COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS

RECORDS:

1963/159

THE SEDIMENTARY BASINS OF AUSTRALIA AND NEW GUINEA

by

M.A.Reynolds & others.

THE SEDIMENTARY BASINS OF AUSTRALIA

AND NEW GUINEA

by

M.A. Reynolds and others

RECORDS 1963/159

CONTENTS

. . . .

THE SEDIMENTARY BASINS OF AUSTRALIA AND NEW GUINEA

The purpose of this report is to briefly describe the sedimentary basins of Australia and New Guinea, their stratigraphy, and structure, and to review current progress in oil exploration.

The term "basin" is used in this report almost exclusively for areas containing deposits of unaltered sedimentary rocks which are recognised as possible sources and/or reservoirs for hydrocarbon accumulation. Most of these basins are also hydrological basins (or contain hydrological basins) and many were originally described as such. (The prefix "sub-" has been avoided because of possible confusion of "sub-" referring to subsurface, subsidiary, or subdivision.)

A revision of the map showing the sedimentary basins in Australia and New Guinea has been made for inclusion in this report and to show the basin outlines as accurately as possible with reference to the Department of National Mapping Index of 1:250,000 maps. The sources of information used in drawing the outlines are included in the descriptions of the basins. Five types of boundary have been used on the map for the following categories:

a. Main Basins - these are the sedimentary basins in Australia and New Guinea which are regarded as most important for oil search because of their large area and thick deposits of sediments including possible source and reservoir rocks. The potential of some basins in this category may not be regarded as high but they are included because they have not been adequately tested. Where boundaries are doubtful, they have been queried.

b. Subdivision of Basins - Some basins have been subdivided into smaller units for which special boundary symbols have been used on the map, e.g. the Great Artesian Basin contains the Carpentaria, Eromanga and Surat Basins (originally defined as "Sub-basins"), the Oxley and Coonamble Basins, and the Lake Frome Embayment.

c. Some sedimentary basins are buried under younger deposits which form part of larger, superimposed basins. Different symbols have been used for these "Basins under Main Basins".

d. Other Basins and Provinces - Special boundaries are used for small basins, areas of thin unaltered sedimentary rocks which are not likely to contain commercial accumulations of hydrocarbons, and for other provinces about which little is known but which may be of interest to petroleum exploration.

e. Boundaries indicated by geophysical anomalies - These have been included where the margins of basins are uncertain or obscured by younger deposits.

Other regions such as some in the Tasman Geosynclinal Zones have not been included for one reason or another. Although they contain sedimentary rocks which may form sources or reservoirs for hydrocarbons, the prospective areas are generally too small (e.g. Yass Basin) or too indefinite to include on a map of this scale and nature. Also, most of these regions cannot really be regarded as favourable for accumulation of oil and gas because of igneous intrusions and/or metamorphism associated with their tectonic deformation.

The 'Generalized Formation Correlator' which was originally prepared by the Bureau of Mineral Resources for the American Oil and Gas Journal (O.G.J., 1962) has been enlarged and brought up to date for inclusion in this report. It has been prepared for comparing the stratigraphic units which have been established for basins and in various parts of basins, but was not intended for detailed stratigraphic correlations.

The definition and description of many basins have been written by those members of the Geological Branch who have either worked in the basins or have had cause to study them. These contributors have been acknowledged in the respective descriptions. The details of other basins in Australia and notes on the trend and status of exploration for oil have been prepared by M.A. Reynolds who has been responsible for collating the material of the report. The summary of the sedimentary basins of Papua and New Guinea was prepared by J.E. Thompson. The abbreviations used in the stratigraphic tables of some basins are those given by Mitchell and Maher, (1957), - see Appendix I.

Twenty-eight basins (including basins under other basins) and eight basins which are subdivisions of two of the main basins are regarded as more or less important from the aspect of oil and gas accumulation. Some other basins and provinces may also be important but little detail of these is yet available. The main basins and their subdivisions are described and discussed hereunder, and a few remarks are then given on some of the other basins and provinces. Apart from the references given for individual basins described in the text, the following are regarded as the most important general references to the sedimentary basins of Australia and New Guinea:

Australia	-	David, (1950); Irving, Smith, and Walker, (1958); Playford and Johnstone, (1959); B.M.R., (1960); Trumpy, Guillemot, and Tissot, (1960); G.S.A., (1962).
Papua and New Guinea	-	David, (1950); A.P.C.P., (1961).
Queensland	-	Hill and Denmead, (1960).
Tasmania	-	Spry and Banks, (1962).
South Australia	-	Glaessner and Parkin, (1958).
Western Australia	-	McWhae, Playford, Lindner, Glenister, and Balme, (1958).

1. ADAVALE BASIN, (Silurian to Lower Permian).

The name "Adavale Basin" was first used by Hier and Fjelstul (1961, p.5) and is referred to in Kitsman, Lewis and Rowe (1962, p.7, and Fig.2). The following description of the basin is taken mainly from Tanner (1962) - It is a Palaeozoic basin in the Quilpie-Blackwater area of central Queensland, and underlies a part of the Great Artesian Basin. The northwestern edge is depositional on a basement arch trending northeast through Yaraka. The western, southern, and eastern borders abut against the 'Canaway Downs Anticline', Eulo Shelf, and Nebine Ridge. The Adavale Basin extends south as narrow prolongations called the 'Quilpie, Cooladdi, and Westgate troughs'. The north and northeast limit of the basin is not yet known.

The basin is approximately 110 miles long in a northeast, southwest direction, and 80 miles wide. Seismic evidence suggests that the thickness of sediments may be as much as 20,000 feet near Adavale. Apart from numerous water bores, few of which penetrate below the Cretaceous - Jurassic aquifers, four wells have drilled into or through the Palaeozoic sediments; two bottomed in Lower Palaeozoic granite or basalt, another in metasediments, and the fourth finished in the Buckabie Formation. Sediments show considerable variation within the basin:- Etonvale No. 1 (Lewis and Kyranis, 1962) drilled 5,000 feet of Upper Silurian-Devonian sandstone and shale with minor carbonate interbeds before reaching granite basement; Gumbardo No. 1 (P.P.C., 1963) finished in 2,500 feet of volcanics, mainly tuff with some arkosic beds, after penetrating just over 2,000 feet of Devonian sandstone, shale and claystone (in part dolomitic); up to 3,600 feet of younger red beds (Buckabie Formation) of ?Upper Devonian-Carboniferous age occur above basement in Buckabie No. 1 (Kitsman, et al, 1962) and above the Devonian in Gumbardo No. 1. ?Upper Carboniferous-Lower Permian carbonaceous mudstone and other sediments, 620 feet thick in Etonvale No. 1, should probably be included in sediments of the Adavale Basin. The sediments of the Adavale Basin are unconformably overlain by thin Upper Permian and up to 6,000 feet of Mesozoic sediments of the Great Artesian Basin, (see Table 5).

Late Palaeozoic tectonic activity in the Adavale Basin resulted in faulting and folding and the development of synclinal, anticlinal, domal and graben-like structures. The region was eroded and peneplained before the Lower Permian sediments were deposited. Regional warping began in Permian time and also led to disconformities below the Upper Permian and Mesozoic; other structures have since been formed in Mesozoic beds by differential compaction over the older Palaeozoic structures and/or by re-activation of the older structures.

Although minor shows of hydrocarbons have been obtained, and closed structures occur in the Adavale Basin, drilling to date has shown no evidence of major oil or gas accumulations. Phillips Petroleum Company and Sunray Mid-continent Oil Company have done most work, and are continuing exploration, in the area.

2. AMADEUS BASIN, (Upper Proterozoic to Ordovician)

Chewings (1935) first used the name "Amadeus" for 'Amadeus Sunkland'. The outlines shown on the map are from mapping by the Amadeus and Georgina Basin field parties of the Bureau of Mineral Resources (B.M.R.) Geological Branch, and from results obtained by the Geophysical Branch (B.M.R.), in the period 1960 to 1962. The basin has been subdivided to show the area in which outcrops of Upper Proterozoic sediments predominate, and the main basinal area of Palaeozoic sedimentation; some Palaeozoic sediments, however, extend over part of the Upper Proterozoic area.

The most useful of recent references to the geology of the Amadeus Basin, are: Prichard and Quinlan (1962), Stelck and Hopkins (1962), Wells, Forman and Ranford (1962), Wells, Ranford and Cook (1963) and Forman (1963). The following description by A.T. Wells and L.C. Ranford is based on field work by geologists of the B.M.R. between 1960 and 1962.

The Amadeus Basin occupies an area of about 72,000 square miles in the southern part of the Northern Territory and part of Western Australia. The basin contains a thick sequence of Proterozoic and Palaeozoic sediments preserved in a downfolded and faulted zone. The sediments are bounded to the north by Precambrian rocks of the Arunta Complex, and on the south by Precambrian rocks of the Musgrave-Mann Complex. To the east the Amadeus Basin sediments are transgressed by Mesozoic rocks of the Great Artesian Basin. The Amadeus Basin sediments extend into Western Australia where they are for the most part blanketed by a thin cover of Permian and Mesozoic sediments.

The Upper Proterozoic sediments of the Amadeus Basin attain a thickness of 8,000 feet and the Palaeozoic sediments about 20,000 feet. The stratigraphic succession and approximate thicknesses of units in the mapped portions of the basin are shown on Table 1.

The Proterozoic Heavitree Quartzite and the Bitter Springs Limestone show little change in lithofacies over large areas. In the south-western part of the basin sediments correlated with these formations have been infolded into older Precambrian rocks. The overlying Areyonga Formation is a lensing formation of possible glacial origin. A sequence of siltstone and sandstone considered to be laterally equivalent to the Areyonga Formation is mapped as the Inindia Beds in the southern half of the basin. The Pertatataka Formation occurs over the Areyonga Formation in the northern part of the basin and is predominantly siltstone. To the south and west a laterally equivalent facies has been mapped as the Winnall Beds. In some areas the Winnall Beds were folded prior to the deposition of the Cambrian sediments. In the eastern part of the basin, the Cambrian rocks are predominantly carbonates; in western areas, sandy facies predominate, and in the central part of the basin, limestone, dolomite, siltstone and sandstone interfinger. The Ordovician Larapinta Group is thickest in the northern part of the basin and thins to the south-east and west. The Group consists of fossiliferous shallow marine limestones, siltstones and sandstones. Some of the siltstone beds contain halite pseudomorphs and gypsum. The Larapinta Group is succeeded by the

TABLE 1.

STRATIGRAPHIC UNITS IN THE AMADEUS BASIN

Era	Period	Western MacDonnell Ranges (after Prichard and Quinlan, 1962)	Cleland Hills	Gardiner Range	Bloods Range 1:250,000 Sheet area.	Southern Half of Lake Amadeus 1:250,000 Sheet area	Rawlinson – McDonald 1:250,000 Sheet area
CENOZOIC	Quaternary	Alluvium gravels	Alluvium, aeolian sand	Alluvium, aeolian sand	Alluvium, gravels, aeolian sand.	Alluvium, aeolian sand	Alluvium, gravels, aeolian sand.
	Tertiary				Conglomerate		Conglomerate
MESOZOIC		? ? Unnamed ? ?		? ? Unnamed ? ?			
PALAEOZOIC	Permian						* Buck Fm. 140'+
	Carboniferous.	Pertnjara Fm. (10,000'+) (Younger than Mereenie Sst. and older than Permian)	Pertnjara Fm. (200'+) (younger than Mereenie Sst and older than Permian)	Pertnjara Fm. (younger than Mereenie Sst and older than Permian)	Pertnjara Fm. (younger than Mereenie Sst and older than Permian)		
	Devonian						
	Silurian	Mereenie Sst (2000') (younger than Stokes Fm. and older than Pertnjara Fm.)	Mereenie Sst (1420') (younger than Stokes Fm. and older than Pertnjara Fm.)	Mereenie Sst (3200') (younger than Stokes Fm. and older than Pertnjara Fm.)	Mereenie Sst. (younger than Stokes Fm. and older than Partnjara Fm.)	Mereenie Sst. (2000'+) (younger than Stokes Fm. and older than Pertnjara Fm.)	
	Ordovician Upper	?	?	?	?	?	?
	Ordovician Middle	Larapinta Group: 0–2000' Stokes Fm. 1075–1840' Stairway Sst. 440–1400' Horn Val. Sltst.	Larapinta Group: 1000' Stokes Fm. 500' Stairway Sst. 420' Horn Valley Sltst.	Larapinta Group: 1500' Stokes Fm. 1070' Stairway Sst. 530' Horn Valley Sltst.	Larapinta Group (Undifferentiated).	Larapinga Group: 464' Stokes Fm. 202' Stairway Sst. 10–80' Horn Valley Sltst.	Unnamed 10' ?
	Ordovician Lower	2000–3000' Pacoota Sst.	1500' Parcoota Sst.	2124' Pacoota Sst.	?	60' Pacoota Sst. ?	
	Cambrian Upper	Pertaoorrta Group: 300 –1600' Goyder Fm.		Pertaoorrta Formation: 920' *Goyder Mb. 840' *Petermann Sst. Member			?
	Cambrian Middle	0 – 300' Jay Ck. Lmst.	3050' *Cleland Sst.	614' *Deception Mb. 650' *Illara Sst. Mb.	*Cleland Sst.	1600' *Cleland Sst.	6000' * Maurice Fm. ? *Ellis Sst. 2000' / * Sir Frederick Cong. 1200'
	Cambrian Lower	1100– 1600' Hugh River Shale ?	?	1300' *Tempe Member 960' *Eninta Sst. Mb.	? Mt. Currie Conglomerate ?	? ?	?
PRECAMBRIAN		800 –2800' Arumbera Greywacke 2200– 4000' Pertatataka Fm. ?	?	Pertatataka Fm. ?	* Winnall ? Beds	6000'± * Winnall Beds	2800' * Boord Fm. / 4100' *Carnegie Fm.
		Areyonga Fm. 1300' ?		Areyonga Fm. ?	Unnamed units	* Inindia Beds ?	?
		?	?	?	?	?	?
		2500' Bitter Springs Lst. ?	Bitter Springs Lst. ?	Bitter Springs Lst. ?	* Pinyinna ?	Bitter Springs ?	1200' Bitter Springs Lst. ?
		600 –1500' Heavitree Quartzite	Heavitree Quartzite		–Dean Quartzite		1200'+ Heavitree Quartzite
		Arunta Compled.					

thick transitional and continental sandstone sequence of the Mereenie Sandstone. The Pertnjara Formation, a thick sequence of siltstone, sandstone and conglomerate in the northern part of the basin, was deposited after the Mereenie Sandstone during the first major uplift of the basin sediments.

A major period of folding along west-north-west trending axes followed the deposition of the Pertnjara Formation. The folding was accompanied by thrusting in some areas and the strike of the thrust planes parallel the fold axes. The Bitter Springs Limestone has acted as an incompetent formation during regional folding, and is sheared and contorted where exposed in the cores of anticlines. Geophysical evidence suggests that some anticlines are not reflected in the basement. Diapiric structures formed by intrusion of evaporites from the Bitter Springs Limestone appear to have developed gradually or spasmodically over a long period; at one locality movement began in the Proterozoic and finished during deposition of the Pertnjara Formation.

Oil and gas shows were obtained in three bores, two by private companies and one by the B.M.R., during drilling in 1963. The shows were at various levels - Upper Proterozoic Pertatataka Formation, Middle Cambrian Jay Creek Limestone, and in the Middle Ordovician Stairway Sandstone. Structures formed by folding and some by salt intrusion have been located by field mapping and geophysical methods, and good reservoir conditions should be present.

Field mapping in the Amadeus Basin was continued in 1963 by private company geologists and by the B.M.R. whose regional work is due to be completed in 1964. Regional gravity surveys have been run over the whole of the Amadeus Basin, mainly by B.M.R., and some seismic and aeromagnetic work has been done by both private companies and B.M.R. The drilling by B.M.R. is part of a shallow-hole drilling programme for phosphate. Two deep wells, Ooraminna and Alice, have been completed by companies.

3. BONAPARTE GULF BASIN, (Palaeozoic).

The basin was named by Reeves (1951) but its outlines for Plate 1 are taken from Traves (1955). The Burt Range and Carlton Basins, to which Traves refers, are subdivisions of the Bonaparte Gulf Basin but they are not shown on the map. Noakes, Öpik and Crespin (1952) take the margins of the basin to the edge of the Continental Shelf; i.e. they include part of the Sahul Shelf. The description of the basin given below is by P.J. Jones; in addition to the above references, the following were used: Matheson and Teichert, (1948); Öpik, (1956); Traves, (1956); Thomas, (1957); McWhae, Playford, Lindner, Glenister and Balme, (1958); Thomas, (1962, 1964).

The Bonaparte Gulf Basin includes the Palaeozoic rocks bordering the Joseph Bonaparte Gulf, see Plate 2; it lies partly in Western Australia, and partly in the Northern Territory. Excluding its seaward extension (the Sahul Shelf), it covers about 8,000 square miles, bounded by the Precambrian rocks of the Kimberley Block and the Halls Creek Mobile Zone (Traves, 1955).

The estuary of the Victoria River (Queens Channel) divides the Palaeozoic sediments into two areas - the southern and northern portions of the basin. Cambrian, Ordovician, Devonian, Carboniferous, and probable Permian sediments crop out in the southern portion, but only Permian, Lower Triassic and undifferentiated younger sediments are known north of Queens Channel.

Upper Proterozoic sandstones, shales, limestones, and dolomites, and highly deformed Lower Proterozoic metasediments are unconformably overlain by basalts, agglomerates, and tuffs (Antrim Plateau Volcanics) or probably Lower Cambrian age. These volcanic rocks cover a large area of plateau country, and in part, form the basement for Palaeozoic sediments.

The Upper Proterozoic sediments and the Antrim Plateau Volcanics are overlain by a marine sequence of 2,000 feet of Middle and Upper Cambrian sandstones with minor shales and limestones. The Upper Cambrian sandstones pass up into about 550 feet of Lower Ordovician glauconitic sandstone.

There is no record of Middle and Upper Ordovician, Silurian, or Lower Devonian sedimentation; during part of this time, the Bonaparte Gulf Basin was probably a land surface. Deposition recommenced in Upper Devonian or perhaps Middle Devonian times, with about 3,000 feet of cross-stratified, conglomeratic sandstone, which overlaps Cambrian and Upper Proterozoic rocks in the present south-west border of the basin. This sandstone is conformably succeeded by a marine sequence of about 4,000 feet of alternating sandstones and limestones, which contains an Upper Devonian fauna at its base, and an early Lower Carboniferous fauna near the top.

This succession is conformably overlain by later Lower Carboniferous sediments, represented by a marine sequence, about 2,000 feet thick, consisting of sandstones, limestones and dark grey pyritic shales. North of the Weaber Range, the Lower Carboniferous sequence is overlain by more than 1,000 feet of cross-stratified, conglomeratic sandstones.

Cross-stratified sandstones, about 800 feet thick, with a basal conglomerate, which may reach a thickness of 1,000 feet, crop out in the present south-east border of the basin; a trachyte flow, 2 feet thick, is interbedded with the sandstones. These rocks represent an undefined part of the Carboniferous-Devonian sequence. The Palaeozoic succession is closed by a marine bed and beds with large pebbles, probably of glacial origin, which probably represents the Lower Permian.

North of the Queens Channel, at least 1,500 feet of sandstone, siltstone, and shale with coal, crops out in a belt extending from Fossil Summit to Point Blaze. This sequence is mainly of Upper Permian age, the lower beds represent late Lower Permian, and the uppermost beds are probably Lower Triassic. On the eastern edge of the basin this sequence unconformably overlies Precambrian rocks.

The youngest rocks of the basin occur as small outliers, south-east of Port Keats Mission. These consist of a thin veneer of laterite, limonite clays and sandstones, with a basal conglomerate, and represent an undefined part of the Mesozoic, or Cainozoic. These have been shown by Traves (1955) as Mullaman Group.

The Bonaparte Gulf Basin is separated from the Ord Basin by a belt of deformed Cambrian and older rocks, which extends southwards from Darwin to Halls Creek. Traves (1955, p.90) referred to this belt as the Halls Creek Mobile Zone.

Faulting provides the major structural features of the basin. Proterozoic faults were reactivated during the Palaeozoic, dividing the basin into areas of different sedimentary histories. Generally, the beds south of the Victoria River plunge gently to the north-east, and those north of it plunge gently to the west.

The dominant fault-system trends north-north-east, and forms the eastern border of the basin. It is visible in the south as the Cockatoo Fault, but immediately south of the Victoria River, it is not exposed. In the north, this system extends inland north-east of Port Keats.

In the southern portion of the basin, a Proterozoic uplift (the Pincombe Range) separates the Carlton area, in the north-west, from the Burt Range and Spirit Hill areas, in the south-east. In the Carlton area, the Cambrian-Lower Ordovician sequence dips up to 40 degrees, mainly to the north-east. Devonian rocks dip gently to the north-east, between Ninbing and the coast. Strike-faults in the Carlton area, trending from north-west to north-north-west, form a minor fault-pattern, subsidiary to the dominant north-north-east trend. In the Burt Range area, the Devonian-Carboniferous sequence dips gently to the east. Exposed anticlines are rare and poorly expressed, appearing as broad folds along the faulted eastern margin of the basin. Immediately east of the Burt Range, a broad anticline is situated within the Cockatoo Fault system. Like the Spirit Hill anticline situated further to the north, its axis has a northerly pitch.

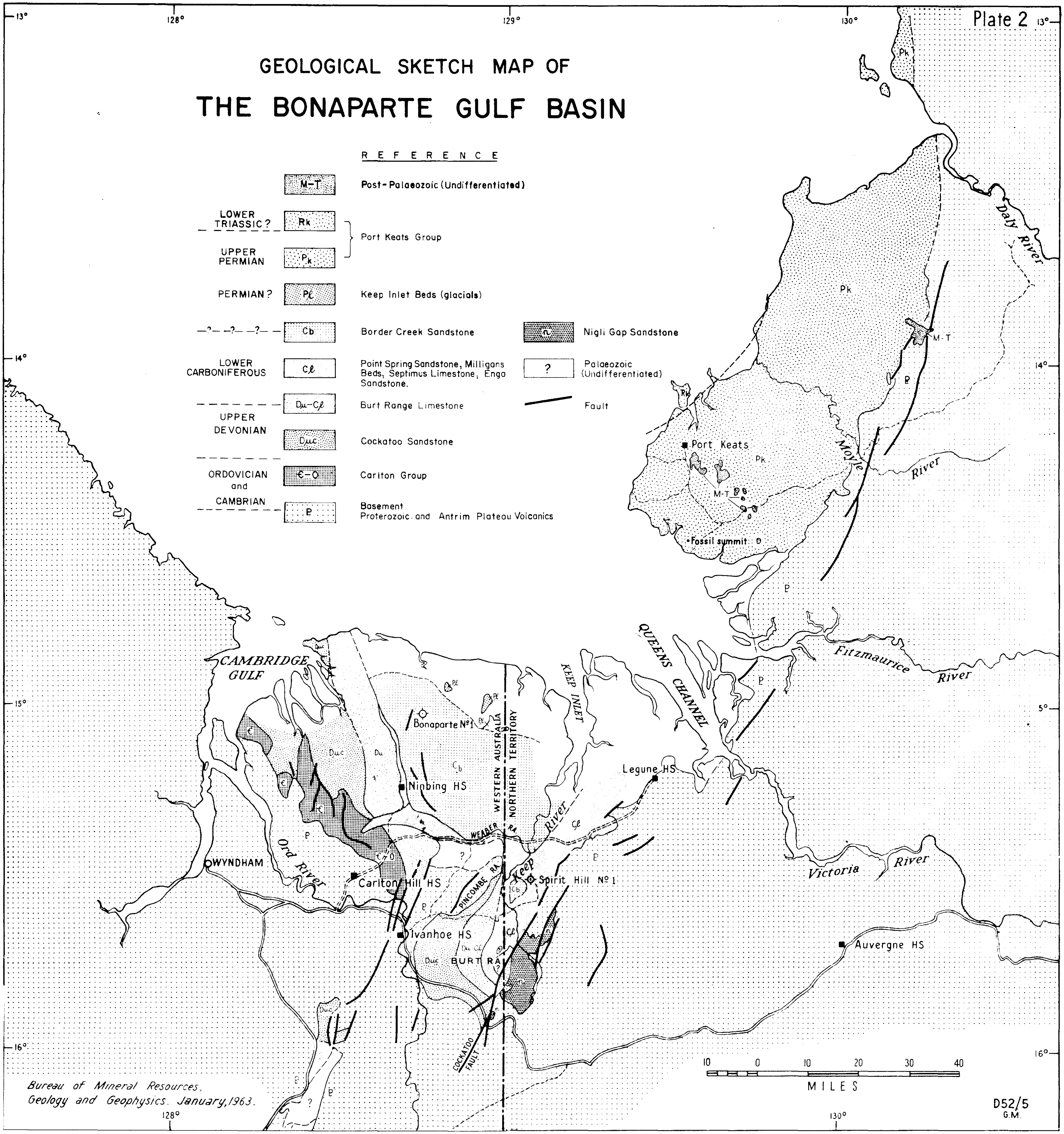


Plate 2
GEOLOGICAL SKETCH MAP OF
THE BONAPARTE GULF BASIN
REFERENCE
M-T Post-Palaeozoic (Undifferentiated)
LOWER TRIASSIC?
Rk
UPPER PERMIAN
Pk
Port Keats Group
PERMIAN?
Pl Keep Inlet Beds (glacials)
Cb Border Creek Sandstone
LOWER CARBONIFEROUS
Cl Point Spring Sandstone, Milligans Beds, Septimus Limestone, Enga Sandstone.
Du-Cl Burt Range Limestone
UPPER DEVONIAN
Duc Cockatoo Sandstone
ORDOVICIAN and CAMBRIAN
Є-O Carlton Group
P Basement Proterozoic and Antrim Plateau Volcanics
Nigli Gap Sandstone
? Palaeozoic (Undifferentiated)
Fault
Daly River
Moyle River
Port Keats
Fossil summit
Fitzmaurice River
QUEENS CHANNEL
KEEP INLET
CAMBRIDGE GULF
Bonaparte Nº1
WESTERN AUSTRALIA
NORTHERN TERRITORY
Legune HS
Ninbing HS
WEBER RA
Keep River
WYNDHAM
Ord River
Carlton Hill HS
PINCOMBE RA
Spirit Hill Nº1
Victoria River
Ivanhoe HS
BURT RA
Auvergne HS
COCKATOO FAULT
MILES
10 0 10 20 30 40
Bureau of Mineral Resources, Geology and Geophysics. January, 1963.
D52/5
G.M.
13° 14° 15° 16° 128° 129° 130°

TABLE 2.

