

1908.
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WESTERN AUSTRALIA.

ANNUAL
PROGRESS REPORT
OF THE
GEOLOGICAL SURVEY
FOR THE YEAR
1907.

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1908.

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THE HISTORY OF THE UNITED STATES

The history of the United States is a complex and multifaceted story that spans centuries. It begins with the early Native American civilizations, such as the Mayans, Aztecs, and Incas, who developed sophisticated societies in the Americas. The arrival of European explorers in the late 15th century marked the beginning of a new era, as they sought to establish trade routes and colonies. The United States was founded in 1776, and its early years were characterized by a struggle for independence and the establishment of a new government. The American Revolution led to the signing of the Declaration of Independence and the Constitution, which laid the foundation for the nation's political system. The 19th century was a period of rapid expansion and growth, as the United States acquired vast territories and became a major industrial power. The Civil War, fought between 1861 and 1865, was a pivotal moment in the nation's history, as it resolved the issue of slavery and preserved the Union. The 20th century was marked by significant social and political changes, including the rise of the New Deal, the Great Depression, and the Cold War. The United States emerged as a superpower, and its influence was felt around the world. Today, the United States continues to play a central role in global affairs, and its history remains a source of inspiration and reflection for people around the world.

Annual Progress Report of the Geological Survey for the Year 1907.

The Under Secretary for Mines.

Geological Survey Office,
Perth, February 10th, 1908.

SIR,

I submit in conformity with the usual custom, for the information of the Hon. the Minister for Mines, a concise account of the operations of the Geological Survey for the calendar year 1907.

This account, which contains a statement of the work carried out by the different members of the staff, both in the field, office, laboratory, and museum, has been arranged upon slightly different lines from those adopted hitherto, in so far that all reports of a purely technical or scientific character have been omitted and their place taken by a *précis* thereof. The full text of such of these as are not of sufficient length to warrant independent publication will be included in a miscellaneous bulletin which it is proposed to issue shortly.

In addition to the ordinary field work and its contingent office duties, the staff has been engaged upon 56 special reports bearing upon the alienation of land set apart for mining purposes, five in connection with the granting of State Aid under the provisions of the Mining Development Act, and one relating to Mining on Private Property, under the provisions of "The Mining Act, 1904."

THE STAFF.

The operations of the Department have been carried out during 1907 by a staff of 13 officers, four of the staff being geologists and one a topographical surveyor; the office staff comprising two draftsmen and one clerk; whilst the laboratory staff is made up of a Mineralogist and Assayer, with two permanent and two temporary assistants. One of the latter, Mr. C. C. Williams, who resigned during the preceding year, rejoined the staff in a temporary capacity and has remained upon that footing since the position he formerly occupied was omitted from the estimates. The second temporary assistant, Mr. Murray, has been employed since the 4th of July, owing to the large amount of work carried on for the Battery Branch of the Mines Department, out of which vote he is paid.

FIELD WORK.

The field work for the past year has been distributed over such portions of Western Australia as the exigencies of the situation demanded.

A GIBB MAITLAND, Government Geologist.—From the 1st of January to the 11th of February, I was absent on leave and by the permission of the Minister was granted 14 days special leave for the purpose of attending the eleventh meeting of the Australasian

Association for the Advancement of Science held in Adelaide, to preside over the section of Geology, and took for the subject of my presidential address "The Recent Advances in the Knowledge of the Geology of Western Australia." In this address, I brought before the meeting the present condition of our knowledge and the contributions which this State had made towards the progress of Geological Science in Australasia during the last decade. This address, with an explanatory map, will appear in the forthcoming volume of the Association's Proceedings, and has already been published in Bulletin No. 26.

The presence of the Government Geologists of Tasmania and South Australia at the meeting afforded an opportunity of conferring on points affecting official geological survey work, and cannot fail to have a very beneficial effect.

During my stay in South Australia, prior to and after the meeting of the Association, the Government of the State, as represented in the person of the Premier, the Minister for Mines, the Government Geologist, and the administrative heads of the Mines and Works Departments, placed very many facilities at my disposal to enable me to enlarge my experience of the geological structure, mineral resources, and underground water supplies of the State, in addition to extending many other acts of official courtesy.

Artesian Water Boring in the Murchison, Gascoyne, and Kimberley Districts.

In the month of April, as the result of a conference between the Surveyor General and the Engineer for Water Supply and Sewerage, the following report was submitted to the Government:—

"In accordance with the wishes of the Government, we have discussed the question of the sites for boring for artesian water in those northern portions of the State within the area which has already been geologically defined as being that likely to yield overflowing supplies of water.

"As pointed out in reports submitted by one of us on 13th February, 1906 (P.W. 12067/05), and 25th July, 1906 (P.W. 893/06), that boring might be carried out with a reasonable degree of confidence, we are of opinion that, upon the grounds of public utility, the two most convenient spots for such operations are:—

- (a) At Gladstone, and
- (b) At Lake Culeurdoo, a little to the north of the Murchison River.

"The question of the chances of success in boring for artesian water in the Lyndon Valley already has been dealt with by one of us on 10th April, 1906 (P.W. 896/06), and the Assistant Government Ge-

ologist on 14th January, 1907 (M. 1871/06). We are of opinion that the public interest would be best served by putting down a bore:—

(c) On Crown lands, at a spot between Maud's Landing and Winning Pool, about 13 miles east from the jetty.

"The prospects of artesian water in the Kimberley Division having been recently exhaustively dealt with by Dr. Jack, who was specially commissioned for the purpose (P.W. 893/06), and the possibilities of town areas defined and discussed, we are of opinion that the interests of the community would be best served by putting down an experimental bore:—

(d) in the valley of Christmas Creek at a suitable spot about 12 to 15 miles above its junction with the Fitzroy River.

"We do not consider that any boring on the Antrim Plateau should be undertaken until considerably more data than are at present available have been obtained. In this connection, we would especially direct attention to the advice of Dr. Jack (in which we concur) that the compilation of reliable data followed by logical reasoning is much to be preferred to embarking upon expensive boring operations of the nature of 'blind-stabbing.'

