PROGRAMME

and

ABSTRACTS

for the

TENTH SYMPOSIUM

on

"ADVANCES IN THE STUDY OF THE SYDNEY BASIN"

DEPARTMENT OF GEOLOGY
THE UNIVERSITY OF NEWCASTLE
N.S.W. 2308

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11th April to the 13th April, 1975

Convener:
ASSOC. PROF. B.A. ENGEL
Department of Geology,
The University of Newcastle

559.4405

Advances in the study of the Sydney Basin; abstracts of the symposia: (annual) 1st symposium 1966 to 4th symposium 1969. Newcastle, University of Newcastle, Department of Geology. Published as one volume with individual title pages. From 5th symposium 1970 title changed to Advances in the study of the Sydney Basin; programme and abstracts, which see also.

Geology - N.S.W. - Congresses
University of Newcastle - Department of Geology
Symposium on Advances in the study of the Sydney Basin,
University of Newcastle (s)

559.4405

Advances in the study of the Sydney Basin; programme and abstracts of the symposia: (annual) 5th symposium 1970 **to date.** Newcastle, University of Newcastle, Department of Geology. Previously known as Advances in the study of the Sydney Basin; abstracts of the symposia, which see also.

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FOREWORD

Ten years have elapsed since the first Newcastle Symposium and during that time our knowledge of the Sydney Basin has increased. Perhaps you will agree with me that this Symposium will be an appropriate time for us to pause a little and recap what we have learned about the rocks, structures and origin of the Basin in the last decade. As a result it may be possible to pinpoint in what directions our respective future endeavours should be channelled and so try to avoid unnecessary duplication of effort.

On behalf of the staff I welcome you to the Tenth Newcastle Symposium and express the hope that you will not only enjoy this one but all those in the next decade.

BERYL NASHAR
Head of Department

PROGRAMME

FRIDAY, 11th APRIL, 1975	hours
Registration in Foyer of Geology Department The University of Newcastle	0900-1700
Excursion to New Lambton Heights Co-ordinator: Dr. K.H.R. Moelle Participants to meet ON SITE (see map)	1400-1700
Informal gathering in the Upstairs Lounge of the Great Northern Hotel	after 2000

SATURDAY, 12th APRIL, 1975	
Registration in Foyer of Geology Department	0830-0900
MORNING TECHNICAL SESSION - Science Lecture Theatre H01 (at rear of Chemistry Building) The University of Newcastle Chairman: Dr. N. Markham Geological Survey of New South Wales	
Opening of Tenth Newcastle Symposium	0900-0905
1. EVIDENCE FOR GLACIATION IN THE SYDNEY BASIN C. Herbert N.S.W. Geological Survey	0905-0935
2. STRATIGRAPHIC CORRELATIONS AIDED BY BOREHOLE GEOPHYSICAL LOGGING IN THE SOUTHERN COALFIELD, N.S.W.	0935-1005

J.F. Doyle, S.J. Gye,
P. Harman & H.W. Read

Australian Iron & Steel Pty. Ltd.

3. THE CRUST BENEATH THE SYDNEY BASIN — 1005-1035

I.R. Qureshi

University of New South Wales

Morning Tea in Geology Department Foyer — 1035-1105

4. SYDNEY BASIN - NEW ENGLAND FOLD BELT RELATIONSHIPS — 1105-1135

I.D. Blayden[1] & E.C. Leitch[2]

[1]Esso Australia Ltd.
[2]University of Sydney (Geology)

5. A REVIEW OF THE LOW COST EXTRACTIVE RESOURCES IN THE CENTRAL COAST REGION OF NEW SOUTH WALES — 1135-1205

I. Wallace

N.S.W. Geological Survey

6. DAWSONITE, ALUMOHYDROCALCITE NORDSTRANDITE AND GORCEIXITE IN THE SHOALHAVEN GROUP OF THE SYDNEY BASIN — 1205-1235

R. Goldbery & F.C. Loughnan

University of New South Wales

Summary and Vote of Thanks by Chairman — 1235-1240

LUNCH IN UNIVERSITY UNION 1240-1345

(due east of Science Lecture Theatre)

