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Queensland.

DEPARTMENT OF MINES.

Queensland Geological Survey.
(B. Dunstan, Government Geologist.)

PUBLICATION No. 238.

OUTSIDE MINES OF THE CHARTERS TOWERS GOLDFIELD.

WITH 1 MAP AND 9 PLATES.

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BRISBANE:
By Authority: Anthony James Cumming, Government Printer, William Street
1913.
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Outside Mines of the Charters Towers Goldfield.

1. INTRODUCTORY.

The mining industry of the Charters Towers Goldfield depends for its support chiefly on the mines situated within or in close proximity to the city of Charters Towers. The proclaimed goldfield covers an area of over 800 square miles, and scattered throughout this area are numerous workings for both alluvial and reef gold, which in distinction from those close to the town are known as "outside mines." In the majority of cases these workings are at the present time deserted, and have been little more than "scratchings" in the oxidised stone of small auriferous quartz lodes. There are, however, many exceptions in which work has taken place on a more extensive scale in mines now abandoned as well as in some now in operation. Departmental work in connection with questions of land settlement in the country surrounding Charters Towers having entailed a visit to the "outside mines," the opportunity has been taken to place on record some of the geological features of the mines as well as of the country.

2. PREVIOUS REPORTS.

The Charters Towers Goldfield was reported on by Dr. Jack in 1878,* reference being made to some of the reefs included in the term "outside." The same writer also reported† in 1883, on the Mount Leyshon workings. The latter place, as well as the Livingstone reefs, were visited also by Mr. Rand‡ when travelling from the Cape River to Dreghorn. A detailed geological§ map of the immediate vicinity of Charters Towers resulted from the work of Messrs. Jack, Rand, and Maitland in 1893, but both this, and some notes by Mr. W. E. Cameron,‖ published in 1909, deal only with the "inside" mines. Some

§ G.S.Q. Publication No. 342.
notes on some outside mines, by Mr. E. J. Laun, Assistant Inspector of Mines, appeared in the *Queensland Government Mining Journal* for March, 1911, and these constitute the only recent literature dealing with the outlying portions of the field.

3. General Geology.

The greater part of the Charters Towers Goldfield consists of granitoid rocks, which form the country rock of almost all the auriferous reefs. As is to be expected over so large an area, these rocks vary considerably in chemical constitution, with attendant variation in their physical nature. Usually a fairly acid hornblende granite, one finds all grades between a highly acid rock carrying little or no ferro-magnesian mineral, and one composed almost entirely of hornblende. In some localities mica, usually biotite, replaces the more usual hornblende.

Considerable areas occur of the more basic rocks which show little or no quartz, and these weather usually into a rich black clayey soil, while the more acid types produce, according to their lessening percentage of ferro-magnesian constituents, red and light coloured soils of a poorer quality.

Intruded into the coarser-grained country rock are numerous fine-grained dykes, both acid and basic. The former, owing to their greater powers of resistance to weathering, are very noticeable on the surface, but are probably not more abundant than their less acid associates.

The relationship and distribution of these various classes of igneous rocks could only be determined by a close geological mapping of the field, a lengthy undertaking over so large an area, and one which would necessitate a previous feature survey, since the present maps are exceedingly sketchy where not actually devoid of information.

The detailed mapping close to the town, done by Messrs. Jack, Rands, and Maitland in 1892 and 1893,* led them to the opinion that the granitoid rocks of varying basicity shade off indefinitely one into the other, and that they are thus contemporaneous as well as not sufficiently well-defined to be satisfactorily indicated upon the map.

The country surrounding Charters Towers gives one the impression, as a rule, of a similar gradual variation in what is physically the same rock, though occasionally a sharp change can be noticed, possibly due to by their labours, Messrs mapping a somewhat co and basic, the latter, ac ages. The acid dykes are one instance he found an truding the basic rock. acid dykes intersect som ones. The present writer trace the relationship of t goldfields, but the gener similar to that of the cour

be noticed, possibly due to faulting. In the restricted area covered by their labours, Messrs. Rands and Maitland succeeded in mapping a somewhat complicated system of dykes, both acid and basic, the latter, according to Mr. Rands, being of two ages. The acid dykes are usually intruded by the basic, but in one instance he found an acid dyke both intruded by and intruding the basic rock. Mr. Maitland also remarks that the acid dykes intersect some and are intersected by other basic ones. The present writer's work was not sufficiently detailed to trace the relationship of the dykes in the outlying portions of the goldfields, but the general geological structure appears to be similar to that of the country rock of the inside mines.

