

from the main Wiluna belt, which lies a few miles to the eastwards. The point at which it bifurcates cannot, however, be seen owing to the covering of sedimentary rocks.

The Wiluna greenstone area* commences a few miles to the S.E. of Mt. Keith. It runs N.N. Westerly in a narrow zone through Kingston to near the "Quartz Blow" on the Lawlers-Wiluna Road. There the Western boundary swings round to the W.N.W. to Diorite Well on the Wiluna-Nannine Road. It then turns northwards again and is seen at intervals underlying the sedimentary series, as far as Thadunganna Pool on the Gascoyne River. This is not the northern limit of the belt as greenstone hills were visible to the North of the pool. There is a marked change in the type of rock in this belt to the Northwards of Wiluna. At Wiluna and to the Southwards of that place large areas are occupied by indurated schists traversed by acid and basic dykes and there are numerous quartz reefs and also a large number of bands of ironstone which coincide with the general strike of the country, and I am of opinion that many of these ironstone outcrops are the capping of lodes some of which may prove to be auriferous. To the Northwards of Wiluna the rock is all of the massive type and there are but few quartz reefs and those seen appeared to be of a particularly hungry character.

What may be called the Barlows belt† lies about thirty miles to the East of Wiluna. At Barlows it is only about five miles in width but from here the Western boundary turns to the West North-West to the May Queen Leases from which point it turns to the North-West and the belt finally pinches out about fifty miles to the North West of Barlows. This belt runs in a narrow zone South Eastwards from Barlow's to a point about five miles South of Maitland Peak (or Mt. Joe as it is known locally). Here it widens out considerably to the Westward but turns back on its original course again at Beats Well on the Sir Samuel-Barlow's Road. Southwards from this point the belt is about 12 miles in width and it extends Southwards beyond the limits of my travels in that direction.

Mining has been carried on in three localities on this area.

1. In the vicinity of Collavilla.
2. Around Barlow's, and
3. At Bronzewing.

All the leases have, however, been abandoned.‡ None of the old workings were accessible, but from what I could gather from a surface examination I formed the opinion that few of the reefs worked were of any width, and a want of linear continuity appeared to be characteristic of all of them.

Throughout this belt there are a large number of bands of ferruginous quartz-schists and these all conform to the general strike of the country, viz., a little to the West of North.

The Northern point of the most Easterly belt§ lies a little to the West of Long. 121deg. 30min. in Lat. 26deg 24min. S. This area runs in a general Southerly direction past the Stirling Peaks and Mt. Carnegie to beyond the Erlistoun Creek. Its Southern limit was not reached by me. A little prospecting work has been done in the vicinity of Mt. Eureka, but none of the country seen gave much promise of becoming important from a mining point of view.

The country between these greenstone belts is occupied by granite of which there are several types. These will be fully described in the detailed report to be written later.

The most interesting geological feature seen during the season's field work was the large area of sedimentary rocks occurring in the vicinity of Charles Wells Creek and Lake Carnegie| these consist of sandstones, shales and limestones. This sedimentary formation, on its Western and Southern edges rests upon granite and outliers of this latter rock are seen in places in the Princess Range. At the Northern boundary of the sedimentary area the beds are seen resting unconformably upon the upturned edges of the belt of metamorphic slates which were fully described in Bulletin 39§. The basal beds consist of soft fine-grained sandstones overlain by grey and blue shales as the belt is followed Eastward thin bands of limestone, about an inch in thickness, are seen interbedded between the shales. A series of excellent sections of these shales and limestones were seen in a traverse made down Charles Wells Creek. As the Creek is followed eastward the limestone beds become thicker and more numerous and near the crossing of the Wongawall track a bed of limestone about five feet thick was seen. The shales and limestones are overlain by coarse flaggy sandstones and

quartzites. These latter form isolated hills and rough broken ranges and the quartzites are invariably found on the tops of these. These are of no great thickness and represent sandstones indurated by the deposition of secondary silica drawn to the surface by capillarity. This surface induration is quite common throughout the interior of the State, in fact it is only rocks seen in cliff sections that are not more or less indurated. The amount and direction of the dip in the beds forming the sedimentary series described above varies in different localities. In some places they are almost horizontal and the greatest angle at which the beds are inclined is about twenty degrees. This latter dip, however, is seen only in the vicinity of faults or local folds of which a few were seen. The mean dip of the beds is about 5deg. and the prevailing direction is to the North-East.

These sedimentary rocks extend far beyond the limits of my travels to the Eastward, and it would be of interest to have their extension in that direction mapped as there may be a possibility of artesian water being found near the centre of the area. This, however, would not be of much value as the area described is watered by numerous large water holes and springs, and water of good quality can be obtained at a shallow depth by sinking.

The area mapped during the season's field work embraces portions of the Lands Department Lithos. Nos. 52/300, 53/300, 60/300, 61/300, and 71/300.