STRATIGRAPHIC SUCCESSION OF THE BOWEN BASIN

	Unit		Maximum thickness in feet (surface)	Lithological Character.
TERTIARY			1,000+	Basic and acidic lavas and associated intrusives; non-marine sediments and alluvial deposits.
TRIASSIC	Moolayember Formation	Cabawin Formation	1,500	Olive-green and brown shales, interbedded sandstone.
	Clematis Sandstone		1,000	Mainly sandstone but with some interbedded shale.
	Rewan Formation		2,300	Brown (chocolate), green and grey shale and lithic sandstone.
PERMIAN (Probably beginning in Upper Carboniferous)	Upper Bowen		10,500*	Lithic sandstone, calcareous sandstone, siltstone, carbonaceous shale and coal, abundant conglomerate in places and some tuff and agglomerate. No evidence for marine conditions.
	Middle Bowen		8,000	Greywacke and sub-greywacke quartz sandstone, calcareous in places with some limestone. In some areas probably entirely marine but elsewhere with marginal deposits and coal measures.
	Lower Bowen		10,000+	Volcanics, mainly andesitic, and intermediate intrusives. Sediments well developed locally. Siltstones, sandstone and conglomerates with some thin coals. No evidence for marine conditions.

* Probably includes some Rewan equivalent.

The geology of the region north of the Weaber Range is not well known. This region probably contains the thickest section of Palaeozoic sediments. From the known thicknesses of the exposed sediments in the south, an estimation of between 10,000 feet and 13,000 feet would be reasonable. If, however, the gravity high at the mouth of the Victoria River represents a basement uplift at shallow depth under the alluvium, then the Palaeozoic section may be much thinner.

The oil and gas prospects of the Bonaparte Gulf Basin are unknown. Traves (1955) recognised source rocks and reservoir sediments in the basin and, although not optimistic about the prospects of finding oil on the available knowledge at that stage, did suggest that structural traps may exist. Field mapping by the B.M.R. in 1963 and current drilling and geophysical surveys by private companies should provide valuable additional information.

4. BOWEN BASIN, (Permian to Triassic).

The definition and description of the Bowen Basin given below is by J.M. Dickins. His references are: G.S.Q., (1960); Hill, (1957, based on the work of Shell Queensland Development); Hill and Denmead, (1960); Malone, Corbett and Jensen, (in press); Reid, (1929, 1930); Veevers, Randal, Mollan and Paten, (in press). The outlines of the Bowen Basin shown on the sedimentary basins map are after Hill and Denmead, and mapping by the B.M.R. and Queensland Geological Survey during the period 1960 to 1962. The part of the basin shown extending south beneath the Surat Basin towards the Sydney Basin is based on evidence available from B.M.R. and subsidised drilling and geophysical work.

The Bowen Basin is a large basin with subsidiary troughs. It is narrow at the north near Collinsville and extends to Theodore in the south-east and Springsure in the south-west. At the south it is overlapped by Mesozoic rocks of the Surat Basin, a part of the Great Artesian Basin; the boundary at the surface is taken at the base of the "Bundamba Group". A structural boundary extending south-south-east from the Eungella strip of Lower Bowen Volcanics and granite to the 'Gogango High' and 'Auburn Granitic Complex' (Hill and Denmead, 1960, Fig.1) is taken to mark the eastern limit of the Bowen Basin; the 'Anakie Structural High' separates the Bowen Basin from the Drummond Basin in the west. The surface area of the Bowen Basin is about 33,000 square miles. The subsurface part of the Bowen Basin below the Surat Basin appears to be mainly fault controlled along the eastern side, but along the western edge the sediments apparently lens out over a basement shelf area.

The main sedimentation in the Bowen Basin occurred during the Permian and Triassic. During the Permian this sedimentation extended also into the Styx River area and possibly into the Yarrol Basin (used in a restricted sense). The stratigraphic succession is shown in Table 2.

The Lower Bowen Volcanics is a very thick unit consisting of flows, tuffs and agglomerates with associated apparently non-marine sediments and thin coals. The undivided fresh-water sediments which contain coals and are found in wells between Roma and Springsure appear to be of the same age. In A.O.E. Reid's Dome No.1 these sediments are 5,000 feet thick. The Middle Bowen Beds (including the Back Creek Group) contain both marine and non-marine strata. Recent work has shown a thickness of 8,000 feet of mainly marine siltstone, subgreywacke and sandstone in the Blenheim area in the north-eastern part of the basin. The Upper Bowen Coal Measures apparently contain Rewan equivalents at the top in the northern part of the basin where the maximum thickness is found.

The Triassic formations, which are predominantly non-marine, are thin in the northern part of the basin and thicken to the south particularly in the Mimosa Syncline which extends from the south-eastern subaerial part of the basin to the south under the Surat Basin; here the Triassic Cabawin Formation may exceed 7,000 feet in thickness, and the top of the Permian is as deep as 18,000 feet in the centre according to seismic data. The Carborough Sandstone of the northern part of the basin is shown on the accompanying stratigraphic chart as equivalent to the Clematis Sandstone of the southern part on the evidence of recent mapping.

The Tertiary which covers parts of the basin consists of volcanics, associated intrusives, and continental sediments; locally these may be relatively thick but generally they form thin superficial deposits.

In detail the basin has a complicated structure with several subsidiary troughs. Tectonic movements appear to have affected different parts of the basin differently at a number of times. The western part of the basin can be regarded as a platform or intracratonic area with both shelf and deeper water sedimentation. Tectonism becomes increasingly complex to the east apparently towards the mobile, geosynclinal area where the thickest marine Permian is found. Extensive late to post-Permian intrusions, strong folding and faulting have taken place in this eastern zone and low grade regional metamorphism is found along the eastern margin of the basin. Relatively gentle folds and possibly drape structures, together probably with some compressional faulting are found in the western platform area. To the south, the Bowen Basin possibly had periodic connections with the Sydney Basin.

The presence of oil and gas in the Permian sediments of the Bowen Basin, below the Surat Basin, (and in the Jurassic sediments of the Surat Basin) has been demonstrated in the Cabawin and Moonie areas. Although thin marine sediments may be present in the post-Permian, the only satisfactory source known for oil and wet gas is the marine rocks of the Permian. The Lower Jurassic Precipice Sandstone has proved to be the best reservoir to date. Permian and Triassic sandstones may have reservoir properties in some parts of the basin, but so far their lenticular nature and poor porosity and permeability characteristics, restrict their prospects as reservoirs. Because of this, many promising structures have proved unproductive, even though oil and gas have been detected. The best prospects in the Bowen Basin seem to lie in the western and southern (subsurface) parts; in the northern and eastern areas, prospects are rated lower because of greater tectonic activity and igneous intrusion.

B.M.R. and G.S.Q. field parties have been mapping the Bowen Basin from north to south since 1960 in a programme designed to finish in 1964. Much work has been done in the past by private companies, but most interest has been shown since the Cabawin discovery in 1961.

5. CANNING BASIN, (Palaeozoic to Mesozoic).

Outlines of the Canning Basin as shown on the map, and the summary of the geology given below are taken mainly from Veevers and Wells (1961), although the south rim of the basin has been altered as a result of gravity surveys by the B.M.R., (Lonsdale and Flavelle, 1963). The Fitzroy Basin ("depression" or "trough") is a division separated from the South Canning Basin by a ridge-like feature, the Broome ridge (or "swell"), which includes the Jurgurra Terrace. A more recent summary of the geology by Playford (1962) has also been used in this description.

The Canning Basin is the largest sedimentary basin in Western Australia, and the second largest basin in Australia. Excluding the seaward extension of the basin on the Rowley Shelf, its area is 150,000 square miles. The sediments overlie a Precambrian basement, which in most areas consists of crystalline rock (gneiss, schist), and in the north-eastern part of unaltered Upper Proterozoic sedimentary rocks.

The Palaeozoic sediments consist of about 3000 feet of widespread Ordovician marine limestone, dolomite, shale, and sandstone; about 5000 feet of Devonian marine organic reefs and associated sediments, conglomerate, sandstone, siltstone, calcilutite, and limestone breccia, all confined to the northern part of the basin, called the Fitzroy Basin; Devonian plant-bearing sandstone in the north-eastern part of the basin; at least 6000 feet of Carboniferous marine calcarenite, sandstone, and siltstone, also confined to the Fitzroy Basin; and widespread Permian fluvioglacial sediments, marine quartz greywacke, conglomerate, sandy limestone, and shale, and freshwater sandstone 14,000 feet thick in the Fitzroy Basin, and much thinner elsewhere.

The Mesozoic sediments consist of about 1000 feet of Triassic estuarine shale and siltstone, and freshwater sandstone; and about 2000 feet of Jurassic and Cretaceous marine sandstone, conglomerate, glauconitic siltstone, and shale, and freshwater sandstone.

Cainozoic sediments are superficial, and consist of coastal aeolianite and other coastal sediments, desert sand, travertine, black soil, alluvium, river gravels, freshwater limestone, and evaporites.

The Canning Basin is a broad area of sedimentation with two main divisions: the Fitzroy Basin and South Canning Basin. The Fitzroy Basin is a trough with about 20,000 feet of sediments folded into three anticlinal belts, and is bounded by hinges (the Pinnacle Fault in the north, the Dampier Structure and Fenton Fault in the south). Playford describes the Jurgurra Terrace, 'bounded on the north by the Fenton Fault and its projection to the west, and on the south by the Dampier Fault', as a small area where basement depths are intermediate between those of the Fitzroy Basin and the South Canning Basin. Drilling of Frome Rocks No.1 on this terrace showed the presence of a salt dome which intrudes Devonian and Permian rocks. Thick sediments, about 10,000 feet thick, are known in a structural depression under Samphire Marsh in the south-western corner of the South Canning Basin; between this depression and the Fitzroy Basin, the sediments are only about 5000 to 7000 feet thick. However, as a result of gravity work, another deep basin is thought to exist in the south part of the South Canning Basin (Flavelle and Goodspeed, 1962). The Lennard Shelf along the northern edge of the Canning Basin, bounded by the North Kimberley Precambrian Massif on the north and the Fitzroy Basin on the south contains Ordovician and Devonian to Permian rocks and the Devonian reef complexes.

Prospects for oil in the Canning Basin must be considered as favourable, because of thick source beds and potential reservoirs. One of the difficulties to date has been the location of closed structures or traps in a suitable environment. For this reason, the efforts of West Australian Petroleum Pty Ltd, since 1960 have been directed mainly towards geophysical surveys, and only three subsidised wells have been drilled.

6. CAPE VOGEL BASIN, (see Papua and New Guinea).

7. CARNARVON BASIN, (Ordovician to Tertiary).

The outline of the main basin is shown in McWhae, Playford, Lindner, Glenister and Balme (1958); the margin on the basins map accompanying this report has been slightly modified after Condon (1956), and his subdivisions - the Onslow, Merlinleigh, Gascoyne, Bidgemia and Byro Basins - are also shown.

J.M. Dickins has described the basin and summarized the geology for this report using the following references: Condon, Johnstone, Perry and Crespin, (1953); Condon, (1954); Condon, Johnstone, Prichard, and Johnstone, (1956); McWhae, et al, (1958); Konecki, Dickins and Quinlan, (1958); Perry and Dickins, (1960).

The Carnarvon Basin stretches from Onslow (slightly north of Latitude 22°S.) to the Murchison River (just south of Latitude 27½°S.) and eastward from the coast for about 130 miles to 116°E. Longitude - its area is about 45,000 square miles. The Proterozoic to Lower Palaeozoic rocks of the Badgeradda area in the south are included in the basin.

The lithological succession which is largely marine is shown in the following table.

TABLE 3

LITHOLOGIC SUCCESSION, CARNARVON BASIN

(Adapted from Playford & Johnson, 1959.)

Age	Maximum thickness (in feet)	Lithological Character
Tertiary	1,900	Calcarenite, limestone, and some minor sandstone near coast, thin Eocene sandstone extending to near eastern margin.
Cretaceous	2,500	Calcarenite, shale and siltstone, with basal sandstone.
Jurassic	11,500+	Claystone, restricted to Cape Range-Rough Range area, thinning rapidly to east with sandstone and siltstone.
Permian	12,000	Shale and siltstone, sub-greywacke, sandstone and limestone, with marine glacials at base.
Carboniferous	2,300	Limestone, sub-greywacke, siltstone and limestone.
Devonian	4,700	Sandstone, limestone, siltstone and sub-greywacke.
Ordovician to Silurian.	6,500+	Limestone and dolomite overlying thick red sandstone with minor siltstone and conglomerate.
Proterozoic to Lower Palaeozoic.	11,000+	Sandstone, siltstone and sub-greywacke.

The Proterozoic to Lower Palaeozoic rocks, Badgeradda Group and Nilling Beds are thick sandstone and siltstone units in which no organic remains have been discovered. These are known only at the south-east end of the basin. The Ordovician to Silurian is composed of thick porous sandstone at the base, the Tumblagooda Sandstone which is 4,000 feet thick and may be non-marine. In the Perth Basin this unit is even thicker. Above this is the Silurian Dirk Hartog Limestone with marine fossils which is not known at the surface. These two units extend from the south-western part of the basin apparently as far north as Wandagee No.1 Well.

The Devonian is composed of sandstone near the base followed by thick fossiliferous marine siltstones and limestones and quartz sandstone, sub-greywacke and conglomerate. The Carboniferous has thick fossiliferous marine limestone near the base with silty sandstone and conglomerate followed by oolitic limestone and dark siltstone and sandstone.

The Permian is thick and widespread and, although mainly developed in relatively shallow water, shows a complex of environments with glacial sediments near the base followed by fossiliferous marine limestone and by clastic sediments varying from porous sandstone to deeper water dark marine siltstone and shale.

A major break is found between the Permian and the Jurassic which is represented by thin restricted pockets of sediments except in the Cape Range-Rough Range area where dark claystone, siltstone and sandstone has been penetrated in bores up to 11,500 feet thick (Cape Range No.2 Well). The Cretaceous and Tertiary are represented by thin marine shelf-type sediments; the Cretaceous succession has a porous sandstone, the Birdrong Formation, at the base.

The basin is dominated by a series of graben or half-graben structures which form a number of subsidiary basins. One of the main dividing features in the basin is the Wandagee Ridge, a major north-south subsurface horst. Faulting has been accompanied by some folding. Evidence for some compressional folding is found in the Devonian-Carboniferous in the Minilya River area in the eastern part of the basin, and in the Mesozoic and Tertiary of the north-western part where a number of north-north-east trending anticlines, some very large, are formed. Reversal of movement has occurred along some old fault lines including the Wandagee Hill fault which forms the east side of the Wandagee Ridge.

The most favourable source rocks for hydrocarbons are found in the Devonian, Carboniferous, Permian and Jurassic, and porous sands occur in the Devonian to Permian, and also in the basal Cretaceous Birdrong Formation which is an important aquifer in the Carnarvon Basin.

Three wells have been drilled under subsidy since 1960; these have been situated in the northern part of the basin along or near the central Wandagee Ridge. Subsidised geophysical surveys, all seismic, have also been concentrated in the northern half, particularly in the Rough Range - Learmonth area. Recent B.M.R. seismic work in the Carnarvon Basin has been mainly in the southern part.

8. CARPENTARIA BASIN, (see under Great Artesian Basin).

9. COONAMBLE BASIN, (see under Great Artesian Basin).

10. DALY RIVER BASIN, (Middle Cambrian).

The northern part of the Daly River Basin is essentially after Noakes (1949) and modified by later mapping by M.A. Randal and others of the B.M.R. Geological Branch; the western part is from Traves (1955); the queried southern and south-eastern boundaries are arbitrary ones suggested by B.M.R. geologists who have worked in nearby regions; and the eastern margin is also somewhat arbitrary, following a meridional trend suggested by the north-south structure in the east part of the Katherine 1:250,000 Sheet area, and a fairly steep gravity gradient from east of Newcastle Waters, (B.M.R. Gravity Map G69-412, 1960). M.A. Randal assisted in defining the limits of the basin and prepared the accompanying notes.

The Daly River Basin is occupied by Middle Cambrian rocks of the Daly River Group. The exposed portion of the basin is 80 miles wide and about 150 miles long, elongated north-west from south of Mataranka to near Adelaide River. The basin is probably continuous with the area of deposition of the Cambrian Montejinni Limestone, which crops out west of Newcastle Waters. However, Mesozoic sediments south-west of Mataranka obscure the contact. A probable connection between the Daly River Basin and the Georgina Basin is obscured by Mesozoic rocks north of Newcastle Waters.

The basin was probably initiated during the Upper Proterozoic with the deposition of the Buldiva Sandstone and other formations of the Tolmer Group, which was followed by the extrusion of the Antrim Plateau Volcanics. The sediments of the Daly River Group rest disconformably on these rocks, but in some areas have overlapped them and rest directly on folded rocks and granite of the Lower Proterozoic Agicondian System. The rocks of the Daly River Group include limestone, sandstone, shale, and siltstone. Outcrops are not common and no more than 200 feet of sediments are exposed at any place; no type sections are available.

The known stratigraphic succession of the Daly River Group includes -

the basal Tindall Limestone (500 feet) of fossiliferous, dark calcilutite and crystalline limestone, with sandstone and siltstone lenses, and some chert bands;

the Jinduckin Formation (200 feet) of unfossiliferous ferruginous sandstone, siltstone, silicified limestone, and dolomite;

the Oolloo Limestone (200 feet), conformably above the Jinduckin Formation, with pink, grey and white, flaggy limestone overlain by black massive lutitic limestone, commonly silicified and with chert bands; some fossil algae.

The Manbulloo Limestone Member is a locally developed horizontal variation of the Jinduckin Formation richer in carbonate lithologies. A basal conglomerate underlies the Tindall Limestone but nowhere is the contact between the two exposed; it has only limited distribution.

Apart from the gravity feature east of Newcastle Waters and the structure referred to in the Katherine area to the north, the Daly River Basin shows little surface evidence of folding or faulting. The Tindall Limestone spreads out as a sheet deposit and to the south-east and south-west is covered by Mesozoic sediments; the Jinduckin Formation and Oolloo Limestone appear to form a closed basin.

Middle Cambrian limestones could be considered as possible source rocks, and some porous sediments probably occur in the section. The location of sealed reservoir conditions, however, may prove difficult. The area remains untested either by geophysical methods or by drilling.

11. DRUMMOND BASIN, (Devonian, Carboniferous).

The Drummond Basin has been described by J.M. Dickins using the following references: Hill, (1957, based mainly on the work of Shell Queensland Development); Hill and Denmead, (1960); Malone, et al, (in press); Veevers, et al, (in press). Figures 1 and 25 of Hill and Denmead were used to delineate the Drummond Basin on the accompanying basins map.

This basin extends from south of Charters Towers southwards to Springsure. On the west it is overlapped by Mesozoic rocks of the Great Artesian Basin, and in the south by Permian rocks (Colinlea Formation) which extend across the Springsure Shelf area. The basin is bounded on the east by the rocks of the folded Anakie Metamorphics.

The lithologic succession is shown in Table 4.

TABLE 4

LITHOLOGIC SUCCESSION, DRUMMOND BASIN

Age	Maximum thickness (in feet)	Lithological Character
Tertiary	-	Basic and acid volcanics of limited extent and continental sediments.
Carboniferous	15,000	Acid lavas, tuff, agglomerate and tuffaceous siltstones and sandstones.
	20,000	Siltstone, siliceous conglomerate, sandstone, tuff and algal limestone.
Devonian	10,500	Siltstone, sandstone, limestone, conglomerate, algal limestone, tuff, tuffaceous sandstone and intermediate to acid lavas. Includes some marine sediments.

The oldest rocks whose age is definitely known are Middle Devonian - the Ukalunda Beds near the northern part of the basin comprise at least 4,000 feet of relatively undisturbed marine siltstone and as well as being Middle Devonian possibly contain Lower Devonian strata. Except in the Upper Devonian Mt. Wyatt Beds no definite marine horizons are known above the Middle Devonian and marginal and continental sediments predominate. In the absence of satisfactory fossil evidence, lateral relationships are difficult to establish and the Devonian and Carboniferous are difficult to separate. The stratigraphic position of the Joe Joe Creek Formation is uncertain; it is unconformable below the Permian Colinlea Formation and may be disconformable over the Lower Carboniferous.

The overall structure of the basin is obscure. On the east, however, sediments of the basin dip westerly off the Anakie Metamorphics and associated granitic intrusions. Many anticlines of moderate complexity trend in a general north-south direction; some of these are large. Considerable faulting, including thrusting, is associated with the folding.

Indications of hydrocarbons, attributed to localised baking of Upper Devonian-Lower Carboniferous shales, were reported from 438 to 477 feet in P.O.P.L. Twin Hills No.1, (G.S.Q., 1960). Source rocks appear to be poorly represented in the section, although the Ukalunda Beds with marine siltstone are at least 4,000 feet thick; the sediments are indurated in parts due to igneous intrusions and folding.

Work done in the area in recent years has been mainly geophysical - aeromagnetic surveys by B.M.R. and private companies cover most of the area, and gravity work has been done in 1963 for B.M.R. in the northern part.

12. EROMANGA BASIN, (See Great Artesian Basin).

13. EUCLA BASIN, (Cretaceous to Tertiary).

The Eucla Basin was first named as an hydrological basin, and the map accompanying the report of the First Interstate Conference on Artesian Water (1913) was used as the basis for its outline; the western edge has been changed to conform with the Tectonic Map of Australia (1960). The margins roughly represent the limits of marine Tertiary deposition north of the Great Australian Bight, and enclose an area of 74,000 square miles.

The basin is broad and shallow with up to 930 feet of Tertiary sediments and 1,200 feet of Cretaceous beds over Precambrian - ?Cambrian rocks, (Ludbrook in Glaessner and Parkin, 1958; McWhae, et al, 1958). The main stratigraphic units are as follows:

Quaternary	- Recent dunes and older aeolianites; a thin veneer of marine sandy limestone (Pleistocene) occurs in Western Australia.
Tertiary	- The Eucla Group of marine limestones (Lower Miocene and Upper Eocene) reaches a maximum known thickness of 903 feet in the Madura Bore in Western Australia; it overlies 24 feet of Lower Tertiary conglomerate. In South Australia, the Eucla Group is underlain by paralic sediments including carbonaceous siltstone and lignite and these are estimated to be up to 160 feet thick.
Cretaceous	- The Madura Shale consists of marine to marginal marine beds with a maximum known thickness of 1,100 feet in the Madura Bore; sediments include shale, sandstone and greensand.
?Lower Cretaceous	- Basal beds of conglomerate and sandstone with thin mudstone bands occur below the Madura Shale and rest unconformably on Precambrian rocks; greatest known thickness is 200 feet and this is found in the northern part of the basin.
Upper Proterozoic - ?Cambrian	- Chocolate and green shale and sandstone occur between basement granite and Cretaceous beds in the South Australian part of the basin. Their maximum known thickness is 200 feet in the Guinewarra (Nullabor No.4) Bore.

An aeromagnetic survey by the Bureau of Mineral Resources in 1954 (Quilty and Goodeve, 1958) showed that the thickest accumulations of sediments (2,000 feet estimated) are in the south-west and north-east parts of the basin; no major structures were apparent. Basement is shallow in the north (and in the southern part of the Officer Basin) and south in the Great Australian Bight, and crops out at the eastern and western sides of the basin.

No further subsidised operations have been undertaken since 1960; on available information, the prospects of finding an economic hydrocarbon accumulation do not appear to be good.

14. FITZROY BASIN, (See Canning Basin).

15. GEORGINA BASIN, (Middle Cambrian to Devonian).

The outlines of the basin are based mainly on mapping in west and north-west Queensland by B.M.R. - Q.G.S. geological surveys and in the Northern Territory by B.M.R. parties from 1957 to 1963. The 'Barkly Basin' as shown by Noakes and Traves (1954) and the 'Undilla Basin' of Opik (1956) are included in the Georgina Basin. However, the Mitchieboo Fault in the Mt. Drummond area (Smith and Roberts, 1962) may trend south-west towards the Tennant Creek - Frew River area and up-thrown basement may form a concealed boundary to a northern subdivision of the Georgina Basin. The north-east part of this possible boundary is shown on the map. Extensions to the western part of the basin are based on information obtained from stratigraphic drilling by the B.M.R. and from water bores. The definition and description of the basin is given by K.G. Smith.

The Georgina Basin is defined as that area of lower to middle Palaeozoic sediments extending in a north-west trending belt from the Mt. Whelan area of western Queensland to the Larrimah area of the Northern Territory, and bounded on the east, north-east and west mainly by Precambrian rocks; in the north-west, it is covered in part by Mesozoic sediments. The basin contains several thousand feet of marine sediments and occupies an area of about 110,000 square miles. Sediments regarded as the basal beds of the Georgina Basin in this report are Middle Cambrian in age, but they are underlain in some marginal areas by thousands of feet of Upper Proterozoic and Lower Cambrian sediments, including sandstone, siltstone, arkose, greywacke and carbonate rocks. The Georgina Basin sediments extend subsurface below Mesozoic sediments of the Great Artesian Basin to the south-east in the south-east plunging Toko Syncline, and are partly buried to the east around the southern edge of the Cloncurry Shield Complex; the Georgina Basin sediments actually occur in a Precambrian to Lower Cambrian shelf area and, where folded, may protrude as inliers through the Mesozoic sediments. The edge of the shelf area is reflected as an extensive belt of steep gravity gradients and is shown on the basins map.

The thickest known stratigraphic successions in the Georgina Basin crop out in the south and south-east, in the Huckitta, Tobermory, Glenormiston and Boulia areas and are formed by Cambrian and Ordovician sediments. Palaeontological evidence indicates numerous breaks in deposition of the Cambrian and Ordovician sequence. Measured sequences in these areas are as follows:

Huckitta area - 5,500 feet of dominantly carbonate rocks with subordinate siltstone and sandstone. This succession ranges from lower Middle Cambrian to Middle Ordovician in age and it is overlain unconformably by sandstone of Upper Devonian age.

Tobermory and Glenormiston area - mainly carbonates with minor sandstone, siltstone and shale, 5,000 feet thick and ranging in age from lower Middle Cambrian to Middle Ordovician. The best exposures are in the limbs of the Toko Syncline which plunges south-east beneath the Great Artesian Basin. Upper Cambrian carbonate sediments are much thinner in this area than in the Huckitta area, but the Ordovician sequence is thicker.

