocks met with are similar harsh, massive, and rather granular felsites. In places I observed in them irregular scoriaceous-looking cavities, but no other distinguishing characters. I examined this side of the valley, which rises to a great height, for some miles.

Some two or three miles up Butcher's Creek from the line of this section I observed a large mass of intrusive compact felstone which had penetrated the older granular felsites. Two faults seem to be indicated in this section. One at the western side of the stream, where the limestones terminate abruptly ; the other perhaps at the stream, where the peculiar yellow calcareous beds seemed to me to end against the breccia, or else possibly on the east side of the stream, where the ordinary harsh felsite commences.

From this place the Murendel River flows in a generally southerly direction to its junction with the Buchan, and it becomes strikingly evident, on looking down its valley, that the limestones are confined to the western side, showing a succession of cliffs and grassy, thinly timbered hills, while the east side of the valley has the usual rugged and more densely timbered appearance of the tracts where occur the felsites of this district.

This would receive a sufficient explanation by supposing the existence of an extensive north and south fault, which has determined the course of the stream, erosion having been most easy along the contact of the limestones and the felsites. This suggestion is further confirmed by the occurrence of a well-marked abrupt line of demarcation on a steep cliff side about a mile down stream from the last section, and a sketch of which is here given (Fault at Murendel). Lower down the stream, however, it is evident that the peculiar alternation of high limestone cliffs with lower spurs of felsitic rocks is due to a folding of the strata along the strike by which the underlying formation is occasionally brought to the surface.

This cliff is about 70 feet in height. The dip ofthe limestone at one end of the cliff S.W. to S. 60° N. at 18°; at the other end N. 85° W. at 20°. At the base of the cliff are yellowish or greyish beds, some almost wholly composed of angular felsitic material, others only containing a few scattered fragments. These fragments are either in bands or irregularly distributed. Above half-way up the cliff the usual bluish-grey limestones of Buchan come in, but even here some beds contain numerous felsitic fragments. At the summit are limestones with the usual characteristic Buchan fossils. Spirifera lævicostata is even met with in isolated instances in the lower beds.

To the east of the limestone cliff, and separated from it by a grassy hollow, is a second cliff of great masses of a rough felsitic rock. It weathers reddish-brown,

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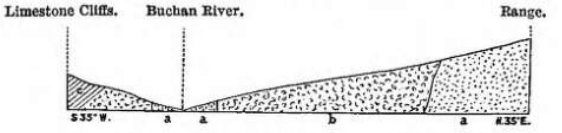
VIEW OF FAULT MURENDEL CREEK

but on a fresh fracture is greenish. It has then the appearance, when observed under the lens, of a rather coarse felsitic ash.*

Near the junction of the Murendel with the Buchan, however, other sections may be seen, which again show features somewhat similar to those already given, but with still others added.

The first one which I shall give is taken just below the junction of the Murendel and Buchan.

No. 7.—Sketch-section across the Buchan River.



Scale.—Horizontal, 20 chains to 1 inch; vertical, 1,200 feet to 1 inch.

"*a*." Massive felsitic rocks, showing in places traces of fragmental structure. They are grey, cream-colored, or reddish, and weather in rugged blocks or masses. No bedding is visible.

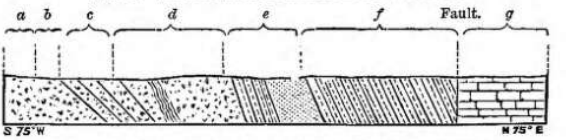
"*b*." Intrusive basalt. This rock is somewhat variable in physical character. On the north-eastern side of the section it is compact, and separates into plates which ring under the hammer, or it is scoriaceous, or including scoriaceous fragments, in which case it is light-colored. This last variety seems to be subsequent in occurrence to the general mass, as it forms a band some 100 feet in width, standing up in rough blocks.

"*c*." Thick-bedded, grey, compact, or sub-crystalline limestones, dipping about S. 60° W. at 27°. Near the upper part of the cliff is an irregular band of greyish or blackish chert, which in one place has been opened in search of ore. Galena and green carbonate of copper are sparingly distributed along this cherty band, and also throughout the mass of the limestone. These ores do not appear, however, to occur at this locality in quantity or as a well-defined vein or lode.†

In order to ascertain whether any data were to be obtained on the south-western side of the Buchan basin, I traced up the Tarra Creek, and ascended the Tarra mountain, but without meeting with any section affording much information. The mountain seems to consist of various kinds of harsh and massive felsitic rocks, and at its base the Buchan limestones cease at a point where no rocks are to be observed at the surface.

The next section which I propose to describe is taken at the Buchan River, near Mount Dawson.

No. 8.—Sketch-section across Buchan River.



Scale.—Horizontal, 10 chains to 1 inch; vertical, 600 feet to 1 inch.

* The cliff figured at page 194 of the former paper must be classed with the Buchan and not with the Snowy River series.

† Two other sections taken near this place will be found at pages 129 and 131, where they are given in connection with remarks on the Buchan lead mines.

"*a*." Massive felsitic rocks. Here and there fragmental structure may be recognised.

"*b*." Rocks similar in character, but earthy in texture; color greenish, somewhat coarse in structure, and more included fragments visible.

"*c*." Earthy felsitic rocks, such as those of "*b*," but with more distinct signs of bedding. Among them are some greyish in color, and including angular and sub-angular fragments of other felsites of different color and texture. Dip probably N. 80.° E. at 40°.

"*d*." Following the last are dark-colored to black felsitic breccias or agglomerates, which continue to "*e*." In this stretch occurs an apparently intrusive, or possibly contemporaneous sheet of greyish compact felsite (felstone). In places this is even minutely porphyritic.

"*e*." Red felsitic breccia, dip N. 70° E. at 75°, passing from minute fragments up to pieces of 2 inches diameter, followed by thickly-bedded red breccias, composed of rather small fragments. Part of these beds are rubbly, or earthy. The band is, as last stated, succeeded by and passes into red, hard, and silicious felsites, in which the fragmental structure is wholly obliterated. The gradual passage, apparently by mere alteration, of rocks of this class from a marked fragmental structure to one indistinguishable from that of many of the hard quartziferous felsites is often to be suspected, but is here evident.

"*f*." Succeeding these are fine-grained, rather thickly-bedded, felsitic (trappean) sandstones, which become at a little further distance jointed, and in appearance resemble a red and rather sandy shale. Calc-tufa begins at this place to obscure the surface indications, being deposited by a small creek flowing from the limestone hills.

"*g*." The first rocks seen here are thin-bedded, fine-grained, calcareous beds, dipping S.E. at 70°, followed by the ordinary Buchan limestone, dipping S. 30° E. at 45° to 50°, which then rise in an unbroken series in hills of several hundred feet in height.

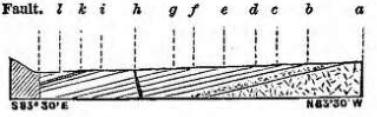
On the west side of the section are high hills of harsh, massive, felsitic rocks.

We have here a departure from the features disclosed by the former section, in so far that a marked unconformity, indicating a fault, exists between the Buchan limestone and the older felsites. In former sections it has been evident that the limestones graduate more or less rapidly and yet conformably downwards into beds, which are not only calcareous, but which have all the signs of having been accumulated as felsitic and calcareous tufas and breccias, and which are in places associated with probably contemporaneous flows of felsites. Unconformity in those instances has been with the older and generally more massive felsites. In this section, however, the rocks with which the limestones show such a marked unconformity consist of beds which exhibit both a fragmental structure and aqueous arrangement, while the alteration in their physical and mineral condition has proceeded to greater lengths than I have observed in the lower portion of the Buchan group at the Murendel or Butcher's Creek. But it is less by far than that common, or even I may say universal, in the more ancient felsites of the Snowy River. I incline to regard the beds "*a*" to "*f*" as belonging, probably, to an earlier period than that to which the Murendel beds might be referred.

The next illustration to be taken is from Gellingall, which is situated on the Buchan River, some miles up stream from the site of the last section.

Gellingall is one of the small limestone basins which occur in the district lying deep among surrounding hills of felsites, granites, or Lower Palæozoic sedimentary rocks. I have briefly referred to this place in the former paper on the subject.

No. 9.—Sketch-section at Sheepwash Creek, Gellingall.



Scale.—Horizontal, 20 chains to 1 inch; vertical, 1,200 feet to 1 inch.

This section commences in the Sheepwash Creek, about a mile above the crossing of the Glenmore track.

"*a*." Ordinary ternary granite of the district. Lying upon this is a coarse breccia, consisting of varieties of felsites. The component fragments are of various dimensions up to 18 inches diameter. Among them I observed a block of granite about 2 feet across. The breccia is not only firmly bound together by silicious cement, but seems in places even to pass into the mass of the granite. A careful examination of the surface where this very peculiar appearance shows itself led me to believe that the seeming passage is due merely to the filling in by the felsitic breccia of an extremely uneven granite surface. Subsequent induration has welded both formations completely together.

The upper part of this breccia at "*b*" is finer, but it is so completely silicified in places that the structure is obliterated, and where the outlines of the fragments are lost it looks like a compact felsite.

"*c*." Compact to fine-grained beds of 18 to 24 inches in thickness; dip S. 40° E. at 15°.

"*d*." Similar beds, but not more than 6 to 12 inches thick, and of coarser material.

"*e*." Thick-bedded and rather coarser than "*d*," but not so coarse as to become a breccia like "*b*." These beds are all of felsitic materials and extend to "*g*." They are silicified and contain among the smaller angular particles some larger pieces of from 1 to 2 feet diameter.

"*h*." A large diabase dyke crosses the beds at this place. It is about 30 feet in width, and most probably has a dip N. 80° E. at 80°.

"*i*." Thick beds, dipping S. 30° E. at 13°, now assume the ordinary appearance of sandstones, and show well-marked instances of false bedding, which is nowhere observable in the earlier deposits. In the finer portions of these stratified sediments occur a few rounded pebbles, also, so far as I know, the first instance of this in the ascending series. These beds in fact have a marked difference from the earlier ones in being distinctly stratified sediments and in the component particles being rounded.

"*k*." Resting upon these thick sandstones is a peculiar band of igneous rock of porphyritic granular composition. It is of a reddish color, and wherever seen is much decomposed and earthy. From its general appearance it most probably belongs to one of the varieties of less silicated felsites. The surface has probably been originally irregular and uneven, and this points to contemporaneous origin. It may be from 5 to 10 feet, or even more, in thickness locally. Resting upon

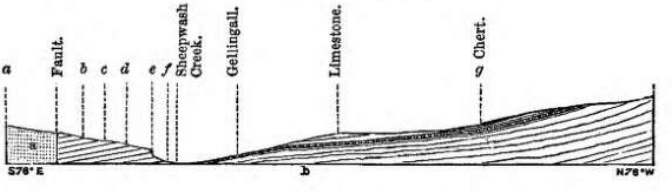
it are several narrow bands of clayey or rubbly material, seemingly derived from its abraded upper surface. Some of these bands have a calcareous appearance, and effervesce with dilute hydrochloric acid.

"*l*." Overlying these regularly are rather thin yellow calcareous beds, in which is a band of blackish chert. Dip of these beds about S.E., at a low angle.

At this point there occurs a fault, the rocks now described ceasing and being succeeded by a series of limestones bearing the characteristic Buchan marine fossils. These beds show themelves in the creek as compact bluish limestones, followed by compact grey calcareous beds, and again succeeded by grey or bluish rather crystalline limestones, with many minute included fragments of felsites. Above these are the usual grey or blue Buchan limestones. These rise up into hills of about two hundred feet in altitude, and have a general low dip to the S.E.

About a mile lower down the Sheepwash Creek, and close to the Gellingall homestead, I obtained a second interesting section.

No. 10.—Sketch-section at Gellingall.



Scale.—Horizontal, 20 chains to 1 inch; vertical, 1,200 feet to 1 inch.

This section commences on the high ridge separating the Sheepwash Creek from the Buchan River, and crosses the little open forest basin in which the Gellingall homestead is situated.

"*a*." Massive felsites, such as are seen in the Buchan River valley from the mouth of Sheepwash Creek upwards. In places faint shapes of included fragments may be traced. Bedding is nowhere visible, and the general character is that of a compact quartz felsite (*see* lithograph plate No. 2, Fig. 9).

"*b*." Compact bluish limestones, in beds of from 6 to 18 inches, dipping S. 70° E. at 21°.

"*c*." Thick-bedded blue limestones, dipping S. 70° E. at 18°.

"*d*." Alternating thick and thin bedded bluish limestones, dipping as at "*c*." These extend down to "*e*," where they form a cliff of about 30 feet in height, and thence downwards to "*f*," where is a band of blackish or greyish chert, about 3 feet in thickness.

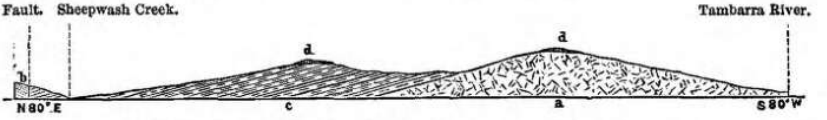
"*g*." The chert band is succeeded by yellowish calcareous beds, 12 to 18 inches thick, which rest upon a thick mass of reddish porphyritic felsite, similar to that referred to in the preceding section.

On crossing the Sheepwash Creek and ascending the opposite side of the valley these two last well-individualized beds, the chert and the granular felsite, can be traced, either the one or the other, as forming the surface of the slope, until rocks are met with having the aspect of the thick beds "*i*," of Section No. 9. On

crossing the hills lying between the Sheepwash Creek and the Tambarra River, similar rocks show themselves for some distance, ending at granite. The general succession and relation of the rocks of this tract may be generalized as in Sketch-section No. 11.

The granular felsite sheet and the chert band serve to connect the two sections.

No. 11.—Sketch-section from Sheepwash Creek to the Tambarra River.



a Granite. *b* Snowy River porphyries. *c* Buchan limestone group. *d* Tertiary basalts.
Scale—Horizontal, 80 chains to 1 inch; vertical, 4,000 feet to 1 inch.

In the Gellingall basin the same features therefore exist that are shown in the former sections from Murendel and Buchan. We may not unfairly consider that we have at Gellingall a view of the whole group as it now remains—from the underlying granite on which its base rests to the limestones of purely marine origin with which the series terminates, and which, up to the present time, have been mainly the representatives of Middle Devonian formations here.

The Buchan limestones are therefore only a part of a continuous series. The lower part of the group consists of coarsely aggregated felsitic breccias, the coarseness of material decreasing, but with alternations in texture, in ascending. The deposits also become more distinctly bedded, and in places, as at Butcher's Creek, pass into, or alternate with subordinate conglomerates, in which angular or rounded fragments of sedimentary rocks are of common occurrence. In all the late and in many of the earlier beds aqueous arrangement is clearly distinguishable. The coarse angular breccias at the base indicate, I think, a shore line.

In all the sections occur felsite sheets, which as a rule are compact, and are found under conditions which almost always suggest that they are of contemporaneous origin.

The passage beds are compounds, in varying percentages, of limestone and felsitic particles, the latter varying in dimensions from mere dust to several inches in diameter. The felsitic admixture gradually, or in places suddenly ceases, and the remaining beds of the group are then purely limestones of the ordinary character seen at Buchan, and characterized by a numerous marine fauna of Devonian age.

It may be added that the felsitic particles which are found diffused throughout the passage beds, not only in their physical appearance, suggest that they are particles of ejected volcanic materials, but are shown by quantitative analysis to have the normal constitution of a quartz felsite, if we regard them as trappean, or of a rock allied to quartz trachyte, if we compare them to the more acid class of modern lavas.

It may, I think, be possible to estimate provisionally the character and thickness of the Devonian formations of North Gippsland. Other interesting sections, of the

existence of which I am aware, but which I have not yet found occasion to examine, will not, I anticipate, materially alter this estimate or narrow the conclusions which it may be possible to draw.

PROVISIONAL ESTIMATE OF THE PROBABLE THICKNESS OF THE DEVONIAN ROCKS OF NORTH GIPPSLAND.

			Feet.
Upper Devonian ...	Iguana Creek beds ...	Sedimentary formations, with plant remains	5,750
	Snowy Bluff beds, &c. ...	Contemporaneous felsites and basalts	
Middle Devonian ...	Upper Buchan beds ...	Marine fossiliferous limestones	400—500
	Lower Buchan beds ...	Calcareous tufas, felsite tufas, breccias, &c.	750—1,000
Lower Devonian (?)	Snowy River porphyries ...	Felsite ash, agglomerates, massive felsites, &c.	2,000
		Estimated total thickness	9,250

For the upper groups the mean of my former estimates of the Snowy Bluff beds has been taken.* The thickness of the Buchan limestones has been estimated from the elevation of hills near the Murendel and Buchan rivers, all allowances being made for the probable amount and alternation of dips.

The Snowy River porphyries have been estimated by their thickness as shown in the natural section of the Little River near Woolgoolmerang. Their base is not even there disclosed, and as it is only locally that they have any regular bedding, the height given by aneroid has been used.

The Middle Devonian formation of Tabberabbera has not been considered in this estimate. It is the only one of this age which has undergone extensive foldings, such as have elsewhere affected the Older Palæozoic strata. Its limits are at present undefined, and much of it probably extends underneath the nearly horizontal Upper Devonian conglomerates and grits of Iguana Creek. Although it is marked at Tabberabbera by a band of limestone and other well-individualized fossiliferous beds, these do not, so far as I know, recur. Data are therefore wanting to estimate the thickness of this group. I think, however, it is probably of greater dimensions than that at Buchan.

In considering what may be the conclusion to be fairly drawn from the preceding statements, it would appear necessary, in the first place, to separate all the lower part of this group, namely, the fragmental and sedimentary beds, from the Snowy River porphyries, with which I have previously classed them. This would, however, leave a vast tract untouched of the massive mountain-forming felsites of Gelantipy, the Black Mountain, and Wombargo, together with the compact felsites (felstones) and the fragmental rocks (agglomerates) which are found associated with them there. The latter group is indicated by "*a*," section No. 10, and probably more or less by "*g*," section No. 3; "*a*," section No. 5; 1, section No. 6; and "*a*," "*b*," "*c*," "*d*," "*e*," "*f*," of section No. 7.

A well-marked distinction may be drawn as to position, structure, and physical and mineral condition between the Buchan group, using this term in its comprehensive sense, and the vast porphyritic masses from which it is generally found to be separated by faults, as shown in the given sections.

* Report of Progress of the Geological Survey of Victoria, Part IV., p. 77.

After carefully examining the localities now described, together with much of the country adjoining them, I still believe the discordance between the Buchan group, as now defined, and the Snowy River porphyries to be as great as I formerly indicated, and that therefore the latter may possibly be Lower Devonian.

The general conditions indicated are, I think, these:—

1. A sinking coast-line, with either marine or littoral volcanoes, from which trachytic materials were ejected as fragments or emitted as flows of lava (felsite breccias, tufas, compact and porphyritic felsites).
2. Gradual extinction of volcanic activity, as indicated by the finer character of the felsite fragments, their intermixture with calcareous materials (calcareous felsite tufas), and their final cessation, with succession of purely marine limestones.

We have therefore evidence of the occurrence of volcanic activity in the Middle Devonian age, and thus of its continuance from the earlier Devonian times of the Snowy River porphyries to the Upper Devonian felsites of Tabberabbera, Maximilian Creek, and the Snowy Bluff.

The gradual spread of marine conditions over the Buchan and Gellingall area would therefore suggest previous terrestrial conditions, and I think probably situated to the north or north-west. The Tabberabbera beds suggest also proximity of land, while the Iguana Creek beds speak of it in the plainest language in the numerous fossil plants alone found in them.

Hence we may conclude that the Devonian age was in North Gippsland a period characterised by the occurrence of vast volcanic manifestations, which were most probably terrestrial.

The Lead Mines of Buchan.

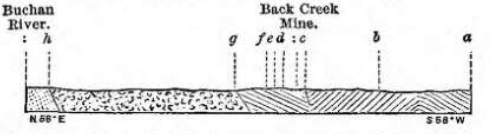
I have in the former part of my paper on the Devonian rocks of North Gippsland referred shortly to the occurrence of galena at Buchan. In working out the present details my attention has been directed to the various ore deposits in connection with the Buchan beds; and it has become evident to me that an investigation into their mode of occurrence, their origin, and their connection with the containing rocks, as well as into their economic value, would be of interest.

It is not necessary for me to describe in detail all the places where ore has been found. No useful purpose would thereby be served, nor would the details, so far as I know, add any information to the data procurable at the two mines which have been to a slight extent already opened and explored.

THE BACK CREEK MINE.

This mine, which is now completely abandoned, is situated at the Back Creek, and about 30 chains from the Buchan River. The subjoined section will afford details as to the position of the mine in respect to the containing formations.

No. 12.—Sketch-section at Back Creek.



Scale.—Horizontal, 20 chains to 1 inch; vertical, 1,200 feet to 1 inch.

"*a*." Thick-bedded limestones, weathering brown. Dip W. at 14°.

"*b*." Chert band.

"*c*." Dyke of basalt. At this spot is situated the deserted Back Creek mine.

"*d*." The beds on the south-west side of the dyke are all limestones, with a general dip to the north-east of about 30° to 45°. At "*e*," however, the dip changes to W. at 16°, and the limestones almost immediately cease, and are followed by calcareous fragmental beds of the usual brecciated character seen in this district. Similar rocks, for instance, at "*e*" and "*f*," extend to "*g*," where they abruptly terminate at a mass of basalt. The beds "*e*" and "*f*" are more felsitic and less calcareous in descending.

The basalt is highly altered from its normal character, as met with on the east side of the Buchan River, where it adjoins massive felsites. At the contact with the limestones it is either dark-blue, with irregular light-colored specks, which effervesce with dilute hydrochloric acid, or, where weathered, and the carbonates thus removed, is seen to be full of irregular cavities, which give it a scoriaceous appearance. When blocks are freshly broken, these cavities are found to be filled either by various carbonates, or by red jasper, or by jasper and chalcedony, or more rarely quartz. In fact, in many places, the masses and veins of jasper form a peculiar and marked feature in this rock. It must be remarked that such peculiarities are to be seen all along the line of contact of the limestone and basalt, but not, so far as I know, along the contact of the felsites and basalt.

Adjoining the limestone the basalt has been converted into a rock which can only be classed mineralogically as a melaphyr; adjoining the felsites it is still a basalt. If it is intrusive and of Tertiary age, as seems not improbable considering the neighboring vast basaltic flows to the northward, we should then have the anomaly of a Tertiary melaphyr; if, on the contrary, it should prove to be pre-Tertiary in age, then we should have a pre-Tertiary basalt. We have here exactly an instance of the inconvenience of the present petrographical classification to which I drew attention in a previous paper.

"*h*." The basalt extends nearly to the mouth of the Back Creek, where felsitic rocks of the character generally met with east of the Murendel River come in, and thus indicate, as I believe, the presence of the fault on which I think that river flows.

The features disclosed by this section accord with those already illustrated. From "*a*" to "*e*" we have the Buchan limestones; from "*e*" to "*g*" the calcareous breccias, or tufas; "*c*" and "*g*" appear to represent the position of fault, for, as regards "*c*," the brecciated beds do not occur on both sides of the dyke, nor do they reappear to the west in the section. The basalt seems to have come up along faults, and, looking at it in the mass, it conforms to this view throughout its occurrence at the Murendel and Buchan rivers.

At the Back Creek mine the ore is not found in a true lode, but in irregular bunches and strings in the bedding planes of the limestones, as well as disseminated in grains throughout not only the calcareous but also the adjoining felsitic rocks. The shaft sunk in following the ore forms an irregular opening, dipping to the S.W. at 12° to 15°. A dyke shows in the shaft passing through the limestones, and it seems to have followed a fault. It is much decomposed, and in places it, as well as the containing walls, bears some radiated pyrites. It does not carry galena, although, so far as I could ascertain, that ore is met with in the bedding planes of the rocks on either side of it. This might be held to indicate that the dyke is of

subsequent age to the ore vein, but I think that I shall be able to show reasons against this belief. In examining the two sides of the small gully in which the Back Creek flows, there are indications of an east and west fault, for a dyke shows on the north side which is similar in every respect to the one just mentioned, although discordant with it by an apparent horizontal shift of about 50 feet.

An adit was driven for some distance in the decomposed dyke, under the impression that it would prove to be a true lode. This belief was not confirmed, and was not indeed justified by the conditions.

No machinery was erected at this mine.

The following information has been obligingly furnished to me by Mr. H. Rich, formerly manager of the Back Creek mine :—

"The amount of ore raised may be estimated at from 180 to 200 tons, including all kinds raised during the progress of the work ; 70 to 80 tons of this quantity was of good quality, say from 45 to 55 per cent., and it was not dressed in any way, but just as broken out ; the balance of the ore would probably yield from 14 to 16 per cent. This quantity of ore raised was only that obtained during the prosecution of works confined solely to the object of testing the continuation of the lead deposits to the greatest depths from the surface. During this a large amount of hard work was done, with the object of intersecting a bed of ore at the lowest depth practicable by tunnelling, and from which no ore was raised.

"The limestone beds did not preserve the same angle of dip as that calculated, and their continued flatness necessarily gave much more driving to intersect them. The country was extremely hard, costing upwards of £5 per foot, and progress was therefore slow.

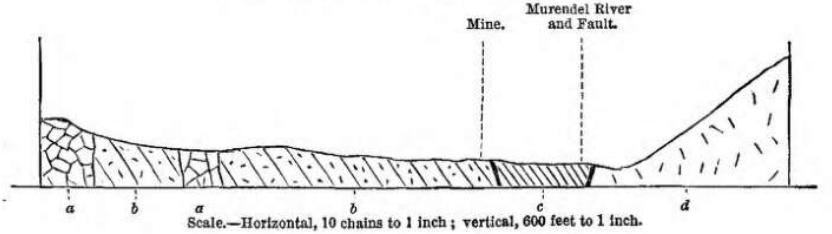
"Speaking from memory, the analyses, which I cannot now place my hands on, gave, as the best results, from 70 to 74 per cent. of lead, and from 18 to 42 oz. of silver per ton of lead. The ore consisted chiefly of steely galena, some carbonate and oxide, antimony, and iron.

"I sent a little over 50 tons to Melbourne, some of which was smelted at the antimony works, Collingwood, which I think realized only about 38 per cent."

THE MURENDEL MINE.

This mine is situate close to the Murendel River, not far above its junction with the Buchan. It is on a mineral lease, and has been worked by the Murendel Silver Lead Mining Company (Limited). So far as I am aware, this company is now in a moribund or defunct condition, and the works have been discontinued for some time. In September last I visited the locality, and obtained the following particulars. The subjoined section will illustrate the features of the locality :—

No. 13.—Sketch-section at the Murendel River.



Scale.—Horizontal, 10 chains to 1 inch ; vertical, 600 feet to 1 inch.

"*a*." Intrusive basalt. This mass appears to be connected with that shown in the Back Creek section, but it does not immediately adjoin this mine. It is only affected by the usual surface alterations, and does not show the peculiar melaphyr character seen when in contact with the limestone.

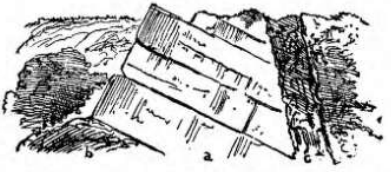
"*b*." Fragmental felsite rocks; occasionally having signs of bending. These are overlaid conformably but abruptly, by

"*c*." Buchan limestone.

"*d*." Massive felsite. Harsh to the touch, and where weathered showing irregular but narrow horizontal cavities. More rarely yellow or grey, and then compact; or else purple, with small porphyritic patches of felspar. They are generally quartziferous. A fault separates them from "*c*" and "*b*," with the latter of which they bear but slight resemblance, if any.

In examining this mine I observed that the ore, as at Back Creek, follows the bedding of the limestones, penetrates crevices in them, or is disseminated in crystalline grains and spangles throughout the mass of the rock. The mine has been opened by an underlay shaft at about 50 yards from the river, and follows down the trend of the ore vein. At the time of my visit it was full of water to within 20 feet of the surface, and was therefore inaccessible to me. The upper part of the workings showed details which I have roughly given in the subjoined sketch:—

No. 14.—Diagram of Murendel Mine.



a Buchan limestone. *b* Murendel felsite. *c* Lode.

The limestones dip W. at 20° to 25°. The ore occurs in the bedding planes in "*a*." These beds are cut off by "*c*," which I regard as a fault, filled at the surface by a mingled mass of clay and limestone fragments.

Mr. S. Preston, who has been for nearly four years the manager of this mine, obligingly accompanied me over the works, and to him I am indebted for the following information:—

"In following the underlay shaft the ore continued in the bedding and joints of the limestone, until the beds were cut off by a mass of fragments cemented by various ores, and about 7 to 8 feet in thickness. This was backed by a smooth hanging wall. The best ore followed down this wall, being about 5 feet wide. At about 70 feet depth* the width of the lode was about 5 feet, and its strike north and south. This was ascertained by driving along it for 30 feet. The dip remained constant to about 60 feet, where it became more vertical.

"The ore in this lode is in strings, bunches, and in the joints. At the surface there was no mundic, only iron-ore and galena; but below the water-level, at about 50 feet depth, mundic came in. At this depth, also, the hanging wall became well defined, cutting off the limestone beds. It was nowhere broken through in the workings. The foot wall is slaty in character.

* About 30 to 40 feet in vertical depth.

"It was observed in following down the ore that, where the vein was hard and crystalline, it became barren; where the vein stone was dark and jointed, the ore increased in amount.

"The mine when working made about 1,000 gallons of water per shift.

"About twenty yards to the west of the mine a shaft was sunk for 60 feet through hard grey crystalline limestone, which was much disturbed, and without any regular bedding.

"The plant at the mine consists of a Flintshire furnace, capable of smelting three charges, of 21 cwt. each, in 24 hours; but the dirty nature of the ore prevented more being dealt with at a time than about 17 cwt. as a charge. At the same time it must be said that 21 cwt. of clean ore has been smelted.

"There is an 8-horse power tubular engine, an ore-breaking machine, sluice-box for cleaning the ore from clay, and two jigging sieves.

"Before erecting the present furnace the company had an American ore hearth, and a Spanish reverberatory furnace, neither of which proved to be satisfactory.

"The results of smeltings varied much. In one of the earliest smeltings with the present furnace, made in December 1874, 5 tons of ore only yielded 16 cwt. of lead. The last smelting was on 15th January 1877, when six charges of 17 cwt. each were operated upon, giving 25 pigs of lead from the first lot, and 24 pigs of lead from the last. The ore was all that then remained at grass, and contained much scrapings.

"From 1st May 1876 to the time of ceasing operations in 1877 the total amount smelted was 74 tons of ore, yielding 482 pigs of lead. Each pig weighed about 112 lbs."

Besides the above information afforded by Mr. Preston, it must be noted that an extensive brick flue and stack has been erected at the furnace, and extending I think some 400 feet from the mine.

The examination which I personally made at the mine showed me that the ore vein worked is connected with a fault which has traversed the limestones immediately adjoining their abrupt contact with the underlying fragmental felsite beds. It has all the appearances of a true lode filling a fault, the gangue being a limestone breccia cemented by carbonate of lime and metallic sulphides.

I observed that the limestones to the east of the mine were immediately followed by felsite rocks, while on the west side were hard grey crystalline limestones. A shaft shows that these descend at least to 60 feet, which would be considerably below the depth vertically to which the mine has been carried. As no felsite beds were met with, this indicates a down-throw in the west side of the fault.

In order to obtain a further insight into the relations of these rocks, I carefully examined the Murendel River for about a mile above the mine.

At the point where the western fault, shown in the section, crosses the river, I found the contact of the limestones and the harsh massive felsites to be very irregular. The former were without apparent bedding, grey in color, contorted, splintery, and crystalline. In following down the river from this point, the contact of the greyish-blue limestone beds with the underlying felsites became immediately evident, the dip being S. 15° E. at about 15°. This contact is well shown in a

series of cliffs along the river. The limestones, as I have before said, are conformable to the felsitic rocks, which latter are only rarely rudely bedded. Between the two sets of beds there is a thin shaly parting, and the contact not only dips towards the west as a rule, and at a low angle, but is more or less undulated with the strike. In examining the felsite rocks by means of a lens, on a fresh surface of fracture, it is seen that it is composed of angular or slightly-rounded felsite fragments, imperfect felspar crystals, and some quartz grains. The texture is rather coarse than fine, and it has all the appearance of a somewhat coarse felsite "pepperino." I think that these beds may be regarded as the representatives of the Lower Buchan beds of Butcher's Creek and Gellingall, but without the passage-beds which there connect the two members of the Middle Devonian group.

No. 15.—Sketch of Cliff near Murendel River.

a Buchan limestones. *b* Murendel felsites.
The limestones dip S. 70° W. at 15° to 20°.

The following sketch shows the relation of these rocks :—

In following round the contact of the basalt with the limestones from the mine at the Back Creek to the Murendel mine, it is evident that all the ore deposits which have been discovered and partly opened lie more or less along it ; whilst on the east side, where the basalt is in contact with the felsitic rocks, no ore deposits have been, so far as I am aware, found. Alongside the limestones the basalt has been so extensively altered that it has become a melaphyr, whilst it maintains its character unaltered on the east side along the felsites. Moreover, there would seem to be a connection between the basalt and the occurrence of ore, and relations connecting the galena veins and faults.

The data which I have as yet collected are insufficient to determine whether the basalt is intrusive or is anterior wholly or in part to the limestones. The appearances I have observed at the Murendel suggest the former, while those at Back Creek point rather to the latter supposition. At present, regarding the basalt at the Murendel as intrusive, the following considerations suggest themselves. If the basalt was intrusive it seems probable that it would be connected with heated waters. Whether these thermal waters were directly associated with it, or merely became heated on reaching it by percolation downwards from the surface, would not affect the question. The association of the sulphides of iron, lead, copper, and zinc, which are found in these mines, with minerals which evidently owe their genesis to the intervention of water, such as calcite or barite, necessitates that we should attribute to the metallic sulphides a similar origin, and we may further conclude that they were precipitated from the condition of sulphates. If we therefore picture to ourselves that, at the time of the irruption of the basalt, chemical waters holding metallic sulphates in solution percolated through the rock masses, finding their passage, especially by the planes of bedding, by joints and dislocations, as well as generally permeating the strata, we shall perceive that, coming into contact with the highly fossiliferous and often bituminous limestones, the sulphates would become reduced through the

oxidation of organic substances, the result being the precipitation of sulphides of the metals and the generation of carbonic acid and water.

