COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF
NATIONAL DEVELOPMENT

BUREAU OF MINERAL
RESOURCES, GEOLOGY
AND GEOPHYSICS

Record 1972/50

# THESES IN AUSTRALIAN UNIVERSITIES 1969-70

## ABSTRACTS

Compiled by

M.A. Etheridge and S. Irving

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# PREFACE

The theses abstracts contained in this volume were collected and collated by Messrs Irving and Etheridge when they were graduate students at the Australian National University; and were offered by them for publication by the Bureau.

The Bureau is glad of the opportunity to make available some of the knowledge gained during graduate study, much of which is accessible only in University libraries. With the compilers, the Bureau thanks Universities for their co-operation in the project.

## AUSTRALIAN NATIONAL UNIVERSITY

Chatterton, B.D.E. (Ph.D.) (1969) Australian National University

Some aspects of the palaeontology, palaeoecology and biostratigraphy of the limestones of the Murrumbidgee Group at Taemas, near Yass, New South Wales. - 2 vols, Vol. I, vii + 370 pp., 50 text-figures, 38 + 7 plates, Vol. II, 327 pp., 23 text-figures, 20 plates - grid ref. Goulbourn 182683.

The area studied is a basin of Lower Devonian to ? lower Middle Devonian acid volcanics, shales and limestone, situated about 15 km south-west of Yass, N.S.W. The thesis is primarily concerned with the taxonomy, ontogeny, and ecology of a brachiopod and trilobite fauna that occurs in the upper limestone units of the Taemas Formation. Sections are also included on palaeoecology, palaeozoogeography, age, and correlation, and conodont assemblages. It was concluded that the age of the upper limestones of the Taemas Formation is probably late Emsian, but may be as young as early Eifelian; the animals lived in and the sediments were laid down under a shallow subtropical sea; the brachiopod and trilobite fauna is representative of part of a Tasman Subprovince of the Old World Province; the occurrences of certain conodonts in the Receptaculites Limestone were grouped statistically into associations, which are apparently representative of natural conodont assemblages; 8 new genera and 34 new species of brachiopods are described; 1 new genus, two new subgenera and ten new species of trilobites are described; and ontogenies of most of the trilobites are described from protaspid to holaspid stages.

Day, R.W. (Ph.D.) (1969) Australian National University

Biostratigraphy and taxonomy of Lower Cretaceous molluscan faunas from the Queensland portion of the Great Artesian Basin -

Vol. I. Part I. Biostratigraphic Studies.
264 pp., 3 maps, 3 appendices.
Vol. II. Part II. Taxonomic Studies.
546 pp., 8 text-figures.
Vol. III. 59 plates and explanations.

Recent geological mapping and concurrent palaeontological studies have provided detailed information on stratigraphic and geographic ranges of marine Lower Cretaceous molluscan species in the Great Artesian Basin. In Part I, Biostratigraphic Studies, the faunal sequence in the Queensland parts of the Eromanga and Surat segments of that basin is documented. A correlation of Australian marine Lower Cretaceous formations utilizing this succession is

presented. The biostratigraphic value of Roma and Tambo faunas distinguished by Whitehouse is confirmed. However, his interpretation of their ages, respectively Aptian and late Albian, needs modification in view of recent ammonite studies. These suggest that the Roma fauna represents only late Aptian time, while the Tambo possibly represents all Albian time.

In pre-Roma (Neocomian - early Aptian) faunas a northern, warmer water assemblage may be differentiated from southern, cooler water ones. Roma and Tambo faunas are interpreted as provincial, temperate or cool temperate equivalents of Northern Hemisphere boreal faunas.

Reconstruction of Lower Cretaceous events in the Great Artesian Basin from stratigraphical and palaeontological data shows marine transgressions were initiated in Neocomian - early Aptian time, and reached their zenith in the late Aptian. Regression in southern and eastern areas occurred in early Albian time, followed by renewed transgression over a more limited area later in the Albian. Seas apparently withdrew from the basin before the close of Albian time.

In Part II, Taxonomic Studies, systematic descriptions of 115 species, comprising one nautiloid, 32 ammonites, 7 belemnites, and 75 bivalves, are presented.

Arndt, N.T. (B.Sc. Hons) (1969) Australian National University

The igneous and metamorphic rocks of the Walwa area, N.E. Victoria.
74 pp., 1 appendix, 1 map, 18 figures, 39 plates.

Lat. 35°55'S to 36°05'S; Long. 147°30'E to 147°40'E.

Three periods of metamorphism are recognized in the Walwa District of the northeastern Victorian metamorphic belt. Regional metamorphism resulted in the formation of large areas of cordierite-andalusite schists and lower-grade metasediments. The intrusion of granites then superimposed on these rocks concentric zones of contact metamorphism up to the sillimanite-cordierite grade, and also caused some retrogressive metamorphism. A third stage which led to the muscovitization of the higher-grade minerals was probably metasomatic in nature.

Two granite types are found. The older, a hornblende granite containing basic xenoliths, was formed by partial melting of lower crustal material. The younger, which intrudes and partially assimilates the hornblende granite, contains two micas and metamorphic minerals, and was formed by partial melting of se iments similar to the country rocks.

The Jemba rhyolites, a large body of acid volcanics, were found to consist of many flows of welded ash-flow tuffs affected by passive cauldron subsidence. Several leucogranitic plutons and possibly a swarm of porphyrite dykes are associated with the ash-flow tuffs.

Measurements of the remanent magnetism of the porphyrite dykes show that the ages of the dykes range from Late Devonian to as least Late Carboniferous.

Cristie, D.M. (B.Sc. Hons) (1969) Australian National University

Geology and geochemistry of Crown Reef, Norseman, W.A., - 58 pp., 2 appendices, 2 maps, 26 figures, 15 tables, 23 plates.

Lat. 32°10'S; Long. 121°50'E.

Two distinct tectonic processes appear to have been involved in the geological development of the Norseman Goldfield.

First, a 'normal' tectonic cycle from tholeiitic vulcanism in a sedimentary basin through granophyric intrusion and granite emplacement gave rise respectively to the volcanic-sedimentary sequence, the acid intrusives, and the granites observed in the area today. Rocks of this cycle have Rb/Sr ages of about 2,600 m.y.

Second, an 'event' about 2,400 m.y. ago resulted in regional metamorphism to lower amphibolite facies, the formation of major reverse-faulted shear zones and the intrusion of a large basic dyke.

Detailed studies of the Crown Reef and its wall rocks suggest that mineralization occurred during this event by concentration of mobile components of the original tholeiites in dilatant parts of the reverse-faulted zones.

Curtis, L.W. (B.Sc. Hons) (1969) Australian National University

Geochemistry of high-potassium rocks, southeastern New South Wales. 105 pp., 32 figures, 21 tables, 8 plates.

Lat. 35°15'S to 35°25'S; Long. 150°20'E to 150°30'E.

A description of a group of high-potassium rocks from the south coast of New South Wales is given; their chemistry is typical of that of the shoshonites.

A detailed examination was carried out on the rocks from the Milton-Termeil district, and this has indicated that rocks of shoshonitic chemistry are characterized not only by high-potassium content, but also by high contents of barium, strontium, phosphorus and zirconium. The chemistry of the rocks is distinctive and is possibly related to an alkaline undersaturated magma.

The Milton Monzonite has a composition close to that proposed by Chappell for the basic parent of the Moonbi granite series.

Davoren, P.J. (B.Sc. Hons) (1969) Australian National University

The geology of the Taralga-Bannaby district, New South Wales. 103 pp., 2 maps, 7 figures, 3 tables, 14 plates.

Lat. 34°25'S to 34°45'S; Long. 149°28'E to 150°00'E.

Mapping in the Taralga District has shown the presence of a sequence of Palaeozoic rocks commencing with Upper Ordovician deep-water deposits and ending with Lambian sediments mainly of deltaic origin.

The Ordovician sequence of unknown thickness contains late Eastonian graptolites and underwent deformation during the Benambran Orogeny. Silurian sedimentation began during or before the early Ludlovian zone of Monograptus nilssoni, the oldest parts of the sequence probably being of relatively deep-water slump origin. Higher in the Silurian succession, there are black graptolitic shales followed by algal limestones, indicating a relatively shallow-water, marine depositional environment. The brachiopod fauna at the top of the Ludlovian sequence is the same as those of early late Ludlovian age in the Yass Basin. The Bowning Orogeny tightly folded the Upper Silurian succession, caused faulting and deformation of most of the Ordovician deposits, and produced a faulted, probably thrust, contact between the Upper Silurian and Ordovician sequences.

Early and/or Middle Devonian igneous activity produced both pyroclastics and high-level intrusions such as the Bindook Porphyry. The sedimentary-volcanic sequence consists of about 150 m of ash-flow tuffs interbedded with minor amounts of conglomerate and sandstone. The Tabberabberan Orogeny produced large open folds in the Lower to Middle Devonian sequence in contrast to the underlying tightly folded Ludlovian sediments.

A thick succession of about 2,500 m of first marine and then fluviatile and deltaic sediments was deposited during the late Devonian. The Upper Devonian sequence on the western side of the area mapped lies on the eastern flank of a large northward-plunging syncline, presumably formed during the Carboniferous Kanimblan Orogeny. The Upper Devonian beds to the east are flat-lying.

Felton, E.A. (B.Sc. Hons) (1969) Australian National University

Geology of the Mount Fairy area, N.S.W. 127 pp., 3 maps, 6 figures, 5 diagrams, 4 tables.

Lat. 35°05'S to 35°15'S; Long. 149°35'E to 149°40'E.

The Mount Fairy region of New South Wales comprises sedimentary and igneous rocks of Ordovician, Silurian and Devonian age. The Silurian rocks, formerly thought to extend over a large area, are shown to be confined to a narrow meridional belt. The remainder of the sedimentary rocks, of Ordovician and Devonian ages, are separated from the Silurian strata by major faults.

The Ordovician rocks are intruded by granites in the western part of the area. Copper mineralization occurs along shear zones in the Mulloon region.

The Silurian strata are divided into two formations and three members of limestones, arenites and shales, which together comprise the Mount Fairy Group. The Devonian rocks consist of limestones at the base, with overlying conglomerates and terrestrial beds.

The sediments of the three systems represent bathyal, shallow shelf and terrestrial sedimentation regimes. The changes in sedimentary environment are related to tectonism in the area, in which four deformation phases have been recognized. The F2 phase has been the most intense and has caused regional slaty cleavage and greenschist facies regional metamorphism. This phase resulted from strong compression from the west and was also associated with major, high-angle reverse faults whose thrust planes dip steeply to the west.

Huleatt, M.B. (B.Sc. Hons) (1969) Australian National University

The geology of Palaeozoic sediments southeast of Taralga, N.S.W. 96 pp., 2 maps, 1 section, 20 figures, 3 text-figures, 2 tables, 6 plates.

Lat. 34°25'S to 34°35'S; Long. 149°50'E to 150°00'E.

A study of the stratigraphy, palaeontology and palaeoecology of the Palaeozoic sediments southeast of Taralga, New South Wales, shows that Ordovician, Silurian, and Devonian sediments are involved.

The Ordovician sediments consist of deep-water sandstones, cherts and shales. The black shales contain a late Eastonian graptolite fauna.

Deep-water sandstone, cherts, and shales and shallower-water shales and limestones characterize the Silurian sequence. In this there is a facies change from east to west, with the sediments, becoming more sandy towards the west, associated with a deepening of the basin. Graptolitic faunas are also present and indicate a Late Silurian age.

The Upper Devonian sediments consist mainly of sandstones and shales. These range from shallow marine to fluvial in origin, and contain a small fauna on which precise age determinations are not as yet possible.

Structurally, the Ordovician and Devonian sequences are tightly folded whereas the Devonian sediments dip fairly uniformly to the west.

Labutis, V. (B.Sc. Hons) (1969) Australian National University

The geology of the Yarrangobilly area, N.S.W. 87 pp., 3 maps, 6 figures, 9 plates.

Lat. 35°30'S to 35°50'S; Long. 148°20'E to 148°30'E.

Sedimentary, volcanic, and igneous rocks were mapped in the north-western part of the Kosciusko National Park between Kiandra and Talbingo.

The sedimentary succession begins with the Ordovician Kiandra Beds consisting of metamorphosed tuffs, cherts and siltstones, which are probably unconformably overlain by siltstones and sandstones of the Tumut Pond Group, the Yarrangobilly Limestone and the shales, greywackes and conglomerates of the Ravine Beds. The Cave Creek and Lower Jounama Creek limestones are apparently extensions of the Yarrangobilly belt. A late Wenlockian-early Ludlovian age is indicated for the Yarrangobilly Limestone

and the Tumut Pond Group from palaeontological evidence. The sediments and volcanics of the Boraig Group (Lower Devonian) unconformably overlie the Silurian sequence. Cainozoic sediments and basalts complete the succession.

The Silurian rocks are intruded by porphyry and the Bogong Granite of probable Silurian and Devonian age respectively. Minor faulting and mineralization are associated with the igneous intrusions.

Folding is probably related to the Bowning Orogeny, with slight effects caused by the Tabberabberan Orogeny.

Palaeoecological and palaeogeographical implications are discussed, and a broad correlation with other Silurian areas is effected.

McKay, W.J. (B.Sc. Hons) (1969) Australian National University

Metamorphic and igneous rocks in the Tallangatta district, Northeast Victoria. 62 pp., 1 appendix, 1 map, 29 figures, 18 tables.

Lat. 36°10'S to 36°30'S; Long. 147°00'E to 147°25'E.

The Ordovician sediments of the Talangatta area in Victoria form portion of the Wagga Trough. They have been subjected to at least three phases of folding, the first of which involved the formation of tight isoclinal folds. These structures are overprinted by upright, more open second-generation folds, which show a well-developed axial-plane crenulation cleavage. The relationship between the first-, second- and third-generation structures is defined in thin-section by the occurrence of a second crenulation cleavage foliation.

Extensive regional metamorphism began during the first phase and continued until after the second phase of deformation. The metamorphism had its greatest effect during and after the second phase of deformation.

Mineral assemblages of the pelitic rocks indicate that the metamorphism is of the andalusite-sillimanite type. At least three progressive zones may be mapped, namely, biotite, andalusite, and sillimanite. Sillimanite has been superimposed across part of the andalusite zone by the intrusion of small pods of Lockhart Granite. The maximum pressure and temperature reached in the metamorphism of these rocks are discussed in the light of experimental data.

Migmatites of the lit-par-lit type occur extensively throughout the western and northern parts of the area. They are considered to be genetically related to the regional metamorphism and to have formed by differential anatexis. The sporadic occurrence of the assemblage garnet-cordierite in the migmatitic selvedges allow certain limits to be placed on the P-T conditions at which the migmatites formed.

The Lockhart and Yabba Granites are a typical example of the Cooma-type granites of southeastern Australia. Chemically they display low Ca contents and a high K:Na ratio. A possible origin for the granites is discussed.

Powell, I.L.L. (B.Sc. Hons) (1969) Australian National University

The geology of the Eurobodalla area, New South Wales. 105 pp., plus Appendix, 2 maps, 1 section, 34 figures, 10 tables, 18 plates.

Lat. 36°05'S to 36°15'S; Long. 149°55'E to 150°00'E.

The stratigraphic succession in the Eurobodalla area includes rocks of Ordovician (?) and Devonian ages. The Devonian Merrimbula Group and Comerong Volcanics form a narrow, northward-trending synclinorium with a maximum width of 8 km. These rocks of shallow marine and continental origin rest unconformably on folded sediments of probable Late Ordovician age.

During the Carboniferous Kanimblan Orogeny, the sediments of the Merrimbula Group and the Comerong Volcanics were folded and faulted. No later sedimentation has apparently occurred in the area with the exception of localized Tertiary and Quaternary deposits.

Price, R.C. (B.Sc. Hons ) (1969) Australian National University

Granites of the northeast Victorian metamorphic complex. 45 pp., 1 map, 21 figures, 11 tables, 14 plates.

Lat. 35°55'S to 36°25'S; Long. 147°15'E to 147°35'E.

The metamorphic complex to the east of Tallangatta in northeastern Victoria is intruded by two types of granitic magma. The earlier muscovite-bearing granites are believed to have been intruded in Silurian-Devonian times, whereas the later leucogranites appeared in Middle to Late Devonian time.

Three muscovite granites were studied. The most westerly (Yabba Granite) and probably the oldest has not been studied in detail. The other two bodies (Granya and Koetong Granites) appear to be genetically related to each other. The earlier Granya granite is enriched in alkali feldspar, which is considered to have been the first phase to crystallize. In doing so, it gave rise to a magma depleted in $K_2O$. This magma formed the later Koetong Granite. Fractionation occurred during crystallization of the Koetong Granite and was accompanied by an increase in water pressure. This granite crystallized at depths of 12-18 km at temperatures of 680-760°C. Water pressures increased from 0.5 to 5 kb as crystallization proceeded.

The granites intruded a sequence of Upper Ordovician sediments, which were metamorphosed during the Benambran Orogeny, affecting the Lachlan Geosyncline in Late Ordovician time. The metamorphism was of the low-pressure intermediate type, the highest grade reached in the map area being the biotite type.

The muscovite granites are surrounded by contact aureoles of knotted schists. The knots are composed of pinite which represents retrogressed cordierite, probably associated with the increasing water pressure during crystallization.

The leucogranites were derived by fractional crystallization from the granodioritic magmas forming the batholiths of the Snowy Mountains region. The Thologolong granite in this area crystallized at temperatures of 600-800°C at depths of 5-10 km.

The structural geology and economic geology of the area are also discussed.

Williams, N. (B.Sc. Hons) (1969) Australian National University

Palaeozoic Geology of Bethanga Goldfield area, N.E. Victoria. 98 pp., 1 appendix, 1 map, 26 figures, 7 tables, 42 plates (40 micrographs and 12 photographs).

Lat. 36°05'E; Long. 147°05'E.

The rocks of the Bethanga Goldfield constitute part of the western metamorphic belt of southeastern Australia. The metamorphic rocks are divided into four zones, namely,

1. Biotite
2. Andalusite-cordierite
3. Sillimanite-muscovite
4. Sillimanite-orthoclase.

Mineral assemblages in these zones are similar to those described elsewhere in southeastern Australia. The most significant differences are the occurrence of staurolite in the rocks of the andalusite-cordierite zone, and of alamndine + cordierite in the sillimanite-orthoclase zone. These differences are attributed to the very iron-rich nature of the pelitic rocks around Bethanga.

The compositions of two existing pairs of garnet and cordierite are given. These compositions indicate that metamorphism took place under low-pressure conditions. A study of the Fe/Mg ratio of all available analyses of coexisting garnets and cordierites shows that the partition coefficient $K'_{Fe/Mg}$ is temperature dependent, but is of little use as a geothermometer.

A mineragraphic study of the sulphide mineralization of the Bethanga Goldfield indicates that the mineralization took place in three stages:

(a) Primary hydrothermal stage
(b) Secondary hydrothermal stage (carbonate alteration)
(c) Supergene stage.

During the second stage, pyrrhotite was altered to colloform pyrite and marcasite, but it is suggested that this was necessarily a colloidal process. The compositions of the sphalerites from the Bethanga orebodies are in agreement with the extrapolations of Barton & Toulmin (1966), and at variance with more recent experimental studies. The composition of the sphalerites, and the mineral assemblages present in the ores, indicate a temperature of ore formation in the range of 315-351°C.

The occurrence of Upper Devonian conglomerates in the Bethanga District suggests that during the Late Devonian no land barrier existed between the Avon River Basin in Victoria and the Central Province Basin of New South Wales.

Young, G.C. (B.Sc. Hons) (1969) Australian National University

The geology of the Burrinjuck - Wee Jasper area, New South Wales.
115 pp., 2 maps, 28 figures, 21 plates.

Lat. 35°00'S to 35°05'S; Long. 148°35'E to 148°40'E.

In the limestones exposed along the Goodradigbee Valley where it enters the Burrinjuck Dam, lithostratigraphic units corresponding to those in the Taemas sequence have been recognized, up to and including the Bloomfield Limestone. Above this level extensive reefal development precludes a close lithological comparison with the Taemas sequence.

Six units are defined and described in biostratigraphical detail. Evidence for diachronism as between the two sequences mentioned is presented.

Fish remains are common at some localities and at least two new genera in the Family Buchanosteidae are proposed. Evidence of ontogenetic changes in skull-roof proportions suggests that the two species of Buchanosteus previously recognized may be one and the same. Some plates of the thoracic armour of this genus are described for the first time, and the course of the sensory canal across the anterior dorsolateral plate suggests affinities with the Family Dinichthyidae. A complete account of the endocranial morphology of Buchanosteus is presented for the first time and indicates a close similarity to the dolichothoracid Kujdanowiaspis.

Joyce, A.S. (Ph.D.) (1970) Australian National University

Geochemistry of the Murrumbidgee batholith. 131 pp., 1 map, 29 text-figures, 43 tables, 2 appendices.

The batholith crops out over an area of 1,400 $km^2$ and contains abundant sedimentary xenoliths. It consists of many discrete intrusions ranging from tonalite to leucogranite as indicated by Snelling (1960). The present investigation attempts to define the nature and extent of chemical, modal and mineralogical variation within the batholith and to assemble significant features that may be used as controls in examining the petrogenesis of the rocks.

Halford, G.E. (M.Sc.) (1970) Australian National University

Dykes and their inclusions from Kelly's Point, New South Wales. 132 pp., 16 text-figures, 23 tables.

Lat. 36°03'S; Long. 150°10'E.

Basic dykes at Kelly's Point, in southern New South Wales, intrude the gabbro-diorite-tonalite-granite complex of Moruya. There are two distinct chemical and petrographic types although both have similar structural settings and possibly time relationships. One set of dykes (called porphyrites) have calc-alkaline affinities and are chemically similar to the granodioritic rocks of the Moruya Complex. Others are lamprophyric in that they contain amphibole and have been extensively autometamorphosed with the production of carbonates and actinolite, but they have chemical features indicative of an alkaline basalt or hawaiite.

The lamprophyric dykes are composite. In places they are crowded with an unusual set of inclusions including anorthosites, gabbroic anorthosites, spinel pyroxenites and large xenocrysts or megacrysts of kaersutitic pargasite, almandine-rich garnet, plagioclase (near $An_{50}$) and rare biotite and iron-rich olivine. Inclusions of country rock are also present.

Chemical and mineralogical data suggest that most of the inclusions are the deep-seated crystallization products of an alkaline basalt. The pyroxene (containing spinel) is an aluminous but low-Na variety of the type found by Green & Ringwood (1967) on the liquidus of similar alkali basalt compositions near 10kb. The abundant plagioclase is considered to have crystallized at higher levels (at about 5kb). Continued crystallization at moderately deep crustal levels caused the equilibrium water pressure to build up to a value where abundant amphibole could crystallize, which is in accord with the presence of abundant volatiles in the lamprophyres containing large amphiboles.

The separation of abundant volatiles including $CO_2$ at deep levels in the crust probably caused the rapid intrusion of the fractionated magma so that inclusions could be carried up. Rapid near-surface chilling resulted in the preservation of inclusions and in the 'sealing in' of volatiles that caused autometamorphism at the centres of the dykes.