AFTERNOON TECHNICAL SESSION -

Science Lecture Theatre H01

The University of Newcastle
Chairman: Dr. D. Swaine
C.S.I.R.O. Division of Mineralogy

7. TRIASSIC PALAEOSOLS IN THE UPPER NARRABEEN GROUP OF NEW SOUTH WALES 1345-1415

G.J. Retallack

University of New England

8. WEATHERING OF SYDNEY SANDSTONES IN BUILDING STONE AND OUTCROP 1415-1445

G.S. Gibbons & C.R. Ward

N.S.W. Institute of Technology

9. WEATHERING PROCESSES IN AN ANCIENT SAND DUNE AT AGNES BANKS, N.S.W. 1445-1515

D.J. Plowman & B.G. Davey

University of Sydney (Soil Science)

Afternoon Tea in Geology Department Foyer 1515-1545

10. A DECADE OF COAL PETROLOGY IN THE SYDNEY BASIN — 1545-1615

A.J.R. Bennett, M. Smyth & M. Shibaoka

C.S.I.R.O. Division of Mineralogy

11. THE OCCURRENCE OF NATIVE COPPER IN THE NARRABEEN GROUP — 1615-1645

J. Dolanski

N.S.W. Geological Survey (Mining Museum)

12. A QUARTER OF A CENTURY OF BUREAU OF MINERAL RESOURCES RESEARCH IN THE SYDNEY BASIN — 1645-1715

S.J. Mayne

Bureau of Mineral Resources

Summary and Vote of Thanks by Chairman — 1715-1720

END OF SESSION

Sherry followed by Symposium Dinner in EDWARDS HALL OF RESIDENCE (Drive entrance off Rankin Drive, east of entrance to Newcastle College of Advanced Education) — 1900 for 1930

SUNDAY, 13th APRIL, 1975

The technical sessions will take the form of seminars, all of which will be held in the Geology Department.

SEMINAR I (0930-1105)	-	THE ORIGIN OF THE SYDNEY BASIN AND ITS PHASES OF DEVELOPMENT Room 101 Geology I Laboratory Chairman: Mr. K. Mosher C.R.A. Exploration Pty.Ltd.
SEMINAR II (0930-1105)	-	ECONOMIC RESOURCES AND THE DIFFICULTIES ASSOCIATED WITH THEIR RECOVERY IN THE SYDNEY BASIN Room 111 Geology III Laboratory Chairman: Dr. K.H.R. Moelle University of Newcastle
1105-1130	-	Morning Tea in Foyer
SEMINAR I (continued) (1130-1300)	-	THE ORIGIN OF THE SYDNEY BASIN AND ITS PHASES OF DEVELOPMENT Room 101 Geology I Laboratory Chairman: Mr. K. Mosher C.R.A. Exploration Pty.Ltd.
SEMINAR III	-	A RE-APPRAISAL OF THE FAUNAL AND FLORAL RECORD IN THE SYDNEY BASIN Room 111 Geology III Laboratory Chairman: Professor J. Roberts University of N.S.W.
1300-1400	-	Farewell Luncheon in the University Union

EVIDENCE FOR GLACIATION IN THE SYDNEY BASIN

C. Herbert
N.S.W. Geological Survey

Since glacial and glacigene sediments were first reported by Sussmilch and David (1920), Carboniferous and Permian rocks occurring throughout the Tamworth Trough and the Sydney Basin have subsequently been found to contain similar, if not better, evidence for contemporaneous glaciation.

The earliest Carboniferous glacial rocks are of Westphalian age and have been reported from Barraba (Spion Kop Conglomerate) and from Gosforth (Mt. Johnstone Formation). Later Carboniferous glacigene sediments of Stephanian age have been delineated in the Tamworth Trough (Rocky Creek Conglomerate, Currabubula Formation), in the Hunter Valley (Seaham Formation, Grahamstown Lake Formation) and in the Southern Sydney Basin (Tallong Conglomerate, Badgerys Breccia).