Other reactions may then easily be supposed to follow. The ore veins being thus generated, the waters holding free carbonic acid would, where permeating the limestones, dissolve carbonate of lime, while, on the other hand, in the basalts, the silicates would be decomposed, and iron, lime, magnesia, and the alkalies, would be removed as carbonates. Ultimately, so far as these reactions penetrated into the basaltic mass, its mineral structure and composition would be greatly altered. An examination of thin slices of the rock under the microscope shows that not only have individual minerals been removed, but that the ground mass surrounding them has been extensively affected. Irregular cavities have been formed, which are now filled in by carbonates, and by those chloritic silicates which may be generally classed under the term "Viridite," as proposed by Professor Streng. In some less altered examples, hematite pseudomorphs after crystals of olivine are still recognizable. We have here, so far as the alterations of the basalt are concerned, changes similar in character to those which I have observed and described as occurring in the Devonian basalt of the Snowy Bluff (melaphyr). In both cases the changes may be referred, with much probability of truth, to the action of heated water under pressure. But there is one marked distinction. In the basalts of the Snowy Bluff the changes have been the decomposition of the original silicates and the recomposition (probably during the cooling down of the rock masses) of a new class of silicates, which, on the whole, seem to be, as we might expect, of a more stable character than those that were decomposed—as, for instance, pistacite. The changes which have taken place at Back Creek have been the decomposition of the original silicates, and the recomposition, to a less degree, of a new class of silicates, which, together with carbonates, have been deposited in the resulting cavities. In the first case the secondary minerals are almost wholly silicates, in the second case they are mainly carbonates. Further, at Back Creek, there has been an elimination of much silica and iron, which now exists as red jasper and chalcedony throughout the altered basalt. These differences may, I think, be fairly attributed to the different character of the stratified rocks associated with the igneous masses. Those at the Snowy Bluff are highly siliceous and aluminous, while those at Back Creek are as highly or even more highly calcareous

The application of these conclusions to the Buchan mines seems to me to be evident. The ore deposits may be directly connected with reactions set up by the intrusion of basalt in certain cases in the calcareous rock masses, and with other reactions in the igneous rocks ; and the intrusion of the basalt, if intrusive, as well as the deposition of ore in certain veins, has, it seems, been influenced by the existence of numerous faults. If, on the other hand, it should prove that the basalt is not intrusive, but contemporaneous, or of anterior age, then I conceive that the processes which have taken place must be referred to a form of metamorphism such as has affected allied rocks at the Snowy Bluff. At Back Creek, the fault, which apparently cut the vein and was then injected by basalt, had, I conceive, a previous existence. The appearances of subsequent age of the dyke may be accounted for by the supposition that the intrusion of the igneous rock and the deposit of the ore were directly connected, and were therefore contemporaneous. The decomposition of the dyke stone and its impregnation by pyrites is of quite recent date, and may be referred to the percolation of surface

water holding in solution oxygen, carbonic acid, and, according to the late researches of Mr. J. C. Newbery, also the acid carbonate of ammonia. It is not therefore probable that galena will be found in connection with the dyke, which I anticipate would be found to be undecomposed at a greater depth than that to which the workings have been carried. At the Murendel mine slightly different conditions obtain. The basalt is at a little distance. Two faults have let down a tract of limestone into the felsite rocks underlying it. The eastern fault is immediately adjoining the base of these limestones. The east wall of the fault would be therefore composed entirely, in all probability, of the Lower Buchan beds, while the western wall would consist of the Upper Buchan beds (limestones). What the down-throw has been is not ascertainable, and the depth to which the western wall would carry calcareous rock is uncertain. Upon this would, however, depend, on the principles which I have sketched out, to what depth the galena deposits would reach. I think that they would certainly cease so soon as both sides of the fault came to be formed of the felsite beds.

The fault at the Murendel mine has not, like that at Back Creek, been injected by basalt, but appears to me to show the existence of a true lode, the gangue being a limestone breccia cemented by carbonates and metallic sulphides. The actual value, economically, of the lode, can only be ascertained by its systematic examination and exploration.

Up to the present time this has not been done. Most of the capital and energy of the company seem heretofore to have been expended in erecting smelting works, and generally doing much in bricks and mortar. The actual development of the lode by mining has been thus neglected. If at any future time operations are resumed by any other company at this place, the exploration of the mine should be the first work carried out.

In a legitimate mining adventure this would be the proper and reasonable course. It might prove the mine to be of great extent and value; but, on the other hand, it might prove it to be of little value. In the latter case, such operations would be entirely destructive of any merely speculative intentions, such as have too universally attended mining of all kinds in North Gippsland.

APPENDIX.

Notes on the Examination of Rock Samples collected to Illustrate the Characters of the Buchan Beds.

1. In order to test the accuracy of the conclusion arrived at in the field as to the nature and amount of the fragments observable as being included in some of the lower beds of the limestones of Buchan and Murendel, an average example collected from near the Murendel Hill (Sec. No. 3, *g*) was roughly broken up and treated with dilute hydrochloric acid. The carbonates being thus dissolved out, the remainder was washed, dried, and weighed, giving 29·20 per cent. of the whole

amount of rock. Under the lens these fragments showed rough and angular or else somewhat rounded forms. They were generally cavernous, and in one or two I observed hemispherical cavities exactly resembling the vesicles occurring in Recent Volcanic rocks. The colors were grey or reddish. The texture was mostly compact, but more rarely slightly granular, and occasional bright facets as of quartz were to be seen.

A portion of this residue was subjected to a quantitative examination, giving the following results :—

Silica	79·62
Alumina	9·99
Ferric oxide	3·22
Lime	·37
Magnesia	·22
Potash	3·94
Soda	2·64
	100·00*

These percentages are in accord with the constitution of the most acid class of Ancient Volcanic rocks—quartz felsites†—or of the recent class, quartz trachytes.‡ A reference to the microscopic examination of the volcanic ash tufas and quartz felsites of this group will show further that the above percentage of soda receives an explanation through the occurrence in all of these rocks of subordinate triclinic felspars.

The mode of occurrence, the physical characters, and the chemical constitution of these fragments, point, I think, unmistakably to their being volcanic lapilli. Other examples taken from the base, from half way up, and from the summit of the cliff, sketched near No. 5, were treated as above, and gave 31·79, 11·17, 1·50 per cent. of fragments respectively. These, when examined under a low power (about 25 linear), accorded in character with those already described.

2. *Butcher's Creek.—Section* 1 *c.*

A thin slice examined under the microscope by ordinary light has the appearance of having a compact felsitic base, in which are great numbers of imperfect crystals, or crystalline grains of quartz and felspar. Polarized light, however, causes the structure to become evident, and it is then seen to be entirely composed of minute angular fragments of felsite, of monoclinic felspar, and many fractured grains of quartz. A little felsitic-looking base cements the whole into a mass. The fragments are not only arranged with an approximately similar direction, but are further arranged in bands. This slice was cut perpendicular to the apparent bedding of the rocks.

3. This example was taken from a bed underlying the last. In texture it resembled a moderately fine sandstone.

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* The total percentages amounted to 101·58, from which the above was calculated.

† Jukes and Geikie, Manual of Geology, p. 109.

‡ Zirkel Petrographie, vol. II., p. 159.

A thin slice showed it to consist of angular fragments of—

(1.) Felsite and fine felsite ash or tufa.
(2.) Orthoclase.
(3.) Quartz.
(4.) Plagioclase.

The fragments are cemented by a little dark-colored felsitic paste.—(*See* Lithographic Plate No. 2, Fig. 8.)

4. *From the seemingly Felsite Sheet at the mouth of Gap Creek.—Sec.* 1 *d.*

These rocks vary in character from a compact to a granular grey or yellowish felsite. I found it impossible to decide from the occurrence of the rocks *in situ* whether they were contemporaneous volcanic or fragmental ; in other words, lavas, or ash, or tufas.

A thin slice, however, showed that the compact variety is in fact a fragmental compound. The amount of felsitic paste preponderates so much, and the alteration which has taken place has been so great, that the outlines of the scattered fragments are rarely, if at all, visible by ordinary light. By polarized light, however, they at once start out into individuality.—(*See* Lithograph Plate No. 2, Fig. 7.) The more granular variety almost exactly reproduces the characters of 3.

5. This example was taken from what seemed like a massive quartz felsite, immediately underlying the beds from which the samples last described were taken. Examined as a thin slice, it proved equally with them to have been fragmental. In this case, however, the fragments seemed to have been mainly derived from orthoclase felspars, and among them a few individuals showing distinct triclinic striation. The felsitic paste is dark and cloudy. In this magnetite occurs.

6. *Section No.* 3 *d.*

This was a sample of the vitreous masses forming the foot or base of the basalt sheet. This is a volcanic glass of a pale golden-brown. It contains—

(1.) Very numerous crystals in more or less perfect stages of development. A few larger ones are clearly distinguishable both by their shape and optical characters as olivine, and individuals of decreasing magnitude connect them with numerous granules, which are scattered about either singly or in groups.
(2.) Mere rhomboidal outlines, which disappear when the prisms are crossed, and which are not otherwise individualised.
(3.) A few long, narrow twin prisms, having plane terminations. These may be plagioclase.
(4.) Very numerous minute microlites, either merely acicular or having forked or ragged terminations.
(5.) A few included glass masses, which disappear where the prisms are crossed, and finally a few gas bubbles.

This basaltic glass is but slightly attacked by long continued digestion with hydrochloric acid, and would therefore come under the definition of Hyalomelane rather than Tachylite.*—(*See* Lithograph Plate No. 2, Fig. 1.)

* Rosenbusch. Mikroskopische Physiographie der Petrographisch Wichtigen Mineralien, p. 183.

7. This sample was taken from the edge of the basalt sheet overlooking the valley of the Murendel in Section 3 *g*.

It has a semi-crystalline ground mass of—

(1.) Plagioclase prisms irregularly grouped.
(2.) Aggregations of pale-brown augite granules.
(3.) Rather larger grains of olivine.

The interspaces are filled in by magnetite and by a rather dark-green glass. In this ground mass are larger and in places well-formed olivine crystals; but they are, without exception, more or less affected by alteration which has followed irregular flaws and cracks. A yellowish or brownish serpentinous substance has been produced. This may also be seen in the ground mass, and may thus perhaps indicate the former position of small olivine grains. A characteristic example is figured in Lithograph Plate No. 2, Fig. 3.

8. This felsite, when examined under the microscope as a thin slice, has characters which recall both the true felsites and the regenerated felsite tufas or ash of the Butcher's Creek.

The ground mass of this rock is felsitic, and it shows distinct fluid structure; but the fractured and angular shapes of the contained felspars and quartz, and the manner in which they are arranged, strongly resemble the structure of the fragmental rocks already described. Magnetite grains and crystals also occur. In this instance the microscopic examination favors the belief that this also may be merely a regenerated felsite ash or tufa rather than a true quartz felsite.

9. This example was taken from the thick compact yellow beds occurring at *g*, Sec. 2. The appearance of these beds seen ***in situ*** simulated that of a felsite sheet, but a thin slice showed that the rock is composed entirely of fragments of felsite, felspar, and quartz, set in a dark-colored felsitic paste; this latter is dark-colored in consequence of the ferruginous infiltration which has affected all these beds. This band is therefore clearly not a felsite, but a regenerated ash or tufa similar in character to those of the Butcher's Creek.

10. *Section 9 c, Gellingall.*

This rock is composed entirely of light-grey to almost white felsite and quartz, in small angular grains, set in a felsitic paste. By ordinary light the structure is scarcely recognizable or to be distinguished from an ordinary example of compact felstone. By polarized light, however, the fragments at once stand out from each other. It presents no peculiarities to be noted, and is of the same class evidently as those beds already described at Butcher's Creek.

11. *Section No. 9 h, Gellingall.*

This example has a reddish felsitic base. The color it seems is due to red granules, which more or less permeate and even make up the mass.

Those felspar crystals (orthoclase), which are still distinguishable in the ground mass, are also filled by a grey granular material. The difference between the two classes of granular material is apparently only in the color. Where the grey material is very abundant, the felspar crystals are quite opaque. It suggests itself that this is due to the production of kaolin through decomposition of the felspar, in the one case being with and in the other without ferric hydrate.

Some opaque black substance is widely scattered, which may be magnetite.

On examining the felspar prisms by polarized light they prove to be partly made up of the grey cloudy substance and partly of minute quartz granules. These latter, in the view that the cloudy appearance of the felspars is due to the production of kaolin, might represent the excluded silica.

A few clear quartz crystals complete the list of constituents. This may be classed as a porphyritic felsite.

12. *Section No.* 10 *a, Gellingall.*

This rock has a grey or elsewhere yellowish felsitic ground mass. It varies in color, and shows fluid structure in waving bands of irregular width.

In the ground mass are—

(1.) Felspar prisms, more or less perfectly formed. One large prism has been broken across, and the base has passed through the fracture, carrying with it some minute felspar crystals.

(2.) Crystalline grains and crystals of quartz. These are in places fractured.

(3.) Rarely, small distinctly striated plagioclase felspars.

(4.) Magnetite in crystals and grains.

(5.) A dark-green translucent mineral.

This latter is in rhombic, or octahedral (modified rhombic) forms. It is always more or less associated with magnetite, and polarizes as an aggregate of scales, thus resembling chlorite. I am unable to define it, except perhaps as being an altered hornblende, to which mineral the rhombic forms have resemblance.—(*See* Lithograph Plate No. 2, Fig. 9.)

13. *Buchan River, near Gellingall.*

This rock sample was selected from the intensely hard, dark-colored, and massive quartz felsites of the Buchan River near Gellingall. They are the extension of those mountain-forming masses from which the last example was derived. ***In situ*** they could only be described as quartz felsites, and yet I observed more than one place where included fragments were by no means rare.

This rock has a brown felsitic ground mass, in which the fluid structure is not very apparent. Between crossed nicols it reacts in a remarkable manner. It becomes dark, and remains so, with the exception of faint traces of light in places during a complete rotation. This points to a vitreous condition, such as that of pitchstone. I have nowhere else observed this in this class of rocks of Gippsland.

In the ground mass are—

(1.) Very numerous more or less imperfect prisms of orthoclase, which include a green flaky mineral, some magnetite, and a few stout colorless microlites.

(2.) A few small prisms of plagioclase.

(3.) Small grains and a few large crystals of quartz. These latter contain portions of devitrified base and many minute fluid cavities.

(4.) Magnetite in crystals and grains in small quantity.

(5.) The dark-green translucent mineral described in 12.

14. *Dyke.—Section No. 9 h, Gellingall.*

This dykestone has a felsitic ground mass of a pale-brown color. In this are—

(1.) Number of very minute plagioclase prisms.

(2.) Very numerous grains and crystals of magnetite.

(3.) Minute colorless acicular microlites.

In this ground mass are—

(1.) Porphyritic crystals of felspar.

They polarize with color, and have a faintly striated appearance, but not the polysynthetic structure of the ordinary triclinic felspars. They resemble instances which I have observed in gabbro, diabase, and even basalt.

Their structure is such as might be produced by numbers of very narrow laminæ, composed each of shorter lengths placed endways to each other, and each chain of parts optically discordant with its neighbour. The appearance is such as I have observed in cases of intergrowth of plagioclase with orthoclase. I have no doubt, however, that these felspars are triclinic.

(2.) Pale-yellow grains, or more or less perfect crystals, whose angles, where I could measure them, were those of augite. Some of these have been altered into viridite. An example is figured (Lithograph Plate No. 2, Fig. 2).

This dyke is, therefore, composed of plagioclase, augite, and magnetite (with some chlorite), porphyritically embedded in a felsitic base. Were there no augite, this would be classed as a porphyrite; were there hornblende, in lieu of augite, it would be a hornblende porphyrite; were the felsitic base absent, it would be a diabase. The rock is anomalous; but it may perhaps be described as a porphyritic diabase or an augite porphyrite.

15. *Basalt.—Section No. 12 g, Back Creek.*

The ground mass is composed of a network of minute plagioclase prisms. The interspaces are filled in by calcite and viridite, with a considerable amount of magnetite and ferric hydrate.

In this are large plagioclase prisms, which are, however, much altered, the interior being more or less replaced by calcite or viridite. The general alteration to which this rock has been subjected is shown by the large numbers of irregularly-shaped spaces filled in by (1) calcite, (2) viridite, or by both.—(*See* Lithograph Plate No. 2, Fig. 6.)

It may be observed that the small plagioclase prisms in the ground mass are arranged round these cavities in the same way as they may be also seen to be arranged round crystals, for instance in the basalts. This clearly points to fluid structure, and to these spaces as representing the sites of crystals of felspar, augite, or olivine; which not only have been removed, but have implicated portions of the surrounding mass in their decomposition.

16. *Intrusive Basalt, near the junction of the Murendel and Buchan Rivers.*

The rock has a micro-porphyritic structure. The ground mass is semi-crystalline, and consists of—

(1.) A large amount of devitrified base.

(2.) Numbers of small plagioclase prisms, which form an open network.

(3.) Grains and crystals of magnetite, and, perhaps, titanic iron, which are so numerous as to render the slice somewhat opaque in places.

In this ground mass are—

(1.) Larger prisms of the usual character of the plagioclase of basalts.

(2.) Somewhat broader prisms, which have rectangular outlines and are not striated. These have, almost without exception, a considerable amount of devitrified base included centrally, leaving a clear margin. These are, no doubt, orthoclase, and precisely resemble, in every particular, similar occurrences in the porphyritic basalt of the Dargo High Plains.

(3.) Grains of light brownish-yellow augite. This only includes minute portions of base, and, in some places, a secondary product, hematite, in translucent red scales.

This may be regarded as representing the unaltered condition of the rocks ; the altered form being that just described (15). Surrounding a group of these augite grains the amorphous base preponderates, and the smaller plagioclase prisms of the ground mass are arranged in conformity with the outlines of the augite group. The stream, so to say, of felspars, divides on nearing it, passes round on each side, and reunites beyond. These are just those features which are evident in the calcite and viridite concretions of the altered rock. The decomposites of augite may be supposed, under certain conditions, to result in the products of viridite and calcite. In the altered rock the devitrified base seems to have been very generally replaced by viridite.

17. *Intrusive Basalt, Murendel Mine.—Section* 13 *a.*

This basalt has a micro-porphyritic structure. The ground mass is semi-crystalline, being composed of—

(1.) A large amount of devitrified base.

(2.) Numerous small plagioclase prisms, which form an open network. Many of the prisms are arranged with their longer diameters approximately parallel ; and in this direction the prisms form streams, which pass round the larger constituent minerals in well-marked examples of fluid structure.

(3.) Pale brownish-yellow augite grains.

(4.) Very numerous grains and crystals of magnetite.—(*See* Lithograph Plate No. 2, Fig. 4.)

The small interspaces are often filled in by viridite ; very minute circular colorless microlites penetrate the devitrified base.

In this ground mass are—

(1.) Large plagioclase prisms.

(2.) A few shorter, broader felspars, with rectangular outlines, and not striated —orthoclase.

(3.) Brownish-yellow augite, in grains, and occasionally in well-formed crystals. One of these shows the planes I, ii, ĩ, and has an internal nucleus with the prismatic planes only. Below this and the bounding planes are well-marked lines of growth. The augite only includes a little magnetite.

(4.) Irregular spaces filled by calcite, viridite, and chalcedony. The latter in concentric mammillary masses implanted on the inner surface of the cavity. The viridite is of two kinds, which are distinguished in ordinary light by their color, and by their reactions with polarized light. One variety consists of an aggregation of green scales, and is almost certainly chlorite.

In this slice changes may be viewed which connect the unaltered augite grains and crystals with those concretions which I have suggested represent the former position of augite, and perhaps olivine.

This rock is unmistakably a basalt. It greatly resembles a sample which I have prepared from the porphyritic basalt of the Dargo High Plains.

No conclusion can be drawn from an examination of thin slices as to its geological age. I have as yet found no characters which can be said to be peculiar to the Newer or Older Tertiary basalts, or to the still older Palæozoic basalt of the Snowy Bluff.

18. *Altered Basalt, Murendel South.*

This example was collected where the basalt has penetrated among the limestones.

It has a grey somewhat indistinct ground mass, in which are—

(1.) Somewhat dim outlines of minute plagioclase prisms.

(2.) Dark-brown or black specks or squares, representing probably magnetite and its alteration to ferric hydrate.

(3.) Interspaces filled by light-green viridite.

In this ground mass are—

(1.) Rarely, large plagioclase prisms, which are much altered.

(2.) Hexagonal or irregularly shaped dark-brown spaces, most of which have centrally clear portions which polarize as aggregates. The most regularly formed of these occurrences have the angles of olivine.—(*See* Lithograph Plate No. 2, Fig. 5.)

Those which have dark-brown margins have also an internal dark network, connected with the exterior, which is highly suggestive of olivine. Some portions are translucent, and are then of a deep-red color, and with polarized light react like mica. Examined in the rock by the naked eye or by a lens, this mineral is seen to be highly cleavable, even approaching micaceous, to be soft—about H.3 or less—and to have a brownish-red or bright-red streak. Its mode of occurrence in this altered basalt and its crystalline form connect it with olivine. Its structure and the translucent red crystallized portions connect it with rubellane.

Mr. G. H. F. Ulrich has described a micaceous mineral found in basalt at Vaughan and Footscray. He attributes it to the alteration of olivine, and refers it to rubellane.* He informs me that in the mineral which he described the micaceous structure is more perfect than in that from Murendel, of which I forwarded him an example.

Mr. Allport describes olivine altered to hematite at Burling in Dumbarton.†

I observe that rubellane is described by J. D. Dana as being considered an altered biotite, and as occurring in hexagonal forms of a red color in a kind of wacke.‡ Des Cloizeaux also states that the rubellane of Breithaupt is found in a wacke at Schima in Bohemia, at Zwickau in a porphyry and an amygdaloid.§

The terms "wacke" and "amygdaloid" may be regarded as synonymous with altered basalt, and the porphyry may or may not be basic.

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* Intercolonial Exhibition Essays, 1866—"Mineralogy of Victoria," p. 64.

† On the Microscopic Structure and Composition of British Carboniferous Dolerites, by S. Allport, Esq., F.G.S. Quarterly Journal of the Geological Society, vol. xxx., p. 541.

‡ A System of Mineralogy. J. D. Dana, p. 307.

§ Manuel de Minéralogie. A. Des Cloizeaux, p. 495.

It seems, I think, questionable whether these recorded occurrences of rubellane might not all be referred to the alteration of olivine rather than biotite

19. *Limestone from Western Fault, Murendel River.*

This rock, examined as a thin slice, showed no peculiarity worthy of notice except that its structure was minutely granular.

20. *Limestone.*

This sample was taken from a very hard band, near where the western fault crosses the Murendel River. A shaft of the Potosi Company had been sunk following the dip of this band in search of ore. It is extremely hard, crystalline, and of a pale slaty-grey color.

Under the microscope it proves to be crystalline granular. The granules are either more or less rhombic or irregular in shape. Some have distinct cleavage, while others show no trace of it.

A qualitative examination showed it to be a dolomitic limestone, with a little carbonate of iron. A comparative examination of a fragment of similar size of dolomite from Predazzo indicated that the former rock probably contains in the carbonates of magnesia and iron an amount about equivalent to the magnesian carbonate of the true dolomite.

Reference to Plate No. 2.

The figures preceded by the sign × indicate the number of times the object has been linearly magnified.

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APPENDIX.

Remarks on Rock Samples collected by Mr. Reginald A. F. Murray from the Avon River, Mount Wellington, etc.

1. *Mount Hump Creek, Avon River.*

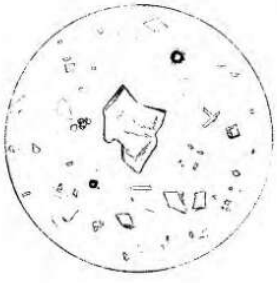
Examined under the microscope as a thin slice, this rock proves to be *Diabase* consisting of—

(1.) Triclinic felspar.
(2.) Pale-brown augite in grains.
(3.) Magnetite.
(4.) Chlorite.

2. *Mount Hump Creek, Avon River.*

A slice of this rock examined under the microscope proves to have lost all distinctive characters which could be relied upon to indicate its original structure.

PLATE 2.



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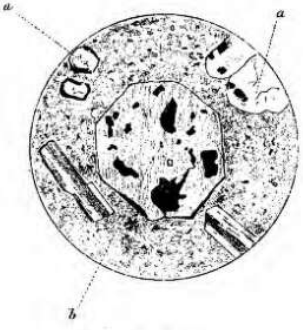

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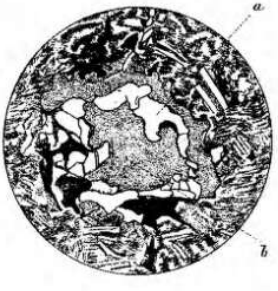
5 × 24



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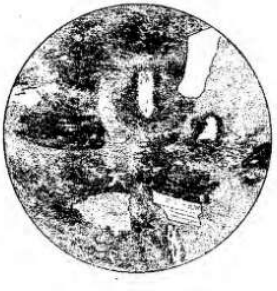
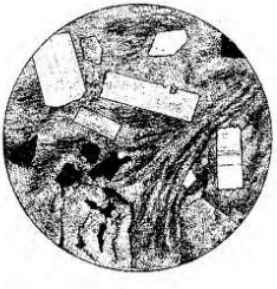


7 × 24

8 × 24



9 × 24

MICROSCOPIC ROCK SECTIONS

Howitt. Del.

R. Shepherd Lith

It much resembles a highly altered hard serpentinous rock from Tasmania, a sample of which is in my possession.

It is composed almost wholly of concretions colored throughout by some chloritic mineral.*

I regard it as probably representing one of the most completely metamorphosed forms of melaphyr.

3. *Avon River.*

This is stated to be a fragment from a boulder.

The ground mass of this rock consists of a network of minute plagioclase prisms. Much viridite is distributed through the base. In the ground mass are very numerous grains and imperfect crystals of augite. Magnetite is also present with occasional flakes of hematite. The structure narrowly resembles that of an example of *basaltite* from Zwickan in my possession. It would therefore be classed, if of Pre-Tertiary age, among the melaphyrs.

4. *Branch of Mount Hump Creek, a Tributary of the Avon River.*

This is a variety of granite which, in its structure, stands somewhat nearer to the quartz felsites than to the true granites. It is a crystalline granular compound of—

(1.) Orthoclase felspar.
(2.) Quartz in crystalline grains.
(3.) A very little plagioclase in small striated prisms ; and
(4.) A little biotite mica.

The two latter are quite subordinate to the former.

5. *From Section crossing from Mount Hump Creek towards Mount Wellington.*

The greater part of the mass consists of irregularly spheroidal or quite irregular concretions. The outer part of these concretions is full of a grey cloudy and granular substance resembling that so often to be observed in altered felspars. Following this and extending centrally are grey or almost colorless prisms, having somewhat the crystalline appearance of epidote. The centre is filled up by colorless quartz.

The space between the concretions is rendered obscure by the same grey cloudy material already mentioned, but in it here and there are outlines narrowly resembling in shape and position those of the ordinary plagioclase prisms of basalt or melaphyr.

I believe this to be an extreme form of melaphyr.

5. *Ben Cruachan Creek.*

A crystalline ground mass of plagioclase prisms in which the twin structure is well displayed. In this are—

(1.) Porphyritic plagioclase prisms.
(2.) The remains of augite granules.
(3.) Magnetite, and other opaque black material.

There are numerous irregular concretions occurring, filled mainly by quartz, in which are crystals of epidote implanted marginally. Viridite is generally distributed through this rock.

* Where it is necessary in these notes to mention these undefined chloritic or delessite-like substances, which are of so frequent occurrence in the older basic rocks, I shall avail myself of the term "Viridite," as proposed by Professor Streng.—*Neues Jahrbuch für Mineralogie* 1877, p. 45.

From its rather coarse structure, it might be termed a fine-grained diabase, and would then bear the same relation to melaphyr that some dolerites bear to basalt.

6. *From Section from Mount Hump Creek towards Mount Wellington.*

The structure is minutely granular rather than micro-crystalline. A few porphyritic plagioclase prisms are to be recognised in the general mass. In this rock, as in sample 5, concretions take up much space. The general green color of the rock is due to the universal occurrence of viridite.

7. *From Section from Mount Hump Creek towards Mount Wellington.*

The character of this rock is almost wholly obliterated by internal changes which have taken place in it. The concretionary structure is strongly developed, as in other samples.

Flocks of dark-green chlorite are plentifully distributed in the quartz which fills in part of the concretions. This is again, I think, an extreme form of melaphyr.

8. *Mount Hump Creek.*

This rock resembles sample 5, but is more cloudy and opaque. The concretions are not so close together, and the outlines of the plagioclase prisms in the interspaces between them are more numerous and more distinct in character.

The concretions seemingly consist entirely of—

(1.) Epidote.
(2.) A little quartz.

I regard this as a form of highly-altered melaphyr.

9. *Mount Hump Creek, towards Mount Wellington.*

The remarks made as to 5 apply equally to this example.

10. *Mount Hump Creek.*

This rock is made up almost entirely of minute plagioclase prisms, with some magnetite, a little viridite throughout, but the ground mass is mainly filled in by the grey cloudy substance so commonly observable in altered felspars. In the ground mass are—

(1.) A few irregularly-shaped porphyritic triclinic felspars.
(2.) A solitary crystalline grain of clear quartz, which has exactly the habit of the crystalline grains of quartz felsites. It includes a portion of the base, and the minute triclinic felspars surrounding it conform in their direction to its outlines. It would seem therefore to be an original constituent, and not a secondary alteration product.

The occurrence of a quartz granule in so basic a rock as is this melaphyr must be regarded as a most exceptional occurrence.

11. *Summit of Mount Wellington.*

A fine-grained quartz felsite.

12. *Ben Cruachan Creek.*

This rock has a micro-crystalline ground mass of small triclinic felspars. The interspaces are filled in by viridite, and here and there by epidote. There are a

few larger porphyritic prisms, and magnetite is irregularly scattered through the mass. The concretions which occur are—

(1.) Marginally of epidote.
(2.) Following this, quartz.
(3.) Centrally, a mass of chlorite.

The basaltic structure can be well recognised, but this rock, being of Pre-Tertiary age, would be classed as melaphyr.

13. *Ben Cruachan Creek.*

A ground mass of small plagioclase prisms filled in by viridite. In this are—

(1.) Porphyritic larger triclinic felspars.
(2.) Magnetite.
(3.) Numerous cavities and interspaces filled by epidote.

This also belongs to the melaphyrs, and the basaltic structure is still recognisable.

14. *Ben Cruachan Creek.*

This rock exactly resembles the last in structure and composition, but in it a few grains of augite are still recognisable.

15. *Ben Cruachan Creek.*

The structure is micro-crystalline, and composed mainly of small plagioclase prisms. Among them are a few larger ones, and the interspaces are filled in by viridite. One or two concretions occur, but of not well-defined character. There are a few minute grains of augite and some magnetite. The basaltic character is recognisable.

16. *Ben Cruachan Creek.*

The ground mass of this rock is peculiar in being filled in by small lighter-colored spots, which in places nearly touch each other, and then take a linear direction. Through the mass wavy lighter-colored bands pass. Crystalline grains of quartz are numerous. This is a quartz felsite, and somewhat nearly resembles occurrences at the Snowy Bluff.

The samples which in the preceding remarks I have defined as melaphyrs form a series of more or less altered rocks, at one end of which the basaltic character of the rock and of its constituent minerals is well marked, while at the other end this character is completely obliterated by alteration. Intermediately are instances which combine both structures, and thus connect the whole series.

After having made a careful examination and comparison of them with a series of examples from the Snowy Bluff, I regard these malaphyrs as representing the same group of basic igneous rocks met with at that place, but they have in these examples lost far more completely their original structure. To such an extent has the metamorphism of many of these rocks extended, that, taken separately, it would be most difficult to conjecture their former condition. Regarding, however, the stratigraphical conditions of their occurrence, as indicated to me by Mr. Murray,* their connection with the group of more basaltic melaphyrs of the Snowy Bluff becomes more apparent.

On grounds which I have previously stated at length, I regard the alterations observable here as due to metamorphism.

A. W. HOWITT.

* *See* Report on South-east Gippsland by R. A. F. Murray.

REPORT ON THE SOUTH EXTENDED SULTAN COMPANY'S MINE, BLACKWOOD.

THE ground occupied by the South Extended Sultan Company is traversed by several quartz veins, and also contains a deposit of auriferous drift, both of which have been and are now being worked upon. The attached geological plan and section show the occurrence of these veins and drifts, as well as the sites of the several shafts, adits, &c., on and adjoining the company's leasehold. The large drawing accompanying this paper represents a plan or horizontal section of the main or lower adit, with all the workings carried on to date. The notes inserted on this drawing describe the character of the "country" exposed by the mining operations.

QUARTZ LODES.

The quartz lodes, or indications of lodes, which have been touched upon in the shafts and adits, or are cropping out on the surface, are nine (9) in number. Their trend, in common with the normal strike of the Silurian rocks, is from 10° to 17° east of north. Commencing at the western boundary of the leasehold, on the left bank of the Lerderderg, and proceeding in an easterly direction, these veins are as follow:—

No. 1 *Vein.*—A thin band of quartz, half an inch thick, cut through by the adit 20 feet from the entrance. It is worthless.

No. 2 *Vein.*—At a distance of 177 feet from the mouth of the adit the country is faulted by a slide dipping south-westerly under an angle of 28°. Above this slide there is a reef-like body of indurated sandstone (quartzite) 3 feet 4 inches thick, streaked with numerous bands of quartz; below the slide occur three veins, as shown on Figure 1. The central vein has a persistent course which has been followed northward for 264 feet in No. 2 level. The greatest thickness observed is 4 inches; it splits up in places into several ramifications; in others it is completely pinched out. The vein has been well prospected and proved barren. It will answer no useful purpose to continue further operations on this vein.

FIG. 1.

Section at No. 2 Level on southern wall of Adit.

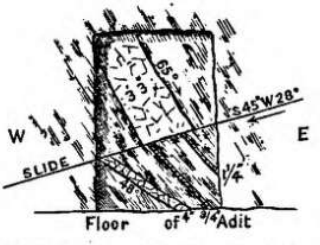
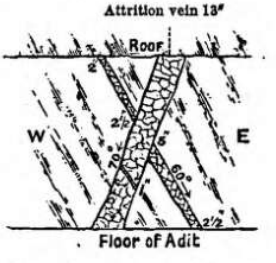


FIG. 2.

Section of No. 3 Vein on northern wall of Adit.