While almost all the rocks of igneous origin in the Charters Towers Goldfield are of plutonic or intrusive types, volcanic rocks occur at and near Mount Leyshon and to the south of the confluence of the Broughton with the Burdekin. Mount Leyshon was considered by Dr. Jack to be a volcanic neck, and the fine-grained felspathic rock, of which it is composed, markedly elastic in some places, bears out his view of its origin. The range of hills south of the Broughton confluence is composed of somewhat altered rhyolite and of breccia consisting mainly of granite fragments. This breccia is well exposed also in the banks of the Broughton and Burdekin near their junction.

In regard to the age of the volcanic activity represented by these rocks, no evidence is forthcoming beyond the fact that it is more recent than the granite which supplied the fragments for the breccia and forms the surrounding country.

Besides the igneous rocks, some masses of mica schist and other metamorphosed rocks, considered to be of sedimentary origin by the previous writers, occur near the city and in the southernmost part of the field. To the south of Mount Leyshon these rocks are of considerable extent, and may, perhaps, prove to be altered rocks of volcanic origin, being fine-grained and of a felsitic nature.

That part of the goldfield lying to the west of Southern Cross Creek is almost entirely covered by a stratum of sedimentary rock, which in most places is obviously formed from the detritus of the underlying granite, and consists usually of angular and subangular quartz grains embedded in an aluminous matrix. It is often markedly ferruginous, while the proportion of quartz grains varies greatly, up to what is an ordinary
slightly aluminous sandstone. Though usually fine and sub-angular, the quartz is sometimes well rounded and may include fair-sized pebbles.

At its edge, this formation usually stands out in prominent escarpments over the granite country, and these escarpments seldom, if ever, show a thickness of more than 100 ft. of the sandstone.

The boundary, however, is not always well marked, and, where, as is often the case, the soils resulting from the decomposition of the sandstone and granite are similar, the boundary can only be placed between the visible outcrops, possibly miles apart.

Numerous outliers of this formation occur scattered over the goldfield, and their distribution has been indicated on the accompanying map.

Near the precipitous escarpments (known locally as "walls") there is usually little or no soil upon the surface of the aluminous sandstone, which weathers frequently into forms resembling to a certain extent the solution-weathering of limestone. Away from the escarpments the soil, as already mentioned, is similar to that of the granite areas. While the ordinary forest trees of the latter are also found on the sandstone, where the soil is similar, the poor soils close to the escarpments are occupied usually by lancewood (Anacardium oxycarpum) scrub. The growth of lancewood on sandstone country, and not on the underlying rocks has been referred to by Dr. Domin, and it is remarkable how one finds it only upon arenaceous rocks near Charters Towers, as well as in many if not all other localities. In the absence of an actual outcrop, this tree thus forms a safe indication of the rock beneath.

In one locality, near Dillon Creek, fragments of quartz showing gold have been discovered in the sandstone formation, derived from a vein, which has, since the writer's visit, been discovered by tunnelling from a shaft sunk through about 30 ft. of the sandstone into the granite beneath. In at least three localities (The Warrior, Little Red Bluff, and Micklethorpe leads) alluvial gold has been obtained beneath the sandstone which appears to have been deposited on an uneven surface similar, probably, to the present undulating surface of the granite country. In the case of the Little Red Bluff (of Dr. Jack's naming) the lead passes under a small but very prominent mesa of the sandstone, having an

Plate 1

LITTLE RED BLUFF.
area on the summit of perhaps a quarter of an acre. The gently rising granite ridge to the immediate north is of greater elevation than the summit of the sandstone mesa. The absence of any traces of this rock from the higher hills elsewhere in the goldfield is in contrast to the occurrences of the Desert Sandstone which usually caps the higher ground in the localities where it occurs, and to which formation some of the Charters Towers rock has been referred.

At Rishton, on the Burdekin, a somewhat similar but more gravelly rock forms mesas of lower elevation than the usual type, while a similar gravel at Sellheim, also close to the river, gives one the impression of being an old alluvium of the Burdekin. Isolated patches of sandstone occur, separated by short intervals, from Rishton eastwards to within a few miles of Ravenswood. A similar extension of the sandstone "walls" occurs from that constituting the Bluff on the south-eastern boundary of the goldfield, to near the Burdekin at St. Paul's Station. The Bluff is at a greater elevation than the Rishton sandstone, but another residual close to the old Brooks alluvial diggings is intermediate in position and elevation, showing that the Rishton occurrence, though differing somewhat lithologically, is probably part of the same stratum.

