COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF NATIONAL DEVELOPMENT.

BUREAU OF MINERAL RESOURCES
GEOLOGY AND GEOPHYSICS.

RECORDS.

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TABLETOP - 4 MILE GEOLOGICAL SERIES

Sheet F/51-11, Australian National Grid

Explanatory Notes No.18

Compiled by A.T. Wells

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Issued under the authority of Senator the
Hon. W.H. Spooner, Minister for National Development, 1958.

EXPLANATORY NOTES ON THE TABLETOP 4-MILE GEOLOGICAL SHEET

F/51-11

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INTRODUCTION

The Tabletop Sheet covers part of the south-western marginal area of the Canning Basin, between latitudes 22°00' and 23°00' south and longitudes 123°00' and 124°30' east. Lake Dora in the north-west corner of the Sheet lies 308 miles on a true bearing of 112° from Port Hedland on the coast. The area is uninhabited by white people and is not crossed by any roads or vehicular tracks. The Canning Stock Route crosses the south-east corner, and wells, which can mostly be relied upon for ample supplies of good water, have been sunk every 10 to 15 miles along the route. Cattle are periodically driven along the stock route from Billiluna Station in the north to Carnegie Station farther south; but the Sheet area does not and is not likely to support any cattle stations.

Scattered groups of nomadic aborigines wander over the area and depend on water obtained from either the stock-route wells or scattered rock holes and soaks throughout the desert. The native wells and soaks marked on the map were not all visited and are located by reference to old exploration maps and charts. They cannot be relied upon for supplies of water, and any party entering the area must carry sufficient supplies of food and water. The average annual rainfall is generally less than 10 inches.

The area is accessible by 4-wheel-drive vehicle either from the Woody-Woody manganese mine, travelling eastwards parallel to the sand dunes, or from Balfour Downs Station, travelling eastwards and avoiding the large ranges at the head of the Rudall River and then following the Canning Stock Route northwards onto the southern portion of the sheet. The travelling methods and general conditions encountered are

described by Traves & Casey (1954). The area can also be traversed by camel or horse.

History of Investigations

The earliest explorer to visit the area was L. A. Wells, who in 1896 crossed the desert from south to north, starting at Wiluna and finishing at the Fitzroy River. His route passed through the Tabletop Sheet and he named several prominent features in the area. W. F. Rudall also covered a good deal of the area in 1897, looking for the lost members of the Wells Expedition.

The stock route from Wiluna to Halls Creek was surveyed by A. W. Canning between 1906 and 1907. In 1908, H. W. B. Talbot (1910) accompanied Canning when the stock route was opened and published an account of the geology and water supplies; E. Kidson (1914) recorded magnetic observations along the route. L. J. Jones travelled along the route in 1922 and made a geological investigation of Block 21 H (lat. 20-22°S, long. 123°30'-129°E) for the Locke Oil Development Syndicate and Kimberley Petroleum. He found Permian marine fossils north-east of No.27 well.

D. F. McKay (1934) covered a good deal of the Canning Basin during an aerial survey expedition. Aerial photographs were taken and a topographical map compiled from strip maps made during flights. One of his flight lines crosses the Tabletop Sheet. A preliminary aerial reconnaissance of the south-western desert area was carried out by C. St. J. Bremner (1940) for Caltex (Aust.), mainly to assess transport difficulties and the distribution and type of outcrops.

F. Reeves (1949) entered the desert via Roy Hill and investigated the basin sediments at Scott Bluff.

The Sheet was photographed by the R.A.A.F. in 1953 from 25,000 feet, giving vertical coverage at a scale of approximately 1:50,000. Semi-controlled photo-mosaics at

4 miles to the inch, supplied by the National Mapping Division, were used for geological compilation by a geological party from the Bureau of Mineral Resources, which was the first to enter the desert with mechanical transport. In 1956 the party entered the Tabletop Sheet from the south and travelled northwards along the Canning Stock Route as far as Helen Hill. A surveyor from the Lands and Surveys Department, Perth, accompanied the party and took astrofixes. In 1954 the Geophysical Section of the Bureau carried out an airborne magnetometer reconnaissance survey of the southern area of the basin; one of the traverses terminates at Lake Auld.