Boulia area - 4,200 feet of dominantly carbonate rock with shale, sandstone and siltstone ranging from Upper Cambrian to Lower Ordovician; Middle Cambrian sediments are not known in outcrop. The thickest section of Lower Ordovician crops out in this area.

In most other parts of the Georgina Basin, marine Middle Cambrian sediments dip off the Precambrian rocks and form a thin blanket of almost horizontal deposits over a large area which includes the Barkly Tableland, the Frew River - Elkedra area, and the north-western part. The thickness is usually less than 1,000 feet, but a water bore at Alexandria Station was drilled through 1,760 feet of Middle Cambrian sediments. The sediments are mainly richly fossiliferous shales and limestones, with some sandstone and dolomite.

In the area covered by the thin blanket of Middle Cambrian sediments the only evident structural deformation is due to a few faults of small displacement. Farther south, between Ranken and the areas of thick sedimentation south of 22° S. Latitude, gentle folding is evident. However, the Lake Nash "Anticline", a fairly prominent structure about ten miles long and trending east-west in this region, is due to draping over a basement high.

In the areas of thick sedimentation structural deformation is locally intense, and associated mainly with faulting movements. The most prominent fold structure is the Toko Syncline, which is an asymmetric fold trending from the Tobermory area south-eastwards into the Mt. Whelan area of Queensland. In the Huckitta area there are a small number of anticlines and domes closed in Upper Cambrian sediments, and in both the Huckitta and Tobermory areas there are several monoclines associated with faults. The most prominent structures in the Huckitta and Tobermory areas are north-westerly trending faults. Some of these can be traced for distances of up to fifty miles; displacement is consistently down on the east. Upper Devonian sediments have been displaced by some of these faults, which probably occurred in Kanimblan time.

In western Queensland the Burke River Structures trend from Duchess south-south-east across the Boulia area, where the Upper Cambrian and Lower Ordovician sequence has been folded and faulted.

The Cambrian rocks in the northern part of the Georgina Basin have yielded small amounts of asphaltic material by drilling, and small gas shows. Ordovician sediments in the southern (Toko Syncline) part of the basin have possible source rocks. However, good reservoirs may be hard to locate. Phillips Petroleum drilled 3,800 feet of Middle Cambrian sediments in the Black Mountain structure but no oil or gas shows were found.

Most of the Georgina Basin has been mapped by B.M.R. and joint B.M.R. - Q.G.S. parties; some surface mapping and photogeological interpretation has been done by private companies. Eight holes have been drilled by companies and, with the exception of Black Mountain No.1, located basement at about 1,700 feet or less. A shallow stratigraphic coring programme was conducted by the B.M.R. in 1962. A series of three deeper holes is to be drilled by the B.M.R. late in 1963 and early 1964. Most of the Georgina Basin has been covered by geophysical surveys, mainly gravity and aeromagnetic. Seismic methods have not been successful in areas of thick carbonate deposits, but are proving useful in the southern, subsurface part of the Toko Syncline where the non-carbonate clastics are thicker.

16. GIPPSLAND BASIN, (Cretaceous - Tertiary).

The outline of the Gippsland Basin was first shown in the report of the Fifth Interstate Conference on Artesian Water, Sydney, 1929. Boutakoff (1955) shows the structure of the basin. These outlines have been drawn on the limits of Tertiary sedimentation. Recent drilling, however, has shown the importance of Cretaceous sediments in this basin, and the western end has been extended to include the Cretaceous rocks trending south-west to the Bass Basin. The south-east side of this extension is based on a steep gravity gradient bordering basement outcrops. The land area of the Gippsland Basin occupies 3,500 square miles. Submarine continuations of the basin to the east have been drawn from aeromagnetic work done by the Geophysical Branch of B.M.R., and by Haematite Explorations Pty Ltd, (Reford, 1962).

The stratigraphy of the basin is given by Webb (1961), and further information is provided by the log of Wellington Park No.1 which was abandoned in 1962, (Ingram, 1962). Webb states that Tertiary sediments are up to about 4,200 feet thick south of Lake Wellington, but only 3,400 feet were penetrated in Wellington Park No.1 where the section was as follows:

Quaternary	- White, yellow, red sand, and blue, green, brown clay to 120 feet.
Upper Pliocene	- Haunted Hill Gravels - sand, pebbles, 260 feet.
Lower Pliocene	- Jemmy's Point Formation - sand, abundant fossils, 80 feet.
Upper Miocene	- Tambo River Formation - brown marl, fossiliferous sand 260 feet.
Miocene	- Gippsland Limestone - grey fossiliferous glauconitic marl and limestone, 1430 feet.
Oligocene	- Lakes Entrance Formation - green and brown calcareous shale, abundant forams, glauconite, 230 feet.
Upper Eocene - Lower Oligocene	- Latrobe Valley Coal Measures - sand, brown coal, siltstone, clay, dolomite, 1,000 feet.

Below these sediments were 430 feet of ?Lower Cretaceous sandstone, claystone and mudstone which may be compared with the Waarre Formation in the Otway Basin, and more than 8,000 feet of Strzelecki Group (Lower Cretaceous) arkose and greywacke, with some shale, siltstone, sandstone and coal.

Webb describes three areas of Devonian sedimentation from around the edge of the basin:

(i) The Mitchell River area where fossiliferous Lower-Middle Devonian sediments - coarse sandstone and conglomerate up to 1,200 feet thick, 350 feet of siltstone, and sandstone, limestone and calcareous sediments up to 8,600 feet thick - unconformably overlie folded Ordovician beds. These Devonian sediments from the Wentworth Group are overlain with pronounced unconformity by non-marine clastics and some volcanics of the Iguana Creek Group (Upper Devonian) about 1,000 feet thick.

(ii) The Buchan area. Volcanics of Lower Devonian age up to 2,000 feet thick are overlain by the richly fossiliferous and cavernous Buchan Caves Limestone (up to 800 feet thick). The Taravale Formation of fossiliferous shale, limestone and calcareous mudstones, and Murrindal Limestone (up to 970 feet) occur conformably above the Buchan Caves Limestone. The Murrindal Limestone is regarded as a Middle Devonian bioherm development with the Taravale Formation being its fore-reef facies.

(iii) Along the west side of Waratah Bay, (north-west of Wilson's Promontory and just south-east of the western limits of the basin), are 900 feet of Middle Devonian fossiliferous limestones which overlie Cambrian greenstones.

The Lower-Middle Devonian sediments were deposited in troughs with meridional trends which were formed in the strongly folded Lower Palaeozoic basement rocks. During the Tabberabberan Orogeny which followed, the Lower-Middle Devonian beds were also folded and faulted with some thrusting. The main Palaeozoic orogenies at this time were along north-east - south-west and north-west - south-east axes, (Boutakoff, 1955). The Upper Devonian sediments of the Mitchell River area are only gently deformed.

Mesozoic structures are almost east-west. They consist of faults and folding associated with major block faulting. Tertiary strata are only gently deformed and Webb considers that in most cases Tertiary structures reflect the Mesozoic structures.

Oil has been known in the Gippsland Basin for a long time, but good reservoir - trap relationships have yet to be found. Recent drilling results and geophysical work suggest that encouraging prospects may occur off-shore.

17. GREAT ARTESIAN BASIN.

The Great Artesian Basin has three main divisions: the Surat, Eromanga, and Carpentaria Basins, and some smaller subdivisions. The boundaries of most of the subdivisions are indefinite and the division "Great Artesian Basin" cannot yet be abandoned in favour of the smaller units. The subdivisions are briefly defined hereunder in alphabetical order and their stratigraphy is compared in Table 5. The total area is 680,000 square miles.

Carpentaria Basin, (Mesozoic - 93,000 square miles - land area).

The Carpentaria Basin was first named by Gentilli and Fairbridge (1951) who separated it from the "Great Artesian Basin" by a topographic divide, the "Kynuna Platform". Mott (1952) called it a "sub-basin" of the Great Artesian Basin and described it as the area north of the Euroka Shelf including and fringing the Gulf of Carpentaria. (The Euroka Shelf is a basement structure first referred to by Hill, 1951, as "Euroka Ridge" but it is nowhere clearly defined and shown as a boundary between the Carpentaria Basin and the Eromanga Basin.) The margin of the Carpentaria Basin shown on the sedimentary basins map is taken from Whitehouse (1954), the Tectonic Map

TABLE 5. A COMPARISON OF STRATIGRAPHIC SECTIONS IN THE GREAT ARTESIAN BASIN. Table 5.

AGE		COONAMBLE - OXLEY BASINS	SURAT BASIN Cabawin	SURAT BASIN Roma	SURAT - EROMANGA BASINS
		(Mulholland, 1950; David, 1950)	(Keller & McGarry in U.O.D.C. 1963)	(Traves, 1961; Derrington in A.O.G.J., 1961, p.27)	(Whitehouse, 1954)
CAINOZOIC		Alluvium up to 200 ft. Tertiary basalts	Gy. cly., slty. ss, 40'		Plb beds, mdst, ss, up to 200 ft.
MESOZOIC CRETACEOUS	UPPER				ROLLING DOWNS GROUP: Winton Fm., ss, and coal
	UPPER				ROLLING DOWNS GROUP: Tambo Fm. sh, ls./coq at base.
	LOWER		GREAT ARTESIAN GROUP: Roma Fm.* Fos.calc.sh. 1,250' Sh, sltst, coal ss. carb. 1,550'	Roma Fm.Ls, sh, carb. ss, 0 - 1,000'	ROLLING DOWNS GROUP: Roma Fm., sh, ls.
	LOWER			BLYTHESDALE GP.: Transition Mbr. sh, sltst, ss. 150'	BLYTHESDALE: Transition Beds.fos.ark. sh.coal. 600'
MESOZOIC JURASSIC			Blythesdale Fm. - F. - c.ss,/cgl, sh, sltst. 1,350'	BLYTHESDALE GP.: Hooga Mbr. ss. 175- 300'	BLYTHESDALE: Hooga Sandstone ss. 150 - 200'
		Pilliga Beds, mas.c.ss.cgl. 600-750'		BLYTHESDALE GP.: Fossil Wood Mbr. sh. ss. 200'; Gubberamunda Mbr.ss. 350- 350'	BLYTHESDALE: Fossil Wood Beds. sdy. sh. ark. 300'; Gubberamunda Ss. ms. 200'
		Purlawaugh & Gowen Beds-sdy & red Beds 200'; Garrawilla Ser.basalts; Pottinger Beds. ss, sh.700'	Walloon Fm. coal, carb. sh, sltst, ss. 1,250'	Walloon Coal Measures. Sh.minor ss. coal 1,400'	Walloon Coal Measures calc.sh. & ss/coal. 1,350'
		(including Napperby-Merrygoen Beds; Vallance. ?	Bundamba Fm.** f.- c. ss & cgl. 650' sh, coal, sltst. 450' mas. ss, cgl. 1,100'	Bundamba Sandstone 600- 750'	Marburg Fm.(Hutton Ss.Reeves. 1947) ss & sh. 400-1,000; Bundamba Gp.: Boxvale Ss. 80'; Evergreen Sh. 250'; Precipice Ss. 700' (Evans, pers.comm.)
MESOZOIC TRIASSIC		Digby Beds. cgl. 200'	BOWEN GROUP: "Wandoan Fm." ss,sltst.shl. 1,300'.	Moolayember Fm. 500-700' sh, sltst, minor ss.	Moolayember Sh. calc.& sdy. sh. 0-1200'.
			BOWEN GROUP	gy.brn.sh, ss, carb.sh. cgl. 315'+	Clematis Ss. 400'
			BOWEN GROUP: Cabawin Fm. (U.O.D.C., 1964) c.cgl/dtrl. volc. & thn.brn.gh. 2,200'	Pickanjinnie Fm. 380'	Rewan Fm. Cly./slty bnds/ss. 1,700'; Ss. & grit 0- 900' (Hill, 1957)
PALAEOZOIC PERMIAN		Upper Coal Measures & Black Jack Fm. 550'	BOWEN GROUP: Kianga Fm. tuff, coal,ss.520'	Latemore Fm. ss, sltst, sh.tuff,coal; marine at base. ? 600'	Permian and older Palaeozoic formations of Bowen, Drummond Basins.
		? Volcanics 700'+ (Bohena No.1) ?	BOWEN GROUP: Back Creek Fm. gy.fos.calc. sltst, dk. sh, tuff. ss. 1,300'		
			Cracow Fm. Volc.rks. 370'+	?Dev.Timbury Hills Fm. bd. sil. & calc. sltst, ss and sh. 550'+	
PRECAMBRIAN					

Eastern Birkhead 1.	EROMANGA BASIN Above Adavale Basin	EROMANGA BASIN Innamincka 1.	EROMANGA BASIN Dullingari 1.	EROMANGA BASIN Western	EROMANGA BASIN North-west; North	CARPENTARIA BASIN
	(Lewis & Kyranis,1962; Kitsman,Lewis & Rowe, 1962; P.P.C., 1963)	(Ryan, 1961)	(Harrison & Greer 1963)	(Glaessner & Perkin 1958; Ludbrook, 1961)	(Casey,J.N., 1959; Vine,Bastian &Casey.D.J. 1963, Vine,in prep.)	(Laing & Power, 1959a,b; Terpstra & Evans, 1962b).
	Surface soil, 'duricrust' laterite. 110'		Recent sd, mot.cly. 150'; Tertiary sft.carb. sh/& ss. 290'		Sd,alluvium; silcrete. lacustrine ls,35'; basalt,laterite;cgl, ss.clay. up to 200'	Sd. & gvl. up to 400'
	Winton. sh. clyst, ss, coal. 1,350'	Carb.& gy.gn.mdst, sltst.ss, leached red sltst at top 800'	Carb.slty.sh, s.& p. ss, ls. 2,000'		Wilgunya Fm.: ? Winton Fm.m non-marine mdst, lithic ss,ls,coal 1,000'	Winton Fm.,mainly marine seds. sh.ss. sltst. ls. 650'
	? Upper Tambo ss, sh, thin coal 470-620'	Gy.carb.mdst, calc. ss. & sltst, ls. sh, fos. 980'	Dk.gy.sh, sltst, ss & arg.ls. 1,000'; Glau.calc.ss. 30'	fos. mdst./ Terebratella bd at base 435'	Wilgunya Fm.: Mackunda Beds- similar to Winton transition 500-800	? Normanton Fm., fos. dk.sh, sltst, ss/ calc.bnds 670 - 100'+
	Lower Tambo fos. sh, ls, ss. 650' (imcluding probable Toolebuc)				Wilgunya Fm.: Allaru Mbr, fos. clyst,sltst,ls. 1,500'; Toolebuc Mbr. fos. ls,calc.sg.30-40'	Kamileroi Ls. 20'
	Roma, gr.ss & sh, glau.ss. 910'	Calc.slty. sh, ls. gn. sd, fos. 1,150'	Dk.gy.sh, thin bds. glau. ss. 950'	? mdst.& ls. 220-570'	750 feet: ? ? Ranmoor Mbr, clyst.calc.sltst. 200'; Jones Valley Mbr. fos.sltst.ls. 25'; Doncaster Mbr. clyst,glau.ss,ls. 350-450'	Blackdown Fm., dk.sh/calc.bnds. 780-1,000' & dk.gy.sh/glau. ss. 200 - 400'
	Blythesdale. carb. sh. ss. ? 1,100'	ss, sh, sltst. thin bdd. 740'; C.ss, sdy. sh thk bdd. 480'	Ss,glau,calc.& sh. 280'; Ss, f.-c. 1,020'	?Jurassic non-marine sds. 250'	Loose Ridge Gilbert: Cgl, ss, cly. 200-1,400' ?	Wrotham Park Ss & Gilbert R. Fm. ss & sh. 8- 200' ?
	?Middle Jurassic. ss,sh.up to 320' (Walloon equiv.?)	Shy.carb.ss. carb. sh. thn.bdd. 280'	Ss. carb.sh, lig. 360'; Cgl. 30'			Jurassic ss/coal (Z.C.L. No.1 Weipa). 350'
Jurassic ss, sh, cgl. 1,400'	?Lower Jurassic Hutton equiv. 880'	C.ss, thn.sh.thk. bdd. 500'; c.dol.ss, bd. dol. sh.gn.& red sh. 620'				
Sd, sh. (gy.& multicoloured lignite, cgl. 1,250'+ ?		Gy.hd.dol.sh, red & gn.gy.sh/thn ss. 210'	Brn.red.cgl. 5'; Gy.gn.f.ss. red & gn.shy.sltst. 520'			
Sd,sh,calc.bds. 600'+ (incls.equiv. Mantuan Productus bed)	Up.Permian. Carb. mdst. ss, sh, cgl. 110'	Dk.gy.blk. carb. sh, ss, coal. 330'	Dk.gy.blk. carb. sh, coal. 2,220'			
Ss, cgl, sh. volc, ls, dol. 1,700'	Lower Permian. Carb. mdst, ss, sh, cgl. 620'		Bldr. till 120'	mdst.coal,ss, sltst, 2,100' marine mdst.290' till 760'		
Devonian ls, sh, ind. sh, sltst. 240'+	Buckabie Fm.red ss,sh, cgl. 3,600' (U.Dev.-Carb) M.Dev.-calc.sh, ss,dol. 1,400' volcanics 2,400' (in Gumbardo) L.Dev. ss. 1,800' U.Silurian mdst,ss. 1,620'	?Dev.red & purp. sh. red & gn. ss. 5,600'+	From 9050 to 11,588' Dk.gy.hd.slty. calc. dol.sh/bd. cgl. (?thickness)	Lower Pz or Up. Prot.dol.fld. grit.		
				Prot.choc.sh & sd.		

Notes:

* Keller and McGarry give thickness of Roma Fm. as 2,800 feet but the only beds which appear to be typical Roma Fm. lithology are the upper 1,250 feet of fos.calc. sh; the underlying beds are more like the Transition Beds of Whitehouse (1954). This division is in agreement with microfossil and palynological evidence in Appendices 1, 3 and 6.

** Palynological evidence shows that the 'Bundamba Fm' of Keller and McGarry extends from Triassic into Jurassic and includes the Moolayember Shale (Evans, Appendix 1 of Keller & McGarry).

of Australia (1960), and from mapping by joint B.M.R. - Q.G.S. field parties (1959 to 1962). The Cooktown party (1962) showed the possible link between the Carpentaria and Laura Basins.

Coonamble Basin, (Mesozoic - 20,000 square miles).

Mulholland (1950) named the Coonamble Basin as an artesian basin in New South Wales. The northern limit is the Namoi River, to west and south its margin coincides with the edge of the Great Artesian Basin, and it is linked in the east to the Oxley Basin along a line joining Narrabri to Gilgandra and Dubbo (mainly a topographic divide).

Eromanga Basin, (Upper Permian to Cretaceous - 70,000 square miles).

Mott (1952) described the Eromanga Basin as a "Sub-basin" in the Queensland part of the Great Artesian Basin. The name now applies to the whole of the central and south-western parts of the Great Artesian Basin extending from Queensland into the Northern Territory, South Australia and New South Wales. The margins are generally the limits of fairly continuous outcrops of Mesozoic sediments, although some outcrops of Permian sediments which dip into the basin along the eastern parts are included.

The north-western edge of the basin in Queensland has been drawn on the basins map from mapping by joint B.M.R. - Q.G.S. field parties, and the Northern Territory part from other B.M.R. regional surveys. Apart from the unknown area in the south-west corner, the outline in South Australia has been taken from the Tectonic Map of Australia (1960). The south-west edge falls within the area of shallow basement outlined by geophysical work. The south-east margin is generally referred to loosely as the Eulo Shelf - Nebine Ridge area in Queensland. The Eromanga Basin in this report includes the Eulo Shelf area and extends eastward to the Nebine Ridge; the southern edge of the basin is taken from the Tectonic Map of Australia. The other margin shown on the map enclosing the Lake Frome Embayment and Eulo Shelf area, and joining the Adavale Basin is after Whitehouse (1954).

It is not known if the Nebine Ridge joins the Springsure Shelf area west of the Bowen Basin, and this area has been left blank on the map. The eastern side of the Eromanga Basin, where it joins the Drummond Basin is shown in Whitehouse (1954, Fig. 44), and Hill and Denmead (1960, Figs. 1, 25); the north-east part has been mapped by joint B.M.R. - Q.G.S. field parties.

Lake Frome Embayment, (Lower Palaeozoic, Mesozoic).

The first detailed report of the embayment was given by Osborne (1945) who referred to the 'Frome Embayment'. However, because the name "Frome" has been used for stratigraphic units in Queensland, "Lake Frome Embayment" has been used in this report. The outline of the embayment shown on the map is after Osborne. Further investigations may show this to be a Lower Palaeozoic basin under the Great Artesian Basin. The main interest in the Lake Frome Embayment lies in the reports of inflammable gas from water bores in the area. Other references may be found in Dooley, (1948), and a report by Geosurveys (1960).

Oxley Basin, (Mesozoic - 7,000 square miles).

The Oxley Basin is a south-east tongue of the Great Artesian Basin and joins the Sydney Basin; its relationship to the Sydney Basin is not clear. In the west, the Oxley Basin joins the east side of the Coonamble Basin and in the north extends almost to Gunnedah. In the east it ends against the Mooki Thrust zone. The outline of the basin follows the map of Dulhunty (1940).

Surat Basin, (Jurassic-Cretaceous - 90,000 square miles).

The Surat Basin is an eastern lobe of the Great Artesian Basin east of the Nebine Ridge and overlapping the southern part of the Bowen Basin. It may be linked with the Eromanga Basin in the gap north of the Nebine Ridge. The northern margin follows the outcrop of the base of the Bundamba Group as shown in Fig. 1 of Hill and Denmead (1960) and by mapping by the Bowen Basin field parties; the north-east side is taken from Hill and Denmead, Fig. 1. Because of the Tertiary volcanic cover, the relation between the Surat and Ipswich-Clarence Basins is not clear; the margin between them on the map follows the topographic division (Great Dividing Range). The rest of the eastern margin to where the Surat Basin joins the Coonamble Basin follows the limits of Mesozoic sedimentation around the western edge of the Texas-New England structural high, (see Tectonic Map of Australia, 1960).

The main divisions of the Great Artesian Basin are separated by basement high areas - the Surat and Eromanga Basins are divided by the Nebine Ridge, and the Carpentaria and Eromanga Basins by the Euroka Shelf. The Nebine Ridge is part of the Eulo Shelf region and its continuation south-west into the Callabonna area in South Australia. The Euroka Shelf has not been specifically defined and the margin between the Carpentaria and Eromanga Basins shown on the basins map is taken from Whitehouse (1954). Geological mapping and reconnaissance gravity surveys in 1961-62 have shown, however, that an extensive region of fairly thin sediments over shelving basement with some local depressions probably exists south of the Carpentaria Basin, and that this region became an effective barrier to the sea before Winton Formation sedimentation began. This region is an extension of the Boulia Shelf of Whitehouse (1954) and Euroka Ridge of Hill (1951), and appears to be bounded on the east by a major fault zone including the Cork Fault of Vine, (1962). In the north, the fault zone possibly joins the south-west corner of the Broken River Rift (White, 1961); it runs south-south-west from there to the Brighton Downs area and swings south-west more or less following just north of a line of strong gravity gradient called the 'Diamantina Gravity Gradient' by Gibb (1962). The north-north-west to north structural trend of the Cloncurry basement high area persists to the south-east edge of this shelving region, and abuts against a strong north-east - south-west lineament, reflected farther south by the Innamincka- Betoota belt of folding and its extension towards the Longreach spur, (Wopfner, 1960).

Stratigraphic nomenclature used for Mesozoic sediments in the Great Artesian Basin generally follows the nomenclature of Whitehouse (1954). Other units have been described, however, and the more important of these and various Palaeozoic formations which occur in the Great Artesian Basin are listed in Table 5. Abbreviated details of lithology and thicknesses of the formations are also shown on the table.

Only general lithologies and thicknesses are given for the Cainozoic sediments which occur in various parts of the Great Artesian Basin. The sediments occur in small scattered basins and individual formations have been named from many of these; they are too numerous for inclusion in the table.

The nomenclature used for Mesozoic sediments by Whitehouse for the Queensland part of the Great Artesian Basin is shown under the Surat - Eromanga Basins in the table. Most of the formations named by Whitehouse have their type areas in the Surat Basin, but some are from the Eromanga Basin. Sediments which occur elsewhere in the Eromanga and Surat Basins, as shown by drilling, have been shown on the table for comparison. The formation names used by joint B.M.R. - Q.G.S. parties (Casey, 1959) when they started mapping in the north-western part of the Eromanga Basin is shown together with the more detailed breakdown of Vine, Bastian, and Casey (1963), Vine, (in preparation). Vine's nomenclature is included because the units named are from the first-mapped complete section of Cretaceous beds cropping out in any one region of the Queensland part of the Eromanga Basin unaffected by deep weathering; the section extends from west of Hughenden towards Winton. The Jurassic-Cretaceous sediments named by Laing and Power (1959a, b) for the Carpentaria Basin are shown with their lithologies and maximum thicknesses known from drilling; micropalaeontological work by Terpstra and Evans (1962) is also referred to. The Coonamble and Oxley Basins have some formations in common (see Mulholland, 1950, and David, 1950) and have been combined in Table 5.

The stratigraphy of the Lake Frome Embayment (after N. Osborne and H.J. Evans) is summarised in Table 1 of Dooley (1948). The succession is similar to that shown for the central part of the Eromanga Basin except that Cainozoic deposits are thicker and Mesozoic beds are thinner. The sandstone, conglomerate, sandy shale, etc., which form the basal Mesozoic unit (possibly equivalent to the Blythesdale Group) unconformably overlie sandstone, and conglomerate with thin shale beds of the 'Mootwingee Series', and indurated sediments, metamorphic and igneous rocks of the 'Torrowangee and Willyama Series'. The Mootwingee beds were shown by Warner and Harrison, (1961) to be Cambrian in age.

To the east of Mootwingee, and at the southern edge of the Eromanga Basin near Cobar in New South Wales are folded and intruded Silurian sediments, locally metamorphosed, and Upper Devonian (-?Lower Carboniferous) sediments (including the Belford, Mulga Downs and Amphitheatre Beds) which are mainly sandstone, partly fossiliferous, and conglomerate, with some siltstones and mudstones, over 20,000 feet thick, (Spence, 1958).