South-west from Southern Cross the railway passes for many miles over country presumably underlain by the sandstone exposed near Southern Cross and Powlatharga Lake. With the exception of occasional inliers of the underlying rocks, the sandstone probably extends to the Cape River Goldfield, as it appears to be identical with the deposit mapped by Mr. Rands in his Cape River report as alluvial. It certainly includes some of this as well as some areas mapped tentatively by Mr. Rands as Desert Sandstone. At the Cape River Goldfield, Mr. Rands separated this alluvial formation from the sandstones of the Dividing Range and Betts Creek, which he, as well as Dr. Jack, considered to be Desert Sandstone (Upper Cretaceous), though it had been found to include shale beds bearing *glossopteris* impressions. Mr. A. Gibb Maitland* considered also that two distinct formations are present, that of the *glossopteris*-bearing beds of pre-Cretaceous, probably Jurassic age, and another of Desert Sandstone. Mr. Maitland's Desert Sandstone certainly includes some of Mr. Rands' alluvium. A recent visit of the present writer to the Cape River led him to the opinion that there was there only the one series of sandstones, and that the

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alumina, or Desert Sandstone of Pentland, and near Mount Remarkable, which resembles to a certain extent the Charters Towers "walls," is really one with the ordinary sandstone of the dividing range and the glossopteris-bearing beds, whatever age they may eventually prove to be. The distance is too great to consider, without a closer examination of the country between, that the Charters Towers rock is certainly identical in age with that of the Cape River, but, it does not seem improbable that this is the case, although some of the Charters Towers outliers give the impression of being comparatively recent in origin, and were considered so by Dr. Jack.

The mode of occurrence of the aluminous sandstone in a thin sheet, and where ferruginous the character of the rock itself as seen in the neighbourhood of Charters Towers, suggests many of the features characteristic of the Indian laterites of the more arenaceous types.*

Like the Indian, the Charters Towers rock is obviously in part, if not altogether, of sedimentary origin, though in some places, such as near Dillon’s Creek, where included angular fragments of arenaceous quartz have not travelled from the site of their parent reef, the rock must have originated practically in its present position from the decomposition or alteration of the granite.

The essential distinguishing feature of the rock termed laterite is considered to be the presence of free alumina. A careful chemical examination of two samples of the Charters Towers rock was made by Mr. F. E. Cownie, F.I.C., of the Government Analyst’s Department. The analyses showed that there is no appreciable quantity of free alumina present, while there is more than sufficient “combined” silica to satisfy the total alumina. The partial analyses were—

<table>
<thead>
<tr>
<th></th>
<th>No. 1</th>
<th>No. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ferric Oxide</td>
<td>8.6 per cent.</td>
<td>4.9 per cent.</td>
</tr>
<tr>
<td>Alumina</td>
<td>227 &quot; &quot;</td>
<td>211 &quot; &quot;</td>
</tr>
<tr>
<td>Silica</td>
<td>59.6 &quot; &quot;</td>
<td>62.6 &quot; &quot;</td>
</tr>
<tr>
<td></td>
<td>99.9 &quot; &quot;</td>
<td>99.7 &quot; &quot;</td>
</tr>
</tbody>
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Though the Charters Towers rock can thus scarcely be considered a laterite, in character and mode of occurrence it presents many features similar to the sheet laterites of India, and in its mode of formation pre-rock does to a satisfactorily.

The Charters Towns bold features. The gra of the field weathers us sessing a gentle slope t Burdekin itself, as not appearance of maturity, penplain. The only maturity are the coals in short rapids possessi of any really extensive expect to find in an ance.

Prominent above tl great height, stand out resistant rocks, sometim hills, sometimes conic Mount Leyshon and iDhominent on the field, a volanic materials.

The outliers of su height, owing to their w position in the topogr command.

Old as is the appen are steep and valleys in sandstone area to the we of which may be due, a to Powlathanga Lake, † Dr. Danes says, the shall of a tributary valley by though his reasons for a to the lake are not so may be due to warping between the tograph; the granite country, is powers of the two rocks. town, the sandstone to

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† Australian Association of the Physiography of Proc. Royal Bohemian Societ.
mode of formation presents many of the difficulties that that rock does to a satisfactory explanation.

4. Topography.

The Charters Towers Goldfield does not possess any very bold features. The granite constituting so large a proportion of the field weathers usually to a gently undulating plain possessing a gentle slope to the Burdekin or its tributaries. The Burdekin itself, as noted by Mr. W. Poole, B.A.,* has the appearance of maturity, the neighbouring country of an ancient peneplain. The only features of the river not suggesting maturity are the occasional rocky bars over which it passes in short rapids possessing falls of 4 or 5 ft., and the absence of any really extensive deposit of alluvium, such as one would expect to find in an ancient stream of its dimensions.

Prominent above the peneplain, though otherwise not of great height, stand out a few scattered “moondnocks” of more resistant rocks, sometimes in the form of rough but rounded hills, sometimes conical boulder-strewn granite pinacles. Mount Leyshon and the neighbouring hills are the most prominent on the field, and are formed, as already stated, of volcanic materials.

The outliers of sandstone, though only some 100 ft. in height, owing to their wall-like margins, take a more prominent position in the topography than their actual height would command.

