TASMANIA DEPARTMENT OF MINES

1979

GEOLOGICAL SURVEY EXPLANATORY REPORT

GEOLOGICAL ATLAS 1:250 000 SERIES

SHEET SK-55/8

HOBART

by N. FARMER, B.Sc. (Hons), Ph.D.

T. J. HUGHES, GOVERNMENT PRINTER, HOBART, TASMANIA OS-D 590

ISBN 0 7246 0486 3

TASMANIA DEPARTMENT OF MINES

1979

GEOLOGICAL SURVEY EXPLANATORY REPORT

GEOLOGICAL ATLAS 1:250 000 SERIES

SHEET SK-55/8

HOBART

by N. FARMER, B.Sc. (Hons), Ph.D.

DEPARTMENT OF MINES, GPO BOX 124B, HOBART, TASMANIA 7001

FARMER, N. 1979. Geological atlas 1:250 000 series. Sheet SK-55/8
Hobart. *Explan.Rep.geol.Surv.Tasm.*

ISBN 0 7246 0486 3

PREFACE

This explanatory report gives a brief outline of the area of the Hobart 1:250 000 sheet. This sheet is one of a new series of geological maps which will provide a complete coverage of the State.

The geological information is derived from both departmental and external sources.

The list of selected references at the end of the report will serve as a guide to the more important geological publications which deal with the area.

J.G. SYMONS, Director of Mines

PHYSIOGRAPHY

Topography and landform

South-eastern Tasmania is a deeply dissected region of rugged topography with little lowland. Only in a few coastal areas and along the banks of the major rivers is there any flat-lying land. The hills often come down to the coastline where they form impressive cliffs.

Davies (1965) has divided the mountains into plateau type and ridge type. The differences in form between the two arise out of fundamental structural and lithological characteristics of the underlying rocks. The ridge forming mountains are found in areas of pre-Parmeener Super-Group rocks where rivers cut their valleys along the strike of the softer of the comparatively steeply dipping rocks leaving the harder quartzite and conglomerate standing out as ridges. Plateau-type mountains occur over most of the region underlain by Parmeener Super-Group rocks intruded by flat-lying Jurassic dolerite sills. The dolerite is fairly resistant to erosion and often dominates the landscape.

Within the area underlain by Parmeener Super-Group rocks it is possible to distinguish two topographic regions, a high plateau region west of the Derwent and a low dissected plateau extending over all the country east of the Derwent. For boundaries and further characteristics of these two regions see Davies (1967).

The major structural elements of the region are determined by late-Mesozoic faulting which produced a series of fault blocks and grabens that were once filled with easily erodable Tertiary material. Present processes of erosion are exhuming these old late-Mesozoic fault systems by rapid removal of the last remaining soft Tertiary rocks. These exhumed fault lines and fault scarps give deeply indented coastlines with a rectilinear development to some segments and are probably responsible for the angular course of parts of the main rivers.

During Pleistocene times the Derwent and other major rivers cut their channels far below present base level. Later rises in sea-level and consequent flooding of the river valleys produced the drowned landscape characteristic of the present land-sea configuration.

Humid fluvial erosion is now dominant throughout the region and former glacial, periglacial and aeolian processes are now insignificant factors in landscape development. Nevertheless there are still some areas which carry the effects of these past processes in their present form and topography and Davies (1965) has recognised four separate process provinces: glacial, periglacial, humid and subhumid.

Drainage

Most of the area underlain by pre-Parmeener Super-Group rocks drains southwards into the New River which discharges into the sea at New River Lagoon [DM6583]. Rivers from the country underlain by Parmeener Super-Group rocks of the high plateau region to the south and west of Huonville [EN0436] drain via the Picton River into the Huon River which after many angular turnings empties into the D'Entrecasteaux Channel. The Derwent acts as a similar main drainage system for the north-west of the region. The headwaters of the Huon and Derwent rivers have crossed the pre-Parmeener Super-Group boundary onto Lower Palaeozoic and older rocks and are actively increasing their catchments westward by erosion and river capture. To the east of Hobart there are no major river systems.

PRECAMBRIAN ROCKS

Precambrian rocks occur almost exclusively as a narrow fringe along the western margin of the region. The exposed rock sequences are merely small extensions of much larger masses of similar, and better known, rock successions found further to the west in the Port Davey region (Williams and Corbett, 1977).

Metamorphosed rocks are found around the headwaters of New River [DN0103] where the sequence is largely made up of pink quartzite overlain by greenschist and phyllite and with conglomerate beds up to 100m thick (Hall, 1966). The rocks are structurally simple and have a steep dip to the north-west. Both metamorphism and deformation are of a number of phases of the Frenchman Orogeny (Spry, 1962*a*). The grade of metamorphism ranges from the greenschist facies to the epidote-amphibolite facies.

Relatively unmetamorphosed rocks of Precambrian age range from the area immediately west of Maydena [DN6060] southwards to the Cracroft River [DN6010]. The succession consists of a thick sequence of interbedded quartzite and dolomite folded into a series of northwest trending anticlines and synclines.

Immediately to the west of Prion Bay [DM6080] there is a sequence of unmetamorphosed breccia, conglomerate, sandstone and siltstone. The sequence begins with basal breccia overlying metamorphosed Precambrian rocks. This basal breccia, which contains clasts from the underlying metamorphosed basement rocks, is overlain by 600m of siltstone and sandstone with a well developed vertical cleavage (Hall, 1966). The Precambrian rocks are overlain unconformably by a clastic succession of Ordovician age.

The only other rocks of known Precambrian age are dolomitic limestones at Hastings [DM8896] where a considerable underground drainage system has been developed within the limestone.

CAMBRIAN SYSTEM

Outcrops of Cambrian rocks are restricted to a small area along the coast and for a short distance inland from Point Vivian [DM6876], in the extreme south west of the region. The presence of a 'Cambro-Ordovician' sequence in the area was first recorded by Twelvetrees (1915) and later re-examined by Blake (1938).

Abrupt changes of strike indicate structural disruption of the section and consequent uncertainty as to some of the stratigraphic relationships though the major rock types are well documented (Banks, 1957*a*, 1959, 1962*a*).

The Cambrian succession unconformably overlies steeply dipping Precambrian dolomite. The sequence begins with more than 300m of grey, green and red conglomerate and breccia with minor sandstone and siltstone beds. The clasts are mainly of dolomite and serpentinite but there is also a lesser and varying content of siliceous fragments. The sandstone and siltstone of this part of the sequence are commonly green in colour, greasy to the touch and full of serpentinite fragments (Banks, 1959). A 30m sequence of siliceous conglomerate and sandstone is interbedded with the conglomerates along the western side of Rocky Boat Inlet [DM6776].

The thick basal conglomerate sequence passes upwards into dolomitic siltstone, sandstone, and dolomitic siliceous conglomerate. The conglomerates show graded-bedding and large slump folded and rolled siltstone fragments and may be part of a proximal turbidite sequence. Nearby dolomitic siltstone (lithographic stone of Twelvetrees, 1915) exhibits lamination, ripple-marking, interference ripple-marking and worm casts (Banks, 1959).

Beds lying between Point Vivian and Prettys Point [DM7073], and probably higher in the succession, include further interbedded serpentinite conglomerate, sandstone, mudstone and fine conglomerate similar in general gross lithology to the basal conglomerate. Spicules of *Protospongia* (Banks, 1959, 1962*a*) recovered from one of the finer sandstones show the sequence to be, at least in part, marine. No other identifiable fossils have as yet been found.

Cambrian rocks are overlain by a siliceous clastic sequence usually considered to be Junee Group correlates of Ordovician age.

The absence of fossils of zonal value makes dating of the Cambrian succession difficult but analogy with other Cambrian successions suggests a late-Middle to early-Late Cambrian age as the most likely.

