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GEOLOGICAL REPORT ON KELSO AND CLEEVE STATIONS, LONGREACH QUEENSLAND

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Introduction.

The writer, accompanied by Mr. W. L. Hawthorne of the Geological Survey of Queensland, visited Longreach between 6th. to 16th. July, 1950, to inspect an area embracing Oakley, Cleeve and Kelso Stations, 8 to 14 miles north-east and east of Longreach.

The purpose of the inspection was to re-examine the area previously mapped by Oil Search Ltd., and, if at all feasible, to recommend sites for deep drilling or scout drilling.

Almost continuous rain from 8th to 12th July and again from 14th seriously hampered the work and field observations could be made only on 6th, 7th, 9th, and 13th. During this time traverses on foot were made in the vicinity of Cleeve homestead and between Cleeve and Kelso homesteads.

Particular attention was paid to the areas left blank on the geological map by J.F.Foster (1931), in the north-east corner of Cleeve and along the western boundary of Kelso. It was not found possible to examine Oakley without incurring very serious delay as roads had become impassable by 14th July and accordingly the inspection was not extended to that locality.

In all an area of about 18 square miles was examined in sufficient detail to confirm Foster's mapping and to indicate that surface mapping could have little but negative value.

The observations made can be usefully interpreted only against the background of the results of the prolonged study of this area by earlier workers and accordingly brief statements setting out the general geology of the locality and a review of the geological work and results achieved earlier are given.

General Geology.

Longreach lies within the Great Artesian Basin and consequently the broad features of stratigraphy and structure are well known. With the exception of small outliers of Upper Cretaceous sandstones (Winton) a few miles to the north-west of the town, the surface of the area under discussion is occupied by Marine Lower Cretaceous rocks, which in the Cleeve-Kelso area are mainly sandstones with a few fossiliferous calcareous bands.

The Lower Cretaceous beds become more argillaceous at depth and at 2340 feet from the surface (at Longreach) rests on Walloon (Jurassic) sandstone which is about 900 feet thick and contains shale bands. The basement at Longreach is composed of a crystalline rock described in the driller's log as granite.

In the Longreach town bore the main aquifer was struck near the base of the Jurassic and a large supply of pressure water with which was admixed a trace of crude oil was also cut at 2530 to 2550 feet in sandstone between shale beds.

The Lower Cretaceous has been divided into two groups - the Tambo and the Roma - but in the vicinity of Longreach fossils characteristic of both groups have been found in the one specimen and no division has been made between the two groups.

The bedrock floor falls gently to the west and south-west towards the centre of the basin. Relatively minor undulations of the floor, due in part to topographical relief in the pre-Jurassic surface and in part to subsequent faulting have been revealed by boring.

Deep bores and a gravity survey have indicated a broad buried spur of bedrock trending south-westerly from Aramac and passing to the east and south of Longreach. The area discussed in this report lies above the north-western flank of this spur.

Locally the surface is one of low relief and the underlying rock is largely masked by soil cover. Except in stream channels exposures are few and of limited extent, and in many instances consist of single slabs of rock surrounded by soil, or discontinuous lines of tabular boulders which represent the slumped outcrop of a bed. Approximate measurements of dip may be made on a few of these exposures with some small degree of confidence and such observations indicate, according to most workers, a close relationship between topography and structure; for example the areas dividing the stream channels are believed to be occupied by anticlines. This view does not accord with the writer's observations in the south-eastern part of Cleeve Station and cannot be wholly accepted.

Exposures in stream channels are fairly reliable and in places show consistent dips generally between 10 and 20 degrees, but steeper dips have been observed and reversals of dip and sharp sinuous changes of strike occur within distances measurable in tens of yards.

Previous Exploration.

In 1925 an artesian bore drilled on the outskirts of Longreach revealed the presence of natural oil. The oil came to the surface with the hot pressure water as a dark brown liquid which solidified on cooling. A company (Longreach Oil Wells Ltd.) was formed in 1929 to sink a bore expressly for the purpose of obtaining oil in commercial quantities and a site was chosen in close proximity to the town water bore, but without recourse to geological enquiry.