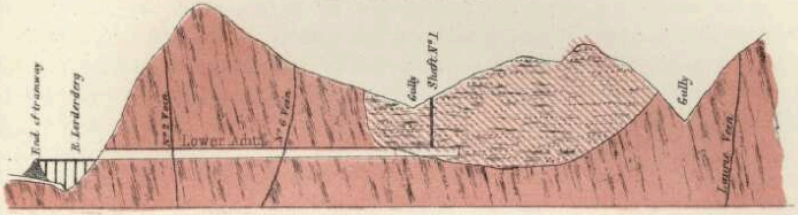


No. 3 *Vein* lies 16 feet east of the last-mentioned vein. It is an irregular body of quartz, from 2 to 5 inches thick, and is faulted in the manner shown on Figure 2. The walls are ill-defined, and the veinstone appears to be of limited extent. It is

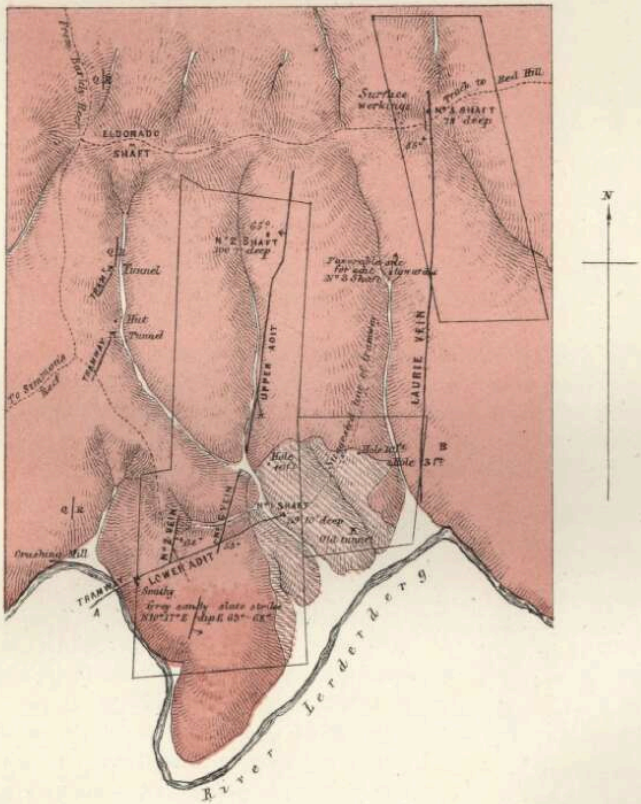
Section on the Line A–B on Plan

Horizontal Scale 0 10.0 CHAINS

Vertical Scale 0 100 FT



Geological Plan
of Country in the neighborhood of
THE SOUTH EXTENDED SULTAN Cos LEASEHOLDS
BLACKWOOD



Alluvial | Middle Pliocene (Older Gold. drift) | Silurian

Scale 0 10 Chains

Ferdinand M. Krause
Mining and Geological Surveyor.
23/5/77.

with these features in view, no doubt, that the vein has not been considered worth prospecting. I concur in the mining manager's opinion that it would be useless to open out upon this vein.

No. 4 *Vein.*—At a distance of 21 feet east of No. 3 vein the northern wall of the adit exhibits a group of thin veins and bands of quartz, resting upon the bedding and joint planes of the slate rock, as indicated on Figure 3. They are evidently local segregations, and, judging by the fact that on the southern wall there is only the faintest trace of the vertical vein visible, their extent is likely to be insignificant. The veinstone is barren and valueless.

No. 5 *Vein.*—This vein, half an inch thick at the adit, dies out at a distance of 10 feet northward. A level was driven for 33 feet, and a winze started in very dense slate. As might have been foreseen this work has turned out as fruitless as it was expensive.

FIG. 3.

Section of No. 4 Vein and Ramifications on northern wall of Adit.

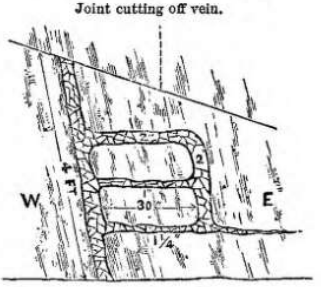
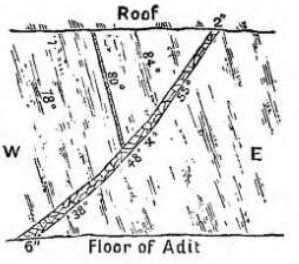


FIG. 4.

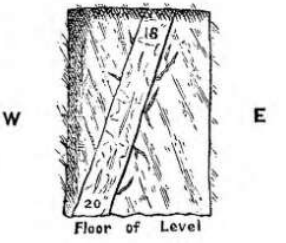
Section of No. 6 Vein on southern wall of Adit.



No. 6 *Vein.*—The dip* of the veins so far described is easterly from 60° to 70°. At a distance of 410 feet east of the mouth of the main adit an opposite inclination (to the west) is observed in a vein from 2 to 6 inches thick, while the constant dip of the schist rock persists in its easterly direction (*vide* Fig. 4). A level has been driven 20 feet north, at the face of which the walls of the vein widen out to from 18 to 20 inches, and enclose an agglomeration of grey sandy clay, and fragments of the bordering rock, with thin streaks and plates of quartz. Irregular veins also join the main body on both sides under various angles (*vide* Fig. 5). Apart from the character of the lode stone, which has so far proved absolutely barren, the features disclosed by the present workings sufficiently attest to the improbability of the vein opening out to workable size on the adit level, and it would, therefore, be injudicious to continue search operations by the extension of any drives on this level.

FIG. 5.

Section of No. 6 Vein at face of Level.



In the upper adit, at a distance of 550 feet north of the last-mentioned point in the lower adit, a vein has been exposed, similar in

* The geological term "dip" is synonymous with the expression "underlay" of the Victorian miner.

dip, strike, and surroundings to, and evidently a continuation of, No. 6 vein. It has there been pursued for a distance of upwards of 200 feet along its strike, but the thickness nowhere exceeded 5 inches, and no gold appears to have been noticed.

From the mouth of the upper adit this vein has been traced on the surface in a series of shallow pits for a space of 1,600 feet to and beyond No. 2 shaft. It crops out 70 feet east of this shaft, in a body of quartz 5 feet 3 inches thick, dipping west 65°. Gold was found on the east side of this lode. The shaft is sunk to a depth of 100 feet 7 inches, and a cross-cut driven easterly towards the lode, 38 feet long. At this distance a quartz band 2½ inches thick, and dipping east 70° to 75°, was struck. This is, no doubt, a distinct vein. If the westerly dip observed on the surface were persistent, then the lode should have been encountered in the 100 feet level at a distance of 22 feet from the shaft. It is, however, not unlikely that the No. 6 vein at a greater depth will assume the constant easterly dip of the surrounding country, and its probable position may be looked for considerably further east.

I would recommend that the cross-cut be extended eastward for a distance of say 30 feet, or until the lode is intercepted. If the character of the stone then exposed warrant the undertaking, stoping may be carried on simultaneously at this level and from the surface downwards. The shaft and ladders are in good working order.

No. 7 *Vein.*—At a distance of 116 feet east of No. 6 vein the lower adit cuts across two veins, 17 inches apart, of black carbonaceous clay with occasional streaks of quartz, encased by well-defined bedding planes of grey sandy slate. These clay veins have been followed in a northerly drive, 18 feet long, under the supposition that they formed the "track" of a reef. They are simply veins of attrition, and the expenditure incurred in opening out upon them is altogether useless.

No. 8 *Vein.*—Forty-six feet further east occurs a vein 2½ inches thick, precisely similar to the No. 7 vein. It has, like the former, been the mistaken cause of opening a drive along its course, 15 feet to the south. This work also serves no profitable end.

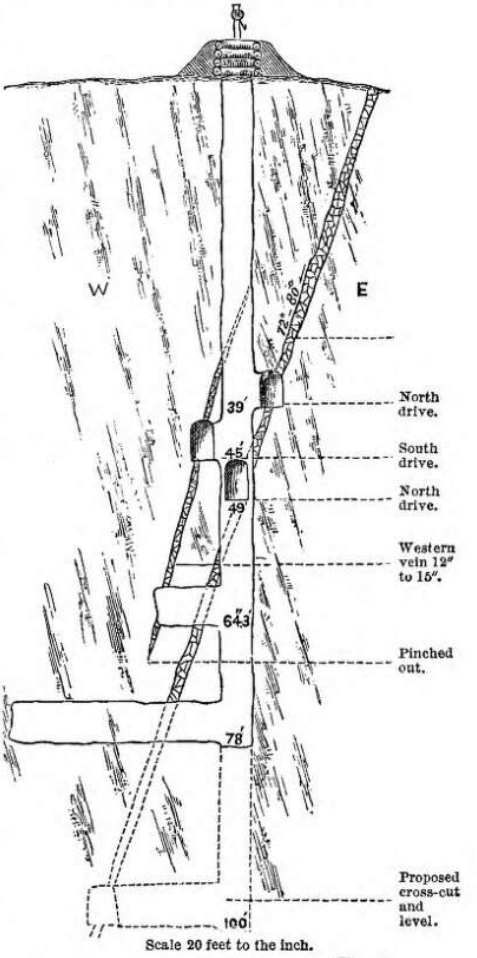
No. 9, *or Laurie's Vein.*—This vein lies from 1,500 to 1,600 feet east of No. 6 vein, occasional outcrops being noticeable for a distance of 28 chains between the Lerderderg and No. 3 shaft on the crown of the range. The vein dips westerly from 65° to 85°. In No. 3 shaft (*vide* Fig. 6) two lodes, from 5 to 8 feet asunder, have been wrought with partial success. At the 45 feet level the western lode is 12 to 15 inches thick, and has been taken out for a length of 20 feet. It there merges in places into the quartzite elsewhere noticed in this locality, and the labor of separating the productive veinstone from the barren rock becomes necessarily costly. The quartz is said to have yielded 7 dwt. per ton. At 65 feet from the surface this lode dies out. The eastern or main lode is from 24 to 12 inches thick, and was wrought for 20 feet north of the shaft, the stone yielding 3 dwt. per ton. At that distance the lode is thrown, as shown in Figure 7, by a fault which was followed westerly for 10 feet, when the faulted portion of the lode was struck, and worked for nearly 100 feet, connecting with the surface workings, which extend to 120 feet north of the shaft. These workings expose three or four irregular veins dipping under a high angle; the stone gave generally good returns (as high as 15 dwt. per ton) on the upper levels, but became profitless at lower depths. The quartz on the north side of the fault is stated to have been more productive than that taken from the southern portion of the lode. At 230 feet south of No. 3

shaft the cap of the vein suddenly increases to the thickness of from 2 feet to 4 feet 6 inches. In making a shallow excavation to lay bare the walls of the vein, gold, I am informed, was freely seen.

I would recommend that No. 3 shaft be sunk to the depth of 100 feet, a cross-cut put in west till the lode is struck—which will be at about 15 feet; then to drive southerly along the course of the lode until meeting the surface. If the lode prove of workable size and productiveness the best mode of working it is by stopes and winzes, the stopes in every case to run south till meeting the sloping surface of the hill, while the tram is to be laid in the stopes and shifted to the different levels as required.

The necessity for driving a tunnel will not in that case arise.

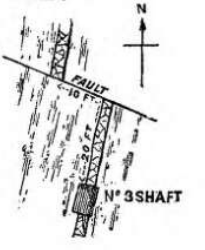
FIG. 6.
Section of Laurie Vein in No. 3 shaft.



ALLUVIAL DEPOSITS.

The "older drift," as shown on the annexed geological plan, occupies an area of about 8 acres. It is clearly a remnant of the river drift accumulated during Middle Pliocene times in an *embouchure* which was formed by a tributary stream flowing southward into a main water-course, probably corresponding to the modern valley of the Lerderderg. Numerous shafts and tunnels have entered the deposit at various times during the last eighteen years; but, owing partly to the primitive mode of working adopted, and partly to the "patchy" nature of the washdirt, mining operations have been abandoned in most cases at an early stage. From the information I was able to collect it appears that the workings were at no time very productive. The "color" was obtained nearly throughout, but on the whole the ground would not have been payable had it not been for the unearthing of some exceptionally heavy pieces of gold. Nuggets weighing 18 to 20 oz. are reported to have been occasionally met with. The northern and

FIG. 7.
Plan showing Laurie Vein thrown by a fault.



greater part of the deposit has, however, hardly been touched except by the workings from the company's lower adit, and even these, it must be admitted, have been carried on in a somewhat desultory manner. They should, in my opinion, be conducted in the first instance more with a view of exploring the extent and character of the auriferous deposit than one of establishing the most direct communication on the easiest gradient.

The lithological character of the drift has been described in the remarks inserted on the mine plan. It remains only to be noted that the coarse gold here, as elsewhere, is likely to rest along shelves and terraces of the bed-rock, and it is well, therefore, to examine at the outset the upper or northern margin of the *embouchure*. For this purpose the drives already put in by the company are of little value. The southern drive, apart from the inconvenience of starting at the roof of the adit, is too close to the steep bank of the lead channel; the north-western drive has too much lateral bearing for a level, yet is entailing too much dead work for a cross-cut. I would suggest to return to a point 36 feet west of No. 1 shaft, where the bed-rock sinks to the floor of the adit, and drive a tunnel south 12° east 300 feet more or less to the surface. In the same way continue the northern drive, near No. 1 shaft, in a direction north 10° east 250 feet or thereabout to the limit of the drift deposit. In both cases cross-cuts should be driven at regular intervals of say 50 feet to the western margin of the lead, making careful trial washings in every instance. If the result of these explorations justify the blocking-out of the lead, then let the main adit be abandoned as a means of traffic, and work be conducted from a new tunnel which should start from the left bank of the Lerderderg, south-east of No. 1 shaft, but the exact position of which can be fixed only after the deepest level of the lead has been ascertained. The driving of the main adit should be discontinued for the present.

Summary Remarks.

1. I cannot recommend any further expenditure for the exploration of the quartz veins in the lower or main adit.

2. No. 6 vein is worth prospecting from No. 2 shaft. The cross-cut in that shaft should be extended eastward in the way described in the concluding paragraph under the heading "No. 6 vein."

3. No. 9 vein presents features favoring further exploration. No. 3 shaft to be sunk to a depth of 100 feet; a cross-cut put in west 15 feet more or less to reef, and a level driven along lode (*vide* Fig. 6).

4. The "alluvial," offering prospects of more immediate returns of profit, should be at once systematically examined by means of two levels and cross-cuts as above described, and indicated in red lines and notes on the mine plan.

Concluding Remark.

Mr. Elliot, the company's intelligent mining manager, has afforded me every assistance during the survey and examination of the mine and environs.

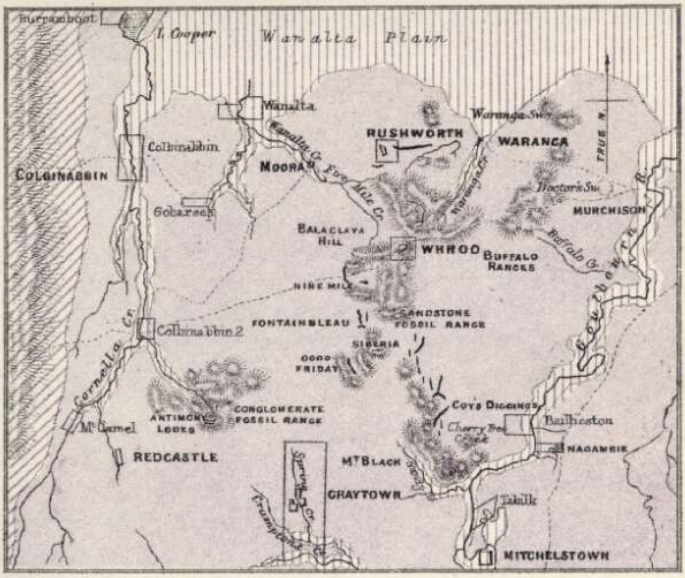
FERDINAND M. KRAUSÉ,
Mining and Geological Surveyor.

Daylesford, 19th May 1877.

Geological Sketch Map of portion of the

NORTH WARANGA MINING DIVISION

Scale 8 Miles to One Inch.



GRANITE UPPER SILURIAN TRAP TERTIARY

SIR, Melbourne, 30th September 1877.

I have the honor to enclose "Remarks on the Geology and Mining Resources of the North Waranga Mining Subdivision."

I have the honor to be, Sir,
Your most obedient servant,
WILLIAM NICHOLAS.

Thos. Couchman, Esq.,
Secretary for Mines, &c., Melbourne.

REMARKS ON THE GEOLOGY AND MINING RESOURCES OF THE NORTH WARANGA MINING SUBDIVISION.

THE interesting area of country comprised within this subdivision is but little known to the public. It has received scant attention from the press or official reports, the published maps show approximately only the positions of a few mountains, creeks, and towns, the remainder is a blank, and it may therefore well be termed a *terra incognita*. In the following remarks it is my intention to supply some topographical as well as geological and mining information respecting this country.

GRANITE.

The only outcrop of granite in the district lies in the south-eastern corner between Sandy Creek and the Goulburn River. (This outcrop of granite is not marked on the geological sketch-maps of Victoria.) As will be seen in the accompanying sketch-map, that portion of it which is exposed occupies but a limited area of the surface. To the north of the creek, at the foot of Mount Black, the granite (ternary) is rather coarse-grained, of a brown-pinkish color, and is fast decomposing; but to the south it is finer-grained, of a light-grey color, and evidently durable and well fitted for building purposes. Some of it has been quarried—if I may use the expression—from a huge boulder which lies near the foot of the mount on its northern flank, and used for the foundation stone of the Waranga Shire Hall at Rushworth.

FIG. 1.—Granite Boulder.

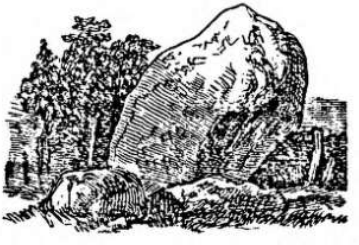
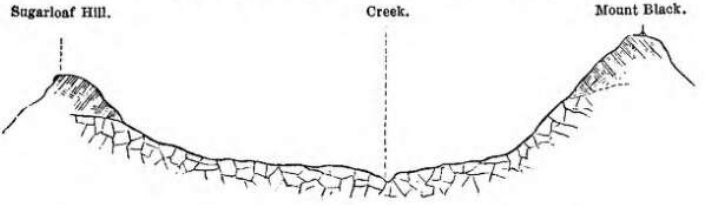


Figure 1 represents another large boulder, which lies to the west of the one just mentioned, and distant from it some few hundred yards.

The granite is evidently exposed through the effects of denudation. It occupies the whole of the bottom of the valley, which is surrounded by precipitous hills composed of apparently indurated Upper Silurian rocks. Granite forms the base and lower half of Mount Black, whilst the upper half consists of Upper Silurian rocks. The Sugarloaf Hill to the north of the mount, on the opposite side of the valley, was, I found, of a like construction ; and the hills to the west were based on granite which did not, however, ascend so high up their sides, owing to the rocks having been subjected to less denudation. The sketch-section Fig. 2,

Fig. 2.—Sketch-section showing the junction of Granite and Slate Rocks.



illustrates the exposure of granite rock in this valley. From what I observed of the relative position of the rocks existing here I should say that the deeper valleys for some distance round this place were separated by but thin deposits of detritus and Silurian rocks from the underlying granitic formation. On the south-west side of the Sugarloaf Hill the strike of the slate rock is north and south, with a slight dip to the east. These observations were made on a strong outcrop only a few yards above where the granite was visible in the side of the hill.

To the north-east of Mount Black, and on the opposite side of the creek at its foot, a granite (binary) vein or dyke exists, which consists of a pink orthoclase base having a little light-colored mica in very fine scales distributed throughout it, and occasionally quartz grains.

Upper Silurian.

The whole of the country lying between the high range bounding the Spring Creek Valley on the north and to the Murray tertiaries, and between the Mount Camel Trap Range and the Goulburn Valley, apparently consists of Upper Silurian rocks. The auriferous portion is hilly and very thickly wooded.

Perhaps the most singular feature connected with the geology of this district—as compared with the larger portion of Victoria—is the want of uniformity in the strike of the Silurian strata. For example, in the immediate vicinity of Rushworth it is east, about a mile to the west it is north-east, and about two miles and a half distant it is north-west. Between Rushworth and Whroo it is east and west. In the neighborhood of Whroo the latter strike prevails, and continues as far south as a sandstone range about four miles distant from the last-named place. At Fontainbleau, about five miles west of this range, the strike is north-west; and at about a mile to the south of this place it is again found to be east and west. The strike at Coy's Diggings and Cherry-tree Flat, to the south of the sandstone range beforementioned, is north-west, and prevails at least as far as two miles west of the last-named place. It is nearly north and south at Mount Black and at the ranges about

ten miles to the west of Coy's Diggings. From the foregoing statements it is evident that the strata for about ten miles in length between Rushworth and the sandstone range have undergone considerable disturbance, insomuch that the rocks strike at nearly right angles to the prevailing direction of the strata to the south and west. Further evidence of the disturbance of the rocks will be found under the head of "Quartz Reefs." I may also remark that the strata generally are tilted very nearly to the perpendicular.

Near the granite at Mount Black the rocks become metamorphosed—darker in color than that prevailing in the district (which is yellowish-white and cream color) —are harder, and the cleavage more perfect.

The sandstone adjoining the Fossil Reef at Rushworth contains numerous casts of encrinite stems and other fossils.

In the latter part of the year 1867 I found some fossils in a sandstone range a few miles to the south of Whroo, which have been examined by Professor McCoy, who stated in his report that the fossil casts were almost indeterminable. * * * "There are two articular surfaces of crinoid stems of the actinocrinus type, one small coral, probably *Favosites fibrosa*, one indeterminable Lamellibranch, and two fragments of the Upper Silurian variety of the *Orthis calligramma*. The balance of the evidence is therefore in favor of the rock being Upper Silurian."

A small range in which a bed of fossiliferous pudding-stone conglomerate outcrops is situated near the head of one of the eastern branches of the Cornella Creek. It is surrounded by higher and more conspicuous ranges. In fact the whole of the country here for many miles in all directions consists of precipitous Upper Silurian hills, thickly covered by a forest of box and ironbark trees, with here and there patches of the tree-grass. (Not being successful in at first finding the site of the fossils in the conglomerate, much of the neighboring country was examined.) The quartz pebbles from the conglomerate bed, which bed occupied the crown of the range, were strewn over its sides down to the edges of the gullies. In several places parallel beds of lesser width outcropped, and large blocks of cemented gravel lay partly hidden in the scrub. The water-worn gravel and pebbles ranged in size from coarse sand to large pebbles as much as three inches in diameter. The existence of these pebbles and of corals in the conglomerate beds indicate that they were originally deposited in a shallow sea. The strike of the beds and of the bounding strata was ill-defined; it may, however, be set down as nearly north and south. Indications of fossils were numerous, but perfect or nearly perfect casts were rare, and obtained only by considerable labor and search. Twenty fair specimens were obtained, and these have been submitted to Professor McCoy.

Alluviums.

The Waranga goldfields were first opened in the latter part of the year 1853. They may therefore be reckoned amongst the oldest of Victorian goldfields; and, by this time, as may well be understood, nearly all the gullies are wrought, and some, worked over again and again, still yield a livelihood to a considerable number of miners.

The name "Waranga" was obtained from the native title of the squatter's run on which the first gold discoveries were made.

The most northern and most important gold workings are at and in the vicinity of Rushworth, where, at the close of the September quarter of this year, 513 alluvial miners were employed in mining. The principal alluvial workings are, or have been, on the Old Lead. The head of the lead is in Growler's Gully, at the back and to the west of the township. This lead trends easterly, and probably terminates in the Waranga Swamp. Many rich tributaries flow into it, but those joining it on the southern side are the most considerable. This lead has yielded more gold than any other in the district; it is but shallow, as the deepest shafts sunk on it are only from 35 feet to 55 feet in depth.

Since the date of my recent visit (23rd August 1877) Mr. S. Bryant Rowe, the local mining surveyor, has reported on a small "rush," to a place situated about two miles and a half to the east of Rushworth, on the road to Waranga. He describes the ground in work as being distant about a quarter of a mile from the old shafts on the Old Lead, of which it is considered a branch. The depth of the sinking is from 25 to 35 feet, and it was hoped that the gold would continue down into the Old Lead. At the time of reporting only two claims besides the prospector's had yielded gold.* The sinking was through soft sandy loam, and was quite dry.

The character of the cement and washdirt in the lead is very like to the Deep Lead at Bendigo, and both leads are probably of the same age (Older Pliocene, oldest gold drift).

Other minor auriferous streams flow into the Waranga Swamp, but they have as yet received little attention.

Whether Waranga Swamp, the receptacle of these golden creeks, will ever pay to work, is a matter that can only be decided by the miner. It is, however, not unreasonable to conjecture that the basin occupied by it is auriferous.

To the west of Rushworth is situated the Castle Lonely Lead; the sinking here ranged from 20 to 30 feet in depth, and the washdirt was from 1 foot to 2 feet 6 inches in thickness. This lead appears to be connected with Chinaman's Flat and Old Ned's Gully, and it has been inferred that if the lead were followed further towards the north the wide spread washdrift would be found to become concentrated and form into a more regular lead.

Nuggety Gully, the main feeder or tributary to the Old Lead, crosses the Nuggety Reef in its northerly course. This gully was very rich; the gold found in it was of a rather pale color, and little, if at all, water-worn; the washdirt was of a very ferruginous character, and contained a large quantity of bean iron ore (magnetic); there was also sub-angular quartz. The very ferruginous character of the washdirt is not surprising, seeing that the Nuggety Reef, at the head of the gully, contained such a large proportion of iron ore. (*See* page 160.)

Mr. T. W. Benbow, the late manager of the Bank of Victoria at Rushworth, who resided on this goldfield for many years, has courteously supplied me with much valuable information. He says, "Rushworth alluvial gold ranges in assay between 21·3⅜ and 22·1⅛, with a loss in melting of 1½ per cent. The average buying price (with standard at 77s.) is 76s. 9d. to 77s."

About four miles south of Rushworth are situated the auriferous deposits at Whroo, in a distinct but adjoining basin. Alluvial mining here has been carried on

* One of these claims had bottomed, so the mining registrar reported, with the excellent result of three-quarters of an ounce to the tub.

principally in the Main Gully, the Union Lead and its tributaries. These auriferous streams take their rise in the neighborhood of Balaclava Hill, and trend in a south-easterly direction towards the Reedy Swamp. The overflow waters of this swamp pour into the Goulburn River. The deepest sinking in the alluviums is on the Union Lead, and ranges from 35 feet to 55 feet in depth. This lead has been traced nearly to the swamp, and nearer to it than the operations carried on thus far upon the Main Gully. The washdrifts of all the gullies on the south-eastern fall from Whroo are connected with the Union Lead. The cement and washdirt of the lead are of much the same character as those found in the Old Lead at Rushworth.

The washdirt in the Cemetery Lead, at Whroo, was 18 inches in thickness, and yielded as much as 1 oz. of gold to the load.

Mr. Benbow states:—"Whroo alluvial gold is much better than that from Rushworth. The average assay is 22·1⅞ and buying price 77s. 6d. Loss in melting 1½ per cent. The gold from some gullies assays as much as 22·3⅜."

Coy's Diggings lie to the south of Whroo, and are distant from it about six miles. A non-auriferous low barren range, composed of arenaceous sandstone, separates the gold workings of these two fields.

The shallow alluvial gullies at Coy's trend in a north-easterly direction into the same watershed as the Whroo auriferous drifts; so far as they have been developed these deposits are of little importance. The operations have been almost confined to Coy's, Burrens', and Hard-scrabble gullies. In the latter the washdirt was from 10 to 12 inches in thickness. The depth of sinking generally ranged from 4 to 12 feet, and the yields during the first twelve months' mining varied from 4 dwt. to 1 oz. 4 dwt. per load of washdirt.

As Coy's is essentially a quartz mining field, more details respecting it will be found under the head of "Quartz Reefs," at page 170.

The rocks forming the hills round which the gullies trend are more argillaceous than those prevailing at Whroo and Rushworth.

The alluvial works at Cherry-tree Flat, which lie about two miles to the south-east of Coy's Diggings, are confined to the flat and two small gullies which fall into it. The alluvial deposits are comparatively unimportant as compared with the auriferous quartz reefs. A description of the latter is given at page 171.

To the west of Whroo, and about five miles distant, on the McIvor road, are situated the Nine-mile Creek diggings. The depth of the alluvium at this place varies from 6 feet to 25 feet. A section of the sinking at the latter depth is made up of surface soil, clay, white cement, a very heavy deposit of quartz boulders and washdirt (from 12 to 20 inches in thickness, which yielded from 4 to 18 dwt. to the load). The hills here are of the kind named by miners "made hills," and they are probably of the same age as the White Hills of Bendigo (Older Pliocene, or oldest gold drift).

The main lead has been worked for two miles in length, and tributary gullies have also been mined. On this lead the shallow sinking was at a lower level as regards surface elevation than the deep sinking, and the cement and washdirt were less in thickness, width, and richness than at higher levels, where the auriferous wash was found at greater depths. Like circumstances are not uncommon in some of the important western goldfields of Victoria. In this instance it appears to have been caused by the new watershed deviating from the old one, crossing it at a low level, removing and redistributing the overlying detritus and the washdirt.

The thickness of the alluvium at Good Friday Creek, which is situated a few miles to the south of the Nine-mile, is 40 feet. It consists of surface soil and gravel, cemented clay and gravel, and a compact argillaceous sand deposit (false bottom) and washdirt, from 6 to 12 inches in thickness.

At Fontainbleau, which lies midway between the Nine-mile and Good Friday, a little alluvial mining has been done.

The only large nugget of which I can find any record as having been discovered in any of these Waranga goldfields was one which weighed 60 oz. It was found at Siberia in October 1863. The scarcity of nuggets exceeding 5 oz. in weight is a remarkable feature in connection with the history of these goldfields. The auriferous alluvium deposits at Siberia are confined to two small patches, each of about half a mile in length, which are separated by a range through which runs an east and west quartz reef.

At Friesland (North Spring Creek), which is situated on the eastern branch of Spring Creek, the sinking was from 20 to 30 feet in depth, the washdirt was about 15 inches in thickness, and the yield of gold was about 5 dwt. to the load.

Shallow alluvial mining has been carried on to a considerable extent in the numerous gullies which wind between the Buffalo Ranges. These ranges lie to the east of Whroo and between it and the Goulburn River. The "old lead" here at 25 feet in depth proved to be narrow, only about 8 feet in width; the washdirt was from 18 inches to 4 feet in thickness. At four miles to the north of this lead washdirt was found 1 foot in thickness at 6 feet in depth, and it yielded over 12 dwt. to the load. The want of permanent water is the one great difficulty which retards the development of the undoubtedly payable auriferous deposits at the Buffalo Ranges.

Near Mount Black a little gold has been obtained by alluvial prospectors.

Cement Mining.

Immense deposits of cement cover considerable areas of the country about Rushworth, Whroo, Nine-mile, and Fontainbleau. The cement lies exposed on the surface in places, and has never been found at other than what may be considered shallow depths. It has been extensively worked at the undermentioned places, yielding remunerative quantities of gold and frequently rich patches—Chinaman's Hill, Gravel Pits, Old Lead, Nuggety, Cockatoo, Rushworth township, Butcher's Gully, &c. Crushings of several hundreds of tons have from time to time been recorded which have produced from 6 to 10 dwt. of gold to the ton, and there can be little doubt that as rich cement still remains to be crushed as has been put through the mills in the past.

General Remarks.

A few prospectors are now engaged in testing the ranges and gullies in the vicinity of the ranges to the north-east of Redcastle. The extensive tract of country which lies between Good Friday Creek and Redcastle undoubtedly presents a good field for the prospectors' operations, and so does that area from the fossiliferous Sandstone range to the north of Coy's, which spreads out in hilly land in a south-easterly direction to the Goulburn River. It may, in fact, be stated that all the hilly country to the south of the old Bendigo and Beechworth road not already

occupied by gold workings is worthy of being thoroughly tested. Few such large areas of promising auriferous country so likely to repay the prospector (with small capital) now remain untried in Victoria.

The North Waranga division may be truly termed the poor man's diggings, for the alluvial sinking is rarely deeper than 40 feet, the greater part of it is less than 20 feet in depth, and a living can be made almost anywhere in and near the old workings.

The following remarks made by Mr. Benbow are supplementary to those made by myself at page 158:—"The largest nugget I know as having been found was at Old Ned's Gully, Rushworth, weighing 30 oz. 3 dwt. 18 gr. At Waranga Diggings, near Gunn's Swamp, one was found weighing 25 oz. 18 dwt. Storekeeper's Gully, Rushworth, yielded one of 21 oz."

Watersheds.

The singular manner in which the waters from the basins facing towards the north are absorbed gives an interest to this subject which it would not otherwise possess.

The heads of the Wanalta and its tributary creeks are separated on the south from the Major's and Spring creeks by high Silurian ranges, and on the east from creeks flowing into the Goulburn River by the high land between Coy's Diggings and Whroo. The Wanalta Creek literally flows into the Murray tertiaries, for before it reaches as far north as the parallel of Lake Cooper it becomes absorbed by the sandy soil and is lost to view.

From the range to the north of Whroo flow the Waranga Creek, which takes a north-easterly course to the Waranga Swamp; and the Moora Creek, which trends in a north-westerly direction to the Wanalta Creek.

The Waranga Swamp—or lake as it was at one time and may again be fitly termed after one or two wet seasons—like Lake Tyrrell, Lake Coorong, and Lalbert Swamp, is situated in the Murray tertiaries, and, like them, it absorbs the waters poured into it, but fails to show any outlet. Possibly its waters drain off through the sandy soil into the Goulburn River.

A dividing range separates the eastern from the western watersheds. This range may be said to commence near the source of the Sandy Creek and to take a nearly meridional direction northwards to Rushworth.

Auriferous Quartz Reefs.

The peculiarities in the strike and the dip of the reefs in the northern part of the Waranga division mark them as worthy of the special attention of all persons who desire to study the circumstances connected with the occurrence of auriferous veins.

QUARTZ MINING AT RUSHWORTH.

The quartz reefs near Rushworth, with only three exceptions, have an east and west direction in conformity with the strike of the strata in which they occur. The reefs, however, underlie to the north very quickly and irregularly, whilst the strata are nearly vertical. A transverse section would show the dip of the reefs to be broken like a series of steps.

There are about forty reefs which, by reason of their east and west strike, may be called cross reefs, as they run at right angles to the prevailing strike of the auriferous reefs in Victoria. They are characterized by very rich patches of golden stone. The gold in the reefs which run north and south is evenly distributed, and the reefs dip both east and west, but do not show evidence of "saddle" formation. The veins range in thickness from 6 inches to 6 feet.

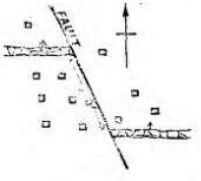
There has been but one deep shaft sunk on a quartz reef, and that reached to a depth of 573 feet. It is situated on the Nuggety Reef. This shaft was sunk by the Perseverance Company, who obtained 9 oz. of gold to the ton at 330 feet in depth; from 1 oz. to 1 oz. 5 dwt. to the ton of quartz raised from 450 and 460 feet; 1 oz. 15 dwt. 18 gr. of gold from 651 tons got from 510 feet in depth; and good yields from various other considerable depths.

Scarcely a shaft has been sunk below the water-level on any of the other reefs, although many of them have proved very rich above that level, as will be seen at page 162. The quartz of the veins above the water line is of a dull vitreous appearance; the natural fractures of the veinstone are more or less covered by ferruginous clay and oxide of iron, which latter is at times a full inch in thickness, and very little pyrites is visible.

