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ABSTRACT OF THE STRATIGRAPHY OF THE SPRINGSURE AREA AND ADJACENT AREAS (QUEENSLAND)

by

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The following abstract was written in order to facilitate the compilation of the Queensland four-mile geological sheets and the explanatory notes accompanying them. The area described covers the Springsure, Emerald, Jericho and partly the Tambo and Baralaba four-miles sheets.

1. STRATIGRAPHY.

A. The Basement Complex.

The basement has been observed in two areas, i.e. as a comparatively small occurrence in the southern part of the core of the Telemon Structure and in the large Anakie Uplift.

In the Telemon Structure the bulk of the basement rocks exposed are metamorphics, including quartz schists, schistose grits, quartz-muscovite and hornblende schists and a possible ortho-gneiss. In association with these rocks is a considerable amount of vein quartz. There is also white biotite-granite which does not seem to have undergone any great shearing effect. According to Mackay the cleavage in the metamorphics appears to be in a north-east direction with a steep cleavage dip to the south-east.

The basement rocks of the Anakie Uplift consist mainly of granite, which however, has been so greatly altered in places as to be gneissic in structure. Associated with it are a variety of schists such as hornblende, quartz-muscovite and mica schists. A thin band of white marble is recorded from one locality. Intrusions of syenite have taken place on a small scale. The syenite does not show any trace of shearing.

Some complexes of slaty quartz and phyllitic schists, with a lesser degree of metamorphism, were found within the highly metamorphosed rocks. They might represent a younger metamorphic suite.

Apart from the syenitic intrusions and the possibly younger metamorphics, the metamorphic suite with the accompanying granites and ortho-gneisses in Telemon as well as in the Anakie area have all the characteristics of a basement complex. There is no doubt that the granitic intrusions and the metamorphic alterations are older than the overlying sediments.

In Telemon, the contact of the sediments with the basement complex is concealed by residual basaltic soil and the young basalt flow which covers a large areas in the centre of the structure, but exposures in the vicinity indicate that the Telemon formation is in contact with the granite, and that no older formation is intervening.

In the south-west flank of the Anakie Uplift, however, andesites and amygdaloidal lavas of the Dunstable Formation, of Lower Middle Devonian age, are in contact with the basement, a fact which indicates a pre-Devonian or at latest a Lower Devonian age of the basement complex.

B. The Devonian.

The Devonian is divided into -

(a) the Dunstable Formation of Lower Middle Devonian age and,

(b) The Telemon Formation of possible Upper Devonian age.

(a) The Dunstable Formation.

Named after homestead and P.O. Dunstable (Nogoa area). Thickness exposed at type locality ±4,000 feet.

The oldest suite of sediments exposed in the core of the Nogoa anticline (type locality) are siliceous grit, pink and brown mottled, feldspathic sandstone, pink or brick red, siliceous siltstone or tuff with intercalated yellow and purple clay and shale, overlain by a thick siliceous, gritty to conglomeratic sandstone.

The higher part of the section is composed of two types of volcanics which alternate in a most intricate manner. One type is an amygdaloidal, deeply weathered lava, which in places contains a great amount of chalcedony and jasper. It is interbedded by indurated, slaty shales and it forms sharp ridges and cliffs. The other type is a fresh-looking, greenish, porphyritic massive adesite.

Lenses of reef limestone, interbedded in the andesite and containing fragments thereof, have yielded abundant corals in two localities (M.232 and 233). The corals, determined by Dr. Dorothy Hill, indicate a Lower Middle Devonian age of the limestone.

On the south-west flank of the Anakie Uplift, the Dunstable Formation is still typically developed. Mackay describes it as follows: "The succession includes fairly fresh, brown andesite, the amygdaloidal varieties as found in the Nogoa Structure, and much brown rhyolite exhibiting parallel banding and flow structure. In the upper portion the above volcanics inter-finger with contorted, indurated shales, tuffaceous conglomerates, rhyolite breccias and a coarse conglomerate containing fragments of mica schist".

(b) The Telemon Formation.

Named after the Telemon Pastoral Holding in the Nogoa area.
Total thickness approximately 7,000 feet.

In the west flank of the Nogoa Structure (near Shell's Trig. E) this formation shows in its lowermost part coarse to conglomeratic sandstone and siliceous grit which overly unconformably tuffaceous clay and lava of the Dunstable Formation. In the upper part of the siliceous grit silicified wood is fairly abundant.

The arenaceous rocks are overlain by a suite of reddish-brown, mottled, flaggy sandstone and chocolate-brown, undulating cherty shale and indurated yellow mudstone, which in their turn are overlain by badly bedded, conglomeratic brown sandstone with thick beds and lenses of coarse conglomerate. The components of the conglomerate consist of quartzite, schist, andesite, felspar porphyry and other igneous rocks, embedded in a coarse arkosic or tuffaceous matrix. The thickness of the formation is approximately 2,000 feet. The same sequence is, although not very well exposed, to be observed along the Telemon road, where its thickness is 2,600 feet.

A further section was obtained about 3 miles to the north of the Telemon road. The lithological types are still the same, but the thickness has increased to nearly 4,000 feet. Plant remains, unfortunately undeterminable, were found in the upper part of the sequence.

The upper part of the Telemon Formation consists of pink, mottled, dense, slabby sandstone, medium grained pink and brown, laminated arkosic and felspatic sandstone and quartzose grit with a pink matrix. These rocks types are interbedded with purple, chocolate brown, bright green and yellow clay. They usually are crumbling and mudstone is very rare. In places some bands of hard, dense brick-red siltstone or tuff are interbedded in the clay.

Some of the sandstones are more of dark indian-red colour, slightly micaceous and extremely fine-grained. Theyshow fountainbleau structure and resemble closely the "Old Red" of Great Britain. Olive green and chocolate brown flaggy sandstones were found to form the highest portion of the sequence and are unconformably overlain by the Mount Hall conglomerate.

Sandstones and shales are devoid of carbonates, but comparatively thin bands of light to dark grey concretionary or algal limestone occur throughout the section interbedded in clays.

Many of these limestones form irregular incrustations, rounded aggregates or cylinders, up to 5 feet in length and one foot in diameter. They are of algal origin and the concentric growth lines are clearly visible in the hand specimens, but better still in the thin sections. They represent real tufas (not tuffs!!) which, according to Twenhofel (1932) are formed mainly in saline lakes and playas. A similar, but recent example, was described from South Australia by D. Mawson (1929). Some of the limestone aggregates are fractured and recemented by a darker matrix. We shall discuss the significance of this phenomenon later.