A genetic relationship between the alkaline lamprophyres and the Moruya Complex is unlikely.

Baczynski, N.R.P. (B.Sc. Hons) (1970) Australian National University

Geology east of Bredbo, N.S.W. 41 pp., 2 maps, 1 chart, 7 plates, 10 text-figures.

Lat. 35°53' to 36°00'S; Long. 149°05' to 149°15'E

The deformation state of the Ordovician and the Silurian rocks is the same, and although the Bureau of Mineral Resources considers there to be a faulted unconformity between these systems in this area, the author was unable to map a boundary. Minor members of the Silurian sequence are tightly folded whereas the massive tuffs are probably more simply folded though this is difficult to establish because of the lack of marker beds.

The rocks mapped previously as Early Silurian in age proved to be Middle-Late Silurian, thus suggesting correlation between the Cappanama and Goosoon Beds.

The Colinton Volcanics have been interpreted as a series of ash-flow tuffs interbedded with minor flow and intrusive units. The petrography and chemistry of the volcanics suggest that the sequence may be a synclinal structure. This conclusion, together with other stratigraphic deductions, suggests that the sequence as a whole is a synclinorium.

Gossans occur throughout the whole area and minor copper, lead, and zinc mineralization commonly occurs where faults intersect limestone lenses.

Bucknell, W.R. (B.Sc. Hons) (1970) Australian National University

Environment of deposition and deformation of the Merrimbula Group south of Eden, N.S.W. 69 pp., 1 map, 2 charts, 1 section, 20 plates, 14 text-figures.

Lat. 37°10' to 37°46'S; Long. 149°55' to 150°55'E.

The Upper Devonian Merrimbula Group, on the far south coast of New South Wales, consists of three formations, the Twofold Bay Formation at the base, the Bellbird Creek Formation, and the Worange Point Formation at the top. The Twofold Bay Formation was deposited by a braided or meandering river, the Bellbird Creek Formation mainly under subaqueous deltaic conditions, and the Worange Point Formation by a meandering river traversing a coastal plain. A dry, warm environment is postulated at the time of deposition of the Worange Point Formation. Subsequent near-surface deformation fo these sediments has produced meridional, asymmetric buckle folds under a horizontal E-W compression. Folding is controlled by the competent sandstone units and the fold styles indicate considerable brittle deformation within these units. A slaty cleavage is well developed in the incompetent siltstone units. Following the folding a conjugate pair of oblique joint sets has developed normal to bedding.

Kelly, G.R. (B.Sc. Hons) (1970) Australian National University

The geology and Soils of the Towrang district, N.S.W. 81 pp., 3 maps, 1 section, 8 plates and explanations, 15 figures, 2 appendices.

Lat. 34°37' to 34°45'S; Long. 149°46' to 149°57'E.

The district has been mapped geologically and pedologically. This has revealed a major phase of geological evolution confined to the Palaeozoic rocks, separated so far as evidence goes from a major phase of landscape evolution in the Cainozoic. A thick (4,000 m) sequence of Ordovician interbedded cherts, quartzites and shales was slightly warped in the Benambran Orogeny and on this were deposited over 1,600 m of Upper Silurian shales and interbedded quartzites and arenites. Structural analysis reveals that these sediments were affected by the Bowning Orogeny forming inclined (80°W) isoclinal folds trending 010° and plunging at 0-5°.

Two types of Middle Devonian granite intrusion were identified by petrographic examination - a quartz porphyry and a hornblende-biotite granite.

Late Devonian sedimentation took place on the folded Ordovician-Silurian rocks in a near-shore environment, as evidenced by the basal conglomerate and quartzites. The Kanimblan Orogeny affected these rocks forming shallow open folds trending 000°

Tertiary extrusives occur in the form of basic plugs, and Tertiary ferricretes form dissected isolated remnants.

Post-Tertiary gravels form a basis for the Tarago lateritic soil development. Incision of this ground-surface during the Pleistocene allowed Gundaroo soil profiles to form.

A scheme for classifying subsola features of both soils is presented, and profile descriptions are given for the Tarago, Gundaroo, and younger soil units.

Madsen, P.N. (B.Sc. Hons) (1970) Australian National University

Palaeozoic rocks of the Cowra district, New South Wales. 80 pp., 1 map, 46 plates, 12 text-figures, 11 tables.

Lat. 34°03' to 34°15'S; Long. 148°39' to 148°56'E.

The Palaeozoic rocks of the Cowra district form part of the Molong Geanticline and the Cowra Trough, Central New South Wales. The Ordovician basic volcanic rocks have been altered by burial metamorphism to the actinolite greenschist zone of intermediate-type metamorphism. The metamorphism has caused an internal rearrangement of elements, especially calcium, leading to a Ca-rich epidote-quartz assemblage and a Ca-poor spilitic assemblage. The chemistry indicates that the basic rocks were originally similar to continental tholeiites.

The Wyangala Batholith has been subdivided into six separate elliptical intrusions on the basis of mineralogy, chemistry, and field relationships. In this respect it is very similar to the Berridale Batholith in the Snowy Mountains area.

A study of the chemistry and petrography of garnet phenocrysts in the Cowra Granodiorite shows that they have a compositional and reaction relation that is characteristic of garnets in granites from many areas. The phenocrysts have crystallized directly from the magma at depth and subsequently reacted in a lower-pressure environment.

A mineragraphic study of the sulphide mineralization shows that primary chalcopyrite is the original mineral in a replacement sequence:

(1) Chalcopyrite
(2) Digenite-covellite
(3) Cuprite
(4) Limonite
(5) Hematite

Moignard, P.S. (B.Sc. Hons) (1970) Australian National University

The Geology of the Boambolo district, New South Wales. 92 pp., 1 map, 2 charts, 10 plates and explanations, 9 text-figures, appendix.

Lat. 35°S; Long. 148°55'E.

In the Boambolo area a central lineament divides the area into discrete northern and southern fault blocks. The Silurian rocks are placed in a lithologically defined sequence for which boundaries are defined and a new nomenclature proposed. Lithological characteristics of the sequence are described, and the depositional environment interpreted for the sedimentary units. These interpretations point to the diachronous nature of the lithologic units; a more sound biostratigraphic zonation has not been possible. The palaeontology and palaeoecology of the fossiliferous units are briefly described.

Descriptive palaeontology has been undertaken to clarify the faunal elements and outline their taxonomic affinities. A new species of the ostracod genus Velibeyrichia is described. Closer examination of the conodont faunas of the Copplestone Member is recommended, but primary correlation with the Yass Basin sequence indicates that sedimentation occurred in late Wenlockian to early Ludlovian times.

Nisbet, B.W. (B.Sc. Hons) (1970) Australian National University

The Structural Geology of the Captain's Flat area, N.S.W. 52 pp., 2 maps, 7 plates, 13 text-figures.

Lat. 35°32' to 35°38'S; Long. 149°25' to 149°28'E.

Structural studies indicate that the area suffered at least three phases of folding, two of which were major plastic phases, and the third a kink phase. All are believed to have occurred in post-Silurian times. It is not known whether faulting in the area is related to the folding.

Four types of strain marker were investigated - pebbles, quartz phenocrysts, folds, and cleavage. It was found that the quartz phenocrysts alone were suitable for a strain analysis, but the amount of strain in one area was determined by a study of the fold geometry. In addition the deformation of quartz and feldspar phenocrysts was related to cleavage development.

Structural and stratigraphic considerations indicate that the Ordovician-Silurian contact is probably an unconformity or disconformity, and that the surface is complexly folded.

From the aspect of economic geology, the writer favours the view that the deposition of sulphides at Captain's Flat was due to volcanic exhalations of the classical type, but cannot dismiss structure as a control mechanism. It may in fact have had a remobilizing effect on the sulphides.

Veijayaratnam, M. (B.Sc. Hons) (1970) Australian National University

Petrology of the Myalla Road syenite complex and its environment. 61 pp., 1 map, 9 plates, 33 text-figures, 22 tables.

Lat. 36°15' to 36°20'S; Long. 149°05' to 149°10'E.

The Myalla Road syenite complex is a heterogeneous body with a central ring intrusion of quartz monzonite. The main body has gradational phases of various syenites and banatite. Dykes are abundant in and around the central intrusion, and there is a dyke of explosion breccia on the eastern side of the ring structure.

The complex has traditionally been regarded as calc-alkaline in composition, based on the assumption that the hornblende in it is a common variety and that there is a spatial association with the Berridale Granite. It is now demonstrated that the hornblende is a ferrohastingsite and K/Ar age determinations give a date of 174 million years as opposed to 393 $\pm$ 10 for the Berridale Granite. On this basis, the syenite cannot be calc-alkaline, but is a high potassic body, a member of the shoshonite association. It is concluded that the undersaturated nature of the magma with respect to water is the dominant factor responsible for the characteristic features of the complex.

The Myalla Road syenite intrudes the Cooma Complex. The immediately adjoining parts of the latter are divided into andalusite and sillimanite zones and a zone of migmatite surrounding the granite. A petrogenetic grid is constructed and a PT gradient inferred. The alkali basalts in the area are briefly discussed.

## UNIVERSITY OF TOWNSVILLE

Lemmon, T.C. (B.Sc. Hons) (1969) University of Townsville

Geology and mineralization of the Ewan - Mount Brown area, Queensland. 94 pp., 3 maps, 21 plates, 5 figures.

The area mapped for this report is divided into two major fault blocks by a main NNW trending fault and a system of major cross-cutting faults which trend approximately east-west. The fault blocks are here named the Western Fault Block and the Eastern Fault Block. In each a stratigraphic sequence can be recognized but because of the lack of age criteria the sequences cannot be related to one another. In the western Fault Block the sequence consists of a basement of high-grade quartzofeldspathic schists, micaceous quartzites and minor amphibolites (Running River Metamorphics of Wyatt et al., 1965). Unconformably overlying the metamorphics is a thick sequence of micaceous sandstones which pass upwards into lensoidal 'reef' limestone of (?) Middle to Upper Silurian age. The sequence within the eastern fault consists of hornfelsic ignimbritic lavas (oldest), a

thick sequence of coarse grained terrestrial clastics, and a sequence of acid to intermediate pyroclastics and lava flows (youngest). The contact between the clastic sequence and the overlying volcanic suite is possibly unconformable. Neither the sequence of the Western Fault Block nor that of the Eastern Fault Block can be correlated with certainty with other formations in the region. A third discrete structural unit, here named the Northern Fault Wedge, contains a sequence of rocks which are, in part, similar to those of the Western Fault Block. Part of a large Lower Carboniferous (early Visean) granitic batholith outcrops in the south of the area. Post-Carboniferous faulting is the dominant structural feature. Quartz-feldspar porphyry dykes have been intruded along these fault planes and are possibly genetically related to the hypothermal tin quartz-chlorite lodes which pervade the area. Large irregular rhyodacitic to dacitic intrusions predate the quartz feldspar porphyries.

Mineralization in the southeast section of the Kangaroo Hills Mineral Field is primarily tin mineralization. Cassiterite occurs in hypothermal quartz-chlorite and chlorite lodes along fault zones and xenothermal tin-sulphide deposits occur in complex fissure zones and pipe-like orebodies. Other deposits are of copper, lead-silver, and tungsten. Definite centres of mineralization occur. Regional and district zoning is not apparent, though work is required on this problem. Within the area mapped for this report hypothermal tin lodes appear to be genetically related to quartz feldspar porphyry intrusions and not to the main intrusive phase of the Oweenee Granite.

Lister, G.S. (B.Sc. Hons) (1969) University of Townsville

Aspects of metamorphism and structure across the Mount Isa Fault, in the Mount Novit area. 111 pp., 1 map, 93 figures, 43 plates.

In an area south of Mount Isa, five Precambrian rock types have been recognized. Metabasalts and chloritic pelites in the chlorite zone of the greenschist facies are juxtaposed against quartz-mica rocks and amphibolites in the lower amphibolite facies. The amphibolites in the west are intruded by the Sybella Granite.

Three generations of folds are recognized. The first generation is recognizable only on the macroscopic scale. Second generation folds have an axial plane schistosity or slaty cleavage, and third generation folds deform this axial plane surface.

Lithological layering (S) transgresses major lithological contacts ($S_1$), and is interpreted as a transposition foliation parallel to the axial plane ($S_2$) of large recumbent first generation folds. The western part of the thesis area consists of part of two of these large folds.

Second generation folding on the scale, resulted in the formation of a tight syncline in the enveloping surface to $S_1$. First generation recumbent folds have become tightened into isoclinal structures on the eastern limb in the Mount Isa Shale, but the number of isoclinal fold closures is small because of the size of the first generation folds. The Eastern Creek Volcanics and related greenstones have acted as a 'decollement', while plis de couverture folding occurred in the overlying less competent rocks. A slaty cleavage or schistosity developed axial plane to second generation folds.

During the second phase of deformation, intense folding occurred in the axial zone of the major syncline, and a movement zone was formed that resulted in considerable upward displacement of the west limb relative to the east. This has resulted in the juxtaposition of medium-grade metamorphics against low-grade metamorphics, across a zone in which retrograde metamorphism (chlorite zone of the greenschist facies) has occurred.

This movement zone is the 'Mount Isa Fault'.

Goulevitch, J. (B.Sc. Hons) (1970) University of Townsville

Geology of an area in the Mount Philip - Fountain Range region, Mary Kathleen district. 262 pp., 2 maps, 42 figures, 16 plates.

Eight metasedimentary units, a younger granite, and dolerite dykes have been recognized in the area. The metasediments belong to the Corella Formation, but the granite, which intruded passively, is not part of the Wonga Granite. The petrography of these and other major rock bodies is described in detail. Except for the late granite and dolerite dykes all the rocks have been subjected to regional metamorphism which can be interpreted as hornblende hornfels or amphibolite facies.

Structurally, two steep, north plunging, antiforms dominate the area. It is uncertain if these two features are cogenetic. Two later phases of folding affect the antiform to the west. Minor faulting has been detected within the area and the western boundary of the area is defined by the Fountain Range quartz ridge, which is believed to be a major fault.

Scapolite is abundant in the calc-silicate granofelses. It is considered that this scapolite originated from sedimentary evaporitic material which was locally redistributed prior to and during regional metamorphism.

Economically the area holds little promise. Copper mineralization has been observed at various localities, but at none of these does it appear to reach economic proportions.

Slessar, G.C. (B.Sc. Hons) (1970) University of Townsville

Geology of Cape Hillsborough, Mackay region. 181 pp., 1 map, 26 figures, 50 plates.

Eighteen hundred feet of lower to middle Tertiary terrestrial sediments and volcanic rocks of the Cape Hillsborough Beds are downfaulted against the Campwyn Beds (U. Devonian - Lower Carboniferous) at Cape Hillsborough.

The nature of the sediments, of which 800 feet, is known from outcrop and exploratory drilling, suggests they were deposited in an estuarine environment. They are unconformably overlain by 1,100 feet of dominantly acidic lava flows and pyroclastics, which were erupted over a short interval of time 32 million years ago. The source area of the volcanics probably lay in the near north.

Petrographic studies suggest the volcanic rocks are sodic members of the alkali rock series. However, provisional chemical data available conflict somewhat with this conclusion. The volcanic rocks have suffered extensive deuteric and hydrothermal alteration. The relative scarcity of basaltic rocks and the lack of alkali enrichment in the acid lavas suggests that the acid volcanic rocks have been evolved by some process other than fractional crystallization of a basaltic magma.

The geological development of the Cape Hillsborough area is closely related to that of the Hillsborough Basin, which sank rapidly to a maximum depth of 10,000 feet 7 miles northeast of Cape Hillsborough during the lower Tertiary. Cape Hillsborough lies on the edge of a step-fault system which terminates the basin to the southwest. The rate of sinkage in the Cape Hillsborough area relative to other parts of the Basin must have been slow. Block faulting in the area involving vertical displacements of 500 - 1,000 feet parallel regional structural trends and post-date the eruption of the volcanic rocks. These faults have disrupted the otherwise primary southerly dip of the Cape Hillsborough Bed.

UNIVERSITY OF QUEENSLAND

Maxwell, W.G. (D.Sc.) (1969) University of Queensland

VOLUME I

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2. 1960: "The Yarrol Basin - Devonian" in Chap. V "Geology of Queensland" ed. by Hill, D. and Denmead, A.J., J. geol. Soc. Aust. 7: 106-162.

3. 1960: "The Yarrol Basin - Carboniferous" Ibid, 167-175.

4. 1961: "Lower Carboniferous brachiopod faunas from Old Cannindah, Queensland" J. Paleont. 35(1): 82-102, pls. 19-20.

5. 1961: "Lower Carboniferous gastropod faunas from Old Cannindah, Queensland" Palaeontology 4(1): 59-70, pls, 7-9.

6. 1964: "The geology of the Yarrol region. Part 1. Biostratigraphy" Pap. Dep. Geol. Univ. Qld. 5(9): 1-65, pls. 1-14.

II. Sedimentological - Great Barrier Reef

7. 1971: "Carbonate sedimentation on the Heron Island Reef, Great Barrier Reef" Jour. Sedimentary Petrology: 31(2): 215-230, figs. 1-8. Joint authorship with Day, R.W., Fleming, P.J.G.

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11. 1964: "Lithofacies analysis, southern part of the Great Barrier Reef" Pap. Dep. Geol. Univ. Qld. 5(11): 1-11. Joint authorship with Maiklem, W.R.

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14. 1969: "Radiocarbon ages of sediment, Great Barrier Reef Province" Sedimentary Geology 3: 331-333.

15. 1969: "Regional aspects of the Great Barrier Reef Province" Australasian Oil and Gas Review 15(11): 15-22.

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17. 1968: "Atlas of the Great Barrier Reef" Elsevier Publ. Co., Amsterdam. 258 pp.

Armstrong, J.D. (Ph.D.) (1969) University of Queensland

Permian Spiriferida of Eastern Australia. 2 vols, 37 figures, 2 tables, 59 plates.

Spiriferids are abundant in the Permian faunas of eastern Australia and all the currently known species are discussed in this thesis. Eastern Australian Permian spiriferid species belong to 13 genera distributed amongst seven sub-families. The punctate genera Pseudosyrinx Weller, Subansiria Sahni & Srivastava, and Punctospirifer North are each represented by several species. Subansiria occurs in the Permian faunas of Queensland, New South Wales, and Tasmania, but Pseudosyrinx is as yet unrecorded from the Tasmanian Permian, and Punctospirifer is at present known only from Queensland. In comparison with its overseas occurrences the unusual Permian spiriferid Attenuatella Stehli is rather common in eastern Australia. Five species of Attenuatella are distinguished and serial sections of one of these provide additional data about the brachial skeleton of the genus. Grantonia Brown is now believed to be a synonym of Trigonotreta Koenig. The relationship between Trigonotreta and Neospirifer Fredericks is discussed. It is also suggested that Cancellospirifer maxwelli Campbell,

the type species of Cancellospirifer Campbell, may comprise juvenile individuals of a species of Trigonotreta. Other trigonotretid genera to which some of the eastern Australian Permian spiriferids belong are Fusispirifer Waterhouse and Sulciplica Waterhouse. Martiniacean genera represented in the eastern Australian Permian are Martinia M'Coy, Notospirifer Harrington, and Ingellarella Campbell. A new generic name is proposed for three distinctive martiniacean species, and is grouped with Notospirifer and Ingelarella in the Ingelarellinae.

Previously proposed classifications of the Spiriferidina are briefly reviewed and the subfamilial categories adopted in this thesis are discussed.

Three morphological aspects of the spiriferids described herein warrant particular mention. Pallial markings are moderately well preserved on some specimens of Subansiria, Trigonotreta, Sulciplica, Martinia, Notospirifer, and Ingelarella, and these are described and discussed. Fragmentary delthyrial covers occur on a specimen of Trigonotreta and on a specimen of Sulciplica. The fragment in the delthyrium of the former specimen has features in common with the symptidial plates which occur in the delthyrium of Mucrospirifer. The characteristics of the micro-ornament of some species of Notospirifer appear to be unique amongst spiriferids. The micro-ornaments of the species of Notospirifer are examined and they are compared with the micro-ornamental and punctal characteristics of two of the species here included in Subansiria. Articulate brachiopod shells are opened by diductor muscles and some of the parameters which govern the movement of one valve of the articulate brachiopod shell with respect to the other are also analysed.

The microstructural components of the shells of four spiriferids, one terebratulid, one productid, and one strophomenid have been examined with the aid of an electron microscope. It is apparent that fundamentally different types of microstructural components comprise the shells of the different articulate brachiopod orders. The studied shells of the spiriferids and of the terebratulid consist of readily distinguishable primary and secondary layers. The latter layer consists of fibres inclined obliquely forwards into the shell from the inner surface of the primary layer. No primary layer was detected on the shells of Streptorhynchus pelicanensis Fletcher (Strophomenidina, Davisoniacea) and Terrakea solida (Etheridge & Dun; Productidina, Productacea). Moreover the shells of these species consist of tabular components (herein termed blades) which are arranged in sheets parallel to the surface of the shell. Blades within a sheet are parallel to each other but are not parallel to the blades in the contiguous underlying and overlying sheets. Pseudopunctae penetrate the shell of T. solida but punctae occur in the shell of S. pelicanensis.

The stratigraphic occurrence of the spiriferids described herein lend support to correlations of the Permian faunas delineated in eastern Australia by Drs J.M. Dickins and B.N. Runnegar. The distributions of some of the genera may have palaeogeographical implications.

Gould, R.E. (Ph.D.) (1969) University of Queensland

Some palaeobotanical studies of the coal measures of Queensland:
I. The Jurassic flora of the Walloon Coal Measures - Hepaticae (?), Equisetaceae, Osmundaceae.
II. Upper Permian (sic) osmundaceous trunks from the Bowen Basin.
238 pp., 19 plates, 21 figures.

Fossil megafloras obtained from the Jurassic Walloon Coal Measures (and correlatives) of the Clarence-Moreton, Surat, and Mulgildie Basins of Queensland comprise at least 33 species distributed among the Bryophyta(?), Arthrophyta, Pterophyta, and gymnosperms. The Coniferophyta are dominant; Ginkgophyta are conspicuously absent. Representatives of the Hepaticae(?), Equisetaceae, and Osmundaceae are treated in detail. The genera 'Thallites Walton, 1925', Equisetum Linnaeus, 1753, and Osmundacaulis Miller, 1967 are discussed, and species of all three described in detail. The significant features of O. gibbiana (Kidston & Gwynne-Vaughan) Miller, 1967 are also documented. A table of morphological comparisons of all known Mesozoic species of Osmundacaulis is presented.

Stratigraphic data on the Walloon Coal Measures, their lithological equivalents, and associated rock units, are compiled. From floral, faunal, and stratigraphic evidence, it is considered that the Walloon Coal Measures are probably of Middle Jurassic age.

Arthur, G.C. (B.Sc. Hons) (1969) University of Queensland

Granite and basaltic intrusions are regional metamorphic rocks from the Chapinga district, southeastern Queensland. 61 pp., 5 tables, 19 figures, 9 plates, 5 maps.