"Having given the whole question careful consideration, we are of opinion that boring operations at the four sites to which we have drawn attention should suffice to demonstrate the possibility or otherwise of the occurrence of artesian water in the Western and Kimberley Divisions, and if successful would lead, as has been the case in the Gascoyne, to private enterprise doing its part in embarking on a policy of water boring and the better utilisation of those areas of pastoral country which are known to exist."

The Country between the Gascoyne and Roebourne.

This area was examined by myself between the months of May and December for the purpose of investigating and reporting upon its copper, lead, and gold resources, as well as the possibilities of the occurrence of its underground water supplies and that of Coal in the basal members of the Carboniferous Formation, which occupies such an extensive area in the district.

The ground traversed embraces portions of the Gascoyne, Ashburton, and West Pilbarra Goldfields, in addition to other country outside the limits of any legally defined mineral field.

Field work was commenced at Carnarvon early in May last. Leaving the township, I followed the valley of the Gascoyne as far as its junction with the Lyons River. From here, I travelled *via* the Lockier Range as far as the mining centre of Bangemall, at which locality about three weeks were devoted to such an investigation of the field as the condition of the workings allowed. Having completed the survey of Bangemall, Mounts Phillip and Augustus were visited and thence a traverse *via* Coorabooka made across the rough country dividing the waters of the Lyons from those of the Ashburton as far as the Soldier's Secret Mining Camp.

From the Soldiers Secret, the valley of the Ashburton was traversed as far as the Dead Finish and Mount Mortimer centres, at both of which places a few days were spent. I travelled from Mount Mortimer *via* Coorara Claypan, as far as Uaroo, where are some extensive copper and lead deposits. About four weeks were spent in this locality examining and

mapping the mineral belt, which proved to be about six miles in length.

From Uaroo, I visited Weston's Copper Find, which lay some miles to the west, and from thence proceeded to the Minilya River for the purpose of examining the basal members of the carboniferous strata in the vicinity of Windalia and Chugareyardoo. The hurried investigation in this neighbourhood having been completed, I travelled *via* Yanyerredie, Glen Florrie Station and Coorara to Mount Stuart. From this locality, the Cane Hill Copper Workings were visited and examined, and, thereafter, those of Red Hill and the Fortescue River.

From the Fortescue River, I travelled as far as Cossask, reaching that place on the 12th December, having been continuously engaged in the field for 236 days.

H. P. WOODWARD, ASSISTANT GOVERNMENT GEOLOGIST.—Upon Mr. Woodward's return from the Minilya district on January 5th, 1907, he assumed the duties of Acting Government Geologist during my absence from this State. He was also engaged upon the preparation of his report upon the possibilities of obtaining artesian water along the coastal belt between the Gascoyne and Ashburton Rivers, which report, accompanied by a plan, appeared in Bulletin No. 26.

In the middle of February he proceeded to Mingenew, after which he furnished the following report upon an application made by the Geraldton Coal Co. for State assistance in boring for coal at Depôt Hill, in the Irwin District:—

Boring for Coal at Depôt Hill, Irwin Coalfield.

"Depôt Hill is upon the Irwin River, about 3½ miles north-west of Mingenew, a railway station upon the Midland Railway line, 227 miles north of Perth, and 79 miles south of Geraldton.

"The general character of the country is a high sandy tableland, intersected by deeply cut river valleys, along which are strips and patches of fertile land, with here and there rock outcrops in the stream bed itself.

"At Depôt Hill itself, beds of coloured, shaley soft sandstones make their appearance, having a slight but constant dip to the westward, whilst about one mile to the north-east, still in the river valley, beds of shale with small seams of brilliant black lignite were cut.

"This series is in all probability of Mesozoic Age, being the southern extension of the Jurassic rocks, which outcrop upon the Greenough River.

"In this river valley no further rock outcrops are visible for about 15 miles, where Lower Carboniferous limestone outcrops, overlaid by the Permo-Carboniferous series with coal seams dipping to the north-eastward.

"In the Lockier River, which junctions with the Irwin River at Strawberry, a little below Depôt Hill, the same series of rocks are met with as far as Mingenew, a short distance above which Lower Carboniferous limestones make their appearance.

"Close to Mingenew, which is on the same line of country as Depôt Hill, a bore hole was put down some years ago with State assistance, this passed through rocks apparently belonging to the Mesozoic series, and would if continued deeper have in all probability encountered the Lower Carboniferous series, lying unconformably beneath them; therefore, there appears to be little hope of

meeting with the coal measures by boring at Depôt Hill. It is possible, however, that the black lignite beds may be cut, but since these coals are too friable to stand handling, they would be of but little value, particularly at a point so far from market.

"Several other Government reserves were inspected with the object of shifting the site of boring operations, but since these were either too small or situated directly upon formations of greater age than the coal measures, none of these could be recommended."

This report being unfavourable, the Company made an application for a portion of the Coal Boring Reserve, situated upon the southern side of the Greenough River, between Eradu and Mullewa. He, therefore, inspected this locality in company with a representative of the Company, after which he made the following report:—

Boring for Coal at Eradu, Greenough River.

"Eradu is situated upon the Geraldton-Murchison Goldfield railway line, 34 miles east of Geraldton, and 225 miles West of Day Dawn; it was formerly known as the Greenough River Cross from the fact that the railway crosses the river at this point.

"Like the Irwin basin, rocks only outcrop in the river valley, the higher land being covered by elevated sand plains.

"In the river valley a series of sandstones and shales outcrops to the eastward until the crystalline rocks are met with near Mullewa.

"With the object of testing this, which appeared to be the northern extension of the Irwin basin, a bore was put down upon the sand plain at a point some 15 miles to the eastward of Eradu, but owing to the great thickness of mesozoic rocks passed through, which consisted largely of soft sandstone to a depth of 950 feet, it was found impossible to bore deeper than 1,360 feet, although the last 400 feet appeared to be in the coal measure series. It was therefore decided to prove the section by a series of shallow bore holes along the river valley.