The Great Artesian Basin is a vast depression filled with sediments which have been draped over basement highs and later affected by regional warping and gentle Cainozoic folding in the central regions where sediments are thickest; where sediments are thinner, such as in marginal zones of the basin or near the margins of basement high features, minor uplifts and faulting have occurred. The axes of folding and faulting commonly follow the trends of structures in the Precambrian or Palaeozoic basement rocks, although in some cases the Cainozoic movements have been in the reverse direction to the earlier movements. The early trends show up not only around the margins of the basin, but also in the attitudes of shelf region and basement highs known from geophysical surveys and subsurface stratigraphic studies. Some of the basement highs are "bald-headed" structures; they are formed of Precambrian or Lower Palaeozoic rocks which enclose younger Palaeozoic sediments in basins such as the Adavale Basin but are overlain directly by the Great Artesian Basin sediments.

The ages of the various basins within the Great Artesian Basin have been shown, by definitions, to vary. The main phase of sedimentation in the Great Artesian Basin began in the Upper Permian in the central-eastern part. Upper Permian sediments were spread north-west from the Bowen Basin into a depression east of Longreach and flanking the western and southern sides of the Drummond Basin, (Whitehouse, 1954), and west to the central part of the Eromanga Basin. This blanket deposit of Upper Permian sediments is in contrast to older Permian deposits which appear to be confined to structural depressions in the basement. Triassic deposition followed conformably above the Upper Permian in the Bowen Basin and also without an obvious break in the Eromanga Basin but was not as widespread. The Bowen Basin Permian-Triassic sequence, however, was subjected to structural influences associated with the Hunter-Bowen overthrusts and the beds were folded by the end of the Triassic Period. From the beginning of the Jurassic period, regional warping effects which controlled deposition in the Eromanga Basin, prevailed also over the southern part of the Bowen Basin and the Surat, Coonamble and Oxley Basins were formed. The Carpentaria Basin apparently also developed at this time. Although Jurassic and Cretaceous sediments were deposited over most of the Great Artesian Basin, each individual basin had its own separate history of sedimentation: the Coonamble and Oxley Basins have Jurassic sediments but no Cretaceous; the Cretaceous Roma Formation (marine) was deposited conformably above the Jurassic sediments in the Surat Basin and is up to 1,250 feet thick - the Tambo Formation and younger Cretaceous formations are missing; the Jurassic varies in thickness and distribution in the Eromanga Basin but the Roma Formation is widespread and up to 1,150 feet thick; it is conformably overlain by up to 3,000 feet of younger Cretaceous sediments which change upwards from marine to freshwater; sedimentation in the Carpentaria Basin is very similar to that in the Eromanga Basin except that there is no change to freshwater conditions in the uppermost Cretaceous sediments.

The main structural influences on deposition in the Great Artesian Basin from the Jurassic to the Cainozoic may be summarised as follows:

(1) continuous warping, and uplift in the marginal areas, particularly in the north-east;

(2) minor folding (some asymmetrical and attributed to transcurrent faulting at depth) and faulting of Tertiary age;

(3) later south-west tilting towards the Lake Eyre region, which has become depressed because of the tilting and because of uplift to the south in the Mt. Lofty - Flinders Ranges due to block-faulting movements during the Pliocene.

A more detailed account of the structural evolution of the Great Artesian Basin is given by Sprigg, (1962).

The prospects for oil and gas in the Great Artesian Basin seem to depend mainly on sources from subsurface basins and rocks older than the sediments of the Great Artesian Basin. This is the case in the Bowen - Surat Basin relationship although some thought has also been given to the partly marine Jurassic Precipice Sandstone and Evergreen Shales as possible source rocks. Marine Cretaceous sediments have shown no encouraging signs as producers of oil or gas. The best sources from sub-surface rocks appear to be:

(1) marine Permian such as known to occur below the west part of the Eromanga Basin and in the east below the Surat, Coonamble and Oxley Basins;

(2) Devonian sediments, which although unproductive in the Adavale Basin, are largely untested south of the Drummond Basin and north of the Cobar region in the Eromanga Basin;

(3) Cambrian-Ordovician rocks below the western part of the Eromanga Basin -
  (a) in the southern end of the Toko Syncline;
  (b) east of the Amadeus Basin in the Simpson Desert area;
  (c) north of the Lake Torrens area (Pirie - Torrens Basin) towards Lake Eyre;

and in the Lake Frome Embayment - Mootwingee area.

Possible reservoirs exist in the Great Artesian Basin sediments but these also form the main aquifers of the basin. Any hydrocarbon accumulations may therefore have been flushed out - on the other hand some accumulations may have been retained under suitable hydro-dynamic conditions. Other reservoirs may also exist in Palaeozoic rocks in structural or stratigraphic traps below the Great Artesian Basin sequence.

Regional mapping by combined B.M.R. - Q.G.S. parties has continued from 1959 until 1963 and most of the northern part of the Eromanga Basin has been covered; this programme is continuing. Regional mapping has also been done by the South Australian Mines Department, the Department of Mines of New South Wales, and by private companies. A large area has also been covered by geophysical parties including those from B.M.R., the South Australian Mines Department, and private companies.

18. IPSWICH - CLARENCE BASIN (Mesozoic, Tertiary - 10,000 square miles)

Although the Ipswich-Clarence Basin appears to be a single structural and physiographic unit, its sediments have generally been described as occupying separate basins - the Ipswich Basin in Queensland and the Clarence Basin in Queensland. Reeves (1951) first referred to the Ipswich-Clarence Basin. For the basins map, however, it has been necessary to refer to Hill and Denmead (1960) for the Queensland part and to David (1950) for the New South Wales part. The relationship between the Great Artesian Basin to the north and the Ipswich-Clarence Basin is not known and a physiographic boundary, the Great Dividing Range, has been drawn.

McElroy (1959) calls this basin the 'Clarence-Moreton' Basin; 'Moreton Basin' was first used by Mott (1952) and Whitehouse (1953).

The stratigraphy of the Ipswich-Clarence Basin is summarised in Table 6. Basin sediments appear to be mainly Mesozoic non-marine sandy beds and coal measures. They probably overlie Permian volcanics and marine beds and Carboniferous fossiliferous beds such as crop out around the western margin of the basin and which have been intruded by late Palaeozoic granite, and slightly metamorphosed Silurian beds to the north-east. Tertiary basalts and some acidic lavas have intruded the Mesozoic sediments in some parts of the basin.

The northern and eastern margins of the Ipswich-Clarence Basin 'have been interpreted as epi-Permian (or early Triassic) fault line scarps that have not moved since', (Hill and Denmead, 1960, p.15). The western margin appears to be depositional on the Texas-New England Structural highs. Faulting and folding have occurred during the Mesozoic and Tertiary along axes which are mainly meridional in the south but trending north-west in the northern part of the basin, i.e. following the direction of the central axis of the basin. Minor faulting is prevalent in the Ipswich area, Queensland, in directions varying fron north-west - south-east and east-north-east - west-south-west.

Hydrocarbon shows were obtained in The Overflow No.1 Well (Q.A.O.C., 1963), and gas flows were reported from Clifden No.2 (A.O.G.J., 1962), in the Ipswich-Clarence Basin; these occurrences are attributed to Mesozoic coal measures. Possible marine source sediments are not known among the basin deposits, but some Palaeozoic marine rocks occur below the basin. Sandstones and conglomerates, which could form reservoirs, occur throughout the basin, but are generally poorly sorted and kaolinitic with low porosity and permeability. The effect of Tertiary volcanic intrusions on the prospects of hydrocarbon accumulations in parts of the basin is not known.

Exploration since 1960 has been by private companies, mainly drilling but some seismic work has also been done in the New South Wales part.

19. LAKE FROME EMBAYMENT, (See Great Artesian Basin).

20. LAURA BASIN, (Mesozoic).

The main references to the Laura Basin are Hill and Denmead (1960), Lucas (1962), and M.A.P.L. (1962). Jurassic to Cretaceous sediments fill the large synclinal area of 8,000 square miles which is called the Laura Basin. The basal beds rest on Precambrian granite and metamorphics in the west, and slightly metamorphosed Silurian-Carboniferous rocks of the Chillagoe Shelf and Hodgkinson Basin in the south and east. Along the north-eastern margin, the basal sandstone overlaps and abuts granite and a northerly extension of the Devonian-?Carboniferous rocks from the Hodgkinson Basin (i.e. the Hodgkinson Formation); the south-east corner of the basin extends into the Great Barrier Reef area east of Cape Bedford. The extent of the basin into Princess Charlotte Bay to the north is not known. Mapping in 1962 showed that the basin may be connected in the south-west part with the Great Artesian Basin.

TABLE 6.

SUMMARY OF STRATIGRAPHY OF IPSWICH-CLARENCE BASIN

Age	Ipswich Basin (Hill and Denmead, 1960.)	Clarence Basin (David, 1950)	P.E.L's 36, 62, N.S.W. (Ralph, 1962)
Quaternary			Alluvium - slt, sd, gvl.
Tertiary	Booval Group. Silkstone Fm. (Oligocene?) - basalts and lacustrine seds, sh, ls, oil-sh. 910 feet. Redbank Plains Fm. fos. mdst, cly, sh, ss. (Eoc. or Olig.) 100 - 420 feet.		Basalts up to 1,500 feet thick and Rhyolites (800 feet).
Cretaceous - Jurassic		Clarence 'Series': Grafton 'Stage' - arg. fld. calc. ss, mdst, sh, coal. 1,450 feet Kangaroo Creek 'Stage' - mas. ss, cgl. 410 feet	Grafton Beds, ss, sltst, clyst, coal. 500 feet. Kangaroo Creek Ss., ss, cgl. 500 feet.
Jurassic	Walloon Coal Measures. lt.gy.sh, sltst, f.ss, coal. 700 feet.	Clarence 'Series': Mallanganee Coal Measures - sh, coal, ss. 490 feet	Walloon Coal Measures - coal, carb. sh, sh, ss, ironstone. 800 - 1,000 feet (2,000 feet - McElroy, 1959 *)
Jurassic - Triassic.	Marburg Ss. - calc. ss, sh, grit, cgl. - 400 feet + ? 1,950 feet Bundamba Group - cgl, ss. 750 feet	Clarence 'Series': Tabulam 'Stage' - ss, sh, mas.cgl, abnt fos. wood. ? ? 1,020 feet	Marburg Fm. - ss, cgl, sh, clyst, fos. wood. 2,000 feet. Bundamba Gp. - ss, cg, sltst, sh, (5,000 ft. McElroy) 2,000 feet.
Triassic	Ipswich Coal Measures. sh, ss, coal, cgl, tuff, brec, basalt at base. 4,300 feet	Nymboida 'Series' - ss, sh, cgl, coal, rhyolite, tuff, carb. sh. 750 feet	
Palaeozoic	Silurian Neranleigh - Fernvale Group. Mildly metamorphosed bnd sh, mas. gywk, bnd chert, jasper, impure ls, phos.	Clarence Series overlaps Nymboida Series and rests on Brisbane Schists and their southern continuations in north-east, and on Permian Drake 'Series' and late Palaeozoic granite in west; the Drake 'Series' is mainly volcanics but with fos mdst.	Permian Plumbago Creek Beds - pyroclastics, lava, fos. mdst, ss, qtzt, ls, slate, chert 7,000 feet + Carboniferous Emu Creek Beds - dk. mdst, tuff, sh, chert, qtzt.

* McElroy, C.T., 1959 - quoted in Relph.

The Cabot-Blueberry Marina No.1 Well penetrated sandstone, siltstone and coal of Permian age from 3566 to 3786 feet, at which depth basement was entered. The Permian beds dip at 30° and may form part of an outlier within the basement similar to other outliers of Permian south of the Laura Basin.

The Permian is overlain by 2,400 feet of Jurassic to Lower Cretaceous sandstones with some siltstone, shale and coal in Marina No.1. The Jurassic beds are mainly non-marine but probably marine in part towards the base; the upper (Lower Cretaceous) sandy beds are marine and are overlain conformably by 920 feet of marine Lower Cretaceous shale with minor siltstone and sandstone intercalations. Upper Tertiary to Recent sediments, including some marine beds, overlie the Cretaceous sediments around the south end of Princess Charlotte Bay and elsewhere in the basin; they are 220 feet thick in the well.

The basin is a north-west - south-east trending depression with greatest deposition in the western central part. Its shape is probably controlled by Palaeozoic fault trends and later tilting from uplift along the eastern margin. The main fault is the Palmerville Fault which appears to separate the thickest deposits, along its eastern side, from thin deposits to the west. This and other faults were apparently active from Palaeozoic to Cretaceous times, although the younger movements were only minor displacements; Mesozoic sediments were displaced about 200 feet at the most along the Palmerville Fault.

Cabot-Blueberry Marina No.1 showed that good reservoir conditions exist in the Laura Basin and rare traces of fluorescence were noted during drilling. Source beds occur in the Lower Cretaceous and Jurassic, and it is possible that Permian marine rocks may occur in outliers below the basin.

In addition to field work in the Laura Basin area by the B.M.R., Marathon Petroleum Ltd have been actively engaged in the area; they have had one well, Marina No.1, drilled, and have since been engaged in a seismic survey.

21. MARYBOROUGH BASIN, (Mesozoic).

The description of the Maryborough Basin is by J.M. Dickins; the main references are Siller, (1961), and Hill and Denmead, (1960). Because of the slightly metamorphosed nature of the Permian rocks which occur below Mesozoic sediments around the edge of the Maryborough Basin, the basin is regarded as Mesozoic and its western margin follows the approximate eastern limit of granite intrusions shown by Siller (Map 2, p.33). The eastern margin is submarine.

The Maryborough Basin is relatively small, narrow and elongate, and about 8,000 square miles in area. It extends on either side of Maryborough from near Round Hill Head in the north to Noose Head in the south, and inland for about 30 miles west of Maryborough.

The stratigraphy is mainly after Siller (1961) and Table 7 is a generalised, slightly amended copy of his table.

TABLE 7

LITHOLOGIC SUCCESSION, MARYBOROUGH BASIN

Age	Maximum Thickness (in feet)	Lithological Character.
Tertiary	400	Basalt, sands and clays.
Cretaceous	16,000	Sandstone, shale, minor limestone, coal; marine in middle part and with volcanics near base.
Triassic to Jurassic	6,500	Shale, sandstone, conglomerate and coal seams; not known to contain marine beds.
Permian	4,800 +	Mildly metamorphosed shales, sandstones, conglomerates, limestones, tuffs and breccias, with marine beds.

The Permian sediments are slightly metamorphosed, strongly folded, intruded by granite and contain quartz veins, some of which are auriferous; some beds contain marine fossils. The Permian is regarded as the floor of the basin. The Triassic to Jurassic is predominantly or wholly non-marine and is also intruded by granitic rocks. The Cretaceous rocks were deposited in a rapidly subsiding trough; the lower part contains intermediate and acidic volcanics, and some apparently non-marine sediments (The Graham's Creek Formation). The middle part (the Maryborough Formation), which may be entirely marine, has been shown by boring to be up to 6080 feet thick and contains dark pyritic shales as well as sandstone, some glauconitic, and limestone. This is overlain by the Burrum Coal Measures.

The Tertiary has thin basalts and superficial sands and clays. The Humble Barrier Reef Oils Pty Ltd's Wreck Island Well, about 64 miles north of Round Hill Head, penetrated marine Miocene from 945 to 1795 feet where it reached basement. A similar or a greater thickness of marine Tertiary may be developed offshore to the south and east.

The overall structure of the basin is obscure, but the thickest sedimentation (in particular in the Cretaceous) is apparently to be found along the coast in the middle part of the basin near Maryborough. The Cretaceous is moderately folded into north-north-west trending anticlines and synclines paralleling the main elongation of the basin. The Susan River Anticline is one of the largest structures, and is known to extend for 20 miles. Two systems of faults have been reported - a group of reverse faults parallel to the folding, and a group of normal faults at right angles to the fold axes.

The main prospects for oil appear to occur in the marine Cretaceous beds or marine Permian. The latter could only provide an objective if accessible by drilling and not locally intruded by granite. Marine Cretaceous sediments are thick, possible source rocks, and reservoirs may be present in the overlying coal measures. Some gas may be associated with the Triassic to Jurassic sediments.

Geological surveys are currently being carried out by the Queensland Geological Survey and some seismic work is being done by Shell Development (Australia) Pty Ltd.

22. MURRAY BASIN, (Cretaceous, Tertiary).

The Murray Basin is a large artesian basin of 100,000 square miles covered by Cainozoic deposits which extend from south-eastern South Australia into south-western New South Wales and north-west Victoria. It is bounded on the south-west side by the Kanawinka Fault and Padthaway Horst, on the west by the Mt. Lofty - Olary arc of Precambrian and Lower Palaeozoic rocks, on the north-west by the Willyama Complex, and on the east and south by the Silurian and Ordovician metamorphics. An east-west belt of Devonian to Lower Carboniferous sediments limits the north side. Isolated outcrops of marine Cretaceous deposits on the northern and southern sides of this belt suggest a connection may have existed with the Great Artesian Basin during Mesozoic times. The outlines of the basin as shown on the map were taken from Spence, (1958); A.O.G. (1962); Reford, (1962); and reference was made also to Ward (1946), and Glaessner and Parkin (1958). Doubt exists as to the positions of the extreme western (Murray River mouth) and northern margins of the basin.

Unmetamorphosed fossiliferous Cambrian and Ordovician sediments occur at Mootwingee north-east of Broken Hill, and Upper Devonian to Lower Carboniferous rocks around the north edge of the basin and most of the sandstones of the same age in the Grampian Range in Victoria are unaltered. These sediments have not been penetrated in deep wells in the basin. Other Palaeozoic rocks older than Permian which occur around the margin are metamorphosed.

Permian sediments are known from water bores and wells drilled for oil. In the south-west part of the basin, small thicknesses of Permian fluvioglacial sediments have been drilled; Renmark North No.1 Well bottomed in 1,000 feet of siltstone, shale, and sandstone with a band of tillite. In the east, 3,860 feet of Permian coal measures and marine siltstones occurred between the Tertiary and Ordovician phyllite basement in Jerildie No. 1 Well north-west of Oaklands. Lower Cretaceous marine beds extend from the north side of the basin into the north-west part, and are up to 1,400 feet thick in Renmark North No.1 where they overlie the Permian. The Cretaceous sediments are mainly sandstone, siltstone and shale. Tertiary paralic and marine sediments up to 1,600 feet thick cover the basin. They include sands, carbonaceous clays and lignites, and fossiliferous limestone.

The Tertiary blanket of the Murray Basin obscures most of the older structural elements known to exist around the margin. Important events in the structural history of Palaeozoic formations in the Murray Basin region as outlined by Spence (1958) may be summarised as follows:

(1) Silurian sediments of the Tasman Geosyncline were subjected to intense folding and shearing along north-north-west - south-south-east axes during the Taberabberan Orogeny in Middle Devonian times and were affected by low grade metamorphism;

(2) a marginal trough developed during Upper Devonian times in the region now covered by the eastern part of the Murray Basin and extended north into the region of the Great Artesian Basin;

(3) during Upper Devonian to Lower Carboniferous times there were three main periods of uplift and compression the last of which probably occurred during the Kanimblan Orogeny and ended deposition in the trough; in the final orogenic period, folding along north-north-west - south-south-east axes was followed by major displacements and some folding along strong north-east - south-west lines, (the 'Darling, Neckarbo and Lachlan Lines').

Permian sediments which crop out around the southern margin of the Murray Basin, and probably also those known to occur under the basin, are preserved in graben structures which usually trend in a north-north-west - south-south-east direction. Sinking of the basin may have commenced in Cretaceous times and continued into the Tertiary accompanied by uplift of the Dividing Range along the margin of the continent; the regional warping within the basin was accompanied by minor faulting and tilting. The main faults in the east part trend just east of north whereas lineaments in the west, as shown by the extensive Murrayville and other monoclines (Spence, 1958), have a north-west - south-east direction (parallel to the Kanawinka Fault).

The best prospects for oil and gas in the Murray Basin appear to lie in the Palaeozoic rocks below the Cretaceous: the Cambrian-Ordovician in the north (east of Broken Hill), the Devonian-Lower Carboniferous below the north-eastern part, and the marine Permian which occurs in a structural depression below the south-east (Oaklands) area and may be present elsewhere.

The Murray Basin has been covered by aeromagnetic surveys. Seismic surveys have been run in various parts of the basin, and some gravity work was done in New South Wales. The operators were mainly private companies but surveys were also done by the B.M.R., (gravity and aeromagnetic), and the South Australian Mines Department (seismic). Only five subsidised wells have been drilled since 1960.

23. NORTHERN NEW GUINEA BASIN, (see Papua and New Guinea).

24. OFFICER BASIN, (?Ordovician, ?Permian).

The margins of the region which is now referred to as the Officer Basin are still uncertain particularly in the west and east. The north margin has been drawn for this report on the basis of recent geological work by the Geological Survey of South Australia and South Western Mining Pty Ltd, and after Sprigg, et al, (in Glaessner and Parkin, 1958). The north-west lobe has been included as a result of mapping by B.M.R. field parties, 1960-1962, and from the results of B.M.R. Geophysical Branch surveys, 1957-1962). The western edge is drawn to the edge of Archaean outcrop in Western Australia and the north edge of the Eucla Basin forms the southern margin of the Officer Basin. The eastern limit is somewhere over the shallow basement belt determined by geophysical methods between Ooldea and Tarcoola in the south and Cooltarlinna Hill in the north. An area of 133,000 square miles has been calculated for the basin as shown on the map.

The deepest section determined by geophysical work is in the opening into the north-west lobe. Seismic work (B.M.R., 1961-1962) suggests that up to 15,000 feet of sediments may be present. At least 8,000 feet are thought to be Upper Proterozoic and the rest Palaeozoic, with Permian at or near the surface.

South-east of the lobe and along the northern margin of the basin in Western Australia and north-west South Australia, sandstones, shales and oolitic limestones of late Proterozoic (Marinoan) to Cambrian age have been mapped dipping generally south-west and into the basin, (South Australian Geological Survey and South West Mining Pty Ltd). East from here but along the northern margin, Sprigg, et al, state that more than 5,000 feet of well-bedded and cross-bedded sandstones of Ordovician age rest unconformably on Proterozoic (Sturtian) sediments, and also have shallow dip south into the Officer Basin.

Permian sediments are estimated by Leslie (1961) to be at least 750 feet thick in a disturbed area with diapiric structures (the Woolnough Hills) in the north-east corner of the north-west lobe. They occur around an intruded core of dolomite and gypsum of probable Upper Proterozoic age, Elsewhere in the western part of the basin, the Permian sediments are flat and crop out in exposures up to 100 feet thick in scattered mesas. They are composed mainly of fluvioglacial sediments. Marine and marginal marine (?Jurassic and Cretaceous) sediments crop out but only in the western part of the Officer Basin, mainly in the north-west lobe. They occur in scattered mesas and are composed of up to 100 feet of ?Jurassic micaceous mudstone, sandstone and grit with plant fossils and burrows overlain by a maximum of 250 feet of Cretaceous siltstone and mudstone.

Apart from the diapiric structures in the north-west lobe, little is known of the other possibly important structures within the Officer Basin. Quilty and Goodeve (1958) showed that the region now included in the Officer Basin north of the Eucla Basin is an asymmetrical structure with basement deeper than 2,000 feet near the north edge and becoming shallower to the south. Depth to basement near the north edge was later estimated to be over 10,000 feet by J.O. Galloway Ltd, (in Shiels, 1961). This is confirmed by Bowman and Harkey (1962) whose seismic survey in the Mabel Creek area (between meridians 131° and 132° in the north-east corner of the basin) showed increase in sedimentary section from 5,000 to 10,000 feet in a north-west direction from the east side of the basin. They also noted that a possible dip reversal occurred at the eastern end of the survey line.

Little is known of the stratigraphic succession within the Officer Basin and of its oil prospects. Hunt Oil are conducting field surveys in the Western Australian part, and Emu No.1 Well is being drilled by Exoil in the Mabel Creek area.

25. ORD BASIN, (Cambrian).

The following description of the Ord Basin is by P.J. Jones who used the following references: Wade, (1924); Matheson and Teichert, (1948); Traves, (1955); Opik, (1956).

The Ord Basin of 12,000 square miles includes the Cambrian sediments and Lower Cambrian volcanics, south of the Bonaparte Gulf Basin, between longitudes 128°10' E. and 129°30' E, and between latitudes 16°00' S. and 18°30' S. The Cambrian sediments have been preserved in three subsidiary basins; these are from north to south, the Argyle, the Rosewood, and the Hardman Basins, with its extension from the north end into the Northern Territory. The outlines of the basins have been taken from Traves (1955) for the basins map.

Lower Cambrian basalts (Antrim Plateau Volcanics), about 3,000 feet thick, were deposited on a deeply eroded surface of Upper Proterozoic rocks. The Middle Cambrian succession is thickest in the Hardman Basin, where the volcanics are disconformably overlain by 2,000 feet of alternating shales with gypsum, and fossiliferous limestones (the Negri Group). This sequence was deposited during early Middle Cambrian and perhaps, late Lower Cambrian time, and probably represents cyclic conditions of evaporitic and marine sedimentation. Lithologically, it is related to the carbonate province of the Daly River area, in contrast to the arenitic province of the Bonaparte Gulf Basin. The Negri Group is overlain by 1,500 feet of sandstone (the Elder Sandstone), which represents an undefined part of the upper Middle Cambrian and, probably, Upper Cambrian. The Elder Sandstone and the Cambrian sandstones of the Bonaparte Gulf Basin both may have been deposited in the one and the same inlet of the Cambrian sea.

A small residual outlier of fresh-water chert, marl, and siltstone, 370 feet thick, overlies the Elder Sandstone with a major unconformity. A Tertiary or Pleistocene age has been suggested for these sediments.

Both the Lower Cambrian basalts and the Cambrian sediments have been eroded to a level where the sediments are mainly preserved in three basins. These are from north to south:

(a) The Argyle Basin, about 25 miles long and 7 miles wide, trending north-east.

(b) The Rosewood Basin, about 40 miles long and 11 miles wide, roughly parallel to the former.

(c) The Hardman Basin, 75 miles long, and 35 miles wide, originally referred to by Wade (1924) as the Ord River Basin. It trends north-east, and is truncated at the northern end, almost at right angles, by a shallow anticline situated in the vicinity of Kelly Creek, and extending south-east into the Northern Territory.

Faulting is rare, both within the basins themselves, and within the plateau volcanic country; the basalts are strongly jointed. Two dominant fault-trends (north-north-east, and east-north-east) have been mapped within the Proterozoic rocks of the Halls Creek Mobile Zone, and in the area immediately north of the Hardman Basin.