Old as is the appearance of the granite country, its slopes are steep and valleys narrow when compared with those of the sandstone area to the west of the goldfield, the gentle inclination of which may be due, as suggested by Dr. Danes† in reference to Powlathanga Lake, to a warping of the earth’s crust. As Dr. Danes says, the shallow lake is evidently due to the damming of a tributary valley by the alluvium of the main Balifes Creek, though his reasons for attributing a former much greater extent to the lake are not so evident. While the gentle inclinations may be due to warping, it is also possible that the difference between the topography of the sandstone, as compared with the granite country, is merely due to the different weathering powers of the two rocks. As seen from Towers Hill, close to the town, the sandstone to the west forms a horizontal stay line,

* Australian Association for the Advancement of Science, Brisbane, 1909.

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contrasted with the undulating granite peneplain, whose monotonous is broken by scattered monadnocks and sandstone outliers backed by the outline of distant ranges.

5. DEPOSITS.

With the exception of the alluvial deposits and of Mount Leyshon, all the mines worthy of the name in the Charters Towers Goldfield, are situated on quartz reefs of the ordinary fissure lode type. The reefs are frequently branched enclosing horses of the country rock, while the occurrence of parallel reefs in proximity to one another is a common feature. The reefs strike in all directions in different parts of the field, though there is a tendency in some localities towards a parallelism, a tendency most marked to the south-east, where the Upper and Lower Lighthouse, Livingstone and Pinnacle reefs practically all have an east and west strike. In dip the reefs vary from nearly horizontal to perpendicular, but the majority lie at between 35° and 55° from the horizontal.

In the lode the veins of auriferous quartz and metallic sulphides are usually associated with a greater or less width of dark “formation,” enclosed often by well-defined walls. This formation occasionally has a sheared structure, when the material simulates a soft slate. The presence of basic dyke rock is not infrequent in the lode material, but evidence is wanting to show that this has had any influence on the deposition of gold. Both acid and basic dykes are common in the neighbourhood of the gold-bearing reefs, but as they are probably equally as numerous away from the known reefs, there is at present no real reason to suppose any connection between them and the later formed reefs, though possibly a closer examination might make this evident.

The tendency exhibited by the quartz veins to split into hanging and footwall branches in the lode formation, or to form branches of lodes in the country rock, is in places very pronounced. An examination of such workings as are now accessible shows a still more marked tendency on the part of those controlling the mines to follow one lode, or even only one wall of a lode, for considerable distances without doing anything in the nature of crosscutting in either direction.

As a reasonable amount of crosscutting is surely one of the first principles of intelligent mining, and is more than usually demanded by the nature of the lodes in the Charters Towers Goldfield, its almost total absence cannot be too strongly condemned.

The auriferous quartz in the immediate vicinity of the mines is oxidised ore carries a surface deposit of iron and oxidised ore. The proportion of these two adsorbed metals being usually 5 to 1, a view of the deposit is usually obtained from purely local experience, as is the case in the area in question. The “buck” quartz in the adjoining Ravenswood Gird, however, they are mostly in the worked, and are thus in the case with the main lode.

Areas of valuable gold-bearing lodes, denuding exposed ore, have been “blown” of speculation whether they are of great width, ascertain whether the deposit is not more favourably placed.

The depression exist “inside” mines of Charters Towers, attending the working there has led many people to the belief that the future support of the mines is numerous, and many companies are now in a state of depression, until they are ready to look forward to the future. There is, however, no time which can compare reefs which have been, a perfect field. Until such a field is reached, the inside mines should be developed as at present.

6. THE MARY LOU AUCTION FROM CHARTERS TOWERS.
Goldfield, its almost total absence from so many of the workings cannot be too strongly condemned.

The auriferous quartz veins of the outside reefs in the unoxidised ore carries a varying percentage of "mineral," consisting of iron and copper pyrites, galena, and zinc blende. The proportion of these sulphide minerals is usually regarded as an indication of its gold content, stone carrying little or no mineral being relegated to oblivion as "back." While this view of its poverty is usually correct, the fixed idea prevailing that an outcrop of such quartz is not worth testing results from purely local experience, and is not in accord with occurrences in other places. There exist many large outcrops of "back" quartz in the Charters Towers, as well as in the neighbouring Ravenswood Goldfield, and it is worthy of note that they are mostly in the vicinity of other reefs which have been worked, and are thus in auriferous localities.

Areas of valuable quartz are by no means unknown in the best gold-bearing lodes, and such stone, bad the vicissitudes of denudation exposed it on the surface, would certainly have formed a "blow" of white quartz. It is thus a matter for speculation whether the "back" reefs now exposed, many of them of great width, are not worthy of a little testing, to ascertain whether the white quartz continues in depth or gives place to a more favourable reef.

