

THE PERMO-CARBONIFEROUS IN TASMANIA

This system, as its name implies, is represented by members of Carboniferous and Permian formations with, however, no identifiable line of division. The carboniferous proper, characterised by Lepidodendroid flora and Calamites are absent, and we find as basal members rocks indicative of frigid climatic conditions. Wherever the Permo-Carboniferous appear glacial conglomerates constitute the basal member. These conglomerates vary greatly in thickness from place to place, being but a few feet at Mt. Nicholas and as much as 1200 feet near Preolenna; and they rest upon rocks of pre-Cambrian, Cambrian, Ordovician or Silurian age and in some places upon denuded granite and serpentine and serpentine of Devonian age.

Strata of the Permo-Carboniferous formation comprise:-

- (6) Sandstones and shales;
- (5) Sandstones and shales with coal seams such as those of Cygnet and Bruni Island and the uppermost seam at Preolenna corresponding to the Tomago series;
- (4) Upper marine mudstones with intercalated beds of sandstone and pebbly mudstone, as those of Mersey Valley and Preolenna;
- (3) Lower coal and oil shale measures (Greta horizon) of Mersey Valley, Oonah, Preolenna, Barn Bluff, Quamby and Greshunt.
- (2) Lower marine mudstones, grits, conglomerates, limestones and mudstone conglomerates.
- (1) Glacial conglomerates, grits, flagstones and micaceous sandstones.

1. The glacial beds of Wynyard, Preolenna and Calder River are estimated at 1200 feet in thickness. They consist there of glacial till, conglomerates, and sandstones with erratics. Between Barn Bluff and Mt. Pelion are glacial conglomerates, about 300 feet in thickness, resting upon pre-Cambrian quartz and mica schists.

At Mersey Valley the basal beds are comparatively thin and consist of conglomerates and gritty sandstones.

In the valley of St. Paul River near Avoca the basal Conglomerates 60 feet thick rest upon granite, and consist largely of the waste of that rock, and the finer material contains much tin ore.

In some places as at Bruni Island the base consists of marine gritty conglomerates with enormous granite erratics; in other places of conglomerate with a calcareous cement, also with erratics, as at Maria Island.

In Weld River valley the basal conglomerates, over 200 feet thick, rest upon Cambro-Ordovician quartzites and slates and Devonian serpentine, granite porphyry and alaskite.

2. The lower marine series consisting of sandstone, mudstone conglomerates, mudstones and limestones vary greatly in thickness and reach their maximum (1000 feet) aggregate on the south-east coast.

Calcareous mudstones and mudstone conglomerates are well exposed along the Derwent Estuary. The beds have been divided for purpose of reference into three zones named in accordance with the dominant fossil. The

principal organisms represented are:-

1. Eurydesma Zone	2. Spirifera Zone	3. Fenestella Zone
Eurydesma hobartensis	Spirifera darwini	Fenestella internata
" cordata	" duodecim-	Fenestella plenaia
Spirifera convoluta	" costata	Protorettopora
" stokesii	" convoluta	ampla with
Productus brachythaerus	" strzleckii	organisms
Deltopecten lima-	" glabra	of the
" formis	" tasmani-	other zones.
" fittoni	" ensis	
Pleurotomaria morri-	" oviformis	
siana	" lata	
Pterinea macroptera	" vespertilis	
Conularia derwent-	" stokesii	
tenses	Orthotetes creni-	
Conularia tenuistriata	stria	
Lithodomus gouldii	Terebratula	
	sacculus	
	Deltopecten lima-	
	formis	
	" fittoni	
	Aviculopecten	
	squamuliferus	
	Chaenomya etheridgi	
	Stenopora Tasman-	
	iensis	
	" crinita	
	Platyschisma ocula	

Lower marine mudstones and sandstones reach a maximum of 600 feet in Mersey Valley. The fossils found in the upper beds (300 feet) of this member are identical with those in the succeeding oil shale and upper marine mudstones and include:-

Spirifera tasmaniensis	Orthotetes
Cardiomorpha gryphoides	Aviculopecten sprengii
Pleurotomaria morrisiana	Eurydesma hobartensis
Pleurotomaria woodsii(?)	Keenia twelvetreesi
Pteronites latus	Stenopora tasmaniensis
Aviculopecten latrobensis	Fenestella plebeia
Aviculopecten subquiquelineatus	Protorettopora ampla
Aviculopecten fittoni	Dielasma sacculus

At Preblenna the blue-grey mudstone (unfossiliferous) with bands of mudstone conglomerate, reaches a maximum thickness of 300 feet. Overlying that member are mudstones (140 feet thick) with marine fossils of the following genera:-

Fenestella	Productus
Spirifera	Aviculopecten
Eurydesma	

At Sheshunt below the oil shale bed the mudstones contain Spirifera, Productus, Dielasma, Eurydesma, Pterinea, Deltopecten, Aviculopecten, Platyschisma, and Pleurotomaria.