Regional mapping indicates that a zone about 8 miles wide at the exposed western margin of the Permian granite west of Kingaroy is predominately a paragneiss (a biotite-quartz-feldspar rock with minor garnet and muscovite).

Petrological evidence presented from two small areas which have been studied in detail indicates a difference in metamorphic grade in the two areas. In both, the maximum metamorphic grade attained was close to the upper amphibolite facies of the Barrovian type facies series.

Foliation within the paragneiss may be a result of isoclinal folding; this foliation has itself been folded. Two different periods of directed stress are indicated, the first resulting in abundant grwnite and pegmatite veins infilling the tension cracks thus produced, and the second resulting in emplacement of basalt as small dykes.

Garnet is of common occurrence in most rock types of the area. It occurs in the granite and pegmatites (almandine - spessartine), within the paragneiss itself, and in garnet-rich 'calcareous nodules' dotted throughout the gneiss (grossular - andradite). Tourmaline is of fairly common occurrence within the pegmatites, occurring as graphic intergrowths with quartz and as isolated tabular crystals in massive quartz.

The age of the paragneiss is uncertain. The granite which is intrusive into it is presumably Permian (from correlation with other granites on a regional scale), so that the paragneiss is older than upper Permian.

Barlow, S.D. (B.Sc. Hons) (1969) University of Queensland

Geology of the Rosebud area, Mary Kathleen, northwestern Queensland. 111 pp., 13 plates, 42 figures, 26 tables, 5 maps.

Lower Proterozoic rocks at Mary Kathleen have been metamorphosed to the cordierite-amphibolite facies (about 5000 bars and 650°C).

Five major rock units are represented in the thesis area. The continental lavas of the Argylla Formation are overlain conformably by the shallow marine sediments of the Ballara Quartzite and the Corella Formation. The Wonga Granite intrudes the Argylla Formation, and all units except the Ballara Quartzite are intruded by dolerite dykes and sills.

East-west compression has resulted in the formation of a syncline which plunges gently to the south. The bedding has been transposed into the plane of foliation, and two types of fault systems have formed. These consist of a set conjugate about the north-south axis at 30° and 330° and a number of meridional thrust faults.

Scapolite is found in all rock types except the granite and the quartzites. It occurs in two distinct environments; on fault zones and localized in particular beds. The bedded scapolite ($Me_{59}$ - $Me_{65}$) is produced by the isochemical metamorphism of halite-bearing sediments, the halite having crystallized from connate water under conditions of deep burial. Analyses have shown the parent material to be a calcareous shale which differs from nonscapolite-bearing metasediments only in chlorine content. The migration of halite-derived chlorine into zones of weakness during metamorphism has resulted in the formation of 'metasomatic' scapolite ($Me_{43}$-$Me_{78}$) by replacement of plagioclase. Both types of scapolite show anomalous refractive indices, and analyses indicate that this may be due to an unusually high chlorine content.

Cordierite-bearing rocks have formed by the isochemical metamorphism of magnesium-rich shales deposited in a basin with restricted circulation; the cordierite-anthophyllite gneisses being extreme variants.

An occurrence of coexisting hornblende and cummingtonite within a dolerite is due to the loss of calcium and silica into the adjacent fault zone. This process is also responsible for the formation of other unusual assemblages in the amphibolites. These include gedrite-quartz rocks and cummingtonite amphibolites. The gedrite is much higher in iron and aluminium than anthophyllite from the Corella gneisses, while the cummingtonite is very similar to other analysed specimens from the Mary Kathleen district.

Copper mineralization occurs at Rosebud in a fault zone within basic rocks. It is also found at Mona and Lime Castle in association with calcite lenses. Copper has been leached from acid lavas and basic dykes during metamorphism and deposited in structurally and chemically favourable sites. Investigations indicate that areas north and south of the Rosebud Mine warrant further appraisal, (possibly including a drilling program). 'Metasomatic' scapolite is associated with mineralization, and this means that a geochemical program involving both sulphur and copper could be effective.

Bavinton, O.A. (B.Sc. Hons) (1969) University of Queensland

Aspects of the geology and mineralogy of the Northern Green's Creek area, Mary Kathleen, northwest Queensland. 105 pp., 6 plates, 17 figures, 10 tables, 2 maps.

This thesis is in two sections: the first is a description of the geological features of the Northern Green's Creek area, a small area of Precambrian metamorphic rocks near Mary Kathleen in far N.W. Queensland; the second section deals with more specific mineralogical aspects of this area.

The rocks of the thesis area belong to the Argylla Formation (dominantly acid metavolcanics with minor basic rocks), the Ballara Quartzite (dominantly quartzites and quartz-muscovite schists), and the Corella Formation (dominantly metapelites and calcareous granofeldses with minor cordierite- and cordierite-anthophyllite-bearing rocks): they are isoclinally folded, vertically dipping, meridionally trending, and are faulted and fractured to varying extents. The rocks have suffered regional Abukuma-style metamorphism to the middle temperature subfacies of the Amphibolite facies and in most cases this metamorphism was isochemical.

New analyses of cordierite-bearing rocks have shown that the formation of the cordierite-anthophyllite rocks depends on the metamorphic differentiation, by small-scale migrations of calcium, of a dolomitic shale in two main stages: the first being a calcium loss to form anthophyllite-free cordierite rocks, and further calcium differentiation to form banded cordierite-bearing rocks with anthophyllite-free bands alternating with anthophyllite-bearing ones.

Chemical analyses of one magnesian cummingtonite, three magnesian anthophyllites, one actinolitic hornblende, and one magnesio-hornblende have shown that the iron-magnesium amphiboles are unusually magnesium-rich (Mg/Mg + Fe about 0.70), but that the other amphiboles are not unusual in composition.

Assemblages containing finely intergrown anthophyllite-cummingtonite and anthophyllite-hornblende-cummingtonite were newly found, and appear to be equilibrium assemblages resulting from exsolution.

The hydroxyl-stretching region of the infrared spectrum of the seven analysed amphiboles was studied: in the simpler amphiboles (cummingtonite, anthophyllite, and actinolitic hornblende) the infrared data indicated that the iron and magnesium were not randomly distributed over the four available cation-sites, but were so ordered that iron preferred the ($M_2$, $M_4$) sites to the ($M_1$, $M_3$) sites. In the remaining amphiboles (magnesio-hornblende and hastingsite) the complexity of the spectra precluded the determination of cation-ordering by this method.

The tourmalines of the four major occurrences were shown to be dravites which are not unusual in composition. The average of several distortion-indices of cordierites was a high 0.26, indicating that they formed just above the minimum temperature of cordierite formation. The zoning in the corundum was explained in terms of titanium variations, while the coloration of the pink calcite was ascribed to fine iron-oxide particles along the cleavages.

Beard, D. (B.Sc. Hons) (1969) University of Queensland

1. Endoceroids from northwestern Queensland. 132 pp., 2 plates, 6 tables, 21 figures, 1 map. 2. Stratigraphy of the Silverwood area, southeastern Queensland. 114 pp., 3 plates, 4 tables, 6 figures, 2 maps.

1. In the light of the taxonomic problems associated with the structures of the endosiphuncular deposits of endoceroid cephalopods, a preliminary revision of the family Manchuroceratidae is herein undertaken. The genera Coreanoceras, Meniscoceras, Allotrioceras, Emmonsoceras, and Williamsoceras are considered as junior synonyms of Manchuroceras. Two new species of Cacheoceras are described. Another new species belonging to the 'Proterocameroceratidae' is also described. Developmental and functional morphology is discussed for the genera Manchuroceras, Cacheoceras, and Proterocameroceras.

Because of the presence of the North American Chazyan species Manchuroceras adnatum and Mirabiloceras cf. multitubulatum in the 20-foot thick coquinite horizon near the base of the Nora Formation, the Nora Formation is tentatively assigned a Chazyan age.

2. The Silverwood area has been found to contain Devonian, Permian, Jurassic, and Quaternary strata. The Devonian Silverwood Beds consist of andesites, lithic greywackes, limestones, conglomerates, banded radiolarian rocks (fine bands of siltstone, lithic and feldspathic greywacke), and shales. The limestones have a probable age within the range Middle Siegenian to Eifelian. Discontinuance of sedimentation producing the Silverwood Beds, probably corresponded with a post-Lower Devonian pre-Artinskian orogenic movement, which caused the folding of the Silverwood Beds. Sedimentation began again in the Lower Permian, producing siltstones, feldspathic and lithic greywackes, subgreywackes, and orthoconglomerates, with an unconformable relationship to the Silverwood Beds. Post-Sakmarian pre-Upper Permian volcanic activity resulted in the repeated extrusion of andesites succeeded by rhyolites. Block faulting, which was probably synchronous with the emplacement of the Stanthorpe Granite (Upper

Permian - Lower Triassic), followed this vulcanicity. As a result much of the Permian strata was down-faulted into the Silverwood Beds. This block faulting accounts for the present disparity in attitude between the Rhyolite Range Beds and the Eight Mile Creek Beds. The fauna contained in the sediments of the Eight Mile Block is thought to be related both to Fauna II (Bowen Basin) and the Ulladulla fauna (Sydney Basin), and is considered herein of Aktastinian or Baigendzhinian age. Jurassic and Quaternary sediments unconformably overlie the Palaeozoic strata.

Brunt, D.A. (B.Sc. Hons) (1969) University of Queensland

Sedimentology and stratigraphy of the Caloundra area, southeast Queensland. 137 pp., 5 tables, 9 plates, 30 figures, 4 maps.

The geology of the Landsborough Sandstone in the Caloundra area is investigated. Various lithological types are described and the provenance of the sediments is determined. Palaeocurrent directions are established from cross-stratification measurements, and are discussed with respect to the orientation of fossilwood. Lithology, varieties of cross-stratification and analysis of grain-size characteristics are used in the determination of the environment of deposition of the sediments.

The sediments of the Brighton Beds in the area are described, and a very small outcrop of beach rock is examined with regard to its origin and the type of cementation.

Clifford, N.J. (B.Sc. Hons) (1969) University of Queensland

Structural analysis of the Corella Formation near Mary Kathleen, north-western Queensland. 74 pp., 34 figures, 10 plates, 4 maps.

Rocks of the Corella Formation near Mary Kathleen display folds of several distinct types and a complex array of associated planar and linear elements. Structures typical of highly deformed rocks, including discontinuities, lensoid structures, and parallelism of lithologic layering to schistosity, are common.

Initially, calcareous and dolomitic pelites with interbedded quartzites were deposited in a shelf environment. Any syntaphral or diagenetic effects did not survive later deformation. Tilting of the sequence southward and intrusion of the Wonga Granite and small basic dykes occurred prior to deformation in an intense dynamothermal metamorphism. Isoclinal folds of

several km amplitude, with vertical, meridional axial planes, developed with several orders of associated parasitic folds. Penetrative S-surfaces developed in all rock types. The macroscopic structural relations are explained by a model of intensive parasitic folding and subsequent attenuation and pulling apart of the major fold limbs. Folding about discordant axes occurred in the late stages of this metamorphism in association with the development of ubiquitous non-penetrative foliations. The non-penetrative foliations have, in places, been subsequently folded.

Lingering thermal activity following stress release caused relatively mild recrystallization. Granoblastic textures in the calcareous rocks are believed to reflect conditions of low differential stresses rather than intense post-tectonic recrystallization.

Two distinct styles of mesoscopic folding of schistosity are developed, testifying to later phases of minor deformation. Schistosity is also flexured on a regional scale. Major normal and later conjugate wrench faults formed subsequent to the principal phase of deformation.

Cowie, M.V. (B Sc. Hons) (1969) University of Queensland

The petrology of the Memerambi Dolerite intrusion near Kingaroy, SE Queensland. 66 pp., 10 tables, 14 figures, 4 plates.

The Tertiary Memerambi intrusion consists of picrite-dolerite and teschenite. A progressive decrease in olivine with increasing height in the intrusion, and increasing plagioclase and clinopyroxene, constitute the principal modal variations. During differentiation the olivines show iron enrichment ($Fa_{28}$ to $Fa_{50}$) while the plagioclase feldspar is enriched in sodium ($An_{66}$ to $An_{61}$). A reversal in the trend is observed in the upper margin. The associated bulk titaniferous clinopyroxene undergoes little compositional change with differentiation ($Ca_{46}$ $Mg_{39}$ $Fe_{15}$ to $Ca_{47}$ $Mg_{37}$ $Fe_{16}$). Evidence is presented suggesting that the variations in the rock series and their component minerals can be explained by a mechanism of crystal and liquid fractionation, with the liquid fractionation occurring possibly slightly earlier in the formation of the series than the crystal fractionation.

Gravity accumulation, convective currents, and water are believed to have been significant factors in the evolution of the intrusion. The main factor responsible for the formation of the picrite-dolerite layer is believed to be gravity accumulation on the lower front of consolidation.

Lau, G.C. (B.Sc. Hons) (1969) University of Queensland

Aspects of the geology of the Copper Conquest area, Mount Isa. 52 pp., 3 maps, 5 plates, 23 figures.

Several of the rock units near Mount Isa have distinctive outcrop patterns. The physiological and photogeological parameters which characterize them are systemically described.

The Myally Beds are brown metasedimentary rocks, containing quartzites and micaceous arenites. Discontinuous conglomerate beds may represent local diastems, but are of little value as a stratigraphic marker horizon.

In the Eastern Creek Volcanics, lava flows are interbedded with quartzite metasediment, and both are described. The rocks were regionally metamorphosed to the quartz-andalusite-plagioclase-chlorite subfacies of the Abukuma facies series. Interbedded breccias consist of angular fragments of basalt set in a quartz-epidote matrix. Their lithology and some suggested modes of origin are discussed.

The formations within the project area are part of the eastern limb of a meridionally trending syncline. Mesoscopic scale observations of asymmetric folds and bedding-cleavage relationships support this concept of the megascopic structure. The dip isogon method is used to classify the geometry of some fold profiles, but the results are largely inconclusive. However, mesoscopic fabric analysis, using S diagrams, suggests the presence of two perpendicular fold systems. Some aspects of the relationships and genesis of the fold pattern are discussed, but no definite statement on their origin and time sequence can be made.

Rowley, M. (B.Sc. Hons) (1969) University of Queensland

Amphibolites and associated rocks of the town area, Mary Kathleen, northwestern Queensland. 89 pp., 10 plates, 11 figures, 9 tables, 3 maps.

The rocks in the Town Area, Mary Kathleen, northwestern Queensland, can be assigned to three conformable formations. They include acid metavolcanics of the Argylla Formation, quartzites of the Ballara Quartzite and calc-silicate and pelitic rocks of the Corella Formation, which are intruded by massive pink granite, gneissic granite, and fine-grained granite of the Wonga Granite. All the rocks are of early Proterozoic age and have been regionally metamorphosed to the lower amphibolite facies.

Basic igneous intrusions (now mostly amphibolites and biotite schists) occur in all formations, in particular the Argylla Formation, and are of interest because of their association with copper mineralization.

A dolerite intrusion in the Wonga Granite shows various stages of conversion to amphibolite. The metamorphism of the dolerite is essentially isochemical with only limited introduction of $K_2O$ into locally sheared rocks. After initial replacement of original pyroxene and biotite by hornblende (magnesian hastingsite), mineralogical variation is restricted to increase in soda content of plagioclase, alteration of ilmenite to sphene, and the formation of biotite from hornblende in the sheared rocks. The secondary biotite contains higher total Fe and MnO and lower $TiO_2$, CaO, and MgO than the primary. The hornblende compositions show a strong dependence on total rock composition. Metamorphic recrystallization has resulted in simplification of the plagioclase twins.

In the Argylla Formation mineralized amphibolites contain scapolite and have relic textures which confirm their igneous origin. Geochemical data (whole rock and scapolite analyses) indicate that the formation of scapolite from plagioclase was caused by metasomatic introduction of Na, Cl, and S into the rocks. The compositions of coexisting plagioclase ($An_{37}$) and scapolite ($Me_{41}$) and the final scapolite ($Me_{32.5}$) suggest a dependence of the scapolite composition on the availability of metasomatic elements. The scapolitized rocks show a marked increase in Cu content and contain hornblende (edenite) with higher $SiO_2$, less $Al_2O_3$ und higher Mg/Fe ratio than the hornblende from the non-scapolite amphibolite.

Copper mineralization (chalcopyrite) is considered epigenetic. The supergene enrichment reactions and ore grades were controlled by the presence of abundant pyrrhotite. The ore fluids probably came from outside the basic host rock but their origin is uncertain. The migration and deposition of the ore metals are fault-controlled.

Ballinger, T.A. (B.App. Sci.) (1969) University of Queensland

Geology of the Black Snake Plateau with emphasis on the Shamride Mine. 20 pp., 21 plates, 8 figures, 3 maps.

The Black Snake Plateau lies approximately 12 miles by road south of the township of Kilkivan. The presence of the plateau is due to a porphyrite intrusion which is roughly circular in outcrop with a diameter of 1½ to 2 miles.

The area was mapped using aerial photographs as a base, at a scale of approximately 1:4,500. The area studied was limited to the porphyrite intrusion and its margins because it is only within this area that mineralization has occurred.

Nieper, C.M. (Ph.D.) (1970) University of Queensland

Middle Ordovician conodont faunas from the Toko and MacDonald Ranges, Australia. 385 pp., 2 tables, 14 figures, 7 plates.

Well preserved assemblages of conodonts have been extracted from two Australian Ordovician rock units of approximately equivalent age: (1) the Nora Formation, a predominantly shelly-limestone sequence, of the Georgina Basin in the Toko Range, western Queensland; (2) the Horn Valley Siltstone (lithologically similar to the Nora Formation) of the northeastern Amadeus Basin in the Macdonnell Ranges, Northern Territory.

The conodont fauna of the Nora Formation comprises 105 species, of which 83 are new. Twenty-eight genera are represented, including three newly described. Two faunal assemblage zones appear to be represented. The lower one is characterized by Cyrtoniodus palmatus sp. nov., C. platysmatus sp. nov., Scolopodus filosus Ethington and Clarke, 1964. S. multicorrugatus sp. nov., Tokgnathus sinuosus sp. nov., and Trissodella grossa sp. nov., the upper zone by Cyrtoniodus cirrus sp. nov., C. sinuatus sp. nov., Gothodus carinatus sp. nov., G. coleatus sp. nov., and Ozarkodina coactilis sp. nov.

The age of the Nora Formation, on conodont evidence, is lower Middle Ordovician (lower Chazyan) which agrees with previously adduced stratigraphic and macrofossil evidence. The conodont fauna of the Horn Valley Siltstone is very similar to that of the Nora Formation, but the absence of characteristic lower Middle Ordovician species suggests it is slightly older than the Nora fauna. There is little obvious correlation with the European faunal succession. The Nora fauna shows closest affiliation with North American faunas, especially the fauna of the lower Chazyan Joins Formation of Oklahoma, and with an assemblage from the Lower Setul Limestone (probably Lower Ordovician) of Malaya. The similarities with the latter fauna (which is as yet incompletely known) and the number of new species and genera suggest that the Nora fauna could be part of a possible Australian-Asian faunal province.

Batchelor, B.C. (B.Sc. Hons) (1970) University of Queensland

Carboniferous geology of the Baywulla area, Yarrol Basin. 308 pp., 5 tables. 19 figures, 8 plates, 4 maps.

The present study was aimed at elucidating the detailed Carboniferous geology of the Baywulla Area, 16 miles southwest of Monto. These folded sediments have been mapped into six lithological units. The previous stratigraphy has been revised with the discontinuation of three formation names - the Tellebang, Rands, and Burnett Formations. This results from the determination of elements of the Crana Beds and Dakiel Formation comprising the former, and the extreme difficulty in mapping the poorly differentiated lithologies of the Rands-Burnett Formation. Calcareous sediments of the Upper Visean Baywulla Formation are found to be largely allochthonous. An outlier of flat-lying ?Tertiary laterite has been determined in the west.

The included fossils were studied. Brachiopods are the major faunal element and have been used largely with pelecypods in the biostratigraphic zonation of the associated sediments. Two new species of conulariids have been described and the classification of Levipustula levis and Marginirugus barringtonensis reviewed. A study of Marginirugus barringtonensis shells provides the theoretical basis for further studies into the effects of bottom currents on shell accumulations.

Two major longitudinally oriented folds, the tightly folded Yarrol Syncline in the east and the broad Tellebang Anticline in the west, extend throughout the thesis area. Folding occurred at the end of the Permian, following the deposition of more than 15,000 feet of Upper Palaeozoic sediments. Faulting and andesite intrusion is probably related to this activity. Dacite and rhyolite were intruded during a period of earlier (lower Westphalian) igneous activity.

Bottomer, L.R. (B.Sc. Hons) (1970) University of Queensland

Aspects of the geology of the Biggenden magnetite deposits, with particular reference to those in the Mount Hastings area. 131 pp., figures, tables, 4 maps.

Oxygen isotope studies of the contact metasomatic magnetite deposits of the Biggenden area indicate that the magnetite has formed at temperatures slightly below those to which the surrounding country rocks were raised during thermal metamorphism associated with the intrusion of the Degilbo Granodiorite. This is consistent with textural evidence which indicates formation of the magnetite after the skarns in the contact zone, but before the cessation of late stage granitic activity.

The indicated temperature of formation of the ores found in the vicinity of the contact is in the range 500 to 520°C. Textural and mineralogical features of the intrusive indicate a temperature of crystallization

of about 800°C, and the temperature of the metamorphic assemblages found in the country rocks close to the contact is estimated as between 560 and 580°C.

The magnetite bodies are localized in the zone close to the granite contact, and along limestone-bearing horizons in the country rocks. The ore is notably deficient in ferromagnesian trace elements, and an origin involving preferential diffusion of iron into a vapour phase under lower crustal conditions of wet partial melting of a geosynclinal sequence is proposed.

In the Mount Hastings area, the Biggenden Beds consist of immature feldspathic sandstone, limestones, and partly spilitized basic volcanics and pyroclastics. The sequence is wholly marine in origin. Here, and elsewhere in the contact zone, numerous minor intrusives ranging in composition from basic to acidic cut the Biggenden Beds.

The possibility of discovering further large magnetite bodies in the contact zone appears small. The high value of bismuth, ores of which are widespread adjacent to the contact, should however serve as encouragement for further prospecting activity in the area.

Brown, R.S. (B.Sc. Hons) (1970) University of Queensland

Stratigraphy and palaeontology of the Yarrol area. 7 plates, 3 tables, 7 figures, 4 maps, 1 cross-section.