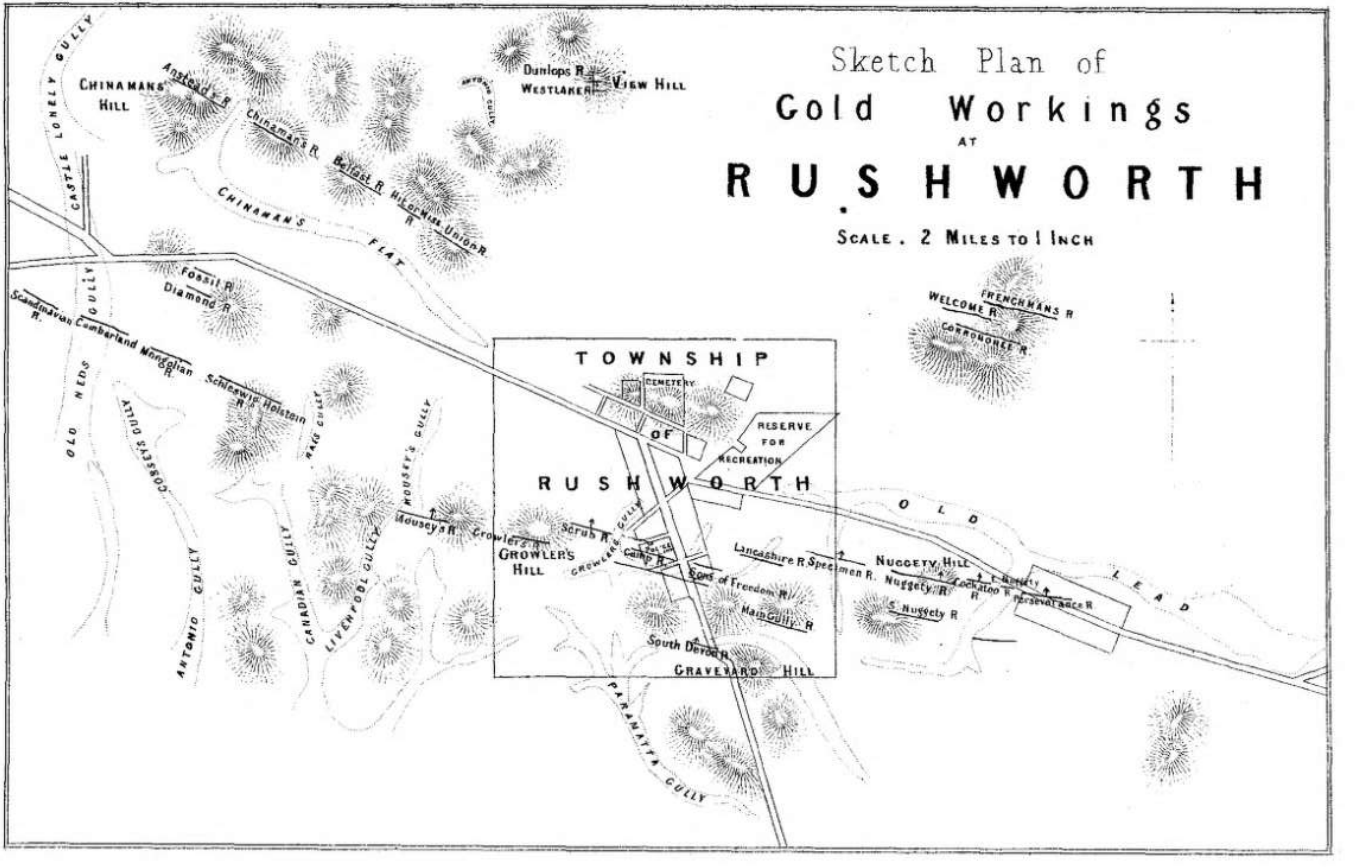
Galena occurs in small quantities with fine gold in the solid quartz in the Doctor's Reef at the White Hills.

The following particulars respecting an interesting fault of the Nuggety Reef are obtained from an official report supplied by Mr. H. B. Nicholas, the late mining surveyor of the subdivision:—

FIG. 3.



"The reef was opened about the year 1857 on the eastern side of the fault (*see* Plan, Fig. 3), and upon that side, during the greater portion of the time, has been regularly and prosperously worked. Many unsuccessful attempts were made to find the reef on the western side; shafts were sunk where any trace of a quartz vein existed, exhausting the patience and purses of the claimholders by repeated failures, until February 1864, when Fisher and Co., who had steadily prospected the ground, struck a vein at 210 feet north from where the fault commences in Anderson's claim, and further development proved it to be the continuation of the same quartz vein. After making a survey I found that the bearing and underlie were similar, the width of the quartz vein (from 2 to 3 feet) the same; and, more fortunate coincidence, the quartz crushed yielded from 1 oz. to 3 oz. of gold to the ton, which was about the range of produce in the opposite claim. 'Breaks' in the underlie of a similar character also existed.


Sketch Plan of
Gold Workings
AT
RUSHWORTH
SCALE. 2 MILES TO 1 INCH
TOWNSHIP
OF
RUSHWORTH
CEMETERY
RESERVE FOR RECREATION
CHINAMANS HILL
CHINAMANS FLAT
CASTLE LONELY GULLY
Dunlops R
WESTLAKE R
VIEW HILL
Fossil R
Diamond R
Scandinavian R
Cumberland R
Mongolian R
Schleswig Holstein R
OLD NEDS GULLY
COBBETTS GULLY
ANTONIO GULLY
RAGE GULLY
HOUSEY'S GULLY
CANADIAN GULLY
LIVERPOOL GULLY
Housey R
Crowler's R
GROWLER'S HILL
Scrub R
Camp R
Sons of Freedom R
Main Gully R
South Devon R
GRAVEYARD HILL
PARRAMATTA GULLY
Lancashire R
Specimen R
NUGGETY HILL
Nuggety R
S. Nuggety R
Perseverance R
OLD LEAD
FRENCHMANS R
WELCOME R
CORNISHMANS R

"A slide or cross-course of decomposed clay slate crosses the hill transversely, the walls, which were from 12 to 20 inches apart, were polished, and in both claims the quartz terminated abruptly at each wall of the 'cross-course.'"

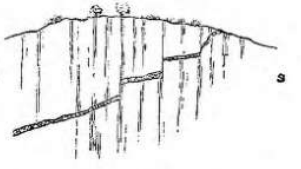
Ten shafts were sunk in unsuccessful attempts to find the continuation of this reef, and the patience and means of the claimholders were exhausted; but they both might have been spared from exhaustion had they known a little more of the results of vein-mining in other countries. In Cornwall, for example, many more right-hand than left-hand heaves are known, *i.e.*, the prospects of finding a vein are better in driving along a cross-course to the right than to the left. The late Mr. W. J. Henwood's records show that out of 215 cases of intersection of lodes by cross-courses 181, or more than 84 per cent., were found by driving on the side of the greater angle, and only 34, or less than 16 per cent., on the side of the smaller angle. It will thus be seen that the chances are more than five to one that the vein will be found on the same side as the larger angle.

Another rule which should be well known is that the flatter the underlie of a vein that is faulted the greater the distance the vein will be faulted.* The underlie of the Nuggety Reef is very flat, as will be seen in Figure 4, and the faulted distance is 210 feet.

This fault in the Nuggety Reef fully supports these rules, and it is not the only example in Victoria, for I have now collected several other exemplifications, particulars of which I purpose publishing in a future paper in continuation of my "Notes on some characteristics of auriferous quartz reefs or veins" which appeared in Progress Report, No. IV.

In a large open cutting on the Nuggety Reef was exposed a section of the vein of which Figure 4 is a sketch made by myself on the 9th September 1867.

FIG. 4.



At the time of my recent visit I found that this cutting was partly filled up, the sides had fallen in, and the section of the vein was no longer visible. The depth of the lower break or slide in the reef was about 6 feet, the length of the lowest part of the vein open to view was about 20 feet, and the dip or underlie of the reef was about 10 feet in 6 feet.

The above sketch-section, Figure 4, not only illustrates the breaks or slides in the Nuggety Reef, but it is also typical of the Specimen Hill Reef, the Lima, South Devon, Belfast, and the Union Reef, all of which dip at a similar rate between the slides, to the north. The same, or a like motion in the strata, appears to have broken the whole of these reefs, which, it is worthy of mention, have proved to be the richest veins at Rushworth.

Another remarkable vein is the Fossil Reef, which derives its name from the numerous casts of Upper Silurian fossils which it contains. The stone crushed consists of a porous quartzite, many of the numerous cavities in which are undoubtedly produced by the absence of the fossils which were at one time entombed in the rock.

* This statement is to be taken on the authority of the contributor.—ED.

The following account of yields of gold from veinstone crushed have been extracted from the Mining Registrar's quarterly reports. From them an idea can be formed of the past richness of some of the quartz reefs:—

From the Specimen Hill Reef 1,092 oz. of gold were obtained from 228 tons of quartz crushed.

The Union Reef yielded 265 oz. of gold from 20 tons of quartz.

The Mongolian Reef gave a yield of 19 oz. to the ton of quartz from 160 feet in depth, and 17 oz. per ton at 200 feet, and from 4 to 6 oz. of gold per ton were got from quartz raised from 220 and 256 feet in depth.

The Frenchman's and Welcome Reefs have yielded very rich stone above the water-level; the latter as much as 24 oz. of gold to the ton of quartz.

The Main Gully Reef gave 12 oz. to the ton for 40 tons crushed.

From the Growler's Reef 136 oz. of gold were obtained from 45 tons of quartz.

The Cockatoo Reef yielded 11 oz. to the ton.

The Scrub Reef gave 3 oz. of gold to the ton.

Crocker's Reef; quartz from this vein yielded at different times 22 oz. 11 dwt. per ton (and before this crushing was made the owners took about 60 oz. of gold from the quartz in specimens), 23 oz. to the ton, 59 oz. to the ton, and some of the stone raised from below 200 feet was estimated to yield as high as 100 oz. of gold to the ton.

Intersections of east and west and north and south veins occur at Dunlop's or View Hill (Dunlop's and Westlake's reefs), and at Growler's Hill, Rushworth, at Balaclava Hill, and in the U. and F. Antimony Company's mine (Albert Reef and antimony vein), Whroo, and at Cherry-tree Diggings, south of Coy's.

Mr. T. W. Benbow has supplied me with the following additional facts and interesting remarks respecting quartz gold and the reefs in the Waranga district:—

"Quartz gold is always brought to the banks ready for sale, being melted by the crushing machine proprietors. It varies very much in quality from the different reefs, the alloy being almost exclusively silver. * * * All gold in this district when impure by the admixture of any other metals than silver or antimony is the result of accidental circumstances, the reefs seeming to be absolutely free from the base metals in a form capable of readily amalgamating during the process of crushing the quartz. Even the admixture of antimony in melted gold is the result of careless washing of the amalgam and the subsequent reduction of the sulphide of antimony in the melting pot.

"I have detected copper in the London Reef, at Coy's Diggings, but only as a carbonate, and in very small quantity. Zinc occurs in many reefs under the form of 'Black Jack' of the miners. Lead is present in the shape of galena; iron as crystallized sulphide or pyrites. But all these ores are found principally under water-level, which I place at an average depth of 240 feet.

"The assay of quartz gold varies between 21·0$\frac{3}{8}$ of Clarke's Reef, at Siberia, and 23·2$\frac{3}{8}$ of the Whistler's Reef, Coy's Diggings, which, with Balaclava Hill gold, I think I may place as the finest gold in the district.

"The quality of the alluvial gold in each gully varies, so that it is almost impossible to find two alike, and the quality of the gold seems to be determined by that

of the reef or reefs at its head or in the vicinity. But it is always a little better than the gold in the reefs so situated, owing probably to the large surface presented by the multitude of particles of gold for the action of water and air, by which the silver present becomes in course of time oxidized and lost (to the miner), thus rendering the bulk of the gold purer.

"This is the only theory upon which I can account for the well established fact that the fine 'flour' gold obtained principally by Chinamen from quartz tailings is always the purest to be met with in the district; and this, notwithstanding the fact that such quartz when originally crushed, it may be years before, contained gold of a very inferior quality. There are many instances which could be cited, but I will mention the most striking.

"The Perseverance Company, South Nuggety Reef, crushed their own quartz for some years. The average quality of their gold was 21·2⅜; but, after lying for several years, the tailings were worked by a party of Chinamen, with large quicksilver cradles, and blankets or canvas catches, and the average assay of the gold thus produced was 23·3⅜, or at 77s. standard worth 83s. per oz., or only 6s. 8d. less than absolutely pure gold.

"In the case of quartz tailings the oxidization of the silver would go on much more rapidly than in the case of alluvial gold, because the 'flour' gold is in so finely a divided state that when the silver on the surface of each particular atom had been reached that portion still remaining in the interior of such atom would seem to be a very small quantity. Besides, in this case there may be other causes operating to produce the same effect. For instance, it is well known that the iron pyrites contained in once worked tailings, after lying for some years, become wholly or partly decomposed, and by thus setting free the gold they contain often render the tailings capable of being worked again. It may be then, and probably is a fact, that when the pyrites are decomposed by the action of air and water, a portion of the sulphur and oxygen goes to form sulphuric acid, which not only acts upon the silver on the surface of any particle of gold it may meet with, but penetrates some distance under the surface, or in the case of a very attenuated particle even through it, converting all the silver it meets into a sulphate, which is subsequently washed away and lost.

"The under-noted are the average assays of some of the principal reefs :—

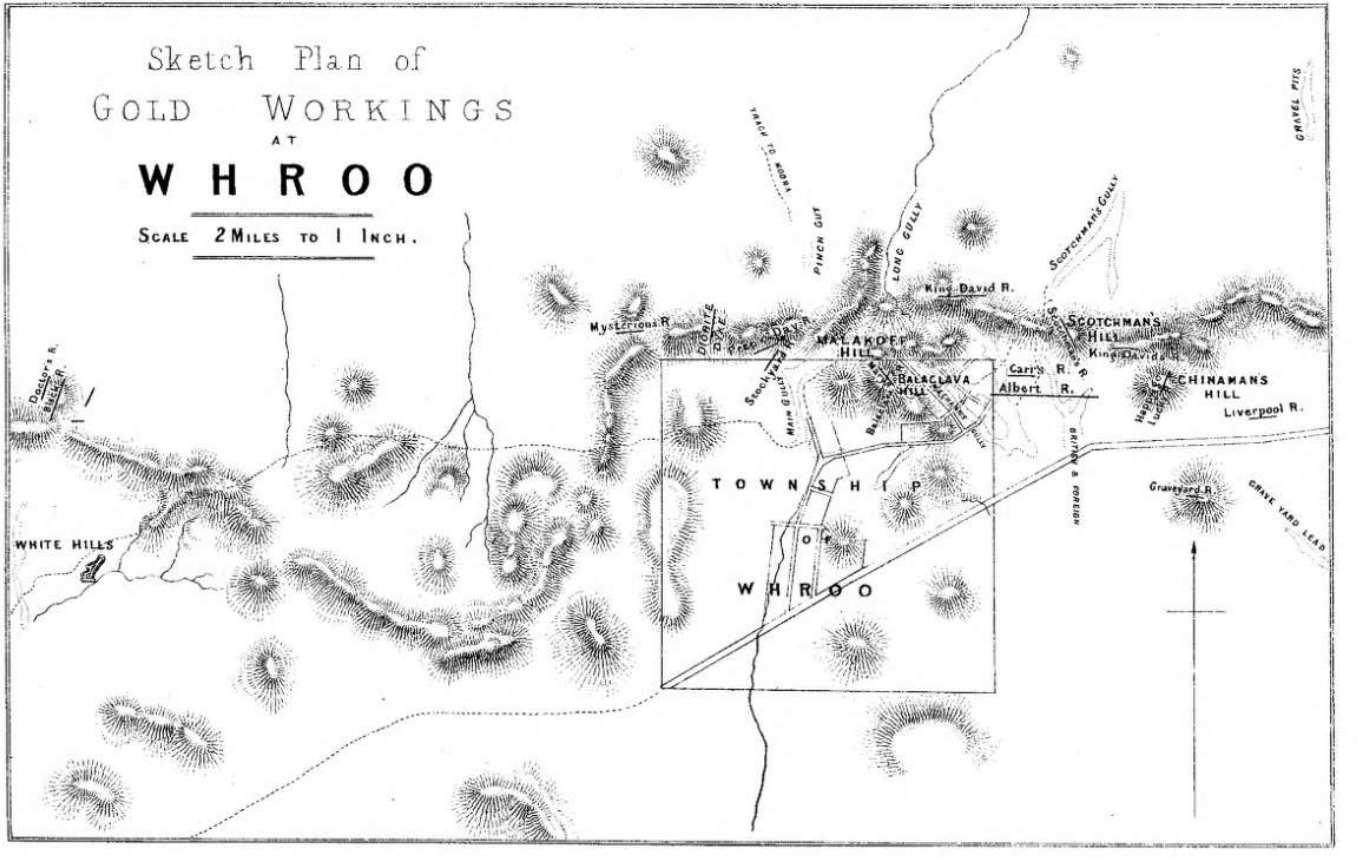
At Rushworth.

Reefs.		Mine-owners.
Cumberland	23·1⅘	... Mather and Co.
Growler's Hill	23·1⅖	... Randolph.
Frenchman's	23·0⅘	... Cracknell.
Mongolian	22·3⅞	... Cracknell.
Union	22·3	... Darby.
Schleswig-Holstein ...	22·2⅛	... Moller.
Specimen Hill	22·0	... Goyle.
Nuggety Hill	22·0⅛ and 21·3⅝	... Taylor and Co.
South Devon	21·3⅝	... Ayers.
South Nuggety	21·2⅜	... Perseverance Company.

"It is a curious fact that to the north and south of Rushworth the reefs are, as a rule, the richest in quality, and on the east and west the poorest."

STRIKE, DIP, AND WIDTH OF SOME OF THE QUARTZ REEFS NEAR RUSHWORTH, AND THE DEPTH OF SHAFTS SUNK ON THE REEFS.

Name of Reef.	Strike (magnetic).	Direction of Dip.	Width.		Depth of Shaft.
			ft.	ins.	feet.
Perseverance	E. and W. ...	North ...	...	...	573
Nuggety	N. 88° E. ...	North ...	2–3	...	...
South Devon	N. 88° E. ...	North ...	...	...	...
South Nuggety	N. 87° E. ...	... ...	3–4	0	...
Scrub	N. 87° E. ...	North ...	...	...	...
Frenchman's	N. 82° E. ...	... ...	0	6	240
Eclipse	N. 82° E. ...	... ...	...	...	...
Mongolian	N. 82° E. ...	... ...	...	...	...
Main Gully	N. 82° E. ...	... ...	...	...	...
Ahern's	N. 79° E. ...	... ...	...	...	...
Mousey's	N. 79° E. ...	North ...	...	...	...
Lancashire	E. and W. ...	... ...	...	...	...
Charcoal	N. 78° E. ...	... ...	...	...	...
Welcome	E. and W. ...	... ...	...	...	...
Belfast	N. 74° E. ...	... ...	...	...	...
Sons of Freedom	E. and W. ...	... ...	...	...	...
Luna	E. and W. ...	North ...	...	...	...
East Nuggety	E. and W. ...	... ...	...	...	...
Union	E. and W. ...	... ...	...	...	...
Westlake	N. and S. ...	East	...	...	...
Specimen Hill	E. and W. ...	North ...	...	...	...
Dunlop's	E. and W. ...	North ...	...	...	...
Dunlop's	N. and S. ...	West ...	...	...	...
Result or Black	... ...	... ...	2	0	...
Hope of Denmark ...	E. and W. ...	... ...	0	6	145
Scandinavian	E. and W. ...	... ...	...	...	...
West Growler's	E. and W. ...	... ...	7–17	0	130
Corroboree	E. and W. ...	... ...	...	...	...
Forlorn Hope	E. and W. ...	... ...	0 to	½ 6	65
Anstead's	E. and W. ...	... ...	...	...	...
Schleswig-Holstein ...	E. and W. ...	... ...	0	5	200
Black Joe's	E. and W. ...	... ...	...	...	...
Cumberland	E. and W. ...	... ...	...	...	...
Growler's	N. and S. ...	East	...	...	...
Crocker's	E. and W. ...	... ...	...	...	...
Chinaman's	E. and W. ...	... ...	...	...	...
Fossil	E. and W. ...	... ...	...	...	...
Diamond	E. and W. ...	... ...	...	...	...
Cockatoo	E. and W. ...	North ...	...	...	...
Erin-go-Bragh	E. and W. ...	... ...	0	6	170
Camp	E. and W. ...	... ...	...	...	...
Hit-or-Miss	E. and W. ...	... ...	0	6	170
J. O. R.	E. and W. ...	... ...	1	6	20
Good Luck	E. and W. ...	... ...	2	0	30
Bowman	E. and W. ...	... ...	...	...	...


Sketch Plan of
GOLD WORKINGS
AT
WHROO
SCALE 2 MILES TO 1 INCH.
TRACK TO HOBBS
PINCH GUT
LONG GULLY
GRAVEL PITS
King David R.
SCOTCHMANS GULLY
Mysterious R.
DIORITE DYKE
DEEP CREEK
MALAKOFF HILL
SCOTCHMANS HILL
King David R.
Doctor's R.
Baker R.
Stockade Hill
BALACLAVA HILL
Carr's R.
Albert R.
CHINAMANS HILL
Liverpool R.
TOWNSHIP OF WHROO
WHITE HILLS
Graveyard R.
GRAVE YARD LEAD

QUARTZ MINING AT WHROO.

The auriferous reefs at Whroo, in general terms, may be said to differ but little from those at Rushworth. The only noticeable exceptions are the Balaclava Hill veins, the Albert Reef, and the Stockyard Reef. In each of these lodes the occurrence of antimony veins, or the association of antimony ores in the auriferous veins, is a marked feature.

The most considerable mining operations at Whroo have been carried on at the Balaclava mine, from which it has been estimated that considerably more than £150,000 worth of gold has been extracted. Mr. John T. Lewis, one of the proprietors, has supplied me with the following particulars of this mine, in a letter dated 20th October 1877 :—

"The mine was opened in May 1855, and the main shaft is now down 450 feet. The strata run east and west, and the whole hill is intersected with north and south and east and west veins (the latter running with the strata). Where these veins cut one another they are generally very rich, but vary much in thickness. All the north and south veins underlie to the west and the east and west to the north.

"Last week we crushed 25 loads from a thickness of 10 feet at the 196-foot level, which gave 36 oz. of gold. We also crushed 150 tons from the Mary Reef, which gave 56 oz. This reef (the Mary) runs north-west and south-east. It is situated to the east of the old Balaclava Reef, and underlies to the east. The 'Mary' intersects the Balaclava Reef. The crushing of quartz above mentioned was taken frem the reef, where it averages 7 feet in width. One very peculiar thing about the 'Mary' is the fact that the gold in it is so poor, only worth about £3 15s. per oz., while only a few yards away the Balaclava gold, in either E. and W. or N. and S. veins, is worth on the average £4 2s. 6d. per oz."

An interesting and elaborate report on the numerous veins that have been discovered in the Balaclava mine was prepared for the proprietors, a few years since, by Mr. George H. F. Ulrich, F.G.S. The extracts from this report which follow will afford a good idea of the peculiar intermixture of quartz and antimony veins in this prominent hill :—

"From the mode of occurrence of the different quartz veins opened in your ground it appears that, from the top of the Balaclava Hill, an auriferous zone, following spurs of the range, extends from E. and W. along the strike of the rocks, which consist of Upper Silurian sandstone. Westward of the hill, for about six chains to the point where the spur commences to slope off into an auriferous flat, this zone has been proved richest, and is characterized by a network of quartz veins, which can be distinguished as belonging to three systems :—

"1st. *East and west veins,* dipping rather steeply (about 70°), with the rocks northward, and appearing neither well-defined nor permanent in depth or strike. They are rarely above a few inches in thickness, but several worked out in the large open cutting on top of the range have proved highly auriferous, whilst one is at present being worked by tributers on western point of spur.

"2nd. Cross veins varying in strike from N. 15° to 25° E., and underlying westward at a mean angle of about 65°. These are the main auriferous veins of the Balaclava Hill mine, and especially to one nearest the top of the hill. The so-called "Balaclava Reef" has, on account of its extraordinary richness from the top

downward to a depth exceeding 300 feet, established the fame of the district. This vein is not, however, well-defined as regards walls and casing, and showed in the portion worked many irregularities both in strike and dip, whilst its thickness varied in places from less than an inch to above two feet. Besides this main cross vein another small one, likewise auriferous, has just been opened in a cutting intended for a powder magazine on the south side of the spur, and still further west, on the north side of the spur, was the so-called "Anglo-French Reef," which has been worked and traced for several claims up the slope to very near the crest of the spur. Excellent returns are said to have been obtained from this vein by several small parties of miners that originally opened it, but on account of the gold more or less disappearing in depth it has for some years been neglected, though certainly deserving further examination.

"3rd. The veins of the third system, called the *flat veins*, intersect the east and west and cross veins just mentioned at a variable strike intermediate with theirs, and dip throughout at very flat angles, varying between nearly horizontal and hardly 20°, mostly northward. Although these *flat veins* are in the average stronger and better defined than the other two kinds of veins, they have, with the exception of one small vein worked in the open cutting, not proved payably auriferous.

"Touching the geological relations of the three systems of veins, it appears that the E. and W. and cross veins are of the same age, as at their intersection the identity of either is lost, and no trace of faulting is perceptible, whilst the "flat veins" seem younger than both, because they can be plainly traced through and sometimes slightly fault them.

"The chief workings of the mine are those in the main cross vein—the 'Balaclava Reef.' * * * * Both these main workings follow the vein—the first southward, the last northwards—to its disappearance in strike in a kind of tough bluish-grey sandstone, the favorite rock for gold, intermediate being a softer sandstone of a greyish-white or brownish color and rather argillaceous character.

"As regards the mode of occurrence of the gold in the reef, it seems from the workings that it lies in two shoots and a small attached patch. * * * And it was observed, more especially in the northern shaft, that the richest quartz invariably occurred at points where the reef showed irregularities, as bends, &c., in its course.

"Touching the portion of the reef between the two shoots, it is also auriferous, but not considered rich enough for working."

Further on in his report Mr. Ulrich refers to a small E. and W. vein, and to several small N. and S. veins.

In the 290-foot level, he says, the reef increases in thickness to nearly 2 feet, and assumes a greater regularity in strike and dip, besides being strongly charged with sulphide of antimony. A small antimony vein (E. and W.), carrying a little gold, is also mentioned as occurring a few feet above this level.

He also states :—"A review of the prospects of the reef in the workings connected with this level, both north and south of the shaft, renders it thus evident that both shoots lose their payable auriferous character about the same horizon. * * In a cross-cut, at about 360 feet in depth, there were signs of apparently the commencement of a new rich shoot, which would lie intermediate between the two shoots worked at shallower levels."

Mr. Lewis has furnished me with the following information respecting the Stockyard, Peep-o'-Day, and Happy-go-Lucky reefs :—

"The Stockyard Reef was originally worked for gold; the antimony ore in it was only found in patches, which were crushed, and some turned out very good. It was not then (some years since) considered payable, being so patchy.

"The Peep-o'-Day was also originally worked for gold. Some fine parcels of antimony ore from this reef have been sent to Melbourne and realized a good price.

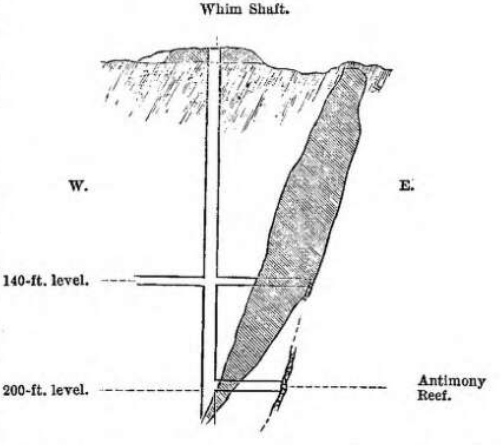
"About 160 yards to the west of the last-named reef is a diorite dyke, which is about 20 feet in width. It runs N. 5° E., the walls being apparently perpendicular. I have sunk in it over 30 feet, and found no change, but purpose giving it a further trial."

"The Happy-go-Lucky, after being idle for a long time, has been started by Hodge Brothers. They have just finished a crushing of 8 tons, and got 33 oz. of gold."

The Albert Reef, which is next in importance to the Balaclava, is situated to the east of the latter-named reef. It strikes N. 87° E., is very nearly vertical, having but a slight northerly dip, and varies in thickness from 1 or 2 inches up to 12 feet.

FIG. 5.

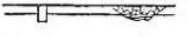
Longitudinal Section, Francis and Co's. Claim, Albert Reef, Whroo.



At the time of my visit to the Albert Reef the U. and F. Antimony Company were raising antimony ore and gold-bearing quartz from their mine. They then had several tons of the ore stacked at the surface, and were crushing the quartz, which did not contain much antimony. I went underground and inspected their mining operations, as they were then at work on the junction of the antimony lode with the golden reef; and I thought the junction of the two veins was likely to afford some facts that would prove worthy of notice. The section (Fig. 5) shows the dip of the shoot of gold in this mine and the positions of the antimony lode at the 140-foot and 200-foot levels.

The plan (Fig. 6) of the reef at the 140-foot level represents the manner in which the reef bulged out where the shoot of gold occurred.

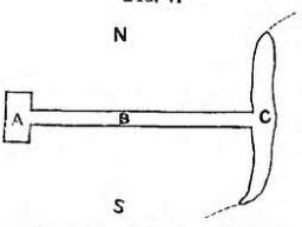
FIG. 6.



This is an example of the shoot of gold conforming to the dip of the shoot of quartz. The reef diminishes in thickness to the west of the shoot of stone; and, although the quartz contained some gold, there was so little quartz—nowhere more than two inches—that it would not pay to work.

The manager (who courteously guided me through the claim) is of opinion that a new shoot of auriferous quartz will be discovered beneath that which has been wrought, and he informed me that they purpose sinking the shaft with the object of intersecting the antimony reef and testing the ground where the two veins are likely to come in contact at a greater depth.

Fig. 7.



A Whim Shaft. B Level on Albert Reef. C Antimony Reef.

The Albert Reef strikes east and west, whilst the antimony vein for about 12 feet in length on each side of it ran at right angles, or north and south, and then appeared to be taking a course to the north-east and south-west, as indicated by dotted lines on the plan (Fig. 7), of the veins at the 200-foot level.

The antimony vein is evidently of more recent formation than the Albert, as it divides it at 160 feet in depth and throws or faults it to the north about 2 feet. At the 200-foot level the Albert Reef is cut off by the antimony, and its continuation to the east has not yet been observed.

The antimony vein dips to the west about 15 inches in 6 feet, and the Albert Reef slightly to the north.

Since my visit the manager, Mr. Wm. Uren, has informed me that the winze at the junction of the two veins has been sunk 10 feet, the quantity of antimony slightly increasing, and the gold showing freely in the quartz. The quartz and antimony are found to form alternately as the winze is sunk.

The undermentioned particulars of assays which have been kindly supplied by Mr. T. W. Benbow give the average results of gold obtained from some of the principal reefs :—

At Whroo.

Reefs.					Mine-owners.
Chinaman's Hill	...	...	23·2⅝	...	M. Sanchez.
Stockyard	...	...	23·2⅜	...	Sharpe.
Balaclava Hill	...	...	23·2	...	Lewis and Menzies.
Happy-go-Lucky	...	...	23·0⅜	...	Hodge.
Albert	...	...	22·3⅜	...	Benbow.

At White Hill, near Whroo.

Doctor's	...	...	22·1⅜	..	Welch.
Woodward's	...	...	22·0⅝	...	Woodward.

At the White Hills, which lie to the west of Whroo about three miles (*see* plan of Whroo), there are a number of reefs which have recently attracted attention through the richness of their yields. These reefs may be said to be a continuation of those at Whroo, for, like them, they have a general strike east and west in conformity with the strata in which they occur.

The following particulars of some of the reefs at this place were kindly given me by Mr. John T. Lewis, of Whroo :—

"Welch's Reef was opened on 15th June 1873; it runs east and west, and underlies to the north 3 feet in 5 feet; the greatest depth the works have

attained is 300 feet. It runs with the strata (which are very soft), and averages 18 inches in thickness. The total amount of quartz crushed out of this reef is 790 loads, which yielded 1,731 oz. 11 dwt. 12 gr., or an average yield of 2 oz. 6 dwt. The lowest yield 1 oz. to the load, and the highest 88 oz. from one load. The reef has a very hard cement back."

"The Black Reef runs east and west diagonally across the strata, with an underlie of 3 feet in 5 feet. The average thickness of this reef is 3 feet. It was opened about the year 1859. The perpendicular depth of the deepest workings is 220 feet. The highest yield was 16 oz. to the ton, the average 1 oz. 10 dwt. up to 1874, and the late yields have been from 1 oz. 6 dwt. to 9 dwt. to the ton.

"Jerry's Reef was opened in 1861, and runs about north and south, averaging 20 inches in thickness; the highest yield was 5 oz. 10 dwt., and the lowest 6 dwt. 12 gr. The greatest depth of works is 50 feet.

"Woodward's Reef was opened in 1874; it runs east and west; its average thickness is 18 inches; the first crushing from the surface of 14 tons gave 88 oz. of gold, but the yield from the quartz gradually decreased as the quartz was got from deeper in the reef.

"The Rose of Denmark Reef was also opened in 1874; it runs east and west; its width averages about 12 inches; the highest yield from it was 22 oz. of gold to the ton, and the lowest 1 oz. 5 dwt.; it has not been worked below 40 feet."

STRIKE, DIP, AND WIDTH OF SOME OF THE REEFS NEAR WHROO, AND THE DEPTHS OF SHAFTS SUNK ON THE REEFS.

Name of Reef.	Strike (magnetic).	Dip from horizon.	Width.	Depth of Shaft.
			ft. ins.	feet.
Prince of Wales	N. 88° E. ...	... ...	...	...
Victoria	N. 87° E. ...	45°	0 6 to 6 0	200
Carr's	N. 87° E. ...	North ...	0 6 to 6 0	200
Johnson's	N. 87° E. ...	... ...	...	...
Albert	N. 87° E. ...	North ...	0 1 to 12 0	240
Happy-go-Lucky	N. and S. ...	West ...	Broken veins	...
King David	N. 78° E. ...	... ...	...	...
Stockyard	N. 59° E. ...	North ...	0 6	180
Malakhoff	N. 38° W. ...	... ...	...	...
Balaclava	N. 20° W. and N. 15° E.	West ...	*Not known	450
Peep-o'-Day	N. 65° E. ...	North ...	...	200
Anglo-French	N. and S. ...	West ...	1 0	130
Scotchman's	N. 25° W. ...	East	2 0	150
Woodward's	E. and W. ...	... ...	1 6	180
Black	E. and W. ...	60°	3 0	220
Jerry's	N. and S. ...	... ...	1 8	50
Welch's	E. and W. ...	North 60° ...	1 6	300
Rose of Denmark	E. and W. ...	North ...	1 0	40

* Network of quartz veins and spurs as much as 100 feet in width has been broken and crushed.