Evidence for glaciation during the Late Carboniferous is restricted to a terrestrial palaeoenvironment and comprises thick fluvio-glacial conglomerates occupying large elongate channels or valleys, tillites, varves with dropped pebbles, striated and facetted pebbles and boulders, and a striated and polished pavement. From this evidence it is clear that during the Late Carboniferous, locally restricted alpine or valley glaciation of elevated highlands to the west, extending from Barraba to Braidwood (600 km), provided huge quantities of coarse clastic detritus which was transported eastwards for distances of over 50 km down palaeoslope.

In Permian rocks of the Sydney Basin no definite terrestrial evidence for glaciation has so far been produced. Instead there is widespread evidence of adjacent glaciation preserved in fine grained marine sediments from the lowest Permian to the highest marine Permian sediments which are known from the Tomago and Illawarra Coal Measures. This evidence consists only of exotic megaclasts and aggregate type megaclasts, which have presumably been ice rafted and subsequently dropped into position.

The total absence of evidence for terrestrial Permian glaciation tends to discount former speculation of an adjacent ice sheet close to the Sydney Basin. However, the abundant dropped megaclasts and the dominant northerly longshore palaeocurrent in Permian marine sediments suggests a derivation of

of glacigene material from an area well to the south of the Sydney Basin - possibly Antarctica and/or Victoria-Tasmania.

STRATIGRAPHIC CORRELATION AIDED BY BOREHOLE GEOPHYSICAL LOGGING IN SOUTHERN COALFIELD N.S.W.

J.Doyle, S.Gye, P.Harman, H.Reed
Australian Iron and Steel Pty. Ltd.

Contract geophysical borehole logging services suitable for the small diameter holes commonly used i coalfield exploration, were introduced in New South Wales in 1971.

Logs readily available include gamma, neutron neutron, density, S.P., resistivity and caliper.

Australian Iron & Steel Pty. Ltd. have had 20 holes logged in the Southern Coalfield of New South Wales. The geophysical logs accurately identify the Bald Hill Claystone ("chocolate shale") at the top of the Triassic Narrabeen Group and the Bulli, Balgownie and Wongawilli coal seams of the Illawarra Coal Measures.

Other formations such as the Wombarra Shale, can be identified less readily.

As current exploration practice is to open hol (non-coring), to immediately above the coal seam of interest, to reduce drilling costs, borehole geophysical logs are valuable, and comparatively inexpensive means of obtaining stratigraphic information in place of bore core. Other benefits include seam thickness and quality and some information on likely mining conditions.

THE CRUST BENEATH THE SYDNEY BASIN

I.R. Qureshi
Department of Applied Geology
University of New South Wales

The present ideas about the structure and composition of the continental crust are reviewed an an outline of the crustal studies of the Australian continent is presented.

The Sydney Basin is characterized by a promin-

ent gravity high which runs along its axis. The significance of this high is discussed in view of the available seismic information and geological considerations. It is inferred that the crust underlying the basin is less thick than it is under the flanking fold-belts. Similar inference has been derived for several basins and rift valleys on other continents.

SYDNEY BASIN - NEW ENGLAND FOLD BELT RELATIONSHIPS

I.D.Blayden[1] and E.C. Leitch[2]

1. Esso Australia Limited
2. University of Sydney (Dept. of Geology)

Synchronous sedimentation in the northern part of the Sydney Basin and the southern portion of the New England Fold Belt was probably separated by a major volcanic chain. In spite of this a marked correlation exists between major tectonic events in the two regions.

Stratigraphic evidence indicates that within the Sydney Basin tectonic movements occurred at the following stratigraphic levels: at the base of the Dalwood Group, within the Maitland Group, within the Tomago Coal Measures, and at the top of the Newcastle Coal Measures. Deformation also took place subsequent to the Permian but the chronology of these movements has yet to be accurately established.

