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ANNUAL PROGRESS REPORT

OF THE

GEOLOGICAL SURVEY

FOR THE

YEAR 1932.

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1933.

*Annual Progress Report of the Geological Survey of Western Australia
for the year 1932.*

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Annual Progress Report of the Geological Survey for the Year 1932.

Under Secretary for Mines.

I have the honour to submit to you, for the information of the Hon. the Minister for Mines, my report on the work of the Geological Survey for the year 1932.

STAFF.

The personnel of the staff remained unchanged during the year under review, and still remains at two field officers, one technical assistant, and a messenger.

FIELD WORK.

Government Geologist.—During the year, in addition to the ordinary routine work, I was absent on 11 occasions making field inspections. As these inspections were made mainly for departmental information, the reports are not submitted for publication, but for reference purposes are listed as follows:—

1. Inspection of Gold Prospecting Areas at Yindiding Creek, Toodyay District.
2. Inspection of New Gold Finds on Edwards' Farming Area 450, nine miles south-west of Cockatoo Tank; also Reynolds' Find, Block 58, lying some ten miles north-east of Bullfinch, Yilgarn Goldfield.
3. Inspection of O.P.A. 236H with regard to a sample of Stinkstone (Stinkstein) found in a Lime Deposit on Boolardy Station, Murchison District.
4. Inspection of the Water Supply for Mining Treatment Purposes at Ora Banda, Broad Arrow Goldfield.
5. A Second Inspection of the Mines in the Ora Banda District, Broad Arrow Goldfield.
6. Inspection of the Paringa Gold Mine, Kalgoorlie.
7. Inspection of Cameron and Paulson's Gold Mine on Mt. Stuart Station (Wyloo), Ashburton Goldfield.
8. Inspection of the State Battery, Ravensthorpe, including Inventory of the Copper Separation Plant and Inspection of Ore purchased for the Ravensthorpe Smelters.
9. Collecting further evidence for Dr. Herman, including the Revision of the Collie Map and Sections.
10. Inspection of the Boring at Lancefield, Mt. Margaret Goldfield.
11. Inspection of the Reported Find of Mineral Oil at Yarloop, South-West Division.

The number of enquiries for geological information, particularly regarding gold mines, and the demand for bulletins and maps is still maintained, and if the present demand for publications continues several of our much sought-for bulletins will be completely out of print.

F. R. Feldtmann, Field Geologist.—During my absence on leave in the early part of the year, Mr. Feldtmann dealt with the more important enquiries from the public and with a few cases on proposed alienation of lands.

The far greater portion of his time was taken up in preparing maps and a written report on the western portion of the Golden Mile. This report is now nearly completed.

F. G. Forman, B.Sc., Assistant Geologist.—From the 19th-28th April Mr. Forman accompanied me on a reconnaissance of O.P.A. 236H. From the 12th September-10th November, he carried out a reconnaissance survey of O.P.A. 235H and parts of adjoining O.P.As. to the south. From 13th-21st December he was engaged in inspection work at Mt. Magnet and Boogardie.

The remainder of Mr. Forman's time was taken up in the office. His report on the Warburton Range Area was completed about the middle of August, the delay in its completion being due to the difficulty in obtaining the service of a petrologist to carry out certain sections of the enquiry. Apart from the time taken up in writing reports on his other field work, Mr. Forman also assisted with the assembling of the collection of minerals and ores, now on exhibit in the main hall at the Mines Department, and with the re-arranging of the Departmental Library.

CLERICAL WORK.

F. Armstrong, B.Sc., Technical Assistant.—In addition to the ordinary routine work and interviewing the general public, Miss Armstrong has this year assisted with the assembling of the Mineral Exhibits at the Mines Department and at the Royal Show.

The work of cataloguing, by cross reference, the articles in both current and back numbers of the publications dealing with Australian Geology has been continued; also the cross-indexing of the rock and mineral collection. In addition, the Library has been re-arranged.

To assist those searching for maps and reports published in bulletin form, Miss Armstrong has compiled a wall map of the State indicating in colour the area or centre described in each bulletin with the number of that bulletin clearly marked, so that the particular bulletin dealing with any part of the State can be seen at a glance. It has been so arranged that where an area or part of one is reported on in more than one bulletin, each has a distinguishing colour and its number.

A similar map showing the localities for reports published in the Annual Progress Report is nearing completion.

PETROLOGICAL WORK.

With the exception of the special case of the rocks from the Warburton Range Area, which were reported on by Mr. R. W. Fletcher, B.Sc., the remainder of the determinations was carried out by Miss Armstrong.

The summary of Mr. Fletcher's report is attached hereto, and it is to be hoped that later on Mr. Forman's full report with the petrology will be published in bulletin form.

PALAEOLOGICAL WORK.

As in former years, we have been again indebted to Miss L. Hosking, B.A., of the Department of Geology of the University of W.A., who has gratuitously made determinations of any specimens collected in the field from various localities throughout the State.