Apart from the algae and some oyster-like pelecypods, which indicate lacustrine or shallow marine to brackish water conditions, the only other fossil found, is the minute branchiopod (not brachiopod!!!) Leaia. It was found near the top and at the base of the sequence and it indicates fresh water conditions. Its range is Upper Devonian to Permian and therefore its occurrence is consistent with an Upper Devonian age of the Telemon Formation.

There are other, more regional, considerations which in our opinion suggest such an age for this formation. A well marked unconformity is known to separate the Middle Devonian limestone sequences from the Upper Devonian brackish to fresh water sequences in the southern coastal areas of New South Wales and in Victoria. There the Middle Devonian is much more strongly folded than the Upper Devonian (Brown, Ida.(1928), and Skeats (1935)). A similar unconformity is also established in the Kimberleys between the Middle Devonian Rough Range and the lagoonal Mt. Pierre Formations (Wade (1938)). It is therefore logical to identify the Dustable/Telemon unconformity, separating the limestone bearing Dunstable from the lagoonal or freshwater Telemon Formation with this Middle/Upper Devonian unconformity.

In the south-west flank of the Anakie Uplift the Telemon Formation is developed as a suite of gritty, sandstone and conglomerate with intercalated mudstone, variegated clay and thin algal limestone, i.e. in a similar facies as in the Nogoa area whith the exception of sills of a pink felspar-porphyry, which have not been observed in the type area.

C. The Carboniferous.

The following formations are assigned to the Carboniferous; in ascending order:

(a) The Mount Hall Conglomerate
(b) The Snake Range Sandstone
(c) The Ducabrook Formation.

Fossil Evidence.

Acanthodean and Palaeoniscid fish, Stigmaria ficoides and Lepidodendron sp. in several horizons of the Ducabrook Formation.

(a) The Mount Hall Conglomerate.

Type locality: Mount Hall in the south-eastern part of the Telemon Anticline. Thickness variable: 200 - 1,100 feet.

In the type locality the Mount Hall Conglomerate consists of a white siliceous conglomerate with well rounded quartz pebbles of about walnut size, imbedded in a porous, gritty matrix, which in places, however, is very dense through secondary silification. The pebble beds are dove-tailing into white, flaggy or massive, generally highly false-bedded gritty to medium grained, micaceous sandstone, or they occur as thin bands, irregular lines and pockets within the sandstone.

In some localities the conglomerate contains pockets of head-sized boulders, an indication for temporary torrential conditions. A fluvio-glacial origin was suspected, but a careful search for striated boulders did not yield conclusive evidence for contemporaneous glaciation.

The pebble beds merge upwards into massive, dense, quartzitic sandstone and procellanous siltstone, which form a slight depression between the dipslopes of the Mount Hall Conglomerate and the overlying Snake Range Sandstone and are transitional to the latter.

The Mount Hall Conglomerate proved to be an excellent marker bed. It was plane-tabled around the Telemon Anticline.

In the west flank of the Anakie Uplift it changes somewhat in appearance. According to Mackay "the rock types include clean quartz conglomerates, grits and sandstones, similar to those of the type area. There is, however, a great development of flaggy, siliceous sandstones".

"There is also a considerable thickness of dense, massive quartzitic sandstones overlying the Mount Hall Conglomerate proper. These sandstones thin rapidly as they are followed to the south and finally wedge out completely some distance south of the railway line".

"The lensing nature of the Mount Hall Conglomerate is well seen in this area and it too, when followed to the south, gradually thins out, until at Borella Creek it disappears completely". This, however, is rather caused through alluvial covering.

In the north-western extension of the Anakie flank the Mount Hall Conglomerate was picked up easily in the aerial photographs as a series of thick, comparatively well bedded rock ledges.

In several localities a slight angular unconformity was observed between the uppermost chocolate-brown flaggy

sandstone of the Telemon Formation and the overlying Mount Hall Conglomerate. In the west flank of the Anakie Uplift, however, the unconformity is much more strongly expressed and the conglomerate is loverlapping even onto the volcanics of the Dunstable Formation. In the north-western area the Mount Hall Conglomerate is the deepest formation exposed and forms the core of the Pebbly Creek Anticline.

(b) The Snake Range Sandstone.

Type locality: North-west and west slope of the Snake Range (Telemon Anticline). Referred to in Shell's reports as "Flaggy Sandstone Group". Thickness ±1,100 feet.

In the Telemon area, especially on the south plunge of the anticline, the Snake Range Sandstone is developed as a suite of white, siliceous, flaggy sandstone, coarse inthe lower part, but finer higher up. The white sandstone gradually merges into olive-green or khaki-brown, fine grained, and very well-bedded types, which segregate through weathering into thin slabs. Very fine ripple marks, minute cross-bedding and the concentration of mica flakes and carbonaceous particles in irregular patches on the bedding planes, indicate deposition in shallow, quiet water. Indeterminable plant remains ?Lepidodendron are the only fossils found.

The perfect bedding is well expressed in a series of cuestas with even dip slopes. On the south plunge of the Telemon Anticline these cuestas are nearly as high (1,460 feet) as Mount Hall itself (1,517 feet), whereas in the northern Snake Range they are lower, but well defined ridges running parallel to the high Mount Hall cuesta.

In many places a chert breccia accompanied by a basic igneous rock marks the upper limit of the Snake Range Sandstone. It is an excellent marker bed for the delineation of the contact between the Snake Range Sandstone and the Dudabrook Formation. Professor Prider describes the breccia as "a silicified banded mudstone which has possibly suffered slight thermal metamorphism. It is an extremely fine grained mechanical sediment, which probably consisted originally in part of colloidal silica of chemical origin - there is evidence to suggest that the rock has suffered secondary silification after its formation and no trace of radiolaria is to be seen". He suggests further that "the brecciation may quite possibly have been of submarine origin".

In the aerial photographs of the north-western flank of the Telemon Anticline this chert breccia with the accompanying basic igneous rocks is clearly visible as a fine striated ridge, quite distinct from the under- and overlying sequences.

Along the Anakie west flank Mackay found that "a series which includes flaggy sandstones exactly similar in lithological character to those of the type area, is always to be found overlying the Mt. Hall Conglomerate. However, the series differs here in having many felspathic sandstones and mudstones interbedded with the flaggy sandstones and the beds do not show the cuesta forms so tpical of the series elsewhere".

In the north-western extension of the Anakie west flank the Snake Range Sandstone shows up quite clearly in the aerial photographs and it is recognizable as a series of cuestas in both flanks and the south plunge of the Pebbly Creek Anticline.

