accident to the boring rods, operations were stopped in both cases without having unequivocally reached the base of the Coal Measures.

Gascoyne River.—Undoubted Carboniferous Rocks being known to exist on the Gascoyne River, the possibility of the occurrence of commercial coals associated therewith is apparent. In view of the utility of such in connection with the exploitation of the Murchison iron ores, the Government are putting down a bore on the coast at Carnarvon. This bore has now attained the depth of over 2,000ft.,* and, after piercing a considerable thickness of Tertiary Rocks, entered the Carboniferous Series at about 1,200 feet. The bore is now in progress, and it is contemplated continuing it until the base of the formation has been unequivocally reached, when the question of the occurrence of coal seams will be definitely settled.

Summary.—The ores of iron are very widely distributed in Western Australia. The deposits of the Murchison stand out prominently before any of the others yet reported upon, but, owing to their geographical position, they are practically valueless under present conditions. Although practically neglected at present, they are destined to form a very important State asset. No detailed geological surveys of any of the Murchison deposits having yet been made, an approximate estimate of the minimum quantities of ore in sight in any one of these deposits cannot be made. No coal suitable for smelting has yet been found in the State.

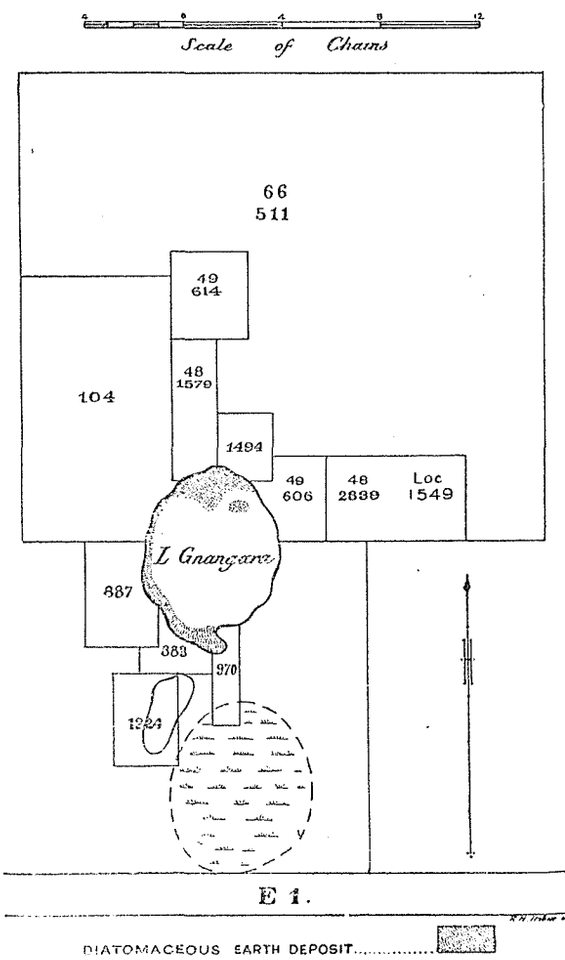
Diatomaceous Earth, Wanneroo.—The discovery of an extensive deposit of Diatomaceous earth at Lake Gnangara, in the Wanneroo district, formed the subject of the following report by Mr. Simpson:—

"The first sample of this material was sent to the laboratory, through the medium of the Hon. the Minister for Mines, by Mr. W. B. Gordon, M.L.A. It was marked "clay," and a report was desired as to its value and possible applications. It has been partly calcined, and a preliminary examination revealed its extreme lightness, and also that it was composed mainly of silica (78·26 %), alumina (9·44 %), and water. This pointed to the probability of the material being a silicious infusorial earth, and a subsequent examination proved that it was composed almost entirely of the skeletons of the minute algæ known as Diatoms, and of equally minute fresh-water sponges (Spongilla).

Through the courtesy of Mr. Gordon and Mr. McLeod, the owner of the land adjacent to the main deposit, I have been able to inspect the deposit *in situ*. It occupies the northern and western edges of Lake Gnangara, a permanent fresh-water lake eleven miles due north from Perth, and about four miles north-east of Wanneroo.

PLAN OF
LAKE GNANGARRA — SWAN DISTRICT

SHEWING PROBABLE EXTENT OF DIATOMACEOUS EARTH DEPOSIT



* On the 8th of June, 1903, the depth reached was 2,611 feet.

At the time of my visit (October, 1902), the main deposit was found to form a quaking bog, with a smooth surface starting immediately at the foot of the sandy banks on the northern shore of the lake at a height of a few inches above water level, and sloping gradually towards the lake, beneath the surface of which it passes. The whole deposit is covered with a scanty growth of reeds, and, from all appearances, is still in process of formation. Opposite blocks 48/1579 and 10/357 these reed beds are seen to extend out into the lake for about 10 chains, and may be taken as a rough indication of the extent of the deposit. On the shore side it passes under the sand banks for some little distance, as evidenced by the quaking nature of the latter close to the lake on the north side.