The reports or summaries of the work done in the field by the members of the staff, except when written for departmental purposes only, are attached hereto.

In conclusion, I take this opportunity to express my appreciation of the work and loyal support of the members of the staff during the past year.

T. BLATCHFORD,
Government Geologist.

16th March, 1933.

1.—CONCLUSIONS OF REPORT ON A RECONNAISSANCE SURVEY OF THE COUNTRY LYING BETWEEN LAVERTON AND THE WARBURTON RANGES.

(F. G. Forman, B.Sc.)

That part of the country between Thatcher's Soak, near Mt. Shenton, and the junction of Hughes and Elder Creeks, near the Warburton Range, is occupied by sediments of the Wilkinson Range Series, except for a small patch of highly metamorphosed rocks, which outcrop in the vicinity of Minnie Creek, about sixteen miles east of Mt. Shenton.

The area in the Warburton Range District described in G.S.W.A. Bulletin 75 as being occupied by greenstones, which were considered to be the equivalent of the greenstones of the Western Australian Goldfields and therefore to be placed in the Kalgoorlie Series, is now shown to be occupied by a series of metamorphosed sediments and interbedded basaltic flows or sills which it is believed can be correlated with the Nullagine formation.

This series has been named the Townsend Range Series because the series of that name, described in Bulletin 75, constitutes the upper portion of the formation as now mapped.

The sedimentary portion of the series consists of conglomerates, grits, quartzites, sandstones and shales, which exhibit various degrees of metamorphism from entirely recrystallised and chloritised rocks to others which are almost unaltered.

The basic rocks occur as flows or sills interbedded with the sediments. The basalts are of three types—spilites, greenstones, and epidiosites—which are intimately associated and are considered by Mr. R. W. Fletcher, B.Sc., who undertook the petrological work in connection with the recent investigation, to represent different phases of the one magma. Spilites from the vicinity of the Charnley and Isdell Rivers and epidiosites from Synnott Creek in the Kimberley Division are remarkably like some of the Warburton Range spilites and epidiosites. These rocks from the Kimberley occur as flows or sills interbedded with sediments, and are probably of Nullagine age.

The porphyries, which occupy a considerable part of the Warburton Range area are now regarded as sills intercalated with the metamorphosed sediments and basalts of the Townsend Range series. Almost similar rocks occur as sills in the Nullagine formation at Bamboo, Pilbara Goldfield.

The Townsend Range series, subsequent to the intrusion of the porphyry sills, has been thrown into a series of broad folds along axes with a general east-west trend.

Micropegmatites and granites in the vicinity of Mt. Squires are considered to be co-magmatic with the sill porphyries, and are mineralogically dissimilar to the older granulites and granites which border the Townsend Range series on the north and extend eastward towards the South Australian border.

From the conclusions reached in Bulletin 75 that the "Greenstone" areas in the vicinity of the Warburton Ranges probably belong to the Kalgoorlie Series, the hope was justified that payable gold deposits might ultimately be found within these areas. The conclusions reached in the present investigation considerably reduce the economic mineral possibilities of the area, as no large gold-bearing lodes or reefs have yet been discovered in rocks of the Nullagine formation in any part of the State. There is an undoubted possibility of finding gold in the conglomerates of the Townsend Range series, but deposits of this character would be almost certainly of low grade and quite unworkable for many years to come in such a remote region as the Warburton Ranges.

The possibilities of the discovery of deposits of copper, lead, or other economic minerals are no brighter, and on the present evidence the Warburton Range area cannot be regarded with favour as a potential mineral field.

WATER HOLES AND SOAKS BETWEEN THATCHER'S SOAK AND ELDER CREEK.

Thatcher's Soak at the starting point of the traverse is a stoned and covered well. It has been known to dry up in severe seasons.

Bildbit Soak at PB.16 is a large soak in the bed of a small creek tributary to Minnie Creek. It is apparently of a permanent character.

At PB.17 there is a large pool in Minnie Creek from which a copious supply of water was available when seen by us. It was, however, rapidly drying up when seen on the return journey, and, like the many other pools in Minnie Creek, would be useless except for a few months after heavy rains.

Eurothurra rock hole at PB.41 is a gnamma hole of about 200 gallons capacity situated on a low stony rise to the south of the track.

Beegul rock holes consist of two holes in the bed of a small watercourse at the top of a breakaway cliff on the south side of the track. Their position is marked by two caves in the low cliff of the breakaways in which are many aboriginal drawings. The total capacity of these holes is probably 400 gallons.

Gnamal rock holes at PB.55 are marked by a sharp northward turn in the track over a low gravelly rise. Their capacity when full is about 250 gallons.

At PB.75 water is obtainable at a depth of 2ft. 6in. in lake country.

Buldya Soak at PB.84 yields a good supply of potable water. On being cleaned out and slightly deepened water entered as springs from the sandstone bottom. If timbered and deepened a very good supply would be obtainable.

Nullye Soak at PB.95 is situated in the bed of a shallow watercourse flowing from the north and crossing the track. The soak or water hole is about five chains up the creek.