The depression existing lately in the mining industry in the "inside" mines of Charters Towers, together with the success attending the working of the Cumberland and Stockholm mines, has led many people to consider that the outside mines will be the future support of the field. The outside reefs are certainly numerous, and many of them will in all probability prove remunerative to work. There is thus every likelihood that they will continue to support a considerable number of miners. There is, however, no outside reef being worked at the present time which can compare in size or continuity with those "inside" reefs which have been, and still are, the mainstay of the Charters Towers Field. Until such is discovered, one cannot confidently look forward to the outside reefs supporting the population, should the inside mines not continue to afford the same employment as at present.

6. THE "OUTSIDE" MINES.

The Mary Lou and Mary Lou United, about three miles from Charters Towers, are working a small and almost flat vein,
50 ft. deep, in a rock composed almost entirely of hornblende. The reef, though small and usually not of great value, contains patches of very coarse leaf gold. Some very handsome specimens have been obtained both of the leaf gold and of gold on native arsenic. The hornblende rock is seen in contact with the ordinary granite country in both claims, but the vein has not so far been sought in the granite, and it is thus not known whether it continues payable in it.

*Cumberland P.C.* is an old mine reopened, with conspicuous success, in 1908. An underlie shaft has been sunk 335 ft. on an incline of 50° to the north-east. At the time of the writer’s visit the No. 2 level to the south-east was the only one connecting with an old underlie shaft 220 ft. from the new one. The depth of the old shaft was not known at that time, the old workings not being accessible, though these have since been cleaned out, with, it is reported, satisfactory results. In the No. 2 north-west level the reef is thrown 15 ft. to the hanging-wall by a crosscourse. It then branches into two, the hanging-wall branch continuing in the same direction, while the footwall branch strikes almost east and west, with a much flatter dip to the north. Both reefs vary greatly in quality and up to perhaps 3 ft. in thickness. The footwall branch joining the other above the third level, only one reef is known below that, though possibly it may have continued through into the hanging-wall. The footwall branch has been worked down to a fault, beyond which it has not been picked up, and which cuts it off a little above No. 3 level. A winze 25 ft. below No. 3 level was showing 2 ft. 6 in. of good stone. Beyond the slide which cuts off the footwall reef the No. 3 level turns somewhat to the left, and exposes a vein of fair looking mineral stone in granite walls, though the dark “formation” further back leaves one in some doubt as to whether the main reef should not be sought in the hanging-wall. The bottom (No. 4) level west was 128 ft. from the shaft, with more or less quartz all the way, though not of the size, nor apparently of the same high quality, as that obtained higher up. In the end it was split into several small leaders in a great thickness of dark “formation.” Since reopening, the mine has produced (up to December, 1911) 4,715 tons, valued at £34,359, an average of £7 5s. 8d. per ton.

About 900 ft. to the east of the Cumberland shaft the *Cumberland East* are sinking a vertical shaft to test the same reef at an estimated depth of 200 ft. On the western side the *Cumberland No. 1 West* have sunk a vertical shaft 110 ft., at
which depth there is 6 in. to 1 ft. of formation dipping slightly to the south-east. From 55 ft. in the vertical shaft an underlie of 45° has been sunk 65 ft. to the north-north-east. Some stipping from this underlie, only the upper portion of which was accessible, produced stone worth about 12 dwt. per ton. A vein of 6 in. of quartz underfoot was being tried at the time of my visit.

The Cumberland and Golden Ant is situated on a reef parallel to the Cumberland reef, but some 11 chains to the south-west. To the south-east of the underlie shaft of 300 ft. no ore of value has been exposed. The levels driven north-west met ore close to the shaft, and, after a blank and crossecourse, for about 40 ft., before meeting another crossecourse 80 ft. from the shaft. This stone, about 8 in. thick, has been stipped out, and the continuation of the reef is being sought beyond the crossecourse. Judging by the smaller crossecourse already passed through, as well as that in the Cumberland, the reef is to be sought in the hanging-wall.

The Cumberland Grove is another small mine on a parallel reef to the south-west of the Cumberland and Golden Ant. At the time of the writer's visit the shaft was down 70 ft. on the underlie, but had not succeeded in finding payable stone.

The Golden Bar and Golden Spider are claims situated to the south-east of the above workings, probably on the Cumberland and Cumberland and Golden Ant reefs respectively.

The Stockholm, the property of the Brilliant P.C., is the best equipped of the outside mines and is connected by a short branch line with the main Northern Railway. The Stockholm reef, on which the original workings were situated, has been worked out to below the 800-ft. level, not being payable much below that depth. This reef runs in a north and south direction, dipping to the east. The present workings are on a branch reef which runs east and west, dipping to the south. The work is carried on by means of an underlie from the 800-ft. level, the latter being connected with the vertical shaft. In the bottom of the underlie, which is over 1,000 ft. in vertical depth and is being sunk still further, some ore is showing, while in a drive to the east near the bottom, over 3 ft. of stone is exposed. The reef as seen elsewhere in the mine is extremely irregular, and on that account apt to be misleading on a first acquaintance. The profitable nature of the mine can best be judged by the satisfactory
returns, the mine producing during 1911, 10,517 tons, worth £35,554.