The southern part of the New England Fold Belt also underwent deformation at about the beginning of the Permian and in the Late Permian; radiometric data indicate a close time correlation between the latter event and that in the Tomago Coal Measures. Fault movements probably affected the New England Fold Belt throughout the Triassic.

Difficulties in applying existing terms such as "Hunter-Bowen" Orogeny are discussed.

A REVIEW OF THE LOW COST EXTRACTIVE RESOURCES IN THE CENTRAL COAST REGION OF NEW SOUTH WALES

I. Wallace
N.S.W. Geological Survey

During the ten year period leading up to 197! significant progress has been made in the geologica appraisal of low cost extractive resources in the central coast region of New South Wales. Prior to 1965, little detailed research work had been conduc on the construction material resources of New South Wales and, although potential land use problems wer foreseen, little qualitative and quantitative data were available to reinforce the argument. Much of the work undertaken on this topic has been conducte by the Geological Survey of New South Wales. In recent years, detailed studies were undertaken as p of a major project of the Geological Survey.

During the period 1972 to 1974, a project te comprising nine geologists and supporting technical staff investigated some of the geological constrain to regional planning within the central coast regio of New South Wales. This region extends from Port Stephens in the north to Jervis Bay in the south ar as far west as the lower Blue Mountains and Moss Va Between 1975 and the year 2000 it is estimated tha the population of the central coast region will increase from 3.9 million to 6.0 million people and this region in 2000 will accommodate about 84% of population of New South Wales.

In the period 1975 to 2000 it is estimated the maximum requirement in the central coast regio will be 700 million tonnes of hard rock aggregate, million tonnes of construction sand, 25 million to of industrial sand and 200 million tonnes of struc ural clay-shale. Provided that planning provisio are made now for the systematic extraction of the suitable resources, there should be no shortage of hard rock aggregate and clay-shale to the year 200 However, some potential environmental problems wil need to be resolved. There is likely to be a sho age of construction sand, particularly in the Wollongong and Gosford-Wyong areas, unless estuari are dredged in a controlled manner. It is likely that "alternative" construction materials such as sandstone aggregate, metallurgical slag, fly ash, colliery and coal washery refuse, burnt shale aggregate and marine aggregate, will become more significant in the future supply situation.

Owing to the lack of detailed geological mapping in this region, the project area was mappe

at 1:50,000 scale. Some thirty-two 1:50,000 sheets were involved and this mapping served as a basis for assessment of low cost extractive resources and for definition of slope stability in certain areas. Nine sub-regions were selected within the main study area, each of which served as a unit for reportage.

Unpublished reports of the Geological Survey have been prepared to accompany the geological and resource maps at 1:50,000 scale. Resource data were presented in two ways on separate resource sheets. Related closely to the geology, large areas of a particular resource were denoted, from within which optimum extraction sites could be selected. In addition, actual sites with high extractive potential have been delineated.

A summary of the low cost extractive resources of the central coast region is to be published in the Records of the Geological Survey series. Map presentation will be at 1:500,000 scale.

The geology of the region will be published in colour, in the form of seven 1:100,000 sheets with explanatory notes.

DAWSONITE, ALUMOHYDROCALCITE, NORDSTRANDITE AND AND GORCEIXITE IN THE SHOALHAVEN GROUP OF THE SYDNEY BASIN

R. Goldberry and F.C. Loughnan
Department of Applied Geology
University of New South Wales

Dawsonite [$NaAlCO_3(OH)_2$], alumohydrocalcite [$CaAl_2(CO_3)_2(OH)_4.3H_2O$], nordstrandite [$Al(OH)_3$] and gorceixite [$BaAl_3(PO_4)_2(OH)_5$] are relatively rare minerals and whereas each has been found within a limited range of geological environments, there has been no previous record of the paragenetic development of all four minerals.

Dawsonite was originally believed restricted in occurrence to the products of hydrothermal decomposition of alumosilicate minerals, particularly feldspars, but in recent years it has been demonstrated that it may also form in an authigenic environment where unusually high pH conditions prevail.