(c) The Ducabrook Formation.

Named after the Ducabrook Pastoral Holding south of Bogantungan. Thickness varying through overlap by Joe Joe Creek Formation, 5,800 - 8,500 feet.

The Ducabrook Formation overlies the Snake Range Sandstone with perfect conformity. There is no reason to assume a break at the basal chert breccia.

In the west flank of the Telemon Anticline two polymict conglomerates have been found, the lower one forming conspicuous hogbacks, which could be followed over considerable distance.

Above these conglomerates there is a succession of fairly soft, greenish felspathic sandstone alternating with green and purple or chocolate-brown clay and mudstone, purple, laminated and spotted sandstone, olive green, flaggy sandstone and some very dense siltstone of the same colour. Some siltstones are more of a pale pink with pale green bands. The density of this type was so high that secondary silification was suspected. Professor Prider, However, reports as follows: "There is very little (if any) silification of the rock and there does not appear to have been any material introduced by solutions from outside. The rock is a somewhat argillaceous siltstone in which cementation has been effected by superincumbent load leading to a slight recrystallisation of the original clayey matrix to sericitic material without the introduction of secondary silica. The quartz of the rock is entirely of detrital origin and indicative of a granitic provenance".

Some sandstones contain sharp angular fragments of green mudstone, which in places may form real breccia in miniature. These fragments are invariably embedded in the lowermost few inches of a sandstone where it is in contact with a mudstone. They indicate a temporary break in the sedimentation combined with desiccation and cracking of the deposited mud. The fragments of the cracked mud were then embedded in the sandy material which was rushed in by a period of increased precipitation.

Irregular aggregates of algal limestone are interspersed in this sequence. They seem to be rather connected with the purple and green mudstone and clay, whereas thin oolitic limestones and limestone breccias with green mudstone fragments, occur more frequently in the flaggy silt- and sandstone. These limestones contain abundant fish scales and yielded a spine fragment of an Acanthodian fish.

In the Rooken Glen-Lockington area flaggy sandstone predominates over the clay and mudstone, but there also, algal and oolitic limestone, the latter with fish remains, is intercalated

The lithological types of the lower part of the Ducabrook Formation are very similar to those of the upper part of the Telemon Formation. They represent a recurrence of similar depositional conditions after the influx of coarse and siliceous material during the deposition of the Mount Hall Conglomerate and the Snake Range Sandstone.

The higher part of the Ducabrook Formation is characterized by a rapid alternation of purple and green clay- and siltstone with massive angular grey and pale pink sandstone. Towards the top, yellow or brown felspathic sandstone is more frequent. The most striking feature, however, are dark to pale pink, very dense and fine grained silstone and tuff in individual beds, 5-10 inches thick. Through their colour and their resistance to weathering - even in badly exposed areas, fragments of them are usually found scattered about the surface - they are very conspicuous and a reliable indicator for the uppermost part of the Ducabrook Formation.

Professor Prider to whom specimens of this rock type were sent, reported that "the rock appears to be a rhyolite vitric tuff, with an ashy structure, containing numerous tiny, sharply angular quartz fragments and splinters, which have suffered absolutely no abrasion. The colouration is due to limonite dust disseminated through a distinct set of fragments and it appears to be an original character of these ?glass fragments. In view of the pyroclastic character of the rock, this colour is of no significance as far as environmental conditions obtaining during or after the formation of the rock is concerned".

Although a definite contact line between the lower and the upper part of the Ducabrook Formation cannot be drawn, the lithological change is apparent enough to distinguish the two parts from one another.

There is a slight change of facies in a north-western direction to be recognized. In the Anakie west flank Mackay reports that "the difference is mainly to be seen in the occurrence of many thick beds (up to 20 feet) of dense, massive, siliceous sandstones interbedded with the usual types, but with a greater developement of shales than usual". The chert breccia, however, has been recognized near or at the base of the formation, although its position is somewhat doubtful owing to tectonical complications.

Pallister, who had mapped the Bogantungan-Zamia area more in detail, was able to distinguish several members. He reports on his findings as follows:-

"For local correlation, subdivisions were made of the Ducabrook Formation as follows:-

5.	Upper Member	1,800 feet
4.	Flagstone Member	1,900 "
3.	Purple Shale Member	500 - 600 feet
2.	Massive Sandstone M.	2,000 feet
1.	Basal Member	2,500 "

"This subdivision is based on the variable predominance of certain lithological types and no distinct boundary can be traced, therefore the members are not expected to be of wide application nor are their separate thicknesses closely comparable even within the limits of this area."

"The base of the Ducabrook Formation, marked in the Nogoa area by a chert breccia, has not been recognized, but unless the Ducabrook Formation here is considerably thicker than in the Withersfield-Anakie area immediately to the east, it seems that the lowest beds examined in the Zamia Range, are near to the base of the formation.

"The Basal Member is poorly exposed in the core of the Zamia Structure. It is composed of pale mauve and red porcellanous siltstones and sandstones at the base. These are fractured and faulted in the squeezed core of the anticline. They are overlain by some coarse, brown and green felspathic sandstones and in places felspathic conglomerate and green silty mudstones".

"The Massive Sandstone Member forms the highest part of the Zamia Range. It is characterized by six or seven bands of compact, very hard, dark green, massive, irregularily jointed sandstones. They are 15 to 25 feet thick and break into rectangular blocks. At P.250 some large stems of Calamites sp. and Lepidodendron sp. occur in a finely current-bedded zone. At the base, the sandstones are frequently slightly coarser and contain angular fragments of the underlying mudstones. They pass through a thin flaggy zone into silty, green "blocky" mudstones. The higher sandstones are more flaggy and laminated".

"The Purple Shale Member is a narrow variable zone with flagstones; pink and green mottled sandstone, thin, fine, silty, dark purple sandstone and purple and green, nodular, shaley mudstones with lime concretions. A banded chert, only a few inches thick, is generally found in this zone. These unusual rock types are well exposed in railway cuttings around the nose of the Zamia Structure. At this locality, a coarse felspathic conglomeratic grit with rounded pebbles of mudstone and chert, can be traced."

"The Flagstone Member forms the small range of hills running south-east from Mt. Mayde on the plunging nose of the Zamia Structure and also gives rise to the prominent dip slopes east and south-east of Bongantungan. It is characterized by rapid alternation of flaggy, rather fine, green sandstones and green mudstones. Other rock types are buff, felspathic sandstones, white cherty, porcellanous mudstones and occasionally chocolate-brown shaly mudstones. The rapid alternation gives rise to very well marked dip and scarp slopes. Some flagstone horizons contain silicified plant stems, mainly Calamites sp."