A number of serpentinite bodies are known within the area of Cambrian outcrop. These were first noted by Twelvetrees (1915) who recorded a small outcrop of 'pyroxene contact rock' on the beach and outcrops of serpentinite inland. Further work (Craig, 1970, 1971) has located another serpentinite body intimately associated with dolerite. Some of the finer grained dolerite is described as showing 'basaltic textures' and one sample is described as a basaltic tuff.

Chromite is always found in association with sediments derived from the serpentinites and small quantities of gold and osmiridium have been recovered from secondary alluvial deposits (Blake, 1938).

The only other rocks in the region believed to be of Cambrian age lie beneath almost 600m of Permian cover in the Glenorchy bore [EN2056] where cleaved high-alumina rocks were found similar in composition to basalt of the Mt Read Volcanics. (Leaman, 1972; Solomon and Griffiths, 1974).

JUNEE GROUP CORRELATES (ORDOVICIAN SYSTEM)

Junee Group correlates are at present known only from a number of widely scattered localities along the western margin of the region, from Maydena [DN4726] in the north to Surprise Bay [DM4717] in the south, and from a few isolated inliers near Hastings and Ida Bay [DM4919]. The country in which Junee Group rocks are found is mostly remote, difficult of access and geologically poorly known. Future work will undoubtedly extend the distribution of Junee Group correlates far beyond the boundaries currently accepted.

Rock sequences assigned to the Junee Group and its correlates are divided into two groups: a *lower* variable coarse clastic sequence with subordinate siltstones and an *upper*, more uniform, carbonate sequence - the Gordon Limestone and its correlates. An overall lithological description of the Gordon Limestone, which applies over most of its area of outcrop, has been given by Banks (1957*b*). It is described as a compact, brittle, medium- to dark-grey limestone of high purity (over 90% $CaCO_3$ in places). The limestone is sometimes dolomitic and often cherty. Grain size ranges from fine to coarse but with fine to medium as the predominant range. Fossils may be abundant but are often restricted to individual beds.

The most northerly area of outcrop is at Maydena [DN4726]. Here the lower clastic sequence of the Junee Group is represented by a minimum of 140m of well-bedded, well-sorted quartzite with thin interbedded siltstone. Sedimentary structures indicate current flow from the north. Faunal evidence suggests an Arenigian age for the beds (Kobayashi, 1940; Brown, 1948; Thomas, 1960; Banks, 1962*b*).

The Gordon Limestone has its thickest development in the Florentine Valley [DN4528], a little beyond the western edge of the region considered here, where Corbett (1964) recognised five members within the limestone with an aggregate thickness of 1560m. At Maydena (Jago, 1972) 610m of beds are exposed. These beds have been equated with the lower three members of Corbett's 1964 succession. The upper part of the limestone sequence has been faulted out.

The lowest member present is a 240m thick, poorly-bedded, cherty limestone, with chert reaching 75% of total rock in some places. The chert content decreases upwards. No fossils have been found. This lowest member grades upwards into 200m of dark-grey, pale-grey weathering, dolomitic limestone. Fossils are common and varied and in the upper part of this member *Girvanella* colonies and associated macluritid gastropods are sufficiently abundant to provide a distinctive marker horizon. Banks and Johnson (1957) consider the beds to be Chazyan in age; Corbett (1964) concurs. If Jago's (1972) lithological correlation with the Florentine Valley can be sustained then these beds may belong to the lower, Marmerian, stage of the Chazyan (Corbett and Banks, 1974; Cooper, 1956). The third, and highest, member of the limestone at Maydena is dark-grey, fine-grained and heavily criss-crossed by calcite veins. Stylolites are common. Corbett (1964) suggests a Blackriverian age for this member.

To the south of Maydena more than 200m of Gordon Limestone is known to floor the valley of the Picton River in the neighbourhood of DN7515. The beds range from equivalents of the Lords Siltstone up into the Upper Limestone Member of the Benjamin Limestone of Corbett and Banks (1974). The fauna includes stromatoporoids, heliolitid corals, orthoid and rhynchonelloid brachiopods, conodonts, fragmented graptolite debris and the trilobite *Pliomerina* (M.R. Banks pers. comm.). *Pliomerina* is characteristic of beds of Middle Ordovician age in China.

Outcrops of Gordon Limestone are reported from Judds Cavern [DN6811] by A. Goede (pers. comm.). The contained fauna includes conodonts and the *Maclurites-Girvanella* association indicative of a Chazyan age for the rocks. A short distance to the west of Judds Cavern [DN6711] Stephenson (1954) recorded well-bedded, white quartzite with occasional conglomerate bands. These beds were thought to be lateral equivalents of the basal clastic sequence of the Junee Group, resting unconformably on older rocks, but there is now doubt both as to the identity and disposition of the rocks and they may well be much older than previously supposed (M.R. Banks, pers. comm.).

Gordon Limestone correlates are also known around Vanishing Falls [DM7097] where the disappearance of surface drainage is presumably due to the development of an extensive underground drainage system in the limestone.

Gordon Limestone at Precipitous Bluff [DM6784] east of New River Lagoon has been described by Black (1938). The limestone is prominent along the lower western slopes of the Bluff and has many solution cavities and caves developed within it. The limestone is light- to dark-grey in colour with much crystalline calcite. Rough sampling indicates high carbonate values in places. A clastic rock sequence immediately to the west of New River Lagoon [DM6383] represents the basal clastic sequence underlying the limestone. These beds are well seen at Prion Bay [DM6381] where the main rock types are, puddingstone conglomerate, finer grained conglomerate and sandstone; the clasts are mainly siliceous.

At Point Cecil [DM6877] fairly steeply dipping Ordovician conglomerate is faulted against limestone. Thinly-bedded, heavily bioturbated siltstone underlies the limestone (?Lords Siltstone correlate). This siltstone contains cryptolithid and other trilobites and a few orthoid brachiopods (Banks, 1959).

Rocks essentially similar to those of Point Cecil are found at Surprise Bay [DM7274] - (Twelvetrees, 1915).

Junee Group correlates crop out at Ida Bay and also over a considerable area around the head of the D'Entrecasteaux River [DM8987]. The lower, clastic, part of the sequence consists in the main of white saccharoidal quartzites which have so far yielded only macluritid gastropods as evidence of their age.

The overlying Gordon Limestone correlate consists of a minimum of 150m of well-bedded, well-jointed, medium- to dark-grey, granular limestone with a normal grain size ranging through the sand and silt grades. Some areas of coarser grained material are, however, known. The limestone occasionally develops a reddish or brownish hue owing to the presence of hydrated oxides of iron. Beds differ from one another considerably in grain-size, texture, colour, frequency of partings, presence and number of stylolites, presence or absence of algal lamination, dolomitisation and fossil content. Veins and irregular masses of calcite are common at some localities. The calcium carbonate content is usually high (>90%). Early work associated with proposed exploitation of the limestone includes that of Nye (1926), Dickenson (1945) and Everard (*in* Hughes, 1957); a more recent survey is that of Forsyth and Green (1976).

The limestone contains a considerable fauna which includes *Ischadites, Oncolites, Girvanella,* and tabulate corals, amongst which *Tetradium,* probably near *T.syringoporoides* Ulrich, suggests a Blackriverian age (Banks, 1957*b*). Other common fossils include large trilobites, orthoconic nautiloids, compound corals and a number of genera of brachiopods. A study of the fauna by Hill (1955) led her to suggest the presence of both Blackriverian and Trentonian fossils in the Ida Bay area.

A small inlier of fossiliferous Gordon Limestone correlate has recently been located near Hastings Caves [DM8895] by I.B. Jennings (pers. comm.). Unlike the Precambrian limestones of the caves themselves the Gordon Limestone correlate is almost free of dolomite.