"With this object the first hole was put down half a mile north of Eradu, which passed through sandstones and shales to a depth of 118 feet, when a 6ft. 6in. seam of weathered coal was cut.*

**Analyses of Coal by the Mineralogist and Assayer.*

I have analysed three sections of the coal seam cut in this bore at 118 to 125½ feet with the following results:—

		2720	2721	2722
Moisture	.. ..	8.14	9.59	6.99
Volatile Hydrocarbon	.. ..	38.08	40.28	30.05
Fixed Carbon	.. ..	30.80	37.97	27.06
Ash	.. ..	22.97	12.16	35.90
		100.00	100.00	100.00
Colour of Ash	.. ..	Greyish-white	White	White
Coke	.. ..	None	None	None
Calorific Value, B.T.U.	.. ..	—	9900	—

Of these three [2720] is a poor friable shaley coal of little or no value. [2721] is a very dull friable coal which appears to be much weathered, and may therefore improve at a greater depth in the basin. Its calorific value is equal to that of the lower grades of Collie Coal. [2722] is coaly shale of no practical value.

"At this juncture the Geraldton Coal Co. made an application to the Government for a portion of the Mining Reserve, with assistance in the shape of a subsidy, and since the Company were unfortunate in their selection of the Depôt Hill site, I would recommend that their request be favourably considered, since at this locality there are certainly considerable prospects of success."

His next main piece of work was the preparation of his report upon Cue, Day Dawn, and Cuddingwarra Mining Districts, which report, accompanied by three geological maps, and a number of mining plans, is now issued as Bulletin No. 29. Owing to the fact that in the preceding year Mr. Woodward had been recalled from the Murchison Goldfields to proceed north before his field work was quite complete, he found it necessary to return to Cue and Day Dawn for a short time before finishing his report.

Upon my departure for the north in the first week in May, I placed Mr. Woodward in charge of this office, with instructions to superintend the carrying out of all departmental duties until my return, and if possible, not to undertake any field work which would necessitate an absence for a longer period than one week. He also had instructions to revise and correct proofs, and to generally superintend the publication of the Annual Report and Bulletins Nos. 26 to 30, whilst any spare time he was to occupy upon a geological examination of the Greenbushes Tinfield, including the bringing up to date of my geological map, and to extend this work to the boundaries of the field.

But slow progress has necessarily been made upon this piece of work owing to the fact that only a week could be devoted to it now and again as opportunity offered, whilst of the six days in the week two would be occupied in travelling. However, Mr. Woodward informs me that he will be able to complete it in two weeks of solid work.

The result of this work, with a large scale geologically coloured topographical map, it is hoped will be published early in the year.

In the first week in June, Mr. Woodward received instructions to visit and report upon an application for deep boring from the British and Foreign Development Syndicate, Ltd., upon their property known as Fraser's Mine, situated at Southern Cross. The following is a condensed version of his report, which will appear *in extenso* in a Miscellaneous Bulletin to be published:—

Deep Boring on Fraser's Mine, Southern Cross.

"This property, which embraces the Central, Fraser's and Fraser's South mines at Southern Cross, has been worked continuously since 1888, during which period a total of 151,771 tons of stone have been treated, which yielded 67,870.33 ounces of fine gold, or at the rate of .44 ounces per ton, or close upon half an ounce per ton, whilst if the rich sands which were used for mine filling before cyanide extraction was introduced are taken into account, it would most probably equal that.

"The reef or ore channel is of the composite order, striking in a north-westerly and south-westerly direction, with a dip which varies from 60 to 70 degrees to the westward. It averages something like 20 feet in

width, consisting of numerous strings and bunches of quartz, intermixed with a considerable quantity of schistose rock, enclosed between well-defined amphibolite walls, the whole being cross faulted at two or three points.

"It is accompanied by two parallel auriferous reefs, whilst the whole belt is contained between a white barren reef upon the east, and a series of banded hematite quartzites upon the west, the country rock being granite upon the east and amphibolite upon the west, whilst the whole formation is traceable for a length of two miles. This main formation has proved auriferous for a length of 60 chains, and the deepest point reached in sinking is at present 480 feet, but the main workings only extend to a depth of 350 feet, at which level it has been worked for a considerable length.

"The present owners consider that if they can prove the continuity of this large low grade lode at a depth of 750 and 1,000 feet, they would have no difficulty in obtaining the necessary capital to equip and develop it; they are therefore making application for a £1 for £1 subsidy to put down bores to this depth. Since this is a question of vital importance, not only to this mine or district, but to the State as a whole, this request is worthy of consideration, for should the fact be once established that these large low grade bodies carry payable ore at a depth, there is not the least doubt but that a number of others of the same class will also be tested.

"This lode is especially suitable for this experiment, firstly because its great size and length and the character of its walls point to the conclusion of permanency in depth; secondly, the general dissemination of the gold through the lode body for so great a length without the marked occurrence of shoots or lenticular bunches affords great encouragement with regard to its continuation to carry values to a depth; thirdly, the enclosure of a well-defined ore channel between a white barren reef of considerable extent upon the one side, and the ferruginous quartzite veins upon the other also support the theory of permanency; fourthly and lastly, this lode lying in a contact zone parallel to and dipping from the intruded granite which lies at a short distance to the eastward, is also favourable to both permanency and the continuity of values.

"The only conclusion that can be drawn is that if boring is undertaken here conjointly by the Government and the Company, it will be with every probable prospect of success."

Upon July 27th, he was summoned by the Royal Commission on Water Supply and Sewerage to visit and report upon the prospects of obtaining a solid foundation for a dam at Kelmscott, but in order to make a thorough examination he found it necessary to revisit the locality a few days later by himself, after which he furnished the following report:—

Alternative Dam Site at Kelmscott.

"The proposed dam site as surveyed is just within the Darling Range in the old Kelmscott townsite, about one and a-half miles from the railway station.

"The survey line crosses the river at a point where it breaks through the last granite bar before making its *debut* on the plain.