Around Bogantungan and to the south-east of this locality, the Flagstone Member is overlain by the Upper Member of rather similar lithology, but distinguished by the presence of some pink siltstones or tuffs and pinkish green mottled felspathic sandstones. The latter form gentle dip slopes at the foot of the Drummond Range south of Bogantungan. This member varies in thickness with the overlap of the Joe Joe Creek Formation".

Apart from the pink coloured rhyolitic, vitric tuffs which indicate contemporaneous volcanic activity elsewhere, a suite of amygdaloidal basalts and pink porphyries aggregating to about 5,000 feet thickness, were found by Woolley at Mt. Beaufort in the upperpart of the Ducabrook Formation. The extrusions appear to have been contemporaneous with the deposition of the Ducabrook sediments. The Mt. Beaufort area apparently was the centre of volcanic activity, whence the ahses were spread over the surrounding regions.

Intrusions in the Ducabrook Formation were found in the core of the Drummond Anticline, in the form of a laccolith with lit-par-lit intrusions. Pallister reports as follows:- "On the west flank of the Drummond Structure, north of the railway line, about 1,000 feet of augite-porphyry is intruded into the lower part of the Ducabrook Formation and is also intruded into the upper beds on the north-east flank of the structure. The main mass of the intrusion is prominently exposed in rounded hills to the west of Mt. Chantrey Creek. It is in the form of a lit-par-lit injection of laccolithic type. The sandstones immediately underlying the intrusives are baked, fractured and crusted, but the overlying beds are scarcely disturbed. The sandstone at one point has a dip of 22° in contact with underlying fine-grained intrusive, which contains xenoliths of sandstone. The intrusive relationship is well exposed in the eastern flank of the structure, where there are chilled margins against overlying sandstones and xenoliths. The intrusion is thinning to the south of the railway line and in the steep zone of Drummond, it merely forms a narrow faulted outcrop a few feet across". This intrusion apparently antedates the main folding.

D. The Permian.

Two facies provinces are to be distinguished - a continental-terrestrial province in the west and a marine-paralic province in the east. The lower part of the Permian sequence is characterized by the evidence of a strong glaciation, i.e. tillites and varve shales in the west, iceberg-transported boulders embedded in marine sediments in the east. But there are also areas within the terrestrial facies province where no glaciation occurred.

The following formations are assigned to the Permian:

Western Area	Eastern Area
(d) Cheshire Formation	(d) Rewan Formation
(c) Mantuan Downs Productus Bed	(c) Productus Bed
(b) Colinlea Formation	(b_3) Catherine Sandstone
	(b_2) Ingalara Formation
	(b_1) Aldebaran Sandstone
(a) Joe Joe Creek Formation	(a) Dilly Beds, Cattle Creek Formation.

Fossil Evidence.

Plants, such as Phyllotheca, Neuropteridium or Gondwanidium, (a Permian form not recorded previously from Australia, but known in India), Vertebraria, Noeggerathiopsis Gangamopteris, Glossopteris in the terrestrial phases, and a rich fauna of brachiopods, pelecypods, bryozoas, and corals in the marine phases.

1. The Western Area.

(a) Joe Joe Creek Formation.

Named after the Joe Joe Creek in the south-western part of the Ducabrook Pastoral Holding. Thickness: 2,500 feet +.

Although this formation appears to be conformable with the underlying Ducabrook Formation, regional mapping of the contact revealed a very strong overlap, which in places reaches down to the lowermost part of the Ducabrook Formation.

In the type area the following members were distinguished, although it has to be realized that through lateral changes in facies they cannot be mapped as such over the whole area:-

Upper Glacial Member	500 feet
Mud- and siltstone Member with some glacials	900 feet
Lower Glacial Member	1,100 feet.

The base of the formation is formed by khaki-brown, pebbly, felspathic sandstone, which merges upward into thick beds of badly sorted, angular to well rounded boulders up to head-size, embedded in a felspathic or arkosic matrix. The boulder beds are dove-tailing in pebbly felspathic sandstone. A characteristic feature of these sandstones, also observed elsewhere, are rounded to angular fragments of green mudstone. In places thin beds of well bedded green mudstone and of the same pale pink tuff as described from the upper part of the Ducabrook Formation, are interbedded in the felspathic sandstone.

The absence of bedding and the clastic, unsorted appearance of the sediments, together with an abundance of striated and faceted boulders, are sufficient evidence for their glacial origin. However, we have not to deal with moraines in situ, although in places tillites are well developed, but largely with reworked and water-transported morainic material with transition to fluviatile gravel and grit, deposited as a large gravel apron in front of the actual moraines. Oscillations of the ice sheet would account for the admixture of striated boulders with the fluviatile material.

The contact of the main glacial horizon with the overlying mudstone shows signs of a disconformity through local

erosion of the sandstone and lensing of the lowermost mudstone bed. The mudstone is flaggy and finely laminated. The lamination is caused by the alternation of very thin layers of silty material. It suggests that the mudstone actually is a varve-shale, deposited in a lake marginal to the ice-covered area. In several places stringers of glacial material are interbedded in the mudstone. On the bedding planes which are coated with a fine mud, crustacea and worm tracks with faint impressions of algae and some kind of reed are to be seen. Pith casts of ?Schizoneura were found in its upper part near Trig. 13.

The Upper Glacial Member is thinner than the Lower or Main Glacial Member. As a rule it occupies the talus below the Colinlea sandstone scarp. At Trig. 7 it forms a line of separate scarps in front of the main scarp line, but to the east these gradually disappear and only heaps of loose water-worn boulders, covering irregular low hills of felspathic sandstone, indicate the presence of the glacials of their fluviatile equivalent.

The erratics are mainly schists, quartzite and quartzitic sandstone. Gneiss, granite and other intrusives are very scarse. They range from fist-size to head-size, but in places boulders up to one cubic yard and more are to be found. It is not clear yet whence the erratics were derived. The Anakie basement uplift is not the likely source, since there are many lithological types represented as erratics, which are not to be found in the basement complex. Furthermore, the diminishing of glacial evidence in a norther direction is contradictory to such an assumption and would rather suggest an ice sheet in the south.

An interesting feature is the occurrence of boulders of a coral-bearing rock in the upper glacial beds (S.274b at Trig. 13, and M.284b, found in the Nogoa area). The corals were determined by Dr. D. Hill as forms indicating Middle to Upper Middle Devonian. This proves that the Dunstable Formation was exposed in the vicinity during Permian time.