On the other hand, alumohydrocalcite is known only as an authigenic mineral. It was initially described from Russia in 1960 and subsequently has been found as an alteration product of allophane in

Germany and in association with dawsonite, calcite, gibbsite and allophane in Cretaceous marine mudstones near Osaka, Japan.

Nordstrandite also appears restricted solely to authigenic environments. It was synthesised originally in 1958 and subsequently was found in natural occurrence associated with carbonates in Guam, Sarawak, the Sydney Basin and Hungary.

In contrast, the principal mode of occurrence of gorceixite is as a constituent of highly leached soils, particularly those developed on igneous rocks, or of sediments derived from such soils. In these occurrences gorceixite is anhedral and invariably shows partial replacement of barium by strontium or calcium.

The discovery that these minerals coexist in the Shoalhaven Group is of interest since the conditions that gave rise to the Shoalhaven Group appear to have differed considerably from those responsible for the development of the accompanying host rocks elsewhere throughout the world.

TRIASSIC PALAEOSOLS IN THE UPPER NARRABEEN GROUP OF NEW SOUTH WALES

G.J. Retallack
University of New England

Detailed study of palaeosols exposed in the sea cliffs between Long Reef and Palm Beach, north of Sydney, gives a much clearer idea of the environment and climate of the area during the late Scythian to early Anisian.

At the base of the exposed succession, kaolinite clayey soils with red B horizons were formed on vulcanogenic sediments derived from the old Gerringong volcanic ridge to the east. The red Bald Hill Claystone consists largely of resorted and in situ grey-brown podzolic soils (ferrods) formed on well-drained sites under coniferous forest. Humic gleys (fibrists) within the overlying Garie Formation are probable lowland equivalents formed under *Dicroidium*, *Voltziopsis* and equisetale swamp woodland.

These soils were drowned by the relative rise of the Narrabeen lagoonal complex and the concomitant southward growth of sediments of the Gosford Delta. These formed the lower Newport Formation of clean quartz-lithic sandstones and grey kaolinite-illite

shales derived from an extensive northern and western source land. The most widespread soils in the delta were gleyed podzolic soils (aquods) under *Dicroidium* dominated heath. Younger soils of a similar type (alluvial soils or aquents) also supported *Dicroidium* heath in low-lying areas and *Pleuromeia* meadows in interdistributary bays. In slightly more elevated areas a more oxidised gleyed podzolic soil (ochrept) developed. On clayey levees, grey clay soils (fluvents) formed under a *Dicroidium* flora locally dominated by *Taeniopteris lentriculiforme* (Etheridge) Walkom 1917.

Few palaeosols are preserved in the upper Newport Formation and Hawkesbury Sandstone because of the more frequent channel reworking of the floodplain during their deposition.

The dominance of podzols is compatible with a cool temperate climate for the late Scythian to early Anisian of the Sydney area.

WEATHERING OF SYDNEY SANDSTONES IN BUILDING STONE AND OUTCROP

G.S. Gibbons & C.R. Ward
The NSW Institute of Technology

Elizabeth Bay House in Sydney was constructed some 140 years ago from Hawkesbury Sandstone quarried on the site. Its stone blocks exhibit various kinds of weathering, depending both on the various grades of stone and on the physical conditions applying in different parts of the structure. Observations of this variation, together with relevant laboratory studies, have implications in interpretation of natural outcrop patterns and landforms.

WEATHERING PROCESSES IN AN ANCIENT SAND DUNE AT AGNES BANKS, N.S.W.

D.J. Plowman, B.G. Davey and C.E. Nockolds
Department of Soil Science
University of Sydney

The sand dunes at Agnes Banks N.S.W. are believed to have formed between the beginning and middle of Pleistocene (Herbert 1975, personal communication). They provide an interesting example of a

formation exposed to surface weathering for at least 500,000 years, which has resulted in the development of a recognisable soil profile.