"This bar is clearly visible, running up the hill on the south side of the river, but upon the north it is

overlaid first by alluvium then by a bank of boulders embedded in clay, with, higher up the hill, soil and occasional rocky outcrops consisting of granite diorite and quartz reefs.

"After a careful examination of the proposed dam site, I find that the rock can nowhere along the surveyed line be at any great depth beneath the present surface, since in the section marked A-B, which lies upon the southern side of the river, granitic rocks outcrop almost to the water's edge. In section B-C upon the northern side a bank of what appears to be made ground occurs, but judging from the evidence afforded by a thorough examination of the river bank, which lies parallel to it at this point, I do not consider that this formation will prove to be of greater thickness than from 10 to 15 feet, the greatest thickness being probably about where a house stands upon Sub. 105, close to Marmion street. In the remaining section C-D rock outcrops are of frequent occurrence.

"The nature of the rock in section A-B is of a solid granitic character, the only weakness apparently being a pegmatic dyke near the main road. In this section I should estimate that at a depth of about 10 feet a good solid foundation would be obtained.

"In section B-C, which includes the river channel, the nature of the rock cannot be determined, therefore it is possible that diorite dykes or other fissures may occur, causing lines of weakness, but leaving these out of the question, I estimate that a solid foundation should be obtained at depths of from 20 to 30 feet, varying with the thickness of the superficial deposits.

"In the section C-D, although the rock outcrops it is not of such a solid nature as that in A-B, being intersected by diorite dykes and quartz veins, and in consequence it is probable that solid rock will lie a little deeper, say 15 feet. In this section it is not probable that so good a foundation will be obtained, but owing to its elevation the weir at this point will not be called upon to stand so great a pressure as in the other two sections.

"Upon the whole I do not apprehend that any out of the way engineering difficulties will be met with, but at the same time it is impossible for me to make any definite statement with regard to section B-C."

In the middle of August the question of extending the municipal boundaries of Kalgoorlie-Boulder City towards the Golden mile belt was raised, it therefore became necessary for him to proceed to that district in order to delineate upon a plan, in conjunction with the Government Land Agent, that portion of the auriferous area which should be reserved exclusively for mining purposes, and that portion of the abandoned leases over which subdivisions might take place.

The following week he visited Eulammina (late Anaconda) with the object of examining the Mt. Malcolm Copper Mine, in order that a reference could be made to it in the *Baser Metals Bulletin*, No. 30, a full report of which will be issued in a bulletin to be published shortly of which the following is a condensed outline:—

The Mount Malcolm Copper Mine, Eulammina.

"The Mount Malcolm Copper Mine, more generally known as the Anaconda, is situated upon the railway line between Mount Malcolm and Murrin Murrin. It was first worked from 1899 to 1904, during which period it produced 32,981 tons of ore valued at

£60,191. The Company then went into liquidation, and the leases were sold, and are now owned by the West Australian Copper Company, Ltd., who had raised up to July, 1907, 7,101 tons of ore valued at £117,305.

"The lode has been worked at three points over a length of 1,300 feet, but of this so far only about one-half of the total has been driven on above the water level, and about one-third below, the deepest shaft being 386 feet. Above the water level at the three points worked, the rich portion of the lode occurred in the form of lenses, the upper part of which had been removed by denudation. The ore in these consisted for the most part of carbonates, with ferruginous gossan (iron oxides) and a certain amount of siliceous gangue. Below the water level secondary sulphides were met with, the richest portions occurring immediately below the water, whilst the zone of enrichment gradually decreased in value with depth.

"The zone of primary sulphides has not yet been tested, but to judge from the character of them in that portion of the lode where secondary enrichment has taken place, this will in all probability prove to be of considerable size and of generally low grade, with bunches of shoots of higher values.

"This mine has been the greatest producer of copper in this State, it having yielded up to July, 1907, about one-half of the total production, whilst owing to the fact that relatively little prospecting has been done there are great possibilities of other large and rich bunches still being discovered between the existing workings."

Guano Deposits at Watheroo.

In October he proceeded to Watheroo with the object of examining some reported guano deposits in that district. These he found to consist of recent accumulations in caves beneath heavy beds of quartzite, which latter in one place were over 70 feet in thickness. These deposits consist of wallaby dung, and bat and bird guano, the latter being of high quality but of limited quantity, whilst the main deposit, which proved to be 20 feet in depth at one point, contains a considerable quantity of sand, and is particularly siliceous near the bottom. The value of this discovery apparently rests upon the extent of the caverns and the quantity of the deposit.

In November he visited Mundijong, where gold was reported to have been discovered upon private property and a number of leases applied for, the following being his report:—

Reported Gold Discoveries at Mundijong.

"At a point 29 miles from Perth upon the South-Western Railway is the township of Mundijong, formerly known as Jarrahdale Junction, from the fact that the Roekingham-Jarrahdale timber line crosses and junctions with the Government line at this point. The township is situated upon the coastal sandy plains, close to the base of low foot hills, composed of ironstone gravel and shingle, which in all probability overlie the clay slate beds which outcrop to the northward between Cardup and Armadale.

"Between one and one and a-half miles eastward from the station the range rises fairly abruptly from the plains, but not so steeply nor does it attain such an elevation as it does to the eastward of Perth.

"The rocks constituting this range are crystalline schists intersected by numerous coarsely crystalline diorite dykes and quartz reefs, these latter often pre-

senting the structural character of altered pegmatic dykes due to metasomatic action, in which process the potash and alumina have been replaced by silica.

"Near the face of this range is the old Mundijong silver and lead mine, from which a few tons of massive galena were shipped as far back as 1870, since which time until recently it has been closed down owing to the low price of lead. This lode strikes in a more or less north and south direction, and has been tested to a depth of 100 feet, the vein stuff consisting mostly of quartz. Near the surface galena occurred in fair-sized bunches, but made into zinc blende near the water level, beneath which these two ores were met with in small quantities disseminated through the quartz, which also contained small quantities of copper.