Tugaila gnamma hole at PB.101 consists of two holes with a total capacity of about 200 gallons, situated near the base of a gravelly rise on the east side of a wide grassy flat and thirty chains north of the track.

Terhan gnamma hole at PB.117 has a capacity of 200 gallons and is situated on a low gravelly rise in the middle of a wide flat.

Babool gnamma holes at PB.131 consist of two large holes with a capacity of about 700 gallons. These holes are on a laterite rise in a patch of mulga on the western edge of a long stretch of sandhill country. The holes are situated on the north side of the track just before it passes into the sandhill country to the east.

Whalgu gnamma holes at PB.143 have a capacity of about 300 gallons and situated at the base of a breakaway facing the east and on the south side of the track.

Muggan gnamma hole at PB.153 is situated on the south side of the track, where it makes a sharp turn to pass over a gravelly rise.

Narratha rock holes at P.B.158 consist of several gnamma holes, lying along the edge of a westerly facing breakaway. They are marked by a wide flat on the north of the track and ending abruptly against the breakaway cliffs. The two larger holes have a capacity of from 300 to 400 gallons.

Manunda rock hole at PB.177 is situated at the base of an isolated patch of breakaway country and at its eastern end.

Yowalga rock holes at PB.181 consist of two gnamma holes with a total capacity of about 400 gallons and situated on a low gravelly ridge bordering the track.

At PB.195 the track crosses a dry watercourse in a north-south trending valley. A little water is obtainable here by digging in the sandy bed of the dry creek.

Gahnda rock hole is situated in a watercourse near the top of a breakaway ridge immediately to the east of the wide valley just mentioned. When seen by us it held about 1,000 gallons of water, but if cleaned out would hold at least 10,000 gallons when full.

Winduldarra rock hole at PB.210 has a capacity of about 1,000 gallons and is situated in a watercourse trending westerly out of breakaway cliffs, about ten chains to the north of the track, where it gains the top of the breakaway ridge.

Babbagoola gnamma holes at PB.223 have a total capacity of about 400 gallons and lie about five chains to the south side of the track, where it takes a sharp northerly turn to gain the crest of a breakaway ridge.

Gnawlbath at PB.226. By digging in the sandy bed of the creek where it passes through a narrow gap between the breakaways on either side, a good supply of water is obtainable.

At PB.235 are the Weeljarra rock holes. These are three in number and have a total capacity of perhaps 300 gallons. They are situated to the north of the track on the edge of an easterly facing breakaway.

Korndiggurra gnamma holes, two in number with a total capacity of about 100 gallons, are situated right on the track at PB.236.

Milesia well at the junction of Hughes and Elder Creeks at PB.256 is in the bed of Elder Creek and appears to be permanent.

Few of the above-mentioned waters could be relied on to be serviceable at the end of the dry season, as the rock holes without exception were very low on our return journey at the end of September, 1931. It must be admitted, however, that the holes had been used by four parties during the season, so that they were heavily drawn on. Offset against this is the fact that at the beginning of the season all the holes were filled following on the exceptionally good rains. The large hole at Ghanda may possibly be permanent.

Of the soaks only those at Bhildbit and Buldhya appear to be of a really permanent character. The wells at Thatcher's Soak and Milesia may also be classed as permanent in ordinary seasons.

WATER HOLES AND SOAKS IN THE WARBURTON RANGE AREA.

At the junction of Warburton Creek and Elder Creek at the west end of the Warburton Range there are two soaks in the bed of the larger creek.

Gombugurra well is a native well in the bed of Elder Creek three miles north of the Warburton Ranges.

About a mile above where Scamp Creek comes out from amongst a mass of rough granite hills, and ten miles north of the Warburton Ranges, there is a small rock hole about sixty chains up a small tributary watercourse on the right bank of Scamp Creek. The junction of this watercourse with Scamp Creek is marked by a tree blazed P.B. 273.

At Spring Granite (Beelorro-Coonabaroo), discovered by Sir John Forrest in 1874, there is a large rock hole on the east side of a bare granite outcrop. This hole would hold water for a long time.

A similar rock hole on a granite outcrop lies two miles eastsoutheast of Spring Granite. It is known to the natives as Windarro, and should hold water for a long time.

In the bed of Hughes Creek, about six and a-half miles above its junction with Elder Creek and close to a rocky hill on the right bank, there is a native well which would require cleaning out before being of much use.

On the southern side of the chain of hills joining Cassidy Hill and Mt. Herbert, and two and a-half miles east of Cassidy Hill, there is a soak (Gaminah) in the bed of a small watercourse, which yields a good supply when dug out.

In the bed of Lilian Creek, about half a mile above where it passes through the gap in the Townsend Range, there is a native well (Choogidda), which yields a copious supply of water.

Weelgryne Spring is situated in a rough and deep gully, difficult of access for camels, on the southeastern slope of Mt. Eveline. The spring is about twenty chains above where the watercourse enters the flats.