The Gordon Limestone has been extensively exploited in both the Maydena and Ida Bay areas (Hughes, 1957; Forsyth and Green, 1976).

Rocks of the Junee Group (and all older formations) suffered deformation during the Middle Devonian Tabberabberan Orogeny. No Eldon Group correlates are known and Parmeener Super-Group rocks rest unconformably on the deeply eroded surface of Lower Palaeozoic rocks.

LATE DEVONIAN - ? EARLY CARBONIFEROUS GRANITE OCCURRENCES

The lithology and field relationships of the granite at Deep Glen Bay [EN8142] have been described by Jennings (1974). The granite is overlain unconformably by Parmeener Super-Group sedimentary rocks which are very arkosic towards the base and contain granite boulders.

The emplacement of most Tasmanian granites occurred in the time range 375-335 Ma B.P. and the Deep Glen Bay granite probably falls into this group. Granite emplacement post-dates the main tectonic events of the Tabberabberan Orogeny.

The granite has been described by D.C. Green (pers. comm.) as a medium-grey, porphyritic, adamellite with prominent potash feldspar and quartz phenocrysts in a matrix of quartz, plagioclase and potash feldspar. The potash feldspar may be extremely altered to clay minerals.

The Hippolyte Rocks [EN8525], shown on the map as being composed of dolerite, are now also known to be of granite (B.J. Griffin, pers. comm.).

PARMEENER SUPER-GROUP
(? UPPER CARBONIFEROUS - PERMIAN - TRIASSIC SYSTEMS)

Emplacement of Late Devonian-Early Carboniferous granite was followed by a long period of erosion, and sub-horizontal Parmeener Super-Group rocks everywhere rest with deep landscape unconformity on an eroded basement of granite and folded Lower Palaeozoic and older rocks.

The Parmeener Super-Group was erected by Banks (1973) to include a widespread sequence of rocks ranging in age from Late Carboniferous to Late Triassic. Later (Forsyth *et al.*, 1974) the sequence was further subdivided into a lower division (Lower Parmeener Super-Group) of glacial and glacio-marine rocks with a minor intercalated freshwater sequence and an upper division (Upper Parmeener Super-Group) of essentially freshwater sandstone and mudstone with subordinate coal-measure sequences.

Lower Parmeener Super-Group

Rocks now grouped together to form the Lower Parmeener Super-Group are traditionally regarded as having a tripartite subdivision into: a lower glacio-marine sequence (Lower Marine Sequence), a lower freshwater sequence (Lower Freshwater Sequence) and an upper glacio-marine sequence (Upper Marine Sequence), (*see* Johnston, 1888; Twelvetrees, 1911; David, 1950).

To the south and west of Hobart the lower glacio-marine sequence normally begins with a massive, dark-grey, pebbly basal tillite of variable thickness. At Cygnet [EN0722] more than 300m of tillite was proved in a drill hole without reaching a base whereas the Glenorchy bore [EN2056] reached basement without encountering tillite. The Margate bore [EN2236] penetrated more than 130m of tillite without finding a base and at Woodbridge [EN1922] there is more than 150m of tillite outcrop. In the Maydena area [DN6469] Jago (1972) recorded 175m of tillite and associated rocks. Outcrops of tillite are also known near Hastings [DN8887] and more extensive sequences are recorded at Shoemaker Point [DN7272] by Twelvetrees (1915).

The matrix of the tillite is mainly fine grade silt, clay, and rock flour. The clasts vary greatly in composition and range widely in size from granules to boulders but with pebble and cobble sizes by far the most common. Individual clasts are often faceted and sometimes striated. The ratio of pebbles to matrix varies greatly, not only from locality to locality, but also vertically through the sequence at any given locality. The tillite is sometimes well-jointed.

Varved siltstone (laminite) is associated with the tillite at Maydena [DN6469] (Banks, 1962*c*; Jago, 1972), black pebble-free mudstone (possible laminites) in a shallow bore at Woodbridge [EN1922] and Twelvetrees (1915) noted 'thinly bedded mudstone' (?laminite) intercalated near the base of the tillite at Shoemaker Point [DN7272].

Supposed fluvioglacial conglomerate and sandstone beds are associated with the tillite at Maydena (Banks, 1962*c*; Jago, 1972).

The matrix of the tillite at Maydena [DN6469] contains fragmentary fossils. These include stenoporids, fenestellids, spiriferids and crinoid plates (Banks, 1962; Jago, 1972).

Mechanisms of deposition of tillite from a wet-base glacier have been examined in detail by Carey and Ahmad (1961) and support for the marine nature of much of the tillite is provided by the presence of acritarchs at several localities (Truswell, 1978).

The basal tillite is overlain by a variable thickness of buff-weathering, light- to dark-grey, massive, monotonous, often well-jointed siltstone and mudstone. Although massive the rock characteristically breaks down on weathering into small cuboidal fragments with edge dimensions of a few centimetres. Jago (1972) has recorded a kind of massive spheroidal weathering at Maydena [DN6469]. The succession is mainly pebble-free except for the occurrence of rare dropstones; usually small and often of quartzite. Small pyrite and large (3-4m) calcite concretions are common. Glendonites are both common and characteristic of this part of the succession. They have not yet been found at higher stratigraphic levels in Tasmania. This part of the sequence is usually unfossiliferous but rare finds of spiriferids and *Eurydesma* are known from the main body of the siltstone. Towards the top of the sequence fossils are more common and include stenoporids, *Martiniopsis, Strophalosia, Deltopecten, Eurydesma, Peruvispira* and crinoid columnals (Banks *et al.*, 1955; Jago, 1972).

The thickness of the siltstone sequence varies greatly. In the Glenorchy bore [EN2056] the thickness is 200m (Leaman, 1976) and the succession rests directly on basement rocks of probable Cambrian age. The Margate bore [EN2236] proved 172m. At Maydena [DN6469] 137m was recorded. At Cygnet [EN0722] the thickness is 100m and at Satellite Island (Woody Island) [EN1804] only 26m is recorded but the sequence is without a base.

The highest beds of the lower glacio-marine sequence consist of 100m of buff-weathering, dark-grey, sparsely to richly fossiliferous, fairly uniform siltstone and sandstone with frequent large and small dropstones. Thin impure limestones and calcareous beds are developed at Satellite Island (formerly Woody Island) [EN1804] (Banks *et al.*, 1955), Maydena [DN6469] (Jago, 1972), Glenlusk [EN1658] (Sutherland, 1964), Cape Surville [EN8144] and Castle Forbes Bay [DN9824]. Information concerning the latter two localities was not available at the time of compilation of the map.

The fauna of the lower glacio-marine sequence is often rich in individuals and varied in number of species. The dominant bivalves are *Eurydesma* and a large coarse-ribbed *Deltopecten* both of which often occur in great abundance. Other forms include *Megadesmus globosus*, J. Sowerby, *Myonia* and *Pyramus*. The characteristic brachiopods include *Trigonotreta stokesi* Keonig, *Martiniopsis konincki* Etheridge, *Pseudosyrinx*, *Strophalosia subcircularis* Clarke and *Streptorhynchus*. Large specimens of the gastropod *Keeneia* are common and bryozoans occur profusely throughout. For a detailed discussion of faunas and faunal zonation see Clarke and Banks (1975) and Clarke and Farmer (1976).