This thesis deals with the stratigraphy, palaeontology and sedimentology of the Upper Carboniferous and Lower Permian strata in the Yarrol Basin of the Yarrol Basin of Queensland. The Rands and Burnett Formations consist of a similar sequence of lithic greywackes, conglomerates, siltstone, mudstone, and shales. Consequently the two formations have been redefined as a single formation - the Rands-Burnett Formation, and this has been subdivided into four lithological units based on overall sedimentation trends. The Rands-Burnett Formation is placed into the Boiling Creek Group because of its lithologic similarities with the Branch Creek and Poperima Formations. A detailed facies study of the Yarrol Formation on the western limb of the Yarrol Syncline revealed that the formation consists of a sequence of course bioclastic limestones rapidly alternating with calcareous and non-calcareous siltstones and lithic greywackes. A fluctuating shoreline has been inferred as having existed at the time of deposition of both the Rands-Burnett and Yarrol Formations, based on the cyclinal nature of the sedimentary types. Contemporaneous vulcanism occurred, at times, during the depositional

history of these formations, and reached a climax with the large-scale volcanic outpourings of the Owl Gully Volcanics. Deformation of the basin occurred in the late Permian and produced the plunging synclinal form in the Yarrol Region. Two subsequent phases of diastrophism occurred during the Mesozoic. The productid brachiopods Strophalosia preovalis Maxwell, 1964, Taeniothaerus subquadratus (Morris, 1845), Anidanthus springsurensis (Booker, 1932), and Cancrinella farleyensis (Etheridge & Dun, 1909), and a new bivalve species Cypricardinia ?multicostata n. sp., all of which were collected from the Yarrol Formation, are described in detail. The Rands-Burnett Formation has been divided into two biostratigraphic units - a lower unit containing a fauna of Stephanian age, and an upper unit containing a fauna which is similar to the Allandale Fauna of the Sydney Basin, and consequently lower Sakmarian in age. The fauna of the overlying Yarrol Formation is typical of the Aktastinian Fauna II, and so correlations of the Yarrol fauna with similar faunas in other Permian marine basins in eastern Australia, as well as with basins in Western Australia and New Zealand, have been established. The economic potential of the region is disappointing. Mineralization is too sporadic and of too low a grade to warrant any interest, while the existing structures and physical parameters of the strata, such as porosity and permeability preclude the presence of oil.

Cowlishaw, W.R. (B.Sc. Hons) (1970) University of Queensland

The geology of the Cardwell Range area, north Queensland. 110 pp., 26 figures, 9 tables, 10 plates, 2 maps.

The northern part of the Cardwell Range and the coastal plains bordering the Hinchinbrook Channel has been mapped. The area is approximately 160 km north of Townsville. Four igneous phases forming part of a larger batholith are recognized. The first phase, the Glen Gordon Volcanics, is made up of dacite, rhyodacite, and rhyolite. The phases which followed were coarse quartz-feldspar porphyry, adamellite, and finally alaskite, the last phase being the major intrusion in the area. These phases are concluded to be derived by differentiation and assimilation from a primary magma of adamellite composition, and were emplaced by magmatic stoping.

Tin is of major economic importance, and in the vicinity of Five Mile Creek there is an eluvial tin field. A geochemical prospecting method for tin is developed. This method uses the concentration of tin in the heavy minerals obtained from granite samples as a geochemical indicator. Using this technique the granites were divided into tin-bearing

(alaskite) and non-tin-bearing, and the known tin field was successfully delineated. An anomaly determined by this means was found, and is an area requiring closer prospecting study. The coarse quartz-feldspar porphyry varies from pink (microadamellite) to grey (microgranodiorite) in colour. It is considered to be of economic importance as an ornamental stone.

Gould, W. (B.Sc. Hons) (1970) University of Queensland

The petrology of the Mount Nullum igneous complex, east of Mount Warning, northeast New South Wales. 112 pp., 11 plates, 10 tables, 29 figures, 2 maps.

Mount Nullum is composed of an Upper Tertiary igneous complex, intrusive into Palaeozoic phyllitic shale. Contemporaneous volcanic phases, notably rhyolite and trachyandesite, also intrude the shale. The first intrusive phase of the complex comprises a lenticular quartz monzonite, consisting of three main rock types:-

(a) One-pyroxene (diopside) quartz monzonite.

(b) Two-pyroxene (diopside and hypersthene) monzonite.

(c) Coarse-grained quartz-rich monzonite.

The second phase of intrusion is represented by the Mount Nullum microgranite, which has been subdivided into four distinct mineralogical zones, as indicated by the following assemblages:-

Zone 1 Pyroxene-hornblende plus remnant fayalite-pyroxene-hornblende.

Zone 2 Pyroxene-hornblende-epidote.

Zone 3 Hornblende-biotite-epidote.

Zone 4 Hornblende-biotite.

Around the monzonite is developed a metamorphic aureole, reaching hornblende hornfels facies adjacent to the intrusive contact. Another metamorphic aureole is recognized around the microgranite, reaching only the albite-epidote hornfels facies of contact metamorphism.

The epidote (iron-rich) is derived by hydrothermal alteration of the earlier formed ferromagnesian minerals. The fayalite, which formed early in the paragenetic history of the microgranite, is indicative of a low oxygen fugacity and a low load pressure.

Chemistry of the rocks suggests that the Mount Nullum complex is tholeiitic in character and has been derived from a basaltic parent by essentially fractional crystallization processes. The compositional zoning of the microgranite is interpreted as caused by in-situ differentiation of the magma following intrusion. Chemical relationships also suggest that Mount Nullum may represent a phase which preceded the intrusion of the exposed part of the Mount Warning Igneous Complex, situated 6½ miles to the west.

Gregory, P.W. (B.Sc. Hons) (1970) University of Queensland

The geology of the Pelican-Malbon River area, northwest Queensland. 128 pp., 48 tables, 28 plates, 33 figures, 5 maps.

Three formations, the Mitakoodi Quartzite, Corella Formation and Mount Philp Agglomerate, are represented in the Lower Proterozoic metamorphic terrain of the Pelican-Malbon River Area. The Corella Formation consists of metamorphosed evaporitic shales, limestones, dolomites, calcareous sandstones and jaspilites originally deposited as a shallow-water marine shelf sequence. Pyroxene (ferriferous augite) -scapolite -feldspar para-amphibolites are the most prominent metamorphic representatives. Calcareous granofelses with spessartine garnet and actinolite-bearing granofelses also form conspicuous units. Metajaspilites were probably chemically precipitated following the erosion of basic volcanics on the sea floor. The last episode of Eastern Creek-Marraba vulcanism is represented by agglomerate lenses within the Corella Formation.

Dynamothermal metamorphism of the sedimentary sequence under a pressure of about 2000 bars and a temperature of about 550°C raised the rocks to the sillimanite-cordierite-almandine subfacies of the amphibolite facies. Intrusion of bodies of dolerite and gabbro took place throughout the metamorphic cycle. Pegmatites, fractionation products of granites at depth, were intruded into the sedimentary sequence and subsequently metamorphosed. Both exsolution and replacement perthites are developed in the metamorphosed pegmatites. Scapolite in the metapelites formed by the reaction of evaporitic halite on microcline, whereas scapolite in the ortho- and para-amphibolites developed from the action of metasomatic volatiles on plagioclase. Boron was concentrated in the evaporitic sediments and was incorporated into the growth of tourmaline upon metamorphism. Trace element data for Rb and Sr, chemical analyses, and textural relations provide some basis for distinguishing ortho- and para-amphibolites, but the effects of metasomatism make such a distinction unreliable.

Two periods of folding have affected the rock units. The calcareous rocks and jaspilites have undergone extreme plastic flowage. Shearing and hydrothermal activity associated with strikeslip faulting on conjugate trends superimposed a thermal metamorphism (often retrogressive) on the rock units and extensive areas of 'red rock' formed by the precipitation of hematite from hydrothermal solutions. Soda metasomatism was actively associated with the faulting episode. Some of the faults were silicified, but the Manganese Fault was also infilled with manganese probably derived from the enclosing manganiferous metasediments by hydrothermal action. The distinction between brecciation due to faulting and metamorphosed sedimentary breccias is controversial.

Mineralization is confined to uranium, thorium, and copper. Three of the five recorded uranium-thorium deposits are granitic pegmatites containing allanite, thorogummite, and/or zircon. Davidite at the Malbon Anomaly is probably a fractionation product from a granite at depth. Uranium and copper mineralization at the Pelican Uranium Mine is the direct result of the introduction of these constituents through the Pelican Fault zone. Other small copper deposits were formed by remobilization of copper during metamorphism.

Koppe, W.H. (B.Sc. Hons) (1970) University of Queensland

The Mesozoic sequence of the Djuan area, southeast Queensland. 94 pp., 13 figures, 5 tables, 7 plates, 2 maps.

The Mesozoic sequence of the Djuan area, southeast Queensland, consists of 900 feet of continental sediments unconformably overlying Silurian? metamorphics and Permian? tonalite. The sediments dip gently to the southwest and are overlain by Tertiary basalts. The Mesozoic units are, in ascending order, the Tarong Beds, the Helidon Sandstone, and the Marburg Formation.

Sedimentation of the Tarong Beds, which occupy a narrow linear basin, was in part fault-controlled. On a local scale, facies distribution and thickness of the unit are controlled by basement topography. The lithic rudites and sandstones which constitute the unit were derived from the basement rocks of the adjacent Yarraman High.

Conformably overlying the Tarong Beds is the Helidon Sandstone, which consists of subarkoses and orthoquartzites derived from a nearby granitic source to the north. An episode of faulting at the end of Helidon deposition was accompanied by a change in dominant current direction.

The Marburg Formation, which disconformably overlies the Helidon Sandstone, is divisible into a lower argillaceous sequence of flood-plain or lacustrine origin and an upper arenaceous sequence of fluviatile origin. The litharenites and feldspathic litharenites of the unit were derived from basic volcanics, greenschist facies metamorphics, and acid plutonics to the east and northeast.

A heavy mineral study of outcrop material from the Djuan area, and core from drill-holes 12, 13, and 14 down dip to the west, has defined three heavy mineral zones, each of which corresponds to one of the three formations. Correlation between drill-holes shows that the Helidon Sandstone is missing from the section of drill-hole 14, probably as a result of erosion subsequent to fault movement at the end of Helidon deposition. Permeability has been an important factor in the intrastratal solution of detrital minerals and in the epidiagenetic formation of authigenic minerals.

Paterson, H.L. (B.Sc. Hons) (1970) University of Queensland

The geology and petrology of the Korrumbyn Creek area of the Mount Warning Igneous Complex, northeastern New South Wales. 174 pp., 36 figures, 15 plates, 13 tables.

Mount Warning is the eroded remains of the magma chamber which fed basaltic lava to the vent of the Tertiary Tweed shield volcano. The intrusive complex can be divided into an outer (older) series, comprising gabbro and quartz monzonite, and an inner (younger) series, comprising gabbro (dated as $23 \times 10^6$ years), alkali syenite, and trachyandesite.

The Korrumbyn Creek section of the intrusive complex is composed mainly of fine-grained gabbros, of which several separate types have been recognized, with a younger, marginal intrusion of quartz-fayalite monzonite. A syenitic ring dyke (also younger than the gabbro) marks the boundary between the inner and outer series.

The intrusion has been emplaced along the unconformable boundary between the lower Palaeozoic Brisbane Metamorphics and the Mesozoic sediments which overlie them. Contact metamorphism has reached hornblende hornfels facies. The amphibole in the metamorphic rocks is kaersutite, suggesting an unusual original composition for these rocks.

The gabbros typically contain labradorite and two pyroxene species, which exhibit exsolution phenomena characteristic of tholeiitic pyroxenes. Olivine is common, but not ubiquitous. The gabbros of the inner series are andesine bearine, reflecting their more alkali nature. The monzonite intrusion is characterized by orthoclase, oligoclase, quartz, pyroxene, and fayalite, although the latter mineral is only present in the area adjacent to the gabbro contact.

Although the gabbro shows typical tholeiitic affinities, the Korrumbyn Creek rocks as a group are transitional towards mildly alkaline types.

The gabbroic magma, believed to have been derived by partial melting in the upper mantle, was originally an olivine tholeiite, which was modified by high-level fractionation to a quartz-normative tholeiitic magma. The monzonite has evidently been derived from the residual gabbroic liquids by a combination of the processes of fractional crystallization and assimilation of the country rock. The origin of the ring dyke is problematical, and several theories are proposed.

Rollason, R.G. (B.Sc. Hons) (1970) University of Queensland

The geology of the Marodian area, near Gympie, southeast Queensland. 170 pp., 14 plates, 23 figures, 9 maps.

Geological mapping in the Marodian area northwest of Gympie revealed tightly folded sediments of the Lower Permian Biggenden Beds which are intruded by Middle Triassic granodiorite to tonalite of the Musket Flat Granodiorite. The Lower Permian sediments are divisible into four units: the Mant Basalt, Gundiah Bridge Greywacke, Gigoomgan Limestone, and Teebar Greywacke. Correlation is based on both lithological and palaeontological evidence. Regional tectonism has produced folding which has been followed by the granodiorite intrusion and faulting. A dyke swarm with a mean strike of 080° intrudes the area. Heavy faulting has occurred and a down-faulted block of Mesozoic sediments was recognized. The granodiorite intrusion has contact-metamorphosed the limestone and other Lower Permian sediments to hornblende hornfels facies. Contamination of the granodiorite magma has formed an appinite, and late-stage metasomatism has changed the composition of the metamorphic hornfels and introduced Cu-Au mineralization in the form of a disseminated bornite-chalcopyrite ore with minor gold (as in Munna Mine in the north of the area).

Smart, P.G. (B.Sc. Hons) (1970) University of Queensland

The petrology of the summit region of the Mount Warning central complex of northeastern N.S.W. 123 pp., 37 figures, 21 tables, 13 plates, 4 maps.

The rocks of the summit region of the Mount Warning central complex include a variety of gabbros (some of which are layered), porphyritic trachyandesites, and numerous saturated alkaline and peralkaline rocks. The latter comprise syenites, trachytes, comendites, and rare leucorhyolites. These saturated peralkaline rocks contain aegirine/aegirine-augite, arfvedsonite, and aenigmatite, commonly together with fayalite and quartz. X-ray methods indicate that microcline microperthites form the dominant feldspar in the syenites, and the trachytes contains sanidine phenocrysts and sanidine-anorthoclase cryptoperthite in the groundmass. In the trachyandesites alkali mafic minerals are absent and the major mafic constituent is augite to ferroaugite. The gabbros consist essentially of plagioclase (labradorite to calcic andesine), augite, olivine, uralite, magnetite, and ilmenite in varying modal proportions, with biotite and apatite as major accessories.

Geochemical data (31 whole rock analyses) indicate that many of the rocks forming the complex are products of a strongly differentiated, saturated alkali basalt magma. Low Sr abundances in the trachytes and comendites indicate that feldspar fractionation has played a major role in the differentiation of these Mount Warning rocks. The early gabbros investigated by Paterson (1970), however, show evidence of tholeiitic parentage and the change to alkali magma appears to be completely transitional.

Crystallization trends based on five analysed pyroxenes (and several optically determined) indicate intitial Fe enrichment in the intermediate rocks followed by a strong trend toward Na enrichment.

K-Ar dates indicate that the extrusives of the shield are lower Miocene in age (24 to 22 m.y.) and that the complex was intruded synchronously with the effusive types or may slightly post-date them. The proposed sequence of intrusion (based on field relationships and/or geochemical evidence) for the major rock units of the complex is:- early tholeiitic gabbros - transitional to alkaline laminated gabbros - monzonite and trachyandesite - central syenite - multistage ring dykes - trachyte and comendite dykes - leucorhyolite dykes.

The Mount Warning central complex is interpreted as a high-level pluton, intruded along a reopened N-S fault(?) between the Palaeozoic basement and Mesozoic sediments of the Clarence - Moreton Basin.

Following cessation of eruption of the shield volcano, the emplacement of the central trachyandesite plug sealed the vent. Subsequent cauldron subsidence of the central portion of the volcano produced a caldera and the ring dykes.

Woodford, P.J. (B.Sc. Hons) (1970) University of Queensland

The geology of an area east of Mount Samson, southeastern Queensland. 202 pp., 68 figures, 21 tables, 26 plates, 5 maps.

At Mount Samson, southeast Queensland, a scapolite - garnet - brown hornblende - plagioclase - diopside hornfels was produced by the contact metamorphism of an original spilite member of the Neranleigh-Fernvale Group. The banding of the brown hornblende was produced by metasomatism and subsequent growth along parallel shear planes in the spilite. Extensive Ca metasomatism has occurred.

The scapolite is a metasomatic vein-filling of composition $Ma_{59}Me_{41}$. The often associated garnet is andradite-rich. The colour of the brown hornblende is attributed to high titanium and ferric-iron content.

Biotite was developed in the greywacke horizons by the granodiorite intrusion. Biotite composition is a function of proximity to the intrusion.

Geochemical and mineralogical evidence suggests small-scale potassium - rubidium metasomatism into the greywacke away from the contact.

The Triassic epizonal intrusion is characterized by the initial injection of a gabbro-diorite suite as satellitic stocks, followed by abundant granodiorite and finally granite, graphic pegmatite, and aplite. Analyses of the major oxides plus Rb, Sr, Zr, and Cu from the igneous members demonstrate that they belong to a calc-alkaline suite.

An extensive range of compositions is shown by CaO - $K_2O$ - $Na_2O$ and MgO - FeO - Alkali plots. Chemical trends are similar to those outlined for calc-alkaline suites in western North America.

The chemistry, mineralogy, structural features, and regional geological setting are compatible with a parent magma of approximate andesitic composition. The strong zoning of plagioclase, the successive appearance of several mafic mineral phases in most rocks, the sequence of emplacement, and the chemical trends of the intrusive suite suggest the

operation of fractional crystallization. Partial or complete assimilation of unknown quantities of cognate mafic rocks is considered to have been a modifying process.

The granite composition, plotted in an Ab-Or-Q-$H_2O$ system, suggests that it was derived from the parental andesitic magma. Both assimilation and differentiation appear to have occurred at deeper levels than are now exposed.

Feros, J.M. (B.App. Sc. Hons) (1970) University of Queensland

The nature and genesis of the ore deposits of S.E. Mole Tableland. 54 pp., 22 plates, 14 figures, 2 maps.

The Mole granite, which is part of the New England Batholith is part of a high level pluton, passively emplaced in Permian mudstones of the Boorock Group.

The granite suffered deformation controlled by the bedding anisotropy of the surrounding mudstones. Orogenic Compression from the east, in closing the Permian trough produced a primary shear zone trending N.E.-S.W. parallel to the direction of weakness. This shear zone localizes the numerous tin and wolfram lodes in the area. A subsequent tensional release episode produced an orthogonal N.W.-S.E. fracture set which is barren of mineralization.

In the next phase of deformation the bedding anisotropy continued to control deformation. Shortening along an N.W.-S.E. axis (at right angles to the direction of weakness) produced a very acute angled conjugate shear set.

The orthogonal joint sets are not considered to be conjugate shears resulting from orogenic compression.

The tin and wolfram lodes are zoned, wolfram lodes being within 300 yards of the contact while tin lodes are consistently farther into the granite but within 1 mile of the contact.

The intensity of N.W.-S.W. fractures is greater in mineralized areas. The average joint spacing is 1 joint/5 ft in mineralized areas, compared with 1 joint/25 ft in unmineralized areas.

The cassiterite lodes are mesothermal. This is indicated by the abundance of chlorite as a gangue, the conspicuous lack of fluorite and boron minerals, the unique cassiterite-adularia paragenesis, the cassiterite-zeolite assemblage in some lodes, and the definite structural control by the N.E.-S.W. shear zone.

Texturally the cassiterite and adularia appear simultaneously at the expense of quartz. At low temperatures, as shown experimentally by H.G. Smith, alkaline potassium stannate solutions react with quartz and kaolinite to produce adularia and cassiterite.

Regional prospecting in the area should be on a twofold structural and geochemical basis. The structural requirements are passively intruded granites with associated vein dilation preferably into low pressure zones viz. lineament intersections and fold salients. The geochemical requirement is that the biotite of granite samples contains more than 50 ppm tin.

Detailed prospecting should consider cusps in the original granite surface and associated cuspate control of tin lodes. Criteria for cusp location should involve a recognition of the typical geometry of a cuspate controlled lode system.

Use of fluid inclusions to locate regions of anomalous cooling, and detection of flow layering to find original humps in the granite surface, is viewed as impracticable for cusp location, although technically the best methods.

Furness, C.P. (B.App. Sc. Hons) (1970) University of Queensland

Electrical prospecting for highly resistive ore at the Neardie Antimony Mine, Gympie. 91 pp., 29 figures, 4 plates, 5 maps.

A surface potential trenching technique, suitable for rapid horizontal investigations in the search for vertical, highly resistive zones, has been developed. In this method, the problem of potential electrode contact resistances has been overcome by the use of a high impedance voltmeter in the measurement of potential drops.

The use of alternating current in the technique has great operational advantages, but interpretation is hampered by the lack of current penetration information for finite electrode separations.

The theoretical behaviour of the apparent resistivity obtained by this method over vertical, resistive, dyke-like features has been derived from first principles, and evaluated using the University of Queensland PDP 10 computer. Results are presented in graphical form.

This surface potential method was tested in prospecting for near vertical, resistive shoots of stibnite-quartz mineralization at the Neardie Antimony Mine, Gympie. Results of the survey seem most encouraging and warrant the considerable expense of testing electrical indications at depth by diamond-drilling.

Krosch, N.J. (B.App. Sc. Hons) (1970) University of Queensland

A geological study of the Gold Creek area. 79 pp., 13 figures, 1 table, 16 plates, 3 maps.

An area of 6 square miles was mapped. Within this area the major lithological units are Enoggera Granite, Bunya Phyllite, and Neranleigh - Fernvale Group.

The Enoggera Granite is a composite intrusion consisting of granodiorite intruded by adamellite. Both phases of intrusion show wide variations in texture, from porphyritic to equigranular varieties. Dykes, sills, and plugs of acid igneous material in the surrounding area are related to the Enoggera intrusion.

The Bunya Phyllite consists dominantly of micaceous phyllites which are products of regional metamorphism of pelitic sediments. Foliation is well developed, but original bedding planes are often obvious. These phyllites have been contact metamorphosed to a low grade by the Enoggera pluton. Pneumatolytic fluids have penetrated these hornfelses forming quartz-tourmaline-albite rocks.

Intrusion of the Enoggera Granite was mainly mechanical - especially for the granodiorite. The adamellite was probably intruded by a process of block stoping. Breccia zones within the hornfels formed by collapse of overlying material following subsidence of a block at depth. A theory of potassium metasomatism may be used to explain the nature of the intrusion.

The Neranleigh - Fernvale Group is a heterogeneous assemblage of greywackes, shales, siltstones, bedded cherts, and basic volcanics. Some of the siltstones are phosphatic, containing segregations of a greenish

aluminium phosphate mineral. One manganiferous chert horizon is also known. Minor gold mineralization occurs in quartz lodes in the vicinity of the Kenmore Fault.

The major structural feature of the area is the folding on the Indooroopilly Anticline. The compression which produced the folding gave rise to conjugate shears and transverse tension joints. These structures controlled the later intruded dykes.

## UNIVERSITY OF NEW ENGLAND

Jackson, J.H. (Ph.D.) (1969) University of New England

Middle Devonian conodonts of the Timor Limestone, New South Wales. Vol. 1:- 460 pp., 14 text-figures; Vol. 2:- 65 pp., (3 supporting papers), 68 plates, 12 tables.