Nundull rock hole is about one mile west of Mt. Esmé in a small rocky watercourse on the southern slope of a porphyry hill. There is a larger and much broader gully immediately to the east, between the rock hole and Mt. Esmé. This soak was almost dry when visited by our party.

A good rock hole (Brellyalee) with some soakage is situated at the eastern end of a line of rocky hills about two miles east of Mt. Elvire.

At Barlee Springs there is a good soakage in the bed of a sandy creek flowing southwesterly from a

mass of rough porphyry hills. The soak is situated just below the point where the creek issues from a low rocky gorge. This soak is capable of being deepened and appears to be reliable.

Meewajarra soak lies about two and a half miles southwest of Cairn H.P. 41 on the western side of the Barrow Range, opposite a wide gap at about the middle of its length.

Winburn Rocks gnamma hole lies on the eastern side of the Barrow Range, about six miles east of the Cairn H.P. 41.

Bilbring rock hole lies at the base of a bare granite outcrop about thirty-five chains south of the Cairn H.P. 42 on Lightning Rock.

Of the above-mentioned waters only the rock holes at Spring Granite, Windarro and Brelyalee, and the soaks at Choogidda, Gamminah, Weelgryne and Barlee Spring can be considered as possibly of a permanent character.

2.—SUMMARY OF THE PETROLOGICAL REPORT ON THE ROCKS FROM THE WARBURTON RANGE AREA.

(R. W. FLETCHER, B.Sc.)

The Warburton Range Area consists of a folded series of fragmental rocks, comprising shales, mudstones, sandstones, grits and conglomerates, with intercalated acid and basic flows and sills which have in places completely metamorphosed the sediments.

The basic sill or flow rocks include three important types which outcrop repeatedly, due to folding, throughout the area. These are the Spilite (abitised basalt), Greenstone (chloritised basalt), and Epidosite (epidotised basalt) types respectively. Certain rocks, described under the heading "Miscellaneous Rocks," represent single limbs of folded flows or sills outcropping south of the Warburton Range only.

The three principal types are characterised by amygdaloidal structure which is particularly well-marked in the spilites and epidiosites. The greenstones are coarser in grain and less amygdaloidal, so that they appear to represent the more central portions of flows or sills. All three are similar to each other in micro-texture and mineralogical constitution but they differ in mineral proportions. The principal minerals are albite, chlorite, epidote, amphibole, iron ore, leucoxene, calcite and quartz. In the spilites, albite, iron ore and leucoxene are very abundant, while chlorite, epidote, calcite and quartz are more frequently found as amygdules; in the greenstones, chlorite, amphibole and epidote are the common minerals; and in the epidiosites, epidote is far in excess of the other constituents. All three types have well-defined plexal fabrics, the laths consisting principally of albite (in the spilites), chlorite (in the greenstones) and epidote (in the epidiosites).

In view of the field association, and the general similarity in structure, micro-texture and mineralogical constitution, it is considered that the three types represent phases of the same magma. The differentiation was probably caused through circulating solutions and gases during the final stages of consolidation.

An attempt has been made to correlate these basic rocks with similar rock types from other parts of Western Australia and sufficient evidence obtained to prove definitely that the Warburton Range rocks are more closely allied to the basic flows and sills of

the Nullagine formation in the Kimberley and North-West Divisions, than to any other known rock series in Western Australia.

The acid sill rocks include a variety of porphyries such as felspar-porphyry, quartz-felspar-porphyry, granite-porphyry, granophyric-porphyry and biotite-rich-porphyry. It is impossible to determine petrographically whether these types are all phases of the one sill or whether they represent several different sills, for they are all more or less similar in composition. The principal differences, those of texture and structure, are due to different rates of cooling, and to different degrees of mechanical deformation which occurred during the final stages of crystallisation. The minerals of the porphyries belong to three stages of development, the phenocryst stage (quartz, alkalic felspar, iron ore and green mica), the groundmass stage (quartz, alkalic felspar, micas and iron ore), and the hydrothermal-pneumatolytic stage (quartz, biotite, epidotes, calcite, fluorite, tourmaline and pyrite).

The rocks described by Farquharson as "dyke porphyries" belong to this group of acid sill rocks, but I can find no relationship between the so-called granular-porphyries (which are really metamorphic rocks) and the true porphyries. The "granular porphyries" are, however, related to the partially metamorphosed (recrystallised) granite outcropping in the north of the area, in the vicinities of Bentley Hill, Spring Granite and Gneiss Hill, and it seems evident from the general metamorphic character of these acid rocks, that they belong to some earlier period of igneous intrusion. On the other hand the accessory-rich granite in the vicinity of Mt. Squires is very similar in mineralogical constitution to the sill porphyries, and there can be no doubt that this granite and the porphyries are co-magmatic and are of the same age, the granite being probably the feeder of the porphyry sills.

