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The present author accompanied Mr. R.W. Coxon, Director, Mines Department, Alice Springs, and Mr. S.M. Sneddon, Mines Inspector, Alice Springs, as geologist on their journey for road survey and inspection in the mining area of "Tom Hanlon's Camp" in the Eastern Jervois Ranges.

OBSERVATIONS ON METAMORPHOSED FORMATIONS

The present writer assisted Mr. Coxon by determination of rocks which could be important for the identification of roads and tracks for travellers in the future. The rocks met along the track were mainly of metamorphic and igneous origin since the tracks are originated by prospectors looking for ore deposits, and, of course, ore deposits are not usually found in sediments. On the way to Jervois Ranges an examination was made of a flat-topped hill, 3-4 miles SW of the Plenty River Crossing. The hill consists of schist with a few feet of horizontal shale on the top completely silicified into chalcedony, without any fossils and therefore of un unknown age. The shales are covered by a thin layer of Tertiary limestone. The structure described is known from the time of H.Y.L. Brown (1897).

Only in the wide gap between the Eastern and Western Jervois Ranges (Hornet's Nest) the writer had a little time to look around the Jim Sharp's copper mine. An old metamorphosed supercrustal formation of greenstones, amphibolites, leptites, andalusite or cordierite schists, limestones, and perhaps scarns seems to be preserved within migmatites. In some places the limestone forms thick compact bodies, in other places the limestone is transformed into diopside slates. A spectrum of all these rocks including Tertiary freshwater limestones and travertines is displayed in the alluvial pebbles in a creek crossed by Jim Sharp's track. This previously unnamed creek was called "Museum Creek". Hornet's Nest area is rich in tourmaline which in many pegmatites is the diminating mineral. Well developed big crystals of tourmaline are present in Mr. J. Sharp's collection. Mica is relatively scarce. The rich occurrence of tourmaline according to V.M. Goldschmidt may be an indication of a sedimentary origin for the schists bearing this mineral.

Satisfactory observations on the strike of the metamorphosed rocks could not be obtained. South of the Jervois Ranges a roughly E-W, NE-SW direction seems to be general. To the north-east a generally N-S strike seems to come in.

OORABRA CREEK

The gully of Oorabra Creek is famous for its picturesque rock holes with perennial water, caves with aboriginal pictures, etc. Among the people of Central Australia the rocks of Oorabra Creek are known as a "granite". In reality it is not an igneous rock at all, but is an indistinctly bedded coarse grit and sandstone conglomerate with some layers of sandy shales. Among the boulders of the conglomerate are pieces of quartz from reefs (probably from the Oorabra reefs), pieces of copper ore, granite similar to the granites exposed in connection with the Oorabra reefs, limestone with Collenia-like structures (obviously Pre-Cambrian), shales and sandstones of the Jervois Ranges.

The Oorabra conglomerate represents therefore a basal formation and it seems to be the base of the Ordovician there. South of Oorabra Creek the same conglomerates are covered by sandy shales and sandstones in a series of ridges which are unfossiliferous. Normal faults seem to be well expressed in these ranges.

The sedimentary nature of the Oorabra "granite" was already observed and well described by H.Y.L. Brown (1897) who mentioned also the occurrence of a quartz boulder with argentiferous galena in the conglomerate. The geology of the area is redescribed by Madigan (1932).

Examination through binoculars revealed that the sandstones in the cliffs of the Jinkah springs north of the Oorabra reefs resemble the sediments of the Oorabra Creek area. From the Jinkah Springs fossils, apparently of Ordovician Age, are represented in the collections of the Adelaide University. The Jinkah Plain itself represents perhaps a granite covered by its products of disintegration.

The interpretation of the Oorabra conglomerates as the base of Ordovician is suggested by the presence of boulders of all older formations in it. But the conglomerates and the overlying sandy shales and sandstones at Grants Bluff observed by myself and described also by Madigan are tectonically disturbed whereas the Ordovician sandstones at Jinkah Springs are nearly horizontal. Moreover, Madigan (1932, p.93) wrote - "the beds at Grants Bluff bear a resemblance to the Ordovician quartzites of the tablelands to the north, but owing to the absence of fossils they are placed in the basal series of the Portaknurra".

As yet the area has been visited only by Brown and Madigan and the amount of observations is too small for any definite interpretation of this key area of the Pre-Cambrian Ranges and the Ordovician Tableland. For example, the Ordovician Tableland has been visited only three times - (1) by Brown on May 21-22 in 1896; (2) by Tindale in 1930, who collected Ordovician fossils at Mt. Ultime, and (3) by Madigan in 1931, who climbed the scarp of the Tableland at Huckitta Station only and collected poorly preserved fossils from boulders at the foot of the escarpment.

THE EASTERN JERVOIS RANGES

Two days were spent in the Ranges on foot excursions. Walter Smith, who is an employee of Mr. Crosby, owner of a mine on the "Hanlon's copper lode", acted as guide.

The headquarters (camp) were situated on a place known as "Tom Hanlon's Camp", which is marked by a respectable chimney built of stones, about 1.5 miles S.E. of the Ranges.