At the Black Jack, a mine that became prominent by its success in 1887, the Peter and Jack Company are working a small reef in the hanging-wall of the old workings. This was discovered by a fall of ground, and is an excellent example for the former management of the folly of not crosscutting to test the ground in either wall.

The Swedenborg is another old mine which has been re-opened after many years of idleness. Except near the surface, the timbering has been found in good condition, and the company in this respect have been very fortunate. It was hoped that the old workings would contain ore left by the former proprietors on account of its refractory nature, but which would be payable with modern methods. A careful examination of the mine in connection with an application for Government assistance to erect a battery showed that there is not likely to be more than 800 tons of quartz already developed, while how much of this would be payable no sampling or other work has been done to determine. The disappointment in this result is not alleviated by the fact that, with the exception of the No. 2 level, none of the ends show payable stone nor was any showing in the shaft at the lowest accessible depth. While it is quite possible that further driving, sinking, or crosscutting might result in developing fresh ore, it must be borne in mind that the former company sank the shaft over 475 ft. and drilled numerous levels for an output of only 1,375 tons and 3,552 oz. of gold. Considering the area stoped with the tonnage crushed, the thickness of the reef must have averaged only about 8 in., so that unless fresh discoveries are much bigger, only stone of a high quality will pay the development expenses.

The Labour Victory, formerly the Try Again, situated near the site of the old Southern Cross battery, was about to be closed down at the time of the writer’s visit. The owners, a small syndicate of working miners, found the water too heavy and the ore not rich enough to make it profitable for them to continue the work, since the shoot of richer ore they had been stopping was cut off by a fault. In general appearance the reef gives a very favourable impression, and it seems a pity that it should be necessary to close the mine. The reef is bigger than in most of the “outside” mines, and is encouraging for further work. A feature of it is the existence of quartz in the well-defined hanging-wall as well as in the vertical shaft the mine of a crosscut. One can I desirability of such work previous management allowing a well-defined hang

The Warrior Pup Uni No. 2 West are working on and dips to 30° west of x thickness in the Warrior P 6 in. of stone in about 3 shaft. The Warrior is a b of east, and a little work i workings.

At the Republic and 6 two reefs are being worked workings. The stone is a reef opened so far is very s

At the Mabel Jane mix near the Mount Leyshon x 90 ft. through old workings rocks, both acid and basic, 80 ft. to the south-east, but not the mine has been closed do

The Mabel Jane 1 and same reef varying here up shaft (30 ft. vertical and 1 made at about 110 ft., and a during sinking, yielded 213

About two miles south has recently produced some is being sunk on the reef v and during this work the oth filled with water, so that the new shaft has not yet met of the shaft bears testimony

At Mount Leyshon trub old Mount Leyshon com an of the mountain, while the G the stone in two cuttings no
hanging-wall as well as in the foot, while, with the exception of
the vertical shaft the mine is devoid of anything in the nature
of a crosscut. One can hardly imagine a mine in which the
desirableness of such work could be more obvious, though the
previous management appears to have been satisfied with fol-
lowing a well-defined hanging-wall.

The Warrior Pup United, Warrior King, and Warrior Pup
No. 2 West are working on a reef which runs 30° north of east
and dips to 30° west of north. It varies up to 2 ft. 6 in. in
thickness in the Warrior Pup, while in the No. 2 West there was
6 in. of stone in about 3 ft. of formation in the bottom of the
shaft. The Warrior is a back reef which runs about 50° north
of east, and a little work is being done on it, chiefly in the old
workings.

At the Republic and Golden Dot, on the Upper Broughton,
two reefs are being worked by parties of miners close to old
workings. The stone is said to be rich, but in both places the
reef opened so far is very small.

At the Mabel Jane mine, situated on the Upper Broughton,
near the Mount Leyshon road crossing, a shaft was sunk about
80 ft. through old workings on a small reef in hard fine-grained
rocks, both acid and basic. A level driven from the shaft for
80 ft. to the south-east not disclosing any encouraging features
the mine has been closed down.

The Mabel Jane 1 and 2 East (Hooper Brothers) is on the
same reef varying here up to 18 in. in thickness. In the main
shaft (30 ft. vertical and 110 ft. on the underlie) the ore first
made at about 110 ft., and a crushing, said to have been obtained
during sinking, yielded £13 per ton.