The successions of conodont faunas are described from two almost complete Middle Devonian sections within the Timor Limestone. A number of eastern Australian Middle Devonian limestones are correlated on the basis of the Timor Sequences. Relationships to overseas sections are also discussed.

Supporting Papers:

1. Lower Devonian subspecies of the conodont Polygnathus Linguiformis Hinde from southeastern Australia (G.M. Philip and J.H. Jackson).
2. Extract from: Lower Devonian biostratigraphy in the Wee Jasper region of New South Wales (A.E.H. Pedder, J.H. Jackson and G.M. Philip).
3. The sequence of Lower and Middle Devonian Conodont Faunas in eastern Australia (G.M. Philip and J.H. Jackson).

Fisher, D. (B.Sc. Hons) (1969) University of New England

A structural study of the Warnes River district. 109 pp., 39 figures, 1 map, 1 table.

The project area is approximately 50 miles SSE of Armidale, approximately 30 miles ESE of Walcha, and covers roughly 30 square miles. The area has been deformed at least four and possibly five times. These deformation periods can be summarized as follows. First deformation: resulted in a planar foliation $S_1$; no evidence on the style of the folds, or on the kinematics and dynamics. Second deformation: macroscopic folding of $S_1$ into broad but closed folds; the kinematic $\underline{a}$ axis or movement direction of these folds plunges 65-70° south with the principal stress direction approximately subhorizontal and east-west. Third deformation: mesoscopic folding of the planar limbs of the $F_2$-folds; the mechanism appears to have been buckling followed by flattening normal to the axial surface; the kinematic $\underline{a}$ axis plunges to the north or northeast with the principal stress oriented north-south. Fourth deformation: macroscopic folding which has rotated $S_3$ into closed angular folds. Analysis of mesoscopic fabric elements suggests that one structural domain within the area has been reoriented relative to the rest after the fourth deformation.

Hawke, J.M. (B.Sc. Hons) (1969) University of New England

The geology of a Carboniferous sequence west of Bingara. 40 figures, 91 pp., 6 tables, 3 maps.

The 35 sq mile area studied is about 20 miles west of Bingara, N.S.W. (Sheet 8 - Bangheet - Geological Map of New England, 1:100,000 Series). A sequence passing from pelagic Visean Namoi Formation mudstones, through a near-shore transitional zone, to extensive terrestrial sediments was mapped, and the sedimentary petrology, provenance, sedimentation, and stratigraphy of the area studied in detail. The base of the Caroda Formation is taken at the lowest marine fluviatile sandstone. The area of littoral and neritic sedimentation has been mapped as the 'Upper Facies' member of the Namoi Formation. Extensive faulting occurs in the upper Namoi Formation. Structural relationships in the centre of the area have been reinterpreted. The Ladysmith Anticline is blanketed by Pallal Conglomerate and the structure is now thought to be equivalent with the Killara Anticline. The Ladysmith Fault does not exist.

Hughes, D.C. (B.Sc. Hons) (1969) University of New England

Nickeliferous laterite deposits at Wingelinna, Central Australia. 68 pp. , 5 maps, 8 plates - general form, igneous and metamorphic petrography, economic, laterites.

Nickeliferous laterites formed by intense chemical weathering of olivine- and pyroxene-rich ultrabasic rocks. The 'ochreous' laterites overlie relatively fresh peridotites and pyroxenites. Peridotites are believed to have been emplaced as 'pods' and 'lenses' following the partial consolidation of an earlier intrusive phase. Where the bedrock is a serpentinite or serpentinous clay it is overlain by a nickel-poor 'jasperoidal' type laterite, largely made up of iron oxide and microcrystalline or chalcedonic silica. Nickeliferous hydrosilicates of magnesium are rather scarce in the Wingelinna deposit, but where present are believed to have been formed during a later supergene enrichment phase consequent on gradual uplift and erosion of the lateritic overburden.

Jenkins, T.L. (B.Sc. Hons) (1969) University of New England

The Carboniferous sedimentary sequence in the Caroda district, Upper Horton, N.S.W. 163 pp., 49 figures, 5 plates, 2 maps.

The area investigated covers 25 square miles of the northeastern section of the Horton map sheet No. 290, and part of the southeastern section of the Bangheet map sheet No. 280 (Geological Map of New England, 1:100,000). Sedimentation, stratigraphy, and sedimentary petrography are examined in detail. Secondary aspects of the study include vulcanism, structural geology, and palaeontology. The Carboniferous sequence in the area consists of an essentially conformable succession of lithic sandstones, conglomerates and tuffs. The older Carboniferous units contain marine limestones, shales and paralic iron sand deposits, calcareous oolith-rich sandstones and pebbly sandstones; the younger rocks are predominantly terrestrial conglomerates and sandstones containing an increasingly acidic volcanic contribution as the sequence becomes younger. Many units contain abundant reworked juvenile pyroclastic debris and abundant opaque minerals. Burial metamorphism, mainly producing a laumonite-chlorite assemblage with minor clinoptilolite, affects the entire 6,000+ feet succession. Age relations established for this sequence in other parts of the New England Geosyncline are confirmed by palaeontological studies of fauna and flora at Caroda.

Mason, D.R. (B.Sc. Hons) (1969) University of New England

Part I - The geology of the Kyogle district, northeastern New South Wales. Part II - The Glenugie Peak intrusion, near Grafton, N.S.W. 123 pp., 3 maps, 13 plates, 11 figures, 20 tables; - sediments, igneous petrography, mineralogy, petrogenesis.

Part I describes the geology of the Kyogle district, N.S.W., which lies on the southwestern flanks of the Tweed Shield Volcano. The volcanic sequence is subdivided into four units, in which two distinct lineages are recognized: a mildly undersaturated sodic alkaline series, and a moderately saturated potassic tholeiitic series. These are described and discussed in terms of petrographic, mineralogical, and partial chemical data. Separate sources are proposed for the two lineages. The alkaline lavas were erupted first from a source possibly in the Woodenbong district to the northwest of Kyogle. The tholeiitic lavas were erupted somewhat later from the Mount Warning Central Complex to the northeast of Kyogle. Petrogenetic interelationships between the two volcanic series are discussed.

Part II: The undersaturated rocks of Glenugie Peak, near Grafton N.S.W., are discussed in terms of field relationships, petrography, and partial chemical data. Their derivation by partial melting of initially volatile-rich mantle peridotite at depths of 35-70 km is proposed.

McClung, G. (B.Sc. Hons) (1969) University of New England

Biostratigraphy and general geology of an area east of Mudgee, N.S.W. 71 pp., 17 plates, 2 maps, 7 figures.

The area investigated, approximately twelve square miles east of the town of Mudgee in the Central West of New South Wales, contains sediments of Emsian to Famennian age outcropping on the limbs of the Pine Ridge Syncline. The Mount Frome and Mount Knowles limestones outcrop at the base of the sequence. Samples from these two limestones were processed with the aim of recovering, describing, and obtaining an age from conodonts by comparison with other Australian and European conodont assemblages, thus ascertaining the age relationships of the Mount Frome and Mount Knowles limestones to other Eastern Australian formations. A lithostratigraphic map of the area is presented with particular emphasis on the limestones and areas adjacent to them.

Gunthorpe, R.J. (Ph.D.) (1970) University of New England

Plutonic and metamorphic rocks of the Walcha-Nowendoc-Yarrowitch district, northern New South Wales. 405 pp., 22 plates, 30 figures, 3 maps.

The Walcha-Nowendoc-Yarrowitch district lies within the Central Complex of northeastern New South Wales. Palaeozoic strata here are extensively faulted, deformed, and metamorphosed; however, two major lithological subdivisions have been recognized. The name Tia Complex is

proposed for that part containing regionally metamorphosed rocks showing evidence of widespread multiple deformation and recrystallization, into which the foliated Tia Granodiorite has been emplaced. Three further subdivisions have been recognized within this major structural unit, which is separated from less strongly deformed rocks by zones of major faulting. Two contrasting styles of regional metamorphism are present within the area mapped. The relationship between the fabric of the metamorphic minerals and the successive structural elements establishes at least six episodes of metamorphism within the Tia Complex. Low-pressure regional metamorphism culminating with emplacement of the Tia Granodiorite was followed by localized high-pressure alteration associated with the Nowendoc serpentinite intrusion. Mineralogical and geochemical data are presented for regionally metamorphosed basic and semipelitic rocks and for the Tia Granodiorite and Nowendoc Serpentinites. The Tia Granodiorite belongs to the Hillgrove Plutonic Suite, and has caused potassium enrichment in its envelope rocks. Unaltered ultramafics are present in the Nowendoc intrusion, where field and petrographic evidence favour volume expansion during serpentinization. A Permian age is suggested for regional metamorphism and igneous activity in this region.

Khan, I.A. (Ph.D ) (1970) University of New England

The nature of the bands and its genetic significance in some banded sulphide ores. 2 vols, 343 pp., 248 figures, 4 plates, 21 tables.

The investigation is designed as an attempt towards the resolution of the problem of ore genesis of the banded sulphide orebodies. For a generalized approach three banded sulphide deposits - Captains Flat, N.S.W., Rosebery, Tas., and Mount Isa, Qld - are selected.

On the basis of the information collected on field associations, textural interpretations, mineralogical relationships, and anealing and grain boundary migration in sphalerite in the three banded sulphide ore deposits, it is concluded that a plutonic hydrothermal replacement theory of ore genesis does not satisfactorily account for the features observed in these ore deposits. The banded nature of these orebodies, their close association with particular sedimentary formations, the absence of high temperature effects in the enclosing sediments, combined with the inferences drawn from the studies of mineral associations, indicate a strong possibility that these orebodies may be sedimentary in origin.

It is concluded that the banded sulphide ore deposits were formed as a resu't of sulphide deposition in near-shore basins with reducing environ-

ments; the deposition being contemporaneous with the formation of ore bearing sediments. The source of base metals and sulphur was the volcanic exhalations of the area at the time of ore deposition. After the cessation of the depositional phase, the areas were subjected to deformation and metamorphism. The present features of the ores were developed as the result of metamorphism and represent simultaneous growth in the solid environments accompanying metamorphism.

Hall, R.L. (M.Sc.) (1970) University of New England

Ordovician and Silurian coral faunas from northeastern New South Wales. 144 pp., 25 plates, 52 text-figures.

Two isolated fault blocks of Ordovician sediments occurring within the Peel Fault system near Tamworth represent the oldest strata known in the northern part of New South Wales. A new formation name, the Uralba Beds, is proposed for rocks forming one block (of Eastonian age) exposed northeast of Attunga. The coral fauna from this unit is compaered with that from the Trelawney Beds and with Fauna III in the sequence proposed by Webby (1969) for the Ordovician limestones in central western New South Wales. The appearance of several halysitids suggests that the Uralba Beds fauna may be slightly younger than Fauna III of Webby. The second block, southeast of Tamworth, comprising the Trelawney Beds of Philip (1966), has yielded conodont species which also indicate an Eastonian age. East of the Peel Fault System to the northeast of Attunga, the 'Woolomin Beds' contain numerous limestone lenses. Two of these have yielded a fauna consisting almost entirely of tabulate corals, particularly halysitids. Comparable faunas are known in the Rosyth and Quarry Creek Limestone Members of the Silurian Panuara Formation from the Central and Southern Tablelands of New South Wales. Graptolites from associated strata of the latter, more complete, sequences indicate that both the Attunga limestone lenses are middle Llandovery in age.

Ransley, J.E. (M.Sc.) (1970) University of New England

The petrology of the New England Batholith in the Yarrowyck-Balala-Uralla area, northeastern New South Wales. 447 pp., 68 figures, 3 tables, 3 maps.

Some 70 percent of the area studied (240 square miles lying west and northwest of Uralla) is underlain by granitic rocks belonging to the New England Batholith. Pre-batholithic rocks include greywackes, acid and basic

volcanics, and small hypabyssal-plutonic intrusions, probably of mid- to upper Palaeozoic age. Their contact metamorphism is briefly described. A total of fourteen major plutonic intrusions, four of batholithic dimensions, are recognized and an intrusive sequence is established from field relationships. A remarkable dyke swarm, indicating 15 percent crustal stretching, cuts certain earlier plutons. The calc-alkaline affinities of both the plutons and the dyke swarm are established by abundant mineralogical and petrographic data, supported by four new chemical analyses. Arrested crystallization phenomena evident in the dykes suggest a two-stage evolution, involving fractional crystallization from hornblende gabbro to tonalite followed by hybridism with granite magma to produce more acid variants. A similar scheme of petrogenesis is proposed for the plutons. Water contents exerted an important control on magmatic differentiation.

Chisholm, J M. (B.Sc. Hons) (1970) University of New England

Geology of Livingstone's Prospect, NW Queensland. 140 pp., 2 maps, 32 figures.

The lithology of the Westmoreland area is part of an extensive volcanic-arenite sequence that constitutes the Carpentarian System of Australia. The Westmoreland Conglomerate which overlies the volcanic unit used to define the base of the Carpentarian, consists of conglomerates and sandstones that are intruded in places by tholeiitic dykes.

Statistical analysis of cross-bedding in association with the other sedimentary features indicates an alluvial fan environment of deposition. Evolution of the area is attributed to erosion of a tectonic ridge with sedimentation in two flanking basins.

Mineralization (primary) is due to hydrothermal solutions that have travelled along fractures to be deposited within the dyke. Secondary mineralization occurs adjacent to the dyke as the result of supergene processes. The major uranium occurrences at Colorado Plateau, Blind River, Jacobina, and Witwatersrand are reviewed and compared with the vein occurrence at Livingstone's Prospect.

Hutchison, D.S. (B.Sc. Hons) (1970) University of New England

Molybdenite Pipes at Bolivia, Northern New England. 85 pp., 4 tables, 23 figures, 2 maps.

Molybdenite-bismuth pipes at Bolivia occur within the Mount Jonblee Leuco-Adamellite which is an epizonal pluton forming part of the New England Batholith. This is a subsequent batholith formed during the latter stages of the Hunter Orogeny and, at Bolivia, is intruded into a sequence of almost flat-lying interbedded tuffs and lavas. These volcanic rocks range in composition from rhyolite to andesite.

The pipe deposits are confined to the western margin of the Mount Jonblee Mass and all are very similar in composition and structure. Molybdenite shows a marked association with massive smoky quartz and commonly contains inclusions of bismuthinite and native bismuth along cleavage traces. Native bismuth tends to form a separate ore type (usually associated with granitic lode material) with minor bismuthinite, ikunolite and molybdenite.

Both phyllic and argillic facies of hydrothermal alteration are developed, but there is no spatial zonal relationship commonly developed in other hydrothermal ore deposits. Sericitization and silicification are very characteristic of the Bolivia ores.

The Bolivia deposits are very similar to other molybdenite deposits in eastern Australia which constitute a distinct molybdenum epoch and province. The Bolivia ores also resemble porphyry copper-molybdenum deposits in some respects, but there are some major differences between the two ore types.

It is proposed that the Bolivia ores were deposited from hydrothermal fluids which separated (at shallow levels in the earth's crust) from a rising calc-alkaline magma which was formed by partial melting of Palaeozoic geosynclinal sediments.

The ores have been classified as moderate temperature deposits of the xenothermal or gaseous igneous enanation types as defined by Ridge (1958).

Price, I (B.Sc. Hons) (1970) University of New England

The setting of an Alpine-type Serpentinite intrusion near Woodsreef, N.S W. 157 pp., 1 map, 19 diagrams, 27 plates.

The area studied occupied 40 square miles (110 sq km) near Woodsreef 340 miles (544 km) northwest of Sydney. An intrusion of serpentinite, one of several along the Peel Fault, separates tightly folded Silurian greenstones and jaspers (the Woolomin Beds) from an isoclinally folded, marine, Upper

Carboniferous sequence and Lower Permian arenite (named the Crow Mountain Creek Beds and the Ironbark Creek Arenite respectively). Horizontal tertiary conglomerates overlie parts of the area. The palaeogeographic setting of the sediments, especially the Upper Palaeozoic rocks, and structural relationships are examined with regard to the nature of the Peel Fault. The ultramafic intrusion is related to its place in the geological history of the area and its situation on the Peel Fault.

Evidence of a tectonic high to the east developing in the Upper Carboniferous is presented. In Lower to Middle Permian times the Peel Fault developed, probably as a major thrust fault, and serpentinite was emplaced along it essentially as a cold body. Subsidiary faulting provided an environment for the development of chrysotile asbestos.

Stroud, W.J. (B.Sc. Hons) (1970) University of New England

A detailed structural and petrological examination of a small south-western portion of the Willyama Complex, Broken Hill, N.S.W. 124 pp., 35 figures, 71 plates, 2 maps.

The area investigated is situated 37 miles southwest of Broken Hill, New South Wales. The area has been subjected to both high grade regional and retrograde metamorphism. The original sediments have also suffered at least two periods of folding.

The aim of the project is to obtain a detailed petrological and structural picture of this high-grade portion of the Willyama Complex. From this it is thought that the problems of granulite/amphibolite facies transition, and retrograde metamorphism are more accurately outlined. An attempt is also made to correlate degree of retrogression with structure.

Yeates, A.N. (B.Sc. Hons) (1970) University of New England

The Gravesend sequence. 156 pp., 1 map, 51 text-figures, 2 tables.

A folded and faulted Upper Devonian and Carboniferous volcanic derived sequence in the Gravesend district, New South Wales, is described in detail. The lower part of the sequence consists of near-shore shallow-water marine deposits which pass up into terrestrial coastal plain and piedmont deposits. Vulcanism accompanied sedimentation. The volcanics show a trend from andesitic flows in the older strata to more acid pyroclastics towards the top of the sequence. An important disconformity

has been established and a new major fault, the Yagobie Fault, has been recognized. The name 'Glencoe Anticline' is proposed for a large, gently plunging fold in the southeast of the area. A burial metamorphic prehnite-bearing assemblage overlaps with a zeolite facies assemblage at the base of the sequence.

## UNIVERSITY OF NEWCASTLE

Kristensen, S.E. (B.Sc. Hons) (1969) University of Newcastle

The geology of the Carrow Brook - Lostock district, N.S.W.
77 pp., 3 maps, 3 diagrams, 2 tables, 10 plates.

The region mapped is situated between the Paterson River at Lostock Dam, north of Gresford, and the settlement on Carrow Brook, a tributary of Glennies Creek. The area covers approximately 95 sq km and can be reached by road from Gresford, or northeastwards from the New England Highway at Branxton or Singleton via the Mirannie and Carrow Brook roads. The sequence exposed is Carboniferous in age and comprises a lower, marine unit of olive green mudstones, lithic sandstones, and siltstones (Burindi Facies) conformably overlain by terrestrial lithic sandstones, conglomerates, and mudstones, interbedded with several ignimbritic horizons (Kuttung Facies). Structurally the eastern region from Lostock to Mirannie contains flat-lying beds broken only by northeast trending faults. West of Mirannie the dip increases sharply and the beds thereafter are strongly folded and faulted into numerous structures.

The area adjoins the mapping of White (1969), which was to the immediate south.

Parkinson, B.A. (B.Sc. Hons) (1969) University of Newcastle

The geology of the Rouchel Basin, N.S.W. 120 pp., 4 maps, 8 diagrams, 6 tables, 22 plates.

The region mapped is situated east of the New England Highway between Muswellbrook and Aberdeen, 135 km north of Newcastle. The area covers about 130 sq km, being bound on the north by Rouchel Brook and extending south to McCulley's Gap and Kangaroo Mountain. The major structure is the Rouchel Basin, which contains a Carboniferous sequence of marine mudstones, limestones, and arenites (Burindi Facies), overlain by terrestrial arenites, conglomerates, tuffaceous sediments, and numerous

ignimbritic units (Kuttung Facies). This latter sequence contains a fossiliferous marine intercalation which bears an abundant brachiopod, coral fauna. Movements associated with the Hunter-Bowen orogeny have produced marginal faulting. The thesis describes the distribution and nature of all lithologies and gives further detailed study of the volcanic portion of the sequence.

White, N.C. (B.Sc. Hons) (1969) University of Newcastle

The geology of the Mirannie - Mount Rivers district, N.S.W.
13 pp., 3 maps, 10 diagrams, 22 plates.

Mapping of an area of 50 sq km was carried out in the region from Mount Rivers, on the Paterson River near Gresford, westwards to the vicinity of St Clair on Carrow Brook, a tributary of Glennies Creek. The area is situated some 95 km by road from Newcastle and is accessible either from Gresford or northeastwards from the New England Highway at Branxton or Singleton. It contains a stratigraphic sequence of Carboniferous marine arenites, mudstones, and siltstones containing fossils (Burindi Facies) conformably overlain by terrestrial arenites, conglomerates and a few ignimbrites (Kuttung Facies). Structurally the region east of Mirannie comprises flat-lying beds broken only by northeast trending faults. West of Mirannie, the area becomes structurally complex with several large faults and numerous folded structures in beds which thereby have assumed much steeper dips. A detailed study of the nature and possible origin of the ignimbrites is included.

The area adjoins the mapping of Kristensen (1969) which was located to the immediate north.

Frater, K.M. (B.Sc. Hons) (1970) University of Newcastle

The geology of the Upper Rouchel Brook - Back Creek district, N.S.W.
234 pp., 5 maps, 34 figures, 7 tables, 36 plates.

Mapping of an area of 130 sq km was carried out in the Woolooma Gully - Back Creek area to the north of Rouchel Brook. The area is situated approximately 160 km by road from Newcastle and is accessible from the New England Highway at Aberdeen. It contains a stratigraphic sequence of Lower Carboniferous terrestrial and marine facies rocks. The lowermost unit is devoid of fossils and consists of siltstones, mudstones, and marine arenites f Burindi Facies character. This is conformably overlain by

terrestrial arenites, siltstones, and conglomerates in the west and by interbedded marine and terrestrial arenites and siltstones in the east. The overlying sequence of coarse terrestrial sediments and ash flow tuffs of the Kuttung Facies is interrupted by a wedge of marine siltstones and mudstones which increase in thickness to the east. The early encroachment and late withdrawal of these marine sediments in the east is illustrated. The stratigraphy has been correlated with the European stages on the basis of marine faunal assemblages with the assistance of Dr J. Roberts of the Bureau of Mineral Resources.

The area lies to the northeast of the Rouchel Basin and to the south of the Belltrees Structure (Osborne, 1950). The region is structurally complex owing to intense transcurrent faulting. The dominant structure is a syncline whose axis traces a curved trend through the western area. The eastern limb of this syncline is displaced by a series of high-angle faults and minor flexures. In the northeast the beds are folded into a further anticlinal and synclinal structure, which is also highly faulted.

A study of the nature and provenance of the arenites has been made. A detailed petrographic analysis of the ash flow tuffs was carried out and a reconstruction of their cooling history attempted.

The area adjoins the Upper Rouchel Brook - Davis Creek district to the south, which was mapped concurrently by Sippe (1970).

Kisi, J. (B.Sc. Hons) (1970) University of Newcastle

The geology of the Stroud - Stroud Road district, N.S.W. 121 pp., 2 maps, 33 figures, 43 plates.