Rocks of the lower freshwater sequence are very variable in both thickness and lithology. Lithologically the sequence consists of beds of conglomerate, pebbly sandstone, coarse quartz siltstone and flaggy micaceous siltstone, and sandstone with occasional plant fragments and scraps of wood (Leaman, 1972). The sequence is well developed in the Hobart area where it has a thickness of up to 30m. Details of the succession around Hobart are given by Banks and Hale (1957), Sutherland (1964) and Leaman (1976). The lower freshwater sequence is either thin or absent south and west of Hobart. It can be traced southwards to Taroona [EN2946] but is absent at Snug [EN1934] where a series of bores proved upper glacio-marine sequence beds resting directly on lower glacio-marine sequence beds without the intervention of a freshwater sequence. A similar situation is found in the Cygnet area [EN0722] where both outcrops and bores show the upper glacio-marine sequence to be resting paraconformably on the lower glacio-marine sequence.

The upper glacio-marine sequence is widely distributed across the region and has a thickness of approximately 175-200m. Although the overall thickness of the sequence remains nearly constant there is much variation in the thickness of individual units. Thus the main limestone within the sequence (Berriedale Limestone) has a thickness of more than 60m at Granton [EN1966] a thickness of only 42m at Weily's Quarry, Glenorchy [EN2156] and then thins rapidly and finally disappears in the southern suburbs of Hobart. A 30m thick limestone and calcareous siltstone sequence at Harts Hill [EN2134] may represent a lens at a similar horizon developed beyond the area of the main crop.

The upper glacio-marine sequence can be conveniently considered in two parts. The lower 100m consists of a very variable sequence of cream-weathering, light- and dark-grey siltstone, sandstone, and limestone, fossiliferous throughout and probably deposited under near-shore, shallow-water, fairly open marine conditions. Abundant dropstones throughout testify to the presence of floating ice during deposition and the abundance and great variety of the fossils throughout almost the entire succession is indicative of fairly open-water marine conditions. The upper 200m of the sequence consists mainly of dark-grey, heavily bioturbate, monotonous siltstones and sandstones with numerous, and sometimes very large, dropstones throughout. A coarse, feldspathic, pebbly sandstone marks the base of the sequence and other, somewhat similar, sandstones are known higher in the sequence. The rocks are poorly fossiliferous with only three known thin fossiliferous marine horizons (Clarke, 1973). Plant material and fossil wood may occur throughout but is especially common near the top and may occur in great abundance locally (Hale, 1953). At the very top of the sequence the siltstones darken upwards to a black almost pebble-free mudstone with convolute lamination and a carbonaceous appearance. Estuarine conditions have been postulated for much of the sequence.

Characteristic fossils of the upper glacio-marine sequence include *Taeniothyrus*, *Cancrinella*, *Terrakea*, *Wyndhamia*, *Echinalosia*, large smooth martiniopsids, extensiform spiriferids, *Myonia*, *Vacunella*, *Megadesmus*, and many bryozoans. Complete faunal lists for the Lower Parmeener Super-Group can be found in Clarke and Farmer (1976).

Upper Parmeener Super-Group

The base of the Upper Parmeener Super-Group marks the cessation of marine conditions and the establishment of a long sequence of non-marine fluvio-lacustrine and associated sedimentary rocks.

In south-eastern Tasmania these rocks fall conveniently into a natural threefold lithological grouping. The lowest division is a coal-measure sequence of variable thickness consisting of massive, well-sorted, current-bedded, poorly-cemented, feldspathic arenite layers with subordinate beds of mudstone and carbonaceous mudstone and, in places, thin workable coals. Where intruded by igneous rocks the coals may reach sub-anthracite grade. Plant remains are common and the presence of *Glossopteris* and a *Dulhuntyspora* microflora clearly indicate a Permian age for this part of the sequence (Lewis, 1940; Banks and Naqvi, 1967; Balme, 1962). These coal-measure sequences may, at least in part, consist of sediments originally deposited in quiet floodplain and back levee environments where carbonaceous material could accumulate. The coals have been exploited in a number of mines on the flanks of Mt Cygnet [EN1618] and at Adventure Bay [EN2602]. Exploratory shafts and trials have been attempted at Gordon [EN1912] and Sheepwash Bay, South Bruny [EN2309] (Hills *et al.*, 1922). All working of the coal has now ceased.

The middle division of the Upper Parmeener Super-Group consists of units of massive, current-bedded, well-sorted, fairly-clean, sparkling, quartz sandstone. Mudstone plays a very subordinate role and there are no coals. Much of this part of the succession appears to be made up of point bar and other river channel deposits. Spores in this part of the succession give a Triassic age. The exact position of the floral boundary between Permian and Triassic rocks is not yet known.

The upper division of the Upper Parmeener Super-Group reverts to a coal-measure succession of current-bedded, feldspathic and lithic sandstone beds with subordinate mudstone and a number of workable but very variable coal seams. The seams have been extensively worked in the past at New Town [EN2555], Kaoota [EN1236], Mt Lloyd [DN9553], a number of localities along the D'Entrecasteaux Channel from Strathblane [DN9702] to South Cape Bay [DM8572] and on the Tasman Peninsula (Twelvetrees, 1915; Hills *et al.*, 1922).

The biota of the Upper Parmeener Super-Group is heavily dominated by plants, the distribution and occurrence of which are discussed by Townrow (*in* Spry and Banks, 1962). The vertebrate material has been described by Johnston and Morton (1890), Hills (*in* Westoll 1958), Cosgriff (1974), Camp and Banks (1978) and Banks *et al.* (1978). Invertebrate fossils are rare but insect fragments and wings are known and estheriids have been recorded by Tasch (1975).

Apart from coal the Parmeener Super-Group has yielded many commercial products which include paving, walling and building stones from the sandstone members, lime from the limestone members at many localities, and brick-earths from siltstone and mudstone at a number of places.

PERMIAN IGNEOUS ROCKS

Several thin bentonitic mudstone layers occur in the Berriedale Limestone at Glenorchy [EN2157]. These have been interpreted as alteration products of volcanic ash (Hale and Brill, 1955; Brill, 1956).

JURASSIC DOLERITE

No sedimentary rocks of Jurassic age are known but extensive large-scale intrusions of tholeiitic magma took place throughout most of the region in Middle Jurassic times. A date of 165 Ma has been given by McDougall (1961) for the intrusion at Red Hill [EN1832] and by inference for the remainder of the dolerite intrusions but recent work (Schmidt and McDougall, 1977) suggests the possibility of two periods of intrusion. The dolerite bodies mainly take the form of concordant or near concordant sill-like sheets up to 500m in thickness (McDougall, 1962). Each of the sheets may be many square kilometres in extent and individual sheets tend to be of greater lateral extent in the Upper Parmeener Super-Group than in the Lower Parmeener Super-Group (Leaman, 1975*a*). More than one sheet may be present within a single stratigraphic sequence.

The dolerite is almost everywhere intruded into flat-lying Parmeener Super-Group rocks and the intrusions parallel the bedding. At Deep Glen Bay [EN8142], however, the dolerite steeply (30°-45°) intrudes into or onto basement granite and is probably immediately overlain by Permian rocks (M.R. Banks, pers. comm.). Other forms of intrusion include transgressive stepped sheets, inclined cross-cutting sheets (Leaman, 1975*a*) and both broad (2 km) and narrow dykes. Structural forms and the implications of dolerite intrusion have been considered in detail by Leaman (1972, 1975) and Leaman and Naqvi (1968).

Dolerite contacts are sharp and there is little evidence of assimilation. Metamorphism of the country rock may be intense but visually does not usually appear to extend far beyond the contact.

Apart from the fine- to medium-grained dolerite which makes up most of the intrusions there are also lighter coloured, coarser grained, banded and mottled varieties, usually occupying the upper parts of sills. These coarser bands may grade into pegmatitic rocks, with rosettes of both pyroxene and feldspar. Late-stage cross-cutting aplitic veins of dolerite composition also occur. Large areas of granophyric differentiates are known at Red Hill [EN1832], Hickmans Hill [EN1837], O'Briens Hill [EN1930], Oyster Cove [EN2126] (McDougall, 1962; Roger, 1957) and at New Norfolk [EN0559], Flagstaff Gully [EN3154] and Craigow Hill [EN3564] (Leaman, 1976), as well as Bull Bay, North Bruny Island [EN2931].