About two miles south of this Gregory's New Try Again
has recently produced some excellent crushings. A new shaft
is being sunk on the reef which dips at 65° to the north-east,
and during this work the other workings (60 ft. deep) are partly
filled with water, so that the best of the ore cannot be seen. The
new shaft has not yet met the shoot of ore, but the character
of the shaft bears testimony to Mr. Gregory's faith in his mine.

At Mount Leyshon tributers are getting a little ore from the
old Mount Leyshon company's workings on the north-east side
of the mountain, while the Golden Horn Company are quarrying
the stone in two cuttings near the summit of the mountain on
the south-west side. The geological features of this interesting auriferous deposit have been well described by Dr. Jack and Mr. Rands in the reports already referred to, and no fresh features have been exposed by the recent work of the Golden Horn Company, except perhaps that the felspathic rock interspersed by auriferous ironstone veins is not quite so brecciated as appears to have been the case on the other side of the mountain. As was the experience in the old workings, so too in the Golden Horn it has been found that the stone only carries gold when traversed by the ferruginous veins and joints, the stone elsewhere being devoid of values.

At the time of the writer's visit a tunnel was being driven in the side of the mountain 100 ft. below the quarry, with the combined purpose of prospecting and providing a means of introducing the milling system of open-cut working. The tunnel was then in 200 ft. and nearly under the quarry, and was expected to meet the auriferous body at any time. The rock in the end of the tunnel was harder and more porphyritic in structure than that exposed in the quarries. At present the ore is quarried in the ordinary way and trucked out to an open shoot leading direct to the mill hoppers.

The battery consisting of twenty 1,250-lb. stamps is driven by a suction-gas engine. Originally it was proposed to cyanide the sands, and an up-to-date cyanide plant was installed with the battery, but subsequent operations have shown that the sands are not sufficiently rich to be worth treating, consequently the cyanide plant is not in use.

The water supply during the dry season forms one of the difficulties with which the management has to contend, since it is necessary then to pump water from the Clarke River over two miles from, and some 550 ft. below, the battery.

Great interest centres in the welfare of the Golden Horn Company in its enterprise in undertaking so low grade a proposition, and its success in reducing costs to so low a limit is an example in mining and metallurgy to the rest of Queensland. If the development work continues to prove the ore to be of a high enough grade to yield a profit on working expenses, the immense body of stone available certainly renders this company's operations the most important to the mining industry of all the "outside" mining ventures.
Since the common end of July, 1912, the tons for a return of £1

At the Great East Mount Leyshon, a shaft of a shoot of ore was still partial a few degrees north of received a good deal of nature, though it is in the ore was still partial a few degrees north of received a good deal of nature, though it is in

The Welcome reef, of old workings. Own the workings could not be ten attending to a c. direction 25 north of w

The Grafter is not abandoned.

In the early days of an earlier discovery the paratively important mi producing a considerab of the writer's visit, Blucher's Victory, Strick place the reefs were for the examination of the reefs. A reef in the New E's, the possibility of others of the workings. This by previous owners in the to note that something is the ground on either side

Blucher's Victory is worked from the sur tical shaft of 56 ft, and level (96 ft. vertical de part of the old workings the underlie to 206 ft. ve 30° to the south. Lev west at 165 ft. (No. 3) ar
Since the commencement of operations in April, 1911, to the end of July, 1912, the Golden Horn Company has treated 40,254 tons for a return of £13,695, an average of 6s. 9½d. per ton.

At the Great Eastern, on Puddler Gully, to the south of Mount Levshon, a shaft being sunk to prospect for the continuation of a shoot of rich ore previously worked had not succeeded to a depth of 140 ft. in finding any ore of a payable nature, though it is interesting to note that even at that depth the ore was still partially oxidised. The lode runs in a direction a few degrees north of west, and, judging by the old tips, has received a good deal of attention.

The Welcome reef in the same vicinity also shows a long line of old workings. Owing to the holders of the one claim being away attending to a crushing at the time of the writer’s visit the workings could not be inspected. The lodes run in a direction 25 north of west.

The Grafters is another line of old workings at present totally abandoned.

In the early days of the Charters Towers Field, Broughton, an earlier discovery than Charters Towers itself, was a comparatively important mining centre possessing two batteries and producing a considerable tonnage of rich stone. At the time of the writer’s visit, only three mines were in operation—Blucher’s Victory, Struggle, and New Esperanza. The relative position of the reefs worked in these three mines, as well as an examination of the reefs themselves, more particularly the complex reef in the New Esperanza, cannot fail to impress one with the possibility of others occurring in either hanging or footwalls of the workings. This possibility appears to have been ignored by previous owners in the Victory and Struggle, but it is pleasing to note that something is now being done in the Victory to test the ground on either side of the workings.