"The ore is confined to a more or less pipe-like shoot of little longitudinal extent and presents indications of making into copper ore with depth.

"Other deposits of a similar character are met with along this range face near the contact of the schists with the slates at Cardup, and at other points between here and Armadale, which line of country is decidedly worthy of further attention.

"From the lead mine, the range rises rapidly for about one mile, but the rocks assume a less promising mineral character, quartz reefs and diorite dykes being of less frequent occurrence, whilst the hill tops and spurs are capped with ironstone (laterite), what quartz there is being of that small lenticular character common to schistose rocks.

"The line of leases as applied for extends in a more or less south-westerly direction from the road covering Locations 12, 49, 51, and 147, following the same line of country as that prospected at Serpentine, the No. 1 lease being about one mile north-east from the old shaft.

"Although quite some twenty leases must be pegged out, absolutely no work has been done upon them, whilst the No. 1 lease, from which 4 to 5 dwts. stone is said to have been obtained, is situated upon the top of an ironstone hill, upon which no quartz is visible.

"The small scattered fragments of stone upon the various leases did not appear to be worthy of trial, as no reef outcrops could be discovered, whilst a couple of stream concentrates tested did not yield even a trace of gold. As the original prospectors were not present at the time of my examination, until they are in a position to meet me and show me upon the ground that they have made a *bona fide* discovery of value, I cannot recommend that this land should be resumed for mining purposes."

He also made numerous minor reports upon conditional purchase and other applications under the alienation of mineral lands, also reports upon assisted boring upon various gold mines and boring for artesian water and coal, the latter, including the Lennard River road bore, which is as follows:—

Boring for Artesian Water, West Kimberley.

"I have made a careful examination of the core samples from the Derby-Lennard Road bore (67m), and find that they consist of a series of sandstones and shales with occasional beds of grits, conglomerates which are often calcareous, particularly below a depth of 1,000 feet.

"The bore is of great interest, owing to the fact that an artesian supply was cut at such a shallow

depth, the first which consisted of 1,000 gallons being encountered at 170 feet below the surface, then at 230 feet it was at first 3,000 gallons, but later on increased to 40,000 gallons, whilst yet another supply yielding 65,000 gallons was met with at 327 feet.

"Below this depth, no water supply was apparently cut until a depth of 1,003 feet was reached, when a flow of 142,000 gallons was struck. Below this depth a series of calcareous grits, limestones, and conglomerates was passed through to 1,090 feet, being apparently the Napier Range series of lower carboniferous age.

"The striking of this supply is of very great importance, since this tract of country was previously considered to be waterless. This bore, however, not only proves conclusively that a good supply of fresh artesian water can be obtained at a depth of 1,000 feet, but also that a series of small supplies may be tapped at a comparatively shallow depth with the aid of a hand drill.

"The geological age of the upper series in this bore appears to be either Permo-Carboniferous or Upper Carboniferous, both of which formations contain the great coal deposits of the world, therefore, in future boring there is always the possibility of not only obtaining a water supply, but also of cutting a coal seam."

"Mr. Grill, in charge of the drill, informs me that this bore is situated in a depression in the 'Pindan' and that the hydrostatic head is only 7 feet; therefore if other bores were put down to tap this bed at points where the surface was more elevated no overflow would be obtained.

"This being the case I would recommend that this bore hole be carried down to the basement beds of this series, as it is probable that the hydrostatic head in these beds will prove to be greater since their intake is situated at a greater elevation. I should estimate the vertical thickness of these beds at from 400 to 500 feet, but it is quite possible that further supplies may be cut before the entire series is penetrated.

Boring near Wyndham.

Mr. Woodward also reported upon the cores from the bore near Wyndham in which a half-inch seam of coal was cut at a depth of 115 feet, which when assayed yielded:—

Moisture	..	..	..	1.74
Volatile Hydrocarbons	..	..	..	42.80
Fixed Carbon	..	..	..	51.52
Ash	..	..	..	3.94

"The beds passed through to a depth of 159 feet consist of a series of shales and sandstones which have been classed as Upper Carboniferous from their relation to rocks of undoubted Lower Carboniferous and Devonian age.

"Since in this series a small seam of high-class coal has been cut it is possible that others of workable size may also be met with. This point, owing to the geographical position of Wyndham, is of the very utmost importance, since if a good seam of coal of this quality could be obtained in this locality the mines would command the entire trade of the Indian Ocean."

Owing to my prolonged absence from town so large a portion of Mr. Woodward's time was occupied upon official correspondence and other duties including the revision of the publications for press that he

has had little time for field work during the past season, his total being only 60 days spent out of town upon official duties during the year under review.

W. D. CAMPBELL, ASSISTANT GEOLOGIST.—In the early part of the year 1907 this officer was engaged in bringing his work for the Kalgoorlie statistics and mining plans up to date.

Wolfram and Tin near Brookton.

Towards the end of January, a specimen (L2848) was received from Mr. N. Nesbitt for determination, and proved on examination to consist of wolfram (tungstate of iron and manganese). The locality from which it came is stated to have been from a spot 60 (16?) miles east of Brookton.

In the early part of last month, two samples were sent in from Mr. J. O. Summers of the York Hotel, York; the first consisted of a good sample of stream tin, which yielded in the Survey laboratory 66.5 per cent. of tin; whilst the second proved to be an admixture of quartz and wolfram, identical in its character with that sent in by Mr. Nesbitt. The locality from which these came, as declared to the Department, was 60 (16?) miles south-east of Brookton, and the two were obtained from spots 8 miles apart.

From information which subsequently came to the knowledge of the Department, it appeared that the first sample from Mr. Nesbitt was obtained from a spot on the Avon River Valley about 12 miles east of Brookton.