After a somewhat chequered career the bore finally reached the oil horizon in the Jurassic sandstone at 3230 feet, a short distance above the crystalline bedrock, and believed to be just below the main aquifer. Although oil was recovered the results of this testing may be regarded as inconclusive and there is some doubt whether the oil occurs in or below the main aquifer.

Concurrently with the sinking of the bore and for a considerable time thereafter a geological survey was conducted by Oil Search Ltd. in the vicinity of Longreach and embracing Oakley, Cleeve and Kelso Stations. During this investigation, which may be regarded as having proceeded in three stages, the field geologists were visited by Dr. Woolnough, Mr. W.G. Mossfeld and Mr. G.A.V. Stanley all of whom contributed reports. The three stages mentioned are:-

(a) from early in 1929 to June 1931 when, conventional dip and strike mapping of surface outcrops, aided by pit sinking and scout boring, was conducted by J.F. Foster.

(b) from July 1931 to June 1932 when attempts at "contour-outcrop" mapping were initiated by Dr. Woolnough and carried out by J.F. Foster and R.A. Hobson at first, and later, R.H. Pocock, and

(c) to September 1932, when the area was remapped with the aid of air-photos by Dr. F.A. Moss who recommended abandonment.

Notwithstanding the very protracted examinations and re-examinations of the Longreach area by numerous geologists applying different techniques it is noteworthy that no recommendations for boring resulted.

Much energy was devoted to mapping the minor structures evident in small scattered exposures, or revealed by pit sinking. Dip and strike mapping yielded anomalous results which effectively prevented correlation of outcrops, and no marker bed was found to which contour-outcrop mapping could be applied. At Oakley G.A.V. Stanley (1931) cut a trench to follow down the dip a characteristic bed which outcropped as a low scarp of hard sandstone containing abundant Maccoyella. As the bed was traced eastward beneath the soil it became progressively softer and passed into a sandstone devoid of fossils and containing thin bands of mudstone.

As the work proceeded it became increasingly clear that great difficulties lay in the way of interpreting the surface evidence in its relationship, if any, to the bedrock. Senior geologists who visited the area, while unable to agree as to the origin of the disturbed but relatively small structures in evidence, concurred that such disturbances of the regionally gentle dip were very local in character and should not be regarded as reflections of the bedrock surface. Difficulties facing elucidation of the deeper structure were held to be virtually insuperable.

Present Field Investigations.

Two traverses on Cleeve Station were made to check Foster's mapping and to familiarize ourselves with the terrain before examining the areas apparently unmapped by Foster. Observations made along the course of Ten Mile Creek revealed general agreement with the earlier mapping but the shifting of silt in the channel during the past 20 years had covered some of Foster's outcrops and revealed many others apparently not seen by him.

From a point on Ten Mile Creek, about 1½ miles north of the railway, consistently northerly (upstream) dips ranging between 12 and 15 degrees were noted for a distance of about 3200 feet, elsewhere in and adjacent to the stream bed sharp changes of strike and dip were noted within distances of a few yards.

Unreliable outcrops noted on the divides between the stream courses closely conform to the gentle topographic slopes giving the impression that the topography is a faithful reflection of near-surface structure. This view is dispelled by examination of the more intense structural features revealed in the creeks and by consideration of the structures mapped by Foster from the evidence of pits and scout bores. Coincidence of topography and structure does occur however, for example at Gavin's Anticline which forms a gentle ridge ½ mile north-east of Cleeve Homestead.

Similar structural control of topography is believed to exist over an area exceeding one square mile in the north-east corner of Cleeve Station, and to which further reference will be made.

Mr.Hawthorne and the writer agreed that little reliance could be placed upon the few apparent outcrops seen outside the water-courses. It appears very probable that the present attitude of these exposed rocks is due in no small measure, to slumping caused by the withdrawal of lime from calcareous bands in solution and the disintegration of argillaceous bands.

In lithological character the rocks seen by us showed a monotonous similarity. The rock mostly observed was a fawn coloured sandstone, ripple-marked and current-bedded. This sandstone is fairly thin-bedded and has the habit of breaking into slabs of up to a few square feet in area by a thickness of from one to three or more inches. Some thin bands of softer sandstone containing very numerous mudballs were also seen. No fossiliferous rocks were seen in situ.