The petroleum prospects of the Ord Basin have been discussed by Traves (1955). Asphaltite occurs in the region associated with the Antrim Plateau Volcanics, and its origin is still uncertain. Traves suggests the Upper Proterozoic Victoria River Group, with more than 2,000 feet of sediments including algal limestones, as a likely source. Little is known of the source and reservoir potential of the younger sediments; the Middle Cambrian Negri Group contains marine limestones which may constitute source rocks, and interbedded shales may form caps if the limestones have enough porosity and permeability to form reservoirs.

TABLE 8

A COMPARISON OF STRATIGRAPHIC SECTIONS IN THE OTWAY BASIN

AGE	SOUTH-EAST SOUTH AUSTRALIA (Boutakoff & Sprigg, 1953; Sprigg & Woolley, 1963.)	WESTERN VICTORIA (Boutakoff & Sprigg, 1953)	CAPE OTWAY AREA, VICTORIA (McQueen, 1961)	TORQUAY - EASTERN VIEW, VICTORIA (Glaessner, 1953; Raggatt & Crespin, 1954.)
Recent.	Marine, estuarine deposits 20 ft + Sd, marl, cly, ls, 50 ft +	Alluvium, dune sd, 300 ft Malanganee Fm. - swamp deposits (30ft), dune sd (50ft)+, fresh and brackish water ls, and marl.	Quaternary fos, flaggy and dune ls, sd, and alluvium. up to 300 ft.	
Pleistocene	Calc. dunes and aeolianite, soil, 148 ft	Bridgewater Fm. - calc. dunes and aeolianite (135ft) and fos.ls. and silt (25 ft.)		
Pliocene - Lower	Flaggy fos. ls. and calc.slt.	Whaler's Bluff Fm - flaggy fos. ls, (60ft) and marine fos.cly. marl (15ft). High level river gvls. Laterites		
Pliocene - Upper		Grange Burn Fm., glau. sd. and marl, fos.		
Miocene	Gambier Ls. - marine ls, arg. ls, marl, cly, dol. ls. 533 ft	Glenelg Grp.: Muddy Creek Fm. *Lepidocyclina* ls. 'Mt.Gambier Fm.' - fos. marine ls, marl, cly & dol.ls. 2,265 ft	Heytesbury Group - mainly ls. and cly. marl, sdy and slty in parts. 1,180 ft (2,800 ft Portland bore)	Batesford Ls. Torquay Group: Puebla Fm. 160 ft; marl, ls. / fos. ls.; Jan Juc Fm. 180 ft
Oligocene		Nelson Fm. Glau.ss. 174 ft ?		?
Eocene and Paleocene	Knight quarry cly, sd, cgl, and lignite/marine horizons near top. (Limonitic, glau, oolitic grits, 20ft, in Mt. Salt No.1 Well)	Knight Group: Dartmoor Fm. - sd, grit, gvl, mic.slt, carb.cly. 6,329 ft Bahgallah Fm. - Glau, sd and grit, fos. 53 ft ?	Wangerrip Gp - Sd, ss, sltst, cgl. Minor ls, dol, glau, carb. 450 - 5,000 ft	Demons Bluff Fm. - sltst, gywk, ss./pbls &/ *Cyclammina* 1,300 ft Boonah Ss. 1,200 ft Eastern View Coal M. - Fos. sd, carb.sh, coal. 300 ft
Cretaceous	Bl.-gy sh and ss./plant remains. (Comaum bore). (Gy.sds, ark.sltst, cly; cgl, and coal; cly, sh, glau. 4,680 ft Dk.gy.mdst, sh, glau. sltst, fos; ss interbeds. 2,200 ft + Mainly Upper Cretaceous - Mt.Salt No.1) Ark. mdst, grits/ plant remains 3,029 ft (Robe bore)	Merino Group: ? Runnymede Fm. clyst, sltst, fld ss/plant remains 65 ft ? Ark. mdst, grits/ plant remains 1,000 ft	? Paaratte Fm. - ss, sltst, mdst./dol. 350-1,000 ft Belfast Mdst. - dk.gy-blk mdst, sltst, glau. 350-1,000 ft Flaxmans Beds - sdy sh. Waarre Fm. - ss, sltst, mdst, coal. 300 - 700 ft ? Otway Group. Fld. ss, ark, sub-gywk, mdst, grit, cgl, coal. 1,000 - 5,000 ft ?	"Jurassic bedrock" (up to 2,800 ft, David, 1950)
Permian	? Tillite and glacio-fluvial sediments 400 ft + (Alfred Flat bores in Padthaway Horst area, Glaessner and Parkin, p.104).	Coleraine Fm. - 'glacigenes' ?		?
Lower Carboniferous - Upper Devonian		"Grampian Series". Fos.ss and cgl./granite & porphyry intrusives ?		
? Ordovician	Gy. mica. ss, hornfels, schist, etc. (bores north of Kingston; Table 1 of Boutakoff and Sprigg)	Talbot Group - ss, slate, hornfels, schist, etc.		

Notes:

1. The Merino Group is at least 7,000 feet thick between Cape Otway and western Victoria - Bain (1963) records the group from 3,108 feet in Eumeralla No.1 Well to 10,308 feet at which depth the well was abandoned.

2. 1,900 feet of sandstone with thin coal beds was recorded between the Otway Group and Cambrian basement in the log of Pretty Hill No.1. - the unit is thought to be Lower Cretaceous by Evans (1963) and equivalent to part of the lower Merino Group section of Eumeralla No.1.

Recent field work in the Ord Basin area commenced in 1962 with the mapping of the Gordon Downs Sheet area by joint B.M.R. - Western Australia Geological Survey parties, and continued in 1963 with the mapping of the Dixon Range and Lissadell areas.

26. OTWAY BASIN, (Mesozoic, Tertiary).

The main reference to the outline of this basin is Reford (1962) and is based largely on aeromagnetic work. Other references were made to Sprigg (1952), Boutakoff and Sprigg (1953), and McQueen (1961). Information made available by the General Manager of Frome-Broken Hill Co. Pty Ltd, is also gratefully acknowledged.

The eastern margin is a strong aeromagnetic trend which follows south-south-west from the Selwyn Fault (David, 1950, Fig. 176) towards King Island. The northern edge runs west from Melbourne to about Hamilton in westernmost Victoria and north-west to Kingston in South Australia. This boundary is presumed to be mainly due to faulting and/or monoclinal structures (Sprigg, 1962), and envelops three main embayments centred around Mount Gambier in South Australia, and Port Campbell and Torquay in western Victoria. The westerly continuation of the basin margin is based purely on aeromagnetic work, but also shows embayment features. The basin generally deepens to the south towards the continental shelf in a number of steps formed by normal faulting, and no southern margin is known. The land area of the basin occupies 13,000 square miles and at least another 8,000 square miles occurs offshore.

The Mount Gambier and Port Campbell embayments have been called the 'Gambier and Portland Sunklands', (Sprigg, 1952; McQueen, 1961); they are separated by a low platform-like area named the 'Dartmoor Ridge' extending north through Portland and Heywood in south-west Victoria. The Mount Gambier embayment joins the Murray Basin to the north along the Kanawinks fault-line, but becomes separated from it to the north-west by the Padthaway Horst, a wide belt of shallow and outcropping granitic basement. The Tertiary embayment in the Torquay area is separated from the Port Campbell embayment by outcropping Lower Cretaceous rocks in the Otway Ranges and Barrabool Hills, and by a buried ridge of Lower Cretaceous rocks between outcrops. The Barrabool Hills enclose a southerly projection of granite and Cambrian epidiorite, (David, 1950).

Sprigg, (1962), also refers to a north-west - south-east trough of deep sedimentation from south-east of Kingston through Penola in South Australia with a buried '?horst' along its south-west side, and a semi-circular area of positive gravity anomaly, ?basement, below Beachport.

As a result of these structural features sediments deposited during the same periods at different places within the Otway Basin vary both in facies and thickness. This is shown in Table 8 where stratigraphic columns, drawn up from outcrop, oil well and water bore information for four different areas, are compared. In many parts of the area, the Tertiary sediments have been masked by Middle Pliocene to Recent volcanics composed mainly of basalt, tuff, and scoria.

Boutakoff and Sprigg (1953) pointed out that although Palaeozoic fold trends about the 'Gambier Sunklands' are approximately meridional, later sediments have accumulated in a chain of sinking basins or troughs directed north-west - south-east and north-east - south-west across the Palaeozoic trends. Sprigg (1962) also notes that the main fault planes in the Gambier area are west-north-west - east-south-east. The main movements associated with the structures have been block-faults, flexures and warping. Many of these movements occurred in the Quaternary; some were accompanied by volcanic activity. Others were probably active more or less continuously during the Tertiary but their effects have since been masked by Quaternary deposits. Sprigg attributes some faulting and associated minor folding to transcurrent faulting at depth.

The same types of movement also occurred in the eastern part of the Otway Basin, but Bain (1963) suggests that normal faulting occurred during sedimentation in Cretaceous times and that stable conditions then existed until late Tertiary faulting and broad, shallow folding.

Marine Cretaceous formations above the Otway and Merino Group contain both source and reservoir sediments; the Belfast Mudstone is regarded as the most likely source rock. Good reservoir conditions also exist in overlying Tertiary sediments. Port Campbell No.1 gave evidence of hydrocarbon accumulation in the basin with a strong initial gas flow, and coastal bitumen occurrences may reflect seeps from submarine parts of the Otway Basin. The prospects in parts of the south-east of South Australia and western Victoria may have been locally spoilt by Tertiary volcanic intrusions.

Geophysical surveys have been carried out in the Otway Basin, on-land and off-shore, by B.M.R., South Australian Mines Department and other organizations; they include seismic, gravity (on-land only) and aeromagnetic. Nine subsidised wells have been drilled since 1960.

27. **OXLEY** BASIN, (see Great Artesian Basin).

28. PAPUAN BASIN, (see Papua and New Guinea).

29. PERTH BASIN, (Palaeozoic to Eocene).

The margin of the Perth Basin has been drawn from McWhae, et al, (1958), but the north end is altered slightly to conform with Condon, (1956). The basin has been defined and described by J.M. Dickins using the following additional references: Clarke, Prendergast, Teichert and Fairbridge, (1951); Dickins and McTavish, (1963); Johnson, de la Hunty and Gleeson, (1954); Thyer and Everingham, (1956).

The basin is a long narrow trough extending southwards from Latitude 26°15' between the coast and the Precambrian tableland on the east. The eastern margin is formed by the Darling Fault line, a major structure. At the south the basin is bounded along the coast by a narrow Precambrian strip between Cape Naturaliste and Cape Leeuwin. Its area is 21,000 square miles.

The lithologic succession of the basin is summarised in Table 9.

TABLE 9

LITHOLOGIC SUCCESSION, PERTH BASIN
(Adapted from Playford and Johnson, 1959.)

Age	Maximum thickness (in feet)	Lithological Character.
Eocene	1,960	Shale and siltstone.
Upper Cretaceous	300	Greensand and chalk.
Jurassic - Lower Cretaceous	9,000	Predominantly sandstone and siltstone; minor marine limestone, shale and sandstone.
Triassic	5,000	Shale, siltstone and sandstone.
Permian	6,000	Tillite, shale and sandstone with minor limestone, some coal.
Ordovician to Silurian	10,000	Red sandstone, with minor siltstone and conglomerate.
Proterozoic or Lower Palaeozoic	30,000 +	Siltstone with minor sandstone and chert. A few lava flows.

The Proterozoic or Lower Palaeozoic Yandanooka Group, which is very thick and rests on the Archaean, is the oldest exposed unit of the Perth Basin. It is believed to be derived from a volcanic source area and contains no known organic remains. The Ordovician to Silurian Tumblagooda Sandstone, which crops out farther to the north may be equivalent to the top part of the Yandanooka Group. The Permian has glacials at the base followed by marine shale (or siltstone) about 1,600 feet thick, limestone and marginal and offshore sediments with plant-bearing clastics at the top. A distinct time-break separates the Permian from the Triassic, which consists of 2,000 feet or more of marine siltstone at the base with sandstone and subgreywacke above. The Jurassic to Lower Cretaceous is mainly a very thick arenite sequence, regarded mostly as non-marine although the Middle Jurassic is represented by relatively thin marine siltstone, sandstone and limestone. The Upper Cretaceous has thin shelf-type marine sediments and the Eocene is mainly siltstone.

Much of the basin is covered by thin Quaternary sand and aeromagnetic, gravity and seismic work have been of especial importance in this basin.

The main structure is a long narrow graben or half-graben with easterly dips predominating within the trough. Subsidiary troughs are formed by extensive faulting. Anticlines present appear to be closely associated with faulting, either primarily as drags or secondarily as drapes.

The pre-Permian is regarded as unfavourable for hydrocarbon accumulation. Potential source rocks are represented by the siltstones of the Permian and Triassic with which are associated porous sandstones. As shown by Wapet Eneabba No. 1, the thick Jurassic arenites place Permian and Triassic at uneconomic depths in parts of the basin. Suitable anticlinal structures where source and reservoir rocks may be at shallower depths are currently being investigated.

Subsidised geophysical surveys by West Australian Petroleum have been concentrated mainly in the northern central region of the basin, and since 1960, include both seismic and gravity surveys. Their drilling has also been mainly in this region. Some seismic work is being done by B.M.R. in the southern part of the Perth Basin.

30. PIRIE-TORRENS BASIN, (Cambrian, Tertiary).

The Pirie-Torrens basin is an elongated structural basin of 9,000 square miles between Port Pirie in the south and Lake Torrens in the north where it links with the Great Artesian Basin. The western margin is drawn from a pronounced fault line shown by B.M.R. aeromagnetic work in 1962. The eastern side follows the lower limits of Lower Cambrian sediments and Proterozoic outcrops along the western scarp of the Flinders Range from Port Pirie to Parachilna, and from west of Parachilna to Mt. Nor'west. This side is also regarded as structurally controlled (Campana, in Glaessner and Parkin, 1958, p.41). The south end opens into Spencer Gulf.

The oldest rocks known from the basin are Cambrian dolomite and limestone up to 5,000 feet thick, and these are overlain by at least 530 feet of Tertiary sediments which appear to be largely continental. Both the Cambrian and Tertiary beds contain oil showings.

The Pirie-Torrens Basin is a graben structure bounded by faults on the east and west. The eastern movements occurred during the overthrusting of the western Flinders Ranges rocks in Tertiary times. The fault on the west side was shown as a steep gradient anomaly by B.M.R. aeromagnetic traverse in 1962. The graben has preserved Cambrian sediments at depth and been filled by Tertiary and Quaternary deposits.

The presence of source rocks in the Pirie-Torrens Basin has been shown by drilling, and porous zones including reef facies occur in the Cambrian dolomites and limestones; no reservoirs of economic importance have been found, however, and exploration has lapsed.

Geophysical work has been done in the basin by Santos Ltd, South Australian Mines Department, and B.M.R.; it includes gravity, seismic and aeromagnetic surveys. The most recent (1962-63) is aeromagnetic by the B.M.R.

31. SAINT VINCENT BASIN, (Tertiary).

The name 'Saint Vincent Basin' was introduced by Glaessner and Wade (in Glaessner and Parkin, 1958); it includes the 'Adelaide Basin'.

The Saint Vincent Basin is an area of Cainozoic sedimentation controlled on the east by a series of en echelon faults which form a number of subsidiary basins and which extend to just north of the head of Saint Vincent Gulf. The basin includes Saint Vincent Gulf and the Tertiary sediments on the east side of Yorke Peninsula and occupies an area of about 7,000 square miles. In the south the basin is open to the west between the foot of Yorke Peninsula and Kangaroo Island.

The thickest section known from drilling is from the Croydon Bore (Steel, 1962). This bore stopped after penetrating 260 feet of ?Permian fluvioglacial sediments. They were overlain by 2,035 feet of Cainozoic sediments, mainly paralic (alternating marine and non-marine deposits). Thick Lower Cambrian sediments including marine limestones which crop around the margin of the basin have not yet been found by drilling. In the Minlaton bore, on Yorke Peninsula outside the limits of the basin, 60 feet of Permian glacial beds and sandy sediments with foraminifera, 80 feet of Middle Cambrian limestone, and 450 feet of unfossiliferous red bed clastics and evaporites occur above 950 feet of Lower Cambrian Parara Limestone in which the bore finished, (Glaessner and Parkin, p.53).

The main structural elements of the Saint Vincent Basin are en echelon faults with differential uplift and tilting of the intervening blocks. They follow the axial trends of early Palaeozoic folding.

The prospects of this basin appear to depend mainly on finding a suitable source and reservoir combination below the Tertiary sediments; exploration has been unsuccessful on-shore and is currently being directed off-shore.

The main private operators in the Saint Vincent Basin have been Beach Petroleum N.L., who followed the Geosurveys seismic survey in 1960 with the drilling of a well, Grange No.1. A lot of work, both geological and geophysical has been done in on-shore parts of the basin by the South Australian Mines Department.

32. SOUTH CANNING BASIN, (see Canning Basin).

33. SURAT BASIN, (see Great Artesian Basin).

34. SYDNEY BASIN, (Permian to Triassic).

The main references used in this description of the Sydney Basin by J.M. Dickins are: Booker, (1960); David, (1950); Joplin, Hanlon and Noakes, (1952); Hill, (1955); McElroy, (1962); Raggatt, (1938). The outlines of the basin were drawn mainly from David, the Tectonic Map of Australia, (G.S.A., 1962), and the Geological Map of New South Wales, (1962). The north margin coincides with the south edge of the Oxley Basin.

The basin stretches from Muswellbrook in the north to Newcastle and south to near Bateman's Bay. From the coast it extends westerly to a few miles beyond Lithgow and Rylstone. The area is 12,000 square miles.

The stratigraphic succession in the northern part of the basin has a greater range and is better known than elsewhere; the main units and subdivisions are shown in Table 10. Thicknesses given refer to the type areas of the various units.

TABLE 10

NORTHERN PART OF SYDNEY BASIN - STRATIGRAPHIC SUCCESSION
(partly after David, 1950; Hill, 1955)

	Unit		Maximum thickness (in feet)	Lithological Character
TRIASSIC	Wianamatta Group		800	Shale, calcareous flaggy sandstone.
	Hawkesbury Sandstone		880	Cross-bedded white sandstone and shale.
	Narrabeen Group	Upper Gosford Formation	560	Sandstone and shaly sandstone and shale.
		Middle Clifton Subgroup	900	Red and green shale: sandstone and fine conglomerate.
		Lower Clifton Subgroup	880	As above.
PERMIAN	Upper Coal Measures	Newcastle Coal Measures	1500	Conglomerate, sandstone, shale, coal.
		Tomago Coal Measures	2000 +	Shale, sandstone, coal.
	Maitland Group.	Mulbring Sub-group	3000	Shale and claystone.
		Muree Formation	400	Sandstone, sandy claystone, calcareous and with many pebbles, cobbles, etc.
		Branxton Subgroup	1400 1500	Sandy shale and claystone. Sandstone.
	Greta Coal Measures		300	Conglomerate, sandstone, shale and coal.
	Dalwood Group	Farley Formation	985	Sandy shale and claystone; Ravensfield sandstone (200') at base.
		Rutherford Formation	1170	Sandy shale, mudstone, with limestone and basalt.
		Allandale Formation	1000	Calcareous claystone, conglomerate (250') at base.
		Lochinvar Formation	2740	Shale, claystone, sandstone and basalt. Red brown shale at base.

Thick marine sediments of the Dalwood Group ("Lower Marine Series") age are found only in the Lower Hunter Valley. Elsewhere volcanics with minor sediments may be wholly or partly of this age. In the northern part of the basin, the Dalwood Group is overlain by the Greta Coal Measures; their main outcrops are around the Lochinvar and Muswellbrook Domes. The Maitland

Group ("Upper Marine Series") is more widespread and in the Western coalfield, sediments of this age rest directly on folded Silurian and Devonian rocks. In the southern part of the basin also, only the upper part of the sequence found in the Lower Hunter Valley is represented. The Upper Coal Measures are thickest in the Newcastle area where, at the southern end of the Lochinvar Dome, the Maitland Group was apparently eroded before deposition of the Coal Measures.

A regional discordance between the Upper Coal Measures and the Narrabeen Group forms an important break in the sequence.

The overall structure appears to be synclinal with the deepest part towards the north adjacent to the Hunter system of faults. Little subsurface information, however, is available and subsidiary basins may be present. Anticlines, including the large Lochinvar Dome and its probable southerly continuation, the Kulnura Anticline, are elongated in a general north-south direction and affect both Permian and Triassic sediments. The Nepean Fault and the Lapstone Monocline form an important structure on the west side of the basin and may be close to the boundary between shelf and deeper-water deposition during the Permian.

Favourable source beds are to be found in the Permian: these include the Rutherford and Farley Formations of the Dalwood Group and the Mulbring and part of the Branxton of the Maitland Group. The coal measures may provide an additional source of gas. Reservoir beds may occur in parts of the marine sequence, and in the coal measures, but most sandstones in the succession are generally tuffaceous or kaolinitic.

Recent work by companies includes seismic surveys and drilling at scattered localities throughout the basin, and an aeromagnetic survey in the southern part. Results to date have not been successful but not enough wells have been drilled to basement for conclusions on the prospects to be made.

35. TASMANIA BASIN, (Permian, Triassic).

The outlines of the Tasmania Basin on the basins map follow the limits of the Permian shown on the Geological Map of Australia (David, 1950), and the formations shown in the Correlator Chart are taken from Banks (1952, 1958). The area of the basin is 9,000 square miles.

The Tasmania Basin is well summarised in Playford and Johnstone (1959): 'The Tasmania Basin contains several thousand feet of marine and terrestrial Permian and Triassic sediments, intruded by dolerite dikes and sills'. Twenty-one shallow bores have been drilled in the northern part of the basin in the Mersey Valley, and another hole was drilled to 430 feet on Bruny Island south of Hobart. These have yielded little information on the stratigraphic succession in the basin.

Until more is known of the succession at depth within the Tasmania Basin, and whether structures may exist which are not influenced by the dolerite intrusions, the prospects of finding oil or gas accumulations cannot be assessed.

36. YARROL BASIN, (Devonian to Mesozoic).

The references used in the definition and description of the Yarrol Basin are: Driscoll, (1960); Hill and Denmead, (1960); and Maxwell, (1953). The summary given below is by J.M. Dickins.

The basin is long and narrow and extends from slightly north of Rockhampton to south of Mundubburra where it disappears beneath sediments of the Surat (Great Artesian) Basin. A belt of strongly folded and slightly metamorphosed rocks bounds the basin on the east and on the south-west side it is limited by the igneous rocks of the Auburn Complex. To the north the western boundary is taken as the westernmost occurrence of the Yarrol Basin type Carboniferous sequence. The overlying Permian marine sediments may be continuous with them to the north in the Apis Creek, Mackay and St.Lawrence areas, and possibly the Yarrol Basin should be extended to include these Permian rocks. The area of the Yarrol Basin as shown on the map is 7,000 square miles.

The lithologic succession of the Yarrol Basin is summarised in Table 11.

TABLE 11

LITHOLOGIC SUCCESSION, YARROL BASIN

Age	Maximum thickness (in feet)	Lithological Character.
Tertiary	-	Non-marine sediments and volcanics.
Cretaceous	-	Thin marine sandstone and calcareous sandstone.
Triassic - Jurassic	500 +	Siltstone, sandstone and conglomerate with interbedded rhyolite, thick coal seams.
Permian	10,000	Cherty shales, sub-greywacke, sandstone, limestone, rhyolitic tuff, agglomerate tuff, and basic to intermediate lavas.
Carboniferous	12,800 +	Siltstone, chert, sub-greywacke, greywacke, sandstone, conglomerate, limestone(including oolitic limestone). Much volcanic detritus.
Devonian	4,600	Tuff, agglomerate, lava, limestone, tuffaceous sandstone and sandstone.

The Devonian, comprising the oldest rocks of the basin, has much volcanic material, although marine fossil bands are present. The Carboniferous is predominantly marine and varies considerably in thickness. A distinct break separates Lower and Middle Carboniferous in at least some parts of the basin. Another distinct break in places separates the Carboniferous and Permian.

The Devonian contains both marine and non-marine deposits and was a time of widespread volcanism. Although volcanic activity continued into the Mesozoic, the area gradually became more stable; this is reflected in the younger sediments which contain much sandstone and are probably entirely non-marine. A shallow marine transgression took place in the Lower Cretaceous in the northern part of the basin.

During the late Palaeozoic and early Mesozoic the Yarrol Basin was apparently more mobile than the main part of the Bowen Basin to the west. Many north-south trending anticlines were formed and also the Yarrol Syncline. The basin has been affected by much thrust faulting, and possibly by overturning and transcurrent faulting, followed or accompanied by igneous intrusion.

Possible source beds are to be found in the marine Carboniferous and to a lesser extent in the Devonian and Permian. The tectonic and igneous activity accompanying and subsequent to the deposition of these beds, however, makes the possibility of finding oil and gas unpredictable in most parts of the basin.

Amalgamated Petroleum Exploration Pty Ltd have done most of the recent exploration in the Yarrol Basin. Their geophysical work includes both aeromagnetic and seismic surveys, and two wells, Abercorn No.1 and Mulgildie No.1, have been drilled. Some aeromagnetic lines have also been flown across the area, by the B.M.R. Geophysical Branch.