The Eastern Jervois Ranges are separated from the Western portion of the Ranges by a wide Gap (Hornet's Nest) with metamorphic rocks transversed by the Bunya River which does not seem to be identical with the Thring river of the Pastoral Map of N.T. To the South and South-East the Ranges are bordered by the rocks of the Arunta Complex and the plains along the N.W. border show exposures of the old basement, also schists and quartz reefs. The Ranges measure about 3-4 miles across and are about twenty miles long in approximately a SW-NE direction.

The physiography of the Ridges is simple. The southern slopes are steep, often with wall-like escarpments of quartzites, the northern ones more gentle, representing the dip of the beds. The crests are nearly bare, with few trees, spinifex and occasionally succulents. No duricrust was observed and everywhere the sandstones and quartzites are exposed commonly showing well developed ripple marks.

The valleys are rich in vegetation, with gum trees along the creeks and waterholes. The creeks run N.E. along the strike of the beds, and pass to the N. through several gaps. The Ranges are crossed near the middle by a major gap which has been passed once by a motorcar.

Some creeks run to the south also, and one of them has a rock hole (Evala) which lasts for several months.

The highest point of the Ranges is Umgynia (the Grey Man) so called by a spot of white leached shales on its western side which is well visible from the plains. The top of the Grey Man forms a vertical cliff of conglomerate over 100 feet high.

The Eastern Jervois Ranges are indicated as "Primary Quartzite, Sandstone, Grit and Conglomerate" on a map by H.Y.L. Brown in 1897. Since then no geologists have visited the ranges, as the map of Madigan (1932) has its eastern limit along the 136° meridian whereas the Ranges lie east of it.

The rocks of the Ranges are sandy shales interbedded with sandstones, hard quartzitic sandstones and conglomerates. The sediments represent a shallow water facies of a rapid sedimentation on the border of a rising land. Ripple marks, cross-bedding, clay pellets, worm tracks are the most common features known from many other areas of Australian Pre-Cambrian but they are not time markings at all. No limestones are observed. The strike runs approximately SW-NE, the beds dip NW in an angle of about 15°-20°. The thickness of the sediments is about the order of 1000', but it could be only estimated since a duplication, perhaps multiplication of the beds seems to be indicated by one or more strike faults.

In Fig. 1 the possibility of a strike-fault is illustrated and discussed.

Since the Ranges are bordered on both sides along the direction of the strike by metamorphized rocks of the older basement and since a violent discordance of the sedimentary formation of the ranges against the basement can be observed in the field, the Eastern Jervois Ranges seem to be plunged into the basement by faults running SW-NE (Fig. 2). Studying the structure of the Ranges in the field I had no knowledge on the observations published by Madigan 1932 on the western part of the Ranges. His Fig. III shows a section across the Jervois Ranges at Grants Bluff with strike faults. I had a short look at the geology of the Grants Bluff in the field also with the same results, although it seems quite possible that the Grants Bluff sediments are of a different, younger age.

This interpretation of structures (strike faults) within the edifice of the Macdonnell's (sensu lato) by Madigan is an important advance with regard to the explanation of the distribution of the "Quartzite Ridges" in Central Australia. Chewings (1935) and Voisey (1939) worked successfully in the same direction. It points the way to a simplification of the stratigraphical classification and to a reasonable reduction of the perhaps over-estimated thickness of the sediments.

The sediments of the Jervois Ranges have not yielded any fossils of diagnostic value. Worm tracks and stromatolith-like bodies were observed.

The age of the sediments is Pre-Ordovician, since pebbles and boulders of Jervois Range sediments are embedded in the supposed Ordovician conglomerates of the Oorabra Rockholes.

By analogy it seems most probable that the Jervois Range sediments are of a late Pre-Cambrian age. There is evidence also that they were originally covered by limestones with "Cryptozoon". Prospectors and miners who travelled on the old Queensland Road (Lake Nash road) told me that in the NE the

Jervois Ranges are connected with limestones. "Cryptozoon" in the collections from this area in the Adelaide University and observed by the writer in boulders, represents the Collenia-type which is known from the Pre-Cambrian only. The genus Cryptozoon itself has a Cambro-Ordovician range in Australia also. It is well represented, e.g., in the Middle Cambrian of Beetle Creek, Queensland.

No more Ranges of the same age E. of the Eastern Jervois Ranges are known. Tarlton Ranges are represented in the collections of the Adelaide University by sandstones with exceptionally well preserved Diplocraterion indicating their Cambro-Ordovician age. To the west the Eastern Jervois Ranges have more extensions in the form of the Western Jervois Ranges and the Mopunga Range. All these ranges together form a crescent shaped structure open to north seemingly the border of a basin with Ordovician sediments on top.

To the Pre-Cambrian sediments of the Mopunga Range Tindale (1931) applied the formational name "Mopunga Range Series" which can be used for the Jervois Ranges also. Among the "Perta" formations of the Macdonnell Ranges (cf. Madigan 1932) contemporaneous sediments are most probably the Heavytree Quartzite and its duplication (by faulting or overthrust), the Range No. 2. Hann Range as the northern limit of the Macdonnell edifice can be taken also into consideration. But these correlations are based only on similarity of the facies, tectonical structure and position on the Pre-Cambrian basement around a land as a roughly contemporaneous source of sediments.