Details of the petrography of the dolerite are given by Edwards (1942), Joplin (1957, 1968) and Spry (1958) and the differentiation mechanism and chemistry are discussed by McDougall (1962). Much useful information on the dolerite is to be found in the University of Tasmania Dolerite Symposium (1958).

The dolerite is resistant to erosion, forms much of the high ground within the region and often dominates the landscape.

Dolerite is commonly crushed for road metal and aggregate and is also occasionally used for walling stone.

CRETACEOUS SYENITE

The alkaline complex of the Cygnet [EN0722] - Oyster Cove [EN2126] - Woodbridge [EN1922] area was first described by Twelvetrees and Petterd (1900) who thought the rocks to be of Permian age. Skeats (1917) showed that syenite dykes intruded dolerite and were therefore post Jurassic. More modern datings, Evernden and Richards (1962) and McDougall and Leggo (1965), give 100 Ma as the radiometric age thus placing intrusion at about the mid-point of the Cretaceous Period.

The major syenite bodies are concordant sills, probably reaching 100m in thickness, intruded at various stratigraphic levels within the Lower Parmeener Super-Group. Although thin sills occur high in the Lower Parmeener Super-Group at Oyster Cove [EN2126] almost all of the more substantial thicker sills are confined to the lower part of the succession. Neither dykes nor sills intrude the Upper Parmeener Super-Group.

The minor intrusions are mainly dykes which vary greatly in petrological character and gross physical appearance (Edwards, 1947). Dykes are known to intrude sills and to intersect each other but as yet no clear order of intrusion has been determined for the rocks as a whole. Dykes occur in great numbers.

Petrologically the rocks are extremely variable but fall into two fairly distinct suites; a near undersaturated group and an undersaturated group of shoshonitic rocks (Joplin, 1968). The near undersaturated rocks are characterised by more than 8% alkalies; high alumina, silica, barium; moderately high calcium, and low magnesium. Melanite garnets may be common (Edwards, 1947). The undersaturated suite is characterised by high potash and the presence of nepheline, haüyne and other feldspathoids (Edwards, 1947; Joplin, 1968; Leaman and Naqvi, 1968).

The major rock type present in the complex is syenite porphyry (banatite) forming most of the sills and some dykes. The rocks are usually deeply weathered to kaolinite with feldspar phenocrysts but where fresh is a hard, tough, light-grey rock with feldspar (andesine) phenocrysts up to 20mm long in a fairly fine orthophyric groundmass of orthoclase with a little interstitial quartz (Edwards, 1947; Joplin, 1968).

The dykes include a great variety of rock types: haüyne-sanidine-garnet-porphyry, sanidine-garnet-porphyry, sanidine-biotite-porphyry, sanidine porphyry (trachytes), sanidine-tinguaite, syenite-aplite, and garnet-orthoclasite (Edwards, 1947).

Rocks to the immediate south of Cygnet [EN0719] were long thought to be hybrids resulting from admixture of dolerite and syenite magmas but are merely highly thermally metamorphosed dolerite and sedimentary rocks closely intruded by syenite dykes.

Metamorphism in the areas of syenite intrusion may be intense with the formation of reaction haloes around pebbles and temperatures high enough to convert pyrite to phyrrhotite (690°C). The lateral extent of the metamorphism varies and may depend on the nature and amount of the volatiles.

Some mineralisation is known. Gold occurs along some of the contacts of the syenite with country rock. This gold and the alluvial gold derived from it has been worked at a number of localities around Cygnet [EN0722] (Twelvetrees, 1902). Galena is present in small quantities in a dyke south of Cygnet [EN0820]. Deeply weathered syenite has been used for clay at

Police Point [EN0412] (Hughes, 1960).

TERTIARY SYSTEM

Tertiary rocks are separated from the underlying rocks by an erosional hiatus or low angle unconformity. Extensive pre-Tertiary faulting created a number of north-west south-east trending elongate graben and basin structures in which most Tertiary deposits have been preserved. The two major structures are the Derwent Graben and the Coal River Basin (*see* Banks, 1962*d*, fig.39, and Leaman, 1976, fig.10). Thick Tertiary deposits underlie much of the estuary of the Derwent and also much of the D'Entrecasteaux Channel at least as far south as Adventure Bay [EN2709] where Leaman (1975*b*) records 250m of sedimentary rocks in a major Tertiary channel. Other known thicknesses of Tertiary sedimentary rocks are 180m at Sandy Bay [EN2850], 90m in the Derwent River at Hobart, 79m at Middleton [EN2112], 148m a little to the east of Craigow Hill [EN3661] and an inferred thickness of more than 600m immediately offshore from Taroona [EN2944] (Leaman, 1972, 1976). Smaller tributary channels to the main distributaries are recorded in the Margate-Kingston-North West Bay area [EN2338] by Moore (1979) and Leaman and Moore (1975).

Microfloral dating of deposits has been carried out by Harris (1968). The oldest rocks are Palaeocene in age and apparently restricted to the grabens. Lithologically the rocks appear to be totally non-marine but an undoubted Palaeocene deposit at Taroona [EN2944] has yielded microplankton indicative of not too distant marine or brackish water conditions. No rocks of Eocene age are known within the confines of the region but deposits of this age have been identified a little further north at Spring Bay [EN7594]. Mid-Tertiary (? Oligocene) rocks are much more widespread as a consequence of filling and overspill of the grabens.

Leaves and other plant remains are common. Useful information on the macroflora is to be found in Johnston (1888) and Gill (1950, 1968). The microflora is reviewed by Harris (1968).

The fauna is rather sparse but snails and marsupial bones have been recorded from travertine at Geilston Bay [EN2758] (Banks, 1957; Johnston, 1888). There are similar occurrences within the Hobart inner city area and marsupial bones are recorded at Blinking Billy Point (formerly One Tree Point), Sandy Bay [EN2749] (Johnston, 1888). At Pitt Water remains of the turtle *Emydura* have been found (Warren, 1969).

The dominant sedimentary rock types are found within the main grabens and consist mainly of siltstone and clay with subordinate sand grade material. The rocks may be carbonaceous and the sandstone beds feldspathic. Adjacent to faults marking the margins of the basins the deposits often contain large numbers of boulders. At Sandy Bay [EN2749] and Taroona [EN2944] the boulders are mainly dolerite (Leaman, 1976); at Trial Bay [EN2124] mainly syenite.

Gravels, the clasts of which are mainly siliceous, are found beneath the basalt at Ranelagh [EN0338] (not known at time of compilation of map). Beds of large rounded dolerite boulders 'rotted in place' occur at Huonville [EN0537] and are probably of Tertiary age.

Fairly extensive laterite deposits around Great Bay [EN3217] and buckshot gravels near Huonville [EN0434] are probably indicative of hot, wet, seasonal conditions. Spring deposited travertine occurs at Geilston Bay [EN2758] and a few other localities.

Sub-basalt silicified sandstone (silcrete, or grey billy) is both common and widespread over much of the region though patchy in distribution. It serves as an indication of the former presence of basalt in many areas where the basalt has since been completely removed. Silicified 'fossil wood' is common at Lune River [DM9389].

Gravels are worked for ornamental pebbles. Travertine was for long worked for lime, and clay has been quarried for use in the brick and paper industries.

TERTIARY VOLCANIC ROCKS

Tertiary basalts and associated volcanic rocks crop out spasmodically over the greater part of the region. Volcanic activity developed at a large number of isolated centres across a landscape with fairly rugged uneven topography. Many of the flows appear to have been restricted to individual valley systems. Vents are formed at various altitudes ranging from present sea-level to 1200m at the top of Mt Wellington (Sutherland, *in* Leaman, 1976). Lewis (1946) records lava flows filling old channels of the River Derwent to 90 m below present sea-level at New Norfolk [EN0567] and near Granton [EN2066].