A series of the limestones were submitted to Mr. Etheridge, of the Australian Museum, and in one of them [12505] from a locality seven miles South of Wongawall, on the East Murchison Goldfield, this gentleman recognised "in the less dense portion there is certainly a queer half obliterated polygonal structure which to my eye, may be the remains of a coral, such as a minute *Favosites*, but it is altogether too problematical to speak definitely."

The Northern Portion of the Kalgoorlie Goldfield.

Mr. Feldtmann mapped in detail an area at the extreme Northern end of the productive portion of Kalgoorlie, so far as at present understood.

In the course of this work some important data have been brought to light, as set out in the digest, which Mr. Feldtmann has prepared:—

From the beginning of the year until the 30th April I was engaged in completing the field work for the first section of this work, which included roughly that portion of the field which lies to the North of the Kanowna railway line and East of the Menzies line, embracing about one square mile, taking in the Golden Zone, Mystery, and Kapai lines of lode.

Surface features including shafts were surveyed by means of the tachometer, which appears to be an ideal instrument for work of this nature, and were mapped on a scale of 100 feet to the inch. A careful examination was made of such underground workings as were accessible and where no mine plans were available these were drawn on a scale of 50 feet to the inch.

Outcrops within the area mapped being chiefly conspicuous by their absence, accurate mapping of geological boundaries was a matter of some difficulty and for this I had to rely mainly on the underground work.

General Geology.—The results of the detailed examination showed the area to consist for the most part of rocks of gabbroid or doleritic origin, now largely represented by amphibolite, which forms the country rock of the Golden Zone line of lode. On the Western side the amphibolite is generally of fairly coarse grain, carrying a large proportion of felspar. There is also a considerable extent of rock forming the country of the Mystery and Kapai lines of lode composed chiefly of talc and chlorite, possibly representing a more highly altered portion of the amphibolite.

Of later origin than the amphibolitic rock is a pale grey or pinkish rock consisting largely of albite felspar which occurs for the most part in dyke-like masses. This rock has been classified as a quartz-keratophyre; it intrudes the previously mentioned rocks and would appear to be closely connected with some of the ore bodies, particularly along the Mystery line of lode.

Lateritic deposits are common within this area, several being of considerable thickness and containing a high percentage of iron.

The lower lying country is for the most part covered by soil of no great depth.

Ore deposits.—The line of lode which runs through the New Reefers, Golden Zone, and Napoleon Leases, is of different character to the formation of the central and eastern portions of the map. It is composed chiefly of silica, which has metasomatically replaced the country rock along a line of shearing. It averages from two to four feet in width.

* Lands Department Lithos., 52/300, 61/300 and 71/300.

† Lands Department Lithos., 52/300 and 61/300.

‡ The existing leases at Collavilla are on the granite area to the West of the main greenstone belt.

§ Lands Department Lithos., 61/300.

§ Geological Survey Bulletin No. 39, Perth: By Authority, 1910.

The main formation which runs through the Mystery and adjoining leases consists chiefly, in the oxidised zone, of kaolinic material, and is of considerable width; it contains numerous veins and stringers of quartz, striking across the lode, which generally carry values. There is also a series of flat tourmaline-bearing quartz veins which as a whole, are non-auriferous. Stringers and lenses of ironstone are common in the oxidised zone. It is possible that much of the gold in the upper levels is of secondary origin.

The Kapai or eastern line of lode is closely associated with one of those haematite-quartz rocks generally known as "jasper bars" which are so common on these goldfields.

But little gold is found in the haematite-quartz rock itself, the best values being obtained from cross leaders of quartz running roughly at right angles to the "jasper," and also in kaolinic material on the walls of the latter generally on the Western side.

As in the case with the Mystery line of lode, the Kapai line appears to owe much of its gold contents in the oxidised zone to secondary concentration, and neither appear to present the same possibilities at depth as the Western line.

The fieldwork in connection with the second section of the work was commenced on the 8th August. This section will complete the detailed examination of the North End of the field. Since the above date, my attention has been mainly devoted to the mapping of surface features generally.

This portion of the work was completed early in December, and the examination of the underground workings was then commenced.

The Country between Kalgoorlie and Coolgardie.

With the object of linking up mining centres, Mr. Honman mapped, in a more or less broad way, an area between these two centres, and brought several important facts to light. This officer summarises his work in the preliminary report which is as follows:—

A—Binduli mapped in detail, comprises an area of 16 square miles, extending two miles north of Binduli Railway Station, and three miles south of the same, and in an easterly and westerly direction from the Kurrawang conglomerate ridge, to within four miles of Kalgoorlie. Mr. C. G. Gibson, a former officer of the Survey, has already mapped the area in a broad way, and his classification of the rock areas is entirely confirmed by the detail work done last year. Mr. Gibson divided the rocks into two groups, viz.:—Porphyries and Sedimentaries. The Sedimentary Rocks occupy a considerable area of the country under review, about eight square miles. The topographical features compose a conglomerate ridge bearing 340° and running across the Coolgardie road at 16 miles 30 chains from Coolgardie, also a ridge of massive porphyry and schists bearing 325° to 330° crossing the railway line near the Binduli Railway Station. The general slope of the country is to the South where it terminates in breakaways and salt lakes. Two miles north of the Railway Station the country attains its highest elevation, and is very sandy; it falls very gradually northwards for many miles, and culminates in salt lake country; it consists of sand covered with mallee and spinifex.