Quartz Mining at Coy's Diggings.

Coy's Diggings, as it is called, was discovered by Messrs. Coy, Anderson, and Brian in September 1864. The mining operations have been principally carried on upon quartz veins, which extend from Coy's Reef northwards to the London Reef, a distance of between two and three miles. The works on the Byron, Canadian, Great Eastern, Hick's, Welcome, Murray, Essex, and London reefs, form nearly one continuous line in the intervening space between the two first-mentioned veins.

The prevailing strike of the reefs is north and south, although there are two cross reefs, viz., Coy's and the Hit-or-Miss.

The quartz in the veins shows polished faces and striation. These signs of attrition are specially observable in the veinstone of the London Reef. In the quartz from this reef too I observed a little blue carbonate of copper.

The depth of the water-level at Coy's is about 150 feet.

Slate rocks are more prevalent on this diggings and at Cherry-tree Flat than at either Whroo or Rushworth.

The following facts have been supplied to me by Mr. F. S. Pollon, respecting the reefs now at work at these diggings :—

Byron's Reef was opened in December 1864, in Messrs. Martin and Scanlan's claim ; on this reef the highest yield obtained was 9 oz. per ton, and the average yield is 1 oz. 5 dwt.

Welcome Reef.—Opened in February 1865. In Myers and Co.'s claim the highest yield was 28 oz. per ton, and the average yield 2 oz. 10 dwt.

London Reef.—Opened in June 1865. In Judson and Co.'s claim the highest yield was 8 oz. 10 dwt. 8 gr., and the average yield is 3 oz. 10 dwt. per ton.

Taylor and Murry's Reef.—Opened in 1865 ; now the Black Cloud Company. The highest yield of gold per ton was 3 oz. 15 dwt., and the average yield is 2 oz. 10 dwt.

Morning Star Reef.—Opened in 1865. In Apperman Company's claim the highest yield was 1 oz. 5 dwt., and the average yield is 15 dwt. per ton.

Whistler's Reef.—Opened in 1873. In Groombridge and Co.'s claim the highest yield was 3 oz. 10 dwt., and the average is 2 oz. per ton.

Bailey and Mason's Reef.—Opened in 1875. Average yield per ton, 2 oz.

Myers and Fyple's Reef.—Opened in 1876. Average yield of gold per ton, 2 oz. 5 dwt.

Taylor and Murry's Reef.—Opened in 1875. Average yield of gold per ton, 3 oz. 5 dwt.

Liverpool Reef.—Opened in 1873. In Messrs. Johnson and Co.'s claim the strata strike east and west. Highest yield from quartz crushed, 9 oz. per ton ; average yield, 3 oz. 10 dwt.

Corbett and O'Brien's Reef.—Opened in the year 1876. (Strata cross.) Average yield of gold per ton, 2 oz. 10 dwt.

Additional information relating to these reefs, a part of which was obtained from the above-named gentleman, will be found in the table.

The under-noted are the average assays of some of the principal reefs, supplied by Mr. Benbow :—

At Coy's Diggings.

Reefs.		Mine-owners.
Whistler's	23·2⅜	Wilson.
Welcome	23·1⅛	Wilson.
Perseverance	22·3	Pollon.
Byron's	21·2⅜	Pollon.
Kent	21·1⅜	Bryant.
Ladybird	21·0⅜	Clarke.

STRIKE, DIP, AND WIDTH OF SOME OF THE REEFS AT COY'S DIGGINGS, AND THE DEPTH OF SHAFTS SUNK ON THE REEFS.

Name of Reef.	Strike (magnetic).	Dip from horizon.	Width.	Depth of Shaft.
			ft. ins.	ft. ins.
Coy's	N. 82° E.	...	...	...
Hit-or-Miss	N. 67° E.	...	...	...
Murray *	N. 2° W.	West	0 11	...
London	N. 2° W.	...	1 6	220 0
Blackwall	N. 2° W.	...	...	...
Byron	N. 24° W.	West	24 0 to 1 6	185 0
Hick's	N. 29° W.	...	0 4	...
Welcome	N. 32° W.	West	0 6	170 0
Guernsey	N. 43° W.	...	...	...
Morning Star	N. 45° W.	West	2 0	175 0
Inifer *	N. and S.	West	1 0	...
Whistler's	N. W.	West	1 0	90 0
White Elephant	N. W.	...	0 5	65 0
Albion	...	...	0 1	140 0
Bailey and Mason's	N. and S.	West	0 3	95 0
Myers and Fyple's	N. and S.	West	0 3	70 0
Taylor and Murry's	N. and S.	West	1 0	90 0
Liverpool	N. and S.	East	0 2	130 0
Corbett and O'Brien's	N. and S.	West	0 2	90 0

* These quartz reefs contain antimony.

Quartz Mining at Cherry-tree Flat.

The gold workings at this place lie to the south of and adjacent to Coy's Diggings. They were discovered by H. Hyam in February 1865. The reefs here extend from the Homeward-bound by the Cousin Jack Reef southwards beyond the Brighton Reef. Numerous quartz reefs have been mined, and many of them have yielded payable returns.

In the vicinity of this field many auriferous quartz reefs have been discovered and more or less worked. Quite recently two reefs have been opened out in the southern high ranges, not far from the Goulburn River, and distant two miles from each other. One of them yielded, so I was informed, 20 oz. of gold to the ton of quartz, but was only wrought to a depth of 30 feet.

Quartz Mining at Fontainbleau.

At this place the quartz reefs are situated on high ground to the south of the alluvial workings at the Nine-mile Creek, and these reefs are probably the sources from which the auriferous deposits at the latter diggings were derived.

Thompson's Reef yielded at 50 feet in depth nearly 3 oz. of gold to the ton, and many other crushings comprising some hundreds of tons of quartz were raised from this reef and yielded remunerative quantities of gold.

As yet the numerous quartz veins in the neighborhood of Fontainbleau are quite undeveloped, and all quartz mining has now ceased.

Outcrops and indications of quartz reefs are not wanting in the large extent of country lying between the head of Spring Creek and Fontainbleau, and between the latter-named place and Whroo.

Evidence of the existence of quartz reefs is also observable in the Buffalo Ranges, and as alluvial gold is found in payable quanties in the gullies there can be little doubt that the ranges themselves will be found to contain auriferous veins.

Mr. Benbow says the average assay of the Dawn of Hope Reef, at Fontainbleau, from Thompson's claim, was 22·2$\frac{5}{8}$, and of Clarke's Reef, at Siberia, from Clarke's mine, was 21·0$\frac{3}{8}$.

At Friesland (which place I have previously referred to under the head of alluviums at page 158) the Proud Salopian Reef was found to contain large quantities of auriferous pyrites.

TABLE SHOWING THE AVERAGE YIELD OF GOLD FROM CERTAIN PARCELS OF QUARTZ CRUSHED DURING THE TEN YEARS ENDED 1876 IN THE WARANGA NORTH SUBDIVISION :—

Year.	Tons crushed.	Total Produce.	Average yield per ton.
	tons cwt.	oz. dwt. gr.	oz. dwt. gr.
1867	14,760 0	9,221 18 0	0 12 11·9
1868	14,854 0	6,434 16 0	0 8 15·93
1869	10,029 0	5,631 3 16	0 11 5·51
1870	15,111 0	6,824 13 6	0 9 0·78
1871	9,091 0	4,732 1 21	0 10 9·85
1872	7,803 0	3,113 2 0	0 7 23·50
1873	8,321 0	3,341 18 20	0 8 0·78
1874	5,058 0	3,737 17 6	0 14 18·72
1875	2,442 0	2,654 7 4	1 1 17·74
1876	2,307 10	2,371 14 1	1 0 13·36

Antimony Ore.

This ore occurs as oxide or sulphide in a large number of veins in the district and in localities wide apart.

At Whroo antimony occurs in four veins, all of them auriferous or associated with gold-bearing quartz reefs. The richest vein is the Stockyard, which strikes N. 59° E., is very nearly vertical, and like all antimony veins is ever varying

in width. It bunches out to two feet in the widest parts and contracts to a mere thread, but its average thickness may be set down at about eight inches. The vein has not been worked below the water-level. The ore occurs in distinct blocks, having a nucleus of sulphide surrounded by concentric rings of cream-colored oxide of antimony. Pieces of slate of precisely the same character and appearance as that adjoining the vein are enclosed by the antimony ore in the same manner as auriferous quartz reefs in districts situated in Lower Silurian rocks are found to include pieces of the bounding strata. I have also observed in specimens from this vein pieces of quartz enveloped by the antimony ore in a like manner to the nucleus of sulphide above-mentioned.

Fine specimens of the oxide of antimony containing heavy bits of gold embedded in them have been got from this reef.

The main reef in the Balaclava Hill mine contains quantities of antimony ore in addition to gold, and Mr. Ulrich, in his report on this mine, says—"A few feet above the level (290 feet) in the open workings a small east and west antimony vein carrying a little gold is exposed."

The antimony vein which intersects the Albert Reef in the U. and F. Antimony Company's mine, at Whroo, strikes in a north and south direction, and dips slightly to the west (*see* Figs. 4, 5, and 6). The manager of this mine informs me that the vein increases in width through the footwall bulging out, and that the quartz and antimony are found to occur in alternate blocks in the lode as the winze is sunk to greater depths.

Mr. Lewis says that some fine parcels of antimony ore have been sent to Melbourne which were raised from the Peep-o'-Day Reef, and that the ore realized a good price.

Mr. Benbow states that "antimony is present in many reefs throughout the district, but only in one or two places in paying qualities and quantity."

"It is found as a sulphide and yellow oxide in paying quantities at Whroo, in the Balaclava, Albert, and Stockyard reefs, and at Coy's Diggings, in the Black Cloud Reef. The only vein now being worked is that intersecting the Albert Reef, Whroo. It occurs in connection with a gold-bearing quartz vein. The quartz is 'cobbed off' and crushed, and the antimony ore either shipped to England or sold in Melbourne. A lot of 21 tons sent home by me realized £15s. 10s. per ton.

"It is noticeable that gold found in association with antimony is always of a superior quality. For instance, the best assaying gold comes from the following reefs :—Balaclava, Stockyard, Albert, Frenchman's, Growler's, Mason's, Welcome, Whistler's, &c., which all contain antimony in more or less quantity, but it requires some care and trouble in the manipulation of the amalgam before retorting and melting to obtain the gold in its native purity. If there is any sulphide or oxide of antimony left with the amalgam it is reduced when it comes in contact with the carbon of the melting crucible or the charcoal of the fire, and thus causes the melted gold to be impure."

Two veins containing antimony ore occur about three miles to the south of the conglomerate fossiliferous range (referred to in the beginning of this report). These veins were discovered and worked for gold nearly twenty years since by the Messrs. Hamilton. The southern vein, which strikes N. 83° W., has been most

extensively wrought. The depth of the shaft on the underlie is about 300 feet. The vein varied from 15 to 20 inches in width. It consisted principally of the sulphide of antimony, although the oxide occurred, and gold is said to have been found mostly associated with the latter. The strike of the northern vein is N. 78° W.

At Coy's Diggings sulphide and oxide of antimony have been obtained in the Inifer and in the Murray reefs. These reefs may by further exploration, however, prove to be a continuation of the same vein. They have hitherto been only wrought for gold.

In concluding this report, I must state that for a considerable part of the statistical and other information contained in it I am indebted to the published reports of the several mining registrars who have held office in the subdivision since the year 1860, viz. :—Messrs. H. B. Nicholas, Breen, Walsh, and Hicks; and for valuable facts and general assistance to the undermentioned gentlemen, Messrs. John T. Lewis (Balaclava Hill), T. W. Benbow, J.P., H. B. Nicholas, and Wm. Uren.

WILLIAM NICHOLAS.

SCHEDULE OF REPORTS ON FOSSIL SPECIMENS.

(Supplied to the Department of Mines by Professor McCoy.)

Nos.	Names and Particulars of Fossils.	Age of Rock.	Locality.
683	Almost indeterminable casts in sandstone ; of these there are two articular surfaces of crinoid stems of the *Actinocrinus* type, one small coral, probably *Favosites fibrosa*, one indeterminable *Lamellibranch*, and two fragments of the Upper Silurian variety of the *Orthis calligramma*	The balance of the evidence is in favor of the rock being Upper Silurian	Sandstone range between Whroo and Coy's Diggings.
4412	The only fossils are of a new species of Echinolampas of the Miocene Tertiary age, common in the Bird Rock, Geelong beds	Miocene Tertiary ...	Junction of the Loves and Gellibrand rivers.
4418 to 4426	All the fossils belong to various parts of the Tæniopteris Daintreei (McCoy), common in the Cape Patterson coal seams, with a new species of Zingophyllites	Mesozoic Carbonaceous	Coleraine.
4448 to 4450	Imperfect obscure fragments of plant remains, quite indeterminable, with the exception of one obscure impression of *Cordaites Australis*, indicative of uppermost Devonian strata	Upper Devonian ...	Freestone Creek and Avon River, Gippsland.

SCHEDULE OF REPORTS ON FOSSIL SPECIMENS—*continued.*

Nos.	Names and Particulars of Fossils.	Age of Rock.	Locality.
4451 4452	Specimens so exceedingly imperfect and ill preserved as not to admit of exact determination, with the exception of a mass of the *Favosites Goldfussi*, indicative of Devonian rocks, with which are traces of a lamelliferous coral, closely allied to *Diplophyllum cæspitosum*, and small branching forms allied to *Trematopora ostiolata* and *Cladopora fibrosa*; also one *Beyrichia*, closely allied to *B. lata*; and a few crinoid stems of the *Actinocrinus* type. The general facies of these imperfect remains is as nearly indicative of Upper Silurian as of Devonian. (A larger collection of better specimens should be obtained from this locality.)	As nearly indicative of Upper Silurian as of Devonian	Cooper's Creek, Thomson River.
4455	This small piece of limestone contains only indeterminable fragments of crinoid stems, and the coral allied to *Trematopora ostiolata*, found in the Cooper's Creek limestone, with which the stratum is no doubt identical	Upper Silurian, or Devonian	Deep Creek, a branch of the Thomson River.
4456	Dicotyledonous wood of a new type, probably Tertiary	Tertiary (?) ...	Glenmaggie.
4457	This limestone contains abundance of large crinoid stems of the *Actinocrinus* type, and some traces of Gasteropoda, apparently of the genus *Acroculia*, too imperfect to render determination possible, and a fragment of Bellerophon. (It is impossible to determine the precise age of this rock for want of more perfect specimens, but I have no doubt it is identical with that of Cooper's Creek.)	Upper Silurian, or Devonian	Thomson River.
4597 (93 F.)	Specimens of great interest, as they contain a new species of *Tæniopteris*, *T. tenuissime striata* (McCoy), the first example in Tertiary rocks in Australia, although well known in rocks of this age in other parts of the world. There is also a *Lastrea*, *L. Dargoensis* (McCoy), allied to a Miocene species from the Arctic Regions. With these are a few fragments of dicotyledonous leaves, apparently identical with some from Bacchus Marsh, but too imperfect for precise identification	Tertiary	Clays beneath the basalt of the Dargo and Bogong High Plains, heads of the Bundarrah River.
4597 (94 F.)	One specimen containing an imperfect lauraceous leaf, too imperfect for determination	Tertiary	Heads of the Cobungra River.
4597 (95 F.)	Several imperfect lauraceous leaves of undescribed species, occurring also in the Miocene Tertiary beds of Bacchus Marsh. With these is a most interesting specimen of a species of *Salisburia*, *S. Murrayi* (McCoy), nearly allied to some Miocene forms from the Arctic Regions, but not hitherto found in the Australian strata	Tertiary (Miocene) ...	Heads (West) of the Dargo River.

SCHEDULE OF REPORTS ON FOSSIL SPECIMENS—*continued.*

Nos.	Names and Particulars of Fossils.	Age of Rock.	Locality.
4765	*Fusus centrifugus* (McCoy), and a new species of *Murex*, both occurring also in the Mount Martha beds, and indicating Upper Oligocene strata	Upper Oligocene ...	Shelford, near Geelong.
4766	*Cetololites*, or ear bones, and other portions of extinct whales of three species. Teeth of the European Miocene Tertiary shark *Oxyrhina Desori* (Ag.) *Turritella*, new species, also found in the Mount Martha beds *Terebratula Coriensis* (McCoy) *Cellepora*, one new species *Cidaris*, spines of three undescribed species *Graphularia Robinæ* (McCoy), axes of the gigantic extinct sea pen These indicate the Lower Miocene Tertiary period.	Lower Miocene Tertiary	Petteval, near Geelong.
4816	Portions of a *Pecten* and *Terebratula*, too imperfect for determination	(?)	Orbast Station, Snowy River.
4817	The specimens are all clearly of Miocene Tertiary age, the *Cinnamomum polymorphoides* (McCoy), and *Laurus Werribeensis* (McCoy), being the only ones as yet described and figured, but several others are identical with forms in the Bacchus Marsh beds, bearing out my former suggestion of the geological identity of the deposits of these two localities. In addition to these, are some imperfectly preserved impressions, apparently referable to the *Ficus Dionysia* of Mussalongi, from the South European Miocene beds, and traces of at least two plants not previously observed	Miocene Tertiary ...	High Dargo Plains.
4850	Similar to No. 4357 (*vide* Report of Progress, No. IV., p. 158), with the exception of some indeterminable casts of crinoid stems, and a small portion of an *Orthis*, possibly *Orthis calligramma*	Upper Silurian ...	North-east of Redcastle.

LABORATORY REPORT.

By J. Cosmo Newbery, B.Sc., Analyst.

Schedule of Specimens Analysed and Reported on during the Year ending 30th September 1877.

No.	Nature of Specimen.	Locality.
4384 ...	Concretionary brown Iron Ore; the cavities contain phosphatic minerals, and the denser portions also contain Phosphate of Iron, which renders the ore valueless	Traralgon.
4433 ...	Metallic Lead; upon assay contains 13 ozs. 1 dwt. of Silver to the ton of Lead, but no Gold	Ringwood.
4434 ...	Metallic Lead; an analysis gave 21 ozs. 11 dwts. of Silver per ton. No Gold or Nickel was found to be present	New Caledonia.
4435 ...	Rock comprised of Sand grains cemented by Clay and Carbonate of Lime	Western Australia.
4436 ...	Quartz Grit	Western Australia.
4437 ...	A slightly Micaceous Slate with Dendrites. Fine-grained Sandstone—"Flagstone"	Western Australia.
4438 ...	Cube of Iron Pyrites passing into brown Iron Ore, and two samples of Jasper	Western Australia.
4439 A B C and D	A. White Quartzite. B. White Quartz. C. Jasper. D. Jasper	Western Australia.
4440 A B C D	A. Porcelain Jasper. B. Fragments of large Eggshell. C. Dense Quartzite. D. Dense grey Manganese Ore	Western Australia.
4441 ...	Ferruginous Concretions	Western Australia.
4442 A B C D E F G H	A B. Ferruginous Concretions. C. Chrysoprase. D. Chert. E. Quartz. F. Pebble of a Felspathic Rock. G. Opal Jasper. H. Calcareous Ironstone	Western Australia.
4443 ...	Ferruginous Concretion	Western Australia.
4444 A B	A. Lydian Stone. B. Ferruginous Concretion	Western Australia.
4445 A B	A. Brown Iron Ore. B. Chert Jasper	Western Australia.
4446 A B	A. Brown Iron Ore. B. Ferruginous Conglomerate ...	Western Australia.
4447 A B C D E F	A. Quartz. B. Limestone. C. Quartzite. D. Limestone. E. Quartz. F. Dense Quartz Sandstone	Western Australia.
4458 ...	Pyrites Sand with amalgam; an assay gave 76 ozs. 17 dwts. 20 grs. of Gold per ton	Swift's Creek.
4459 ...	Brown Iron Ore cementing Quartz grains; upon assay gave 13 dwts. of Gold per ton	Snowy Creek.
4460 ...	Quartzose Sand; no Gold was detected, the sample only weighing 180 grains	Snowy Creek.
4461 ...	Micaceous Iron with Quartz Gangue; of no economic value	West of Grampians.
4462 ...	Brown Iron Ore; gives upon analysis 54·81 per cent. of Metallic Iron, and 14·4 per cent. of Silica. The ore contains a large percentage of Phosphorus and would be of no value as an ore of Iron. Some parts of the specimen are coated with a mineral resembling "Pharmacosiderite," an Arseniate of Iron	Blackwood.
4463 ...	Massive brown Iron Ore—Limonite; it contains a quantity of Sulphur; Phosphorus was not detected. This ore would only produce an inferior cast iron	Dandenong.
4464 ...	Bright-black Coal; very friable, joints coated with Carbonate of Lime and Oxide of Iron; an analysis gave—Moisture, 6·22 per cent.; Volatile matter, 28·79 per cent.; Fixed Carbon, 51·79 per cent.; Ash, 13·20 per cent. A large part of Ash derived from Minerals coating joints	Gippsland.
4465 ...	Tin Ore—Black and Ruby Sand with Zircons; an assay gave 61 per cent. of Metallic Tin	South Gippsland.

SCHEDULE OF SPECIMENS ANALYSED, ETC.—*continued.*

No.	Nature of Specimen.	Locality.
4466 ...	Coal, Bituminous—yielding a good Coke; upon analysis it gives—Moisture, 3·10 per cent.; Volatile matter, 32·48 per cent.; Fixed Carbon, 61·54 per cent.; Ash, 2·88 per cent. Coal of very good quality, closely resembling some of the best samples from Cape Patterson and Kilcunda	Moe.
4472 ...	Brown Coal—Lignite; in 100 parts contains—Water, 28·40 per cent.; Volatile matter, 33·06 per cent.; Fixed Carbon, 33·96 per cent.; Ash, 4·58 per cent. Would make a good fuel if dried artificially, or exposed to the air in sheds	Tyers River.
4473 ...	Mixed Sulphides of Iron and Lead with traces of Copper and Zinc Sulphide; an assay gave 1 per cent. of Lead and an amount of Silver equal to 1 oz. 12 dwts. 16 grs. per ton. Only traces of gold were detected	St. Arnaud.
4474 ...	Similar to No. 4473	St. Arnaud.
4475 ...	Iron Conglomerate; Tin and Gold were sought for, but neither were found	Morwell River.
4477 A and B	A. Carbonaceous Shale impregnated with Iron Pyrites. B. A piece of Jasper, the small water-worn pieces being Pisolitic Iron Ore	East branch of the Tarwin River.
4478 ...	Titaniferous Iron Sand with Quartz grains containing (Cassiterite) Tin Ore in small quantities, and a few specks of Gold	West-south-west branch of the Morwell River.
4479 ...	Titaniferous Iron with Quartz grains containing Zircons, small nodules of Iron Pyrites. Gold in large specks, but no Cassiterite	Tribute of East branch of the Tarwin River.
4480 ...	Tin Sand; upon assay gave 72 per cent. of Metallic Tin ...	Upper Yarra.
4481 ...	Earthy Manganese Ore (Wad), largely impregnated with Oxide of Iron and clayey matter, and does not contain any Cobalt. Of no commercial value on account of its impurity	Costerfield.
4482 ...	Iron Pyrites, impregnated with Slate; an assay was made, but no appreciable amount of Gold was obtained. Of no commercial value	Bald Hill.
4484 ...	Titaniferous Iron Sand with Quartz grains; also contains Pleonaste, Alimandine, Garnets, and Zircons, and Cassiterite present in small quantities	Kiewa Creek (Omeo Prospecting Party).
4485 ...	Tin Sand (Cassiterite) with Quartz grains, Titaniferous Iron Sand, Pleonaste, Alimandine, Garnets, and Zircons	Bundarah River.
4486 ...	Titaniferous Iron, with Quartz grains, Pleonaste, Zircons, Gold in small specks, and Cassiterite (Tin Sand) ...	Tribute of Kiewa Creek (Omeo Prospecting party).
4487 ...	Deposit from Water in condensers; consists of Carbonates of Lime and Magnesia, and Sulphate of Lime with some earthy matter	Clunes.
4488 ...	Deposit from gutter conveying water from condensers. The composition is similar to 4487, but contains less earthy matter, and is softer in texture	Clunes.
4491 ...	Carbonaceous Clay; upon analysis it gives in 100 parts—Water, 13·00 per cent.; Volatile matter, 16·95 per cent.; Fixed Carbon, 12·05 per cent.; Mineral Ash, 58·00 per cent.	Coleraine.
4492 ...	Micaceous Iron Ore; upon assay it gives an amount of Metallic Iron equal to 67 per cent.; may prove of commercial value if in large quantities, and fuel and labor cheap	Grampians.
4595 ...	Brown Coal (variety Pitch Coal); upon analysis it gives in 100 parts—Water 2·95 per cent.; Volatile matter, 40·02 per cent.; Fixed Carbon, 47·88 per cent.; Mineral Ash, 9·15 per cent.	Aire River, Cape Otway.
4596 ...	Aluminous Soapy Clay. If found in quantity may be of value as Fire Clay	Moe.
4598 ...	Arsenical Pyrites, having a thin coating of Arseniate of Iron	Wentworth River.

SCHEDULE OF SPECIMENS ANALYSED, ETC.—*continued.*

No.	Nature of Specimen.	Locality.
4609 ...	Iron Ore—brown Hematite ; contains 74 per cent. of Peroxide of Iron, but as it contains an amount of Phosphorus and Sulphur it can only be considered an inferior ore	Strath Creek.
4612 ...	Dense Basalt, enclosing Oligoclase. Some parts are scoriaceous, and enclose microscopic crystals	Learmonth.
4613 ...	Quartz, with a Steatitic Clay	Learmonth.
4618 ...	Dense earthy Basalt laminated, enclosing Olivine ...	Learmonth.
4619 ...	Scoria, enclosing Olivine and a decomposed Felspar ...	Learmonth.
4620 ...	Scoria, enclosing Olivine and Oligoclase	Learmonth.
4623 ...	Basalt, highly Felspathic Porphyritic ; encloses Olivine, and in the cavities Aragonite	Learmonth.
4624 ...	Crystalline fragments—Hornblende, Oligoclase, and Basaltic Glass	Learmonth.
4625 ...	Dolerite—Vesicular, containing Hornblende and plates of Specular Iron	Learmonth.
4629 ...	Dense Basalt—Anamesite ; Porphyritic with Oligoclase ...	Learmonth.
4632 ...	Scoriaceous Basalt with Hyalite, and dense Anamesite with Olivine	Learmonth.
4634 AB...	A. Anamesite ; patch within circle is Olivine. B. Anamesite with Oligoclase	Learmonth.
4635 ...	Scoriaceous Basalt	Learmonth.
4637 ...	Porphyritic Basalt, with Quartz, Olivine, and Orthoclase ...	Learmonth.
4655 ...	Basalt, with Aragonite, Hyalite, Hornblende, and Ferrocalcite	Learmonth.
4675 ...	Vesicular Basalt, rich in Olivine ; part of the Olivine is enclosed in Oligoclase	Learmonth.
4676 ...	Vesicular Basalt, with Olivine, Oligoclase, and Hyalite ...	Learmonth.
4683 ...	Scoriaceous Basalt, with portions more like Volcanic Ash, enclosing Olivine, Oligoclase, and Hyalite	Learmonth.
4696 (1, 2)	1. Coarse Sand—Brown Iron, Schorl, black Quartz, Tin Ore, and Chromic Iron. 2. Fine Sand ; consists chiefly of Titaniferous and Chromic Iron Sand, with a little Tin Ore	From a shaft 104 feet deep, 2½ miles from Kingower.
4752 ...	Impure clayey infusorial Earth ; could be used as Tripoli if washed and calcined, also in the manufacture of Dynamite	West Melbourne Swamp.
4753 ...	Galena and Arsenical Pyrites	Mount Birregun.
4757 ...	Gypsum—transparent Crystalline. When burnt gives a fine white Plaster of Paris	Mount Birregun.
4758 ...	Copper Ore—Red Oxide with Carbonate of Copper and Quartz. When pure the Red Oxide contains 88 per cent. of Copper	Mount Birregun.
4760 ...	Partially decomposed Rutile, associated with Quartz, Sand, and Tourmaline. Gold in minute specks was also discernible ; no Tin could be obtained.	Inglewood Prospecting Party.
4761 ...	Same as 4760	Inglewood Prospecting Party.
4762 ...	Same as 4760	Inglewood Prospecting Party.
4763 ...	Same as 4760	Inglewood Prospecting Party.
4764 ...	Same as 4760	Inglewood Prospecting Party.
4767 ...	Brown Coal, impregnated with Iron Pyrites ; upon analysis it gives in 100 parts—Water, 14·80 per cent. ; Volatile matter, 37·20 per cent. ; Fixed Carbon, 38·00 per cent. ; Mineral Ash, 10 per cent. Owing to the amount of Iron Pyrites present it is of little commercial value	Coleraine.
4771 AB...	A. Earthy and Calcareous Sand, containing some Phosphate of Lime. B. The same, Ferruginous, 1 to 5 per cent. of Phosphate of Lime. The amount of Phosphate of Lime is too small to render it of use as a manure.	County of Mornington.
4772 ...	Copper Pyrites, with impregnations of Arsenical Pyrites. The sample contains about 25 per cent. of Copper, but no two portions are alike	Bethanga, No. 1 North Gift Reef.

SCHEDULE OF SPECIMENS ANALYSED, ETC.—*continued.*

No.	Nature of Specimen.	Locality.
4773 ...	White Kaolin Clay, containing a considerable quantity of transparent Quartz grains. Would be of value in the manufacture of earthen and china ware	County of Mornington.
4775, 4776	A true Granite, containing Gold. The Gold occurs in thin Quartz veins, and also in what seems to be Quartz grains, surrounded by Felspar. This specimen is of very considerable interest, as it is the first that the Department has received in which Gold is found in a true Ternary Granite	Sandy Creek.
4783 ...	Flint coated with Carbonate of Lime. In the mass of Flint there is also a small percentage of Carbonate of Lime	Belfast.
4788 A B C D	Four samples. A. Highly Quartzose Rock, containing Felspar Pholerite; contains also Gold. B. Small fragment of opaque Crystalline Quartz. C. Hydrous Arseniate of Iron; Scorodite, with a little Quartz. D. Granular Rock, composed of fragments of Quartz in a clayey ferruginous matrix, with some Mica	Sandy Creek.
4789 A B C	A. Partly decomposed Granitic Rock, colored by Oxide of Iron. B and C. Dense Quartz Rocks	Sandy Creek.
4808 ...	Fine-grained Ferruginous Conglomerate	Darling River, New South Wales.
4809 ...	Similar to 4808	Darling River, New South Wales.
4810 ...	Coarse-grained—Quartzose—Ferruginous Conglomerate ...	Darling River, New South Wales.
4811 ...	Fragment of metamorphic Rock-slate	Darling River, New South Wales.
4814 ...	Guano, of brown color, and in a very fine state of division; upon analysis it gave—Water, 11·70; Organic matter, 34·25; Phosphate of Lime, 14·61; Carbonate of Lime, 25·63; Sand, 7·03; Soluble Salts, 6·50; Ammonia, traces; total, 99·72. Not rich enough in Phosphate of Lime or Ammonia Salts to be of commercial value	Gippsland.
4815 ...	Quartz and Pyrites	Bethanga.
4828 ...	Tin Sand; upon assay gave 70 per cent. of Metallic Tin. From 790 grains of this sample 2 grains weight of Gold were obtained	Gippsland.
4829 ...	Tin Sand with Titaniferous Iron Sand; an assay gave 57 per cent of Metallic Tin. Contained small specks of Gold	Gippsland.
4830 ...	Tin Sand, containing Titaniferous Iron Sand; upon assay 49 per cent. of Metallic Tin was obtained. Gold was discernible in the form of very small water-worn specks	Gippsland.
4832 ...	Brown Tourmaline Sand	Bethanga.
4833 ...	Massive brown Tourmaline; contains no mineral of economic value	Bethanga.
4834 ...	Same as 4833	Bethanga.
4835 ...	Granite containing Gold; an assay gave Gold equal to 19 dwts. 14 grs. per ton. Some of the specks of Gold were in isolated Quartz grains, confirming former observation	Sandy Creek.
4836 ...	Tin Sand; contains Cassiterite, brown Iron Sand, Magnetic Oxide of Iron and Chromic Iron Sand. An assay gave 43 per cent. of Tin	La Trobe River, Gippsland.
4837 ...	Iron Ore (Limonite), with clayey cavities; an assay gave 50·4 per cent. of Iron, 25 per cent. of insoluble Clay and Sand	Lal Lal Iron Company's Mine, Lal Lal.
4838 ...	Quartz and Iron Pyrites; no Gold, Silver, or other metals of economic value	Alexandra Prospecting Party.
4843 ...	Quartz, with Oxide of Iron and Carbonate of Copper ...	Flagstaff Hill, Bethanga (above water level).