An analysis of one of the porphyries agrees very closely with that of (5404), described as an acidie (felsite) lava, from the Nullagine formation in the North-West Division. Incidentally, Mr. Forman observed, independently, the similarity in the hand specimens of this rock (5404) and some of the Warburton Range porphyries.

In addition to the acid and basic rocks of sill and flow origin, there are, in the northern part of the area, numerous dykes of epidiorite and dolerite, which may be related, on one hand to the basic flows and sills of the Warburton Range Area, and, on the other hand, to the ultrabasic plutonic mass of the Cavanagh Range. It is suggested, on very slender evidence, that the three groups, corresponding to the three phases of igneous activity, plutonic, hypabyssal and extrusive, may be co-magmatic.

The sedimentary rocks include shales, mudstones, sandstones, grits and conglomerates, some of which have undergone partial, or almost complete, metasomatic changes. The principal molecules introduced during the metasomatism were lime and silica. In the vicinity of the slowly cooled porphyries rich in minerals belonging to the hydrothermal-pneumatolytic stage of crystallisation, the sediments have been completely recrystallised and new mineral assemblages formed. However, in both the metamorphosed and un-metamorphosed sediments, tourmaline has developed as a result of the pneumatolytic action connected with the final stage of crystallisation of the porphyries. There is fairly strong evidence to show that the meta-sediments are the metamorphic representatives of the normal fragmental rocks.

Correlative evidence indicates that the Warburton Range assemblages of acid and basic flows and sills and interbedded sediments, belong to the Nullagine formation.

3.—SUMMARY OF A REPORT ON A SAMPLE OF STINKSTONE (STINKSTEIN) FOUND IN A LIME DEPOSIT ON BOOLARDY STATION, MURCHISON DISTRICT.

(T. Blatchford, B.A., and F. G. Forman, B.Sc.)

From the inspection carried out in the field and from information otherwise obtained, we have arrived at the following conclusions:—

1. Most of O.P.A. 236H is occupied by granite on which may be shallow surface deposits, but deep basins would be most unlikely.
2. The stinkstone is not confined to the spot where it was first found, but was located in four other places by us, so it is probably fairly common.
3. Where found it was evident that the stinkstone was definitely a variety of travertine limestone, usually the darker variety, occasionally the yellow, but never the really white.
4. The stinkstone does not occur in a regular limestone bed similar to oil-bearing limestones in other countries, but is a surface deposit.
5. Confirming field evidence, analyses of the samples collected show no signs of petroleum.
6. In our opinion, therefore, the occurrence of stinkstone at Boolardy Station has no bearing whatever on the possible occurrence of mineral oil in that area.

4.—FINAL REPORT ON THE CORRELATION OF THE ARTESIAN BORES IN THE METROPOLITAN AREA, PERTH.

(F. G. Forman, B.Sc.)

Investigation shows that the information available is insufficient and of too doubtful a character to be used in the production of an accurate sub-surface contour map, indicating the depth below the surface of the various artesian water beds.

The reasons for this conclusion are as follows:—

1. The majority of the bore records available depend on drillers' logs only for a description of the strata passed through. A comparison of the drillers' logs with determination of the strata made by officers of the Geological Survey in the few instances where the cores have been examined by them, shows the drillers' determinations to be often much in error and of very doubtful value.
2. In those cases where sections of the cores have been preserved, there are insufficient samples to allow of these cores being used for accurate correlative purposes.
3. There is great uncertainty in many of the boring records as to the exact depth at which the flows began, in many instances there being in the record simply a note of the amount of flow in gallons per day at a particular depth, the depth at which the flow started being omitted.

4. It has been the custom to record the temperature of the water and its static head only after completion of the bores so that these records for correlative purposes are of doubtful value. The same applies to water analyses.

5. On a study of the bore logs in the Claremont District, it appears that the strata are displaced between the Claremont No. 1 and No. 2 Bores. Lack of information as to the direction and amount of throw of this fault and the possibility of faulting in other parts of the Metropolitan Area make any sub-surface contour plan, drawn without more information than is at present available, of very doubtful value.

The following conclusion have been reached as the result of this investigation:—

The base of the coastal limestone series, consisting of current bedded calcareous sandstones, lies at elevations varying from sea-level to as much as 180 feet below sea-level in different parts of the Metropolitan Area.

Underlying the coastal limestone series there are lacustrine deposits of soft calcareous shales and sandstones passing downwards into a series of marine beds of calcareous shales or mudstones, sandstones and impure limestones. All the beds present are extremely lenticular.

Under the Metropolitan Area there are three distinct artesian water-bearing horizons. These horizons can be distinguished by water analyses, static heads and temperatures of the various flows. The horizons when contoured from bore to bore are found to be unconformable and it is suggested that the water-bearing horizons lie on the surfaces of the unconformities, because of the frequent occurrence of extremely coarse sands and small boulders in the water-bearing zones. These sands are in distinct contrast to the fine-grained nature of the other sediments throughout the series.