Having due regard to the present high prices of both tin and wolfram and the importance of obtaining some further knowledge regarding the occurrence thereof, Mr. W. D. Campbell, Assistant Geologist, visited the district and reported to me as follows:—

"I have visited the Wolfram lode at Mr. Nesbitt's. It is in Loc. 5868 and adjacent portion of 6100 on its south side; it strikes 20 degrees and underlays east at a high angle; there appear to be two parallel granite lodes with quartz veins contained in the lease applied for by Mr. Nesbitt. I cannot say what is the exact width of the lode but about 23 feet was exposed at the time of my visit; the surface indications show a poor proportion of wolfram in the lode. I searched the bed of the river Avon near Nesbitt's but did not see any indications of tin deposits; if any has been obtained it has probably been adjacent to the lode.

"I saw Mr. J. O. Summers at York Hotel, York, but he would not give me any exact position where the tin he sent for analysis came from, beyond saying that it came from the river bed east of Mr. Nesbitt's on the south side of Loc. 7677, and that he would shortly continue his prospecting. This place is where there are some granite outcrops and coarse sand. I saw this place and panned off several dishes without success, as already reported above."

Operations do not appear to have been carried sufficiently far on the deposit to enable very much information to be given about it. It is however important to note that it occurs in a new locality. Wolfram is marketable, and in this instance it seems to be merely a question of concentration provided the mineral occurs in such quantities as to make it worth the expense. The deposit would certainly seem to be worth prospecting on judicious lines.

He then took his long service leave amounting to three months and two weeks annual leave, after which he prepared his plans, etc.

At the end of July he visited Eradu with the object of selecting a site for the State-subsidised bore to be put down by the Geraldton Coal Company and reported as follows:—

Boring for Coal at Eradu, Greenough River.

"I have to report that I arrived at Eradu on Thursday night, 25th inst., with the boring foreman, J. Milne, and on the following day I took the positions and heights of the various bores. From these data, I find that the true dip of the coal seam is in the direction of 102½ degrees true bearing, and its amount is 5 degrees 38 minutes.

"The nearest Crown land in this direction is the commonage about 70 chains distant; I have therefore pegged a site for the No. 2 deep bore at the south-west corner of the commonage, north of the railway. It is half a chain from the railway boundary and two chains from the corner which is fenced. Mr. Hindley saw the peg and said that he was satisfied.

"The calculated depth of the coal seam here would be 646 feet, as shown in the statement below, but in all probability the dip lessens farther east so that the probable depth to expect would be 600 feet.

Depth of coal seam in Calyx bore	
No. 1	121 ft.
Depth of this bore site below	
Eradu Railway Station ..	50 ft.
Height of proposed site above	
Eradu Railway Station ..	30 ft.
Calculated increase of depth in distance of 70 chains	455 ft.
	656 ft.

"I returned to Geraldton on Saturday evening and on Sunday I was asked to stay so as to be present at a directors' meeting on Monday; this I did and explained what I had done. It appears that they had let a contract with Mr. Hindley to bore at Depôt Hill and this will be transferred to Eradu; they said that Hindley had arranged to employ an experienced foreman.

"The Government has offered to either supply a foreman in charge of boring or a representative to preserve a record of the strata and sample. The latter would be the arrangement required, as I explained to the meeting that to have a Government foreman and a contractor as well would be to create the trouble that has occurred with the bore already put down. The syndicate, or contractor, have portions of a boring plant already at Eradu, and Mr. Hindley asked whether he could now "go ahead," but I told him that I could not give him any instructions.

"Four directors were present at the meeting besides Mr. Pope, and after discussing matters generally, including Depôt Hill, which I endeavoured to show them would have only duplicated the Atkinson bore, they said that they would endeavour to have matters arranged quite clearly in regard to the new bore.

"I examined the strata in the neighbourhood, and I consider that they are all belonging to one series, including the cliff to be seen at Eradu Pool, which I included in the other series of sandstones in my report on the Greenough River last year.

"On Saturday I drove out with Mr. Milne's guidance to Pearse's farm, No. 2828, about 11 miles in a direct line north-westerly, where some carbonaceous beds have been found in sinking a well, and also to

Forrester Bros.' farm, 2½ miles farther, where a carbonaceous seam occurs in a gully.

"The route traverses undulating sand plains until within a mile of Pearse's, when an outcrop of horizontally-bedded sandstones appears on the west side of a hill near the track. At the farm the soil is clay, and a well has been sunk 79 feet through dark-coloured clay, and a bore below this went into a dark carbonaceous shale to 104 feet, but no water was found. This spot is about 400 feet above Eradu. At Forrester's the height is 100 feet lower than at Pearse's and the carbonaceous material occurs in the stream bed for a distance of one-third of a mile, and also in patches on the south bank.

"The soil in this neighbourhood is rich in patches, which probably denotes clay and shale beds where not covered by the sandstone, probably all belong to the carboniferous series, and it might be worth while to put down a bore at one or both these localities, at least I would suggest this. The nearest railway station would be Northern Gully.

"The accompanying plan shows the correct position of the Calyx bore and Nos. 1 and 2 hand bores, and the site for the proposed new bore and the localities visited.

"I attach also a diagram of the bore and graphic representation of the strike and dip.

"I can send a sample of clay and carbonaceous bed from Pearse's when I send some samples from Minginew in a few days time.

"By invitation of the Mayor, I accompanied him to the site of the proposed source for a water supply for the town. This is about three-quarters of a mile south of it, where a good supply of fresh water is found to be procurable from a hollow in the sand dunes, the surface is about 17 feet above the sea; springs appear to occur in a trench that has been cut across the hollow. The Mayor (Mr. Armstrong) appears to have been the originator of this proposition."

After this he commenced a detailed examination of the Irwin River coal measure series, upon which piece of work he is still engaged.

During the year he has been engaged in the field for 148 days and at the head office 107 days, the balance being taken up by his leave of absence.

C. G. GIBSON, ASSISTANT GEOLOGIST.—From January 2nd to May 27th this officer was at the head office, principally engaged in preparing his maps and reports and compiling statistics for publication as Bulletin No. 28.

Between May 27th and 30th he visited Yandanooka to report upon some new copper discoveries, the following being his report:—

Copper Deposits at Yandanooka.

"In accordance with instructions, I visited Yandanooka and made an examination of the copper deposit recently reported by Mr. W. B. Gordon.