The volcanic centres are associated with and controlled by late-Mesozoic fracture lines (Sutherland, *in* Leaman, 1976). The majority of the material erupted is basalt in the form of flows but near centres with explosive phases of eruption there may be considerable piles of pyroclastic material associated with the lava. Pyroclastic material ranges from fine tuff to coarse agglomerate. Bombs may be common. Lithic tuffs composed of small basalt particles are common at Sandy Bay [EN2750], Taroona [EN2945] and a number of other localities. (Spry, 1962*b*).

Individual lava flows are usually 10m to 20m in thickness but McDougall (1959) refers to some flows up to 50m in thickness. The basalts exhibit a wide variety of physical form and may be massive, columnar, platy, or vesicular. Vesicular forms often contain much pyrite. *In situ* weathering of the basalts to a stiff, green and brown clay is not uncommon and this can then be recognised as being of basaltic origin only by the relict igneous structures still preserved within the clay. The basalt usually yields highly prized red fertile soils. General accounts of the basalts are given by many workers including Johnston (1888), Lewis (1946), Edwards (1950), Spry (1955, 1962*b*), Green (1961) and Woolley (1959). Much the latest and fullest account is that of Sutherland (*in* Leaman, 1976).

Folded volcanic rocks are reported by Brill and Hale (1954) from the Tasman Peninsula [EN5840] where a considerable thickness of interbedded pyroclastics and alkali basalt has been folded by collapse of a large vent following magma retreat away from the vent. Breccia vents at South Arm are filled with blocks of country rock mixed with scoriaceous lava (Spry, 1962*b*).

The petrology of the basalts was first studied systematically by Edwards (1950) who divided them into a number of groups based on the kind of pyroxene present, texture of groundmass, nature of glass present, and kind and proportion of phenocrysts present. His rock types were to a large extent textural rather than compositional and on a chemical basis fall into two main groups. The first group is that of saturated olivine basalts (olivine augite basalts of Edwards) which lies midway between olivine basalts and tholeiitic basalts. Rocks in this group contain olivine but are in other respects saturated. The second group consists of the undersaturated olivine basalts, the titanaugite basalts, which are much lower in silica.

Without plentiful radiometric dates it is difficult to assess the ages of individual flows or groups of flows since the flows are usually isolated from one another and issue from separate centres. At a few spots however relationships of distinctive rock types to one another have been noted (Sutherland, *in* Leaman, 1976) but no overall order or pattern of extrusion has as yet emerged.

Some idea of the general age of the basalts is gained from the fact that they overlie sediments of undoubted Palaeocene age at Taroona (Harris, 1968) and similar basalts are associated with fossiliferous travertine at Geilston Bay [EN2758] thought to be early Tertiary in age. The most likely period of activity appears to range from Oligocene into Miocene.

QUATERNARY SYSTEM

During much of Pleistocene time the regional snowline was six to seven hundred metres lower than at present (Davies, 1962). This brought much of the high ground within the ambit of ice action. Most of the glacial effects are attributed to cirque glaciation but the low snowline allowed incipient alpine valley type glaciation of some of the higher peaks. Evidence of ice action is well shown at Snowy Range [DN7245], Mt Weld [DN6639], Mt Picton [DN6922], Mt Snowy [DN8212], Mt Bobs [DN6807], Mt Victoria Cross [DM9072], Adamsons Peak [DN8501] and Mt La Perouse [DM7981] (Derbyshire *et al.*, 1965; Davidson, 1970).

The main features produced by ice erosion are cirques, overridden cirques, glacially abraded valley steps, rock basins and ice eroded surfaces. Ice depositional features include both ground moraine and ridged moraine (for distribution and type of deposit see Derbyshire *et al.*, 1965).

Ice covered areas were fringed by zones of periglacial activity which advanced and retreated across the country in step with ice movement. Periglacial activity is evidenced mainly by solifluction and gelifluction deposits on dolerite and by block fields, block streams and residual stacks (Davies, 1962). There is sometimes difficulty in distinguishing Pleistocene from current periglacial deposits.

Quaternary quartz gravels of economic importance occur along both sides of the Huon River from Judbury [DN9340] to Beaupre Point [EN0515] and Randalls Bay [EN0913]. The thickness of the deposits at Randalls Bay varies from 2m to 6m (Keid, 1947). The gravel deposits consist of about equal parts of sand and gravel. Most of the pebbles are of quartz or quartzite but there are smaller quantities of dolerite pebbles and some of mudstone. Grey banded agates are common. Silcrete blocks derived from the Tertiary rocks are to be found in the gravels at Beaupre Point [EN0515] showing the gravels to be post-Tertiary in age. The gravels lie up to 30m above present river levels suggesting deposition in association with a higher interglacial sea-level and thus a Pleistocene age.

Dolerite boulder beds of considerable extent often occur in valleys with underfit streams as at Woodbridge [EN2122]. The clasts are far too large and far too extensive to have been moved by the power available in the present streams and the beds are therefore assigned to a late Pleistocene pluvial phase when water was much more abundant.

Strong winds and cold arid conditions of much of the Pleistocene were conducive to the formation of blown sand formations. Sands are fairly widespread and occur both as sheet deposits, as in North Bruny Island [EN3317] and South Arm [EN3536], and as conical dune deposits as at Adventure Bay [EN3112]. The dunes fall into two distinct groups; an older group stabilised and overgrown by vegetation, and a younger shifting unstable group. Some sand deposits, for example Seven Mile Beach [EN4055], may represent Quaternary lag deposits of sand on underlying Tertiary rocks.

Raised beaches are common and probably range through Pleistocene to Holocene in age.

Scree and talus deposits are found mantling the slopes of much of the region. They fall into two major groups, an older fairly well-consolidated sequence and a younger overlying poorly-consolidated sequence. Clast composition of the talus depends on the source rocks available but dolerite is the dominant material. The older talus and scree is probably Pleistocene in age and the younger Holocene in age.

River terrace deposits occur along many of the rivers and the formation of many of the older ones is probably related to the changes in sea-level associated with the formation of raised beaches.

Other deposits include river alluvium, ranging from fine silt to coarse gravel, swamp deposits, lagoon bottom clays and marine or estuarine mudflat deposits.

REFERENCES

BALME, B.E. 1962. Some palynological evidence bearing on the development of the *Glossopteris* flora, *in* LEEPER, G.W. (ed.). *The evolution of living organisms:* 269-280. Melbourne University Press.

BANKS, M.R. 1957*a*. The Middle and Upper Cambrian Series (Dundas Group and its correlates) in Tasmania, *in* ÖPIK, A.A. (ed.). The Cambrian geology of Australia. *Bull.Bur.miner.Resour.Geol.Geophys.Aust.* 49:165-212.

BANKS, M.R. 1957*b*. The stratigraphy of Tasmanian limestones, *in* HUGHES, T.D. Limestones in Tasmania. *Miner.Resour.geol.Surv.Tasm.* 10:39-85.

BANKS, M.R. 1959. *Preliminary summary of the geology near Rocky Boat Harbour, southern Tasmania.* [Report to Lyell-EZ Explorations].

BANKS, M.R. 1962*a*. Cambrian System. *in* SPRY, A.H.; BANKS, M.R. (ed.). The geology of Tasmania. *J.geol.Soc.Aust.* 9(2):127-145.

BANKS, M.R. 1962*b*. Ordovician System. *in* SPRY, A.H.; BANKS, M.R. (ed.). The geology of Tasmania. *J.geol.Soc.Aust.* 9(2):147-176.