Sieve analysis of >37 µm fraction show that the materials forming the dune are uniform with depth and overlie a soil developed on the Tertiary Terrace of the Nepean River. Quartz is the dominant mineral in the sand fractions.

The dune contains amounts of clay (<2 µm) varying from a few percent in the surface to about 20% at depth. A poorly crystallized kaolinite dominates this fraction with some interstratified and interlayered materials also being present. Gibbsite is present in the surface samples, reaching a maximum at 2.5 metres and is just detectable at depth.

Scanning electron microscopy shows that most of the sand grains throughout the dune are well rounded and show surface features usually associated with dunes. Very little evidence of the surface features associated with sand grains weathering from Hawkesbury sandstone could be found even though this is the presumed source of the sand (Simonett, 1950). Notable exceptions are some of the grains at the 2.5 metre depth, which show well developed euhedral faces. Other grains at this depth show surface features consistent with crystal growth and some few grains even show silica deposited around hexagonal kaolinite plates.

Using methods developed for defining the composition of the solution moving in soils we have been able to show that the composition of the solution in the dune is consistent with the coexistence of quartz, kaolinite and gibbsite.

The weathering process in the dune therefore appears to be a decomposition of the clay minerals to give gibbsite and release silica to solution. Some of the silica appears to be redeposited on the surfaces of the sand grains to give rise to euhedral surfaces and sharp well defined edges.

Studies of weathering in other sandy materials from the Sydney region confirmed that the dominant weathering process is decomposition of kaolinite and other clay minerals and the formation of gibbsite.

SIMONETT, P.S. (1950). On the grading of dune sands near Castlereagh, N.S.W. *J.Roy.Soc.N.S.W.* LXXXIV, 71-79.

A DECADE OF COAL PETROLOGY IN THE SYDNEY BASIN

A.J.R. Bennett, M. Smyth and M. Shibaoka
Division of Mineralogy
C.S.I.R.O.

Petrographic analysis has been of use in the assessment of coal utilisation for more than forty years, particularly in Europe, and data for Australian coals has been steadily accumulating over the last twenty years. In the last ten years, especially, significant advances have been made in the application of petrographic analysis to the study of coal depositional environments and for determining the optimum use of coals in the Sydney Basin. Of the numerous current applications of coal petrology, three will be discussed in detail.

Coal Petrology in the Study of Palaeoenvironments

An early assessment of petrographic data indicated that coal seams in the various Australian coalfields tend to contain coals with a limited range of values for petrographic type and rank. With subsequent refinement, these parameters have now become the basis of a coal classification method by which other coal use properties can be compared. For example, it is now clear that low rank and very low vitrinite content are good evidence that the coal has been deposited with thin sedimentary cover on basement rocks isolated from a major subsiding basin, and that high vitrinite is indicative of an unstable depositional environment.

Early measurements of vitrinite reflectance were mainly limited to shallow coal seams in mines or opencuts. Subsequent measurements on coal lenses in cuttings from deep oil wells have virtually added a third dimensions to studies of regional coalification or diagenesis. By assuming that palaeogeothermal gradients were relatively constant, it is now possible for instance to reconstruct the shape of the Sydney Basin at the time of its maximum development, and incidentally to determine the present day maximum depths at which oil or gas could occur.

Petrographic Methods for the Study of Lateral Variations in a Coal Seam

When calculating the reserves of a particular seam, it is necessary to know its average thickness and lateral extent. Since this data must generally be obtained from widely spaced boreholes, a reliable method of seam correlation is required, as well as techniques to measure any changes in composition between the various subsections of a seam. These

subsections are normally selected on the basis of their visual appearance, bearing in mind that predominantly bright looking coal is generally much better than dull coal for carbonisation or conversion to liquid fuel. Maceral analysis gives an accurate measure of these variations between subsections, and not only provides characteristic profiles for seam correlation, but also by statistical analysis of cyclic variations, gives some clues to the original environment during deposition.