SCHEDULE OF SPECIMENS ANALYSED, ETC.—*continued.*

No.	Nature of Specimen.	Locality.
4844 ...	Consists of Iron, Arsenical and Copper Pyrites, in the following proportions:—Magnetic and Iron Pyrites, 70 per cent.; Arsenical Pyrites, 20 per cent.; and Copper Pyrites, 10 per cent. The Arsenical Pyrites gave, upon assay, Silver equal to 13 dwts. per ton. The Magnetic and Copper Pyrites contain neither Gold nor Silver	Flagstaff Hill, Bethanga (below water level).
4845 ...	Hematite (Iron Ore)—Outer part clayey; gave upon analysis 56 per cent. of Iron, and 9·37 Silica; no Sulphur or Phosphorus was detected	Near Cooper's Creek, Thomson River, Gippsland.
4847 ...	Kaolin Clay; upon analysis, it gives— Silica ... ... 71·85 Alumina ... ... 22·00 Magnesia ... ... 1·48 Water ... ... 4·15 Alkalies and loss ... ... 0·52 100·00 Contains free Quartz grains. This Quartz sand is included in the Silica	Pottery Flat, Epsom.
4848 ...	Kaolin Clay; upon analysis it gives— Silica ... ... 47·65 Alumina ... ... 44·30 Magnesia ... ... 3·44 Water ... ... 4·55 Loss ... ... 0·06 100·00 In part colored by Oxide of Iron. This part was not included in the analysis	Pottery Hill, Epsom.
4849 ...	Mixture—Iron, Copper, with Quartz; contains traces of Gold and an amount of Silver equal to 10 ozs. 12 dwts. 16 grs. per ton	Mountain Creek, Snowy River.
4851 ...	Raw Pyrites; gave by assay—(1) 4 ozs. 19 dwts. 23 grs. per ton; (2) 4 ozs. 19 dwts. 23 grs. per ton; Gold assayed 23.3.4 carats fine. Analyses gave— I. II. Silica ... ... 27·60 ... 27·10 Oxide of Iron (Fe_2O_3) 59·90 ... 61·40 Sulphur ... ... 13·57 ... 14·48 Lime (CaO) ... 2·10 ... not estimated Carbonic Acid ... not estimated The mean of the two analyses gives 24·43 per cent. of Iron Pyrites (FeS_2) and 44·35 per cent. of Oxide of Iron. This is present as Ferric Oxide (Fe_2O_3); Magnetic Oxide (Fe_3O_4); and as Carbonate ($FeCo_3$) and some Sulphate of Iron	
4352 ...	Roasted Pyrites; upon assay gives Gold results equal to—(1) 6 ozs. 17 dwts. 4 grs. per ton; (2) 6 ozs. 17 dwts. 5 grs. per ton; Gold assayed 23.3.4 carats fine. Upon analysis it gives— I. II. Silica (slightly colored by Iron) 43·00 ... 41·70 Sulphur ... ... 0·52 ... 0·57 Oxide of Iron ... ... 60·65 ... undetermined A large portion of the Iron is present as Magnetic Oxide	
4853 ...	Amalgamator Overflow; gave upon assay 16 dwts. 8 grs. of an alloy of Silver and Gold, 6 dwts. 12 grs. being Gold, or Gold value 11.1.4 carats	

SCHEDULE OF SPECIMENS ANALYSED, ETC.—*continued.*

No.	Nature of Specimen.	Locality.
4854 ...	Pyrites in Quartz ; the Pyrites was separated and gave upon assay Gold equal to—(1) 11 ozs. 8 dwts. 16 grs. per ton; (2) 11 ozs. 11 dwts. 22 grs. per ton. The variation in assay is due to a little Quartz retained in the Pyrites grains. The value of the Gold was 23.0.1 carats	
4855 ...	Pyrites in Quartz ; the Pyrites separated gave upon assay Gold equal to 5 ozs. 14 dwts. per ton. The Gold assayed 23.2.4 carats fine	Clunes.
4857 ...	Felspathic Clay with small masses of Silicate of Alumina ; contains a large percentage of water. A variety of Lithomarge	An elvan or basaltic dyke at Daylesford.
4858 ...	Copper—Mixture of Arsenical Iron and Magnetic Pyrites. Taken as a whole the sample gives 14 per cent. Copper and 1 ozs. 12 dwts. 3 grs. of Gold per ton. When dressed as a Copper Ore the percentage of Copper is raised to 21 per cent. By this dressing the Gold is to a great extent separated and left in the Arsenical Pyrites	Flagstaff Hill, Bethanga.
146 ...	Dense Clayey Rock—decomposed Basalt ; shows under the microscope that it has originally been a dense Crystalline Rock. It is very ferruginous ; fuses easily to a black glass, strongly magnetic	Garden Gully Reef.
163 ...	Similar to 146, but softer, probably more completely decomposed ; it fuses easily to a black magnetic glass	Garden Gully Reef.
139 ...	Soft Clay Rock ; microscopically shows a basalt-like structure ; fuses easily to a dark glass, not magnetic. On one side of the specimen are masses of a mineral like Pholerite, arising from the decomposition of a Felspar ; no Silver	Garden Gully Reef.
Z1 ...	Aluminous and Magnesian Clay. It appears to have deposited from water. It fuses easily to a white glass. There is some resemblance between this clay and that on which the crystals of Zeolites are often found resting in the cavities in Basalt	Garden Gully Reef.

LABORATORY NOTES.

PHOSPHATES.

In the brown iron ores (impure limonite), from nearly all points in South Gippsland, I have noted the almost constant presence of phosphates of lime, alumina, and iron, and in one instance, a clayey bog ore, a soluble alkaline phosphate, was found ; while in the similar iron ores from other parts of Victoria, as at Lal Lal, Castlemaine, Newstead, Seymour, and Benalla, phosphates are almost wholly absent. Having some specimens of the rock taken from close to the railway line near Brandy Creek, which Mr. Ulrich recognized as closely resembling the rock from near Bairnsdale in which vivianite was found, at his suggestion an analysis was made of it, and phosphates were found in notable quantity. Further samples of rock and soil gave similar results ; at the same time it was found that the rock, a yellow and grey soft earthy sandstone, disintegrating rapidly when exposed to the weather, also contained soluble silicates and salts of potash, soda,

and ammonia. I suggested to some persons taking up land in the district that they should try some crops on the yellow and grey soil derived from these rocks, and am now informed by some who did try the experiment that these despised soils have produced excellent returns, and that for some crops they are fully equal to the much prized chocolate soil of Brandy Creek. These rocks occur over a very large part of South Gippsland, and instead of being valueless, as is generally supposed they may, and probably are, well suited for the farmer ; and I would suggest that specimens should be collected throughout the district, and tested qualitatively. Similar rocks occur in the Cape Otway district, and may also contain the elements necessary for a good agricultural soil. In former reports I have noted the occurrence of phosphates, as nodules and thin veins, in clayey rocks from near Port Albert and at Bruthen Creek.

Lignite.

Numerous specimens of lignite from near the Gippsland railway have been received from the department and from private persons. They all take the character of the lignite at Crossover Creek, and will some day be of value as furnace fuel. Some are highly bituminous, and will be useful for the manufacture of gas for illuminating purposes. One sample received from the Honorable J. Woods was nearly equal to the average Hartley shale as a source of gas. In the laboratory experiment with it the gas came off readily, and had a high illuminating power. Other samples, not from the same place, but in the vicinity of the above, gave a poor gas, containing a very great quantity of ammonia. Others, again, give no gas. They do not burn with any flame, and while smouldering give off ammonia so freely that it may be detected by the smell, and if burnt in an acid atmosphere the ammoniacal fumes rising from the coal have all the appearance of a white smoke : this is true also of some samples from the Western district.

Guano.

During the year the guano caves at Skipton have been opened, and the guano sold to the farmers. An average of several analyses gave me—

Water (hygroscopic)	23·26
Organic matter	49·48
Strurite—Ammonio-magnesian phosphate	16·48
Hydrous phosphate of lime	5·68
Sand	1·70
Alkaline chlorides and sulphates	3·40
	100·00

Its main value is due to the presence of the mineral strurite—a mineral rarity—and to the still more rare mineral, a hydrous phosphate of lime. Some similar deposits occur in the caves in the Western district, but I believe that they contain so much organic matter, and are so moist, that they are not much esteemed by the farmers.

Rocks.

A careful examination of the various rocks is being continued. The collection of sandstones mentioned in my last report has been added to considerably by new

and duplicate samples. The sandstones, which so far appear to resist atmospheric action most completely are, first, Stawell stone, from Watkins' quarry. A six-inch cube of white fine-grained sandstone, very hard, has been subjected to alternate moist and dry atmospheres, been saturated with saline solutions and then exposed to the summer sun without any change; the polished surface still remains perfect. The quarry from which this sample was taken, some six or seven years ago, has been visited by Mr. Ulrich, and is now being opened. Specimens brought down by Mr. Ulrich show that there is a constant passage of silica from the inner to the outer or exposed parts. He obtained specimens from parts of the old quarry which had not been worked for some years, and found thick silicious coatings, or rather saturations, for the rock is rendered almost vitreous, in some cases, nearly two inches from the surface; the thickness of this layer depending on the length of exposure, and probably the mass of rock from which the silica (or silicate of ammonia?) was to be drawn by the surface evaporation.

Next, and perhaps equal to the Stawell sample, is a block of stone from Briagolong, Gippsland. The Mansfield stone, a white medium-grained hard sandstone, is also of excellent quality, and at present shows no sign of decay or change, other than becoming whiter on exposure.

Many of the others have failed completely, but it may be unfair to condemn the quarries on the failure of a single sample. An instance of this is shown in the sample of stone from Dunkeld, Mount Abrupt. It was selected with so little care and judgment that it has failed to stand the test of alternate wetting and drying, and I am certain that quite as durable stone may be had from that locality as from Stawell.

The examination of our basaltic rocks is being continued in the Museum laboratory by Mr. Ulrich, and as an aid to the microscopic examination of the thin sections of the rocks he has introduced into the laboratory Professor Szaba's most beautiful method of flame reactions, which gives a ready means of determining doubtful felspars. By these methods he has made an examination for me of basalts from Learmonth, Nos. 4692(4) and 4637, collected by Mr. Norman Taylor, field geologist. He finds No. 4692(4) to be a light-bluish grey anamesite, rendered slightly porphyritic by irregular colorless transparent patches of a striated felspar and crystalline olivine. The rock inclines more to the trachytic than the basaltic series. The examination of the sections under the microscope proved the felspar patches to be without exception plagioclase, and that there is a great deal of isotropic clear glass base, forming larger and smaller portions of irregular outline between the crystalline minerals, which, besides the felspar, consist of olivine in considerable proportion, occasionally forming pretty perfect, though very much fractured, crystals; magnetite, or titaniferous iron, sometimes recognizable as octahedral crystals, but for the most part of irregular outline; augite, very scarce, in light-brown irregular crystals.

An examination by the flame reactions above referred to prove the felspar to be labradorite.

The next specimen, No. 4637, is also of considerable interest, as it contains quartz and a potash felspar porphyritically distributed through the rock. Mr. Ulrich describes it as a black dense basalt of rather dull aspect, rendered porphyritic by opaque white grains of partly regular and partly irregular crystalline outline of felspar, a few glassy looking ones, apparently quartz, and greenish grains of

olivine. The reactions of the rock section under the microscope prove it to consist mainly of an isotropic brown glass base, in part devitrified and full of microlites of plagioclase, small grains of olivine, and crystals of magnetite (titaniferous iron?), showing in arrangement fluidal structure. Of the glassy and white opaque grains porphyritically distributed through the rock, the former prove to be quartz, but as regards the latter the entire absence of twin striation and colored bands in polarized light point to its being a monoclinic or orthoclastic species of felspar, and this result is confirmed by examination of the mineral by flame reactions, which unmistakably proved it to be potash felspar, either orthoclase or sanidine; its opaqueness and general aspect indicate it to be the former. As orthoclase felspar is extremely rare in basalts, and when found has usually been identified as sanidine, the occurrence in this instance of true orthoclase must appear the more strange and interesting; but considering that Mr. Norman Taylor states in his report that this basalt comes from a point of eruption which has broken through a deposit of granite detritus, and taking into account the association of the felspar with genuine quartz grains, the probability is that both were mechanically enclosed by the fluid lava, though their uniform porphyritic distribution would remain an unexplained very curious feature.

Auriferous Ores.

The most notable discovery of the year is the finding of gold in true granite at Sandy Creek. Some of the specimens are very rich, and would assay several ounces per ton. Gold in granite has often been reported, but on investigation it has always been found to be a dioritic rock. In this instance we have, however, a true granite, which, so far as its mineral components and general character are concerned, closely resembles the variety of granite called "protogine," abundant in some parts of the Alps.

Some quartz pebbles from Berlin goldfield, presented to the Museum collections by Mr. Ogier, P.M., are especially worthy of note, as they contain gold in thin films lining rusty cracks. The gold is evidently of much more recent origin than the quartz. It seems probable that it has been deposited since the pebbles were water-worn and while they formed portions of the drift from which they were taken, proving the presence of auriferous waters in the drift at comparatively recent times. The gold ores of Bethanga still continue of interest, most of the miners finding cupreous ores below the water-level. Above water-level the ore consisted of quartz with gold, metallic copper, carbonates and oxide of copper, and oxide of iron. As these are worked out and the miners have had to undertake the treatment of more complex ore—specimen No. 4844 is typical of a large number that have been examined, and it may prevent much disappointment if the miners will note that the copper and magnetic pyrites are almost free from gold, which is contained almost if not wholly in the iron and arsenical pyrites. Though these pyritous ores are apparently intimately mixed together, yet it is possible to effect a separation to a very considerable degree by mechanical dressing. For some of the ores this should begin with hand picking, and next passing the ores, after crushing, over a proper dressing floor. If this was done there would be less difficulty in getting the auriferous pyrites, and the copper ores would, at the same time, be raised in standard. With other ores from these mines this mechanical separation is

impossible; the mixture of copper pyrites with the auriferous arsenical and iron pyrites is too intimate, and some other means must be adopted to save the gold. Metallurgical treatment by directly smelting the ore and getting a copper regulus has, I believe, been tried; this regulus will contain most of the gold, but not all, and the separation of the gold from it is a very expensive tedious operation. A much more simple plan would be to prepare the ore for amalgamation, remove the gold, and then, if desired, smelt the waste sand for copper; or, perhaps, as these are not rich copper ores, an adaptation of Hunt and Douglass's, Henderson's, or Gibb's processes would be still cheaper: taking the copper and silver out as chlorides and leaving the gold with the oxide of iron, so that it may be easily obtained by amalgamation. No metallurgical process which entails smelting operations can possibly compete with the mechanical operation of amalgamation. The mechanical contrivances to effect amalgamation of gold by mercury, no matter how fine the gold is, may be called nearly perfect; the difficulty now is to prepare the gold so that it may be taken up by the mercury, and to so treat the ore that the mercury is not "flowered" or converted into a sulphide during the operation. And I have no doubt that, after a few trials, it will be found that, practically, the whole of the gold, silver, and copper contained in the Bethanga ores may be easily saved without any smelting operation, except in the case of the copper.

Several novelties in gold-saving methods and appliances have been brought forward during the year, but before mentioning them it is well to see what is being done by our well-known methods when carefully carried out. A very careful examination was made of some samples of "buddle" pyrites sands—the same after roasting in a reverberatory furnace and the waste from the amalgamators after the gold had been extracted—received from the Port Phillip Mine, Clunes. The statement of the assays and analysis is given in the schedule attached, Nos. 4851–4855, from which it will be seen that, from a sand containing 6 oz. 17 dwt. 4·5 gr. of gold per ton, the waste contained only 6 dwt. 12 gr. of gold per ton, or, in other words there was a loss of between 4 and 5 per cent.; and this loss is represented greater than the actual, as there was said to be some concentration in collecting the amalgamator waste. I do not think that there is a record of a higher percentage return by any known process; and so far as quartzose ores associated with only iron and arsenical pyrites are concerned, I do not think it can be done much cheaper, especially if the so-called waste products are saved. Mr. Henry Rosales, of Walhalla, has devised a process by which he treats the pyrites sands of the Walhalla Mining Company. In this process the pyrites is not roasted, but ground to a fine slime and amalgamated. Mr. Rosales claims, I believe, that the cost of grinding is less than that of roasting, and he does not find the loss of mercury increased by its being distributed through the fine pyrites slime. Messrs. Chapman and Edwards, of Sandhurst, have, I understand, adopted Plutner's chlorine process, and are said to obtain excellent results in treating the ordinary pyrites of Sandhurst. Neither of these processes will, however, deal with auriferous ores containing sulphide of antimony, and, until very recently, many highly auriferous mines have been stopped for want of a process which will extract gold from ores containing sulphide of antimony. Some time since a method was devised for treating rich antimonial ores by fusing the sulphide with a proportion of metallic antimony; the latter having a great affinity for gold takes it up, and, on cooling, may be easily separated from the sulphide, which may then be smelted into antimony. The same

quantity of metallic antimony is used with fresh charges of the ore till it has become rich in gold; the two metals are then separated by the oxidation of the antimony. This process, though suitable to rich antimony ores, will not answer with the poorer ores that are too silicious to fuse, and are, therefore, of no value to the antimony smelter (ores under 30 per cent. of sulphide of antimony), and, owing to the presence of this mineral, they cannot be treated for gold in the usual way. These ores are sometimes utilized in making "crude" antimony, but many are too poor in antimony for even this purpose, and, if placed in a furnace, simply fume, a portion of the sulphide being converted into oxide. Many persons believe that if this process is carried on in an oxidizing furnace that, ultimately, the antimony will be wholly got rid of, and the gold left with the gangue or scoria to be extracted by crushing and amalgamation; but this cannot be done. Upon examining the ore treated in this manner it will be found that a very considerable quantity of antimony remains, mostly in the metallic state; even when exposed to a red heat in a reverberatory furnace, with a good current of air for some hours, there remained as much as 6 per cent. of antimony by assay. This metallic antimony seems to be formed by the reaction of the oxide or air on the sulphide; thus, the parts of the ore first charged into the hot furnace, or that part first acted on by the heat and hot air, give off fumes of oxide which condense on the cool portions of the ore; then, as the heat gains, the two compounds react on each other, producing metal and sulphurous acid; or, if there is any accumulation of fluid sulphide, formed by the running together of quantities from different parts of the ore, hot air passing over it will, by a similar reaction, produce metal. This metal will take up any gold it comes in contact with, and cannot be treated by any amalgamation process. Another cause of the failure of these attempts is that some of the metal is vaporized, and the vapor of metallic antimony, like that of arsenic, is taken up by gold heated to near its melting point, and the alloy so formed will not amalgamate. Again, sulphide of antimony is always more or less vaporized in this process, and its vapor is readily taken up by the hot gold. I do not know what the compound is in this case; it differs from the alloy of gold and antimony, formed by the action of the metal by containing some sulphur; it will not amalgamate with mercury, is very brittle, and of a bronze color; probably a sulphide of gold and antimony. This compound may always be seen in the auriferous scoria from crude furnaces, and is probably the main cause of the loss of gold; in the crushing operations it is reduced to a fine slime and washes away; it has a tendency to cleave into flakes, so that each particle of the slime is a flake, and is thus more readily acted on by any current of water, rendering it almost impossible to arrest its course by any of the ore-dressing appliances. The ordinary alloy of gold and antimony has a similar but not so great a tendency to cleave into flakes and float away with the quartz and substances of a less specific gravity. For some time I have been experimenting with the view of finding a process by the aid of which we might save both the gold and antimony contained in these ores, and have now devised a method which seems to answer well. The ore as it comes from the mine or the scoria from furnaces is placed in a close furnace or kiln with an amount of salt or other chloride, and brought up to a dull red heat; steam is then introduced and continued until the whole or nearly the whole of the antimony is got rid of. The bronze-colored alloy mentioned is decomposed, leaving clean bright gold. The quartz or gangue is rendered extremely friable, the steam penetrating all parts of even the largest lumps that can be

conveniently handled in charging the furnace. The chloride of antimony formed comes in contact with air on leaving the mass of ore and is converted into oxide, and the sulphureted hydrogen is burnt at the same time; the oxide of antimony may then be collected in suitable condensers. When the charge is removed from the furnace it is crushed, and the gold may be saved by amalgamation. Trial lots of 5, 8, and 15 tons have been tried with perfect success. Certain modifications of the above are necessary with antimonial sands; the steam is not so easily introduced into a reverberatory furnace without bringing in an excess of air, but this may be done by using a close furnace with automatic rakes, the rakes being perforated and attached to the steam pipe are then used to distribute the steam in jets through the mass of sand.

Other inventors have erected furnaces for roasting antimonial quartz tailings; a large revolving furnace has been erected at Costerfield by Mr. H. Herrenschmidt, and another furnace of a similar character and intended for the same purpose, devised by Mr. Borthwick, has been put up at South Costerfield. These furnaces are especially intended to save the antimony, and to work over large quantities of sand; from 20 to 50 tons is said to be the estimated amount to be put through daily. There are vast heaps of these sands or "tailings," containing a large percentage of antimony—they assay from 5 to 25 per cent.—but some difficulty will be experienced with the old sands, those that have been exposed for many years; these do not contain any antimony as grey sulphide, the original ore; it has all been decomposed by atmospheric action. There are some sulphur compounds, as may be seen by the colored bands shown where the heaps have been cut through, but by far the greater part of the antimony is in the form of oxide, and most of the sulphur is as sulphuric acid; some of these sands are very acid—so much so that they cannot be washed through iron gratings, the iron being quickly eaten away. These decomposed tailings will need special treatment if the antimony is to be got out by the furnaces recently erected. The cheapest method will probably be to reduce the oxide they contain to metal and then roast, or perhaps, by using charcoal with the charge, the two operations will go on in the same furnace. If these plans are successful, a very large amount of antimony should be produced during the coming year.

The importance of this subject to the colony may be judged of by the fact that there are some mines which, with I believe only one exception, produce auriferous antimony ore that does not yield up to the miners anything like half its gold contents, and when worked for gold does not return any antimony.

Experiments on the deposition of gold are still being continued, but the results are not ready for publication. It is extremely difficult to conduct experiments in mines and guard against the almost numberless chances of error and mistake. For this reason, all the results which apparently confirm the theory of the gold being now in solution in mine waters and being now deposited are being rigidly examined and repeated. I have, as yet, found no proof of the gold-carrier, *i.e.*, the condition in which it exists in the waters; this problem becomes very interesting when we find that if gold is associated with a metal like antimony, or its oxide or sulphide, it cannot be separated by solution. Antimony and gold once associated are never completely separated by any ordinary process of solution; even the forms of antimony used in medicine, such as tartar emetic, contain traces of gold. In the waters of our mines we find antimonial compounds. In the heaps of waste tailings

at the mines we see the gradual decomposition of the sulphide of antimony and the formation of concretionary nodules and layers of oxide and oxysulphide of antimony, changes due to atmospheric causes, and with these larger quantities of antimony smaller quantities of gold change position. In the saline crusts on the heaps of "tailings" I find nitrates with sulphates and chlorides, and free sulphuric acid is continually supplied from the inner portions of the heap; by such saline and acid mixtures gold is, of course, easily dissolved. I am told that the masses of crystalline copper found in the quartz lodes of the Lothair mine at Clunes contain gold; if so, this will be the first instance in which, to my knowledge, gold —beyond a mere trace—has been found actually in the native copper. I have not yet finished an examination of the copper specimens from this mine, but a sample of native copper, consisting of a mass of octahedral crystals, given me by Mr. Norman Taylor, which he obtained from the Lothair mine, contains only traces of gold. This is very strange, for the causes which would deposit one metal should also act on the other. In none of the copper specimens from St. Arnaud or Bethanga reefs, or from the alluvial at Clunes, is there anything like plating or a joint deposit of the two metals. Yet in these reefs and in the alluvial workings there are all the elements necessary for causing galvanic action, and we find the copper as metal by itself, and the gold as metal by itself, and in recent pyrites.

Waters.

The following determinations have been made of the amount of ammonia and nitrogenous bodies in waters, in continuance of the work commenced last year by Mr. Manley Hopwood and myself. That gentleman being otherwise engaged, I have not been able to avail myself of his knowledge of this subject. The determinations have been made by me and my assistant, Mr. Frederic Dunn. The examination of the rain waters is being carried out in conjunction with records made by Mr. Ellery, the Government Astronomer, who has kindly undertaken to supply all the meteorological observations connected with the rainfall.

Results of Analysis expressed in Parts per 1·000·000.

—	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.
Free Ammonia	0·19	0·15	1·55	...	...	...	0·01	0·02	0·01
Albuminoid Ammonia ...	0·22	0·19	0·67	0·07	0·08	0·10	0·03	0·04	0·19
Nitrogen of Nitrates and Nitrites, calculated as ammonia	7·08	7·32	2·62	5·26	3·26	2·98	undet.	undet.	undet.

—	X.	XI.	XII.	XIII.	XIV.	XV.	XVI.	XVII.	XVIII.	XIX.
Free Ammonia	...	undet.	0·0006	0·0009	0·001	0·0009	...	...	...	...
Albuminoid Ammonia ...	0·12	undet.	0·013	0·007	0·006	0·0046	...	...	...	0·001
Nitrogen of Nitrates and Nitrites, calculated as ammonia	undet.	0·46	undet.	undet.	undet.	undet.	...	...	...	...

RESULTS OF ANALYSIS EXPRESSED IN PARTS PER 1·000·000—*continued.*

——	XX.	XXI.	XXII.	XXIII.	XXIV.	XXV.	XXVI.	XXVII.	XXVIII.
Free Ammonia	...	...	...	0·009	1·088	0·788	1·261	·559	·039
Albuminoid Ammonia ...	...	0·002	0·003	0·001	0·947	0·710	0·788	·079	·062
Nitrogen of Nitrates and Nitrites, calculated as ammonia	...	...	...	...	1·340	1·200	1·230	·249	·149

Nos. I. to VI. are well waters from Kyneton. No. I. contained 86·8 grains of solids per gallon; No. II., 67·9 grains; No. III., 121·8 grains; No. IV., 140 grains; No. V., 63·7 grains; No. VI. 68·6 grains per gallon. A qualitative analysis gave chlorides and sulphates of sodium, magnesium, calcium, and potassium, also silica.

Nos. VII. to X.—Waters from the Port Phillip mine at Clunes. The nitrates and nitrites were not determined. The waters were tested for silica in solution, and the amount found was as nearly as possible 10· parts in 1·000·000.

No. XI.—Yan Yean water in this sample. Only the nitrates and nitrites were determined many previous determinations of the ammonia having been made.

Nos. XII. to XV.—Geelong Water Supply, received from the Water Supply Department. The waters were slightly opaque, except No. XV., which had been cleared by lime, of which it contained 1·12 grains per gallon.

Nos. XVI. to XXIII.—Waters from Sandhurst. No. XVI., Town Water Supply; XVII., XX., XXI., XXII., XXIII, under-ground tanks; XVIII. and XIX., well waters. Nitrates were not determined.

No. XXIV.—Rain water from Observatory rain gauge; first fall after drought.

Nos. XXV., XXVI.—Rain water, collected at the Laboratory at same time as XXIV.

Nos. XXVII., XXVIII.—Rain water, from Observatory gauge, 14th and 15th March.

J. COSMO NEWBERY.

RESUMÉ OF OPERATIONS OF PROSPECTING PARTIES.

BALLARAT MINING DISTRICT.

Blackwood Party.

THIS party consisted of J. Benford (foreman), D. Williams, P. Duncan, A. McFarlane, and J. Pincombe, and commenced work on the 12th March, at Sardine Creek. Prospecting this creek they obtained only a few fine colors of gold. The depth of sinking ranged from 4 to 21 feet. The bed of the east branch of the creek proved very shallow and rocky, and non-auriferous; but at a large alluvial flat, near, a few fine colors were obtained. Several quartz reefs in the vicinity were prospected, but did not yield gold. No better result was obtained at Jackson's Creek and the south-west watershed. Husson's Flat and the adjacent gully were prospected. The depth of sinking on the flat was from 15 to 20 feet, and in one shaft fine colors of gold were obtained. Watties' Gully, which is about eight miles in length, was carefully prospected, and about 5 dwt. of


MILLEWA
NEW SOUTH WALES
WEEAH
KARNAROOC
YATCHERA
MARYBOROUGH
GUNDOWER
MOIR
BENAMBRA
LOWAN
BORUNG
CLARENDON
BENDIGO
RODNEY
SANDHURST
BOGONG
BEECHWORTH
DELATITE
TAMBO
CROAJINGOLONG
GIPPSLAND
DARGO
WONNANGATTA
TANJIL
MORNINGTON
HAMPDEN
VILLIERS
BEYTESBURY
POLWARTH
Bass' Strait
SOUTHERN OCEAN
MAP OF
VICTORI
SHOWING AREAS PROSPECTE
Scale of Miles

coarse water-worn gold obtained from several shafts sunk at the upper portion. The lower end of the gully was very rough and stony, and did not yield gold. Leaving the above locality the party moved to the vicinity of Wombat Creek, at about twelve miles from Golden Point. The creek and its branches were prospected without success. The sinking was wet, and from 10 to 12 feet in depth. A hill at the head of the Werribee was tried, and the prospects yielded only a few fine colors. The head branches of the Werribee and the adjacent gullies were likewise examined, and were not found to be auriferous.

The party next moved to Mount Wilson, and prospected the surrounding country and a portion of the Lerderderg River, including its branches, but with no better result than that of obtaining occasionally a few fine colors of gold. Some quartz reefs in the vicinity were also prospected, and were not found to contain gold. After this the party moved to Doctor's Creek, and prospected some of the adjacent hills and gullies. In a blind gully a shaft was sunk, which bottomed at 26 feet; it did not yield gold, but subsequently at the mouth of this gully they obtained a nugget 14 dwt. in weight, and therefore very thoroughly searched the gully; however, no payable ground was found. In the hill side they made a cutting, and washed a quantity of "stuff," but only obtained 3 dwt. of gold, and finally abandoned the place as unremunerative.

On the 30th of June their operations ceased.

Steiglitz Party.

This party consisted of E. W. Lloyd (foreman), J. Reed, J. Burwood, G. Reed, W. Cook, and T. Herring. They commenced work on the 19th March, at Spring Gully, in which the depth of sinking varied from 10 to 36 feet, and was rather wet. No gold was obtained. Along Long Gully many shafts were sunk, and bottomed at depths ranging from 10 to 38 feet. At one point the gully was cut across by a drive from an 18-foot to a 23-foot shaft, distant about 27 feet. No gold, however, was discovered.

In Hut Gully and Gympie Gully prospecting work was done, but without success.

Towards the close of the month of June the party "sank a shaft in the cement, south of Steiglitz," but did not obtain auriferous washdirt.

The party ceased operations on 30th June.

Smythe's Creek (Rokewood) Party.

This party consisted of S. Maddison (foreman), W. Dawkins, J. Crockett, J. Stewart, J. Dial, and O. Jones. They started to work on the 27th February, and pitched their camp at a spot about one and a half miles north from Bulldog Diggings, half a mile west from Moonlight Creek, and about three miles east from Cape Clear. Seven shafts, ranging in depth from 16 to 78 feet, bottomed on sandstone, with a little wash. From several of them drives were made, in some instances as far as 20 feet, and in opposite directions, but in no case was any quantity of gold approaching a payable amount obtained.

The party then moved to a site between Moonlight and Kangaroo, hoping to find a run of gold lost about seventeen years ago, and known as Happy Jack's Lead. With this view four shafts were sunk, and all bottomed on sandstone. The

depth of sinking ranged from 60 to 96 feet, and at each shaft drives were put in for distances varying from 20 to 43 feet. The party failed to find payable ground. Altogether the party sank 530 feet, and drove 266 feet.

At the end of June work was discontinued.

Buninyong Party.

This party consisted of A. W. Chapman (foreman), W. Pengelly, A. Luke, T. M. Stanley, T. Grills, and C. A. Westh. They began operations on the 29th January, prospecting, in companies of two, three localities in the vicinity of Buninyong, simultaneously.

At the Union Jack, about half a mile north-east of the Buninyong post office, twenty holes, varying in depth from 4 to 20 feet, were sunk within an area of about half a mile. Several quartz veins were discovered. At no place tried was gold obtained.

At the Devonshire Range, about three miles south-east of Buninyong, within an area of about two miles, fourteen holes were sunk to depths varying from 8 to 22 feet; here also quartz veins were found, but no gold in either quartz or alluvial.

At the South Durham, six miles south-east of Buninyong, within an area of about three miles, thirteen shafts were sunk and bottomed at depths ranging from 8 to 23 feet. In only the deepest shaft was gold obtained. From the bottom of it a few fine colors of gold were got. The prospect was not sufficient to encourage the party to continue working in this area.

On the termination of these operations the party formed a camp on Monmouth Flat, north-west of Hardie's Hill, and about south-west of Buninyong. Here, within an area of a mile, fifteen holes were bottomed at depths ranging from 4 to 15 feet; in none was gold obtained. The sinking was "through dark yellow clay intermixed with cut quartz, without any sign of wash." The bottom was generally hard sandstone, but in a few places it consisted "of a soft mullocky" formation. In a north-easterly direction, covering an area of one and a half miles, twenty-three shafts were sunk to similar depths as the foregoing. One of this series of shafts, that bottomed at a depth of 13 feet, yielded colors of gold; and three others bottomed on small quartz veins, none of which yielded gold. The sinking in this portion of the flat was principally through "hard yellow clay intermixed with quartz from surface to bottom."

South-east of Monmouth a shaft was bottomed at a depth of 17 feet, on soft sandstone; neither wash nor gold was found in it. The party left this place and camped near a range of hills about seven miles south-east of Buninyong. Here nine holes, from 3 to 9 feet in depth, were sunk through clay intermixed with quartz and ironstone, and bottoming on hard sandstone; no gold was obtained. One mile further east, twelve holes, from 3 to 15 feet in depth, were sunk, eleven of which were non-auriferous; the twelfth yielded a few fine specks of gold. In an adjoining gully four holes were sunk, and bottomed on hard sandstone, at depths ranging from 5 to 9 feet; in none of them was gold found. On the Durham a shaft was sunk "through 5 feet very soft clay and gravel, 7 feet broken basaltic rock, and 8 feet large quartz boulders, intermixed with a sandy wash." The major portion of this shaft had to be timbered, and the influx of water was considerable. In the wash a few fine colors of gold were obtained. The shaft had to be abandoned on account of the water gaining too rapidly.

On the Devonshire Range two holes were sunk, which bottomed on quartz veins, and yielded a few fine colors of gold. Having consulted Mr. Mining Surveyor Harvey, the foreman decided "to move to the foot of the range and put in a tunnel, so as to intersect all the veins in the hill." The whole party engaged in the work. The tunnel was driven through alternating strata of hard sandstone and slate, intersected occasionally by veins of quartz, till a distance of about 225 feet had been driven, when quartz intermixed with slate was struck and pierced to 255 feet, which was the total length of the tunnel on the 30th of June, the date upon which the prospecting vote lapsed. The last few feet of country yielded such fair prospects that the party continued to drive the tunnel.

Writing on the 21st of November, Mr. Mining Surveyor Harvey reports :—

"The tunnel is situated on allotment No. 131, country lands south of Buninyong township, and is 77 chains S. of township boundary ; its dimensions are 6 feet high by an average width of 5 feet 6 inches, arched on top, and no timber except an opening set used ; it is driven due west, through a hard schistose country of sandstone and slate, mostly requiring blasting. The total distance driven by the prospecting party is 239 feet 7 inches, with a few feet of open cutting to entrance of tunnel, passing through numerous quartz veins and leaders ; a strong body of quartz, 3 feet thick, occurs at 223 feet, with about 6 feet on each side of quartz veins mixed with slate casing, from which, the prospecting party informed me, they washed prospects showing a yield of 3 dwt. to the ton. If such be the case, the discovery is a valuable one, and this run of quartz should be followed north and south. The tunnel is surrounded by alluvial gold workings, which have proved very remunerative ; and in the gully a few chains north from it many specimens of gold-bearing quartz were found. The nearest quartz workings are those of the John Bunyan Company, now working the Devonshire Reef, twenty-six and a half miles north from the line of tunnel. They have a reef 14 feet wide, yielding an average of 3 dwt. to the ton, with an underlie about W. 87°, and a strike nearly due north. This would give a total distance of 600 feet from the mouth of tunnel to the line of the Devonshire Reef ; and, from measurement, I find that the party now driving the tunnel, 'The Devonshire Gold Mining Company,' have added a distance of 264 feet through similar country, somewhat harder ; the tunnel is now, therefore, 503 feet 7 inches in length. The driving is quite dry with a slight rise upwards, the summit of the range being about 180 feet above level of tunnel."

Beechworth Mining District.

Beechworth (Murmungee) Party.