BANKS, M.R. 1962*c*. Permian, *in* SPRY, A.H.; BANKS, M.R. (ed.). The geology of Tasmania. *J.geol.Soc.Aust.* 9(2):189-215.

BANKS, M.R. 1962*d*. Cainozoic. Structure, *in* SPRY, A.H.; BANKS, M.R. (ed.). The geology of Tasmania. *J.geol.Soc.Aust.* 9(2):241-243.

BANKS, M.R. 1973. General geology, *in* BANKS, M.R. (ed.). *The Lake Country of Tasmania:* 25-34. Royal Society of Tasmania : Hobart.

BANKS, M.R.; COSGRIFF, J.W.; KEMP, N.R. 1978. A Tasmanian Triassic stream community. *Aust.nat.Hist.* 19:150-157.

BANKS, M.R.; HALE, G.E.A.; YAXLEY, M.L. 1955. The Permian rocks of Woody Island, Tasmania. *Pap.Proc.R.Soc.Tasm.* 89:219-229.

BANKS, M.R.; JOHNSTON, J.H. 1957. *Maclurites* and *Girvanella* in the Gordon River Limestone (Ordovician) of Tasmania. *J.Paleont.* 31:632-640.

BANKS, M.R.; NAQVI, I.H. 1967. Some formations close to the Permo-Triassic boundary in Tasmania. *Pap.Proc.R.Soc.Tasm.* 101:17-30.

BLAKE, F. 1938. Report on Rocky Boat Harbour district. *Unpubl.Rep.Dep. Mines Tasm.* 1938:9-15.

BRILL, K.G. 1956. Cyclic sedimentation in the Permian System of Tasmania. *Pap.Proc.R.Soc.Tasm.* 90:131-140.

BRILL, K.G.; HALE, G.E.A. 1954. Geological map of the north-western end of Tasman Peninsula - a revision. *Pap.Proc.R.Soc.Tasm.* 88:279-284.

BROWN, I.A. 1948. Lower Ordovician brachiopods from Junee district, Tasmania. *J.Paleont.* 22:35-39.

CAMP, C.L.; BANKS, M.R. 1978. A proterosuchian reptile from the Early Triassic of Tasmania. *Alcheringa* 2:143-158.

CAREY, S.W.; AHMAD, N. 1961. Glacial marine sedimentation, *in* RAASCH, G.O. (ed.). *Geology of the Arctic* 2:865-894. University of Toronto Press.

CLARKE, M.J. 1973. Faunas from the Ferntree Group of south-eastern Tasmania. *Tech.Rep.Dep.Mines Tasm.* 16:50-65.

CLARKE, M.J.; BANKS, M.R. 1975. The stratigraphy of the lower (Permo-Carboniferous) parts of the Parmeener Super-Group, *in* CAMPBELL, K.S.W. (ed.). *Gondwana geology:* 453-467. ANU Press : Canberra.

CLARKE, M.J.; FARMER, N. 1976. Biostratigraphic nomenclature for Late Palaeozoic rocks in Tasmania. *Pap.Proc.R.Soc.Tasm.* 110:91-109.

COOPER, G.A. 1956. Chazyan and related brachiopods. *Smithson.misc.coll.* 127:1-1024.

CORBETT, K.D. 1964. *Geology of the Florentine Valley area.* B.Sc.(Hons) thesis, University of Tasmania : Hobart.

CORBETT, K.D.; BANKS, M.R. 1974. Ordovician stratigraphy of the Florentine synclinorium southwest Tasmania. *Pap.Proc.R.Soc.Tasm.* 107:207-237.

COSGRIFF, J.W. 1974. Lower Triassic Temnospondyli of Tasmania. *Spec.Pap. geol.Soc.Am.* 149.

CRAIG, A.J. 1970, 1971. Surprise Creek. *Bull.U.C.Services(Aust.)Pty Ltd* 25, 25 Addendum 1.

DAVID, T.W.E. 1950. *The geology of the Commonwealth of Australia.* 3 vols. Arnold : London.

DAVIDSON, J.K. 1971. Glaciation of the Mt La Perouse area. *Pap.Proc.R. Soc.Tasm.* 105:177-180.

DAVIES, J.L. 1962. Cainozoic. Geomorphology and glaciation, *in* SPRY, A.H.; BANKS, M.R. (ed.). The geology of Tasmania. *J.geol.Soc.Aust.* 9(2):243-248.

DAVIES, J.L. 1965. Landforms, *in* DAVIES, J.L. (ed.). *Atlas of Tasmania:* 18-25. Lands and Surveys Department : Hobart.

DAVIES, J.L. 1967. Physiographic regions. *Tasm.Yb.* 1:31-32.

DERBYSHIRE, E.; BANKS, M.R.; DAVIES, J.L.; JENNINGS, J.N. 1965. Glacial map of Tasmania. *Spec.Publ.R.Soc.Tasm.* 2.

DICKENSON, D.R. 1945. Limestone quarries at Ida Bay. *Unpubl.Rep.Dep. Mines Tasm.* 1945:46-63.

DOLERITE SYMPOSIUM. 1958. *Dolerite: a symposium.* University of Tasmania : Hobart.

EDWARDS, A.B. 1942. Differentiation of the dolerites of Tasmania. *J.Geol.* 50:451-480, 579-610.

EDWARDS, A.B. 1947. Alkali hybrid rocks of Port Cygnet, Tasmania. *Proc.R. Soc.Vict.* 58:81-115.

EDWARDS, A.G. 1950. The petrology of the Cainozoic basaltic rocks of Tasmania. *Proc.R.Soc.Vict.* 62:97-120.

EVERNDEN, J.F.; RICHARDS, J.R. 1962. Potassium-argon ages in eastern Australia. *J.geol.Soc.Aust.* 9:1-49.

FORSYTH, S.M.; FARMER, N.; GULLINE, A.B.; BANKS, M.R.; WILLIAMS, E.; CLARKE, M.J. 1974. Status and subdivision of the Parmeener Super-Group. *Pap.Proc.R.Soc.Tasm.* 108:107-109.

FORSYTH, S.M.; GREEN, G.R. 1976. Investigation of limestone deposits at Ida Bay. *Unpubl.Rep.Dep.Mines Tasm.* 1976/58.

GILL, E.D. 1950. Floras of thirty million years ago. *Wildlife, Melb.* 12:318-319.

GILL, E.D. 1962. Cainozoic history, *in* SPRY, A.H.; BANKS, M.R. (ed.). The geology of Tasmania. *J.geol.Soc.Aust.* 9(2):248-253.

GREEN, D.C. 1961. The geology of the South-Arm - Sandford area. *Pap. Proc.R.Soc.Tasm.* 95:17-34.

HALE, G.E.A. 1953. The geology of the Dover district. *Pap.Proc.R.Soc. Tasm.* 87:97-135.

HALE, G.E.A.; BRILL, K.G. 1955. Clay minerals from the Permian strata of Tasmania. *Pap.Proc.R.Soc.Tasm.* 89:231-235.

HALL, W.D.M. 1966. Interim geological report on the south-west portion of exploration licence 13/65, south-west Tasmania. *Rep.explor.Dep.B.H.P. Melb.* 566.

HARRIS, W.K. 1968. Tasmanian Tertiary and Quaternary microfloras. *Palaeont.Rep.geol.Surv.S.Aust.* 5/68.

HILL, D. 1955. Ordovician corals from Ida Bay, Queenstown and Zeehan, Tasmania. *Pap.Proc.R.Soc.Tasm.* 89:237-254.

HILLS, E.S. 1958. A brief review of Australian fossil vertebrates, *in* WESTOLL, T.S. (ed.). *Studies on fossil vertebrates;* 86-107. Athlone Press : London.