A centre of glaciation seems to have been situated in the Mt. Mudge area. Well developed tillites and varve-shale were found there by J. V. Buley. A brick-red, coarse, felspathic sandstone, containing equiseteous plant remains and fossil wood, is identical with similar types found in the Mistake Creek syncline and in the vicinity of Bogantungan. They seem to occur in the lowermost part of the Joe Joe Creek Formation.

A feature, not found elsewhere, is thin, impure limestones with miniature ripple-marks and disc-shaped limestone aggregates, which may be of algal origin and formed in a lake.

From the Mistake Creek syncline to the east all signs of glaciation disappear. In the vicinity of the Nandowrie Needle, the mudstone (partly varve shale with plant impressions and, interbedded pink cherty siltstone) is overlain by coarse, arkosic breccias with angular fragments of mudstone, which in their turn are overlain by the basal white siltstone of the Colinlea Formation. A similar breccia was found at Trig. 7, just above the upper tillite.

In the Bogantungan syncline, the Joe Joe Creek Formation is entirely non-glacial. A conglomeratic or pebbly, green-brown felspathic sandstone was taken as its base. This bed is well expressed in the aerial photographs 2 to 3 miles west of the northern end of the Telemon plunge. The non-glaciated Joe Joe Creek Formation is mainly composed of green-brown, crumbly felspathic sandstone with abundant plant remains (Phyllotheca) and some green, silty mudstone.

In the Alpha area, near Pine Hill Railway Siding, the lowermost Joe Joe Creek beds are fairly well exposed and still very typical, containing brown, massive sandstone with unsorted pebbles and striated and facetted pebbles. Farther to the north, however, the evidence of glaciation gradually disappears, and the gravels, according to Woolley, are entirely fluviatile.

A locality where an extreme overlap of the unglaciated Joe Joe Creek Formation onto the Ducabrook Formation was observed, is S.244 (147°44'E./24°03'S.). The stratigraphic situation in this area was for some time obscure and puzzling. A cliff section shows that the Colinlea overlies almost horizontally a sequence dipping at 20-30° and containing Gangamopteris and Glossopteris. But only three-quarters of a mile from this locality, at right angles to the strike, the Mt. Hall Conglomerate occurs. Within such a short distance two major unconformities occur, i.e. the overlap of the Colinlea onto the Joe Joe Creek and the Joe Joe Creek onto the basal Ducabrook Formation. The overlap is also very well expressed by the strong obliquity of the stike in the Ducabrook exposures to the northwest of S.244 and the trend of the Colinlea scarp.

Pallister reports on the problem of overlap of the Joe Joe Creek Formation onto the Ducabrook Formation in the Bogantungan areas as follows:-

"The absence of a marker horizon and the great similarity of lithology between the lower Joe Joe Creek Formation and the upper part of the Ducabrook Formation partly obscures the unconformity between them, and an exact boundary is very difficult to determine. Where the upper part of the Ducabrook Formation has moderately high dips, for example near Bogantungan, there is a sharp decrease in the amount of dip in the overlying beds and this is taken to mark the unconformity. Moreover, throughout the whole district there is a contrast between anticlinal areas of regularly dipping beds and synclinal basins with flat or very low irregular dips. The sudden disappearance into almost horizontal beds of the south-west flank and plunging nose of the Zamia anticline is an example of this contrast".

In the Echo Hills region some comparatively small dykes of a doleritic intrusive have been found in the lower part of the Joe Joe Creek Formation.

(b) The Colinlea Formation.

Type locality: Colinlea Pastoral Holding, 15 miles west of Springsure on the road to Tambo.
Thickness: 4,500 feet max.

Apart from the Mount Hall Conglomerate, the Colinlea Formation forms the most conspicuous morphological feature in the whole area, i.e. an escarpment up to 600 feet high extending from the Anakie Uplift (west of Emerald) to the south of Colinlea, thence westwards to Echo Hills and finally across the southern Drummond Range to the north. However, before it reaches the Alpha area, the scarp diminishes in height and finally disappears completely as a morphological feature. White quartz sands and some scattered outcrop of gravel in low lying country, are the only evidence for the occurrence of the Colinlea Formation in the vicinity of Alpha township. The escarpment was mapped, partly by planetable, in the Nogoa River/Echo Hills region and prominent points on it were selected as triangulation points.

In the type locality the lowermost part of the Colinlea Formation is formed by a heavy, massive quartz conglomerate, overlain by extremely crossbedded siliceous grits with bands and pockets of pebbles and white, micaceous, flaggy or gritty sandstone with intercalations of white kaolinic clays.

Sandy Creek on the Colinlea property occupies a marked depression which possible is caused by a complex of clay or shale. To the east of it are several low hills of poorly exposed and deeply weathered quartzose, gritty sandstone, which still farther to the east, are overlain by the Springsure basalt sheet.

The base of the formation is not exposed in the type locality itself, but it was studied in detail in many pleaces along the escarpment south of the Nogoa River and in the Echo Hills region. Some of these sections are shown diagrammatically in Table III.

In sections S.183, S.257 and S.274 the base of the Colinlea Formation is placed below the zone of white tuffaceous siltstone or kaolinic clay. This "White Band" can be recognized at the base of the cliff faces over large distances. In many places it contains irregularily distributed facetted and striated pebbles and cobbles up to double-fist size. They are, however, too few to call the beds a tillite, but nevertheless glacial conditions are definitely indicated for the lowermost Colinlea Formation. The white band is overlain by a quartzose conglomerate which in places, has a band of a few inches of ironstone at its base. The conglomerate merges upward into crossbedded, micaceous, gritty, white sandstone, which is so typical for the Colinlea.

Immediately below the basal "White Band", buff or brown, soft, micaceous sandstone interbedded with buff coloured, carbonaceous paper shale were observed in many places. In some sections they are underlain by greenish-yellow, crumbling clay-shale and olive-green, flaggy siltstone with ripple marks and fine plant fragments, which belong to the uppermost Joe Joe Creek Formation.

In sections S.257 and S.274 the brown sandstone below the basal "White Band" merges downward into the upper Glacial beds of the Joe Joe Creek Formation. There is no evidence of an angular unconformity, although the uppermost beds of the Joe Joe Creek Formation seem to dip at a slightly higher angle than the Colinlea sediments, which rarely dip at more than 5°. This, however, might have been caused by slight slumping, except in section S.244, where an angular unconformity of about 10 degrees has been definitely established. The abrupt lithological change from buff and brown coloured, partly carbonaceous sediments to the clean, white, quartzoze sandstone and kaolinic silts of the Colinlea Formation is so striking, that a profound change in sedimentary conditions seems to be involved, which presumably co-incided with an interval in sedimentation. The assumption of such an interval is also supported by the overlap of the Colinlea onto the Ducabrook Formation at section S.244 and its overlap onto the basement complex without intervening Joe Joe Creek Frmation of the Anakie Uplift, to the west of Emerald.