PHYSIOGRAPHY

The area is composed of practically flat unbroken sand plain, covered by innumerable seif dunes, together with scattered low ferruginous rises and occasional small residual hills. Playa lakes are a prominent feature on the sheet; Lakes Dora, Blanche, Winifred, George, and Auld are salt lakes disposed in an arcuate line. They have been formed by internal drainage, but their distribution and permanency have been controlled by the structure of the Permian rocks: the foundation of the salt lake arc is probably composed of the impermeable Dora Shale. Lake Auld lies at an altitude of 750 feet and Lake Dora at 650 feet, but, from the air-photo pattern of the salt lakes, it appears unlikely that surface water passes from one lake to the other. The bed of the lakes consists of a thin crust of salt and gypsum underlain by at least 18 inches of brine-saturated sand and mud. The salt-water level at Lake Dora was slightly less than 12 inches below the salt crust. Only after comparatively heavy falls of rain is there an appreciable quantity of surface water in any of these lakes. The outline of the lakes is irregular, especially where, on the eastern margins, sand dunes have encroached on to the surface, and the surface extends into the valleys between the

dunes. The extensions between the dunes commonly break into a mass of small salt lakes or clay pans which represent remnants of the lake surface.

There are no well developed drainage channels in the area. Any small streams that drain the low rises are very rarely occupied by surface waters: the migration of water is predominantly subterranean. Water is either lost by evaporation or soaks into the ground. Some drainage channels are present in small rises, monadnocks, and breakaways within the desert, but they rarely extend more than 100 to 200 yards.

The general altitude of the southern portion of the area is 1100 feet. The sand-plain area within the salt lake arc has a maximum elevation of 900 feet, and the lakes are 150 to 200 feet below this. The small hills of the desert, such as Helen Hill, Tabletop Hill, and Thring Rock, rise less than 150 feet above the general level of the sand plain.

The Sheet area is almost entirely covered by seif dunes trending generally west-north-west. They are up to 120 feet high, but average about 40 feet. They are mostly 1/2 to 1 mile apart, but in certain areas up to 8 dunes per mile may be found. The dunes are commonly braided and one dune may posses several crests. Where there are short anastomoses of the dunes the acute angle of the junction points west-north-west in the direction of migration. For about two miles west of the lake edges, the dunes are ill-defined and usually very small, and form a complex pattern; but almost invariably the first half mile from the western shore is free of dunes. On the eastern margin the dunes are well defined, only slightly braided, and abut the lake surface. They continue unbroken over the low rises of Mesozoic and Permian rocks and even encroach on large breakaways, the flat upper surface of which commonly slopes to the east; but they terminate abruptly against the eastern margins of large hills. The dunes have migrated west-north-west, but their movement is now somewhat

restricted by the sparse vegetation which partly covers them.

STRATIGRAPHY *

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* Specimen localities are marked on the Sheet by numbers (e.g. T11); specimens are housed in the Bureau of Mineral Resources' Museum, Canberra.

During the investigation of this area by the 1954 Bureau party emphasis was placed on the stratigraphy of the Permian and Mesozoic rocks, and little time was spent investigating the Precambrian basement rocks. Precambrian, Permian, Mesozoic, and Tertiary rocks have been recognised, and the post-Precambrian sediments are represented by a small thickness of predominantly clastic sediments containing few fossils. Wherever possible existing names have been used, with some slight revision in accordance with the current Australian Code of Stratigraphic Nomenclature.

Precambrian

Lower Proterozoic metamorphics and granite are restricted to the south-western corner of the Sheet. Near the Canning Stock Route they consist of metamorphosed sandstone, quartz-mica schist, and quartzite, and have been intruded by granite and granodiorite, some of which are now gneissic. A sphene-bearing epidosite crops out at T8.

Permian

The Permian glacials and fluvioglacials of the Paterson Formation (Traves et al., 1956) do not crop out in the area but are no doubt present beneath the younger rocks of the central part of the basin. Some rudites below the Cuncudgerie Sandstone in the southern part of the Sheet area may belong to this formation: they have a fluvioglacial aspect, although there is no direct evidence of glaciation in the rock.

The oldest marine Permian fossils were found on the southern part of the Sheet near Well 27 on the Canning Stock Route and confirm the presence of Cuncudgerie Sandstone (Traves et al., 1956). At Helen Hill fossiliferous thin-bedded fine sandstone and shale is overlain by a massive medium to coarse grained ill-sorted sandstone which caps the mesas and buttes in the area.

Outcrops of Dora Shale (Traves et al., 1956) are confined to the eastern margin of Lakes Dora and Blanche, where they form cliffs 50 to 100 feet high. The formation has played an important role in the formation of the salt lake arc, the shale forming the impervious bed of the lakes. Foraminifera collected from Lake Dora have been described by Crespin (in Traves et al., 1956).