HILLS, L.; REID, M.; NYE, P.B.; REID, H.G.W.; REID, W.D. 1922. The coal resources of Tasmania. *Miner.Resour.geol.Surv.Tasm.* 7.

HUGHES, T.D. 1957. Limestones in Tasmania. *Miner.Resour.geol.Surv.Tasm.* 10.

HUGHES, T.D. 1960. Clay at Surges Bay. *Tech.Rep.Dep.Mines.Tasm.* 4:51-56.

JACKSON, W.D. 1965. Vegetation, *in* DAVIES, J.L. (ed.). *Atlas of Tasmania:* 30-35. Lands and Surveys Department : Hobart.

JAGO, J.B. 1972. Geology of the Maydena Range. *Pap.Proc.R.Soc.Tasm.* 106:45-57.

JENNINGS, D.J. 1974. Granite outcrops, Forestier Peninsula. *Tech.Rep. Dep.Mines Tasm.* 17:10-12.

JOHNSTON, R.G. 1888. *A systematic account of the geology of Tasmania.* Government Printer : Hobart.

JOHNSTON, R.M.; MORTON, A. 1890. Notes on the discovery of a ganoid fish in the Knocklofty sandstones, Hobart. *Pap.Proc.R.Soc.Tasm.* 1889:102-104.

JOPLIN, G.A. 1957. The problem of the quartz-dolerites; some significant facts concerning minerals volume, grain size and fabric. *Pap.Proc. R.Soc.Tasm.* 91:129-144.

JOPLIN, G.A. 1968. *A petrography of Australian igneous rocks.* 2 ed. Angus & Robertson : Sydney.

KEID, H.G.W. 1947. Geological section of bore-holes, Randalls Bay - *Unpubl.Rep.Dep.Mines Tasm.*

KOBAYASHI, T. 1940. Lower Ordovician fossils from Junee, Tasmania. *Pap. Proc.R.Soc.Tasm.* 1939:61-66.

LEAMAN, D.E. 1972. Gravity survey of the Hobart district. *Bull.geol. Surv.Tasm.* 52.

LEAMAN, D.E. 1975*a*. Form, mechanism, and control of dolerite intrusion near Hobart, Tasmania. *J.geol.Soc.Aust.* 22:175-186.

LEAMAN, D.E. 1975*b*. Adventure Bay gravity profile. *Tech.Rep.Dep.Mines Tasm.* 18:53-54.

LEAMAN, D.E. 1976. Geological atlas 1: 50 000 series. Zone 7. Sheet 82 (8312S) Hobart. *Explan.Rep.geol.Surv.Tasm.*

LEAMAN, D.E.; MOORE, W.R. 1975. Refraction seismic survey, North West Bay. *Tech.Rep.Dep.Mines Tasm.* 18:46-52.

LEAMAN, D.E.; NAQVI, I.H. 1968. Geology and geophysics of the Cygnet district. *Bull.geol.Surv.Tasm.* 49.

LEWIS, A.N. 1940. Record of *Glossopteris* from Cygnet. *Pap.Proc.R.Soc. Tasm.* 1939:95-96.

LEWIS, A.N. 1946. The geology of the Hobart district. *Mercury Press : Hobart.*

McDOUGALL, I. 1959. The Brighton basalts, Tasmania. *Pap.Proc.R.Soc.Tasm.* 93:17-28.

McDOUGALL, I. 1961. Determination of the age of a basic igneous intrusion by the potassium-argon method. *Nature* 190:1184-1186.

McDOUGALL, I. 1962. Differentiation of Tasmanian dolerites: Red Hill dolerite-granophyre association. *Bull.geol.Soc.Amer.* 73:279-315.

McDOUGALL, I.; LEGGO, P.J. 1965. Isotopic age determinations on granite rocks from Tasmania. *J.geol.Soc.Aust.* 12:295-332.

MOORE, W.R. 1979. Whitewater Creek dam sites, Kingston and the Tertiary channels of the Kingston-Margate area. *Pap.geol.Surv.Tasm.* 3.

NYE, P.B. 1926. Report on the limestone quarries at Ida Bay. *Unpubl. Rep.Dep.Mines Tasm.* 1926:203-211.

RODGER, T.H. 1957. The geology of the Sandfly-Oyster Cove areas, Tasmania. *Pap.Proc.R.Soc.Tasm.* 91:109-114.

SCHMIDT, P.W.; McDOUGALL, I. 1977. Palaeomagnetic and potassium-argon dating studies of the Tasmanian dolerites. *J.geol.Soc.Aust.* 24:321-328.

SKEATS, E.W. 1917. On the age of the alkali rocks of Port Cygnet and the D'Entrecasteaux Channel in S.E. Tasmania. *Proc.R.Soc.Vict.* 29:154-164.

SOLOMON, M.; GRIFFITHS, J.R. 1974. Aspects of the early history of the southern part of the Tasman orogenic zone, *in* DENMEAD, A.K.; TWEEDALE, G.W.; WILSON, A.F. (ed.). *The Tasman geosyncline - a symposium:* 19-44. Queensland Division, Geological Society of Australia : Brisbane.

SPRY, A.H. 1955. The Tertiary volcanic rocks of Lower Sandy Bay, Hobart. *Pap.Proc.R.Soc.Tasm.* 89:153-168.

SPRY, A.H. 1958. Some observations of the Jurassic dolerite of the Eureka cone sheet, near Zeehan, Tasmania, *in: Dolerite: a symposium:* 93-129. University of Tasmania : Hobart.

SPRY, A.H. 1962*a*. The Precambrian rocks *in:* SPRY, A.H.; BANKS, M.R. The geology of Tasmania. *J.geol.Soc.Aust.* 9(2):107-126.

SPRY, A.H. 1962*b*. Cainozoic igneous rocks, *in* SPRY, A.H.; BANKS, M.R. (ed.). The geology of Tasmania. *J.geol.Soc.Aust.* 9(2):272-278.

STEPHENSON, J. 1954. An unconformity in south-west Tasmania. *Pap.Proc. R.Soc.Tasm.* 88:151-152.

SUTHERLAND, F.L. 1964. The geology of the Collinsvale area. *Pap.Proc. R.Soc.Tasm.* 98:119-135.

TASCH, P. 1975. Non-marine arthropoda of the Tasmanian Triassic. *Pap. Proc.R.Soc.Tasm.* 109:97-106.

THOMAS, D.E. 1960. The zonal distribution of Australian graptolites. *J.R.Soc.N.S.W.* 94:1-58.

TRUSWELL, E.M. 1978. Palynology of the Permo-Carboniferous in Tasmania: an interim report. *Bull.geol.Surv.Tasm.* 56.

TWELVETREES, W.H. 1902. Report on gold and coal at Port Cygnet. *Rep. Secr.Mines Tasm.* 1901-1902:260-268.

TWELVETREES, W.H. 1911. The tasmanite shale fields of the Mersey district. *Bull.geol.Surv.Tasm.* 11.

TWELVETREES, W.H. 1915. Reconnaissance of the country between Recherche Bay and New River, southern Tasmania. *Bull.geol.Surv.Tasm.* 24.

TWELVETREES, W.H.; PETTERD, W.F. 1900. On haüyne trachyte and allied rocks in the districts of Port Cygnet and Oyster cove. *Pap.Proc.R. Soc.Tasm.* 1898-1899:3-36.

WARREN, J.W. 1969. Chelid turtles from the mid-Tertiary of Tasmania. *J.Paleont.* 43:179-182.

WILLIAMS, P.R.; CORBETT, E.G. 1977. Geological atlas 1: 250 000 series. Sheet SK-55/7. Port Davey. *Explan.Rep.geol.Surv.Tasm.*

WOOLLEY, D.R. 1959. The geology of the New Norfolk-Black Hills district. *Pap.Proc.R.Soc.Tasm.* 93:97-109.