Towards the east the reed beds gradually become narrowed, and finally disappear near the boundary of blocks 10/357 and 49/606, where they give place to a beach of fine, white sand, mixed with small pebbles of dried diatom-earth. Towards the west, also, the deposit narrows, but does not disappear altogether, continuing as a narrow edging to the lake, more or less obscured by drift sand, etc., all along the west side and possibly also (judging by the reeds) the extreme south side.

It was found that for a few yards from the shore on the north side the deposit had dried sufficiently on the surface to support the weight of a man, though not that of a horse or other beast. The surface quaked considerably with each step, and was composed of moist earth, dark brown in colour, and somewhat sun-cracked, on the top of which were scattered small, dry flakes of the same earth, almost white in colour. These latter floated readily when thrown into water. The earth could be easily dug out with a spade in large blocks, resembling sticky, dark-brown clay, the hole subsequently filling in with water. By means of a short pole, a hard bottom was felt in one place at a depth of five feet; in other places bottom was not reached at that depth.

It was impossible to visit the south-western corner of the lake, where the reeds widen out somewhat; whilst the existence of any notable quantity of the earth along the western shore is more or less hypothetical. Owing to the deposit dipping under water at a short distance from the shore on the northern side, the extent southwards of this, the main deposit, can only be conjectured. Assuming it to have an area of at least 15 acres, with an average depth of five feet, there would be about 75,000 cubic yards of the moist earth available. This would yield (as shown by experiment) 45,000 cubic yards of calcined earth, weighing, roughly, 8,000 tons.

The deposit is saturated with water, and very rich in organic matter. When dug up and exposed to the sun and air, it dries to a tenaceous mass of a dirty white colour on the outside and a light brown within. In this condition it floats readily on water, and, on being thrown into a fire, will smoulder until all organic matter is burnt out of it, leaving an extremely porous mass, which is somewhat tender to handle. During air-drying and calcination, a shrinkage occurs from 100 volumes of crude wet earth to 66 in the first process, and still further to 60 in the second.

The following is the analysis of the partly calcined earth submitted by Mr. Gordon:—

Water and Organic Matter lost at 100°	5·63	per cent.
Water and Organic Matter lost on ignition	16·69	,,
Silica, SiO_2	67·72	,,
Alumina, Al_2O_3	9·98	,,
Iron protoxide, FeO	Trace	
Lime, CaO	·22	,,
Magnesia, MgO	Trace	
	100·24	
Silica in calcined earth	86·91	per cent.

Several samples of the crude earth were collected by myself at Lake Gnangara, and the following results were obtained from an examination of a sample from about 12 inches below the surface of the deposit on the north side of the lake. The detailed analysis was made on the air-dried sample, and the other analyses calculated therefrom.

Analysis.	Crude wet.	Air-dried.	Calcined.
	per cent.	per cent.	per cent.
Moisture and organic lost on air drying	77·88	*Nil*	*Nil*
,, ,, ,, at 100°	2·48	11·20	*Nil*
,, ,, ,, on ignition	7·93	35·79	*Nil*
Silica, SiO_2	10·89	49·08	92·96
Alumina, Al_2O_3	·78	3·51	6·65
Iron protoxide, FeO	Trace	Trace	Trace
Lime, CaO	·03	·16	·30
Magnesia, MgO	·01	·05	·09
	100·00	99·79	100·00
Bulk specific gravity	1·145	·383	·232
Relative change in weight	100·0	22·1	12·2
Relative change in bulk	100·0	66·1	60·2

Under the microscope, the earth is seen to be composed of a felted mass of siliceous spicules, in which are embedded numerous diatom frustules, of perfect form. They belong mainly to the groups of Naviculeæ and Eunotieæ, a very large species of Pinnularia being especially noticeable. The genus Bacillaria, which is said to yield the best dynamite, is apparently entirely absent.

Diatom-earth (called also infusorial earth, diatomaceous earth, tripoli and kieselguhr) has been put to a great many uses, owing to its lightness, its abrasive power, its great absorbent power, and its low conductivity for heat. Foremost of its uses is that of an absorbent for nitro-glycerine, the resulting mixture being known as dynamite. The Wanneroo earth would not appear to be well suited for this purpose, owing to the high percentage of alumina in it, and also owing to the forms of the diatoms present in it. It is eminently suited for the manufacture of disinfectants by the absorption of phenol, etc., as well as for lining cold storage rooms, and railway wagons, and as an ingredient for refrigerating paint. Owing to the extremely small percentage of iron and other mineral impurity present, it would be an excellent source of silica for the manufacture of soluble and other glass. It could be used as an ingredient of metal-polishing powders and soaps. For all these purposes it would require to be calcined and crushed."