The area mapped is meridionally elongated about Stroud and Stroud Road and covers approximately 41 square miles. The stratigraphic sequence is conformable and the lower units consist of Upper Carboniferous arenites, lutites, and conglomerates. Overlying these is a thick section consisting of basaltic and rhyolitic flows, pyroclastics, and locally derived clastics, which is reclassified to a Lower Permian age on fossil evidence. This is in turn overlain by Permian coal measure strata. A number of minor basic and felsic intrusive bodies were delineated. The main structural features are the axial portion of the Stroud - Gloucester Trough and the Tarean Fault. The presence of a number of subordinate fold systems and faults was detected and their relationship to the main deformational episode is discussed.

Sippe, P.C. (B.Sc. Hons) (1970) University of Newcastle

The geology of the Rouchel Brook - Davis Creek district, N.S.W. 161 pp., 3 maps, 9 figures, 16 plates.

The region mapped is situated east of the New England Highway between Muswellbrook and Aberdeen, 160 km by road northwest from Newcastle.

The area covers about 130 sq km, being bounded in the north by Rouchel Brook, and extending south to Stoney Creek and Hartlett's Creek. It occurs in the southwest portion of the Woolooma 1:63,360 military sheet.

The Lower Carboniferous strata mapped consist of a marine sequence of lutites, arenites, and minor limestones ('Burindi' facies) overlain by terrestrial lithic arenites, rudites, and ignimbrites ('Kuttung' facies).

This latter unit interfingers extensively with a fossiliferous marine unit which lenses out to the west and thickens to the east ('Burindi', ? Myall facies).

Fauna characteristic of the Delepinea aspinosa, Werriea Australis, ?Thomasaria voiseyi, Schellwienella cf. burlingtonensis, and Pustula gracilis faunal zones are present in the area.

The area has been subjected to the compressive and shearing forces of the Hunter - Bowen orogeny which has produced extensive folding and faultings.

## UNIVERSITY OF NEW SOUTH WALES

Foldvary, G.Z. (M.Sc.) (1969) University of New South Wales

Stratigraphy and Palaeontology of the Bogan Gate - Trundle district, N.S.W. 285 pp., 11 maps, 24 plates.

Area studied comprises about 300 sq miles, Bogan Gate being situated at the southeast corner D. Sediments are of Silurian and Devonian age. A disconformity of middle Devonian age correlates with the Tabberaberran Diastrophism. Two facies, one Rhenish and the other Hercynian, are described. Emphasis is mainly on palaeontological studies with detailed descriptions of fossils.

Goldbery, R. (M.Sc.) (1969) University of New South Wales

Stratigraphy and Sedimentation of the Triassic units of the N.W. Sydney Basin. 116 pp., 7 maps, 33 diagrams.

The area studied includes the 1:50,000 military base sheets Glen Davis, Glen Alice, Olinda, Coricudgy, and Mellong.

Detailed stratigraphical and sedimentation studies are made of the Narrabeen Group overlying Lower Palaeozoic and Permian rocks found mainly in the west of the area. Detailed comparisons are made with the succession west of the Lockinvar Anticline, Hunter Valley. The northern and northwestern limits of the overlying Hawkesbury Sandstone have been extended by detailed mapping.

Jongsma, D. (M.Sc.) (1969) University of New South Wales

Marine geology and sedimentation of Milne Bay, New Guinea. 79 pp., 1 map, 30 diagrams, 6 plates.

Milne Bay is a graben structure between the Owen Stanley fault lineament and Pocklington shear zone. Bottom sediments, of Quaternary age, are fine-grained and poorly sorted, terrigenous in the west, and becoming more organic eastwards. The sediments reflect their derivation from basic and ultrabasic rock types. The gross structure and bottom sediments were delineated by sparker traverses. Calcimetry of sediments is given.

Cooper, P.F. (B.Sc. Hons) (1969) University of New South Wales

The geology of the Alberta Creek area, Northern Barrier Ranges, N.S.W. 193 pp., 1 map, 30 figures, 50 plates.

The area studied (approximately 50 square miles) lies 45 miles north of Broken Hill. The Willyama Complex reaches granulite facies in places and has been affected by three periods of deformation, whilst the younger unconformable Torrowangee is affected by two. New relationships between the Willyama and Torrowangee are suggested.

Cowan, B.M. (B.Sc. Hons) (1969) University of New South Wales

The geology of the Corona area, Northern Barrier Range, N.S.W. 264 pp., 3 maps, 110 plates, 40 figures.

The area studied (about 40 sq miles) lies 50 miles north of Broken Hill. The rocks consist mainly of the Willyama Complex and the Torrowangee of Proterozoic age. The Willyama is represented by folded metasediments and minor intrusive bodies, the metamorphic grade increasing to the west. The Torrowangee overlies the Willyama unconformably and consists of shallow-water sediments now folded and with the development of a strong axial plane cleavage. Tentative correlations are drawn with the Adelaide System in South Australia.

Gilligan, L.B. (B Sc. Hons) (1969) University of New South Wales

Geology of the Morphett's Creek area, Barrier Ranges, N.S.W. 183 pp., 1 map, 49 plates, 25 figures.

The area of approximately 50 square miles lies 50 miles north of Broken Hill and is bounded by an east-west line through Corona Station in the south, and on the north by McDougall's Well fence. The Willyama rocks show evidence of four periods of metamorphism and three periods of deformation. The Euriowie Inlier is a fault-controlled basement high influencing the deposition of the Torrowangee Group. A correlation of metamorphic events is made with rocks at Broken Hill and the Adelaide Geosyncline.

Kopsen, E. (B Sc. Hons) (1969) University of New South Wales

The geology of the lower Wingecarribee River area, N.S.W. 101 pp., 31 plates, 12 diagrams, 3 maps.

The area studied (47 sq miles) lies 70 miles south of Sydney in the western margin of the Illawarra district. Rocks of Ordovician and Silurian age are intruded by the Marulan Batholith and Bindook Porphyry of presumed Upper Devonian age. Evidence for Kanimblan volcanics is presented. Sediments of Permian age show marginal nature of sedimentation on the western edge of the Sydney Basin and consist of members of the Shoalhaven Group and Illawarra Coal Measures.

Marshall, J. (B.Sc. Hons) (1969) University of New South Wales

The geology of the Upper Turon River, an area between Capertee and Palmer's Oakey. 81 pp., 1 map, 10 diagrams, 21 plates.

Stratigraphy, Petrology, Structure, Palaeontology.

The area (45 miles) studied lies between Capertee and Sofala. Ordovician and Silurian sediments are in flysch facies whilst the Upper Devonian and Permian represent molasse type sedimentation. Petrography of volcanics and greywackes is described. The succession is interpreted as mainly geosynclinal turbidites.

Meares, R.M.D. (B.Sc. Hons) (1969) University of New South Wales

The geology of the Bijerkerno area, Barrier Ranges N.S.W. 170 pp., 1 map, 51 plates, 24 figures.

The area (approx 60 sq miles) studied lies 54 miles north-northeast of Broken Hill. The Willyama Complex originally consisted of a sequence of fine-grained argillaceous and arenaceous sediments together with siliceous dolomite and basic tuffs. The rocks were then subjected to low-pressure regional metamorphism and intruded by tin-bearing and garnet pegmatites. The Bijerkerno Beds are shown to be conformable and it is possible they may be correlated with the Willywangee metasediments occurring to the west of the Euriowie Inlier.

Roberts, B. (B.Sc. Hons) (1969) University of New South Wales

The geology of the Campbell's Creek area, Northern Barrier Ranges N.S.W. 231 pp., 1 map, 73 plates, 55 figures.

The area investigated (approx 56 square miles) lies 35 miles north of Broken Hill, Poolamacca Station being at the centre of the area. The oldest rocks of the Willyama Complex form the Poolamacca Inlier, exhibiting metamorphism of the amphibolite facies. The 'Willywangee' metasediments are correlated with the Bijerkerno beds. The overlying and unconformable Torrowangee Beds show evidence of marine glaciation and control of sedimentation by basement movement.

Roots, W.D. (B.Sc. Hons) (1969) University of New South Wales

The geology of the area around Bindook, N S.W. 122 pp., maps and figures.

The area studied (36 square miles) is 40 miles south-southeast of Oberon and consists of geosynclinal sediments of upper Ordovician to Devonian age, intruded by the Bindook Porphyry, and overlain by Permian sediments of the Sydney Basin. The study confirms Packham's (1969) account of the evolution of the Lachlan geosyncline.

Tonkin, P.C. (B.Sc. Hons) (1969) University of New South Wales

Beryl pegmatites of the Egebek area, Barrier Ranges, N.S.W. 176 pp., numerous illustrations and plates, 5 maps.

A study of an area 25 miles southwest of Broken Hill. The zoning of the pegmatites, their detailed geochemistry, their relation to the country rocks and their orientation with respect to the regional structure, form the main topics of the investigation. Speculations on the origin of the pegmatites, metasomatic processes, and the chronology of the pegmatites.

Woodhouse, J. (B.Sc. Hons) (1969) University of New South Wales

The geology of the MacDougall's Well area, Barrier Ranges, N.S.W. 120 pp., 1 map, 57 plates, 15 figures.

The area investigated (approx 60 sq miles) lies 60 miles north of Broken Hill and includes the northern plunging nose of the Euriowie Inlier. The Willyama rocks forming the core of the Euriowie Inlier consists for the most part of schist, quartzite, and pegmatite, and provide the framework on which the younger Torrowangee sediments were deposited by onlap. These sediments were deposited in shallow to moderate marine conditions with evidence of glacial activity and dolomite formation. An appendix deals with possible Adelaide System correlations.

Boyd, G.L. (B.Sc. Appl. G.) (1969) University of New South Wales

A comparative study of three proposed damsites, Central Western N.S W. 128 pp., 9 maps, 14 plates, diagrams.

The thesis is an engineering geological study of three damsites on the Belubula River, a tributary of the Lachlan. The two Cranky Rock sites would benefit 30 miles of river valley whilst the benefit for the third site at the Needles amounts to 37 miles. The investigation besides local geology includes studies of slope stability, weathering, engineering materials, and soil analysis. Cranky Rock No. 1 site is recommended.

Foo, F.M.R. (B.Sc. Appl. G.) (1969) University of New South Wales

The geology of an area southeast of Nerriga. 60 pp., 1 map, plates, and 15 figures.

The area (approx 84 sq miles) lies just south of the township of Nerriga, about 30 miles southwest of Nowra. Isoclinally folded Upper Ordovician sediments are overlain by Upper Devonian and are in turn overlain unconformably by members of the Shoalhaven Group (Permian).

Johnson, K.R. (B.Sc. Appl. G.) (1969) University of New South Wales

A study of a small sill near Stanwell Park. 130 pp., 2 maps, plates and figures. Petrography.

The study is of a small analcite basanite sill intruding flat-lying Narrabeen Group sediments of Triassic age. Ultrabasic and basic inclusions together with sedimentary xenoliths constitute a prominent fraction of the volume of the sill and form part of the petrological investigation. Relationships with neighbouring intrusions have also been studied.

Luxford, B.M. (B.Sc. Appl. G.) (1969) University of New South Wales

The geology of the Nerriga district. 111 pp., 1 map, 50 plates, 18 diagrams.

The area studied (approx 60 miles) lies at the northern end of Budawang Ranges, approx 140 miles southwest of Sydney.

An earlier phase of sedimentation consisting mostly of subgreywacke and shale was strongly folded in late Ordovician. Sediments of Upper Devonian age are mainly deltaic and there is some indication of a late expression of the Tabberabberan Orogeny. The Yadbora Conglomerate and the Clyde Coal Measures represent Permian sedimentation on the edge of the Sydney Basin.

MacNevin, A.A. (B.Sc. Appl. G.) (1969) University of New South Wales

The geology of the Baryulgil area with special reference to the Gordon Brook serpentine belt. 141 pp., 3 maps, plates and diagrams.

The area embraces both banks of the Clarence River between Tabulam and Grafton. The principal object is a petrological study of rocks associated with the serpentinite belt. Antimony and asbestos mineralization occurs. The genetic and age relationships of the serpentinite belt are investigated and a late Permian age is suggested.

Matson, C.R. (B.Sc. Appl. G.) (1969) University of New South Wales

The geology of the Danjera Creek Dam, Yalwal N.S.W. 70 pp., 4 maps and sections. Plates and figures.

The dam is situated 20 miles west-southwest of Nowra, in a valley consisting of highly folded Ordovician metasediments, and gently folded sediments and volcanics of both Middle and Upper Devonian age. The site lies on the highly faulted west limb of an asymmetric anticline within the Upper Devonian. Faulting, fracturing, and hydrothermal activity have created problems of stability and foundation strength.

McLennan, D.C. (B.Sc. Appl. G.) (1969) University of New South Wales

Gravity survey across the Stroud-Gloucester Syncline with a brief account of the geology of the Mograni Creek - Gangat area. 50 pp., 3 maps, 9 plates, and 3 diagrams.

The object of the gravity survey was to determine the depth and shape of the Permian coal measures, overlying Carboniferous sediments and volcanics in the Stroud-Gloucester Syncline. In addition an area 6 miles square to the southeast of Gloucester was mapped in detail. It consists mainly of folded Carboniferous sediments and volcanics affected by strike faulting.

Pooley, G.D. (B.Sc. Appl. G.) (1969) University of New South Wales

A study of several shoshonitic bodies in the South Coast region. 166 pp., 4 maps, numerous plates and diagrams, chemical analyses.

A petrological and geochemical study of shoshonite bodies in the Milton - Mount Durras region is made. This area lies approximately 140 miles south of Sydney. The main aim of the study is a detailed picture of the extent, structure, physiography, petrological relationships of the shoshonites and their genetic relationship to continental development.

## UNIVERSITY OF SYDNEY

Slater, R.A. (Ph.D.) (1969) University of Sydney

Marine geology of the Banks Strait-Furneaux Islands area, Tasmania. 269 pp., 10 tables, 2 plates, 99 figures, 5 appendices.

The area studied measures some 5,000 sq miles and lies in the southeastern part of Bass Strait, approximately between lat. 40° and 41°S, and long. 147°30' and 148°30'E. It is bordered by the 20-fathom depth contour on the west and the continental slope on the east; the Furneaux Group of Islands forms the northern boundary. The geological setting is a cold, shallow water area of thin carbonate deposition, bordered by Recent terrigenous detritus, in a very high energy environment caused by swift tidal currents which sweep through the many narrow straits between islands. Although the tidal stream reverses itself in the Straits, the net flow of sediment is to the east. The objective of the study was to define the regional distribution patterns of the Banks Strait sedimentary facies and to examine the hydrological, geological and biological factors influencing them. The effects of earlier tectonism and eustatism on the geomorphological and lithological histories of the sediments was also assessed.

Cas, R.A.F. (B.Sc. Hons) (1969) University of Sydney

Geology of the Razorback Road area, east of Sofala, N.S.W 131 pp., 9 maps, 11 diagrams, 116 plates.

The area studied encompasses 25 square miles east of Sofala, 110 miles northwest of Sydney. It lies on the eastern flank of the Hill End Trough. Folded and faulted Sofala Volcanics of Ordovician age, intruded by andesitic plugs and dykes and by rhyolitic dykes, are thrust over Lambie Group (Upper Devonian) rocks, which outcrop to the east of the Razorback Fault.

The thesis discusses the Sofala Volcanics in detail. The previously undifferentiated succession is divided according to dominant rock types (essentially volcanic sandstones, and siltstones with black cherts and volcanic breccias), all probably deposited in a marine environment. Detailed petrographic variation of the sequence is discussed. The relation between the largest andesitic intrusion (a ?vent) and the volcanic succession is also considered in detail: they are believed to be penecontemporaneous. Geophysical methods were used to trace faults and minor mineralization (antimony-gold) in the Razorback Mine area, where outcrop is poor.

Valley and terrace formation in the Turon River and tributaries were studied and a history of landform development extending back to Permian is postulated.

Crawford, Elizabeth A. (B.Sc. Hons) (1969) University of Sydney

Geology of the Limekilns area, northeast of Bathurst, N.S.W. 127 pp., 1 map numerous illustrations.

The area lies 17 miles northeast of Bathurst. It covers approximately 1 square miles, including parts of the parishes of Jesse, Wiagdon, and Winburn in the County of Roxborough. The succession comprises, in ascending stratigraphic order, the Merrions Tuff, the Limekilns Group, and the Winburn Tuff. These are of probable Lower-Middle Devonian age. Subdivisions of the Limekilns Group are mapped, including the recognition of three stratigraphically distinct shale units and two intervening limestones. A description of the detailed sequence and petrography of the limestones is presented. Also, a general petrographic account of the Merrions Tuff and Winburn Tuff is given. It is suggested that the Winburn Tuff is possibly separated by an unconformity from the underlying Limekilns Group. In the central part of the area a series of N-S trending basic-intermediate dykes are reported in the shales of the Limekilns Group. Reference is also made to the alluvial deposits, drainage patterns, and weathering in the area. The palaeontological section includes descriptions of heliolitid and favositid corals from the limestones and the trilobite Phacops from the shales.

Ellis, A.H. (B.Sc. Hons) (1969) University of Sydney

The geology and geophysics of the Lewis Ponds - Mount Bulga district N.S.W. 151 pp., 7 maps, 2 plans, 25 figures, 88 plates.

The district studied (about 20 sq miles in area) is located approximately 160 miles west of Sydney (Orange 1:63,000 sheet; Mount Bulga Trig. co-ordinates 152880). Ordovician andesites and a sequence of Silurian volcanics and volcanically-derived sediments have been folded about axes plunging shallowly north. Major and minor faulting has taken place and regional metamorphism has reached biotite grade. A small granodiorite stock has been intruded in the vicinity of Lewis Ponds and ultrabasic rocks have been intruded along major fault zones. Mineralization is of two distinct types. The Lewis Ponds and Mount Bulga Prospect basemetal orebodies are located within fine-grained rocks at the top of an acid volcanic pile and are volcanic exhalative in origin. Copper mineralization at Mount Bulga and Bobs Mount is structurally controlled and derived from metamorphism of an andesitic volcanic sequence. Emphasis is placed on evaluating and discussing all aspects of the mineralization; where appropriate, various geophysical methods have been applied.

Hill, Heather I. (B.Sc. Hons) (1969) University of Sydney

Geology of the Cudgegong district. 142 pp., 3 maps, 31 diagrams, 151 plates.

The area studied is situated 233 km northwest of Sydney, adjacent to the Mudgee-Lithgow road. The area, approximately 44 sq km, lies between grid lines 276 and 285E and 936 and 948S. The stratigraphic succession consists of a sequence of Ordovician andesitic volcanics, Silurian acid and intermediate volcanics and limestones, Middle to Upper Silurian orthoquartzites, shales and limestones, Lower Devonian orthoquartzites, shales, limestones and volcanic sandstones, and (?)Upper Devonian dolomites, shales and sandstones. This sequence is intruded by the Aaron's Pass granite and unconformably overlain by Permian conglomerates. The thesis discusses the distribution and nature of the major rock types, low-grade regional and contact metamorphism, the fauna of the Silurian, Middle-Upper Silurian and Lower Devonian successions,the vertebrate palaeontology of fauna from caves in Lower Devonian rocks and aspects of copper mineralization.

Johnson, D.E. (B.Sc. Hons) (1969) University of Sydney

The recent geology of the Batemans Bay area, N.S.W. 168 pp., 3 maps, 61 plates, 29 figures, 13 tables.

The Recent geology of the Batemans Bay area is discussed with emphasis on the sediments in the Bay. Some attention is given to the land geology, as a source for the sediments; the structural geology of the area is also briefly described. The sediments, dominantly sands, were analysed in a settling tube and their distribution studied in terms of the modes present. Many of the modes can be correlated with differential components of the sediment. The zonations of flora and fauna, the sediment types and the processes of sedimentation across a tidal flat complex are summarized. The distribution of both living and dead populations of foraminifera are examined and consideration is given to the natural facies of foraminifera and their controls. The important molluscs, their distributions and controls, are also considered. Some generalizations are made on the facies developed in the area.

Laing, W.P. (B.Sc. Hons) (1969) University of Sydney

The geology of the Brewery Well area, northern Barrier Ranges, N.S.W. 135 pp., 2 appendices, 1 map, 1 block diagram, 23 figures, 125 plates.

The 10 sq mile area studied is centred on Brewery Well, 27 miles north of Broken Hill (444096, Broken Hill Sheet SH 54.14) and is best reached via station tracks from Poolamacca Homestead, 5 miles north-east of Brewery Well. The geology consists of Willyama Complex, Mundi Mundi granite, and Torrowangee Group. The Willyama grades from north-west to southeast through a bedded sequence of fine-grained phyllitic and cherty metasediments ('Willywangee') to coarser retrogressed polymetamorphic schists containing prominent muscovite. In many parts original sedimentary structures have survived three penetrative deformations. The relationship of the Brewery Well granite, of Mundi Mundi type, to Willyama metamorphism and Torrowangee sedimentation is discussed. The Torrowangee Group, separated from the Willyama by a closely mappable and strongly deformed angular unconformity, consists of glacigene conglomerates, sandstones, and siltstones with minor dolomites and has been tightly folded, well cleaved, and slightly metamorphosed. No evidences of a pre-glacigene sequence were found. The sediments are of locally derived origin and two recurring bed associations are recognized. The possible environment is discussed. The relationship of Torrowangee folding to Willyama deformation is not clearly established.

Price, G.P. (B.Sc. Hons) (1969) University of Sydney

Geology of the Cartwright's Creek area, northern Barrier Ranges, N.S.W. 146 pp., 2 maps, 136 figures.

The Cartwright's Creek area is situated in the northern Barrier Ranges of western New South Wales and occupies 6 square miles covering a portion of the unconformity between the Willyama Complex and the overlying Torrowangee Group (Broken Hill 1:250,000; grid ref. 095437). The Willyama Complex consists of a series of pelitic, calc-silicate, and amphibolite schists which have been regionally metamorphosed under conditions of the amphibolite facies. They are complexly folded by three periods of deformation with the earliest phase being almost completely destroyed. The Torrowangee Group overlies the Willyama Complex with marked unconformity and consists of a series of coarse and fine-grained sediments containing evidence of glacial activity. The units are folded on a regional scale by a large syncline and locally by a second deformation related to movement on the unconformity surface. The thesis outlines the distribution and nature of all the rocks with detailed studies of the structure and metamorphism of the Willyama schists and the amount of strain exhibited by deformed conglomerates in the Torrowangee Group.

Williamson, P.E. (B.Sc. Hons) (1969) University of Sydney

A geophysical study of part of the Murray Basin, N.S.W. 108 pp., 7 maps, 45 figures.

The 15 square mile area studied lies 20 miles northeast of Deniliquin, near Conargo, on the Deniliquin 1:250,000 sheet - grid ref: 314645. Regional geological, hydrogeological, and geophysical data are reviewed with reference to the determination of hydrogeological basement of the region. At Conargo detailed surface resistivity, well logging, and seismic refraction data were obtained and interpreted in qualitative and quantitative fashion to yield depths to hydrogeological basement.

Facer, R.A. (Ph.D.) (1970) University of Sydney

Magnetic properties of the Giles Complex, Central Australia. 154 and viii pp., 3 maps, 8 diagrams, 8 plates.