The members of this party were W. Dalgliesh (foreman), C. Grant, J. Adams, H. Smith, and G. Thompson. They began operations early in February, at Buckland Gap, on the west side of the road, at the corner of Corbett's paddock. The first shaft sunk bottomed at 70 feet, on "soft open sandstone," with a few specks of gold on the bottom. From the shaft drives were put in east and west. The eastern drive cut through "a hard slaty bar into a red gravel, yielding prospects of two or three specks to the dish." When in 20 feet this drive was abandoned on account of hard rock being encountered. The west drive became dangerous to work, through influx of water, and was discontinued after 37 feet had been driven. No payable amount of gold was obtained in either drive. A second

shaft was sunk further west than the end of the west drive mentioned above, and bottomed at 55 feet "on a rotten slaty formation;" no gold was obtained. About 30 feet still further west a third shaft was sunk, and "bottomed on a high reef," says the foreman, "with a prospect of only a color, at a depth of 40 feet;" and he felt satisfied that no payable lead of gold came down the gully on the west side of the road.

On the east side of the road the fourth shaft was sunk, in the hope of finding the run of gold that was traced some years ago to the falls at Buckland Gap. This shaft bottomed at 80 feet on a fine soft slate bottom with about 2 feet of gravel overlying it, which yielded prospects of about one grain of gold to a dish of wash. On the west side of the shaft the party put in a drive. At 16 feet a hard slate reef was struck, and the drive was continued in a southerly direction, "yielding occasional prospects of from a single speck up to half a pennyweight of very coarse gold to the dish." The washdirt was about 18 inches thick, and the bottom "where best prospects were obtained, a jointy slate; at other times it was a soft close clay, yielding very small prospects." At 24 feet the slate formation entirely disappeared, and the prospects fell off; however, the party persevered, and after driving a further distance of 6 feet drove at right angles to the east, and continued driving in that direction till ground 50 feet in width had been proved. This easterly portion of the drive exposed another lead on the east side of the shaft, about 6 feet in width, thus showing that in the locality there were three different runs all trending in the same direction and towards the same point, but which, worked separately, would not be payable. With the view of striking upon the lead resulting from a junction of the three runs, a shaft 80 yards away from the foregoing, in the supposed direction of the lead, was sunk, and bottomed at 87 feet on a reef dipping sharply off to the east, and without showing the color of gold. The sinking in the shaft was very hard. A drive was put in eastward, which gave varying success, "sometimes fair prospects—oftener very poor." At 95 feet a run of "fine red wash, varying from 2 to 3 feet in depth, was struck, two loads of which, upon being washed, yielded 2 dwt. 2 gr. per load of thirty-six buckets.

The end of the financial year occurring at this juncture the party's connection with the Government had to terminate, and the party pegged off a claim and continued to work on their own account. For a few weeks they had fair success, which induced some other parties to take up claims near; but the discovery of a payable goldfield has not yet resulted from their combined labors.

Alexandra Party.

The members of this party were E. Day (foreman), J. R. Trezise, J. Scott, J. Prime, and A. Milroy. They started on the 15th of May, and travelling by way of the Rubicon River arrived on the evening of the 16th at the junction of the two branches of that stream. The country traversed was very rough and scrubby. From this camping place an exploration was made to and over the middle spur, about two miles south. The geological formation is granitic, and the timber principally peppermint intermixed with blue gum. They then pursued their course in a S.S.E. direction, crossing about one mile of table-land with a deep soil of granitic origin, well impregnated with decayed vegetable matter and bearing messmate. On this table-land they erected a cairn. Continuing their course for some miles further, the party traversed ground of a similar formation, and bearing the same timber,

with the addition at one point of splendid mountain ash, over 170 feet in height. They then turned due east and struck the left-hand branch of the Rubicon, which they followed till the camp was regained. In a distance of about five miles they crossed and re-crossed the river twenty times. Starting from the cairn referred to above, the left-hand branch of the river was prospected for several miles, when some falls were encountered, and the course being very rocky and without promise of gold, the party returned to the camping place. No gold was found on the Rubicon River nor its branches.

The party explored next south-westerly to Mount Arnold. At the heads of the right-hand branch of the Rubicon River they found splendid myrtle and sassafras, also fern trees and tea-tree scrub, and a belt about four and a half miles wide of very fine mountain ash. The party prospected without success onward till Mount Arnold was reached and crossed, when they turned westward to the head of the Taggarty River, and followed it down for about nine miles. They crossed the river many times, and tried several places along its course, but did not succeed in obtaining gold. The last three miles of the banks of the Taggarty proved to be of sandstone formation; the whole of the preceding course was granitic. Leaving the Taggarty River, the party made for their camp across country, a distance of about twenty-eight miles, which was densely scrubby with sword and wire grass 12 feet high.

In accordance with instructions, the party moved to Connelly's Creek, and examined the country within a radius of four miles from their camp. They found quartz upon several of the spurs, but did not obtain gold from any of the spots they tried. The right-hand branch of the creek and its tributaries, together with the principal gullies, were carefully searched for the precious metal, but nothing more than occasional fine colors of gold to the dish were obtained. The shafts sunk in the gullies varied in depth, in some places reaching beyond a depth of 50 feet, and bottomed on sandstone.

On the tributaries of the Niagaroon Creek the country was also deep, and the influx of water so large that the party were compelled to abandon several shafts before reaching bottom. A very little gold was found in this locality, but nothing approaching or giving hope of the existence of a payable field. The party were disbanded on the 30th of June.

Sandhurst Mining District.

Reedy Creek Party.

The members of this party were E. W. Gladman (foreman), J. Farrell, J. Cole, W. Baird, and J. McFie. They commenced work on the 20th of March, at Strath Creek, north-west of the Engineer Spur. Three shafts were sunk; one on the north side of the spur, yielded a few rough specks of gold. On the same side and more to the north than the foregoing a shaft was sunk to a depth of 22 feet through shingle, and had to be abandoned before bottom was reached, it being unsafe to work it deeper on account of the loose nature of the ground. On the south side of the spur a shaft bottomed on hard slate at a depth of 15 feet, and yielded a prospect of about three grains of gold.

The party moved to the Bee-tree Gully, distant about six miles south-east; several shafts were sunk in the neighborhood. One, which bottomed on hard slate,

yielded 10 grs. of water-worn gold. A drive was put in from this shaft, but the prospects were not sustained, and the party moved to about five miles south-south-west, and prospected Silver and Wallaby creeks. At these creeks the sinking was very shallow, from 3 to 5 feet, and bottomed in some places on decomposed granite, at other places on sandstone. Only a few fine colors of gold were obtained. The party likewise prospected a portion of the King Parrot Creek, and the foreman reported:—"Fine gold, nearly payable, can be obtained in the loose drift and wash upon the banks of the creek; the flats have not been tried." On the flats the country was deep and could not be prospected by the party.

The tributaries of Strath Creek were prospected, but without favorable result; the sinking along their course is shallow, not more than 7 feet in depth. At Breakneck Gully and Cannon Creek shafts were sunk, bottoming on sandstone; only fine colors of gold were obtained. Diggers' Gully was also prospected. The various shafts sunk in it bottomed on hard slate, and yielded no better results than the party had obtained at other places.

The party experienced much inconvenience from heavy rain about the middle of May, and two of the party deserted. At the end of May the party ceased work.

Heathcote Party.

This party consisted of D. O'Rourke (foreman), H. J. Bellchambers, G. T. Darvill, H. Field, and J. Brown. They started on the 25th April, crossed the Dividing Range, and proceeded as far as Dairy Creek, near to which they pitched their tents and began operations. An exploration of the country for several miles round the camp showed there was a great scarcity of water. Commencing well up the creek, the party sank four shafts, and bottomed at a depth of about 14 feet. Two of the shafts bottomed on sandstone underlying "hard clay with layers of gravel and large sandstone boulders near the bottom." The others "bottomed on soft slate," underlying "hard sand mixed with gravel and thin layers of shingle." Colors of gold were obtained at each shaft. Moving in the direction of the stream northward four more shafts were sunk, and bottomed on sandstone at depths varying from 15 to 17 feet. One yielded a little gold, and a drive was put in from it for a distance of 12 feet, but no more gold was obtained.

At Mountain Creek holes were sunk ranging in depth from 6 to 9 feet, and bottoming on soft slate; at all, colors of gold were found. Some prospecting was also done at the head of this creek, and the foreman thus reported concerning the formation:—"First 6 feet loamy clay, rather soft, easy to sink, the remainder to a depth of 18 feet was a very hard gravel with thin layers of quartz pebble; bottom, a hard slate." A few specks of gold were found, and from one shaft a drive was put in a distance of 7 feet, but the prospects did not improve.

Speaking generally of the character of the strata on the western side of the Dividing Range, the foreman says:—"There is a great similarity in the sinking; it is either a hard clay mixed with layers of gravel, or an equally hard sand with very thin layers of shingle, with boulders in almost every hole within a few feet of the bottom."

The party crossed to the east side of the range and sank altogether eighteen shafts, ranging in depth from 4 to 32 feet. Some yielded colors of gold. The deepest sinking passed through "alternate layers of clay, sand, and gravel; and,

as it neared the bottom, it was mixed with floating reef or pipe-clay, with pipe-clay bottom." As a few specks of gold were obtained at this shaft, a drive was put in for a distance of 12 feet, but the prospects did not improve. Cuttings also were made across the most promising flat; the depth was from 4 to 5 feet, with pipe-clay bottom. No payable amount of gold was obtained.

Respecting the operations of the party, the foreman in his final report says:—"In conclusion, I beg leave to remark that in almost every flat and gully there is more or less gold, but nothing that will pay. Should there be at any future time any discoveries of gold made (in this locality), I am perfectly satisfied it will be nothing more than a patch; I believe there will be nothing continuous."

The party ceased operations on the 25th June.

Homebush (Axe Creek) Party.

This party consisted of R. Parker (foreman), P. Lynch, W. H. Parker, W. Gillett, and M. Guerin, and began early in April to prospect eastward from south of the Homebush estate. They thoroughly examined the ground east from the late Homebush rush, as far as Axe Creek. A great many holes and shafts were sunk in the low-lying ground, as also upon the cement hills north and south. The sinking ranged from 3 to 27 feet; and, as a rule, the ground was very hard and required blasting. The bottom was generally sandstone, with slate or "pipe-clay." At nearly every shaft gold was obtained, but only in a few sufficient to give hope of success attending eventually the party's labors. The cement hills, in which shafts with drives were put, yielded a few fair prospects; but upon a considerable quantity of the "stuff" at such places being washed the prospects obtained by the dish were not maintained, and in spite of the well directed efforts of the party ground that yielded payable results was not discovered.

The operations of the party were discontinued at the end of June.

Rushworth Party.

The members of this party were S. Ryan (foreman), J. Hannah, C. Mousley, W. Jackson, H. Robertshaw, D. O'Sullivan, and W. Cameron. They began work on the 30th of April, at a site about two and a half miles east of Rushworth. Their efforts were entirely devoted to prospecting the ground in a line north and south from the Old Lead. The first shaft was sunk at a point about 236 feet north of the main road, and subsequently shafts to the number of eleven were sunk to within a distance of about 40 feet from the old workings. On the same line, but north of the old workings, and between the road to Gunn's Station and adjacent creek, two shafts were sunk, and also one about 600 yards to the eastward of them. The "bottom" of all the shafts was "pipe-clay," and the superincumbent strata clay, clay and gravel mixed, cemented gravel, and gravel. The driving was difficult owing to the presence of "ironstone bars" and hard cement.

At the southern end of the line of shafts the ground was between 5 and 6 feet in depth, and it gradually deepened till at the most northerly shaft bottom was not touched before 48 feet of sinking had been done. The distances between the shafts differed, but on the average the shafts were 90 feet apart. At only two places in the line of shafts was appreciably auriferous ground found, viz., at a drive made from shaft No. 9 to shaft No. 10, and at a shaft sunk between Nos. 8 and 9 shafts.

At the drive three and a half bucketsful of wash obtained at one spot yielded a pennyweight of fine gold. At the shaft which bottomed at 31 feet one bucketful of dirt off the bottom yielded 1½ gr. of gold. However, up to the 30th of June, the party did not discover a payable run of gold. During the time the party was at work they did about 350 feet of sinking and 50 feet of driving.

Government aid was withdrawn from the party at the end of the financial year, but they continued to work, and with a gradually increasing measure of success. Eventually they struck payable ground. A "rush" ensued, and by the 10th of October it was estimated there were 700 persons on the spot. One hundred holes had been bottomed, and there were fourteen holes then actually on gold. These claims were doing very well. In the previous week from eight of them 52 loads of dirt were washed and crushed, with a yield of 85 oz. of gold.

Maryborough Mining District.

Amherst Party.

This party consisted of R. D. Burrall (foreman), B. Byrnes, R. McFarlane, J. McKinstray, and C. Anderson. They took the field on the 15th March, and formed their camp east of the Bet Bet Creek, near the Government Reserve, south of Glenmona station. For some time water was very scarce in the district, and the efforts of the party were confined at first to the most suitable spots for prospecting, immediately north and south of the road from Lamplough and on the west side of the range between Amherst and the Bet Bet Creek. Fourteen shafts were sunk in gullies north of the road, ranging in depth from 4 to 13 feet, but without success. On a large flat trending toward the creek and south of the road five shafts were sunk and bottomed, at depths varying from 10 to 23 feet. A small amount of gold was obtained, very fine and widely scattered. At two shafts drives were put in a total distance of 19 feet, as there was fair shingle-wash. From these drives no improved prospects were obtained. Shafts were also sunk in some tributary gullies of the flat, but did not yield auriferous wash.

Satisfied that he had fairly tried the available shallow ground on the west side, the foreman next prospected that on the eastern side of the road, and sank north and south of the road shafts to the number of seventeen, which ranged in depth from 4 to 15 feet. At three of these shafts drives were put in, the shortest being 15 feet, and the longest 30 feet. The party washed three loads of washdirt, and obtained therefrom 4¾ dwt. of gold. They sank shafts along the probable course of the deepest ground, testing the run for a distance of 200 feet, but did not succeed in striking payable ground.

They also prospected many spots in going northward as far as the junction of the Maryborough and Avoca roads, but at no place was any payable ground discovered, though many of the shafts yielded small quantities of gold. Next they prospected a flat north of the Avoca road by sinking a line of five shafts. From the deepest of these, which bottomed at 23 feet, they obtained a prospect of 12 grs. from a tub of dirt. This yield induced the prospectors to drive for several feet in opposite directions, but although they tried several tubs of stuff they did not obtain again anything approaching to the first prospect.

Leaving this locality, the party further prospected the ground east of the range and north of the Amherst road, and continued to work here for several weeks after Government aid had been withdrawn. From three loads of dirt at one shaft they obtained 13¾ dwt. of gold, and registered a claim, in consequence of which a small rush took place. The prospecting party took out a block 30 feet by 15 feet, and obtained 2½ dwt. to the load.

Fifty shafts were sunk; and many that the prospectors had previously sunk were driven in various directions, by miners, but in no case was richer ground found than that registered by the prospecting party. The foreman, writing on the 31st July, says :—"Several of the claims as well as our own would have been wrought if water had been obtainable on the spot, but as the expense of carting to the creek is too great to make it pay the locality is for the present deserted."

Avoca Party.

The members of this party were C. Hall (foreman), J. C. Dowall, J. Wright, P. Donoghue, and W. J. Simmons. On the 8th of May they commenced operations at the head of Wattle Flat, west of No. 1 Creek. The first shaft they sank bottomed at a depth of 9 feet, the sinking being through "hard-baked sand, and unwashed quartz." No indications of gold were obtained. Another, near to the first, bottomed at 14 feet, the sinking here being through hard gravel, and for the last 3 feet heavy wash of quartz boulders and slate." Off the bottom a few colors of gold were obtained. Three other shafts sunk in this gully yielded no better results than the above-mentioned.

The prospectors moved southward to Separation Flat. In the centre of it they sank two shafts, one of which bottomed "on the blow of a quartz reef," and a few fine colors of gold were obtained off the bottom. The other shaft, after piercing through "hard slaty shingle, and unwashed quartz, at 14 feet in depth bottomed on 'pipe-clay.'" From the wash several colors of gold of a "snuffy shade" were obtained, and in one dish as much as half a grain of gold was procured. The party therefore sank shafts in a line with and on each side of the above, so as to "thoroughly test the ground and prove whether any break in the reef existed, and thus afford room for a narrow lead." Nothing however more encouraging than "a quantity of fine colors" of the precious metal could be obtained.

These operations having cut this portion of the flat across, and no payable results appearing, the party prospected the flat as low down as practicable, so as to cut if possible the lost Mountain Hut Lead. At a depth of 17 feet bottom was reached, on which rested a "fine wash of heavy boulders and ironstone;" no gold was obtained. A shaft sunk at about half a mile distant bottomed at 18 feet with a heavy wash, which also was non-auriferous. On the north side of the flat, and in a line with the foregoing shafts, one was sunk which cut through sand and gravel, and bottomed at a depth of 19 feet. From the bottom a few fine colors of gold were obtained. On the northern side of an adjacent cement hill, four shafts were sunk, but only a few fine colors of gold were procured.

Having cut the country from Mountain Hut to Wattle Flat, a distance of one and a half miles, the foreman concluded that "the entire ground prospected is useless to the miner," and he moved the party to the north fork of No. 1 Creek, about a mile above the old workings, and above the paddocks in the hands of

selectors. On a hill between the two creeks that form the southern fork a shaft was sunk to a depth of 60 feet, through—

1. Close gravel with cement.
2. Cemented quartz, mixed with clay.
3. Alternate layers of quartz and shingle.
4. Sand.
5. Concrete of clay or stiff pug.
6. Layers of gravel and pug.
7. Gravel and slate.
8. Concrete clay and gravel.
9. Hard gravel and slate.
10. Cemented gravel, with large boulders, such as is generally found to overlie floating reef or bottom.

The sinking for the last 3 feet was through a heavy wash of sandstone and quartz boulders, with floating reef. At 2 feet from the bottom the wash yielded a dozen colors of fine gold to the dish ; no gold was obtained off the bottom. A drive was put in, but the prospects did not improve.

On a hill between the two creeks forming the north fork of the creek a shaft was sunk that pierced much the same description of strata as the foregoing. It bottomed at a depth of 26 feet, and about a dozen colors of gold were got therefrom. There was no inducement to put in a drive from this shaft, so about 400 yards higher up another was begun, but at 7 feet deep the party "struck heavy water in drift." As there was an under-current running that would have required pumping gear to control it, the shaft was abandoned and another sunk midway between the site of it and the preceding. At a depth of 21 feet the bottom was reached, upon which rested a slate and gravel-wash ; it did not contain gold.

From two shafts sunk in the hill on which the camp stood nothing encouraging was obtained.

At the termination of the financial year the party ceased work.

Inglewood Party.

The members of this party were J. B. McLintock (foreman), T. Barnett, F. W. Coumbe, P. Cotter, and J. McKerdy. They started on the 3rd of February and pitched their first camp at Ferriby Creek, about one mile from Brenanah homestead. The gullies in the vicinity were prospected. The depth of sinking was from 3 to 11 feet, and the formation granite, slate, and sandstone. Not even the color of gold was raised in any of the prospects. Several quartz reefs were seen, and writing about them the foreman says, "they were all alike—a raw white stone, having no appearance of being gold-bearing." The party crossed over to the westerly fall of the range to about three miles west of Brenanah, and prospected Back Creek, Kooyoora Creek, and the gullies in the vicinity of the latter. The geological formation is similar to that on the east side, and the depth of ground from 5 to 25 feet. No gold was obtained. The quartz reefs in the locality were also examined, but none proved auriferous. Leaving this neighborhood, the party crossed to Brenanah Creek and prospected on the made hills due east from Mount Brenanah. On a large flat, three-quarters of a mile from the foot of the mount, about nine years ago, a Government prospecting party sank three shafts, 60 feet apart. In order that this flat should be thoroughly prospected across from ridge to ridge, the prospectors tailed on to the line of old shafts, and sank shafts bottoming at from 35 to 52 feet in depth ; no gold was obtained. The foreman reported :—"There are two distinct formations of ground in this neighborhood ; the surface formation, of a depth of 7 feet, is a red heavy wash of ironstone and quartz, similar to the shallow gully sinking on Kingower and Berlin, while the other 45 feet are a white wash, commencing with a white sandy clay—a sort of false

bottom for the red wash—and from that layers of drift sand and gravel alternately till within 4 feet of the bottom, when a heavy quartz wash sets in with floating sandstone boulders and pipe-clay on to a fine soft granite bottom, white and yellow."

A gully near ("at the head of which is the source of Sunday Morning Reef") was also prospected. Two shafts bottomed at 32 feet; no gold was obtained. In an adjacent gully several shafts were sunk and bottomed on sandstone. In one a few colors of gold were obtained.

Leaving the above neighborhood, the party moved to the north end of the range, and completed prospecting the same to within five miles of Wedderburn. The shafts put down varied from 5 to 20 feet in depth, and bottomed on sandstone. They did not prove auriferous. The foreman remarks:—"The two principal breaks of the range were a failure. It was only at the extreme end of the Brenanah Range we obtained the colors of gold, and that in shallow gullies with a heavy ironstone wash on a decomposed sandstone bottom. In the deeper shafts, with a granite wash and soft granite bottom, we never found the finest color of gold, or black sand. The made hills continue to the end of the range, and I do not consider them gold-bearing."

The party next camped at Kooyoora Springs, and prospected the easterly fall of Kingower. They sank many shafts, varying in depth from 6 to 15 feet, but did not obtain any payable prospects. They also began to prospect the deep ground on the course of the Kingower line of reefs. A shaft was sunk and bottomed, at a depth of 104 feet, on a soft granite bottom; it was perfectly dry. The strata passed through consisted of "layers of sand of different colors, fine gravel, white stiff clay, and seams of dark cement, some of them very hard, the last seam being on the bottom wash." There were nearly 3 feet of wash of good appearance, but it yielded only a fine color of gold to the dish.

Drives were put in east and west to a total distance of 40 feet; but the prospects had not improved when the party ceased work on the 30th June.

Wedderburn Party.

This party consisted of J. O. Shaw (foreman), J. G. Cosh, W. Gilfillan, R. Owen, A. Scruboyna, and T. Murphy. On the 26th March they began by prospecting the gullies situated about four and a half miles south-west of the township of Wedderburn. Eight gullies were thoroughly prospected, sixty-four holes being sunk, varying in depth from 4 to 13 feet. In twenty-three of them colors of gold were obtained, but in no case did a prospect approach to a payable amount.

Leaving these gullies the prospectors moved to Kerang Flat, about five miles north-west of the township. They sank in the locality fifty-four holes varying in depth from 4 to 14 feet, and generally bottomed on slaty formation. Occasionally fine colors of gold were obtained, but no prospects of an encouraging character resulted from their labors at any portion of the flat.

The party next prospected the country for a distance of about eight miles, along the road from Wedderburn to Inglewood. As a rule in this ground hard cement was encountered at 4 feet from the surface. Many shafts were sunk and extensive trenching work done. Several leaders were intersected at various places, but in except a few instances, where fine colors were obtained, no gold was discovered.

The party ceased work on the 30th June.

Charlotte Plains Party.

This party consisted of E. H. Cheney (foreman), J. T. Irvine, M. Bowen, J. Tait, and W. McLaren. They began work on the 23rd February, on the eastern side of the range running between Havelock and Deep Creek. For about five miles north and south of Havelock, on this side of the range, as much of the country as was open to the prospectors was tried by them. The sinking for the most part was shallow; but in two shafts depths of 40 and 42 feet were sunk before bottom was reached. The sinking was hard and the bottom devoid of washdirt. No gold was discovered.

The party moved to Four-mile Creek, near to which, and three miles north of Havelock, their camp was made. On a flat near the Oxonian Reef fourteen holes were bottomed at depths of from 3½ to 9 feet, and in none was there wash or gold. Two shafts in deep ground were sunk to a depth of 60 feet, and then, on account of water, had to be abandoned. More to the south, on the same flat, thirteen holes were sunk; ten were shallow, about 4 feet in depth; one bottomed at 26 feet; and two at 58 feet. All the deep sinking was hard, and in every case the bottom was "a dry hungry cemented sand" without washdirt or gravel, and non-auriferous. An adjacent gully was prospected without result, also a flat running north and south, situated north-west of Havelock.

The party next moved to one mile west of Havelock, so that they might prospect the country between that place and Chinaman's Flat. The ground proved to be from 42 to 43 feet in depth and but slightly auriferous.

At the request of the Crown Lands Department the party was directed to prospect a certain area adjoining H. Oldsen's land, parish of Bet Bet. About twenty-four holes were sunk, in most places through very hard cemented gravel. The depths varied from 3 to 50 feet, and there was wash in two, and only the color of gold in one of them. The party cut also trenches or cuttings at certain places to prospect for reefs.

After this the party again went to the west of Havelock, and at about two and a half miles therefrom prospected a flat. At the head of it the ground proved from 4 to 14 feet in depth, and here the color of gold only was obtained. Lower down and on the west side the ground was found to be 48 feet in depth, with a fair but hard wash on the bottom. Fine colors of gold were obtained and the prospectors put in a drive from the shaft they sank, and raised about a load of washdirt which yielded 1¾ dwt. of gold. Subsequently drives were made in four directions, but only the color of gold could be got in the washdirt taken from them. The foreman considered he bottomed in a "crab-hole." In a flat south of the foregoing a shaft was bottomed at 32 feet deep, with a dip northward 22° towards the above-mentioned. A drive in that direction was made, but not even the color of gold was obtained.

Time did not admit of further work.

Orville Party.

Consisted of W. Williams (foreman), A. Mather, A. R. Treble, D. Davies, and W. H. Donald. They commenced operations on the 30th April, at a spot a little south of the Kangderaar Creek, between R. Allen's holding and the road from Wehla to Tarnagulla. They sank three shafts and bottomed at about 7 feet. The sinking was through "a dark-colored cement," with very little wash and no gold.

They then tried a flat south of and bordering the creek by sinking two shafts. One bottomed at 11 feet on "soft granite," above which was clay sand and light gravel. The other shaft bottomed at a depth of 20 feet, also on soft granite, underlying similar strata. No gold was obtained from either. Having further prospected the locality by trying the surface for some distance around and discovering no gold, the party moved to Murphy's Creek, near Mrs. Bell's selection, and examined the ranges in the neighborhood. The party cleaned out an old shaft sunk through cement with a light wash resting on a soft granite bottom. From it drives were put in 21 feet east and 13 feet west; not even the color of gold was obtained. Two other shafts were sunk in the vicinity of the foregoing, one bottomed at 29 feet, the other at 12 feet on granite. At the deeper of the two a drive was put in for a distance of 20 feet. From neither was gold obtained. The prospectors then moved to near Mr. Miller's selection, situated between Murphy's Creek and the Dunolly Reservoir, with the view of prospecting the made hills in that locality. Nine shafts were sunk and bottomed at depths ranging from 6 to 14 feet. From the bottom of one about 20 grs. of gold were obtained; but, although the ground was carefully prospected all round, only a few colors to the dish could be secured; the wash ran out and the reef rose on all sides of the shaft. At some of the other shafts colors of gold were obtained, but nothing payable, although in a few cases good promising wash was discovered.

The sinking generally was through a light-colored cement on to a granite bottom. The party disbanded on 30th June.

Maryborough Party.

This party consisted of A. Murray (foreman), J. Kessack, T. McPhail, A. McDonald, and T. Murray.

They left Maryborough on 21st February and proceeded to Smoky Creek, west of Archdale Bridge, *viâ* Bet Bet. The country eastward toward Emu was explored, and the color of gold was obtained at the surface on a hill near Mr. Chirnside's property. Systematic prospecting was commenced by sinking across a gully at the most eastern point of the unalienated land in this locality. The depths of the shafts ranged from 10 to 22 feet, and they bottomed on "soft pipe-clay." Only fine colors of gold were obtained. The flats and cement hills about a mile to the westward were prospected. The ground proved shallow, 2 to 9 feet in depth; and at several places a fair amount of wash was struck, but in no instance was a yield of more than a few specks of gold obtained. The party crossed over to the western slope, and prospected upward from the west, but the prospects were poor, and gave no reason to suppose any payable gold country would be found in the locality on this side of the range. Therefore the party moved their camp to near the old road from Dalyenong, which intersects the Avoca and Stuart Mill road, near Voss' holding, about half a mile south of Dalyenong. A large flat (locally known as Mountain Creek Flat, running northward and lying east of the Mount Hawkin Ranges) contains several lines of old drift hills with granite bottom and "surrounded by slate ranges full of quartz veins." The cement hills yielded only very fine gold, nothing payable. In the flat land no better prospects were obtained. A gully and the western branch of the flat were also tried, and the prospects yielding coarser gold, the prospectors were sanguine for a time of meeting with success in the locality. Sinking was carried on across the west branch of the

flat, but no gutter was found; and "the wash all across was poor and barren looking." The camp was moved to the head of the gullies trending into the eastern branch. These gullies, with the intervening cement hills, were prospected, but the efforts of the party to find payable gold were not rewarded with success.

The party returned to Maryborough on the 23rd June.

St. Arnaud Party.

This party, consisting of G. W. Gillies (foreman), A. Reid, C. Smitheram, H. Bell, and W. Smith, left St. Arnaud on the 9th of May and proceeded to prospect the country within a few miles' radius of their camp, which they placed at about six miles north from St. Arnaud. In a gully near the camp three shafts were sunk to the respective depths of 8 feet, 10 feet, and 12 feet. The sinking was very hard, and the bottom rock yellow sandstone. In the deepest shaft a few colors to the dish were obtained; the party therefore put in a drive for a distance of 12 feet, but failed to secure better yields. In a gully half a mile or so west from the camp four shafts were sunk. The sinking was easy and the bottom "a mullocky pipe-clay." The depth of these shafts ranged from 10 to 16 feet, but in none was gold obtained. In the 16 feet shaft a quartz reef, 2 feet in thickness, was struck, but no gold could be obtained from it.

One and a half miles east of the camp, at a promising looking gully, with a fine flat running north and south for about three miles, the hills on each side of which were covered with quartz and sandstone, six shafts were sunk. The bottom was struck at depths ranging from 12 to 24 feet. In only one was the color of gold obtained. Four bottomed on "soft pipe-clay," the other two on sandstone. On a hill about one mile west from the camp two shallow holes were dug, but no indications of gold were obtained.

Two gullies about one mile east from the camp were also prospected. In one two holes, 8 and 11 feet deep, bottomed on slate and did not yield gold. In the other gully three shafts, 11 feet, 33 feet, and 28 feet deep respectively, were sunk and bottomed. The two deepest shafts yielded colors of gold to a bucketful of washdirt, but the prospects did not improve.

The party moved to a spot about six miles east by south from St. Arnaud close to the Inglewood road, and at the St. Arnaud corner of Hackett's farm. From this camp they prospected three cement hills and a flat about one mile in length. Eleven shafts were sunk and varied in depth, on the hills from 8 to 42 feet, and on the flat from 11 to 16 feet. From the deep shaft on the hill a drive was put in a distance of 26 feet; the gold obtained was not a payable amount. At one shaft bottomed at 10 feet, on one of the hills, prospects were obtained of 2 dwt. to the load of "stuff." This was the highest result secured.

The party was disbanded at the end of June. During the time the prospectors were in the field they did about 450 feet of sinking, for the most part through hard cement, and upwards of 50 feet of driving.

CASTLEMAINE MINING DISTRICT.

Daylesford Party.

Consisted of J. Hill (foreman), A. Watt, J. L. Hocking, J. H. Thomas, and H. Couch, and got to work the last week in March. They camped half a mile

south of the head of Wombat Creek, and three-fourths of a mile from the head of the Werribee Creek. At the head of Reedy Creek many holes were sunk and bottomed at depths varying from 5 to 11 feet, with little or no wash and no gold. The formation is sandstone with quartz intermixed. Several trenches were dug and many quartz leaders cut, none of which turned out permanent lodes nor contained gold. The country around the head of Reedy Creek did not prove auriferous. Wombat Creek was prospected for a few miles down from the Dividing Range, but without success; also Stony Creek, where the depth of ground was from 4 to 16 feet, with a wash, composed of sandstone and quartz, that yielded only colors of gold at the deepest shafts. The western tributaries of Stony Creek were also prospected thoroughly. The ground was comparatively shallow, $3\frac{1}{2}$ to 12 feet in depth, and contained little wash and no gold. On a tributary of the Werribee Creek, one speck of gold was obtained at one of the shafts. The party dug trenches for quartz on a spur between Wombat and Cockatoo creeks, and cut several leaders, which, however, died out at a depth of 5 feet; none of them yielded gold. While prospecting at the eastern tributaries of the Werribee, at a hill about one mile south-west of Bullarto, the party encountered "a strong wash of quartz boulders with a little fine gold throughout, which," in the opinion of the foreman, "if not on such high ground and away from water might pay to work by sluicing." On this hill the party did much prospecting, hoping to find a channel of deep ground, but in this failed. They sank across a flat near the Werribee in this locality and obtained a few fine colors of gold. They also tried several quartz reefs, but in none found gold.

From their operations the prospectors were satisfied that the area explored by them contains no alluvial gold deposit, but consider that possibly some of the reefs may prove auriferous if worked to a sufficient depth.

At the end of June the party ceased work.

Steel's Creek Party.

The members of this party were C. B. Spearing (foreman), W. Hunt, S. Clements, and T. Hamilton.

At the beginning of March the party started and made direct for Muddy Creek, with the intention of prospecting it and its branches up to the sources. Owing, however, to the scrubby nature of the country and the want of horse feed, the prospectors found it expedient to recross the Dividing Range and prospect Steel's Creek. This they did, but were not favored by any material success.

The Muddy Creek was next prospected, and about $\frac{1}{4}$ dwt. of gold was obtained, but not even the color was found in the creeks running into it. The foreman pushed on to the head of the creek, and found the ranges in the locality steep and carrying more quartz than lower down. The wash in the creek is full of quartz and granite boulders.

The party next proceeded to Dry and Wilson's creeks and the gullies running into them. Thirty-six holes were sunk in the alluvial without yielding in the aggregate 1 dwt. of gold. Some likely-looking quartz lodes were discovered to the west and north-west of Dry Creek, but the foreman did not think it advisable to spend more time over these than was necessary to assure himself that they did not contain gold in the surface stone, especially as the country was composed principally of hard blue slate, and the party did not carry blasting or other reefing tools.

The alluvial ground near Reed's Creek was tested, but the party were unsuccessful in tracing anything like payable ground, although a few colors of gold were obtained. A considerable amount of trenching on quartz reefs was done in the locality without meeting with any encouragement. The camp was therefore moved back to Muddy Creek, and shafts were sunk in the supposed run of the creek. Owing to the wet nature of the ground, it was impossible to bottom many of the shafts. The color of gold was obtained in almost every instance where a shaft was bottomed, and the general indications point to the presence of gold. The country at the upper portion of the creek is so scrubby that it was found impossible to make use of pack horses until a track had been cleared.