Of the three horizons, the upper two have a limited distribution. The upper horizon is met with in the bores in the vicinity of the city and at Osborne Park, and it is thought that the bores of the Guildford District also draw their water from this horizon. The second horizon is met with in the bores in the Leederville District and in the King's Park bores on Mount's Bay Road. The third horizon covers a larger area, having been encountered in all bores of sufficient depth.

In the attached table the various bores in the Metropolitan area have been divided into groups according to which horizon each bore derives its main supplies of water. In the case of those bores which draw by separate casings from two horizons, the separate flows have been listed in their respective groups. Details, where available, of water analyses, temperatures and static heads are also shown.

Three main artesian water horizons can be recognised and these have been named, for purposes of reference, according to the district in which each horizon has been chiefly exploited by boring. As will be seen from the table, these are the Claremont-South Perth, the Leederville and the City horizons, which occur in that order from the lowest upwards. Owing to the relatively isolated positions of the bores at Fremantle, Guildford and Midland Junction from the remainder of the bores in the Metropolitan Area these have not been correlated, as it is considered that too great an uncertainty exists to allow of this being done.

The following facts stand out clearly from the table. The waters from the Claremont-South Perth and the Leederville horizons have a carbonate content varying from 10.6 to 15.8 grains per gallon. This is in distinct contrast to the carbonate content of waters from the City horizon, which varies from 4.6 to 7.2 grains per gallon.

It will be noticed also that in the case of the two lower horizons the chloride content of the waters is generally higher than that of waters from the City horizon, although in this case there is not the same marked difference as shown by the carbonate content.

The temperatures of the various waters show a definite variation from one horizon to another. In the Claremont-South Perth horizon the temperature varies from 100deg. to 105deg. F., in the Leederville horizon from 88deg. to 95deg. F., and in the City horizon from 75deg. to 81deg. F. This association of definite temperature groups with the several water horizons is probably only of a casual nature as the temperature of the water should be, and probably is, a function of the depth of the aquifer below the surface.

The last column in the table shows the static head of the water in the various bores expressed as height above sea-level at which the water should come to rest

if confined in a column. The water in the Claremont-South Perth horizon has a static head varying in different bores from 110 to 121 feet above sea-level. The static head of the Leederville horizon varies from 70 to 94 feet and that of the City horizon from 58 to 81 feet. It will be seen that the static heads in the Leederville and City horizons are much the same and will not serve to separate the two. It is suggested that this is due to equilisation of pressure caused by the two aquifers coming together because of the unconformity between them.

The temperatures and static heads of several bores show variations from normal. At the Coffee Point bore, which, according to water analysis and from a study of cross sections drawn between various bores, should belong to the Claremont-South Perth group, both the temperature and static head are abnormally low, being 91deg. F and 48 feet above sea-level respectively. An explanation is difficult, as the boring record does not show that upper waters with a low temperature and pressure were passed through, which might account for these abnormal conditions by leakage. It is suggested that the low static head of 97 feet for the Redan Street bore is probably due to this cause. It is also suggested that the abnormally high temperature of 104.5deg. F. of the water from the 10in. casing of the Loftus Street No. 1 bore is due to conduction of heat from the 8in. casing, which carries water at that temperature.

* Exceptions to this will be discussed later.