Coal Petrology in the Study of Coal Utilisation

Traditional methods for estimating the coking properties of a coal required a determination of its rank, generally by volatile yield, and an arbitary measure of its ability to form a coherent coke, such as crucible swelling index. Current methods based on petrographic analysis employ vitrinite reflectance to measure the rank of several coals in a blend, and maceral analysis to relate the actual amount of the reactive components vitrinite and exinite to optimum coking quantities determined by previous coke strength tests. Experiments are currently in progress to determine why prediction methods used for American coals do not work well for Australian coals, particularly those from the Illawarra Coalfield.

It is a long established rule that coals with a high hydrogen content give the best yield of liquid hydrocarbons from low temperature pyrolysis, and since much of the hydrogen in Australian coals occurs in the maceral vitrinite, it is evident that an ideal bituminous coal for synthetic fuel extraction should have a high vitrinite content, or at least should show from a petrographic study of its subsections that it could be possible to concentrate vitrinite by dense medium washing.

From a modest beginning about twenty years ago with a couple of coal petrology research groups, N.S.W. can now boast of at least eight different laboratories, most of which are currently working on Sydney Basin coals. With rapidly increasing awareness by coal users of the benefits of petrographic analysis, particularly in coking and synthetic fuel applications, this number could well increase in the next few years.

THE OCCURRENCE OF NATIVE COPPER IN THE NARRABEEN GROUP

J. Dolanski
Mining Museum
N.S.W. Geological Survey

Native copper is found in core from the Bald Hill Claystone and in its outcrops on the coast at Garie and Long Reef.

The copper was most likely leached from volcanic debris with the resulting solutions having accumulated in the saltpans during arid periods. The low organic and sulphur conditions promoted the formation of weak copper-chloride complexes in these brine accumulations.

Migrating weak copper chloride solutions would have their copper reduced from them by contact with buried plant remains, by diagenesis or by the action of anaerobic bacteria.

Polished section studies on native copper occurrences indicate at least three zones of chalcocite occur on spheroidal copper in the Garie area. Spherical copper formation is similar to that produced in saline and an alkali coal extract in laboratory tests.

The Long Reef copper occurrence, characterised by the plating of organic remains, indicates a saline environment with little or no alkali influence. Alteration copper minerals from this site are copper chlorides, rather than carbonates. These include paratacamite, atacamite and others currently being investigated.

Copper from diamond drill cores in the Camden area resembles the Garie type without a sulphide influence.

Laboratory tests were successful in producing native copper similar to field samples. These were carried out using copper ore, coal waste and various chlorides in neutral, slightly acid, and basic mediums.

A QUARTER OF A CENTURY OF BUREAU OF MINERAL RESOURCES RESEARCH IN THE SYDNEY BASIN

S.J. Mayne
Bureau of Mineral Resources

The BMR's connection with the Sydney Basin began with the work of Irene Crespin who, over a twenty-year period beginning in the 1930's studied the Permian foraminifera of the basin. It was she who identified the Kulnura Marine Tongue in the Tartarian coal measures.

After the establishment of the BMR in 1946 there were sporadic investigations into the geology of the Commonwealth Territory of Jervis Bay. In particular, Perry and Dickins mapped, measured, and named the thick "Jervis Bay Sandstone" which has subsequently come to be known, less appropriately, as the Snapper Point Sandstone.

The decade of the 1950's also saw several BMR officers working under the auspices of the Joint Coal Board in various parts of the Basin, especially in the Hunter Valley. A vast accumulation of data dealing with coal-measure stratigraphy and coal quality is preserved in BMR Records by Burton, Perry, Bursill, Konecki, Veevers and Reynolds.

The BMR entered the geophysical field in 1952 when, following a request from BHP, J. Horvath conducted a magnetometric survey over basic dykes near Newcastle. In 1957 C.S. Robertson made the first seismic surveys in the Sydney Basin to determine the applicability of the method. In the 1960's several BMR officers were involved in various aspects of geophysics in the Basin, and a private company was also employed to carry out vibroseis surveys. Doyle, Everingham, Polak and others investigated the seismicity of the Basin and recorded their findings in scientific Journals; Gerdes conducted an aeromagnetic survey over some of the western part of the Basin; Stott worked on palaeomagnetism and Evernden and Richards on radioactive age determinations.