No signs of marine ingressions have been observed in the Colinlea Formation, although it is not excluded that the depression between the two main sandstone successions, as observed in the type locality, and as it is visible in the aerial photographs in the vicinity of Mantuan Downs, may be occupied by clays and shales, possible of a marine facies.

The main body of the Colinlea Formation, however, is even devoid of plant remains, which were found to be confined to the basal white band, where near Trig. 13, well prese preserved specimens of a fern, referred to by the palaeo-botanists (Sahni and Walkom) as Neuropteridium or Gondwanidium validum. The importance of this discovery will be discussed later. Gangamopteris and ?Glossopteris were found in the white zone in other localities and impressions of large equiseteous plants were observed in pebbly sandstone near the base. A

prolific horizon of silicified wood (Dadoxylon) seems to form the highest part of the Colinlea on the Tambo road, near Mantuan Downs Homestead.

(c) The Cheshire Formation.

Type locality: Cheshire Pastoral Holding.
Thickness estimated: 2,500 feet.

Unfortunately Geological Report No. 5, written by W. F. Schneeberger in June, 1942, does not contain a lithological description of this formation. Reference is made to Geological Report No. 2, written by J. Woolley, who had mapped the western area around Tambo and had defined and formally named the Cheshire Formation.

As far as we can recall it mainly consists of micaceous flaggy sandstone, calcareous sandstone and brittle shale.

Its base is formed by the prolific Productus Bed, which was first seen at Mantuan Downs. In the type locality this bed consists of about 50 feet of light greyish-yellow argillaceous limestone crowded with brachiopods, corals and bryozoas. It is exposed over a short distance only and disappears along the strike under billy. A coarse grit with abundant silicified wood overlies it.

This fossil bed has been recorded by Whitehouse to occur intermittently "from three miles north of Mantuan Downs Homestead to two miles south of Nardoo Homestead" and it was spotted again by Pallister near Wealwandangie in the syncline west of the Springsure Structure. In the Carnarvon area it was found in the west flank of the Springsure Structure, in both flanks of the Consuelo and the Serocold Structures. It is a very good marker and is the only marine stratigraphic element which occurs both in the terrestrial (west) and the marine (east) facies provinces.

2. The Eastern Area.

The eastern area comprises the area around the township of Springsure, as far as it is not covered by basalt sheets, the south plunge of the Springsure Structure, which is interpreted as the continuation of the south plunge of the Anakie Basement Uplift, and the north-western part of the Carnarvon area.

(a) The Dilly Beds.

Named by Jack and Etheridge after the Railway Siding Dilly, 5 miles north of Springsure.
Thickness exp. 2,500-3,000 feet.

For several reasons this is not a suitable type locality. The tectonic situation is not clear in the area where the Dilly Beds are exposed and therefore no normal section can be obtained. Moreover, neither the lower nor the upper limit of the beds is exposed in the type locality, which forms an isolated outcrop entirely surrounded by basalt and other volcanic rocks, possibly of Tertiary age.

Better sections were obtained in the plunging core of the Springsure anticline, south-south-east of the township of Springsure.

The Dilly Beds are the marine equivalent of the terrestrial Joe Joe Creek Formation of the western area. However, it is not entirely developed in a marine facies, but still contains abundant plant remains (Gangamopteris and Glossopteris) in several horizons, although these may partly be drift material. Lithologically there are still certain

affinities to rock types of the Joe Joe Creek Formation.

They include white to buff or khaki-brown, cross-bedded, felspathic sandstone, dark-grey to black indurated and carbonaceous shale with plant remains, grey and brown shale with plates of fibrous gypsum, some green mudstone and very sandy limestone or calcareous sandstone with abundant marine fossils. Scattered pebbles, up to walnut-sized, occur in most of the sandstones and even in the limestones. In some horizons pockets and lenses of sub-angular to well rounded cobbles, up to double fist-sized may suggest a fluvio-glacial origin or iceberg-transported material. The evidence for glaciation increases in a southern direction. The occurrence of large erratics in the Dilly Beds of the southern part of the Springsure Structure was reported by Reid (1930) and confirmed by Shell's geologists. Apart from the Gondwana plants, stem fragments of Dadoxylon were recorded from a horizon near the top of the beds.

The Dilly Beds are the stratigraphically lowest sequence exposed in the core of the Springsure Structure. Their relationship with the Carboniferous Ducabrook Formation therefore is not known. They are absent on the Anakie Uplift west of Emerald, presumably through wedging out and are to be observed first in the Dilly area in a position that is not quite clear tectonically. The steep dips of 60 to 90 degrees in the black shales in Springsure Creek (Dilly area), however, appear to be a local feature, presumably caused by numerous intrusive dykes penetrating this sequence.

In the Springsure structure, between Orion and Aldebaran Creeks, dips are rather low and exposures few. There, the Dilly Beds occupy the wide anticlinal valley along the axis. Black, carbonaceous shales, similar to those found in the Dilly area, but without Glossopteris remains, occur here between two marine horizons.

(b) The Aldebaran Creek Formation.

Type Locality: Aldebaran Creek (Northern part of Springsure Structure.
Thickness in type locality: 4,500 feet.

The Aldebaran Creek Formation as defined for the Springsure Structure, comprises Reid's Aldebaran Sandstone (Serocold Sandstone of Reeves), Ingalara or Coral Stage and Catherine Sandstone. The comprehensive name was chosen because a subdivision as it was made in the area farther to the south, was not feasible here.

It is predominantly/freshwater and delta deposit with plant remains (Gangamopteris and Glossopteris). A few marine incursions of short duration are evidenced by two fossil horizons in the lower part (Springsure Creek), a few fossil casts near its base (Staircase Creek) and abundant solitary corals (Europhyllum reidi, Trachypora wilkinsoni, Monilopora nicholsoni and Conularia sp. in a lensing zone of shale and thin limestone (Reid's Coral Stage) in the upper part.

The correlation of the Aldebaran Creek Formation with the Colinlea Formation is well supported by an almost continuous section across the Wealwandangie Syncline, linking up the eastern with the western area, and the occurrence of Gangamopteris and Glossopteris in abundance in both formations. For a more detailed description of the lithology of the Aldebaran Creek Formation Geological Report No. 4 should be consulted.