The Reputed Petroliferous Deposits of the Warren and the Donnelly Rivers.—Considerable attention having been directed to the reputed occurrence of petroleum in the country drained by the lower reaches of the Warren and the Donnelly Rivers, it has been considered desirable, owing to the fact that the conditions governing the occurrence of petroleum depend upon considerations of geological structure, that an examination of the locality should be made with a view of determining how far the conditions prevailing on the Warren and the Donnelly had any bearing on the future of the district.

The structure of the country drained by the Warren and the Donnelly is of extreme simplicity, as can be seen by a reference to the two sketch sections following, which may be regarded as typical of the country in this district.

A large quantity of bitumen is reported to be washed up and left by the receding waves all along the South Coast of the State, but more especially in that portion between Cape Leeuwin and Point D'Entrecasteaux, into which the Warren and the Donnelly Rivers empty themselves.* No trace, however, was seen by me of asphalt anywhere along the beach. Somewhat similar material has been reported as being found on the beach at many different localities round the shore of the Great Australian Bight. These fragments are washed up from sources at present unknown.

The formations exposed consist of:—

(*a.*) *Superficial deposits*, comprising sand dunes, alluvial deposits, etc.
(*b.*) *Basaltic lavas.*
(*c.*) A series of *sandstones, grits, clay shales,* and *coal seams,* and
(*d.*) *Crystalline rocks,* which form the floor upon which the other formations were laid down.

The Warren River.—The Warren River flows over the hilly country, composed of crystalline rocks, until within a short distance of the coast, when it eats its way gradually to the sea through the sand dunes and peaty swamps which extend for about five miles from the coast.

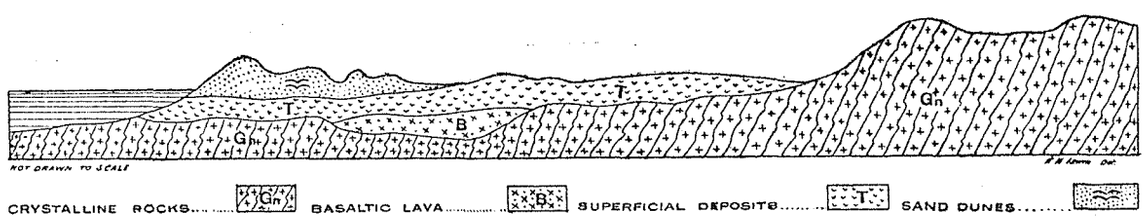
Emerging from the somewhat constricted valley in the hills, the river is flanked on either side by variable width of alluvial deposits. The full thickness of the deposits was not exposed in any single section. In several localities, within a mile or two of the coast, the section in the river exposes at one or two places a deposit of cement, discoloured by vegetable matter—in reality a carbonaceous sandstone. The cement, which rests upon a floor of clay of somewhat variable character, is of not great thickness.

It having been pointed out that this cement yielded mineral oil to such an extent as to warrant its being designated "petroleum rock," two analyses were made in the Departmental Laboratory of the deposit, without any trace of petroleum or asphalt (oxidised petroleum residue) being obtained. It, of course, is conceivable, from the fact that the deposit is exposed at the surface, coupled with the relatively high temperature prevailing during the summer months, that some at any rate of any oil stored therein might evaporate; any such loss would be comparatively insignificant.

The underlying peaty clay ("bituminous clay") also yielded, on analyses in the Departmental Laboratory, no trace of either petroleum or asphalt. Neither of the two deposits can in any sense be regarded as petroliferous.

The local discolouration of the sea in the vicinity has been held to be due to the escape of petroleum from those portions of the rocks which pass beneath the ocean. Owing to the state of the weather it was impossible for me to collect any of the yellowish scum appearing at intervals for analysis, but everything points to the fact that it merely owes its origin to the decomposition of seaweed and the like.

The crystalline rocks make their appearance on the beach beneath the sand hills at high-water mark, some distance to the North of Black Head, which lies to the South of the Warren River. There is every geological reason for believing that they extend Northwards and pass at a relatively shallow depth beneath that portion of the district drained by the lower reaches of Meerup Brook and the Warren River.



GENERALISED SECTION DOWN THE WARREN RIVER.
LENGTH OF SECTION 10 MILES

* H. P. Woodward. The South-Western portion of the Colony. Annual Report of the Department of Mines for the year 1894. Perth: By Authority, 1895, p. 9.