In 1957 the Australian Government began the system of subsidizing the search for petroleum, and several companies received subsidy, via the BMR, for drilling and geophysical projects. The results of these investigations are available to the public in the BMR files.

Palaeontological studies were advanced particularly by J.M. Dickins, who devised a faunal correlation between the southern and northern parts of the

Basin and with the Bowen Basin, and by P.R. Evans who did much to establish a palynological zonation.

In the late 1960's a Sydney Basin Study was embarked upon, with the support when required of the N.S.W. Geological Survey. Many well-studies were completed, and, as a result of correlating by lithologic units rather than by preconceived notions concerning the named stratigraphy, the correct relationships, it is believed, between the different parts of the Basin were established. In 1972 a bibliography of the Sydney Basin was published and in 1974 a Bulletin reviewing the geology of the Basin was produced.

The most recent work in the Sydney Basin has been that of P. Wellman, on the ages of Tertiary basalts.

PAPERS TO BE PRESENTED AT THE SUNDAY SESSIONS

FURTHER THOUGHTS ON THE LAPSTONE STRUCTURE

D.F. Branagan
Department of Geology and Geophysics
The University of Sydney

The Lapstone Structure (monocline-fault and associated faults and folds) is a complex feature which has a long history. Its major characters were described previously (Branagan 1969). Its origin may extend back to the Permian, when a 'hinge' became established within the basin slightly west of the monocline, and which affected patterns of sedimentation.

Following the cessation of major sedimentation in the Basin and a period of erosion, spreading occurred 80-60 m.y. B.P. to form the central Tasman Sea (Hayes & Ringis 1973). The asymmetrical character of the spreading centre relative to the orientation of the New South Wales coastline needs explanation, as does the pattern of offset fractures.

Dissipation of subduction energy seems to have occurred by a holding down of the crust, together with volcanic activity (such as occurred south and north of the Sydney Basin, and to a lesser degree within it and in line with the offset fractures (e.g. Mt. Dromedary, Milton, Mt. Woolnough)).

The time relation between spreading, offset faulting and epeirogeny on the nearby continent needs to be evaluated. It seems likely that the Lapstone structure as we see it today is the direct result of the spreading which formed the Tasman Sea. Its date of formation must therefore be placed <u>early</u> in the Tertiary. A downdragging of the Cumberland Plain area, rather than uplift of the adjacent plateaux, fits more easily into the postulated series of events.

The formation of the Lapstone structure was just one event within a complex history of early Tertiary tectonism (uplift and volcanism) which affected eastern Australia.

The tectonism was a result of continent dispersal.

References:

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FLORAS IMMEDIATELY UNDERLYING THE GLOSSOPTERIS FLORA IN EASTERN AUSTRALIA

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Stratigraphers in New South Wales have reported the occurrence of *Rhacopteris*, presumably *R.ovata* within the Seaham Formation or its equivalent. Unfortunately they do not seem to have collected any specimens. Plants identified as *R.ovata* from varved shales at Hellyer Gorge in Tasmania have proved to be *Gondwanidium plantianum* (s.s., non sensu Rigby). This species usually occurs with *Glossopteris*; at Hellyer Gorge it is 200m approximately below the *Eurydesma* horizon.

It is possible that the *Rhacopteris* flora became extinct either before, or during the early part of, the glacial stage represented by the Seaham Formation or its equivalent.

SOME ENVIRONMENTAL PROBLEMS ASSOCIATED WITH THE WORKING OF QUARRIES AND GRAVEL PITS

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THE PERMO-TRIASSIC MACRO-FLORAL SUCCESSION IN THE SYDNEY BASIN

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INDICES

Abstracts of symposia 1 to 4 were published in one volume. They are shown in these indices by the first digit 1 followed by the page number. For subsequent symposia the first digit refers to the symposium number.

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