"The deposit is situated on private property adjoining the Midland Railway line on the east side, and about three and a-half miles on the Perth side of the Yandanooka siding. The only work done consists of a few costeens and potholes—the deepest being only about 12 feet—in two or three of which a small body of copper ore has been exposed.

"In the north costeen, which is about 10 feet deep, from three to four feet of siliceous lode matter has been exposed, this carries small seams of carbonate—with a little sulphide—of copper throughout, but

taken in bulk, *i.e.*, as far as opened up, it is of low grade.

"Some eight chains south from here are several other costeens, two of which expose copper-bearing material; the more northern of these shows two to three feet of copper-stained material, but the country is too broken—the costeen being only five or six feet deep—to form any idea of the probable value of this; so far it is pretty low grade (a sample subsequently submitted by Mr. Gordon from a depth of 10 to 12 feet gave on assay 9.00 per cent. of copper).

"In the most southern costeen—which is about 12 feet deep—some 18 inches of lode matter is exposed; this consists of rubbly copper-stained lode material, carrying rounded lumps or boulders of rich sulphide and carbonate ore; these lumps of ore are up to six and eight inches in diameter, and consists of a mixture of chalcocite (black sulphide) and malachite (green carbonate), and are apparently the remains of a small rich seam of ore. This seam should be worth opening up into settled country.

"The following are the results of the assay of two samples of ore from this southern costeen:—

No. 1: copper, 33.16 per cent.; gold, 21grs. per ton; silver, 16dwts. 7grs. per ton.

No. 2: copper, 55.53 per cent.

"No. 1 is a 'grab' sample broken from a number of the 'boulders.' No. 2 is a sample of the unweathered part of one of the 'boulders.'

"The lode exposed in the most northern costeen appears to be running about north-east and south-west, and that in the south about north and south. The connection has been proved between the two bodies, and they do not appear to me to be continuous.

"The whole of the surface is covered to a depth of several feet with a secondary deposit of travertine, and no outcrops are visible. The deposit occurs in a belt of volcanic tuff interbedded in sandstones, and is about a quarter of a mile from the junction of these with the main western body of granite; the sandstones and tuffs are the continuation of the Arrino belt.

"Owing to the superficial covering of travertine it is impossible to follow the line of the copper deposit, but there does not appear to me to be the least likelihood of its extending into the Government land on the south-west side of the railway line."

From May 31st to July 3rd he was engaged upon the compilation of the *Baser Metals Bulletin*, No. 30, also in preparations for reporting upon the Bonnievale and Kintore districts.

From July 3rd to August 10th he was engaged in the field in making a geological examination of the Bonnievale, Kunanalling, Kintore, Carbine, etc., districts, returning to Perth upon August 11th, after which he was engaged upon his plans and report until September 19th, when he started for the Black Range district, after making an examination of which he took his annual leave, returning to Perth on November 23rd, since which date he has been engaged upon the preparation of his report.

During the year he has been 95 days in the field and 270, less his annual leave of 14 days, were spent in office work in Perth.

H. W. B. TALBOT, FIELD ASSISTANT.—In the early part of the year this officer was engaged at the Perth Exhibition, and later on upon the

removal and return of the specimens lent. After this he prepared a series of large scale plans of the Greenbushes tinfield, to which district he proceeded upon April 3rd in order to carry on a topographical survey, which occupied him until June 17th, from which date until August 5th he prepared plans of the Phillips River district, with the object of carrying on a similar piece of work which he started on the latter date, and had not completed at the end of the year.

During the year this officer has spent 235 days in the field and 130 in town, the latter including his annual leave.

LABORATORY WORK.

Mr. E. S. Simpson, the Mineralogist and Assayer, who has, as usual, the control of the operations in the Laboratory, reports to me as follows upon the work of the year carried out under his more immediate direction:—

"In the accompanying table is a statement of the samples entered in our books for assay, etc. These figures again establish a record for the laboratory, the number of examples showing an advance of 33 per cent. and the number of assays and analyses 45 per cent. on the figures for last year. As this increase was largely in assays of tailings made for the State Batteries Branch, arrangements were made with that branch to pay the salary of another Assistant Assayer, Mr. D. G. Murray being appointed to the position. A labourer was employed for as great a part of the year as funds would allow. Such a one should form a permanent portion of the staff as otherwise it is impossible to avoid the accumulation of arrears, besides which professional officers are obliged to waste their time over labourers' work. For the same reason there is a need for a junior in the laboratory, either as messenger or cadet, as the correspondence alone entails a lot of clerical work, over 1,000 letters and certificates having been written besides minutes on departmental files. It is to be remembered that whilst the accompanying table gives a complete list of samples entered in the office registers, fully half the time of the staff is employed in attending to matters incapable of tabulation. Thus almost the whole of my time during the last quarter of the year was devoted to the preparation of a mineral exhibit for the Franco-British Exhibition, whilst most of the rest of my time was devoted to correspondence, museum work, assisting field officers in the petrological and mineralogical examination of their collections, etc. During the year a bulletin entitled "The Distribution and Occurrence of the Baser Metals in Western Australia" was prepared in collaboration with Mr. C. G. Gibson, and subsequently published.

Miscellaneous Mineral Notes.

Several minerals not previously recorded as occurring in this State were noted during the year, *viz.*:—

Meymacite (hydrated oxide of tungsten), resulting from the alteration of wolfram by sulphuric acid derived from decomposing pyrites. Locality described as Wodgina District, probably Black Gin Range, 20 miles west of Wodgina.

Tağılite (hydrated phosphate of copper), from the walls of a cave (*Jingemia*), containing much bat and marsupial guano at Watheroo.

Amazonstone, variety of *Microcline* (silicate of aluminium and potassium). Locality, Cape Arid.

Zoisite (hydrated silicate of aluminium, calcium and sodium), in large porphyritic masses in fine-grained greenstone, at Sir Samuel.

Hemimorphite (hydrated silicate of zinc), somewhat plentiful in copper-lead ore, Lennox's Find, Mt. Edgar."