Triwhite Sandstone (Traves et al., 1956) crops cut over a very small area. Fossils collected from the formation one mile east of Dunn Soak suggest a correlation with the upper part of the Noonkanbah Formation or possibly the lower part of the Liveringa Formation of the Fitzroy Basin (Dickins & Thomas, in Traves et al., 1956).

Mesozoic

Mesozoic sediments form the most widespread outcrops on the Sheet. The clastic sediments consist mainly of ferruginized sandstone, and current bedding near T3 indicates that the sediments were possibly derived from the south. East of Lake Auld the Mesozoic rocks consist of coarse and medium grained sandstone and fine conglomerate.

Mulga scrub is commonly associated with breakaways of Mesozoic rocks.

The Anketell Sandstone (Traves et al., 1956) contains the worm Rhizocorallium (Dr. A.A. Öpik, pers. comm.) which has been found together with Lower Cretaceous foraminifera on the neighbouring Anketell Sheet. This indicates a marine or brackish-water environment.

Tertiary

Outcrops of argillaceous rocks are covered by vestigial laterite; sandstone has mostly not been lateritized.

Some small deposits of pisolitic ironstone occur on scattered outcrops but are not associated with a well developed laterite profile.

Quaternary

Widespread superficial deposits of sand, either as seif dunes or flat interdune sand plain, conceal bedrock throughout the region. The sand is ironstained quartz, red and brown, mostly medium-grained, but coarse-grained where it overlies granite. Most of it originated from the easily eroded arenaceous rocks or the laterite or both. The sand has probably not been transported very far from its source: the grains are not well sorted. Permian foraminifera found in the "recent" deposits within Lake Dora have been transported not more than three miles from outcropping sandy shales.

The floors of the large salt-pans and clay-pans in the desert are covered with a deposit of thin-bedded clay or silt and evaporites. The evaporites consist of sodium chloride and calcium sulphate, with minor amounts of sodium sulphate, derived from the adjacent Permian marine sediments. Soft calcite forms on the edge of the salt lake and may represent an old expansion of the lake or recent deposition by surface or near-surface water. Travertine at Lake Dora may have been formed by the consolidation of the caliche. Some of the travertine deposits that are rich in chalcedony and silica may be in part directly deposited from lakes.

STRUCTURE

The Sheet can be divided structurally into the Precambrian basement complex of the south-western section and the relatively undeformed sediments of the Canning Basin. The Precambrian rocks were folded and faulted, possibly in the

course of an orogeny during which granite and associated differentiates were injected. The steeply dipping metamorphics and granite probably form the floor of the Canning Basin.

Regional gravity contours indicate a gradual thickening of the Permian and Mesozoic sediments to the north-east. The fossils and lithology of these rocks indicate that they were deposited in an intracratonic basin. The Permian sediments were slightly folded before the Mesozoic rocks were laid down, and this folding is responsible for the position of the Dora Shale, which forms the salt-lake arc; these salt lakes trace the shale outcrop, and show a syncline between Lakes Dora and Auld and probably an anticline between Lakes Auld and Percival. The Dora Shale has a 1° N.E. dip near Lake Blanche, and the Triwhite Sandstone dips $1/2^{\circ}$ to 1° E.N.E. at Triwhite Hills.

ECONOMIC GEOLOGY

Petroleum Prospects: The sediments of the Canning Basin were deposited in an intracratonic basin and are comparatively thin: the petroleum potentialities therefore are determined primarily by the presence or absence of older Palaeozoic rocks and the nature of the basement topography. Not enough geophysical evidence is available yet to indicate any marked irregularities of the basement topography which would result in appreciable thickening of the sediments. Very large basement relief and a structural trend eastward into the basin is indicated by aeromagnetic and gravity traverses and drill holes along the Eighty Mile Beach. These results suggest appreciable relief elsewhere in the basin.

Other Minerals: No metallic deposits of economic value were found in the basement rocks outcropping on the south-western portion of the Sheet.

Water: Surface water is rare and occurs mainly as small rock-holes, minor sand-soaks, or small pools in the rivers, none of which are permanent. The rock-holes are generally found on the top of flat-topped hills in areas of Permian and Mesozoic outcrops. Several soaks on the eastern margin of Lake Dora yield good supplies of fresh water: Dunn Soak yields 60 gallons per hour. These soaks can be found by the thick vegetation that surrounds them, by signs of native habitation, and by the presence of birds and animals.