It is plain that these rocks are the products of sedimentation in shallow water or even in a littoral environment and it follows that very irregular distribution of fossils and a high degree of lenticularity of beds are likely characteristics. Consequently the failure to find a reliable marker bed, or to find any bed which can be traced for a significant distance need cause little surprise.

It is believed that a domal structure, possibly a mile wide from east to west by about 1½ miles long exists in the north-east corner of Cleeve Station extending slightly into Kelso Station between points on the boundary fence 3½ and 4½ miles northerly from the railway line. The centre of this supposed structure lies at the head of Ten Mile Creek at a point 2.8 miles from Cleeve Bore on a magnetic bearing of 72 degrees and 0.5 mile inside the eastern boundary of the Station. The indications of this structure are slight and there is no direct evidence of closure to the west, though this may exist.

The evidence is -

(a) Radial stream pattern which suggests consequent drainage from a structural dome.

(b) Curved, outward dipping outcrop on the north and north-east margins of the structure.

(c) Air-photos show a bed outcropping as a small scarp to the north-east of the structure and dipping north-easterly in opposition to the topographic slope, and

(d) Gentle outward dips on eastern flank and southern extremity where small outcrops of doubtful validity were seen.

The interpretation placed on these observations runs counter to the foregoing discussion in which the value of apparent outcrops and the supposed relationship between structure and topography were doubted, but all features taken together here permit a strong inference to be drawn.

It is noteworthy that Dr.Woolnough, from a study of air-photos, considered that a closed structure exists in the area mentioned, and thatDr.Moss was of a similar opinion although he attached little importance to it.

The writer and Mr.Hawthorne took air-photos into the field and found that interpretation of them is difficult and unreliable. Patterns showing in the photos and which might be attributed to geological features could not be found on the ground or were traced to differences in vegetation. Undoubtedly some light-coloured bands in the photographs are due to the reflection of light from wind-blown grass and it is probable that new photographs of the same area would show different patterns.

Conclusion and Recommendation.

The object of the present investigation and of the lengthy surveys of twenty years ago was to detect, or to gauge the probability of, the presence of surface evidence of buried hills in Palaeozoic or Pre-Cambrian basement rocks. Only relatively small structures mainly due to folding can be measured with certainty and these are too small to represent reflections of deeply buried structure. Broader structures which might reasonably indicate elevations in the basin floor are effectively masked by the smaller and more intense folding superimposed on them; also lenticularity of the beds and changes of facies prevent interpretation by usual methods of geological mapping.

It is apparent, that notwithstanding marked difference in the bedrock at each locality, the surface conditions at Longreach bear a close resemblance to those encountered near Roma and consequently any recommendation to apply geophysical methods at Longreach should await the outcome of the present geophysical survey at Roma.

Acknowledgement.

The writer is indebted to Mr.W.L.Hawthorne of the Geological Survey of Queensland who assisted both in the field-work and by helpful discussion of the meagre evidence that was available. Since the visit to the field various reports mentioned above have been consulted and were found to be very useful despite the conflict of opinion expressed in them. The more important of these papers all of which are unpublished are mentioned in the list of references given below -

References.

The following unpublished papers in the possession of the Bureau have been consulted.

Chapman F.	1930-1931	Palaeontological reports on fossil collections and outcrop specimens from near Longreach, Qld.
Foster J.F.	1930 et.seq. 1931	Progress reports to Oil Search Ltd. Geological Survey (Map) of Longreach and Cleeve Oil Field. Oil Search Ltd.
Foster J.F., Hobson, R.A. and Stanley, G.A.V.	1931	Report upon the Geological Survey of the Oakley Area, Longreach. Report to Oil Search Ltd. dated 30/11/31.
Moss F.A.	1932	Geology and Oil Prospects in Longreach District. Report to Oil Search Ltd. dated 12/12/32.
Stanley G.A.V.	1931	Report on a visit to the Longreach District, Qld. Report to Oil Search Ltd. dated 14/11/31.
Woolnough W.G.	1931	Untitled report on oil prospects in Queensland and methods of surveying etc. dated 7/9/31.