The office work is not as yet far enough advanced for the formation of any final conclusions as regards the geological structure and history of the area, but the following features are brought out by the field work:—

The strike of the bedding planes does not necessarily coincide with the strike of the schistosity or cleavage.

The presence of conglomerate schists and slates in the porphyry area. The slates are apparently interbedded with the schistose porphyry.

The sedimentaries outside and west of the porphyritic area have a consistent dip to the west at a high angle, which becomes more pronounced in a westerly direction.

The conglomerate formation is persistent right across the area and the conglomerate series is at least half a mile thick.

There are two systems of fissuring in which quartz veins have formed:—

- (a.) Vertical coinciding with shear and cleavage planes caused by pressure at right angles to the strike of the cleavage.
- (b.) Flat, though with a slight southerly; the fissures are small and discontinuous.

The quartz veins occur both in the schists and the massive porphyry. In both they have been found to carry gold which from report averages about 10dwts. to the ton, but the veins are small and the porphyry is too hard to enable them to be worked profitably.

B.—An area between Coolgardie and Kalgoorlie.—This comprises 350 square miles and has been mapped broadly with the object of bringing out the structural relations of the different rocks.

The topographical features are controlled by the geological formations. The greenstone areas which occupy about 100 square miles are characterised by hilly country composed of long rugged hills with their longer axes coinciding with the dominant strike of the rocks which varies from 300 deg. to 340 deg. The granite and porphyry areas compose prominent rises characterised by flat-topped bosses of granite and porphyry. The sedimentary rocks with the exception of the conglomerate and quartzite occupy the depressions and flanks of the ridges. The conglomerates north of the lake which stretches from near Boulder towards Coolgardie form two well defined parallel ridges which are two miles apart and represent the eastern and western legs of the huge syncline. These encroach on the lake country which extends for about 14 miles in a south-westerly direction from M.H.L. 47E to within 7 miles of Coolgardie. This lake is separated from Hannans Lake by a prominent greenstone ridge and it is three miles wide in places. The northern margin of the lake is bounded by breakaways which in places exhibit excellent geological sections, while the southern edge is composed of sandhills and a white powdery deposit locally known as "Copi." The area comprises four main groups of rocks:—Sedimentary, Greenstone, Porphyry, and Granite.

No opportunity has yet occurred of definitely working out the relative ages of the respective rock groups, but when the necessary office work is more advanced the facts observed in the field can be properly studied and correlated. At the present stage the following statements can be provisionally made:—

An important syncline exists between Coolgardie and Kalgoorlie about 8 miles wide, the axis of which is very close to the Kurrawang Railway Station. The syncline has a strike of 340 deg. and if anything pitches very slightly to the North. The presence of this syncline suggests that the country is composed of big folds whose bedding planes have been destroyed by great lateral pressures producing schistosity and cleavage.

The Binduli porphyries persist with an almost uniform width for 24 miles passing through Wongi and are associated with sedimentary beds.

The conglomerates can be followed for over 15 miles along their strike.

Where the porphyries abut the greenstone rocks to the east they contain large phenocrysts of orthoclase which weather out in perfect crystals up to 1½ inches long.

Greenstone bands occur in the sedimentary rocks close to Mungari Railway Station, which make into a larger greenstone formation to the South striking 340 deg. and becoming wider while connecting with the greenstone area of which Mt. Herbert and Mt. Marion form prominent hills in the Hampton Lands and Railway Syndicate's Location 53.

Granite is intrusive into the sedimentary series and has transmuted those in close proximity into micaceous and chistolite schists. This has given the Coolgardie rocks a strike bearing more to the west of north than the main sedimentary area. It is probably to this intrusion that the highly metamorphosed state of the sedimentary rocks and the great abundance of tourmaline in the whole area is primarily due.

A greenstone area occurs at the western end of Location 53 and is probably continuous with that at Coolgardie.

A study of the conglomerates in the field shows conclusively that the bedding of the rocks is independent of the schistosity or cleavage, the elongation of the pebbles corresponding with the latter.

The whole area is intensely metamorphosed resulting from lateral pressure exerted in an easterly and westerly direction, and accentuated, if not actually caused, by the granite intrusions at the 8-Mile on the Coolgardie Road and at the Water Reserve 2956 in Location 53.

Petrological Work.

A brief synopsis of the results of the Petrologist's work during the year is given in his own words below:—

Most of the results of the year's work in detail either are now in the press or have already been issued in Bulletin form. Little more, therefore, is called for in these pages than a brief statement of the broad facts elicited in the examination of the rocks from the various districts. The more important localities from which specimens have been collected during the year are as follows:—

- The North Coolgardie and East Murchison Goldfields.
- The Kanowna Main Reef Line.
- The North End Kalgoorlie Field.