Supplies of underground water can be readily obtained in the desert areas where Permian and Mesozoic rocks crop out: wells in these rocks along the Canning Stock Route have dependable supplies of water at depths generally from 15 to 30 feet. Shallow wells dug by natives are frequently found in low dissected travertinous country where acacias and stunted ti-tree are common.

Details of the wells on the stock route as determined by Bureau geologists in June 1956 are as follows:-

Well No.	Water Level	Total Depth	Remarks
25	-	-	Filled by sand and rubble to within 5 feet of well top. Stock parties use clay pans a few miles to the south-west. Stock fence, camel whip, and troughing still present.
26	12 feet 9 inches	17 feet 3 inches	Water contaminated by dead birds when visited. No well cover, has camel whip and troughing but no windlass.

Well No.	Water Level	Total Depth	Remarks
27	13 feet 7 inches	23 feet 7 inches	Well has cover, no windlass. Spoils of white medium-grained sandstone, with occasional grains of quartz up to 2 mm. across.

Canning's (1908) original description of the wells on the stock route is as follows:-

Well No.	Original Depth	Supply	Remarks
26	23 feet	2000	Excellent water
27	24 "	230	First class water
28	30 "	840	First class water
29	45 "	230	Good water
30 (Dunda Jinda)	26 "	2000	Good water
31	23 "	3000	Excellent water.

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TABLE I. - STRATIGRAPHY OF THE TABLETOP SHEET

AGE	MAP SYMBOL	FORMATION	THICKNESS (feet)	LITHOLOGY	FOSSILS	ECONOMIC GEOLOGY	TIME EQUIVALENT
QUATERNARY	Qa	Alluvium	10±	Alluvial clay and sand.		Shallow water	Similar deposits occur in neighbouring parts of the basin.
	Ql	Travertine	10±	Travertine, marl & chalcedony.		Shallow water, lime.	
	Qs	Sand	0-120±	Hematite stained quartz sand.		Shallow water near high dunes.	
	Qc	Caliche	5±	Soft calcareous powder.			
	Qt	Evaporites	1±	Salt, gypsum, sodium sulphate.			
CRETACEOUS	Ka	Anketell Sandstone	100±	Sandstone and shale	Rhizocorallium and foraminifera		May be equivalent to Frezier Sandstone (Lindner & Drew, 1958) and to beds at Rumbalara, N.T.
MESOZOIC	Ms	Undifferentiated, including the Callawa Formation.	200±	Ferruginized sandstone and conglomerate.	Plant and wood remains	Water	Possibly part equivalent of Erskine Sandstone of Fitzroy Basin or possibly Parda Formation (Lindner & Drew, 1958).
		SLIGHT ANGULAR UNCONFORMITY					
PERMIAN	Pt	Triwhite Sandstone	50-300	Sandstone and greywacke with concretions.	Astartila blatchfordi Warthia cf. micromphala Ptychomphalina maitlandi	Water	Basal Liveringa or Upper Noonkanbah Formation of the Fitzroy Basin.
	Pd	Dora Shale	50±	Marine fine sandy shale. Probably decalcified.	Foraminifera, including Hyperamina acicula (Parr) and wood fragments.		Noonkanbah Formation of the Fitzroy Basin and Byro Group of the Carnarvon Basin.
	Pc	Cuncudgerie Sandstone	130±	Ferruginous shale and fine sandstone.	Linoproductus, Pseudosyrinx, ? Pachymyonia, etc. in shale.		Nura-Nura Member of the Poole Sandstone in the Fitzroy Basin and Callytharra Formation of the Carnarvon Basin.
	Pd	Paterson Formation (not mapped)	100±	Fluvioglacial sandstone, claystone, conglomerate & some tillite.			Grant Formation of the Fitzroy Basin and Lyons Group of the Carnarvon Basin.
		ANGULAR UNCONFORMITY					
PRECAMBRIAN	P lg	Lower Proterozoic Granite		Granite, altered diorite, and gneiss.			Lamboo Complex and Halls Creek Metamorphics of the Kimberley Plateau and Lewis Granite of the North Eastern Canning Basin. Probably equivalent to Warrawoona "Series" of Pilbara area.
	P lm	Lower Proterozoic Metamorphics		Quartzite, and quartz-mica schist.		Possible metallic deposits.	