In a belt ten to fifteen miles wide and over sixty miles long bordered in the north by the Ordovician Tableland and the Pre-Cambrian ridges in the South, Madigan's Map shows Cambrian ("Pertaoorta") limestones, quartzites and slates. It is an extrapolation out of some localities around the Oorabra creek. The Cambrian age of the rocks according to Madigan (1932) is evident from "obscure remains of Archaeocyathinae and "cylindrical forms suggesting Salterella", "also possible Trilobite fragments".

Unfortunately I have not seen these localities nor fossils collected there during my visit in the Adelaide University. Obviously to understand the geological relations in this area more observation on the Cambrian of the Oorabra Area and the whole Cambrian belt has to be made.

The unconformities in the area of Jervois Ranges can be summarized as follows:-

1. The great unconformity of the Mopunga Series against the fold, metamorphized and eroded old basement ("Arunta Complex"). It is well exposed along the southern border of the Jervois Ranges. The topography of the surface of the Old Basement covered by the present Jervois Ranges is uneven. In gullies between the ranges the tops of Arunta hills reach the surface in some places. Among the pebbles in the creeks in the valley of Jervois Ranges a few schist pebbles are observed, some of them stained with copper. On the north side of the Grey Man, on a spot at the foot of the Range, shales of Mopunga Series are stained by copper-bearing solutions.

2. After the sedimentation of the Mopunga Series the area has been lifted again, faulted and eroded, and a new peneplain created, exposing remnants of the Mopunga Series and Arunta formations on the same surface. Oorabra conglomerate represents the coarse facies of the erosion of this surface, introducing a new inundation. The age of the second unconformity is Pre-Ordovician.

3. If the Oorabra conglomerates and the sediments of Grant's Bluff are of a Pre-Ordovician age, a third, minor disconformity is possible at the base of the Ordovician (lower Middle Ordovician) Larapintine of the Tableland

in the North (Jinkah Springs, Dulcie Ranges, etc.). Perhaps it represents an Ordovician inter-formational break of sedimentation only.

SANDSTONES SOUTH OF ALICE SPRINGS

Under the kind guidance of Mr. Sneddon, Inspector of Mines, Alice Springs, the present writer had a short excursion in the Ranges south of Alice Springs. Following observations are collected.

(1) The Heavytree Quartzite does not lie immediately on the gneisses. The basal beds of the quartzite are formed by several tens of feet of a sandy shale.

(2) The Ranges of the Heavytree Quartzite and the No. 2 quartzite are duplications of one and the same formation by tectonic structures in the strike direction.

(3) The "Quartzite No. 3" and No. 4" ridges are built of a sandstone rich in worm tracks, some of which are diagnostic and suggest a Cambrian age. A collection was made. A multiplication of the ridges by strike faults is very probable. "No. 3" and "No. 4" Ridges are duplication of the same sandstone. (Evidence by fossils).

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ILLUSTRATIONS

Illustrations have not been made available in the hardcopy of record 1949/92.

Fig. 1 : Eastern part of the Eastern Jervois Ranges looking east. The Ridge (3) has a steeper dip than the surrounding beds and could be followed for nearly half a mile along a gully in the strike of the beds. In places the displaced quartzite is connected with sandy shales, the lithology of the displaced beds is the same as the lithology of the whole Ranges. It may be interpreted for an interformational unconformity, but more likely it is a displacement along a fault line.

Fig. 2 : The same as Fig. 1.

Fig. 3 : A detail of Fig. 1 and 2, showing the displaced quartzite ridge more closely.

Fig. 4 : Quartzite with ripplemarks from the Displaced Ridge. No difference in lithology from the surrounding quartzites could be observed.

Fig. 5 : Ripple marks with worm tracks (mounds).

Fig. 6 : Ungynia (the Grey Man) from the east. Note the white spot of leached shales on the right side.

Fig. 7 : Ungynia from the west from a creek on the foot of the ridges north-west of Hanlon's Camp.

Fig. 8 : Evalah Rockhole, NW of Hanlon's Camp.

Fig. 9 : Jervois Ranges seen from the "Tom Hanlon's Camp" (from the chimney).

Fig. 10 : Looking southwest from the top of Ungynia. In the distance the Harts Ranges.

Fig. 11 : Jervois Ranges, the NW border. For explanation see Fig. 12.

Fig. 12 : A sketch of a portion of the NW border of the Jervois Ranges, seen from the "Old Queensland track". The two hills in the middle of the plain represant a quartz reef in the Arunta Complex.

Fig. 13 : Oorabra Reefs. The escarpment of the Ordovician
Fig. 14 sandstones (Jinkah Springs) in the distance.

Fig. 15 : A dark hematite reef among the white Oorabra quartz reefs.

Fig. 16 : Oorabra Creek cut into the basal conglomerates.