(c) The Productus Bed.

As mentioned before, the Productus Bed, which

was found in the Carnarvon area overlying the Catherine Sandstone, is identical with the Mantuan Downs Productus Bed of the Western area. In Shell's map it is shown as immediately overlying the Catherine Sandstone, although in fact there might be some shales intervening between these two stratigraphic units, which however, can not be shown on a map having a scale smaller than 1 inch to a mile, the scale which was used for field mapping by Shell's parties.

(d) The Rewan Formation.

This formation comprises the undivided sedimentary sequence between the Productus Bed at its base and the Carnarvon or Clematis Sandstone or Formation at its top.

Triassic plants were found by Reeves in this sandstone, later confirmed by Shell's geologists. However, Trissic plants were also found in the upper part of the Rewan Formation, which would indicate that these beds are also of Triassic age. This might be the reason for the redefinition of the Rewan by Shell, replacing the undivided Rewan by Bandanna for its lower part of Permian age, and restricting the name Rewan to its upper part of Triassic age.

Nothing can be added to Reeves' (1947) description of the other formations of Triassic age.

II. PALAEONTOLOGICAL EVIDENCE.

The following is a brief summary of the palaeontological evidence in hand at 1943.

A. The Devonian.

(a) The Dunstable Formation.

Reports by Dr. D. Hill of 27/10/1940:

M.233 : Xystriphyllum insigne Hill
Acanthophyllum spp.
Phillipsastraea sensu lato
Massive Favositid with large corallites, probably Favosites goldfussi or Gephuropora duni Etheridge,
Small dendroid Favositid, probably Thamnopora sp.

Age : Lower Middle Devonian.

Middle Devonian corals in glacial boulders of the Joe Joe Creek Formation: (Dr. D. Hill's rpt. 16/1/41)

M.284b: "Columnaria" sp. cf. rhenana Frech
?Idiostroma sp.
Syringopora sp.

S.274b: Macgeea or Disphyllum
Alveolites sp.
?Favosites goldfussi or Gephuropora sp.

Age : In all probability Middle Devonian, M.284b probably Upper Middle Devonian (Givetain).

(b) The Telemon Formation.

Lepidodendron sp. was collected from this formation, but could not be determined specifically by Prof. Sahni. It is therefore not to be decided whether the Devonian L.australe is present or not.

Algal limestone specimens were sent to the U.S. (?Ohio University). The result of the investigation was available after the report was written, but it appeared that the

algae were fresh water forms and are not younger in age than Devonian, hence the inference that the Telemon Formation might be Upper Devonian.

B. THE CARBONIFEROUS.

(a) The Mount Hall Conglomerate.

No fossils recorded.

(b) The Snake Range Sandstone.

No determinable fossils recorded, excepting ?Lepidodendron and ?Equisetus.

(c) The Ducabrook Formation.

Reports by Prof. Sahni of 16 and 25/10/41 and Dr. Walkom of 24/3/42:

M.362: Stigmaria ficoides)
P.326: Lepidodendron (Knorria) sp.) Upper part of the
S.419: Lepidodendron sp.) Ducabrook Formation
S.427: Lepidodendron sp.)

A Carboniferous age was indicated by both Palaeobotanists.

Report by Prof. E. S. Hills of 12/6/41 on fish remains:

M.452a,b : Spine of an Acanthodian fish, Gyracanthides murrayi Smith Woodward. The same species occurs in estuarine and fresh water beds at Mansfield, Victoria, associated with other fishes and with plant remains. Very closely related to, if not identical, with Gyracanthus, a typical Carboniferous genus of England and North America.

Age : Carboniferous.

M.318, M.529, M.649, M.778, M.800a, M.825: Contain Ganoid scales and bone fragments of a Palaeoniscid fish, comparable with Elonichthys.

Age : The age of the beds is indicated with some degree of certainty by the occurrence of Gyracanthides to be Carboniferous. The type of fish scale associated is quite consistent with this interpretation, but of itself gives little definite evidence, except that it excludes the possibility of the beds being Devonian.

C. THE PERMIAN.

(a) Joe Joe Creek and Colinlea Formations.

Various repo ts by Prof. Sahni and Dr. Walkom.

Phyllotheca sp.
Vertebraria indica
Glossopteris Browniana
Glossopteris ampla
Glossopteris tortuosa
Gangamopteris cyclopteroides
Noeggerathiopsis Hislopi
?Schizoneura sp.

Gondwanidium validum. This is a Gondwana form, which has not been recorded before from Australia, although it is well known in India. It was first determined by both

palaeobotanists (Prof. Sahni and Dr. Walkom) as closely related or even identical with Aneimites, until is was pointed out to them, that this form was collected from the "White Band" of the basal Colinlea Formation, which elsewhere contained a Glossopteris-Gangamopteris flora. An idential fern was also collected in the highest part of the varve shale between the glacial beds of the Joe Joe Creek Formation. The numbers of these two important specimen are S.274a and S.274f belonging to the section at Shell's Trig. Station 13 in the Echo Hills area.

(b) The Dilly Beds and Aldebaran Creek Formation.

Determinations by Dr. F. W. Whitehouse (Rpt. 4/9/40)	Determinations by Mr. H. Fletcher. (Rpt. 7/3/42)
M.5 Dielasma sp. nov. Stenopora sp. nov. Lyonia sp. nov. Platyschisma? sp.	M.5 Maconia carinata
M.29 Murophyllum reidi Protoretepora montuosa Fenestella spp. Stenopora gimpiensis Stenopora crinita Stenopora sp. Taeniothaerus subquadratus Terrakea sp. Strophalosia sp. Eurydesma hobartense Mourlonia sp.	M.29 Pleurophorus gregarius Eurydesma cordatum Taeniothaerus subquadratus
M.54 Terrakea fragile Terrakea brachythaera	M.54 Dielasma sp. Terrakea cf. brachythaera
M.56 Deltopecten subquinquelineatus Stutchburia costata Ptychomphalina morrisiana Terrakea fragile Pleurotomaria strzeleckiana Platyschisma ocula	M.56 Deltopecten subquinquelineatus D. sp. juv. cf. fittoni Terrakea sp. nov. Ptychomphalina sp. Mourlonia sp.
Age: M.5 Permo-Carboniferous M.29 Dilly Stage as defined by Reid M.54 Middle Bowen M.56 Middle Bowen, Upper Marine	M.5, M.29, M.56 Permian-Middle Lower Marine or Allendale Stage in N.S.W. M.54 essentially of same age as the above specimens, with a possibility of an Upper Marine, but most likely top Lower Marine age

All four collections are from the type locality of the Dilly Beds, 5 miles north of Springsure.