The Giles Complex is a series of distinct coarse-grained layered mafic and ultramafic intrusions 1100 m.y. old. 63 sampling sites in nine intrusions were distributed over 8000 sq km.

NRM directions in the 540 specimens were widely scattered. The magnetic susceptibility ellipsoid was, on the average, triaxial, and hence anisotropy effects on magnetization direction were ignored. Simple computer programmes written specifically for this investigation assisted in analysis of results.

The partial AF demagnetization results correlate strongly with other stability tests such as the Koenigsberger ratio. The stable magnetization (apparently a TRM) gave a mean, non-random direction of magnetization which diverges from the present geomagnetic field by 121°. These results established that the Giles Complex was in its present position at the time of acquisition of its TRM. No evidence of overall reheating of the Complex was found. The magnetic properties tended to correlate with the state of exsolution and oxidation of the iron-titanium oxides. Assuming the stable TRM direction corresponded to that of a dipolar field, the position of the Earth's North Magnetic Pole 1100 m.y. BP, relative to Australia, was Latitude 68°N, Longitude 343°E (semi-axes of the Ellipse of 95% confidence: 23° and 29°).

Goodwin, R.H. (Ph.D.) (1970) University of Sydney

Hydrodynamics and sedimentation in Botany Bay, New South Wales. 240 pp., 78 figures, 7 tables, 7 appendices.

Botany Bay is an estuary in which construction activities of man over the past 20 years have upset the natural stability of the area, changing patterns of current activity, sedimentation, and erosion.

Study of the hydrology of the bay by means of salinity and temperature readings indicates a variable situation highlighting the problem of classification of an estuary based upon salinity variations. Values obtained in the study area are controlled by a number of factors which vary greatly from season to season and, on a lesser scale, from day to day.

Bottom sediments are predominantly sand; sediment type and distribution is a function of current and wave activity as only minimal amounts of sediments are entering the estuary at present. Sediment parameters vary little, areally, and in profile, caused by the unconsolidated sediments having the same provenance.

Fluorescent tracer studies reveal two separate systems of sediment movement, anticlockwise onshore and clockwise offshore, with a partial interchange between the two systems. Sediment transport outside of the surf zone is minimal.

The Quaternary history of the bay suggests that the area has been twice transgressed by sea level rises, one at 30,000 years B.P., and the other at 10,000 years B.P. Age dating of peats indicates the lower portion of the unconsolidated sequence predates 32,000 years B.P.

Helby, R.J. (Ph.D.) (1970) University of Sydney

A biostratigraphy of the late Permian and Triassic of the Sydney Basin. 43 plates, 12 figures, 8 tables.

The stratigraphic framework of Late Permian-Triassic sequences in the Sydney Basin is outlined, with a brief summary of available biostratigraphic information. The vertical distribution of microfossils from 252 samples, arranged in 14 sample sequences, is illustrated. Taxonomic treatment of 74 genera comprising 119 species of spores and pollen is undertaken and 19 species of microplankton briefly described. Nineteen species and three genera are proposed as new taxa. Five assemblage zones

are delineated: (i) the Falcisporites zone (extending from Upper Narrabeen Group through Hawkesbury Sandstone to the top of Wianamatta Group); (ii) the Protohaploxypinus samoilovichii zone and (iii) the Lunatisporites pellucidus zone (exhibiting essentially homotaxial microfloras and occupying the central portion of the Narrabeen Group succession); (iv) the Protohaploxypinus reticulatus zone (occurring in the lower part of the Narrabeen Group); and (v) the Dulhuntyispora zone (occupying the coal measures sequences below the base of the Narrabeen Group). The microfloral sequence of the Sydney Basin compares closely with other Gondwana occurrences (particularly Western Pakistan and Madagascar). Individual assemblages are examined in terms of equivalent microfloras from a number of phytogeographic provinces. Environmental synthesis suggests that the base of the Narrabeen Group coincides with a substantial erosional hiatus, depositional environment of sediments above the hiatus being interpreted as brackish or shallow marine. An erosional hiatus is also indicated between the top of the Narrabeen Group and the Hawkesbury Sandstone. Contemporaneous deposition of Hawkesbury Sandstone and Ashfield Shale is discussed. Similarity of the microfloras of these formations, and their mutually adjacent depositional areas, support the concept of a tidal delta-barrier bar origin for the Hawkesbury Sandstone.

Stone, C.G. (M.Sc.) (1970) University of Sydney

Geology of the Ardlethan Tin Mine area. 104 pp., 19 maps, 7 diagrams, 38 plates, 12 tables.

The area studied is situated 350 miles west-southwest of Sydney, approximately midway between Temora and Griffith. It occupies about 120 square miles, bounded by lat. 34°15'00" and 34°22'30", and long. 146°45'00" and 147°00'00". A tightly folded succession of Upper Ordovician schists, slates, and quartzites represents the oldest outcropping sequence. These are intruded by the Ardlethan Granite, which is a (?)Silurian batholith of porphyritic muscovite-biotite granite. Both are unconformably overlain by Devonian sandstones, shales and conglomerates which are members of the Cocoparra Group, characterized by the basal Barrat Conglomerate. Extensive areas are blanketed by Quaternary alluvials. The Ardlethan Tin Mines are situated within an eastern protuberance of the main granite belt. Geological factors relating to the presence of mineralization have been investigated, including the intrusion of porphyries, brecciation, fracturing, jointing, and wall-rock alteration. An outline of the mineralogy and chemical composition of individual deposits is provided, together with a brief account of exploration techniques.

Webster, S.S. (M.Sc.) (1970) University of Sydney

Interpretation of geophysical logs in water bores in unconsolidated sediments. 212 pp., 5 plates, numerous graphs, diagrams, etc.

The research studies presented in this thesis constitute Phase I of a two-phase project sponsored by the Australian Water Resources Council. They include an appraisal of well-logging practices currently in use for groundwater investigations in Australia; a study of the standardization of gamma-ray logging, especially data presentation and equipment calibration; evaluation of the geophysical well-logging method in its application to unconsolidated sediments; and an interpretation of selected well logs to estimate the possibility of producing a practical quantitative analysis procedure. A digital approach to data acquisition, storage, and interpretation is discussed, together with the description of an inexpensive but efficient magnetic tape-recording system. Aquifer water salinity-resistivity relationships are analysed in their relevance to Australian groundwater conditions. An equation is proposed that may enable salinity to be accurately estimated from water resistivity measurements. An important aquifer parameter - formation factor - is discussed in its theoretical and applied significance to well log interpretation in unconsolidated sediments. Examples are given to illustrate the possibility of quantitative analysis of data obtained in the geophysical logging of unconsolidated sediments.

Keaney, P.A. (B.Sc. Hons) (1970) University of Sydney

Geology of the Yerranderie area, N.S.W. 133 pp., 3 maps, 27 diagrams, 117 plates.

The area studied lies 80 miles southwest of Sydney to the west of the upper levels of stored water in Warragamba Dam. It occupies about 70 square miles, located centrally about the Tonalli River. A slightly deformed Lower-Mid Devonian succession of acid volcanics (the Bindook Porphyry) represents the oldest outcropping unit and this unconformably underlies the Lambian Upper Devonian sequence (marine). This in turn underlies the Permian and Triassic sediments of the western Sydney Basin. The thesis outlines stratigraphic relationships with environmental interpretations of the marine Permian, the fluviatile Illawarra Coal Measures and the Triassic Narrabeen Group. The relation of the Upper Devonian to sediments to the west near Murruin Creek and Taralga is demonstrated and their petrology is considered in minor detail. The extrusive and pyroclastic origin of the Bindook Porphyry was proved and an attempt was

made to re-evaluate the ore genesis of the Yerranderie silver-lead lode. The wall-rock alteration was studied in relation to composition of acid wall-rock material. Structural geology and palaeontology are dealt with in minor detail.

Keene, J.B. (B.Sc. Hons) (1970) University of Sydney

A study of the sedimentary environment of the Lower Hastings River, N.S.W. 177 pp., 10 maps, 6 figures, 9 diagrams, 18 tables, 140 plates.

Geomorphology, bathymetry, and sediment defines abandoned river channels. Organically cemented sediments (Recent-Pleistocene) contain up to 6% carbon. Cross-bedded, burrowed, lagoonal and gravel deposits are cemented by a humic substance precipitated from a solution or colloidal suspension. Permeability controls the distribution of the cement. Incipient jointing is probably due to shrinkage and compaction.

Sediment analysis, including heavy minerals, defines the Maria and Hastings River sediments. Sediment source is barrier system, Port Macquarie Complex, hinterland, biogenic, organically cemented sediments, and offshore. Anisotropic garnet, from an outcrop in the Hastings catchment, can be traced in river sediment. Selectively sorted heavy minerals occur in the lagoon.

Tides are the most important process in the estuary and there is, at present, a net inward movement of sediment.

Sedimentary structures, particularly burrows, define environments. Organisms are important in mud deposition; mats of faecal trails occur on high tidal flats. Sponge spicules and authigenic pyrite characterize lagoon sediment.

Filled burrows, rectilinear cracks, and ripple mark moulds are preserved in relict mud on exposed sand flats and affect permeability and porosity.

Forty-five species of foraminifera are identified, including planktonic species carried into the estuary.

Thomson, Jennifer (B.Sc. Hons) (1970) University of Sydney

Geology of the Pine Mountain region, northeast of Tumut, N.S W. 211 pp., 8 maps, 36 diagrams, 88 plates.

The area studied is 270 miles south of Sydney; it is dissected by the main road which links Tumut to Gundagai. The small towan of Brungle lies on the northern boundary of the area and the southern boundary is about 8 miles north of Tumut. The oldest sequence exposed in the area is pre-Mid Silurian, a succession of deformed deep-water sediments, folded about a southeast-trending axis. This succession is unconformably overlain by the Blowering Group (Mid Silurian). The Blowering Group has been subdivided into three formations - the Wyangle Formation (volcanic sandstones and siltstones) the Honeysuckle Formation (dacites, tuffaceous sediments and volcanic sediments) and the Bauld Hill Basic Formation (basalt flows, lithic and volcanic sandstones). These rocks are intruded by the Killimicat Adamellite, a small lens-shaped granitic stock. This is a massive, leucocratic granite body which contains microgranite, granite porphyry, aplitic, and greisen phases as well as coarse-grained granite. Alkali granite, granite, and adamellite occur in the body; the alkali-rich phases are restricted to the border zones and the more calcic phase occurs in the core. It is believed that this zonation has been caused by assimilation. The adamellite body has subsequently undergone mesothermal alteration.

Vandyke, Ann (B.Sc. Hons) (1970) University of Sydney

Geology and palaeontology of the Mumbil-Dripstone area, N.S.W.
617 pp., 3 maps, 35 diagrams & tables, 480 plate figures.

Ordovician to Recent strata are divided into fifteen formations. Their synonymy, correlation, petrography and fossils are treated. The pre-Tertiary rock types described include micrites, lump-and-pellet calcarenites, "reefal" limestones; spilites, andesites, trachytes, rhyolites; ignimbrites, crystal tuffs, various biotite-rich tuffs, and chalazoidites. Tertiary rocks comprise basalt and quartzose sediments. Vertical structural zones are recognized within the basalt and two former courses of the Bell River are outlined.

Several thousand fossil species probably occur within the area. Of these, 120 are presently illustrated, many being described in detail. Distribution data are given for all species identified. The following Palaeozoic genera are the most important in the area, up to seven species being described in some: Solenopora, cf. Lithoporella, Girvanella, Verticillopora, Renalcis, Litanaia; Diplostroma, Clathrodictyon, Schistodictyon, Ecclimadictyon, Syringostroma, Trupetostroma, Anostylostroma, Stratodictyon, Actinostroma, Densastroma, Amphipora; Heliolites, Propora, Coccoseris, Halysites, Parastriatopora, Favosites, Squameofavosites,

Pachyfavosites, Multisolenia, Desmidopora, Egosiella, Coenites, Bainbridgia, Syringopora; Entellophyllum, Palaeophyllum, Phaulactis, Mucophyllum, Pycnostylus, Holmophyllum, Nipponophyllum, Rhizophyllum, Tryplasma, Plasmophyllum; Conchidium; Palderosus, Hindeodella, Trichonodella, Ozarkodina, Spathognathodus; Retiograptus, Dictyonema, Dicranograptus, Orthograptus, Amplexograptus, Climacograptus, Monograptus, Chondrites.

Four new genera are also proposed.

## UNIVERSITY OF MELBOURNE

Battersby, D.G. (M.Sc.) (1969) University of Melbourne

Petroleum geochemistry of the Lower Cretaceous sediments in the Eromanga Basin. 235 pp., 31 figures.

Geochemical study of 21 core samples from the Rolling Downs Group in the central and southwestern parts of the Eromanga Basin, Australia. Cores from 3 boreholes (Innamincka No. 1, Canaway No. 1 and Longreach, B.M.R. Scouthole No. 1) were analysed for organic composition, trace element (B, Ga) concentration, and clay mineral composition.

Hydrocarbon distributions could be related to type of organic matter originally deposited in the sediment. Boron and gallium concentrations were effective in separating marine and paralic from non-marine sediments. The clay mineral assemblage indicated a detrital origin for the sediments, probably from weathering of volcanic material.

Changes in CPI value and isoprenoid ratios and percentages with depth of burial were attributed mostly to changes in the relative amounts of the various types of organic source materials. The slight changes attributed to the effects of diagenesis were consistent with low temperature/ shallow burial history of the sediments.

It was established that the geochemical parameters studied in this project provide for accurate correlation between sediments deposited in the same environments in different parts of the sedimentary basin.

Moors, H.T. (Ph. D.) (1970) University of Melbourne

Graptolites and black shale in the Ordovician turbidites of Victoria. 289 pp., 29 figures, tables.

Graptolites in the Ordovician black shales of Victoria are large enough and of such shapes as to indicate preferred orientation in deposition, when this cannot be determined from the fine lithic components of the shales themselves. Analysis of the distributions of the graptolite content of these shales indicated currents throughout emplacement of the whole sequence.

On various points of evidence, these were considered to be turbidity currents: such currents may alternate with stagnant conditions suggested by the carbon content of the shales; vertical distribution of the graptolites indicated a waning depositing current; parallelism of current direction was shown for both black shales and associated true turbidites.

Considered then as faunal associations of turbidites, various aspects of the graptolite assemblage are noted. It is suggested that, since different graptolite forms possess different hydrodynamic resistance, independent field associations of different forms does not necessarily confirm mutually exclusive ranges. Scarcity or abundance of forms could be due to elimination during transport, or to mechanical separation, rather than initial density.

The fact that turbidite sediments are exotic to their final position of rest implies that the graptolites are also exotic to the postulated environment, and ecology and evolutionary trends of graptolites are discussed in this perspective.

Eadie, E.N. (M.Sc.) (1970) University of Melbourne

Application of the magnetic method in the geophysical exploration of the Savage River and Long Plains iron deposits, NW Tasmania. 91 pp., 55 plates, 5 figures, 5 tables.

Results of ground magnetic surveys for iron at Savage River and Long Plains, N.W. Tasmania, using an ABEM M24 magnetometer indicate two continuous deposits of varying widths and about 4 miles and 2 miles long respectively.

The effects of topography and of the dip, strike, width, and susceptibility of a vein are demonstrated, indicating the necessity for analysis based on the complete magnetic profile over the anomaly rather than an ad hoc evaluation based on amplitude alone. Topographic profiles were measured using microbarometers.

Theoretical profiles for possible subsurface configurations are compared with observed anomalies and their correspondence with drilling results assessed. It is concluded that more accurate assessment of the subsurface orebodies can be achieved by more detailed investigation of magnetic profiles than is customarily made.

Additional factors affecting the form of the anomaly are multiple veins, and variation in width and grade with depth. Several methods of depth estimation, all assuming an infinitely long dipping vein, have been applied to observed magnetic profiles, and their reliability under different conditions noted. A summary of results is presented. For a multiple source anomaly, Peters' half maximum slope method is preferred.

## UNIVERSITY OF TASMANIA

Brooks, J.A. (Ph.D.) (1969) University of Tasmania

Rayleigh wave dispersion studies of crustal and upper mantle structure in New Guinea.

A study of Rayleigh wave dispersion from earthquakes within the New Guinea area has revealed two features of shear velocity distribution not examined previously.

Variations in depth to 300 km below the tectonically stable platform of southern New Guinea were determined from recordings of fundamental and higher mode Rayleigh waves. This average profile, for paths shorter than 2000 km, contains a low-velocity zone reaching 4.2 km/sec at depths of 120 to 160 km, which is overlain by a relatively thick cap of material with a velocity of 4.4 km/sec.

The lateral gross distribution of shear velocities beneath the crust emerged from examination of fundamental mode dispersion profiles. Many of the phase velocity profiles were resolved from single station data and techniques used to define the correct dispersion in such cases are discussed. Although interpretations of these are strictly limited in structurally heterogeneous regions such as New Guinea, phase velocities at periods near 40 seconds are controlled mainly by shear velocities in the uppermost 50 km of the mantle, in zones of greater homogeneity than the crust.

Known geophysical data, existing hypotheses of geotectonic development of the New Guinea region, the concept of sea floor spreading, and observed

characteristics of mineral assemblages under high temperatures and pressures, provide a framework within which these data are examined.

Upper mantle velocities are highest, about 4.7 km/sec, beneath the crust of the Solomon Sea, lowest beneath the shield structure of southern New Guinea, and appear to have intermediate values beneath the cordilleran region. These differences are large enough to indicate that regional variations exist in the mineralogy of the upper mantle.

The relatively low velocities underlying the southern New Guinea crust may also imply a higher heat flow than normally expected in the most ancient Precambrian shield regions of the world.

In general the results are not sufficiently detailed or comprehensive to test existing hypotheses of geotectonic development of this complex region and the study should rather be treated as a basic contribution to knowledge of the New Guinea area.

Davidson, J.K. (B.Sc. Hons) (1969) University of Tasmania

Upper Permian and Lower Triassic sedimentation and palynology of the La Perouse area.

In the La Perouse area rocks correlating in part with the Cygnet Coal Measures were deposited under deltaic conditions after a change in climate and provenance from deposition of the Ferntree Mudstone. Overlying these rocks is the La Perouse Formation, 250 m thick, deposited by distributary channel systems on subaerial fans. The minerals glauconite and chamosite indicate that parts of these fans were saline. The presence of eroded lateritic material and seasonal drying of some clay units implies that during deposition of the La Perouse Formation the climate was characterized by low seasonal rainfall and temperatures greater than 20°C.

'Palynological units' Trla, Trlb, Tr2a, Tr2b, and Tr3a of Evans (1966) in the Cygnet Coal Measures and La Perouse Formation are useful in correlating these rocks with other Australian basins containing Upper Permian and Lower Triassic strata. The upper units of the Cygnet Coal Measures and the lower 8 to 10 m of the La Perouse Formation are uppermost Permian. The overlying 20 m of the La Perouse Formation are probably lowermost Triassic as the next 65 m at least, containing vertebrate remains and red beds of primary origin, are Otoceratan. The siltstones at the top of the La Perouse Formation are upper Scythian to lower Anisian.

Both formations and the stratigraphically lower Ferntree Mudstone were intruded by a transgressive dolerite sheet rising from northeast to southwest and changing in trend from northwest-southeast to east-west. The area experienced at least one period of glaciation and periglaciation during the Pleistocene.

Large, R.R. (B.Sc. Hons) (1969) University of Tasmania

The Bold Head Adamellite contact aureole, King Island.

In southeastern King Island, sediments and lavas of probable Upper Proterozoic to Lower Cambrian age have been intruded by Lower Carboniferous granitic rocks.

The stratigraphic succession in the area, consists of a sandstone-siltstone unit, overlain by tilloids and dolomitic siltstones of the Grassy Group, which in turn are overlain by picritic and spilitic lavas. In the contact aureole of the Bold Head Adamellite north of Grassy the sediments and lavas have been metamorphosed to hornblende hornfels facies grade. In the hornfels, there is no mineral zoning over a distance of 700 feet from the adamellite, and thus the thermal gradient within the contact aureole must have been small.

Skarns occur both within the adamellite near its contact with the country rocks, and within the country rocks as partial replacements of three dolomitic limestone horizons. The endoskarns within the adamellite are the result of two-way diffusion across the contact; Ca, Al, and Fe diffused from sediment to adamellite as K, Na, and $H_2O$ diffused from adamellite to the sediments. The exoskarns replacing carbonate beds are the results of both diffusion and infiltration metasomatism which supplied Fe, Al, Si, $H_2O$, W, and minor sulphides as Ca and $CO_2$ were removed.

During metamorphism, small scale ionic diffusion across the contacts between pelitic and calcareous beds produced reaction zones which reflect the mobility of Ca.

From estimates of the lithostatic pressure and mole fraction of $CO_2$, the mineral assemblages of the hornfels imply that the temperature of metamorphism lay between 530 and 710°C. This temperature range is in good agreement with minimum temperatures, between 610° and 710°C, for recrystallization of the marbles of the contact aureole, calculated from determinations of the solid solution of the magnesite molecule in calcite.

Lee, T. (B.Sc. Hons) (1969) University of Tasmania

Crustal deformation. 108 pp.

From the assumptions: that the earth behaves elastically, that Poisson's ratio is 0.25 and that the earth has an effective rigidity of $6.3 \times 10^{11}$ dynes per square cm, the maximum calculated displacement induced in the earth's surface by the filling of Lake Gordon (a load of $1.5 \times 10^{10}$ tons) is about 7 cm.

The above assumptions allow computer programs to be written to calculate the stresses and the vertical component of displacement for any lake.

Rees, J.E. (B.Sc. Hons) (1969) University of Tasmania

Instrumentation for magnetotelluric investigations.

Instrumentation for magnetotelluric prospecting has been designed and developed. A brief review of the theoretical implications of the magnetotelluric method and an analysis of the consequences of application with respect to the characteristics of the source field and the distribution of conductivity within the crust has provided an estimate of the quality and quantity of data which must be recorded for satisfactory interpretation. Particular attention has been paid to the preservation of signal quality and amplifier stability throughout the system. The problem of magnetic detector calibration has been investigated and a method employing spectral analysis if proposed to enable determinations of both amplitude and phase response. The four channel system has a maximum magnetic field sensitivity of 0.02 gamma per sec per mm with a flat response from 1 to 100 seconds, while the maximum electric field sensitivity is 0.667 mmV per mm with a flat response from 1 second to d.c.

Sheehan, G.M. (B.Sc. Hons) (1969) University of Tasmania

The gravity field in the Sheffield area.

A regional gravity survey has delineated the major tectonic features in the Sheffield area, northwest Tasmania. The extended residual Bouguer anomalies are correlated with Precambrian geanticlines, Lower Palaeozoic troughs, a Cambrian basic volcanic arc, Cambrian high level intrusive granites, and Devonian plutonic granites.

The regional gravity gradient can be explained by a crust thinning from 45 kilometres under the Central Plateau to 34 kilometres under the northern coast.