TABLE 12

GENERALIZED STRATIGRAPHY OF THE PAPUAN BASIN

AGE	S.W. FLANK (Wide, shallow shelf)	TROUGH (Miogeosynclinal, from Lower Miocene - Recent; jurassic - Aptian environment not known)	N.E. FLANK (Narrow, steep, local and intermittent shelves during Tertiary; Mesozoic sediments slightly metamorphosed)
RECENT	- 100 ft; flood plain and delta unconsol. clastics.	-200 ft; flood plain and delta unconsol. clastics.	-50 ft. alluvium
PLEISTOCENE	- 300 ft. Fly R. delta and flood plain deposits. Basaltic volcanics and piedmont fans.	- 800 ft; Kikori-Purari delta and flood plain. Local reefs raised to 500 ft.a.s.l. Basalt plugs, cones and apron deposits.	Sub-basaltic agglomerate sheets up to 2,000 ft.thick; raised limestone to 50 ft. thick; dissected piedmont deposits 300 ft.
PLIOCENE	0-1000 ft.deltaic clastics	8000 - 10000ft.Trough divided into two subsiding depositional basins by transverse emergent area. Deltaic deposits - greywackes and mudstones with coal measures in lower half of sequence.	1000 - 5000 ft. medium to coarse clastics, greywackes, with notable tuffaceous content; local raised reef limestone to 300 ft. thick. Basaltic volcanic plugs,flows, apron deposits to 3000 ft. thick.
NEOCENE Miocene "g", "f" "e" stages	SLIGHT REGIONAL UNCONFORMITY 500 - 3,500 ft.algal-bryozoal reef and shoal limestone. 11,000 ft. locally in Omati Trough, including 6000 ft.Miocene "e" basinal limestone (calcilutite).	30,000 - 35,000 ft. marine and deltaic deep-water muddy clastics; mudstone and greywacke. Interbeds of basinal ('puri-type') limestone.	ANGULAR UNCONFORMITY Up to 10,000 ft.medium to coarse tuffaceous clastics, including localized reefs to 500 ft. thick. Basaltic volcanics.
		U N C O N F O R M I T Y	
PALAEOCENE (Eocene, Oligocene)	Reef and shoal limestone, local erosional remnants of Eocene to 200 ft.thick. Oligocene missing.	Eocene shoal and basinal limestone and coarse clastics to 2000 ft. Oligocene missing.	Limestone, chert, submarine volcanics (includes Oligocene) to 5000 ft, completely folded.
UPPER CRETACEOUS (Cenomanian) (Turonian) (Senonian)	UNCONFORMITY	10,000 ft.mainly clastics, some local shoal limestone. Greywackes and mudstone (exposed only in Central Highlands).	+4,000 ft.clastics and some limestone completely folded and partly metamorphosed; true thickness indeterminate.
LOWER CRETACEOUS	0-3000 ft.fine clastics, some quartz sand in west.	+6000 ft. fine clastics, mudstone and greywacke (glauconitic), red shale in Aure trough).	Not recognised, possibly because of metamorphism.
JURASSIC	0-6000 ft clastics, mudstone and greywacke, some coal measures, quartzose and arkosic sandstone and conglomerate near base.	10,000 ft.black mudstone, in trough in Western Highlands. (Not exposed in Aure Trough).	Not recognised, probably metamorphosed.
TRIASSIC	Possible 650 ft. arkosic sandstone at Barikewa.	Possible 2000 - 3000 ft coarse to fine arkosic clastic sediments in Central Highlands.	Not recognised (?metamorphosed).
PERMIAN	800 ft.arkosic limestone, limestone and sub-marine volcanics in central Highlands.	Not recognised.	Not recognised.
BASEMENT	(?) Permo-Carb. granite	Probable Palaeozoic metamorphics	Cretaceous and older metamorphics.

(The Papuan Basin is strictly a Tertiary basin - the extent and pattern of Mesozoic sedimentation in Papua has not yet been determined.)

SEDIMENTARY BASINS OF PAPUA AND NEW GUINEA

In the Territory of Papua and New Guinea, thick sequences of marine sediments ranging in age from Jurassic to Pliocene are prospective for oil and gas. Unmetamorphosed Triassic (Dow, 1962) and Permian (Rickwood, 1955) sediments are exposed in the central highlands; these sediments have not been recognised either at outcrop, or in the subsurface, in the flanking sedimentary basins. Low-grade metasediments within this median orogenic belt are probably of Palaeozoic or older age; some Mesozoic sediments, particularly on the flanks of the Owen Stanley Ranges, are also regionally metamorphosed. The original form of the pre-Tertiary basins has been severely disfigured by Cainozoic orogenics which have produced the main present-day cordillera of New Guinea. The principal basins of Tertiary marine sedimentation, namely the Papuan Basin (Osborne, 1955) south of the highlands, and the Northern New Guinea Basin, north of the highlands, received floods of clastic sediments derived from recurring orogenic movements and associated vulcanism along a zone now expressed by the highlands and mountain chains of New Guinea. The basin outlines shown on Plate 3 delimit the present distribution of unmetamorphosed Mesozoic and Tertiary sediments; these outlines do not necessarily conform with the original basin margins before folding, emergence and erosion. Only in the Papuan Basin can opposing basin flanks be confidently recognized. The Northern New Guinea Basin and the Cape Vogel Basin which are truncated by the coastline are probably of the open marginal type (Weeks, 1959). Undoubtedly, thick Tertiary to Recent sediments have accumulated in the offshore areas around the coastline of Papua and New Guinea and adjoining islands but, except off the coast of western Papua, deep water has precluded offshore oil exploration.

The information contained in this summary has been compiled by J.E. Thompson, mainly from published and unpublished reports by the staff of oil exploration companies and the Bureau of Mineral Resources. The principal source of geological information for western Papua is the review by Australasian Petroleum Company (1962). All sources of information cannot be acknowledged specifically in a publication of this type, but a selected bibliography of published literature has been included.

28. THE PAPUAN BASIN, (Jurassic - Recent).

The Papuan Basin (see Plate 1) is a composite basin covering about 80,000 square miles and containing a thick Tertiary succession of marine and paralic sediments overlying, with degrees of unconformity, a Cretaceous and Jurassic succession. A major depositional or erosional break between Lower Cretaceous and Lower Miocene is widespread over most of the basin. However, Eocene limestone, rarely more than a few hundred feet thick, has been recorded from several localities and wells in western Papua. This limestone probably represents a relatively short period of marine transgression during the major break between Cretaceous and Miocene deposition. This break is not present in the Port Moresby area where Upper Cretaceous, Eocene and Oligocene limestone, chert and tuffaceous sediments have been recorded (Glaessner, 1952); the relationship of this sequence to Lower Cretaceous sediments is not known. The stratigraphic succession in various provinces of the basin is shown in Table 12.

The Pliocene sediments of the Papuan Basin are generally not as tightly folded as the Miocene sediments. Folding, erosion and deposition progressed concomitantly during this time and clastic sediments with some coal interbeds, accumulated in paralic and deltaic environments in structurally and topographically depressed areas. In the Aure Trough, this concomitant folding and deposition has produced an effect of catenary folding with broad synclines containing thick Pliocene successions separated by sharp anticlinal crests on which the Pliocene sections are reduced or absent. In the south-eastern part of the Aure Trough the transgression of Pliocene clastic sediments over folded Upper Miocene sediments can be interpreted from aerial photographs.

The pattern of Cretaceous and Jurassic deposition is less clear. The thick marine Mesozoic clastic sections (9,000 feet to 22,000 feet) in the Western and Eastern Highlands Districts of New Guinea (A.P.C., 1961); McMillan and Malone, 1960; Noakes, 1939; Rickwood, 1955; Dow, 1962) suggest marine trough deposition but the axis of the trough cannot be traced. In this same region Permian and Triassic sediments are deposited on or associated with continental-type granite and volcanics. It is possible that the belt of basic and ultrabasic intrusive and volcanic rocks north of the central highlands and Morobe Arc represents a zone of late Cretaceous orogeny in the trough of an orthogeosyncline. Superimposed Cainozoic orogeny and probably transcurrent fault displacements make reconstruction of the pre-Tertiary continental margin virtually impossible. There is no evidence to suggest that the principal axes of Mesozoic and Tertiary deposition in the Papuan Basin are coincident. It has not been possible to detect with certainty any angular discordance between the Cretaceous and Tertiary either in outcrop or in wells in the Papuan Basin. However, the drilling by A.P.C. of the Komewu No.1 and No.2 wells on either side of the Komewu Fault has indicated about 3,000 feet of vertical displacement of the Mesozoic succession before transgression of Lower Miocene limestone. The Cretaceous sediments encountered in the Papuan Basin are dominantly fine to medium grained, grey to green, marine sandstone, silt and mudstone; glauconite is a common constituent. These clastic sediments differ mineralogically from the Tertiary greywackes (Edwards, 1950 (a), 1950 (b)) though, in hand specimen they may appear similar. The Jurassic sediments encountered in drilling in the Papuan Basin are dark grey to red-brown sandstones and mudstones. The sandstones are both quartzose and feldspathic. They contain an Upper Jurassic marine fauna at Omati, Barikewa and Iehi but, at Komewu, Arania and Morehead, the lack of marine fauna and the presence of coals suggest a terrestrial depositional environment.

The broad morphology of the Papuan Basin throughout Miocene time is fairly characteristic of a miogeosyncline, having (1) a broad, slowly subsiding south-western shelf zone on which about 3,000 feet of limestone with complex interplays of shoal and reef facies have accumulated, (2) a deep asymmetrical trough (The Aure Trough) in which about 35,000 feet of alternating greywacke and mudstone have been rapidly deposited, and (3) a narrow north-eastern shelf zone containing localized reef and shoal limestone lenses, and coarse clastic sediments derived mainly from basic to andesitic vulcanism to the north and north-east.

Each of these three provinces has a characteristic tectonic style which reflects both the competency of the sedimentary pile and the type of basement deformation.

In the extreme south-west, where a total Tertiary and Mesozoic sedimentary section, generally less than 10,000 feet thick, overlies granitic basement, folding is very broad and the Mesozoic section and basement have been dislocated by normal faulting. Farther north-east, but still in the province of Tertiary shelf limestone deposition, folding grades from broad to tight and asymmetric as the Miocene reef front, approximating to the Erave-Wana Swell (Plate 3), is approached. At Iehi and Puri near this hinge line, steep and low-angled thrust faulting of both the Tertiary and Mesozoic sections has been recorded.

Beyond the carbonate front, the thick (35,000 feet approximately) Lower Miocene to Pliocene fine-grained clastic succession of the Aure Trough is tightly folded; many folds are crestally thrust-faulted and incompetent mudstones and siltstones have diapirically ruptured the cores of some folds. Major strike faults in this zone, such as Aure and Ekiere Faults, probably have considerable horizontal, as well as vertical displacements.

On the narrow north-eastern flank, where conglomerate, limestone and volcanics are present within the sedimentary sequence, folding is more robust and crestal faulting less prevalent than in the thicker and less competent sedimentary pile of the Aure Trough.

Surface showings of oil or gas are known in sediments ranging from Jurassic to Pliocene age. Most of the oil showings are impregnations in sediments which will either produce an oil film when freshly broken under water or which have a distinct petroliferous odour when broken. No large free-flowing oil seepages are known but oil can be collected from many small seepages by skimming the surface of the water in freshly dug collecting pits. Oil films and odours are also frequently associated with gas blows even though in most cases the gas is "dry". The oil and gas seepage areas in the Papuan Basin can be conveniently grouped into three provinces, thus -

(1) The central Aure Trough: This is the zone of tightest folding in the Papuan Basin and is characterised by crestally faulted anticlines with steep flanks and, in some places, with diapiric mudstone cores. Gas blows and associated oil showings at Hohoro, Upoia, Iavokia, Beleppa Hills, Ivori Junction, Nakoro, Aipa Hills and the Opau area can be included in this category.

(2) The south-western hinge: A small but important group of gas blows and oil showings in the exposed crestal zone of the Puri anticline belong to this province. The oil and gas emanates from fractured, dense Lower Miocene limestone. The gas in this area contains a significant proportion of higher hydrocarbons.

(3) The Southern Highlands zone of thrust faulting: The most prolific oil seepages in Papua come from Cretaceous glauconitic sandstones and basal Miocene limestones near major strike faults which dominate the tectonic pattern of this area. Oil has been used and traded by natives of this area for a long time. Geologists of Australasian Petroleum Company have described most of the known oil and gas seepages of this province in unpublished reports.

Since the last revision of Report 41, the rate of oil exploration in Papua has been drastically reduced by the withdrawal of the British Petroleum and Standard Vacuum Companies as joint operators on Permits and Licences held by Australasian Petroleum Company and Island Exploration Company. Other significant moves in petroleum prospecting in Papua are: the entry of -

(1) The Conorada Group (comprising The Continental Oil Company of Australia Ltd, Marathon Petroleum Australia Ltd, and Amerada Petroleum Corporation of Australia Ltd) into a Permit formerly held by the Papuan Apinaipi Petroleum Company and encompassing much of the south-eastern part of the Aure Trough and part of the north-eastern flank of the basin.

(2) The Triton Corporation, a combine of Canadian independents and small companies, into a large Permit on the south-western shelf province which was relinquished by Island Exploration Company after the drilling of the Aramia, Morehead and Komewu wells.

(3) The Tasman Oil Company, a wholly owned subsidiary of Canadian Superior Oil Company, into three areas under one Permit in the south-western shelf zone. The largest area covers most of the Mesozoic Morehead Basin and part of the flank of the Oriomo Spur. The other two areas are in rough karst country of the Darai Uplift.

These new American and Canadian interests are at present reviewing all available results of previous investigations preparatory to embarking on active field programme.

Feasibility studies by the Burmah Oil Company and Commonwealth Government jointly, of a project to establish a gas treatment plant to utilize natural gas resources indicated in Australasian Petroleum Company and Island Exploration Company drilling at Barikewa, Kuru, Sireru, Puri and Bwata, have been completed. The Burmah Oil Company did not exercise an option they had over these gas resources.

Following the encouragement of good showings of oil and gas at Puri, Australasian Petroleum Company established a drill site about 15 miles north-west of Puri on the Bwata anticline, using Sikorsky S58 helicopters to transport all equipment and personnel. The Bwata well was designed to test the top of a Lower Miocene limestone sequence, within closure on an asymmetrical anticline with steep southern flank. The well spudded in Upper Miocene mudstone and intersected the target limestone at 4,750 feet and drilled to 7,302 feet in the same limestone unit. On test, the interval 4,750 - 5,266 feet produced "lean" gas in excess of 25,000,000 cubic feet per day; this gas yielded condensate at the rate of 0.23 gallons per 1,000 cubic feet of gas. No liquid petroleum was produced. The well was plugged and abandoned.

Australasian Petroleum Company then drilled a test well on the Iehi Anticline, north of the Kikori River, in karst country of very difficult access. This well was a sequel to the Barikewa test about 11 miles to the south-south-east which indicated a large quantity of dry gas, but no oil, in a Cretaceous sandstone unit. The Iehi Anticline is a sinuous west-north-westerly striking feature with a steep northern flank and a gentle southern flank; only Tertiary limestone is exposed by this fold. The well, located high on the southern flank of the structure, was designed to test the Cretaceous sandstone section within closure. The drilling rig and all supplies and personnel were established and maintained in the area by Sikorsky S58 helicopters. Water for drilling was pumped 4 miles from the Kikori River and stored at the site in a large polythene reservoir. Tertiary limestones were encountered from surface to 2,400 feet and Cretaceous marine mudstone, siltstone and sandstone to 5,382 feet, thence a Jurassic fine clastic marine succession to 8,650 feet. At this depth a major reverse fault was encountered and portion of the Cretaceous and Jurassic section was repeated; the vertical displacement on the fault, calculated from electric log correlations above and below the fault, was about 3,300 feet. Drilling ceased in Jurassic? siltstone at 10,042 feet. Permeable sandstone beds in the Mesozoic succession were tested and "dry" gas was produced from a zone from 4,722 - 4,835 feet; other permeable zones produced fresh water. Cores from within the zone 5,238 - 5,250 feet showed good hydrocarbon indications but only fresh water was produced on test. The well was plugged and abandoned. This operation which was partly subsidised by the Commonwealth cost approximately £1,400,000.

The most recent drilling in Papua was done by Oil Search Limited, with Commonwealth subsidy, at Iamara on the right bank of the lower reaches of the Fly River. The object of this drilling was to determine the nature, age and fluid content of the Mesozoic sediments on the north-plunging nose of the Oriomo Spur, a subsurface basement feature which is apparently a prolongation of the basement rocks of Cape York Peninsula. The site was selected after reconnaissance seismic surveys in the region. After penetrating about 200 feet of unconsolidated alluvium, including some old lateritic profiles, Miocene limestone was drilled to 3,000 feet thence Cretaceous and Jurassic sandstones and siltstones. Grey dacite tuff, interpreted as basement, was entered at 5,896 feet and drilled to 5,950 feet at which depth, after testing, the well was plugged and abandoned. Several permeable sandstones in the Mesozoic section were indicated by the logging and a core from 4,196 feet contained a trace of oil. However, only brine was produced from sandstones selected for testing. Road access to a new drill site known as Mutare, 11 miles south of Iamara is being prepared by Oil Search Limited. This well, which is based on seismic surveys done several years ago, will investigate the Mesozoic sandstone beds up-dip from Iamara No.1, on the same north-plunging basement spur. The estimated total depth of the proposed Mutare well is 4,500 feet.

23. THE NORTHERN NEW GUINEA BASIN, (Miocene - Pliocene).

The name Northern New Guinea Basin is applied loosely to a zone of thick Miocene and Pliocene clastic sedimentation north of the central highlands of New Guinea. The present-day southern limit of the basin is topographically expressed by the front of the main cordillera which, in the region of the Markham and Ramu Valleys, is fault-controlled. The basin is elongate, extending north-west into West New Guinea and south-east at least to the Huon Peninsula. The offshore limits of the basin are not known but it is probable that the principal axis of deposition lies offshore, so that only the southern flank is represented onshore. The part of this basin accessible for prospecting covers about 32,000 square miles.

The aggregate thickness of Miocene and Pliocene clastic sediments in the region of the Bewani-Torricelli Mountains is about 35,000 feet. The Pliocene part of this succession comprises dominantly non-marine coarse to fine grained clastics with some coal interbeds; the Miocene part is essentially marine greywacke and mudstone with some globigerinal marl beds. In the Sepik Valley the total section is thinner and the facies suggest shelf deposition. A late Tertiary orogeny has produced the Bewani, Torricelli and Prince Alexander Mountains which have cores of granitic and metamorphic up-faulted basement, and intrusive basic igneous rocks. The Tertiary sediments on the northern flanks of these mountains are very complexly folded and faulted. Oil seepages occur within this zone at Matapau near the coast between Wewak and Aitape; slight oil impregnations in the Tertiary sediments have been recorded from many localities in this part of the basin. Complicated tectonics and the predominance of sediments with low permeability has discouraged intensive oil exploration in this area.

At the south-eastern end of this Basin, inland from Madang and north of the Ramu River, a thick coarsely clastic and partly volcanic Upper Miocene and Pliocene succession is broadly folded. Some gas seepages from folded Tertiary sediments on the northern flank of the Ramu valley have been recorded.

At the extreme south-eastern end of the Basin, in the rugged Finisterre, Saruwaged and Cromwell Mountains of the Huon Peninsula, a very thick, dominantly volcanic, Miocene section has been uplifted, folded and faulted in Pleistocene to Recent time. This part of the basin has very poor oil prospects.

The stratigraphy of the Basin is summarized in Table 13.

TABLE 13.

GENERALIZED STRATIGRAPHY OF THE NORTHERN NEW GUINEA BASIN

	North-western Part (North of Bewani and Torricelli Mountains)	Central Part (Lower Sepik R.)	South-eastern Part (Madang Basin)
Pliocene	Basal marine mudstone and sandstone to upper non-marine conglomerate and mudstone with coal 12,000 - 17,000 feet.	Section thins, volcanic component decreases and shelf facies developed.	Section similar to that in north-western part but Pliocene thinner and volcanic component increases eastward throughout section. Section in Finisterre and Saruwaged Ranges is dominantly volcanic.
Neogene	Miocene interbedded volcanics, limestone, greywacke and mudstone 16,000 - 29,000 feet, uppermost 1,000 - 4,000 feet mainly globigerinal marl with volcanics.		
Palaeocene	Scattered erosional remnants of Eocene limestone.		
Pre-Tertiary.	Metamorphics, granite, basic and ultrabasic rocks of unknown ages.		
Igneous Rocks.	((?) Palaeozoic to Pliocene) - granodiorite, diorite, gabbro, peridotite.		

TABLE 14

GENERALIZED STRATIGRAPHY - CAPE VOGEL BASIN

	AGE	APPROX. THICKNESS	SEDIMENTS	VOLCANIC AND PLUTONIC ROCKS
CAPE VOGEL BASIN	Pleistocene and Recent	300 feet	Alluvium and coral reefs at or near sea level; raised reefs up to 400 feet a.s.l., tilted but not noticeably folded.	Extrusive and shallow intrusive igneous rocks of andesitic to basic composition. Includes (1) Pleistocene to Recent volcanics of Cape Nelson and their apron deposits; (2) basic tuffs, lapilli beds and explosion breccias within the sedimentary succession exposed in Cape Vogel, and (3) basic intrusive rocks which have intruded and domed the Upper Tertiary sediments at Cape Vogel.
		SLIGHT	UNCONFORMITY	
	Plio-Pleistocene	1,000 feet	Interbedded, poorly sorted conglomerates and greywacke, tuff and white marl, mainly non-marine. Gently folded.	
		SLIGHT	UNCONFORMITY	
	Pliocene ("h" stage)	1,200 feet	Light grey and buff coloured marine marls with "h" stage foraminifera. Medium dips. Exposed on both north and south flank of Cape Vogel.	
		SLIGHT	UNCONFORMITY	
	Mio-Pliocene	10,000 feet	Interbedded brown greywacke and carbonaceous mudstone containing foraminifera. Moderately folded. Dips steep and sediments indurated adjoining volcanics and shallow intrusives on Cape Vogel.	
	Middle Miocene	400 feet	Reef limestone and calcarenite at Castle Hill intruded by basic igneous rocks.	
BASEMENT	Lower Tertiary	?		Ultrabasic and basic plutonic rocks in fault contact with calc-silicate metamorphic rocks.
			UNCONFORMITY	
	?Mesozoic	?	Limestone and calc-silicate metamorphic rocks on the northern flank of the Owen Stanley Range, east of the Musa Valley.	
			UNCONFORMITY	
	?Mesozoic-Palaeozoic	+10,000 ft. (?)	Phyllites, schists, and metavolcanics of Mount Dayman and the Goropu Mountains.	

During the period 1930 to 1940 reconnaissance geological mapping related to the search for oil was carried out over most of the basin. In the post-war period oil exploration companies have shown little interest in this area and no deep test wells have been drilled. Some shallow drilling was done in the period 1924 to 1926 near the Matapau oil seepages; and some shallow core drilling for geological information near Waniwa and Napsiei in the Upper Sepik Valley was completed in 1957. In 1926, a well was drilled to 2,705 feet at Marienburg near the mouth of the Sepik River but the results were not encouraging.

6. CAPE VOGEL BASIN, (Middle Miocene to Recent).

The Cape Vogel Basin includes the thick folded sedimentary sequence which forms Cape Vogel. It is exposed over an area of about 5,000 square miles and may extend to the north-west beneath Recent coastal plain alluvium and volcanics. Deeply eroded sediments on the southern shore of Goodenough Bay and along the coast farther to the south-east may also be included in the Basin. The offshore limits of the basin are not known.

The sedimentary sequence exposed on Cape Vogel comprises about 13,000 feet of Upper Miocene and Pliocene sandstone, conglomerate and marl deposited rapidly in the paralic environment of a coastal plain bounding an active fault block of low-grade metasediments and basic to ultrabasic intrusives. Grey foraminiferal Pliocene marl, about 1,000 feet thick, on the northern part of Cape Vogel may have oil-source potential but conditions for the entrapment of oil from this source do not appear to be present.

The tabulated summary of the generalized stratigraphy (Table 14) is derived from unpublished observations by J.E. Thompson and palaeontological determinations by Dr. I. Crespin and D. Belford.

The principal fold on Cape Vogel has an exposed intrusive basic igneous core. Basic tuffs, lapilli beds and agglomerate occur throughout and unconformably on the thick clastic sequence.

Carbon dioxide seepages and hot springs in the Cape Vogel area are related to decadent volcanism.

There has been no active oil exploration in this basin since 1928 when the area was examined by geologists of the Anglo-Persian Oil Company (A.P.O.C., 1929). Two shallow wells drilled by the Cape Vogel Petroleum in 1927 and 1928 near the former village of Kukuia on the southern flank of the Cape Vogel Anticline did not yield any confirmed evidence of either oil or gas.

OTHER BASINS AND PROVINCES

The areas not discussed above but which are basins or may have some prospects for hydrocarbon accumulation are briefly discussed below under the Era or Period during which the main sedimentation occurred.

Upper Proterozoic

The province of Upper Proterozoic deposition in northern Australia including the McArthur and South Nicholson Basins has been shown after discussions with P.R. Dunn and H.G. Roberts who also provided the following description.

(1) McArthur Basin, (Land - 72,000 square miles; off-shore - about 8,000 square miles).

The McArthur Basin extends along the east coastal region of the Northern Territory from Arnhem Land to the Queensland border. It contains a sequence of dominantly shallow water marine Upper Proterozoic sedimentary and volcanic rocks. The basal part of the sequence consists of up to 15,000 feet of arenites, volcanics and carbonate rocks. Overlying the basal part of the sequence is a series of dominantly carbonate rocks locally attaining a thickness of 13,000 feet; within this part of the sequence abrupt lateral lithological changes derive from the growth in the southern part of the basin of an organically constructed barrier reef at least one hundred miles long. The uppermost part of the succession consists of up to 20,000 feet of arenites and lutites.

Except in a strongly faulted north-south zone through the central part of the basin the rocks are only moderately disturbed - in the north-west and south-east areas dips rarely exceed 10° even though transcurrent faults with west-north-west trends have affected rocks locally. The central, strongly faulted zone corresponds to the zone of maximum sedimentation during the two earlier phases of deposition.

(2) South Nicholson Basin, (6,000 square miles).

The history of sedimentation in the South Nicholson Basin parallels that of the McArthur Basin. The two earlier phases of sedimentation are represented in the basin but are areally restricted; the later arenite-lutite phase transgressed the earlier phases and delimits the extent of the basin.

The rocks of the South Nicholson Basin have been moderately faulted, but still retain the overall features of their original attitude.

Palaeozoic

(1) Arafura Basin (new name).

The Lower Palaeozoic sediments north of the McArthur Basin may develop into a basin in the southern part of the Arafura Sea, south of or continuous with the Arafura Depression of Fairbridge (1953). The south margin of the sediments has been drawn by P.R. Dunn and H.G. Roberts who also supplied the following information.

The sediments are exposed in the northern coastal region of Arnhem Land and in the Wessel and English Company Islands. They rest unconformably on Upper Proterozoic rocks and are tentatively regarded as being of Cambrian age - the presence of Scolithus ('pipe-rock'), which in Central Australia is found in Cambrian and Ordovician strata, supports this hypothesis. The section exposed is possibly between 5,000 and 10,000 feet in thickness, and consists of arenites, lutites and carbonates, probably deposited on a shallow marine shelf.

The rocks have been little disturbed since deposition - dips rarely exceed 5° N. and no faulting or folding is apparent at regional scale.

The area occupied by the Arafura Basin on land is only about 4,000 square miles.

(2) Ngalia Basin.