The bryozoa occurring in the above collection were determined by Miss J. Crockford (Rpt. 6/1/42) as follows:

M.5 Dyscritella sp. nov.	Resembling undescribed species from Lower Marine in N.S.W. ?Upper Marine Series
M.29 ?Batostomella sp. nov. Polypora sp. nov. cf. montuosa	Branxton Stage of Upper Marine
Fenestrellina sp. nov. aff. fossula Fenestrellina fossula	Lower & Upper Marine

Stenopora spp. nov.	Resembles S.Crinata, Muree and Mulbring Stages of Upper Marine.

Age: "The age of the fauna is Permian, but there is not sufficient evidence to suggest with which part of the Permian sequence in other States it should be correlated".

A collection was gathered from beds, which are thought to be the equivalent of the Dilly Beds. Dr. D. Hill's provisional determinations are the following:

M.1081: ?Sanguinolites concentricus
Deltopecten ?fittoni
Aviculopecten ?michelli
Deltopecten subquinquelineatus
?Martiniopsis morisii
?Modiomorpha mytiliformis

Age: "The general assemblage is one which might be expected in the Lower Marine of N.S.W. More minute correlations are not justifiable on this present evidence".

Specimens P.122 and P.122a from the Cattle Creek Formation (equivalent of the Dilly Beds) in the southern Serocold Anticline contained according to Mr. H. Fletcher (Rpt. 7/3/42) the following fossils:

Strophalosia cf. gerardi
Spirifer tasmaniensis

Age: Permian.

Bryozoa from sample P.122 (Rpt. by Miss Crockford, 18/8/41):

Fenestrellina fossula	Allandale (L.M.), Branxton (U.M.)
F.sp.nov.aff. fossula	Allandale, Branxton, Muree
F. exserta	Branxton
F. horologica	Calytharra - Noonkanbah (W.A.)
F. canthardiformis	Branxton
F. Kukuaensis	
F. sp.nov.	
Polypora woodsi	Noonkanbah (W.A.)
Polypora sp.cf. magnafenestra	Allandale, Branxton
Batostomella spp.nov.)	Throughout Permian in Eastern
Rhombopora sp.nov.)	and
Dyscritella(?) sp.nov.)	Western Australia.

From the Aldebaran Creek Series (upper part, Reid's Coral St.), determined by Dr. D. Hill (Rpt. 17/11/41):

M.963: Euryphyllum reidi
Trachypora wilkinsoni
Cladochonus ("Monilopora") nicholsoni

Age: "Trachypora wilkinsoni and Cladochonus nicholsoni occur together in the Condamine Block at Silverwood in beds which Richards and Bryan suggested were to be correlated with the top of the Branxton Beds of the Upper Marine of the Hunter River Basin, which is the only horizon in the Hunter R. where T.wilkinsoni is abundant, although it is known from other Upper marine horizons. It may have an extended range and by itself is probably not reliable as an indicator of horizon. The same may be said of C.nicholsoni, which has the Noonkanbah Beds of W.A. for its type horizon".

8 Apart from sample M.963 which is representative of the "Coral Stage" another fossil locality, very likely belonging to the same horizon, has been found: Mr. Fletcher (Rpt. 7/3/42) determined the following forms:

M.1044: Terrakea brachythaera var. elongata
Conularia cf. derwentensis
Spirifer sp.
Camarotoechia cf. pleurodon

Age: "The Terrakea could be from the Upper Marine. The Conularia is closely allied to Conularia derwentensis Johnston from the Lower Marine of Tasmania. The two last named forms are not Permian fossils. The type of Spirifer and the presence of Camarotoechia cf. pleurodon Phillips, indicates an Upper Devonian age for the rocks. The latter has been known from the Carboniferous and Lower Permian, but is rare. They are dissimilar to the M.1044 series and must have been collected from another horizon. Any field notes or fossil associations would give a clue to this apparent discrepancy".

It has to be emphasized that the whole assemblage was collected from one and the same locality and therefore we might have to deal here with reworked forms, although there has been no evidence found for the presence of marine Upper Devonian anywhere in the area.

(c) The Mantuan Downs Productus Bed.

This is, as mentioned before, an important fossil horizon, the only marker bed common to the terrestrial and the marine facies province. Collections were made in the type locality as well as in a number of other localities. The fossils were determined by Dr. F. W. Whitehouse (Rpts. 24/9/40 and 3/1/41), Dr. D. Hill (Rpts. 16/1/41 and 17/2/42), Mr. Fletcher (Rpt. 7/3/42) and Miss J. Crockford (Rpt. 6/1/42). The following forms are listed:

Terrakea brachythaera
T. brachythaera var. elongata
T. solida (Productus solidus)
Terrakea elongata
Dielasma cf. cymbaeformis
Strophalosia clarkei
Terrakea fragile
Spirifer duodecimocostata
Strophalosia ovalis sp.nov.
Stenopora ovata
Stenopora cf. tasmaniensis
Stenopora jackii(?) Stenopora australis(?)
Eurydhyllum reidi
Myonia sp. nov.

Dr. Whitehouse assumed an "early Middle Bowen age, slightly higher than Dilly"; for another collection from the type locality he states that the horizon is "top Lower Bowen or base Upper Bowen". Mr. Fletcher concluded "Lower Marine age".

Dr. D. Hill summarized her findings as follows: "The associat on of Productus solidus and Strophalosia ovalis sp.nov., is highly characteristic of the bed wherever it has been found so far. I have compared these two species very closely with Productus (Terrakea) elongatus and Strophalosia clarkei from the big Strophalosia bed of the

Bowen River field recorded by Jack and by Reid, and I am satisfied that they differ and that therefore the two beds are probably on different horizons, but I have no palaeontological evidence to show which is higher. The association of P.solidus and S.ovalis is unknown as yet outside of the Springsure area".

"There is a rich Productus bed in the Muree Stage of the Upper Marine of the Hunter River facies, but neither P.solidus nor S.ovalis has yet been recognized from it. There is thus as yet no reliable evidence for a palaeontological correlation of the Mantuan Downs bedswith any in the Bowen or Hunter River fields".

In our opinion it appears to be quite likely that the marine incursions of the Dilly, the Coral "Stage" of Ingalara Formation and the Mantuan Downs Productus Bed range in age from the Allandale of the Lower Marine to some horizon (?Muree Stage) in the Upper Marine of New South Wales.