is present. The lime is for the most part quite impalpable and has been produced by an accumulation of tiny gasteroped shells, exfoliated shells, shell fragments, and chemically precipitated lime, the last mentioned substance forming apparently the bulk of the deposit. Associated with this material are numerous diatoms.

Partly surrounding the lake, more especially along its Western side are ridges of Coastal Limestone, the material from which finds its way into the lake during the heavy winter rains; as the summer approaches the lake shrinks considerably in volume, with the result that the water becomes supersaturated with lime and chemical deposition takes place.

Judging from a cursory examination of the shores of the lake, I have little doubt but that an extension of the deposit will be found to occur to the West of the lake on the Government reserve.

Where resistance to the further passage of the pole through the lime was met, an examination of the bottom surface of the pole indicated the existence of a thin deposit of guano beneath the loose lime.

Mr. Claude Newnham of the Boulder Farm, Waroona, has a lease (No. 411/41A) of about 700 acres of the central portion of the lake bed, but the deposit certainly extends far beyond his lease boundaries. The existence of the lime here had apparently not been detected previously to Mr. Newnham's discovery, and some credit is due to that gentleman for the persistence with which he sought for sui able lime deposits in his district for agricultural purposes; the actual fact that the water-covered bed of the lake was one immense deposit of lime might easily have escaped the notice of a geologist.

A strong smell somewhat resembling that of phosphoretted hydrogen is given off when the lime is disturbed below the surface.

Especially along the Eastern shore small circular patches of fairly compact lime are forming as the result of the growth of colonies of small organisms, but the deposit appears to be entirely superficial.

Owing to the receding of the water of the lake in the summer months, the lime forming edges of the lake becomes dried and is inclined to form small soft lumps, but this feature disappears with the return of the winter months.

A carefully averaged sample of the centre of the lake was secured by me from a depth of one foot below the surface of the deposit; this sample has been reported upon by Mr. Simpson, Chemist and Assayer, in the following terms:—

The material submitted was a fresh marl composed mainly of carbonate of lime precipated partly by organic and partly by inorganic chemical agencies in a very finely divided state. An analysis on a sample dried at 100°C showed the presence of:—

	Per cent.
Lime, CaO	48·88
Carbon dioxide, CO_2	37·07
Organic matter (including Nitrogen, 0·32 per cent.)	8·93
Silica, SiO_2	1·61
Magnesia, MgO	1·01
Iron oxide and Alumina	·24
Sulphur trioxide, SO_3	·39
Phosphoric oxide, P_2O_5	·09
Salt, NaCl	2·02
	100·24

Approximately 47 per cent of the lime is present as carbonate (84 % $CaCO_3$), the small remainder being present in combination as sulphate and as a salt of one or more organic acids.

The variety of carbonate of lime in the sample is not calcite, which is that found in almost all limestones, but aragonite. This is of importance in connection with the utilisation of this material as a fertiliser since aragonite is known to be more susceptible to the attack of rain water and ground water than calcite. The minute size of the particles of aragonite will ensure a maximum activity in the soil.

A considerable percentage of nitrogenous organic matter is present, the value of which as a fertilising agent must not be overlooked.

The silica shown by analysis exists almost entirely in the form of siliceous skeletons of diatoms and fresh water sponges.

The proportion of salt in the marl will naturally vary with the season, being dependent entirely on the quantity and degree of concentration of the water associated with the deposit. It will be least during the rainy season, and highest at the end of summer.

A considerable deposit of somewhat similar material occurs in Martin Tank, Salt Lake, and a group of small salt lakes near by, but owing to the heavy amount of saline matter present I do not consider that much attention need be directed to these occurrences in view of the more accessible deposit in Lake Clifton itself. In view of the possible deterioration of the lime by the deposition of salt at the end of the summer, I would suggest that the material be raised during the early part of the season in order that the extra supply of water may be present in the lake; at this portion of the year the salt present would be in solution and would therefore be practically absent from the lime itself.

At the present time this deposit is, of course, too far removed from a railway for cheap transport, but in the event of the construction of the suggested Pinjarrah to Brunswick Junction loop line it would only be about 1½ miles from the latter, to which it could be easily connected by a spur line.

The working of the deposit presents no difficulties whatever as the material could be cheaply taken out either by a dredge or by means of a sand pump or other similar appliance; staging would need to be erected on which the material could be dried before being removed.

Taking into consideration the fact that there are many millions of tons of lime cheaply available and in an excellent physical condition for direct application, there is no doubt but that in Lake Clifton the State has a remarkably fine asset which will very materially assist in the utilisation of the extensive swamp and other lands in the South-West and elsewhere. In my opinion the material forming the lake bed is all of a very similar composition to that of the sample referred to previously, but careful systematic sampling of the deposit is recommended before any serious attempt is made to exploit the deposit.

MINING, ETC.

The Country North of Lake Way.

The principal results of Mr. Talbot's field work in the country to the North of Lake Way are set out in the preliminary report which he has prepared and which is given *in extenso*:—

The following is a short description of the country examined during the past season.

In addition to the Wiluna greenstone area,* the boundaries of which were mapped to its southern limits and northwards as far as the Gascoyne River, three greenstone areas have been placed upon the maps with some degree of accuracy. The most westerly of these † lies about 20 miles to the S.-W. of Wiluna. Its southern point reaches the Wiluna-Nannine road at the Bore well, at its northern end it disappears under the sedimentary series which extends westwards from the Finlayson Range and, in all probability, it is only a branch

* Lands Department Lithos. 53/300, 60/300 and 71/300.
† Lands Department Litho. 60/300.

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

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

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

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

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

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

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

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

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

The most interesting geological feature seen during the season's field work was the large area of sedimentary rocks occurring in the vicinity of Charles Wells Creek and Lake Carnegie|| these consist of sandstones, shales and limestones. This sedimentary formation, on its Western and Southern edges rests upon granite and outliers of this latter rock are seen in places in the Princess Range. At the Northern boundary of the sedimentary area the beds are seen resting unconformably upon the upturned edges of the belt of metamorphic slates which were fully described in Bulletin 39§. The basal beds consist of soft fine-grained sandstones overlain by grey and blue shales as the belt is followed Eastward thin bands of limestone, about an inch in thickness, are seen interbedded between the shales. A series of excellent sections of these shales and limestones were seen in a traverse made down Charles Wells Creek. As the Creek is followed eastward the limestone beds become thicker and more numerous and near the crossing of the Wongawall track a bed of limestone about five feet thick was seen. The shales and limestones are overlain by coarse flaggy sandstones and quartzites. These latter form isolated hills and rough broken ranges and the quartzites are invaribly found on the tops of these. These are of no great thickness and represent sandstones indurated by the deposition of secondary silica drawn to the surface by capillarity. This surface induration is quite common throughout the interior of the State, in fact it is only rocks seen in cliff sections that are not more or less indurated. The amount and direction of the dip in the beds forming the sedimentary series described above varies in different localities. In some places they are almost horizontal and the greatest angle at which the beds are inclined is about twenty degrees. This latter dip, however, is seen only in the vicinity of faults or local folds of which a few were seen. The mean dip of the beds is about 5deg. and the prevailing direction is to the North-East.

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

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

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

The Northern Portion of the Kalgoorlie Goldfield.

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

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

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

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

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

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

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

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

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

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

---

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

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

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

|| Lands Department Lithos., 61/300.

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