The Dundas Trough, and a minor offshot the Dial Trough, are delineated by elongate negative anomalies. At Nook a long narrow negative anomaly is related to a buried Cambrian trough, similar to the Dial Trough. The gravity field indicates that the troughs are asymmetrical, with depths ranging from one to three kilometres, and theyat they are all interconnected.

A line of positive circular anomalies along the centre of the Dundas Trough is attributed to a narrow ridge of basic volcanic piles. This line of anomalies is a westerly extension of the arc of gravity highs which occur at the base of the Western Tiers between O'Connors Peak and Montane. The coincidence of high amplitude circular aeromagnetic anomalies with the centres of the circular gravity anomalies is possibly related to a change to an ultramafic lithology towards the centre of the basic volcanic pile. The structure of each pile is interpreted as ultramafics filling a sub-volcanic magma chamber which is surrounded by a cone of basic lavas.

The character of the anomalies over the Cambrian granites confirms the view that they are small high-level intrusives.

The Devonian Housetop and Dolcoath granites are probably laccolithic and batholithic structures respectively. Erosion has removed the roof of the Housetop granite and any possible mineralization which may have occurred. The pattern of mineralization in the Moina area is consistent with the batholithic structure proposed for the Dolcoath granite. Previous workers have ascribed the mineralization to a granite stock at Dolcoath Hill and a cupola at Stormont. However, the gravity field indicates that there is only one granite body, and that the skarn rocks from both mineral fields lie along its northern edge.

Bigg, A.J. (B.Sc. Hons) (1970) University of Tasmania

Permo-Triassic Stratigraphy, Sedimentation and Palaeontology of South Bruny Island.

On South Bruny Island, sediments correlating with the Grange Mudstone, Malbina Formation, and Ferntree Group of the Hobart area, are exposed, and these were deposited in shallow continental shelf environments, with control of deposition being influenced tectonically. The overlying

Adventure Bay Coal Measures were deposited in lower deltaic plain, interdistributary basin, and deltaic backswamp environments. The overlying Triassic sediments are considered to be typical of fluvial environments, especially flood-plain, and levee bank, containing red-beds, and clay-pellet conglomerates in essentially a thick-bedded sandstone sequence.

An age equivalent to the Ulladulla Fauna of New South Wales is given to the upper part of the Grange Mudstone on the island, which represents a younger age than is reported for the Grange Mudstone in the Hobart area.

The age of the Adventure Bay Coal Measures is determined from palynological evidence as being uppermost Permian, and correlation, on stratigraphic and palaeogeographic evidence, is made with the Cygnet Coal Measures and the Barnetts Member of the Springs Sandstone.

The area has been extensively faulted and intruded by Jurassic dolerite. Uplift and erosion of certain sediments has resulted in the development of distinct secondary jointing patterns.

Butters, J. Jeanne (B.Sc. Hons) (1970) University of Tasmania

The geology of the Apsley area. 84 pp., 3 maps.

The rocks exposed in the Apsley Square, 5077, are predominantly Permian and Triassic sediments, Jurassic dolerite intrusions, and Tertiary basalt flows, with a small amount of Quaternary river gravels and alluvium.

The western part of the area has been broken and blocks tilted by a series of north-trending Tertiary faults. Numerous basaltic volcanic necks, which produce strong dipole magnetic anomalies, occur in an associated graben trending northwest. One of these necks contains tuffaceous material and large blocks of country rock and shows a gross 'stratification'. This was probably formed by a fluidized system in which solid and liquid particles sank or rose according to their size and mass and small solid particles acted as abrading agents. Another of the necks shows unusually intense thermal contact metamorphism with extensive development of buchites.

The presence of three dolerite feeders is indicated by the gravity survey. The sheet emanating from one of these terminates at a Jurassic fault zone. Many complex dykes with various trends are associated with this. The trends of the dykes are distinct from those of the Tertiary faults.

The Jordan River follows the north-south Tertiary fault system and the amplitude of valley windings is fault-controlled. The river is a typical underfit stream and the production of a former larger system is attributed to Pleistocene periglacial climatic conditions.

Leaman, D.E. (B.Sc. Hons) (1970) University of Tasmania

Dolerite intrusion, Hobart district, Tasmania.

Jurassic dolerite intrusions of the Hobart district, Tasmania, have been examined geologically and gravimetrically in order to determine their form. The dolerite intrudes flat-lying shallow marine Permian and continental Triassic rocks. A major problem was the resolution of more recent faulting superimposed upon Jurassic structures.

The intrusions are the result of a limited series of injections (four or five). Each individual intrusion has an irregular flattened trumpet shape. Synchronous intrusions have interconnected to produce a cross-wave pattern in which each hollow represents the site of one or more massive feeders. The feeders are basically dykes up to a mile across, although some are pipe-like extensions or wedges from dykes, and most are related to pre-existing faults.

Sheets have been initiated above feeder wedges at a point where effective intrusion pressure (about $7 \times 10^5$ gm/cm$^2$) has exceeded the load pressure. Dislocation by fracturing was followed by hydrostatic intrusion. The actual form of the sheets, termed chonoliths, is determined at any place by any previous and concomitant fracturing. Fractures are controlled by rock heterogeneities, plastic confining beds, fluid content and distance from the feeder, or proximity of the free surface. Each sheet is about 1,000-1,500 feet thick.

Initial intrusions are normally placed low in the sedimentary column, while later intrusions generally found a higher level. Ultimately a lava plateau could be produced if the magma supply was adequate, although no evidence exists for this feature in Tasmania.

Extreme products of differentiation are to be found only in those parts of the intrusion adjacent to, or above, a feeder. There is no evidence of assimilation within the area.

Moore, J.F. (B.Sc. Hons) (1970) University of Tasmania

Data processing in shallow seismic refraction.

The interpretation of shallow seismic refraction surveys is generally based entirely on the time-distance curves. Provided that the information obtained in these curves is adequate to specify the layer structure and velocities, as well as the intercept time and the reciprocal time, a solution can be obtained by means of a computer programme.

Previously there has been little work done to apply computer processing to shallow refraction data. The input to programs such as that described by Woolley, Musgrave, & Gray (1967) is designed to use velocity information derived independently of the programme by velocity surveys in wells and from wide-angle reflection data.

The input to the programme presented in this thesis consists of the time-distance data together with an interpretation of the layer from which each arrival emanates. The output is the depth and velocity of each layer.

The method of calculating the position of the main refractor recorded is based on a wavefront technique, while the surface layers are calculated by a raypath method, which is sufficiently accurate for the purpose.

Tests of the programme on model data show that the results obtained are accurate. The programme is intended for operation on field data obtained with a standard 12 channel recording system.

## UNIVERSITY OF ADELAIDE

Note: Honours theses at the University of Adelaide are very short and form only a small part of candidates' requirements. Therefore, the University considers that publication of full abstracts is unnecessary and that titles are sufficiently informative.

Bampton, K.F. (B.Sc. Hons) (1969) University of Adelaide

A comparison of the upper and main lodes on the northern leases of North Broken Hill Limited, Broken Hill, N.S.W. 23 pp., 1 map, 5 diagrams, 18 plates, 6 appendices.

Bell, T.H. (B.Sc. Hons) (1969) University of Adelaide

The stages in development of slaty cleavage across the Nackara Arc of the Adelaide Geosyncline. 16 pp., 18 diagrams, 5 plates, 1 appendix.

Blight, D F. (B.Sc. Hons) (1969) University of Adelaide

The geology, petrology and geochemistry of an area south of Tollu, W.A. 19 pp., 4 maps, 3 diagrams, 12 plates, 2 appendices.

Bowden, P.R. (B.Sc. Hons) (1969) University of Adelaide

Geology of the Tollu area, Western Australia. 24 pp., 3 maps, 2 diagrams, 5 plates, 2 appendices.

Bridges, M. (B.Sc. Hons) (1969) University of Adelaide

Faults in 1100 Orebody Mount Isa Mines. 18 pp., 10 diagrams, 4 plates, 2 appendices.

Chenoweth, L.M. (B.Sc. Hons) (1969) University of Adelaide

The geochemistry and geology of the Lancefield Gold Mine, Laverton, Western Australia. 32 pp., 6 maps, 3 diagrams, 3 appendices.

Clifton, T.M. (B.Sc. Hons) (1969) University of Adelaide

The geochemical and mineralogical variations of the host rocks in relation to mineralization Chillagoe, Queensland. 26 pp., 2 maps, 4 diagrams, 4 plates, 3 appendices.

Crase, N.J. (B.Sc. Hons) (1969) University of Adelaide

An investigation of some of the younger basic and ultrabasic rocks to the west of Broken Hill, N.S.W. 24 pp., 9 diagrams, 4 plates, 3 appendices.

Frears, R.A. (B.Sc. Hons) (1969) University of Adelaide

Petrology of the gneisses and associated amphibolites from Sleaford-Fishery Bay, southern Eyre Peninsula. 23 pp., 5 maps, 2 diagrams, 16 plates, 1 appendix.

Harley, D N. (B.Sc. Hons) (1969) University of Adelaide

The mafic and ultramafic intrusives of the Fraser Range, Western Australia. 26 pp., 1 map, 4 diagrams, 14 plates, 8 appendices.

Haslett, P.G. (B.Sc. Hons) (1969) University of Adelaide

The Cambrian geology north of the Wirrealpa Diapir, Flinders Ranges, South Australia. 27 pp., 2 maps, 6 diagrams, 6 plates, 3 appendices.

Ivezich, M.M. (B.Sc. Hons) (1969) University of Adelaide

A geophysical investigation of the Mount Beevor Shear Zone and the Nairne Pyrite Member, South Australia. 28 pp., 5 maps, 7 diagrams, 1 appendix.

Larking, A.N. (B.Sc. Hons) (1969) University of Adelaide

Acid rocks and their relationship to the gold mineralization at Norseman, Western Australia. 29 pp., 2 maps, 8 diagrams, 5 plates, 4 appendices.

Mastins, H. (B.Sc. Hons) (1969) University of Adelaide

Some applications of X-ray mass absorption in mineral and rock analysis. 20 pp., 8 diagrams, 6 plates, 1 appendix.

Netzel, R.K. (B.Sc. Hons) (1969) University of Adelaide

Trace tin distribution in the Ardlethan Granite, N.S.W. 17 pp., 1 map, 4 diagrams, 3 appendices.

Pierce, P.R. (B.Sc. Hons) (1969) University of Adelaide

Cambrian geology south of the Wirrealpa Diapir, Flinders Ranges, South Australia. 24 pp., 3 maps, 1 diagram, 1 plate, 2 appendices.

Poole, L.E. (B.Sc. Hons) (1969) University of Adelaide

The structural geology of an area south of Kanmantoo, South Australia. 32 pp., 2 maps, 16 diagrams, 49 plates, 1 appendix.

Rees, B.V.L. (B.Sc. Hons) (1969) University of Adelaide

The geology of Panguna copper deposit Bougainville, Territory of Papua and New Guinea. 26 pp., 2 maps, 3 diagrams, 2 appendices.

Reid, R.B. (B.Sc. Hons) (1969) University of Adelaide

A survey of Australian barite. 26 pp., 2 maps, 12 diagrams, 4 plates, 7 appendices.

Rooney, P.W. (B.Sc. Hons) (1969) University of Adelaide

An examination of the distribution of minor elements between coexisting hornblendes and biotites from an area east of Springton, South Australia. 18 pp., 11 diagrams, 1 plate, 1 appendix.

Schmidt, B.L. (B.Sc. Hons) (1969) University of Adelaide

The mineralogy and chemistry of the Caralue, Mundrabilla and Witchelina Meteorites. 29 pp., 2 diagrams, 6 plates, 1 appendix.

Williams, R.E. (B.Sc. Hons) (1969) University of Adelaide

An environmental study of base metal sulphide mineralization Eulaminna, Western Australia. 26 pp., 2 maps, 4 diagrams, 23 plates, 4 appendices.

Briese, E.H. (B.Sc. Hons) (1970) University of Adelaide

The geology, petrology and geochemistry of a layered intrusion at Carr Boyd Rocks, W.A. 23 pp., 1 map, 6 tables, 10 plates, 3 appendices.

Cobb, M.A. and Morris, B.J. (B.Sc. Hons) (1970) University of Adelaide

The Weekeroo Amphibolite, Olary Province, South Australia. 54 pp., 2 maps, 20 diagrams, 6 tables, 10 plates, 4 appendices.

Coin, C.D.A. (B.Sc. Hons) (1970) University of Adelaide

A study of the petrology and geochemistry of the granulite facies terrain near Amata, Musgrave Ranges, northwest South Australia. 27 pp., 2 maps, 3 figures, 10 plates, 3 appendices.

Davidson, J.E. (B.Sc. Hons) (1970) University of Adelaide

A petrological and geochemical study of three diamond-drill holes through the Mount Windarra ultramafics and zone of mineralization. 44 pp., 4 plates, 3 appendices.

Drew, G.J. (B.Sc. Hons) (1970) University of Adelaide

A geophysical investigation of the southern Middleback Range area. 21 pp., 3 maps, 8 figures, 4 appendices.

Hatcher, M.I. (B.Sc. Hons) (1970) University of Adelaide

The geology of the Mount Chambers Mine region, northern Flinders Ranges. 22 pp., 1 map, 6 figures, 3 appendices.

Henstridge, D A. (B.Sc. Hons) (1970) University of Adelaide

The petrology and geochemistry of the Upper South East Granites, South Australia. 24 pp., 2 maps, 7 figures, 2 plates, 2 appendices.

Hill, R.J. (B.Sc. Hons) (1970) University of Adelaide

The atomic structure of scholzite, from a small occurrence 1 mile east of Reaphook Hill, Central Flinders Ranges. 31 pp., 4 figures, 5 plates, 6 appendices.

Holt, G.E. (B Sc. Hons) (1970) University of Adelaide

Geology of the Paratoo Diapir, S.A. 28 pp., 2 tables, 2 figures, 6 appendices.

Hone, I.G. (B.Sc. Hons) (1970) University of Adelaide

Interpretation of airborne and ground magnetic surveys with detailed susceptibility measurements at Tennant Creek, N.T. 27 pp., 30 figures, 5 appendices.

Kopcheff, J.T. (B.Sc. Hons) (1970) University of Adelaide

A geophysical interpretation of the Western Murray Basin, South Australia. 32 pp., 11 figures, 2 plates, 6 appendices.

Lipple, S.L. (B.Sc. Hons) (1970) University of Adelaide

The geology of Tal Val near Meekatharra, W.A. and the weathering of ultramafics. 23 pp., 2 maps, 2 figures, 4 plates, 6 appendices.

Moriarty, K.C. (B.Sc. Hons) (1970) University of Adelaide

The clay mineral distribution in the southern ocean between Australia and Antarctica. 42 pp., 16 figures, 3 appendices.

Morris, B.J. and Cobb, M.A. (B.Sc. Hons) (1970) University of Adelaide

See Cobb, M.A.

Mount, T.J. (B.Sc. Hons) (1970) University of Adelaide

Geology of the Mount Chambers Gorge region, Flinders Ranges, South Australia. 22 pp., 4 maps, 11 plates, 2 appendices.

Price, D.G. (B.Sc. Hons) (1970) University of Adelaide

Geophysical investigations of the northern Middleback Range area, South Australia. 24 pp., 9 figures, 2 plates, 7 appendices.

Pridmore, D.F. (B.Sc. Hons) (1970) University of Adelaide

The Edwin Nickel Shoot (located 25 miles S.S.E. of Kambalda at 31°31'S and 121°50'E) - Results of V.L.F. electromagnetic, induced polarization, magnetic and gravity surveys. 27 pp., 10 figures, 9 plates, 6 appendices.

Sibenaler, X.P. (B.Sc. Hons) (1970) University of Adelaide

Geochemical investigations at the Forktree Prospect, Normanville, South Australia. 26 pp., 5 plans, 8 figures, 2 tables, 3 plates, 6 appendices.

Smith, P.B. (B.Sc. Hons) (1970) University of Adelaide

A geochemical study of Diemal's Find copper-zinc prospect south of Lake Barlee in Western Australia. 24 pp., 2 maps, 30 figures, 2 plates, 5 appendices.

Smith, P.C. (B.Sc. Hons) (1970) University of Adelaide

The geology of the Hinckley Ranges, W.A. 29 pp., 1 map, 9 figures, 5 plates, 3 appendices.

Taylor, R.J. (B.Sc. Hons) (1970) University of Adelaide

The geophysical interpretation of some gravity and magnetic anomalies in the Middleback Ranges area of South Australia. 28 pp., 4 contour maps, 13 figures, 4 appendices.

Thomas, A.P. (B.Sc. Hons) (1970) University of Adelaide

Joint analysis and hydrothermal alteration study at Stannary Hills, North Queensland. 19 pp., 2 maps, 5 figures, 2 tables, 4 plates, 2 appendices.

Thompson, R.L. (B.Sc. Hons) (1970) University of Adelaide

A study of the mineralization at the Kitticoola copper mine, Palmer S.A. 31 pp., 7 figures, 1 diagram, 3 plates, 10 appendices.

Watmuff, I.G. (B.Sc. Hons) (1970) University of Adelaide

Some local aspects of the geology, mineragraphy and geochemistry associated with the Edwin Shoot, sixty miles south of Kalgoorlie, W.A. 24 pp., 2 maps, 14 figures, 3 plates, 4 appendices.

Wigglesworth, K.F. (B.Sc. Hons) (1970) University of Adelaide

The geology of the Mount Frome region, Flinders Ranges, South Australia. 28 pp., 2 maps, 9 figures, 2 tables, 4 appendices.

## UNIVERSITY OF WESTERN AUSTRALIA

Hagan, G.M. (B.Sc. Hons) (1969) University of Western Australia

Tidal-flat sedimentation, Hutchison Embayment, Shark Bay, W.A. 86 pp., 25 figures.

The Quaternary history of a modern carbonate tidal flat in the Hutchison Embayment, Shark Bay, Western Australia, is documented. The tidal flat is the product of a series of marine phases termed Dampier, Bibra, and Holocene-Recent. Stratigraphic units recording these marine phases are: 3) Holocene-Recent sequence composed of 3 conformable units, 2) Bibra Formation of 'upper' Pleistocene age and 1) Carbla Oolite of 'middle' (?) Pleistocene age composed of 2 conformable units. The marine formations are separated by erosional unconformities marked by calcrete and incipient soils.

Biotic assemblages in the formations can be compared to contemporary communities in Shark Bay. Fossil assemblages, characteristic of certain environments within Shark Bay (oceanic, salinities 35 to 40°/oo; metahaline, 40 to 56°/oo; hypersaline, 56 to 70°/oo), occurs in the Quaternary sequence. The Carbla Oolite and the Holocene-Recent sequence accumulated in metahaline environments which gradually changed to hypersaline; the Bibra Formation formed under oceanic conditions. Succession of organic communities during deposition of the Carbla Oolite and Holocene-Recent sequence, in response to evolving hydrologic regimes, is reflected in the sediments. Under oceanic/metahaline conditions seagrasses and corals have considerably affected sedimentation; with increasing salinities physical processes become dominant, with modification by algal mats. Marine sedimentation has progressively shoaled the embayment, with decrease in depositional slopes from 20 ft/mile to present-day gradients of 3 ft/mile. Slope reduction during the Recent

has resulted in the development of wide tidal and supratidal flats.

Hough, M.J. (B.Sc. Hons) (1969) University of Western Australia

Basic granulites and high-grade metadolerites from Brunswick Junction, W.A. 205 pp., 2 maps, 94 figures.

High-grade metadolerite and basic granulite bands are interlayered with isoclinally-folded Archaean granitic gneiss near Brunswick Junction, 100 miles south of Perth, Western Australia. The metadolerites have blastophitic texture and relict minerals, and they grade into the basic granulites, which are mostly amphibolites (hornblende-plagioclase granulites). High Ti, Cr, and Ni values, low Niggli k values, igneous trends on variation diagrams, and blastoporphyritic texture in some garnet amphibolites prove the igneous origin of the amphibolites. Some were certainly dolerites, because of apophyses and gradation to obvious metadolerite. Others may have been basaltic lava flows. Most were olivine-free tholeiites, but a few were derived from an alkali basalt magma. The metadolerite-basic granulite sequence in the Olive Hill quarry is an example of both differentiation of a tholeiitic magma and multiple intrusion. Amphibolite and lower granulite facies assemblages are intermingled in the field. East of Brunswick Junction retrograde metamorphism has accompanied the waning phase of orogeny. The age relationship between the basic bands and the granitic gneiss is uncertain. Although the basic bands are apparently intrusive, some basic apophyses appear to have been partly assimilated by granitic magma. Hence, dolerite was perhaps intruded into sediments which later, during orogeny, were granitized and partly mobilized to yield granitic magma.

Karajas, J. (B.Sc. Hons) (1969) University of Western Australia

A geological investigation of an area between Mount Minchin and the Bowes River, Northampton district, W.A. 113 pp., 2 maps, 51 figures.

An area of 20 square miles on the edge of the Greenough Block, between Mount Minchin and the Bowes River, is described. It is significant because it contains the most complete exposures of the Lower Triassic Kockatea Shale known from the Perth Basin. Lower Palaeozoic Tumblagooda Sandstone overlies Precambrian acid granulites nonconformably. The source area was the Greenough Block and palaeocurrent analysis indicates that the palaeoslope was to the west. The Kockatea Shale, which unconformably overlies the Tumblagooda Sandstone, was deposited in a range of transitional environments, and five units are

recognizable. Ammonite faunas indicate an Owenitan age and biostromal algae in one unit are an important addition to our knowledge of early Mesozoic Cyanophyceae. Sedimentation structures in the Kockatea Shale suggest that the palaeoslope of the Early Triassic sea floor was to the southwest. Lower Jurassic strata correlated with the Greenough Sandstone overlie the Kockatea Shale disconformably.

Leishman, J. (B.Sc. Hons) (1969) University of Western Australia

The geology of an area near Marshall Pool, Mount Margaret G.F., W.A. 175 pp., 1 map, 83 figures.

The area studied consists of ultrabasic and basic igneous rocks and associated sedimentary rocks (all of the Archaean Kalgoorlie-Yilgarn succession), near Marshall Pool, north of Leonora, Western Australia. The ultrabasic rocks are mainly peridotites with unusual 'quench' textures. The basic rock types include basaltic dolerites, normal dolerites, and fine-grained to aphanitic rocks loosely classifiable as basalts. The basaltic dolerites have textures indicative of supercooling. Possible pillow structures and variolitic structures occur in the aphanitic basic rocks. The basic rocks are less abundant than the ultrabasic, with which they seem to be comagmatic. The sedimentary rocks are mainly albitized metasiltstones which occur as lenses, aligned with the strike, in the igneous rocks. There are rare hornfelsed sedimentary rocks. Lenses and small dykes of basic-intermediate rocks with rodingitic affinities occur in the ultrabasites. The sequence has been folded into a NNW-trending north-plunging isoclinal syncline. The rocks have been subjected to greenschist facies metamorphism. Petrographic descriptions and accounts of the field inter-relationships of the various rock types are given, along with petrochemical and petrogenetic discussions.

## LOCALITY, SUBJECT AND STRATIGRAPHIC NAME INDEX

## AUTHOR INDEX