On Maria Island 600 feet of limestone and mudstone rest upon 12 feet of boulder limestone and conglomerate with large granite erratics. The late R.M. Johnson divided the series into the following list of palaeontological zones:

- V. Crinoid Zone
- IV. Productus Zone
- III. Fenestella Zone
- II. Eurydesma Zone
- I. Erratic Zone

II. The Eurydesma zone, 80 feet thick, contains a 40 foot bed composed almost wholly of Eurydesma. The following is a list of fossils noted in this zone:

Eurydesma hobartensis	Aviculopecten squamuliferus
Eurydesma cordata	Platyschisma ocula
Deltopecten limaeformis	Stenopora tasmaniensis
" fittoni	" ovata
Conularia tasmanica	" informis

III. A zone of mudstones 124 feet thick replete with

Fenestella internata	Spirifera darwini
" plebeia	" glabra
Protoretrepora ampla	" duodecimcostata
Spirifera Tasmaniensis	Productus brachythaerus
	Strophalosia clarkei
	Pleurotomaria morrisoni

IV. Limestones with alternating beds of calcareous shale and mudstone. The limestones contain Stenopora, Fenestella, Crinoids, Spirifera, Strophalosia, Productus, Deltopecten and Eurydesma.

V. A 30 foot bed of Crinoid limestone.

Lower members of the Permian-Carboniferous outcrop on Bruny Island. The lowest visible beds here are marine gritty conglomerates with Spirifera strzelecki, Spirifera darwini, Pterinea macropteris and trunks of conifers. On north Bruny the lower beds are grits, conglomerates, limestone and arenaceous mudstone. The conglomerate is built up in part of stone and boulders of granite, porphyry, schist, quartzite and slate, some of huge size. A 4 foot bed of overlying limestone consists almost wholly of Stenopora ovata. Large conifer trunks are embedded in the conglomerate and the limestone.

The next in succession is a siliceous limestone and mudstone with casts of Pleurotomaria morrisoniana, overlain with siliceous limestone containing Spirifera convoluta, Spirifera strzelecki, Dielasma sacculus, Deltopecten limaeformis and fittoni, etc., and capped with finely laminated mudstone with abundant Fenestella and Protoretrepora Ampla.

Similar beds occur at Eaglehawk Neck, Tasman Peninsula.

At Cygnet the succession is:- (3) Fenestella Zone; (2) Spirifera Zone; (1) shaly mudstone.

At Mt. Pelion East and Mt. Pelion West and Henty River the lower measures consist of mudstone and limestones with Fenestella, Stenopora, Spirifera, Productus, Aviculopecten, etc.

3. The Lower coal measure series corresponding with the Greta series of New South Wales separate the Lower marine from the Upper marine series. These consist of grits, sandstones and marls with a seam of coal not exceeding 2 feet in thickness.

The plant remains found in this association are:-

Glossopteris browniana
 " ampla
 " indica
 Gangamopteris augustifolia
 " cyclopterioides
 Neoggerathiopsis hislopi
 Phyllothea australis
 Cardiocarpus sp.

Associated with the coal is a bed of oil shale (tasmanite) at Mersey, Nook, Beulah, Quamby, Cheshunt, Oonah and Henrietta; and at Preolenna, Barn Bluff and Mt. Pelion cannel lies in association with the humic coal.

The tasmanite seam and the associated bed of coal lie at the same horizon in the formation. In the coal portion of the basin the coal and carbonaceous shale and containing sandstones lie between the Lower and Upper Marine mudstones, but in the Tasmanite portion the Lower Marine and Upper Marine form a continuous series, the position of the shale seam conforming to the line of division. Long it was doubtful whether the Tasmanite and Coal seams were homologous, but recent investigation set all doubt aside. Early observers noted that in the marine beds above the coal seam fossils are found similar to those in the beds above the tasmanite. The fauna above and below the coal and shale and in the shale are identical and all are identical and all are marine or open estuarine. In boring for oil shale at Latrobe it was found that there is an intergradation of coal and oil shale. At Nook the bed of oil shale abuts or merges into the coal on two sides, and in the valley of Don River near Nook is a thick seam of black coaly shale which differs in many important particulars from tasmanite and marks the transition stage between tasmanite on one side and the humic coal of the region on the other. Now, this black coaly shale is similar in appearance to the porrer cannels of Preolenna, and, excluding a portion of the ash, is of similar chemical composition. It differs here in being more crowded with the sporangia of tasmanite. Another point of interest is the separation of the two layers of black shale here, as in the tasmanite elsewhere, and two bands of coal at Preolenna, by a band of almost barren mudstone. At Chudleigh not far from the Cheshunt bed of tasmanite coaly matter similarly charged with sporangia has been found, and near Cradoc (Southern Tasmania) is an impure bed of cannel similar in character. In further confirmation, the writer has found thin bands of coal, brittle and of pitch-like lustre incased in ore attached to tasmanite at Latrobe. It is worthy of note that the relative proportion of volatile hydro-carbons to fixed carbon is 1 to 1 in this coal as in the main body of coal in the adjacent field.