Name of Bore.	R.L. at Surface.	Total Depth.	Depth to Principal Water Bearing Horizon.	Analysis.**				Temp. of Water.	Static Head.		
	Feet above sea level.			Feet.	Feet.	Car- bonates.	Sulphates.			Chlorides.	Total Solids.
						Grains per gallon.					
°F.											
Feet above sea level.											
Claremont No. 1	24.41	1,506	1,189	12.39	3.22	55.79	72.04	100	110		
Claremont No. 2	30	1,943	1,558	15.82	2.24	40.32	59.64	104	110		
Claremont Hospital for Insane	70	2,070	1,848	15.52	2.24	40.95	60.20	104	112		
Coffee Point	9	1,487	1,487	11.72	3.35	45.04	61.92	91	48		
King's Park No. 2	11	2,406	1,487	10.08	3.08	42.07	55.86	100.4	110		
Leederville Sanitary Site	70	1,680	1,375	...	...	...	...	...	...
Loftus Street No. 1—Sin. casing	45	1,939	1,780	11.01	3.48	42.26	56.40	104.5	110		
Loftus Street No. 2	45	2,097	1,780	14.01	4.80	73.08	90.81	105	110		
Old Men's Home, Claremont	17	2,196	1,828	...	...	...	...	...	...
Redan Street	47.2	1,812	1,024	11.42	4.20	30.48	47.55	100.5	97		
Royal Agricultural Society, Show Ground	54	1,500	1,320	12.25	3.22	57.26	74.13	...	110		
South Perth Zoological Gardens	18	1,856	1,837	13.19	4.50	46.43	...	...	121
King's Park No. 1	11	1,345	...	13.44	4.83	58.38	76.86	88	94		
Leederville Recreation Ground	59	1,113	1,023	14.48	1.96	21.48	39.23	...	70		
Loftus Street No. 1—10in. casing	45	1,001	945	10.60	5.67	73.32	89.72	104.5	87		
Regent Street	...	1,232	881	12.36	3.00	33.96	52.56	89	71		
Subiaco Municipal	117	876	876	14.70	3.99	23.87	42.98	95	74		
Causeway	10	1,200	747	4.62	4.97	55.54	68.08	...	70		
Hector Street	51	762	762	6.09	0.34	38.6	50.08	81	80		
King Edward Street	53.6	568	480	...	...	...	...	75	...
East Perth Tramways	30	1,034	1,010	5.63	0.86	17.97	25.72	...	81		
Roberts Street	51	631	490	5.75	0.67	12.94	20.21	76	63		
W.A. Cricket Association Ground	12.9	948	948	...	...	...	...	...	62
Wellington Street	35	815	600	6.45	2.20	32.97	...	...	58
West Perth Station Yard	38	820	820	7.20	3.40	34.05	48.15	...	73		
Bebbo-Moro or Gull's	19	408	408	10.36	2.10	20.16	34.02	...	37		
Brookman's Estate, Cannington	...	1,000	313	8.64	13.83	114.11	137.91	...	20		
Butcher's (Garden Hill)	...	404	199	5.29	trace.	22.17	38.50	...	21		
Guildford Municipal	11	1,202	1,140	5.94	9.42	74.84	92.55	...	64		
Hampton Road, Fremantle, No. 1	64.23	456	434	8.40	5.25	53.13	68.53	80	24		
Hampton Road, Fremantle, No. 2	68.38	1,322	433	8.61	5.04	58.31	73.64	...	75		
Harper's No. 1	14	236	160	6.65	0.17	20.79	34.03	...	...
Harper's No. 2	...	242	160	...	...	...	...	...	33
Lockeridge or Hamersley's	14	798	784	4.47	trace.	10.39	23.41	...	21		
Midland Junction	13	500	420	7.20	0.36	42.33	56.28	...	...
Midland Junction Municipal	...	618	564	...	...	42.34	...	...	...
Midland Loco. Workshops No. 1	43	322	280	4.68	4.93	37.83	49.40	...	33		
Midland Loco. Workshops No. 2	24	890	600	3.25	4.58	50.91	65.08	...	176 (?)		
Midland Loco. Workshops No. 3	...	362	...	4.90	4.94	39.73	51.97	...	...
Midland Loco. Workshops No. 4	...	353	...	...	...	...	59.04	...	...
Midland Loco. Workshops No. 5	...	218	...	...	...	...	...	...	...
Munday's	22	340	304	...	...	...	32	...	32
Nicholson's	...	400	302	...	...	...	...	...	...
North's	...	589	160	3.54	4.27	41.58	52.03	...	...
Padbury's	...	755	347	8.89	1.61	24.08	36.12	...	46		
Perth Racecourse No. 1	40	1,100	1,070	4.89	0.85	22.18	31.89	...	59		
Perth Racecourse No. 2	13	1,109	1,075	...	...	...	...	...	...
Waterhall or Morrison's	35	691	691	4.48	4.69	49.63	62.44	...	46		
West Guildford	...	1,410	1,395	10.63	16.24	132.76	162.19	...	28		

** These figures are compiled from the reports of the Interstate Conferences on Artesian Water (1912, 1914, 1921, and 1924), and from information supplied by the Government Mineralogist and Analyst.

5.—REPORT ON INSPECTION OF THE MT. MAGNET DISTRICT.

(F. G. Forman, B.Sc.)

Following instructions to make an examination of the Boogardie "Deep Lead," I arrived at Mt. Magnet on 13th December. Here I was met by the Secretary of the Road Board and the Secretary of the Prospectors' Association, who provided transport and arranged with various prospectors to guide me about the district.

Besides making an examination of the so-called "Deep Lead" at Boogardie, at the request of various prospectors I inspected several other localities where prospecting is or has recently been active.

The Boogardie Deep Alluvial.

The Boogardie "lead" lies under a wide flat on the west side of Jones' Creek. The lead extends from the Boogardie Recreation Reserve for a distance of about half a mile to the north.

The floor of the lead, as exposed in the shafts, is composed of kaolin, which probably represents a decomposed greenstone. That this kaolin represents the country rock is indicated by the presence in it at a number of places of jasper bars, which do not extend upwards into the wash.

Lying directly on the kaolin floor there is a variable thickness of from two to ten feet of wash, varying in character. The usual appearance of this wash is that of a gritty kaolin, carrying water-worn quartz and quartzite pebbles from the size of a small pea up to two or three inches in diameter. Interspersed irregularly throughout there are masses of ironstone, which at first sight have the appearance of being foreign masses buried in the wash, but on close inspection it is seen that the ironstone is composed of the same material as the ordinary wash, but is heavily impregnated with iron oxide.

On Latham and Vaughan's claim, near the head of the lead, there are in the wash a number of large boulders and fragments of quartzite and jasper, some of which are fairly well water-worn while others are quite angular.