Although the efforts of the party to find alluvial gold in payable quantities in the vicinity of Steel's, Wilson's, and Reed's creeks were unsuccessful, the foreman is of opinion that there are numerous gold-bearing quartz reefs that only require the outlay of capital and labor to prove ultimately remunerative.

Hoddle's Creek Party.

The members of this party were T. Ewart (foreman), J. Crimp, T. Wildman, and A. Burr. They began work on the 10th of April, in a gully at Sheepstation Creek. Various holes were sunk to an average depth of 11 feet, and the adjacent creeks were thoroughly prospected, the only result being the color of gold.

The Cockatoo Creek at its junction with Shepherd's Creek was next tried; shafts were sunk to depths varying from 7 to 18 feet, and nothing better than colors of gold was obtained. Also the country on the east side of Cockatoo Creek towards the Macclesfield Diggings was tried, but no payable ground was discovered. At one shaft sunk through "rotten basalt" to a depth of 30 feet some "strong colors" of gold were obtained.

The party also prospected McCrea's and Hanson's creeks without finding more than colors of gold. On Hanson's Creek granite bottom was struck.

Then the prospectors crossed the range and camped on Hoddle's Creek, at about nine miles above the old workings. The several shafts sunk by them in the vicinity tested both shallow and fairly deep ground, being from 3 feet to 42 feet in depth. The result was the color of gold only. The party then moved lower down to within three miles of the old workings, and sank shafts from 19 to 40 feet in depth without obtaining so much as a color of gold.

At Tea-tree Gully two shafts were sunk to depths of 30 and 32 feet respectively, but the ground did not prove auriferous.

The party next tried their fortune at Doolan's Flat and adjoining gullies. The ground on the flat proved to be from 26 to 45 feet in depth and contained a well-defined gutter. Two shafts cut through 30 feet of wash, from which colors of gold could be obtained throughout, but no portion yielded payable prospects. The sinking was very wet, and the party had to work night and day to keep the water down.

The ground prospected by this party is a belt of country between the Emerald Diggings and Yankee Jim's Creek. The surface is poor and scrubby, very similar in appearance to that in the neighborhood of the Ringwood mines. The hills have plenty of quartz leaders, which appear, however, to be void, so far as the party were able to decide, of auriferous stone.

Ararat Mining District.

Moyston Party.

This party, consisting of C. Sutcliffe (foreman), W. Davis, A. Hodgson, M. McDonald, and J. Mathew, commenced operations in the Londonderry paddock, about five miles from the township, and thoroughly prospected the adjacent country without meeting with any reward for their labors. A move was then made to the untried ground opposite Lexington station, two miles from the township. Sinking was resumed, but as no leader or spur thicker than from one and a half to two inches was touched the prospectors again changed their scene of operations to unbroken ground between "The White Patch" and "Cawood's," one mile west of the township, and continued work, but without favorable results. From the time of commencing work, early in the month of February to the end of June, when operations were discontinued, the party sank and bottomed twenty-four shafts, twenty-two of which bottomed on "hard mullock" (after penetrating in nearly every instance hard cement) at depths varying from 11 to 45 feet. The remaining two shafts bottomed on a shallow reef at depths of 5 feet and 6 feet respectively. A large amount of driving was done and entailed much labor, the ground being close rough cement and cemented gravel.

Armstrong's Party.

This party, composed of A. Boyce (foreman), W. Turner, R. Whitten, J. Jealous, and I. Jealous, early in February commenced work near Armstrong's, and sank seventeen shafts, in one of which alone a light wash was met with. They then moved to the Six-mile Creek, near Miller's selection ; five shafts were sunk, and in three of them, after passing through hard cemented gravel and large well-rounded quartz boulders, the color of gold was obtained. Numerous other shafts were bottomed with a like result.

Derwent Point, 2½ miles west from Armstrong's school, was the next locality tested. Sixteen shafts, varying from 4 to 28 feet in depth, were put down, and in two only was the color of gold met with.

From the commencement of work until the party was disbanded at the end of June 578 feet of sinking and 267 feet of driving was done.

Cathcart, &c., Party.

The Cathcart, Opossum Gully, and Rhymney prospecting party, consisting of R. Smart (foreman), W. Kelly, T. McCready, E. Webb, J. Mackay, and E. Symons, commenced operations in March in a gully about one mile south from the Port Curtis Lead. Eighteen shafts were bottomed at a depth varying from 5 to 25 feet. The sinking was principally through clay and gravel, with mullocky bottom. The wash where met was a heavy quartz one. In nearly all of the shafts a little gold was obtained. A load of dirt from the shaft in which the best prospect was found, on being washed, yielded 3½ dwt. of slightly water-worn gold. The gully was tried lower down, and prospects that would yield the same average per load were obtained. As it was considered that the existence of several gutters running in a parallel direction containing a little gold had been proved, the camp was removed to another locality. Prospecting was carried on half a mile south of, and

at about four miles north-east of Rhymney's Reef, but in neither of these localities was payable gold obtained. Twenty-four shafts were sunk in the vicinity of Rhymney's Reef, and in most of them was a little gold found, though not in payable quantities. In nearly all the shallow alluvial gullies which were prospected a slight trace of gold was got. From the patchy nature of the country prospected, the foreman thinks there may be gold in payable quantities in some of the gullies he tried unsuccessfully.

Stawell Party.

This party, consisting of A. W. Tucker (foreman), W. Lawrence, E. Parry, D. Garrard, and J. Shelly, proceeded about the end of February to the head of McColl's Flat, and after pitching their tents commenced sinking operations. Near the top hard cement was met with. After passing through coarse sand, a bed of soft granite and a drift of sand overlying quartz gravel, No. 1 shaft was bottomed at a depth of 48 feet, with a good wash, on a soft slate dipping north. On driving to the bottom of the drift and some distance in the opposite direction a few specks of fine gold to the dish were occasionally met with. In No. 2 shaft "soft granite" was struck at a depth of 18 feet from the top, and was bottomed at 50 feet without any gold having been found. Various other shafts were sunk through hard cement without, however, any favorable results being obtained. The country lying between the "Four Posts" and the West Germania and Darlington reefs was then tried. Shafts bottoming at 26 feet and 52 feet, 71 feet and 76 feet respectively, were put down. In one a promising-looking cement wash was met with on the bottom, but in which no gold was found. In another an occasional color to the dish was got from the drift-sand on the bottom, and on driving small patches of gravel-wash were met with from which about 1 dwt. 9 grs. of gold were obtained. Near the Ironbark Ranges various shafts were sunk, and were bottomed on hard cement, in one of which only, at a depth of 13 feet, a fine color of gold to the dish was obtained. As no provision had been made to continue work beyond the end of June, the party at the end of that month received notice to cease operations.

Great Western Party.

This party, consisting of S. Glisson (foreman), F. Blades, J. McOuat, and G. Sargeant, commenced work on 16th April at the Great Western Hill. The first shaft was sunk about 60 chains north-east of the N.E. angle of the township boundary. It bottomed on granite at a depth of 82 feet, the strata passed through being—

5 feet of clay and gravel,	24 feet tight red gravel,
3 feet very hard cement,	16 feet white mullock with brown gravel,
26 feet cemented gravel,	8 feet drift and gravel.

Off the bottom colors only of gold were obtained. At 75 feet water was struck, and throughout more or less timbering had to be done; foul air caused some inconvenience. A depth of 3 feet was sunk in the bottom for the well, and drives were put in east and west from the shaft. The eastward drive was put in a distance of 20 feet through coarse granite with cement on the bottom. For 13 feet colors of gold could be obtained, the remaining 7 feet yielded none. The westward drive was carried a distance of 28 feet, but without yielding gold.

In the same neighborhood, within an area of two square miles, five more shafts were sunk and bottomed at depths of 53 feet, 64 feet, 82 feet, 64 feet, and 75 feet respectively. The geological formation did not differ materially from that given above. At these five shafts drives of considerable length were put in, but at no spot was more than the color of gold obtained.

Between the first or 82 feet shaft and the 53 feet shaft there was a shaft sunk about five years ago ; this the prospectors cleared and timbered throughout, as the ground was very rotten and wet. They put in a drive westward 32 feet, with at first very promising prospects, which, however, gradually diminished to colors only. A cross-drive was put in and a load of dirt taken out and washed ; the yield was only 3 dwt. 1 gr. of gold. The foreman considers "that this find shows that an auriferous lead may exist between the Old Lead, Great Western and the Shakespeare diggings, or a continuation of the Old Lead ; the distance between the two diggings is about two miles." In view, however, of the party's other operations in the vicinity it is doubtful if the prospect obtained in the above drive is sufficient to warrant such an assumption.

The party likewise prospected an area of one and a half square miles about one mile east of Allenvale station. Six shafts were sunk, ranging in depth from 5 to 18 feet. These shafts penetrated clay and gravel, and bottomed on "pipe-clay." At the two deepest shafts (17 feet and 18 feet in depth) colors of gold were obtained. The gully in which they were sunk led into private property, and the party could not further prospect it.

On the western side of the township the party prospected an area east of the Black Ranges and in the vicinity of Tea-tree Creek. The ground proved shallow and granitic. A little gold was obtained in surface prospecting, but none from any of the seven shafts the party sank.

Work was discontinued on the 30th June, up to which date from the commencement of operations the party sank in the aggregate 584 feet, and made drives to a total distance of 264 feet. The great depth of the ground, together with its hard and wet nature, prevented the party from prospecting a larger area.

Landsborough Party.

This party consisted of A. Miller (foreman), W. Phippard, T. Hilton, H. Barnett, and W. Burrell. They began work on the 12th March, after constructing a camp on the east bank of Glenlofty Creek, distant about four miles from Dr. Williamson's Home station.

Within a radius of about a mile seventeen shafts were sunk through cement and gravel strata to a shingle-wash. The depths varied from 13 to 25 feet. At some of the shafts a few fine specks of gold were obtained. From two of the deepest which were sunk on a ridge south-east of the camp short drives were put in, as the washdirt seemed promising ; no payable prospects were obtained.

From the above-mentioned area the party moved to a tract of land situated between Barkly and Darling Flat Diggings. In this area eight shafts were sunk, varying in depth from 27 to 67 feet. "The sinking was mostly through quartz gravel with a sandstone and quartz-wash, and soft pipe-clay bottom." In four of the shafts a layer of very hard cement was encountered at a depth of five feet from

the surface. With the view of ascertaining the width of the wash and depth of the ground, two shafts about 50 yards apart were sunk. They were bottomed at 67 and 54 feet respectively, and though the wash was of a promising appearance it here yielded no gold; in no place was the yield of gold more than a few fine specks. The foreman reported—"We have now sunk right across the wash from one mullock bank to the other, thoroughly testing the ground, both deep and shallow."

The party next prospected Walter's Flat, two miles nearer Frenchman's Diggings. The ground here proved on the average 27 feet in depth, and contained a wash of promising appearance, but very slightly auriferous.

Glendhu Flat was the scene of the party's operations toward the close of the financial year. They camped above the reef that was worked about eighteen years ago. The foreman reported that for the most part the main flat is occupied by selectors. An extensive tract of country exists above the reef referred to, and this was prospected as well as time permitted.

Seven shafts were sunk, varying from 16 to 30 feet in depth. By washing the whole of the washdirt off the bottom of the deepest shaft 2 grs. only of gold were obtained. The other shafts yielded very small amounts.

The party returned to Landsborough on the 29th of June.

Raglan Party.

The members of this party were J. Humphreys (foreman), J. Armstrong, J. Egan, A. Bone, and J. Smith.

They began operations on the 10th of March in a gully at the Langi Kal Kal Ranges, about six miles north-east from Beaufort. In the locality eight shafts were sunk and bottomed at depths varying from 6 to 55 feet. In the deepest shaft a drive was put in. No wash was found, but colors of gold were obtained at several shafts.

The prospectors then moved west to the parish of Eurambeen, and camped about three miles north-west from Beaufort, on the Main Lead. From this point they prospected the gullies lying between it and within a short distance of Beaufort. In the aggregate fifty-seven shafts were sunk, varying in depth from 5 to 19 feet. Except at a shaft that bottomed at a depth of 17 feet, nothing more favorable than colors of gold was obtained. The shaft referred to was sunk in a gully west of the railway, and from it a drive was made which when in a distance of 12 feet cut a wash yielding gold. From the quantity taken out in cutting through it half a pennyweight of gold was obtained. The foreman eventually concluded that it would not pay to work, and reported—"We have not met with sufficient encouragement to spend more time in this locality, the gold being very fine, and in quality very light, that if worked, would not, I think, give payable results."

They next tried ground situated about one and a half miles south-east from Beaufort, and sank seventeen shafts which bottomed at from 12 to 13 feet in depth; only a few of them proved even slightly auriferous.

The party was disbanded on the 30th June.

GIPPSLAND MINING DISTRICT.

North Gippsland Parties.

No. 1 *Party.*

The members of this party were J. S. Kost (foreman), Hugh Waite, Gustav Kremborg, John Buckley, and John McDonald.

The party left Bairnsdale on the 5th of February, and proceeded by way of the Buchan River to the Snowy River, which was crossed near the junction of the Broadbent (Yalmy) River on the 12th of the same month. The party's first camp was made on the Broadbent River at a spot about twelve miles from its junction with the Snowy River, and near the junction of a stream flowing from the north. The alluvial drifts along the low bars of the Broadbent were prospected, and a few specks of fine gold were got at each paddock sunk, but no payable ground was discovered. The land in this locality is well grassed.

The party next camped near to where the Serpentine Creek joins the Broadbent River, and prospected from twelve to fifteen more miles of the river together with its tributaries. Fine colors of gold "were obtained in the loose gravel-drift near the bank of the main stream (the river), but in only one place was as much as half a grain of gold to the dish obtained; here the bed-rock was a soft blue slate." The bed-rock in the river and tributary creeks is a "bluish slate well intermixed with quartz." Very little quartz was visible on the hills.

Leaving the Broadbent River the party pushed eastward to the Brodribb River, experiencing much difficulty in getting through the scrub and fallen timber. On the 7th March the River Brodribb was reached, and crossed a few miles below the junction of the Goongerah River. No alteration in the geological formation was observed in the country passed through with the exception of an intrusion of a small belt of old red sandstone.

A central camp was made, and the foreman estimated the position as fifteen miles south of Mount Ellery, twenty miles from Goongerah station, and fully forty miles distant from Bonang. From the camp the surrounding district was prospected. On the Goongerah River the sinking was through "a gravelly wash with plenty of black sand, and it yielded a few fine specks of gold to the dish." On the River Brodribb a shaft was sunk which bottomed at a depth of 18 feet upon a "yellowish slate;" no gold was obtained. Another shaft was sunk on what appeared to be the old course of the river, and in it the bed-rock—a hard slate—was struck at a depth of 24 feet. Resting on the bed-rock was a deposit of gravel a few inches thick from which "a few fine colors of gold" were procured. All the tributary creeks, and the gullies in the neighborhood, were carefully prospected, but not more than a few colors of gold to the pan were at any place obtained. A large quartz reef was found to run across the head of one of the creeks, but so far as could be ascertained it was not auriferous. Also near one of the creeks the remains of an old camp were seen, but no indications of miners' workings could anywhere be discovered.

The whole area here explored is well watered. The geological character of the valley of the Brodribb is slate and sandstone with much quartz.

The banks of the river are lined with myrtle. On the ranges grow stringy bark and fine mountain ash; in the flats and gullies lightwood, wattle, and fern trees

abound. A few white gum trees of great height and girth grow on the flats. Referring to them the foreman reports:—"I walked along one of these fallen monsters of the forest for eighty-nine yards, and had not reached the end by thirty or forty feet. There are some immense shells of old decayed trees in this locality, and in one of them we found room to pitch a tent, and shelter for all our horses comfortably."

Ferntree Creek, flowing into the Brodribb from the direction of Mount Ellery, was thoroughly prospected. Six large paddocks were put down along its course, covering a distance of about ten miles, but in "no instance was more than a grain of gold to the pan obtained." Two cuts were made across the creek from hill to hill, but to no successful purpose. In a terrace about 30 feet above the level of the creek about a grain of gold to the bucket of dirt off the bed-rock was the best prospect. The little gold found along the course of this creek "is of a scaly water-worn nature."

About ten miles directly eastward from the camp a creek was struck that appears to have its rise near a high conical-shaped peak on the range that trends south from Mount Ellery, about twenty miles distant. The rock through which this creek flows is granite. Certain falls formed by the creek are described as magnificent, and consist of three leaps of 60 feet, 40 feet, and 30 feet respectively. The alluvial deposits did not prove auriferous. The best prospect in this neighborhood was at a dry terrace on the Goongerah, where about 3 grs. of gold to a pan of dirt off the bottom of a large shaft 12 feet deep was obtained.

Returned to their central camp on the Brodribb, the party with much labor cut a track southward to Rich's River, near its junction with the Brodribb. Rich's River was prospected along its entire course, also the terraces and spurs near. Small prospects of gold were here and there obtained, but nothing of a payable amount. The geological formation of the locality is blue slate intersected by quartz veins. Several quartz reefs were found, and generally the sides of the ranges were strewn with quartz debris.

The foreman in his final report of the operations of the party says:—"There appears to be a little fine gold in all the creeks and rivers for a distance of more than thirty miles up and down the Brodribb, but the amount of gold does not seem to be sufficiently concentrated to become remunerative for working. The locality about Rich's Creek is by far the most favorable for prospecting of any we have met with."

The end of June being near by the time the party had finished prospecting at Rich's Creek, the camp was struck, and the march homeward commenced. The river Brodribb was crossed near the site of the camp, and a course as much south-west as possible followed till Orbost station, near the mouth of the Snowy River, was reached. Crossing Snowy River the party "followed the high table-land west of that stream, leaving Mount Tarra to the east, and passing round the head of Lake Nowa Nowa, cut into the Buchan and Bairnsdale road west of Stony Creek, and arrived in Bairnsdale well and without mishap on Saturday afternoon, the 30th June." Mr. Kost, the foreman, remarks:—"The distance from Mount Duffy, south of Rich's Creek, and east of the Brodribb to Bairnsdale, is a little over one hundred miles by way of Orbost station. A good track could be made by way of 'Manero' for stock, avoiding nearly all the mountainous country travelled by the present road by way of Turnback Mountain."

No. 2 (Omeo) Party.

The members of this party were J. Timmons (foreman), P. Cochrane, J. Sandy, C. Woodward, and W. Stewart.

They left Omeo on 13th February, and proceeded west and north to the head of the Cobungra River, which was reached on the 15th. Next day they began to prospect a large alluvial flat near. Two paddocks were put down through about 8 feet of heavy wash, from which colors of gold could be obtained throughout. The bottom rock was not reached, as at a depth of 12 feet the influx of water was too great. Three paddocks were opened on the right branch of the river, which yielded no gold, and five paddocks on the left-hand branch from which colors only were obtained. The eight paddocks all bottomed on slate formation. Other paddocks on each branch were sunk, but with no better success. Some quartz veins were found on the adjacent ranges, but gold was not detected in any of them. The party from this point moved to the high plains at the head of the Bundarrah River. Three of its sources were prospected, but not even the color of gold was found in any of them; the geological formation is granitic. The foreman further reports that the basalt from the Bundarrah to the head of Little River, and from thence round to White's claim, was examined, without any out-crop of wash being discovered.

A move was next made north-westward to a tributary of the Kiewa River; the country proved very rough and scrubby. Several of the tributary creeks of the river were tried, and only small quantities of gold were obtained. Further down stream, at the junction of its east and west branches, other trials were made. Bottom could not be reached on the main stream on account of water and granite boulders, but at several of the tributary creeks a slate bottom was struck that was not auriferous.

Leaving the above locality, a track was cleared to the junction of the Diamantina Creek with the west branch of the Kiewa River. Here several paddocks were put down, but only a few colors of gold were obtained.

The next camp was made at the head of Brandy Creek, where sinking on the spurs under the basalt was prosecuted without success. Several shafts were bottomed, but others had to be abandoned, as the equipment of the party was not suitable for deep sinking.

The party crossed the Dividing Range, and prospected on the Dargo High Plains, where promising prospects were obtained. The foreman reported that some of the "terraces" would pay small wages, but to obtain the requisite supply of water would prove expensive.

On Pic-nic Creek three shafts were sunk, but no auriferous ground was found.

On the spur at the falls of the Little Dargo River the party sank several shafts, ranging from 6 to 12 feet in depth, before they could find the deep ground. Having discovered it, they sank a shaft at its edge, that cut through a heavy quartz and slate wash with patches of cement. Bottom was touched at a depth of 27 feet, and was of sandstone formation. One other shaft was sunk and bottomed at 34 feet. In each shaft a little gold was obtained throughout the sinking, but not in payable amounts at any part.

At this juncture, the weather being unfavorable for further prospecting, the party returned home.

South Gippsland Party.

This party, consisting of Peter Wilson (foreman), F. C. Knyvett, J. Curran, D. Black, and T. Barry, left Foster on the 22nd January. They cleared a pack-horse track from Turton's track northward to the Tarwin River, and here established a camp. On a large stream north of the camp seventeen shafts were sunk, the deepest of which bottomed at 13 feet. In none was even a color of gold obtained. On a branch of this stream ironstone and a black sand were found. All the creeks to a distance of about four miles south-west of the camp were prospected, also those to the north; gold was not obtained at any of them. Colors of gold, however, were found at a branch of the Tarwin River.

A track was next cut along the Tarwin River, and thence to the Morwell River. About two miles south of the Morwell River slate bottom was struck, but no gold obtained. About two miles westward along the course of the Morwell River the geological formation is, the foreman reported, granitic, and in the vicinity colors of fine gold were obtained. The foreman reported that in travelling northward from Stockyard Creek no indications of gold were found till the party arrived within about two miles from the Morwell River. On this line the country changes from a rich agricultural soil, thickly timbered with gums, to a light sandy soil intermixed with quartz, and bearing an inferior timber, undergrowth of native hop, spear grass, and heath. The party prospected portions of the land along the Morwell River, and at the west branch. Colors of gold only were obtained.

The prospectors were instructed to leave the above district, and to prospect south of Foster, in the neighborhood of the Bald Hills, west of the Hoddle Ranges. They camped at a spot about twenty miles south-west of Stockyard, and five miles west-south-west of Frazer's station. The country from Cape Liptrap to the Bald Hills, west of the Hoddle Ranges (being nearly in a north line from Cape Liptrap), was prospected. The bed-rock could not be struck, on account of water and sand, till the party arrived near the Bald Hill, where sandstone rock was reached. Not the slightest indication of gold was obtained on this track. At Bald Hill quartz was discovered, and several leaders were cut, but no gold could be obtained.

In the meantime two creeks in the vicinity of the camp, specified above, were prospected, but no auriferous ground was discovered. On a terrace in the same locality attempts were made to reach the bottom rock, but unsuccessfully. In one shaft, at a depth of 23 feet, a layer of hard cement was broken through, and immediately there was so large an influx of water that the men had to leave the shaft, and in less than two hours the water was welling up and overflowing the mouth of the shaft. The cutting of a drainage tunnel would have entailed an undue expenditure of time, consequently further work on the terrace was not attempted.

The party moved and next camped near a creek (locally known as Dividing Creek), about six miles north of Frazer's station, and sank eleven shafts along the creek, bottoming on slate with quartz wash. Only colors of gold were obtained. On the flat in the neighborhood, fourteen shafts, varying in depth from 4 to 24

feet, were sunk. Quartz wash was found at most of the places tested, but nothing more promising than fine colors of the precious metal was obtained. On the most eastern portion of the flat slightly better results were obtained at one shaft. These prospects were not, however, again secured, although many attempts were made to discover payable auriferous ground in the vicinity.

On a cement hill, about half a mile east from the flat, quartz wash with layers of gravelly cement was discovered, which contained fine gold, equal, the foreman estimated, to about one pennyweight to a horse load of wash. The ground is from 8 to 20 feet deep. At two shafts 50 feet of driving was done, but no payable ground was struck. The ground requires close timbering.

The weather being unfavorable for further work, and the term of service of the party having nearly expired, it was permitted to return, and arrived at Stockyard Creek on the 8th June.

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Castlemaine District, ½ inch to 1 mile.
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Castlemaine Town, 16 chains to 1 inch.
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LIST OF MAPS, PLANS, SECTIONS, ETC., PRINTED AT THE LITHOGRAPHIC BRANCH, GOVERNMENT PRINTING OFFICE.

Name of Maps, &c.	Scale.
Geological Map of Durham Lead	40 chains to 1 inch
Geological Map of Beechworth	" "
Geological Map of Eastern portion of Wooragee Valley	" "
Geological Map of Sandhurst Goldfield	" "
Plan and Sections of Hope Reef, Morning Star Dyke, Wood's Point	120 feet "
Geological Map of Western Port and Cape Patterson Coalfields	100 chains to 1 inch
Four Geological Sections, with Map of Wooragee Valley	Various scales
Twenty-seven Plans and Sections, with Map of Western Port and Cape Patterson Coalfields	"
New Geological Sketch-map of Victoria	16 miles to 1 inch
Plan and Sections of Haddon Lead	Various scales
Plan and Sections of Great Western Gold Mining Company, Maldon	100 feet to 1 inch
Section of Port Phillip Quartz Mining Company, Clunes	200 " "
Plans and Sections of Hepburn Reef, Daylesford	Various scales.
Plans of Dyke and Quartz Lode, Albert Gold Mining Company, Alexandra	"
Plan of Underground Workings of the Brunswick Gold Mining Company, Talbot	1 chn. horizontal and 40 ft. vertical to 1 in.
Plan of Raggedy Gully, Percydale	4 chains to 1 inch
Twelve Lithographs of Fossil Fruits and Seeds	Natural size
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Sandhurst	20 " "
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Huntly	8 " "
Walhalla	10 " "
St. Arnaud	10 " "
Tarnagulla	10 " "
Maldon	12 " "
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Majorca and Craigie	12 " "
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Geological Map of Ballarat Goldfield	40 " "
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Plan—Coast at Spout Creek, near Point Castries	6 " "

Name of Maps, &c.	Scale.
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Section—Tertiary between Boat and Mogg's Creeks, near Airey's Inlet	120 feet to 1 inch
Section—Stony Creek, near Point Castries	45 " "
Sections of Self-acting Shaft Fence	2 " "
Sections of Ayton's Miners' Safety Cage	½ inch to 1 foot
Sketch-sections of Miners' Safety Cage and Shaft Protector	
Section—Tertiary between Stony and Spout Creeks, near Airey's Inlet	120 feet to 1 inch
Section—Shale Beds at Spout Creek, near Airey's Inlet	90 " "
Section—Cliff between Spout Creek and Point Castries	130 " "
Section—Shale Bed, Gum Gully, Wormbete	Sketch
Section—Coal Seam, Gum Gully, Wormbete	"
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Section—Coal Seam, Retreat Creek, Wensleydale	"
Section of Shafts, Nos. 1, 2, and 3, shown on Sketch-plan of Gold Workings on the Glenelg River	40 feet to 1 inch
Sketch-plan showing the Site of the Gold Workings on the Glenelg River	8 chains to 1 inch
Geological Sketch-map of country in the Counties of Dundas, Borung, and Ripon, with two Sections	Various scales
Sections of Davis' Shaft, Cape Patterson, showing Coal Seams, &c.	1 foot to ½ inch
Section showing Lignite Deposit, McKirley's Creek, near Crossover Creek, South Gippsland	20 feet to 1 inch
Section showing the Geological Formations of the Ballarat District in their order of sequence, and Sketch-section illustrating the mode of occurrence of the formations	Sketch
Section of the Band and Albion Consols Company's No. 4 Shaft, and Plan showing the confluence of the Golden Point Lead with a lead from the westward	Various scales
Plan and Sections of the Bunniyong Estate Company's No. 8 Shaft	"
Plan showing the Upper Palæozoic Rocks between Tallarook and Longwood	8 miles to 1 inch
Sections showing the position of the Rocks between Tallarook and Longwood	Sketch
Section of the Sovereign Quartz Mining Company's Works, Whitehorse Ranges, Ballarat	80 feet to 1 inch
Plan showing the position of Freestone Creek, Deep Lead Company's Shaft	60 chains to 1 inch
Plan and Section of the Workings of the Llanberris Quartz Mining Company, Gumtree Flat, Ballarat East	Various scales
Geological Map of the Cape Otway District	100 chains to 1 inch
Geological Map of the Ararat Goldfield	40 " "
Geological Map of Australia, including Tasmania	110 miles to 1 inch

Name of Maps, &c.	Scale.
Geological Map of the Stawell Goldfield (*in progress*)	40 chains to 1 inch
Map of a portion of the Mitchell River Division	" "
Sketch-section from Wahgunyah to Mount Stanley	100 chains to 1 inch
Section of Commercial-street Lead, Stawell	40 chains to 1 inch
Geological Map and Section of Tangil	20 chains to 1 inch
Geological Map of the Foster Goldfield, South-west Gippsland	" "
Plan showing Gold Workings and Dyke, Turton's Creek, South-west Gippsland	" "
Geological Sketch-map and Sections of Mount Tambo and part of Bindi	80 " "
Sketch-section from Bairnsdale to Albury, N.S.W.	8 mls. horizontal and 5000 ft. vertical to 1 in.
Sketch-section from Bairnsdale to Snowy River	4 mls. horizontal and 400 ft vertical to 1 in.
Sketch-section across the Wombargo Mountain from the Limestone River to the Snowy River	4 mls. horizontal and 400 ft. vertical to 1 in.
Plan and Sections of the North Cross Reef Mine, Stawell	120 ft. to 1 in., and 8 ch. to 1 in.
Plan and Sections of the Great Northern Company's Mine, Stawell	4 chains to 1 inch
Plan and Sections of the Carolina and South Scotchman's Mines, Stawell	" "
Sections of the North Scotchman's Pumping Mine, Stawell	" "
Sections and Plan of Levels, Newington and Pleasant Creek Mine, Stawell	" "
Plans and Sections of Albion and South Scotchman's Mines, Stawell	" "
Geological Sketch-map of South-western Gippsland	2 miles to 1 inch
Geological Map of the Creswick Goldfield (*in progress*)	40 chains to 1 inch
Plan showing Coast Line from Cape Howe to Wilson's Promontory	32 miles to 1 inch
Cross-section, North Garden Gully United Company's Main Shaft, Garden Gully Reef, Sandhurst	120 feet to 1 inch
Section showing Fall of Ovens Valley from Bright to Myrideford	Hor. 4 miles to 1 inch Vert. 40 feet to 1 inch
Section showing Bores in the Ovens Valley at Eurobin	Hor. 200 feet to 1 in. Vert. 4 feet to 1 in.
Section showing Bores near Ararat	Hor. 400 feet to 1 in. Vert. 40 chains to 1 in.
Sections of Gift Reef, Bethanga	60 feet to 1 inch
Sketch-section of Tertiaries of Glenmaggie.	
Geological Map of portion of Parish of Glenmaggie, Gippsland	40 chains to 1 inch
Sketch-sections (ideal) near Glenmaggie	
Sketch-sections near Glenmaggie	
Sketch-section showing Upper Tertiaries west of Armagh Reef, Creswick	
Sketch-section showing Lava Flows north of Spring Hill	
Sketch-section showing Lava Flows along Lewers' Lead	
Sketch-section showing Newer Middle and Older Middle Pliocene Gold Drifts	
Sketch-plan showing Middle Pliocene Gold Drifts at Ryrie's Creek	
Sketch-section showing Pliocene Gold Drifts, Mopoke	
Sketch-section showing Railway Cutting at Snake Hill	
Sketch-section of Working Miners' Reef	
Vertical-section of Humbug Reef, at 95 feet below the surface	
Sketch-section of Towler's Reef, and other veins	
Sketch-section—Snowy Bluff to Upper Dargo River	Sketch
Cliff at Wongungarra River	
Sketch-section of the Snowy Bluff	Hor. 40 chains to 1 in. Vert. 200 feet to 1 in.

Name of Maps, &c.	Scale.
Cliff—Snowy Bluff	Sketch
Microscopic Rock Sections	
Junction of the Wongungarra and Wonnongatta Rivers	Sketch
Section along the Reef, Good Hope Mine, showing the Shoot of Gold	320 feet to 1 inch
Sketch-section across the Reef, Good Hope Mine	" "
Diagram of Reef and Dyke, "Little Dorrit Claim," Grant	
Valley of the Wentworth River (from Mount Birregun)	Sketch
Sketch-section from Dargo High Plains to Cobungra River	Hor. 160 ch. to 1 in. Vert. 8000 ft. to 1 in.
Sinnott's Claim, Mayford Spur	Sketch
Diagram Section of Sinnott's Claim, Mayford Spur, Upper Dargo River	40 feet to 1 inch
Valley of the Upper Dargo River (from near Mount Birregun)	Sketch
Snowy Bluff (from the North)	"
Sketch-section from the Mitchell River, across the Granite Hill and the Nicholson River	Hor. 160 ch. to 1 in. (Approx.). Vert. 3200 ft. to 1 in.
Sketch-section across the Granite Hill to Nicholson River	" "
Section illustrating Mode of Occurrence of Rocks near Cape Otway	Sketch
Sketch showing Stratification of Sand Rock	"
Cliffs and Islets west of Princetown, Cape Otway District	"
Geological Sketch-map of portion of Cape Otway District	2 miles to 1 inch
Geological Sketch-plan, Mercer Hill, Newtown and Chilwell, Geelong	10 chains to 1 inch
Geological Sketch-map and Sections of Country near Warburton	80 chains to 1 inch
Sketch-sections (Hope Company's Mine)	
Plan and Sections (Hope Company's Mine)	
Plan and Section of Slide (Hope Company's Mine)	
Plan and Sections of Porepunkah Reef	
Plan showing Christmas Reef Faulted by a Cross Course	
Plan of New Happy Valley Reef in No. 5 Level	
Imaginary Section showing supposed "Throw," New Happy Valley Reef	
Plan showing Faulting of the Old Happy Valley Reef	
Vertical Section showing probable Relation between the Faults and the Old Happy Valley	
Sketch-section, showing mode of Prospecting by Adits	
Sketch (Horizontal) Section of Lodes and Workings, Hope Claim, Ovens River	80 feet to 1 inch
Sketch (Vertical) Section, Hope Claim, Ovens River	" "
Sketch-plan of part of the Hope Claim, Running Creek, Ovens River	
Plan showing Area Prospected by the Mount Buller Prospecting Party	8 miles to 1 inch
Plan showing Area Prospected by the Upper Yarra Prospecting Party	" "
Plan showing Area Prospected by the Moyston Prospecting Party	" "
Plan showing Area Prospected by the Colac Prospecting Party	" "
Plan showing Area Prospected by the South Gippsland Prospecting Party No. 1	" "
Plan showing Area Prospected by the South Gippsland Prospecting Party No. 2	" "
Plan showing Area Prospected by the North Gippsland Prospecting Party No. 1	" "
Plan showing Area Prospected by the North Gippsland Prospecting Party No. 2	" "