A distinguishing feature between the lower coal seam of Preolenna and the coal of Mersey Valley (Latrobe) is the association of torbanite or cannel with the former and tasmanite with the latter. In this connection it is of interest to note that at Henrietta about five miles from Preolenna a seam of tasmanite lies in association with coal of the Mersey Basin type. The inference to be drawn from the evidence is that sporangia of the marine

deposit tasmanite form one of the chief components of torbanite or cannel in which yellow disc-shaped particles of waxy matter can be detected under the microscope. In the Preolenna lower seam of coal there is an intergradation of cannel to humic, just as there is from tasmanite to humic at Mersey and Henrietta. The gradations may be as follows:-

1. tasmanite, carbonaceous shale of Don Valley, humic.
2. Carbonaceous shale, cannel, humic-kerogenite, humic.

There is however, no evidence to indicate that under suitable conditions there should not be a gradation between tasmanite, through cannel to humic. On the contrary, it would seem beyond question that the beds of sediment would exhibit humic coal passing literally into tasmanite through humic-kerogenite or cannel or direct.

At Preolenna the lower productive beds contain two coal seams separated by a band (7 to 9 feet thick) of arenaceous mudstone. The lower seam of coal (steam) is homologous with the known coal seam of Henrietta and is similar to that of Mersey Valley, therefore a cognate seam of tasmanite might be expected in the country adjacent to Preolenna unless it be that the Henrietta seam of Tasmanite corresponds thereto. Between Onah and Henrietta, as at Mersey and Quamby, no cannel is found intergrading the coal, but in juxtaposition lies tasmanite. Now, at Preolenna the upper band of the lower coal seam is a gas coal and contains much cannel, being made up largely of the materials of tasmanite, namely, the waxy covering of spores. The cannel therefore corresponds with the upper band (the richer) of tasmanite and the steam coal with the lower band (the poorer) of tasmanite.

4. The lower coal and oil shale productive sandstones and mudstones are overlain with pebbly sandstones and mudstones carrying fossils of spirifera, fenestella, etc. at Preolenna, Barn Bluff, Mt. Pelion, Henrietta, Onah Quamby, Cheshunt, Georgetown and Mersey Valley. These beds at Mersey Valley reach a maximum of 600 feet in thickness overlying the shale, and a maximum of 500 feet overlying the coal seam. They contain fossil fauna exactly similar to the Lower mudstones and sandstones, but some of the latter have disappeared. Sandstones and mudstones alternate in thin beds of Mersey Valley therefore the coal seam is only one inch thick.

The upper marine series, represented by mudstones, mudstone conglomerates and limestones, vary elsewhere in thickness from 70 feet at Preolenna, 313 feet at Mt. Nicholas, 500 feet at Upper Derwent and 950 feet at Barn Bluff, and 200 feet of the sandstone and shale beds are exposed at and near Porters Hill, where, in addition to fragments of the plant Gangamopteris, they contain the following forms:--

Spirifera tasmaniensis
 " darwini
 " duodecimcostata
 Dielasma sacculus
 Avidula
 Arca
 Aviculopecten
 Eurydesma
 Edmondia
 Inoceramus
 Pleurotomaria
 Conularia

5. The Upper Marine series passes upwards into fresh water sandstones and shales with coal seams as at Preolenna (550 feet), Barn Bluff (740 feet), Mt. Nicholas (260 feet) and Sandfly and Cygnet (200 feet). These correspond with the Tomago series of New South Wales.

At Cygnet the beds rest upon the Fenestella member and the coal seam, 3 to 4 feet in thickness, is incased in sandstone. The proximate analysis of the coal is:-

fixed carbon	- 63.9	per cent
Volatile combustible		
matter	- 13.2	" "
Ash	- 22.0	" "

The shale of this seam contains impressions of *Vertebraria australis* and *Gangamopteris*.

At Adventure Bay a seam of coal, 2 feet thick, and shale contain impressions of *Glossopteris browniana*, *Gangamopteris obliqua* and *Gangamopteris spathulata*.

At Southport the shales contain remains of *Pecopteris lunensis* and *Vertebraria australia*.

In the Mersey area are 300 feet of sandstones and mudstones containing a 1 inch seam of coal; and in the Barn Bluff, Mt. Pelion and Preolenna areas also rocks of these series contain a coal seam.

The thickness of this formation in the aggregate varies from point to point the best sections showing 2000 to 2600 feet. In some places the basal member lies below sea-level and at others over 3000 feet above sea-level.

The great difference in elevation is due to the upthrust effects of the diabase intrusion, to subsequent faulting and to epeirogenic movement.

Despite the extraordinary disruption and dislocation of the members of the Permo-Carboniferous by diabase the beds are not steeply tilted, but are usually horizontal or gently inclined, and are not deformed or folded.

REFERENCES

- Geology of Tasmania
by R.M. Johnson.
Geology of Tasmania
by W.H. Twelvetrees.
Coal Resources of Tasmania.