Classification.	Public.		Departmental.		Total.
	Pay.	Free.	Geological Survey.	Other Departments.	
Total samples dealt with	128	688	111	565	1,487
Assays for gold	88	313	36	403	840
Assays for silver	13	202	24	32	271
Assays for mercury	1	1	...	...	1
Assays for copper	35	152	14	19	220
Assays for tin	6	63	1	3	73
Assays for lead	6	31	7	10	54
Assays for antimony	...	2	...	4	6
Assays for bismuth	...	2	...	...	2
Assays for zinc	...	4	...	8	12
Assays for nickel	...	5	...	1	6
Assays for cobalt	...	4	...	...	4
Assays for iron	...	4	...	...	4
Assays for manganese	...	7	...	...	7
Assays for aluminium	...	1	...	...	1
Assays for tungsten	1	16	...	...	17
Assays for tantalum	1	4	...	...	5
Assays for niobium	1	4	...	...	5
Assays for molybdenum	...	3	...	...	3
Assays for thorium	...	3	...	...	3
Assays for cerium	...	2	...	...	2
Assays for phosphorus	...	36	...	1	37
Assays for nitrogen	...	3	...	...	3
Assays for tellurium	...	1	...	...	1
Analyses complete	...	8	25	25	58
Analyses proximate	...	6	4	5	15
Analyses partial	...	2	7	2	11
Determinations of rocks and minerals	10	299	30	84	423
Calorific valuations	4	9	3	4	20
Gold specimens valued	...	...	...	55	55
Miscellaneous	...	13	5	10	28
Totals	165	1,200	156	666	2,187

GEOLOGICAL COLLECTION.

During the past year the collection has been increased by 736 specimens collected by the staff in illustration of their reports and maps, in addition to many which have been presented to the Department which bring the total number in the register up to 7,832; of microscopic slides there have been 119 made, making a total to date of 838.

The various members of the staff have taken 64 photographs of various subjects connected with their work, several of which have been reproduced in illustration of their reports, whilst others have been enlarged for use in the Museum. The total number of registered negatives of geological and cognate subjects now amounts to 354.

In order that an effective display may be made of the specimens collected during the last 11 years in illustration of the geological structure and mineral resources of the State, increased Museum accommodation has become a necessity and it is to be hoped steps will soon be taken tending towards this end.

In last year's annual report attention was drawn to the need for getting together a collection which would find a place in the Survey Museum and be available for exhibition in any part of the world as required. The need for the nucleus of such a collection has been rendered apparent in connection with the display which it is hoped to make at the Franco-British Exhibition in London in 1908.

The Survey collection has been drawn upon to meet requirements, but in respect to the telluride minerals our collection has left much to be desired. In a lecture on "The Foundation Stones of Western Australia," delivered by myself in Perth and Kalgoorlie in 1907, I drew attention to this in the following words:—

"Kalgoorlie being the home, as it were, of the (West Australian) telluride minerals, it is strange though true that our National Institutions do not possess an adequate typical collection thereof, despite the fact that a unique, magnificent, and costly collection was despatched from this State for exhibition at Paris and Glasgow, almost all of which were either melted down, sold, or give away, and now adorn the show cases of European Museums, practically none were retained for the Museum of the State itself. If specimens of this kind are not preserved for science before it is too late they are lost for ever."

It is to be hoped that the collection which is about to be despatched to the Franco-British Exhibition to be held in London in 1908, will not be dispersed without effort being made to secure for the National Collection such of the specimens as may be held to be of educational and scientific value. Many specimens possess both an educational and scientific value far in excess of their metallic contents, and should find a permanent resting place in the Geological Survey Museum.

PUBLICATIONS.

The following is a list of the different publications issued by the Geological Survey during the year:—

Annual Progress Report for the year 1906.

Miscellaneous Reports, 1-8. *Bulletin No. 26*, containing:—Possibility of the Occurrence of Artesian Water in the Northampton and Geraldine Districts; On the Country between the Ashburton and Minilya Rivers, with a view to determining the Northward Extension of the Gascoyne Artesian Area; The Phosphatic Deposits near Dandaraga; Notes on a Meteorite from the Nuleri District; The Geology of Princess Royal Harbour, with reference to the occurrence of Oil; Notes upon a Geological Map of the Greenough River District; Recent Advances in the knowledge of the Geology of Western Australia; and The Prevention of External Corrosion of Goldfields Water Supply Pipes.

Palæontological Contributions to the Geology of Western Australia. *Bulletin No. 27*, containing:—Plant Remains from the Collie Coalfield; Notes on Fossils from the Collie Coalfield in the Collection of the National Museum, Melbourne; Fossils from Mingenew, Irwin River Coalfield; Descriptions of Carboniferous Fossils from the Irwin River; Foraminifera from a Calcareous Marlstone, Gingin.

The Geology and Mineral Resources of Lawlers, Sir Samuel and Darlot, Mount Ida, and a portion of the Mount Margaret Goldfield. *Bulletin No. 28*.

A Report upon the Geology, together with a Description of the Productive Mines, of the Cue and Day Dawn Districts. Part I.—Cue and Cuddingwarra Centres; Part II.—Day Dawn Centre. *Bulletin No. 29*.

The Distribution and Occurrence of the Baser Metals in Western Australia. *Bulletin No. 30*.

The Geological Survey Library now contains 2,740 volumes devoted to works on Geology, Mineralogy, and other kindred subjects; of these 514 have been added during the year, 481 having been received as donations from various Geological Surveys and Mining Departments throughout the world, and 33 having been acquired by purchase.

A very large number of Geological Maps have been presented to the Department, principally from the United States of America and the various State Surveys; also from the Geological Survey of Great Britain and Ireland, Canada, Cape of Good Hope, Transvaal, Natal, British Guiana, India, Russia, Sweden, Austria, Java, the Philippine Islands, Japan, New Zealand, and the other States of Australia.

I have, etc.,

A. GIBB MAITLAND,
Government Geologist.

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