The rocks composing the large boulders and fragments and the smaller pebbles are similar to rocks seen outcropping in the ridges to the north and east of the lead.

The coarse and fine material in the wash shows little if any sign of being sorted, and many of the fragments show very little sign of being water-worn. However, in the bed of a stream in an arid climate where the flow is only intermittent, marked sorting of the transported material is not to be expected, and as the source of the wash is probably at no great distance from its present position, the lack of attrition exhibited by many of the rock fragments is not surprising. In the writer's opinion the wash in this lead is a true water-borne wash, but one, the component pebbles of which, have not travelled far from their source.

The wash is overlain by a ferruginous laterite which extends right up to the surface, and varies in thickness from 20 to 40 feet.

The gold appears to be very irregularly distributed in the wash, but is apparently confined to the first

three or four feet above the floor. On being questioned, various prospectors expressed different opinions as to the location of the gold.

On Latham and Vaughan's claim the gold is said to be confined to a channel or gutter about 12ft. wide, which is marked by an abundance of dense iron-stained wash or "ironstone" in white "pug" and fine grit. The gold is said to be associated with the ironstone boulders and the "pug" or wash in their vicinity, while similar wash, without associated ironstone boulders, is said to carry little if any gold. Where the ironstone is less dense and more of a loose gravelly nature, the values are said to be poor.

On Harris and Love's Claim (M. 6) the gold is said to occur within the wash close to the floor. The wash is said to be richest near the top of the rolls or banks, of which a number occur in the floor on this claim. In the gutters between the rolls the wash is said to be generally poor.

Similar conditions are said to prevail on Wright and Watson's Claim, which adjoins, on the north, that described above. I was informed by Mr. Watson that slugs, when they occur, are not found on the bottom but about six inches above. They may be in either the white gritty wash or in the ironstone patches.

On Moller's Claim, which adjoins Harris and Love's Claim on the south, the gold is said to occur in the ironstone but not in the ordinary wash or "pug" near it. On this claim the floor of the wash is very irregular, and the prospectors do not consider that the occurrence of the gold bears any relationship to the rolls. I was shown two slugs of gold which came from this claim and which were said to be typical of most of the slugs from the alluvial workings. The larger of these two weighed about 24 dwts. and was elongated and flat and had an extremely rough surface. It could not have been transported by water for any distance and still keep its rough surface.

The absence of a well defined gutter, the distribution of the gold in irregular patches, and the rough surface exhibited by most of the slugs so far recovered, suggest that this deposit is not an ordinary alluvial lead, in which the gold has been transported to its present position by running water in a stream bed.

In the writer's opinion the gold has been deposited in its present position by precipitation from solution. The ironstone masses within the wash may have had some controlling influence, because slugs of gold are often found within or close to them. This, however, is not an invariable rule, as slugs and fine gold are often found in white wash well away from the ironstone masses. The nature of the surface of these slugs appears to be controlled by the nature of the enclosing wash, those slugs occurring in the ironstone patches or in the gritty wash being rough, while those occurring in masses of white "pug" are smooth. This is what one would expect if the slugs are formed by precipitation around some centre; the surface of a slug would naturally take its form from the surrounding wash or "pug." Another fact which supports the precipitation theory is that, in the vicinity of a slug, the surrounding wash often carries much fine gold, while further away similar wash is barren or very poor.

It appears, therefore, that in this deposit a defined gutter carrying gold is not likely to be found and that the gold will continue, as in the past, to be found in irregular patches. No advice as to the location of these patches can be offered, as they appear to occur at random without any definite relation to visible changes in the appearance of the wash.

Other Deep Alluvial Patches.

Two other deep alluvial patches, which have been worked in the past, were examined. As the workings were almost inaccessible the writer had to depend a great deal on descriptions supplied by those who had worked the patches, in order to form conclusions.

One of these patches, known as Burt's Alluvial Reward, is located about half a mile to the north-northwest of the Morning Star Lease, and the other close to the Mt. Magnet-Boogardie Road, northeast from the Hesperus Dawn Lease. In both cases the gold appears to have occurred in isolated patches and to have been due to precipitation from solution in irregular patches. In neither case is there evidence of a definite "lead."

Poverty Flat.

The writer was shown where a considerable amount of work has been done in this area, with some remarkably rich returns. The gold here occurs in breaks or cross faults cutting through a series of narrow jasper bars, and the prospectors of the district are anxious to know whether further possibilities exist within the area. The structure is complicated by an extensive intrusion of porphyry, which has displaced the jasper bars in several places. Owing to the workings being at present inaccessible, the writer was unable to form any conclusion as to the future possibilities of this area. A detailed underground examination of the structural features as exposed in the workings would be necessary before any useful advice could be offered.

Other Inspections.

The remainder of the time spent in the Mt. Magnet District was taken up with giving advice to individual prospectors, who found themselves in difficulties in regard to the structural features of the areas on which they were working. The inspections were of too brief a nature to allow of any definite conclusions worthy of record being arrived at.

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