The Ngalia Basin is an elongated ?'trough' extending 250 miles to the west from the Hann Range in the Northern Territory and between 40 and 50 miles wide in the central, widest part. Its outline on the sedimentary basins map is taken from the Tectonic Map of Australia; based on this outline, the area has been calculated to be 5,000 square miles.

Cook (1963) has estimated that about 11,000 feet of sediments dip south into the basin in the north central part. Upper Proterozoic quartzite, sandstone (in part conglomeratic), arkose, limestone, dolomite and breccia, 3,700 feet thick, are unconformably overlain by 350 feet of Lower Palaeozoic sandstone and greywacke in which only one fossil, Protichnites, has been found. 7,000 feet of conglomeratic sandstone, in part feldspathic, occurs unconformably above the Lower Palaeozoic beds and is believed to have been deposited after movements at the time of the Tabberabberan orogeny, (see also G.S.A., 1962, p.28).

Ngalia Basin has also been called a 'trough' (Cook) and 'syncline' (Tindale, 1933), but little is known of the complete structural framework. Faulting and folding with marked east-west trends have been reported from around the marginal areas, but structures in the central area which is largely covered by sand, are unknown. It is possible that belts of Archaean rocks with east-west trends extend into or occur in the central eastern part as concealed horsts, and that the basin is controlled at least in part by block faulting, (Smith, pers. comm.)

(3) The Bundock, Clarke River and Star Basins, (Silurian to Carboniferous).

These basins have been shown and described in White (1961). They are Upper Devonian-Carboniferous basins of the same age as the Hodgkinson Basin (or Trough) which underlies and extends south of the Laura Basin further north. The sediments are mainly freshwater and have been folded and intruded by granite and acid volcanics; they unconformably overlie the Upper Silurian/ Lower Devonian rocks and overlap Middle Devonian sediments with disconformity. The total area is 10,000 square miles.

The Bundock Basin, at the west end of the Broken River Rift, contains 20,000 feet of greywacke, arkose, conglomerate, shale and minor fossiliferous limestone and calcareous sediments. The sediments have been folded into elongated domes and basins and are intruded by rhyolite porphyry.

The Clarke River Basin is 5 miles east of the Bundock Basin and is separated from it by Silurian/Devonian rocks uplifted in the early Carboniferous to form a land ridge between the basins. The basin is 2,000 square miles in area, and contains up to 7,000 feet of conglomerate, greywacke, sandstone with plant fossils and thin marine basal limestone and calcareous sediments. The edges of the basin are faulted, and sediments have been tightly folded and intruded by minor granite, rhyolite porphyry and diorite.

The Star Basin is ten miles south-east of the Clarke River Basin. It contains about 1,500 feet of similar sediments.

These basins may have some potential as prospects for oil search because they overlie thick marine Devonian rocks including reefs, even though these rocks have been extensively folded and intruded by acid igneous rocks. The Devonian Broken River Formation which has been folded and plunges south-west below the Bundock Basin has been the least affected by igneous intrusion according to White (pers. comm.); it consists of 17,000 feet of marine calcareous sediments and shale with many limestone lenses.

The Hodgkinson Basin has been omitted from the map and discussion because it is not regarded as prospective for hydrocarbon accumulation.

(4) Other Devonian sediments which are unaltered and contain marine fossiliferous beds occur west of Cobar in New South Wales. They are mainly sandstones with some siltstones and mudstones (Spence, 1958), and have been shown on the basins map as 'Devonian Sediments' in the belt of 20,000 square miles between the Murray and Great Artesian Basins. Their age may extend into Lower Carboniferous. The geological history and structure of this area has been summarized earlier under the description of the Murray Basin. The main formations are:

Top.	Belford Beds	-	quartz sandstones	5,800 feet
	Mulga Downs Beds	-	conglomeratic sandstone and sandstone with thin mudstone in lower part	7,500 feet
	Amphitheatre Beds	-	massive sandstone, flaggy green siltstone, mudstone and sandstone, fossiliferous in lower part.	more than 6,500 feet

(After Spence.)

Along the eastern margin of the Murray Basin in the Ardlethan-Cocoparra section north of Narrandera, more than 8,000 feet of red beds, mainly sandstone, crop out. Spence correlates these with the Mulga Downs and Belford Beds and points out that the Amphitheatre beds therefore wedge out south of Cobar.

In the Mansfield-Mitchell River area is a belt of Upper Devonian-Lower Carboniferous rocks, 30 miles wide, extending for about 100 miles south-east from the Murray Basin to the Gippsland Basin. Spence suggests two main divisions occur - a lower of interbedded volcanics, sandstones and mudstones with an Upper Devonian fish fauna, and an upper of mainly fine-grained sediment, some calcareous, with a Lower Carboniferous fish fauna. The thickness is not known but may be several thousand feet. The north part is bounded by strong faults with N35°W trends. The structure is in general a shallow syncline with low dips except at the margins. Further south there are gentle folds with north-westerly axes.

Spence also refers to the Devonian sediments of the Grampians in western Victoria. These are mostly sandstones and conglomerate, up to 15,000 feet thick in the northern part. An additional 2,500 feet of lower beds occurs in the Hall's Gap area. These include some shale. At the north end the structure is an asymmetric syncline, faulted on the steeper eastern side, and with a north-north-west - south-south-east axis. Further south the axis turns south, diverging from the fault, and south-south-west. The sediments have been intruded in some areas by granodiorite and porphyrite.

(5) Two unnamed Upper Palaeozoic areas of deposition have been shown north of the Yarrol Basin; their total area is about 5,000 square miles. The western area is a belt of Permian rocks which extends south-south-east from Bowen to the Apis Creek area and possibly into the Yarrol Basin. It is bounded on the west by Lower Bowen volcanics and granite (the 'Eungella Strip', Hill and Denmead, Fig. 1) and a structural line extending from there to the 'Gogango High'. Laing and Hill (in Hill and Denmead, pp. 221) note that marine Permian strata up to 5,000 feet thick in the southern part of the Apis Creek area are continuous across the divide into the Bowen Basin. The belt is bounded on the east side in the southern part by a fault and granite and metasediments of the 'South Coastal Structural High'. The east margin in the northern part is formed by the other belt of Upper Palaeozoic sediments which have been mapped recently (1962) as Devonian-Carboniferous by B.M.R. - Q.G.S. field parties. This is a narrow coastal belt from east of Proserpine to south-east of Mackay and including nearby islands to as far south as Long Island. It contains several thousand feet of sediments similar to those of the Yarrol Basin. Both areas have been intensely folded and intruded by granite and acid volcanics.

(6) The Collie, Muja and Wilga Basins, (Permian).

These three minor basins form a group on the Precambrian Shield about 100 miles south of Perth (McWhae, et al.). They contain glacial beds and coal-bearing strata with a probable maximum thickness of 3,000 feet in the Collie Basin. They are not considered to be good prospective areas for hydrocarbon accumulation.

<u>Mesozoic</u>

(1) The Esk Rift.

The Esk Rift of 2,000 square miles may have originated in the Permian as a fault trough - it is enclosed between Permian rocks, including marine sediments. However, the oldest known sediments are coarse rudites with plant fossils and these suggest that relief had been accentuated by early Triassic times. No marine deposits are known from the rift; terrestrial sediments and volcanics are characteristic. The youngest unit may be equivalent to sediments of the Bundamba Group. The overall thickness is not known but may be several thousand feet. The sediments have been folded and faulted mainly in a north-north-west - south-south-east direction parallel to the margins of the rift. The beds have been intruded by intermediate and acid igneous rocks. The main source of the map outline and the above summary is Hill and Denmead (Fig.1 and pp. 14, 269-274).

(2) The Styx Basin.

This basin contains up to 1,270 feet of Lower Cretaceous coal measures in a narrow structural belt, 5 miles wide and 25 miles long in a north-south direction, formed in the belt of Permian sediments north of the Yarrol Basin. The eastern side is faulted and intensely folded. The outlines and summary are from Hill and Denmead.

(3) The Lorne Basin, (Triassic).

The Lorne Basin was named by Voisey (1939) and referred to again by him (1959) as a basin between the 'Manning River Fault System' and the 'Hastings Fault' and formed on a subsided block. It is a small basin on the New South Wales coast south-west of Port Macquarie with a few hundred feet of Triassic sediments, mainly sandstone and grit with a basal conglomerate, shales with plant remains, and an overlying massive conglomerate, (Cornish and Connelly, 1962). They possibly overlie Permian fossiliferous mudstone and limestone which crop out just north of the basin, and are elsewhere unconformable on older Palaeozoic rocks. Faulting and intrusion of alkaline igneous rocks has followed deposition of the Mesozoic sediments.

(4) A basin of Cretaceous sediments is known to extend offshore south of Darwin and include both Melville and Bathurst Island. The southern margin overlaps the mainland around Darwin; other limits are not known. Its area is at least 3,000 square miles.

A refraction seismic survey on Bathurst Island showed that basement dipped gently northwest in the area surveyed from 1,160 to 2,930 feet below sea level, (Fife and Tinline, 1962). Because no intermediate reflecting horizons were shown, it is suggested that the basin contains at least 3,000 feet of Cretaceous marine sediments, including glauconitic sandstones, mudstones and siltstones in the upper part, and a thin cover of Tertiary sediments. No major structures are known.

Tertiary

Tertiary marine sediments may be quite thick in some areas in the islands of the Bismarck Archipelago, New Guinea, but they have been extensively intruded by recent volcanics, so that their prospects as sources of hydrocarbons are not highly regarded.

OFF-SHORE PROVINCES

The age, nature and extent of sedimentation in off-shore areas is not well known, but recent geophysical surveys have shown that areas of thick sedimentation occur and may be of importance in the search for oil. Reford (1962) has shown that a basin, the "Bass Basin", exists between the Otway and Gippsland Basins and Tasmania, and may contain sediments up to 12,000 feet thick.

Traves (in Hill and Denmead, pp. 369-371) noted that over 1,200 feet of Tertiary sediments occur below 530 feet of Pleistocene to Recent sediments, and above basement, in the Wreck Island bore at the south end of the Great Barrier Reef. This is the deepest section known in this area, but recent aeromagnetic traverses between latitudes 17° and 24° S. by Aero Services Limited for Australian Oil and Gas Corporation Ltd (1963) suggest that thicker section (up to 6,000 feet according to one interpretation) may be present, and also some structural features.

The Sahul Shelf has been defined by Fairbridge (1953); it is the area of continental shelf down to 300 fathoms with the Sahul Bank along its outer edge extending from a tectonic line running north-west from Cape Leveque to a line north from Bathurst Island. Fairbridge shows a depression on the Sahul Shelf opposite the Bonaparte Gulf Basin and forming an extension of it. He also shows the 'Rowley Depression' on the continental shelf opposite the Canning Basin, and the 'Arafura Depression' north of what has been called the Arafura Basin in this report, and considers that the structural histories of these shelf depressions are analogous to those of the basins opposite on the mainland. This opinion requires confirmation as the stratigraphy of the off-shore area may differ considerably from the on-shore area. However, Noakes, Opik and Crespin (1952) also include the Sahul Shelf depression in the Bonaparte Gulf Basin, and the 'Rowley Shelf' is included in the Canning Basin by Veevers and Wells.

REFERENCES

A.O.G., 1962 - Subsidy application for seismic survey, Wentworth area, Murray Basin, New South Wales. Aust. Oil Gas Corporation Ltd, (unpubl.).

A.O.G.J., 1961 - Newly named stratigraphic units in Queensland. Aust.Oil Gas J., 7(9), 27.

A.P.C.P., 1961 - Geological results of petroleum exploration in western Papua 1937 - 1961. J.geol.Soc.Aust., 8 (1), 133.

A.P.O.C., 1930 - The oil exploration work in Papua and New Guinea conducted by the Anglo-Persian Oil Company on behalf of the Government of the Commonwealth of Australia, 1920 - 1929. Harrison and Sons Ltd, London.

BAIN, J.S., 1963 - Well completion report Eumeralla No.1, southwest Victoria. Frome Broken Hill Pty Ltd, Rep. 7200-W-21 (unpubl.).

BANKS, M.R., 1952 - Permian, Triassic and Jurassic rocks in Tasmania. Symposium sur les series de Gondwana. Int.geol.Cong., 19th Sess., Algiers, 63-90.

——— 1958 - Recent additions to the knowledge of the Permian System in Tasmania. Sobretiro de la Comision de Gondwana. Int.geol.Cong., 20th Sess., Mexico, 151-177.

B.M.R., 1960 - Summary of oil-search activities in Australia and New Guinea to June, 1959. Bur.Min.Resour.Aust.Rep. 41A.

BOOKER, F.W., 1960 - Studies in Permian Sedimentation in the Sydney Basin, New South Wales. Tech.Rep.Dep.Min.N.S.W. for 1957, 5, 10-62.

BOUTAKOFF, N., 1955 - A new approach to petroleum geology and oil possibilities in Gippsland. Min.geol.J.Dept Mines Vict., 5 (4-5), 39-57.

BOUTAKOFF, N., and SPRIGG, R.C., 1953 - Summary report on the petroleum possibilities of the Mount Gambier Sunklands. Min.geol.J.Dept Mines Vict., 5(2), 28-42.

BOWMAN, H.E., and HARKEY, W.J., 1962 - Seismic survey report on the Mabel Creek area, South Australia, Western Australia, for Exoil Pty Ltd (unpubl.).

CASEY, J.N., 1959 - New names in Queensland stratigraphy, North-west Queensland. Aust.Oil Gas J., 5(12) 31-36.

CHEWINGS, C., 1935 - The Pertatataka Series in Central Australia with notes on the Amadeus Sunkland. Trans.Roy.Soc.S.Aust., 59, 141-163.

CLARKE, E. de C., PRENDERGAST, K.L., TEICHERT, C., and FAIRBRIDGE, R.W., 1951 - Permian Succession and Structure in the northern part of the Irwin Basin, Western Australia. J.Roy.Soc.W.Aust., 32, 19-47.

CONDON, M.A., 1954 - Progress report on the Stratigraphy and Structure of the Carnarvon Basin, Western Australia. Bur.Min.Resour.Aust.Rep. 15.

———— 1956 - Depositional structures in the Carnarvon Basin, Western Australia. Relaciones entre la tectonica y la sedimentacion, Pt.2. Int.geol.Cong., 20th Sess., Mexico.

CONDON, M.A., JOHNSTONE, D., PERRY, W.J., and CRESPIN, I., 1953 - The Cape Range Structure, Western Australia. Bur.Min.Resour.Aust.Bull. 21.

CONDON, M.A., JOHNSTONE, D., PRICHARD, C.E., and JOHNSTONE, M.H., 1956 - The Giralia and Marilla Anticlines , North-West Division, Western Australia. Bur.Min.Resour.Aust.Bull. 25.

COOK, P.J., 1963 - The geology of Yuendumu Native Reserve, Northern Territory. Bur.Min.Resour.Aust.Rec. 1963/37 (unpubl.).

CORNISH, B.E., and CONNELLY, M.A., 1962 - Kempsey - Port Macquarie area (P.E.L. 60), N.S.W. for L.H. Smart Oil Exploration Company Ltd, (unpubl.).

DALGARNO, R., and JOHNSON, J.E., 1962 - Cambrian sequence of the western Flinders Ranges. Q.geol.notes, Geol.Survey S.Aust., No.4.

DAVID, T.W.E., 1950 - The geology of the Commonwealth of Australia, edited by W.R. Browne. London, Arnold.

DICKINS, J.M. and McTAVISH, R.A., 1963 - Lower Triassic Marine Fossils from the Beagle Ridge (B.M.R.10) Bore, Perth Basin, Western Australia. J.geol.Soc.Aust., 10, pt.1, 123-140.

DOOLEY, J.C., 1948 - Preliminary report on geophysical survey in the Frome Embayment. Bur.Min.Resour.Aust.Rec., 1948/17, (unpubl.).

DOW, D.B., 1962 - A geological reconnaissance of the Jimi and Simbai Rivers. Bur.Min.Resour.Aust.Rec. 1962/110, (unpubl.).

DRISCOLL, E.G., 1960 - Geology of the Mundubberra District. Pap.Univ.Qld Dep.Geol., 5(5), 1-27.

DULHUNTY, J.A., 1940 - Structural geology of the Mudgee-Gunnedah region. J.Roy.Soc.N.S.W., 74, 88-98.

EDWARDS, A.B., 1950a - The petrology of the Miocene sediments of the Aure Trough, Papua. Proc.Roy.Soc.Vic., 60, 123-148.

———— 1950b - The petrology of the Cretaceous greywackes of the Purari Valley, Papua. Ibid, 60, 163-171.

EVANS, P.R., 1962a - Palynological observations on F.B.H. Flaxman's Hill No.1 Well. Bur.Min.Resour.Aust.Rec. 1962/57, (unpubl.).

———— 1962b - A revised palynological report on S.P.L. No.1 (Birkhead) Well, Great Artesian Basin, Queensland. Bur.Min.Resour.Aust. Rec. 1962/139, (unpubl.).

———— 1963 - The microflora of F.B.H. Pretty Hill No.1 and F.B.H. Eumeralla No.1 Wells, Victoria. Bur.Min.Resour.Aust.Rec. 1963/53, (unpubl.).

FAIRBRIDGE, R.W., 1953 - The Sahul Shelf, Northern Australia; its structure and geological relationships. J.Proc.Roy.Soc.W.Aust., 37, 1-33.

FIFE, J.S., and TINLINE, R.J., 1962 - Bathurst Island Refraction Survey, for Oil Development N.L., (unpubl.).

FLAVELLE, A.J., and GOODSPEED, M.J., 1962 - Fitzroy and Canning Basins, reconnaissance gravity surveys, Western Australia 1952-60. Bur.Min.Resour.Aust.Rec. 1962/105, (unpubl.).

FORMAN, D.J., 1963 - Regional geology of the Bloods Range Sheet, south-west Amadeus Basin. Bur.Min.Resour.Aust.Rec. 1963/47, (unpubl.).

GENTILLI, J., and FAIRBRIDGE, R.W., 1951 - Physiographic diagram of Australia. The Geographical Press, Columbia University, New York.

GEOSURVEYS (AUST.) LIMITED, 1960 - Report on the Lake Frome Embayment area, South Australia, for Santos Limited, (unpubl.).

GIBB, R.A., 1962 - Reconnaissance gravity surveys, 1957-1961, western Queensland. Bur.Min.Resour.Aust., (unpubl.).

GLAESSNER, M. F., 1950 - Geotectonic position of New Guinea. Bull.Amer.Ass.Petrol.Geol., 34, 856-881.

——————— 1952 - Geology of Port Moresby, Papua. Sir Douglas Mawson Anniversary Volume, Univ. of Adelaide, 63-86.

——————— 1953 - Clarke Memorial Lecture. Some Problems of Tertiary geology in southern Australia. J.Roy.Soc.N.S.W. 87, 31-45.

——————— 1959 - Tertiary stratigraphic correlation in the Indo-Pacific region and Australia. J.geol.Soc.India, 1, 53-67.

GLAESSNER, M.F., and PARKIN, L.W., (Ed.), 1958 - The geology of South Australia. J.geol.Soc.Aust., 5(2), 163.

G.S.A., 1962 - Geological notes in explanation of the Tectonic Map of Australia. Bur.Min.Resour.Aust., 1962.

G.S.Q., 1960 - Occurrence of Petroleum and Natural Gas in Queensland. Publ. geol.Surv.Qld, 299.

HANLON, F.N., JOPLIN, G.A., and NOAKES, L.C., 1953 - Review of stratigraphical nomenclature. 2. Permian units in the Illawarra district. Aust.J.Sci. 15, 160.

HARRISON, J., and GREER, W.J., 1963 - Delhi-Santos Dullingari No.1, South Australia. Well Completion Rep., (unpubl.).

HIER, C.D., and FJELSTUL, C.R., 1961 - Geophysical report on reconnaissance seismograph survey of Jundah-Yaraka Blackwater-Langlo area, Queensland, for Phillips Petroleum Company and Sunray Mid-Continent Oil Co., (unpubl.).

HILL, D., 1951 - Geology. Handbook of Queensland. Aust.Ass.Adv.Sci., Brisbane.

————— (Ed.) 1955 - Contributions to the Correlation and Fauna of the Permian in Australia and New Zealand. J.geol. Soc.Aust. 2, 83-107.

————— 1957 - Explanatory Notes on the Springsure 4-mile Geological Sheet, 4-mile Geological Series. Note Ser.Bur.Min.Resour.Aust, 5, 1-19.

HILL, D., and DENMEAD, A.K., (Ed.), 1960 - The geology of Queensland. J.geol.Soc.Aust., 7, 474.

HOLMES, A., 1960 - A revised geological time-scale. Trans.Edinburgh geol.Soc., 17, pt.3, 183-216.

INGRAM, F.T., 1962 - Wellington Park No.1 Well, Victoria. Well Completion Rep., (unpubl.).

———— 1963 - North Seaspray No.1 Well, Victoria. Well Completion Rep., (unpubl.).

IRVING, S., SMITH, E., and WALKER, J., 1958 - Sedimentary basins of Australia - a glossary of nomenclature. Bur.Min.Resour.Aust.Record 1958/80, (unpubl.).

JOHNSON, W., de la HUNTY, L.E., and GLEESON, J.S., 1954 - The Geology of the Irwin River and Eradu Districts and surrounding country. Bull.geol.Surv.W.Aust., 108, 124.

JOPLIN, G.A., HANLON, F.N., and NOAKES, L.C., 1952 - Wollongong - 4-mile Geological Series. Sheet 156-9. Australian National Grid. Note Ser.Bur.Min.Resour.Aust.

KITSMAN, W.L., LEWIS, J.H., and ROWE, S.M., 1962 - Buckabie No.1 Well completion report. Bur.Min.Resour.Aust.Petrol.Search Subs.Act Publ. 41.

KONECKI, M.C., DICKINS, J.M., and QUINLAN, T., 1958 - The Geology of the Coastal Area between the Lower Gascoyne and Murchison Rivers, Western Australia. Bur.Min.Resour.Aust.Rep. 37.

KULP, J.L., 1960 - The geological time scale. Pre-Quaternary Absolute Age Determination, Pt.3. Int.geol.Cong.21st Sess. Norway, 18-27.

LAING, A.C.M., and POWER, P.E., 1959a - New names in Queensland stratigraphy (Part 1). Carpentaria Basin. Aust.Oil Gas J., 5(8), 35-36.

———— 1959b - Idem (Part 2). Carpentaria Basin (continued). Ibid, 5(9), 28.

LESLIE, R.B., 1961 - Geology of the Gibson Desert area, Western Australia. Frome-Broken Hill Company Pty Ltd, Rep. 3000-G-38, (unpubl.).

LEWIS, J.H., and KYRANIS, N., - Phillips - Sunray Etonvale No.1, Queensland. Well Completion Rep., (unpubl.).

LONSDALE, G.F., and FLAVELLE, A.J., 1963 - Amadeus Basin and South Canning Basin, Results of reconnaissance gravity survey using helicopters, Northern Territory and Western Australia, 1962. Bur.Min.Resour.Aust.geoph.Progress Rep. 1963/4 (unpubl.).

LUCAS, K.G., 1962 - The geology of the Cooktown 1:250,000 Sheet area. Bur.Min.Resour.Aust.Rec. 1962/149, (unpubl.).

LUDBROOK, N.H., 1961 - Permian to Cretaceous subsurface stratigraphy between Lake Phillipson and the Peake and Denison Ranges, South Australia. Trans.Roy.Soc.S.Aust., 85, 67-83.

McELROY, C.T., 1959 - Studies in sedimentation and stratigraphy in coal basins of New South Wales. Thesis for Doctor of Philosophy, Sydney University - in press.

———— 1962 - 1:250,000 Geological Series Explanatory Notes, Sydney N.S.W. Sheet I/56-5. Australian National Grid 2nd Edition. Note Ser.Bur.Min.Resour.Aust., 6.

McMILLAN, N.J., and MALONE, E.J., 1960 - The geology of the eastern Central Highlands of New Guinea. Bur.Min.Resour.Aust.Rep. 48.

McQUEEN, A.F., 1961 - Thegeology of the Otway Basin. Aust.Oil Gas J., 8(2), 8-12.

McWHAE, J.R.H., PLAYFORD, P.E., LINDNER, A.W., GLENISTER, B.F., and BALME, B.E., 1958 - The stratigraphy of Western Australia. J.geol.Soc.Aust., 4(2), 161.

MALONE, E.J., CORBETT, D.W.P., and JENSEN, A.R., - The geology of the Mt. Coolon 1:250,000 Sheet area, Queensland. Bur.Min.Resour.Aust.Rep. 64, (in press).

M.A.P.L., 1962 - Cabot - Blueberry Marina No.1, Queensland. Well Completion Rep. Q/61P/112, (unpubl.).

MATHESON, R.S., and TEICHERT, C., 1948 - Geological reconnaissance in the eastern portion of the Kimberley Division, Western Australia. Ann.Rep.Dep.Min.W.Aust., 1945, 3-19.

MAXWELL, W.G.H., 1953 - Upper Palaeozoic formations in the Mount Morgan district - stratigraphy and structure. Pap.Univ.Qld Dep.Geol. 4(4), 1-14.

MITCHELL, J.G., and MAHER, J.C., 1957 - Suggested abbreviations for lithologic descriptions. Bull.Amer.Ass.Petrol.Geol., 41(9), 2103-2107.

MOTT, W.D., 1952 - Oil in Queensland. Qld Govt.Min.J., 53(612), 848-861.

MULHOLLAND, C. St.J., 1950 - Review of southern intake beds, New South Wales, and their bearing on artesian problems. Geol. Reports 1939-1945, Dep.Min.N.S.W., 125-127.

NOAKES, L.C., 1939 - Geological report on the Chimbu-Hagen area, Territory of New Guinea, (unpubl.).

———— 1949 - A geological reconnaissance of the Katherine-Darwin Region, Northern Territory. Bur.Min.Resour.Aust.Bull, 16.

NOAKES, L.C., OPIK, A.A., and CRESPIN, I., 1952 - Bonaparte Gulf Basin, north-western Australia. Symposium sur les series de Gondwana. Int.geol.Cong., 19th Sess., Algiers, 91-106.

NOAKES, L.C., and TRAVES, D.M., 1954 - Outline of the geology of the Barkly Region. In Survey of Barkly Region, 1947-48. Sci.ind.Res.Org. Melb., Land Res.Ser., 3(3), 34-41.

O.G.J., 1962 - Generalized formation correlator of Australia and Papua. Oil Gas J., 60(35), 72-75.