Blucher’s Victory is situated on the old Victory reef which was worked from the surface many years ago. The present vertical shaft of 56 ft., and the underlie down to below the No. 2 level (96 ft. vertical depth) are, according to Mr. J. Carroll, part of the old workings. The present company has continued the underlie to 206 ft. vertical depth on the reef, which dips at 30° to the south. Levels have also been driven east and west at 165 ft. (No. 3) and west at 200 ft. (No. 4).
About 45 ft. on the underlie above No. 3 level a shoot of ore was met with which has now been stoped out. It extended both above and below the No. 3 west level for about 140 ft., and above the No. 3 east for 40 ft., with an average depth on the dip of the lode of some 60 ft. This shoot, the only payable ore found by the present company, produced 763 tons, valued at £4,577.

Under the No. 3 west level a branch reef was worked in the footwall, but a crosscut of over 50 ft. failed to find it and was driven in very hard country. The No. 3 east level has been driven over 170 ft. and a crosscut 20 ft. into the footwall 60 ft. from the shaft. In the end of the level the ground is very broken and contains occasional patches of heavily mineralised quartz.

It is proposed to continue this level another 200 ft., if necessary, at which point it will be to the dip of some old workings (Jessop’s) which are reputed to have given very handsome returns in the early days. As the surface workings seem to show a converging reef, it is intended to crosscut at the end of the 200 ft., and it would certainly be a pity if this is not carried out.

In the Struggle, an old underlie shaft has been repaired. At 155 ft. and 185 ft. on the east side of the shaft a little ore was stoped, but it has not been found beyond a fault in both levels, probably because driving so far has followed the fault which forms a well defined wall. The 300-ft. west level, 120 ft. long, shows ore in places, but insufficient to encourage the syndicate to continue operations.

In the New Esperanza Wood and party are working a very flat reef lying under that mined in the old workings. Numerous other reefs and heads dipping in various directions are known, showing the fissuring of the country rock in this locality to be somewhat complicated.

Like Broughton, Riehton has been in the past the scene of greater mining activity than is displayed at the present time, particularly about twenty-five years ago when an English company was working several reefs in this locality and had a battery crushing the ore on the spot. At present, claims worked by two parties or, rather, two families, are the only mines in active operation. The reefs are numerous, and, though mostly small, some of the workings must have been on reefs of considerable magnitude to judge by the mullock tips and other "remains."
Plate 8

STRUGGLE MINE, BROUGHTON.

Plate 9

NEW ESPERANZA, BROUGHTON.
On the Cardigan road, just outside the south-eastern boundary of the goldfield, two parties are at work on a small but remarkably long and uniform reef, on which the deepest working is only 30 ft. In the two claims working—the *Lord Cardigan* and *Silver Queen*—the reef is not over 6 in. in thickness, but its great length (it is said to be traceable for three miles) gives it an interest it would not otherwise possess. The two claims are about half a mile apart, the *Silver Queen*, as the name indicates, having considerable silver value in addition to the gold.

*Pierce's Double Event*, situated at the Upper Lighthouse, has a shaft down 84 ft. on an almost vertical ledge. The shaft has been filled for 10 ft. up to the bottom levels which have been driven east and west for distances of 40 and 35 ft. respectively. The ground has been stoped out above the eastern level till near the end. In the last 15 ft. in the floor of the level the reef averages six or seven inches of heavily mineralised stone. In the western level the reef has been stoped out above as well as in places below the level. Neither the end of this nor of another level to the west at 30 ft. in the shaft show any ore; the end of the level going east at 30 ft. is obscured by a fall of ground. The prospecting of this mine has been greatly hampered by the very heavy inflow of water which mostly enters in the eastern levels. That the quality of the ore obtained was good is shown by the fact that a crushing of 6 tons 6 cwt. from the western bottom level returned £18 10s. 5d.

The Double Event is situated on a long line of old workings which are probably on a continuation of the old Upper Lighthouse reef worked largely about a mile to the west of the Double Event.

*Alluvial Workings.*—Besides these reefs, a little alluvial gold is still being won, mainly by old-age pensioners, at the old Brooks Diggings and on the numerous alluvial deposits in the neighbourhood of Mount Leyshon.
Permission has been granted by the University of Queensland Library and the executors of the estate of Dr Elizabeth Nesta Marks for display of Outside Mines of Charters Towers Goldfield on the SERF website.

CRICOS No. 00213J
GEOLOGICAL SKETCH MAP
OF
CHARTERS TOWERS GOLDFIELD

Showing position of "outside" mines

TO ACCOMPANY REPORT

BY E. O. MARKS, B.A., B.A.I.
ASSISTANT GOVERNMENT GEOLOGIST.

Granitoid Rocks □
Altered sedimentary Rocks □
Volcanic □
Lateritic Sandstone □

Scale of Miles

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