OPIK, A.A., 1956 - Cambrian Geology of the Northern Territory. El Sistema Cambrico, su paleogeografia y el problema de su base. Int.geol.Cong., 20th Sess., Mexico, Pt. 2, 25-54.

———— 1959 - Correlation chart of Cambrian and Ordovician in Australia. Bur.Min.Resour.Aust.Rec. 1959/52, (unpubl.).

OSBORNE, N., 1945 - Report on oil and gas possibilities of the Frome Embayment, New South Wales and South Australia. Frome - Broken Hill Co. Pty Ltd, (unpubl.).

———— 1956 - The sedimentary basins of the Australian Territory of Papua and New Guinea. Symposium sobre yacimientos de petroles y gas. Int.geol.Cong., 20th Sess., Mexico, 227-235.

PERRY, W.J., and DICKINS, J.M., 1960 - The Geology of the Badgeradda Area, Western Australia. Bur.Min.Resour.Aust.Rep. 46.

PLAYFORD, P.E., 1962 - A geological appreciation of recent oil exploration in the Canning, Carnarvon, and Perth Basins, Western Australia. Aust.Inst.Min.Metall.,Tech.Papers : Oil In Australasia, Ann. Conference, Queensland, 1962.

PLAYFORD, P.E., and JOHNSTONE, M.H., 1959 - Oil exploration in Australia. Bull.Amer.Ass.Petrol.Geol., 43(2), 397-433.

P.P.C., 1963 - Phillips - Sunray Gumbardo No.1, Queensland. Well Completion Rep., (unpubl.).

PRICHARD, C.E., and QUINLAN, T., 1962 - The geology of the southern half of the Hermannsburg 1:250,000 Sheet. Bur.Min.Resour.Aust.Rep. 61.

Q.A.O.C., 1963 - Queensland American The Overflow No.1, Queensland. Bur.Min.Resour.Aust.Petrol.Search Subs.Act Publ. 15.

QUILTY, J.H., and GOODEVE, P.E., 1958 - Reconnaissance Airborne Magnetic Survey of the Eucla Basin, southern Australia. Bur.Min.Resour.Aust.Rec. 1958/87 (unpubl.).

RAGGATT, H.G., 1938 - Evolution of the Permo-Triassic Basin of east-central New South Wales. D.Sc. Thesis, Univ.Syd., (unpubl.).

RAGGATT, H.G., and CRESPIN, I., 1955 - Stratigraphy of Tertiary rocks between Torquay and Eastern View, Victoria. Proc.Roy.Soc.Vict., 67, pt.1 (N.S.), 75-142.

REEVES, F., 1951 - Australian Oil Possibilities. Bull.Amer.Ass.Petrol.Geol. 35 (12), 2479-2525.

REFORD, M.S., 1962 - Airborne Magnetometer survey, Bass Strait and Encounter Bay areas Australia, for Haematite Explorations Pty Ltd, (unpubl.).

REID, J.H., 1929 - Geology of the Bowen River Coalfield. Publ.geol.Surv.Qld., 276, 1-107.

———— 1930 - Geology of the Springsure District, Qld.Govt.Min.J., 31, 87-98, 149-155.

RELPH, R.E., 1962 - Summary of geology of P.E.L's 36, 62, N.S.W. Rep. to Mid-Eastern Oil N.L. Appendix B of Application for Subsidy, Casino Seismic Survey, (unpubl.).

Report of the First Interstate Conference on Artesian Water, 1912. Sydney, 1913.

Report of the Fifth Interstate Conference on Artesian Water, 1928. Sydney, 1929.

REYNOLDS, M., 1953 - The Cainozoic succession of Maslin and Aldinga Bays, South Australia. Trans.Roy.Soc.S.Aust., 76, 114-140.

RICKWOOD, F.K., 1955 - The geology of the western highlands of New Guinea. J.geol.Soc.Aust., 2, 63-82.

RYAN, J.C., 1961 - Innamincka No.1 Well, South Australia of Delhi-Frome-Santos. Bur.Min.Resour.Aust.Pet.Search Subs.Acts Publ. 9.

SHIELS, O.J., 1961 - Report on the petroleum prospects of the Officer Basin South Australia and Western Australia. To Exoil Pty Ltd, (unpubl.).

SILLER, C.W., 1961 - The geology and petroleum prospects of the Maryborough Basin, Queensland. Aust.Oil Gas J., 8(3), 30-36.

SMITH, J.W., and ROBERTS, H.G., 1962 - Explanatory Notes to the Mt. Drummond 1:250,000 Sheet area, Northern Territory. Bur.Min.Resour.Aust.Rec. 1962/113, (unpubl.).

SMITH, K.G., VINE, R.R., and MILLIGAN, E.N., 1961 - Revisions to Stratigraphy of Hay River, Huckitta, and Tobermory 4-mile Sheets, Northern Territory. Bur.Min.Resour.Aust.Rec. 1961/65 (unpubl.).

SPENCE, J., 1958 - The geology of the Murray Basin. Frome-Broken Hill Co.Pty Ltd Rep. 7500-G-27, (unpubl.).

SPRIGG, R.C., 1952 - The geology of the South-East Province, South Australia, with special reference to Quaternary coast-line migrations and modern beach developments. Geol.Surv.S.Aust.Bull., 29.

——— 1958 - Petroleum prospects of western part of Great Australian Artesian Basin. Bull.Amer.Ass.Petrol.Geol., 42, pt.2, (10), 2465-2491.

——— 1961a - On the structural evolution of the Great Artesian Basin. Aust.Petrol.Expl.Ass.Ltd Conference Pap., Melbourne, 1961, 37-56.

——— 1961b - Oil and gas possibilities of the Gambier-Portland Basin. Ibid, 57-70.

——— 1962 - Petroleum prospects of the Gambier Sub-basin in relation to the evolution of the continental terrace. Aust.Inst.Min. Metall.,Tech.Papers: Oil in Australasia, Ann.Conference, Queensland, 1962.

SPRIGG, R.C., and WOOLLEY, J.B., 1963 - Oil and gas prospects of the Geltwood Beach Anticline, Millicent, South Australia. J.Aust.Petrol.Expl.Ass.Ltd, 1963, 69-79.

SPRY, A., and BANKS, M.R., (Ed.), 1962 - The geology of Tasmania. J.geol.Soc.Aust., 9, pt.2.

STEEL, T.M., 1962 - Subsurface stratigraphy in the western suburbs of Adelaide. Q.geol.notes, Geol.Surv.S.Aust., No.2.

STELCK, C.R., and HOPKINS, R.M., 1962 - Early sequence of interesting shelf deposits, Central Australia. J.Alberta Soc.Petrol.Geol., 10 (1), 1-12.

TANNER, J.J., 1962 - New geologic concepts resulting from oil exploration in south central Queensland. Aust.Inst.Min.Metall.Tech.Papers: Oil in Australasia, Ann. Conference, Queensland, 1962.

TERPSTRA, G.R.J., and EVANS, P.R., 1962 - Palaeontological examination of samples from Delhi-Santos Mornington Island No.1 Well, Carpentaria Basin, Queensland. Bur.Min.Resour.Aust.Rec. 1962/177, (unpubl.).

THOMAS, G.A., 1957 - Oldhaminid brachiopods in the Permian of northern Australia. J.Pal.Soc.India, 2, 174-182.

——— 1962 - The Carboniferous Stratigraphy of the Bonaparte Gulf Basin. C.R. 4ieme Cong.Avanc.Etud.Strat.carbon., Heerlen, 1958, Tome III 1962, 727-732.

——— 1964 - Spirit Hill No.1, Northern Territory, by R. Hare and Associates and G.A. Thomas for Westralian Oil Ltd and Oil Development N.L. Bur.Min.Resour.Aust.Petrol.Search Subs.Acts Publ. 24, (in preparation).

THYER, R.F., and EVERINGHAM, I.B., 1956 - Gravity Survey of the Perth Basin, Western Australia. Bur.Min.Resour.Aust.Bull. 33.

TINDALE, N.B., 1933 - Geological notes on the Cockatoo Creek and Mount Liebig country, Central Australia. Trans.Roy.Soc.S.Aust., 57, 206-217.

TRAVES, D.M., 1955 - The geology of the Ord-Victoria Region, Northern Australia. Bur.Min.Resour.Aust.Bull. 27.

——— 1956 - Upper Proterozoic and Cambrian geology in Northwestern Australia. El.Sistema Cambrico, su paleogeografia, y el problema de su base. Int.geol.Cong.20th Sess., Mexico, Pt II, 75-90. Reprinted in Opik, A.A., and others, 1957 - The Cambrian geology of Australia. Bur.Min.Resour.Aust.Bull. 49.

——— 1961 - Recent developments in the Roma District. Aust.Petrol. Expl.Ass.Ltd.Conference Pap., Melbourne, 1961, 95-100.

TRUMPY, D., GUILLEMOT, J., and TISSOT, B., 1960 - Petroleum prospects in Australia. Preliminary review of main sedimentary basins. Institut Francais du Petrole Ref. 5414.

U.O.D.C., 1963 - Union-Kern-A.O.G. Cabawin No.1 Queensland. Bur.Min.Resour. Aust.Petrol.Search Subs.Acts Publ. 43.

——— 1964 - Summary of data and results Union-Kern-A.O.G. Wandoan No.1 and Burunga No.1, Queensland. Bur.Min.Resour.Aust.Petrol.Search Subs.Acts Publ. 53.

VALLANCE, H.B., - Lexique stratigraphique international 6, Fasc. 5b, New South Wales.

VEEVERS, J.J., 1960 - Geology of the Howick area, Singleton-Muswellbrook district, New South Wales. Bur.Min.Resour.Aust.Rep., 53.

VEEVERS, J.J., RANDAL, M.A., MOLLAN, R.G., and PATEN, R.J., - The geology of the Clermont 1:250,000 Sheet area, Queensland. Bur.Min. Resour.Aust.Rep. 66, (in press).

VEEVERS, J.J., and WELLS, A.T., 1961 - The geology of the Canning Basin, Western Australia. Bur.Min.Resour.Aust.Bull., 60.

VINE, R.R., 1962 - Explanatory notes, Mackunda sheet, Queensland. Bur.Min.Resour.Aust.Rec. 1962/70, (unpubl.).

——— - Nomenclature of the Rolling Downs Group, northern Eromanga Basin, Queensland (in preparation).

VINE, R.R., BASTIAN, L.V., and CASEY, D.J., 1963 - Progress report on the geology of part of the northern Eromanga Basin, 1962. Bur.Min.Resour.Aust.Rec. 1963/75, (unpubl.).

VOISEY, A.H., 1939 - The Lorne Triassic Basin and associated rocks. Proc.Linn.Soc. N.S.W., 64, 255.

——— 1959 - Tectonic evolution of north-eastern New South Wales, Australia. J.Roy.Soc.N.S.W., 92, pt.4, 191-203.

WADE, A., 1924 - Petroleum prospects, Kimberley district of Western Australia and Northern Territory. Aust.parl.Pap., 142, 1-63.

WARD, L.K., 1946 - The occurrence, composition, testing, and utilization of underground water in South Australia, and the search for further supplies. Bull.geol.Surv.S.Aust., 23, 281.

WARNER, R.A., and HARRISON, J., 1961 - Discovery of Middle Cambrian fossils in New South Wales. Aust.J.Sci., 23(8), 268.

WEBB, E.A., 1961 - The geology and petroleum potentialities of the Gippsland area of Victoria. Aust.Oil Gas J., 8(2), 14-28.

WEEKS, L.G., 1959 - Geologic architecture of Circum-Pacific. Bull.Amer.Ass.Petrol.Geol., 43(2), 350-380.

WELLS, A.T., FORMAN, D.J., and RANFORD, L.C., 1962 - Geological reconnaissance of the north-west Amadeus Basin. Bur.Min.Resour.Aust.Rec. 1962/63, (unpubl.).

WELLS, A.T., RANFORD, L.C., and COOK, P.J., 1963 - The geology of the Lake Amadeus 1:250,000 Sheet area, Northern Territory. Bur.Min.Resour.Aust.Rec. 1963/51, (unpubl.).

WHITE, D.A., 1961 - Geological history of the Cairns - Townsville Hinterland, North Queensland. Bur.Min.Resour.Aust.Rep. 59.

WHITEHOUSE, F.W., 1953 - The Mesozoic environments of Queensland. Rep.Aust.Ass.Adv.Sci., 29, 83-106.

__________ 1954 - The geology of the Queensland portion of the Great Artesian Basin. Appendix G of Artesian Water Supplies in Queensland. Dep.Coord.Gen.Public Works, Qld, 1955.

WOPFNER, H., 1960 - On the structural development in the central part of the Great Artesian Basin. Trans.Roy.Soc.S.Aust., 83, 179-193.

APPENDIX I

ABBREVIATIONS.

These are the common abbreviations used by the American Stratigraphic Company, and are adopted from Mitchell and Maher, (1957), and the A.A.P.G.

@	At
abnt	Abundant
abv	Above
acic	Acicular
aft	After
agg	Aggregate
aglm	Agglomerate
Alg	Algae (al)
alt	Altered (ing)
amb	Amber
amor	Amorphous
Amph	Amphipora
amt	Amount
andes	Andesite (ic)
ang	Angular
anhed	Anhedral
anhy	Anhydrite (ic)
apr	Apparent
aprox	Approximate. (ly)
arag	Aragonite
aren	Arenaceous
arg	Argillaceous
argl	Argillite
ark	Arkose (ic)
asph	Asphalt (ic)
av	Average
bar	Barite (ic)
bcm	Become (ing)
bd	Bed
bdd	Bedded
bdg	Bedding
Belm	Belemnites
bent	Bentonite (ic)
bf	Buff
bioc	Bioclastic
biot	Biotite
bit	Bitumen (inous)
bl	Blue (ish)
bldr	Boulder (256 mm +)
blk	Black
blky	Blocky
bnd	Band (ed)
Brac	Brachiopod
brec	Breccia (ed)
bri	Bright
brit	Brittle
brn	Brown
Bry	Bryozoa
btry	Botryoidol
c	Coarse (ly)
∅	Core
calc	Calcite (areous)
carb	Carbonaceous
cbl	Cobble (64-256 mm)
Ceph	Cephalopod
cgl	Conglomerate
Chaet	Chaetetes
chal	Chalcedony
chit	Chitin (ous)
chk	Chalk (y)
choc	Chocolate
cht	Chert
chty	Cherty
c-in-c	Cone-in-cone
clas	Clastic
cln	Clean
clr	Clear
clus	Cluster
cly	Clay (ey)
clyst	Claystone
cmt	Cement (ed)
cncn	Concentric
cntr	Center (ed)
col	Color (ed)
com	Common
conc	Concretion (ary)
conch	Conchoidal
Cono	Conodont
cons	Considerably
contm	Contaminated
coq	Coquina
Cor	Coral
cpct	Compact
cren	Crenulated
Crin	Crinoid (al)
crm	Cream
crnk	Crinkled
crpxl	Cryptocrystalline
ctc	Contact
ctgs	Cuttings
cvg	Caving
Cyp	Cypridopsis
dd	Dead
deb	Debris
decr	Decrease (ing)
dend	Dendrite (ic)
dia	Diameter
dif	Difference
dism	Disseminated
dk	Dark (er)
dns	Dense (er)
do	Ditto
dol	Dolomite (ic)
dolc	Dolocast (ic)
dolmd	Dolomold (ic)
dolst	Dolostone
drlg	Drilling
drsy	Druse (y)
dtrl	Detrital (us)
Ech	Echinoid
elg	Elongate
elip	Elliptical
Endo	Endothyra
enl	Enlarged
equiv	Equivalent
euhed	Euhedral
evap	Evaporitic
extr	Extrusion (ive)

f	Fine (ly)
fac	Facet (ed)
fau	Fauna
Fvst	Favosites
Fe	Iron-Ferruginous
Fe-st	Ironstone
fib	Fibrous
fig	Figure (d)
fis	Fissile
fl	Fill - Filled
flat	Flattened
fld	Feldspar (thic)
flk	Flake
flky	Flaky
flor	Fluorescence
fls	Flesh
flt	Fault (ed)
fltg	Floating
fm	Formation
fnt	Faint (ly)
fol	Foliated
Foram	Foraminifera
fos	Fossil (iferous)
fr	Fair
frac	Fracture (ed)
frag	Fragment (al)
fri	Friable
fros	Frosted
frs	Fresh
Fus	Fusulinid
g	Good
Gast	Gastropod
gil	Gilsonite
gl	Glass (y)
glau	Glauconite (ic)
Glob	Globigerina
glos	Gloss (y)
gn	Green
gns	Gneiss
gr	Grain (ed)
gran	Granular
Grap	Graptolite
grd	Grade (ed)
grdg	Grading
grnl	Granule (2-4 mm)
grnt	Granite
grnt.w	Granite wash
grty	Gritty
gsy	Greasy
gvl	Gravel
gy	Gray
gyp	Gypsum (iferous)
gywk	Graywacke
hd	Hard
hem	Hematite (ic)
hex	Hexagonal
hi	High
hky	Hackly
hrtl	Horizontal
hvy	Heavy
hydc	Hydrocarbon
ig	Igneous
imbd	Imbedded
imp	Impression
incl	Included (sion)

incr	Increase (ing)
ind	Indurated
indst	Indistinct
Inoc	Inoceramus
intbd	interbedded
intcl	Interclast (s)
intfrag	Interfragmental
intgran	Intergranular
intgwn	Intergrown
intlam	Interlaminated
intpt	Interpretation
intr	Intrusion (ive)
intstl	Interstitial
intv	Interval
intxl	Intercrystalline
invrtb	Invertebrate
ireg	irregular
irid	Iridescent
jasp	Jasper (oid)
jts	Joints
kao	Kaolin
lam	Laminated
lav	Lavender
lchd	Leached
len	Lentil (cular)
lg	Long
lig	Lignite (ic)
lith	Lithographic
lmn	Limonite (ic)
lmpy	Lumpy
lmy	Limy
Lngl	Linguloid
low	Lower
lrg	Large (er)
ls	Limestone
lse	Loose
lstr	Lustre
lt	Light (er)
ltl	Little
m	Medium
magn	Magnetic
mar	Maroon
mas	Massive
mat	Material, matter
mbr	Member
mdst	Mudstone
meta	Metamorphic
msm	Metasomatic (ous)
mica	Mica (ceous)
micfos	Microfossil (iferous)
mic-mica	Micro-Micaceous
micxl	Microcrystalline
mid	Middle
mky	Milky
mnr	Minor
mnrl	Mineral (ized)
mnut	Minute
mod	Moderate
Mol	Mollusca
mot	Mottled
mrlst	Marlstone
mtx	Matrix
musc	Muscovite

n	No, non
nac	Nacreous
nod	Nodule (ar)
num	Numerous
o	Oil
obj	Object
occ	Occasional
och	Ochre
od	Odor
olv	Olive
ooc	Oolicast (ic)
ool	Oolite (ic)
oom	Oomold (ic)
op	Opaque
org	Organic
orng	Orange
orth	Orthoclase
Ost	Ostracod
ox	Oxidized
p	Poor (ly)
pap	Paper (y)
Para	Paraparchites
pbl	Pebble (4-64 mm)
pbly	Pebbly
pch	Peach
Pdct	Productids
pel	Pellet
perm	Permeability
pet	Petroleum (iferous)
phos	Phosphate (ic)
piso	Pisolite (ic)
pit	Pitted
pk	Pink
plag	Plagioclase
plas	Plastic
Plcy	Pelecypod
pl fos	Plant fossils
plty	Platy
pol	Polish (ed)
por	Porous (sity)
porc	Porcelaneous
pos	Possible (ility)
p-p	Pin point
pred	Predominate (ly)
pres	Preserved (ation)
prim	Primary
pris	Prism (atic)
prly	Pearly
prob	Probable (ly)
prom	Prominent (ly)
psdo	Pseudo
pt	Part (ly)
ptg	Parting
purp	Purple
pyr	Pyrite (ic) (ized)
pyrbit	Pyrobitumen
pyrclas	Pyroclastic
qtz	Quartz
qtzc	Quartzitic
qtzs	Quartzose
qtzt	Quartzite

rad	Radiate (ing)
rd	Round (ed)
reg	Regular
repl	Replaced (ing) (ment)
resd	Residue (al)
rhmb	Rhomb (ic)
rk	Rock
rmn	Remains (nant)
rng	Range (ing)
ro	Rose
rr	Rare
rsns	Resinous
rthy	Earthy
s	Small
sa	Salt
sa-c	Salt cast (ic)
S	Sulphur
sach	Saccharoidal
sal	Salmon
s&p	Salt & pepper
sat	Saturated
sb	Sub
sc	Scales
scat	Scattered
sch	Schist
Scol	Scolecodonts
sd	Sand (1/16 - 2 mm)
sdy	Sandy
sec	Secondary
sed	Sediment (ary)
sel	Selenite
sft	Soft
sh	Shale
shad	Shadow
shy	Shaly
sid	Siderite (ic)
sil	Silica (eous)
sks	Slickensided
sl	Slight (ly)
slky	Silky
slt	Silt
sltst	Siltstone
slty	Silty
sm	Smooth
sol	Solution
sp	Spot (ted) (ty)
spec	Speck (led)
Spfr	Spirifers
Spg	Sponge
sph	Spherules
sphal	Sphalerite
spic	Spicule (ar)
spl	Sample
splty	Splintery
Spr	Spore
sy-Ca	Sparry calcite
srt	Sort
srtd	Sorted
srtg	Sorting
ss	Sandstone
st	Stone
stn	Stain (ed) (ing)
str	Streak

strat	Strata (ified)
strg	Stringer
stri	Striated
Strom	Stromatoporoid
struc	Structure
styl	Styolite (ic)
suc	Sucrosic
sug	Sugary
surf	Surface
srct	Sericite
sz	Size
tab	Tabular
Tent	Tentaculites
tex	Texture
tgh	Tough
thk	Thick
thn	Thin
thru	Throughout
tr	Trace
Trilo	Trilobite
trip	Tripoli (ic)
trnsl	Translucent
trnsp	Transparent
Troc	Trochiliscus
tt	Tight (ly)
tub	Tubular
tuf	Tuffaceous
unconf	Unconformity
uncons	Unconsolidated
uni	Uniform
up	Upper
v	Very
var	Variable
vcol	Varicolored
ves	Vesicular
vgt	varigated
vit	Vitreous
vn	Vein
volc	Volcanics
vps	Very poor samples
vrtb	Vertebrate
vrtl	Vertical
vrvd	Varved
vug	Vug (gy) (ular)
/	With
w	Well
wh	White
wk	Weak
wthr	Weather
wthrd	Weathered
wtr	Water
wvy	Wavy
wxy	Waxy
xbd	Cross-bedded
xbdg	Cross-bedding
xl	Crystal (line)
xlam	Cross-laminated
yel	Yellow
zeo	Zeolite
zn	Zone

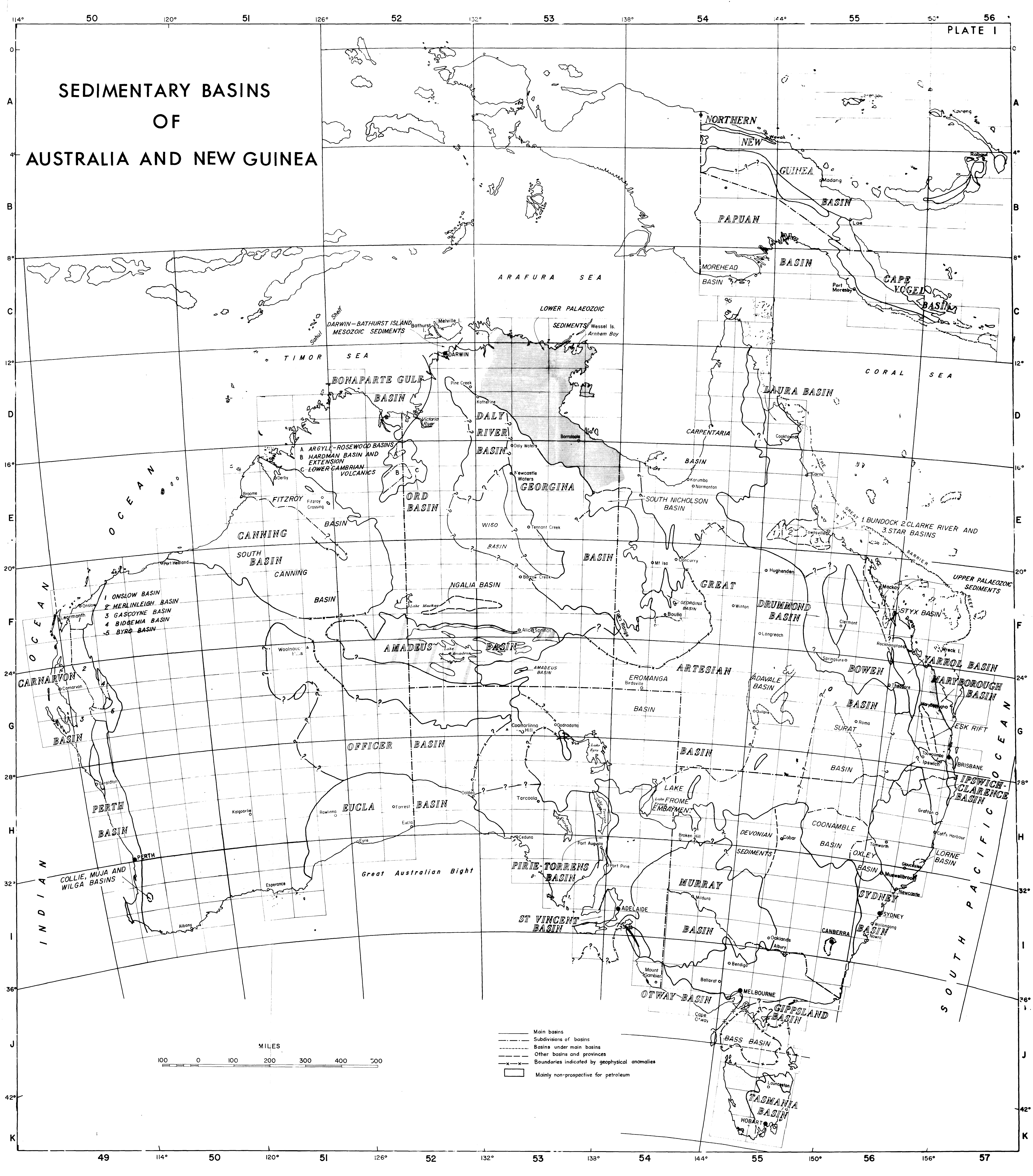
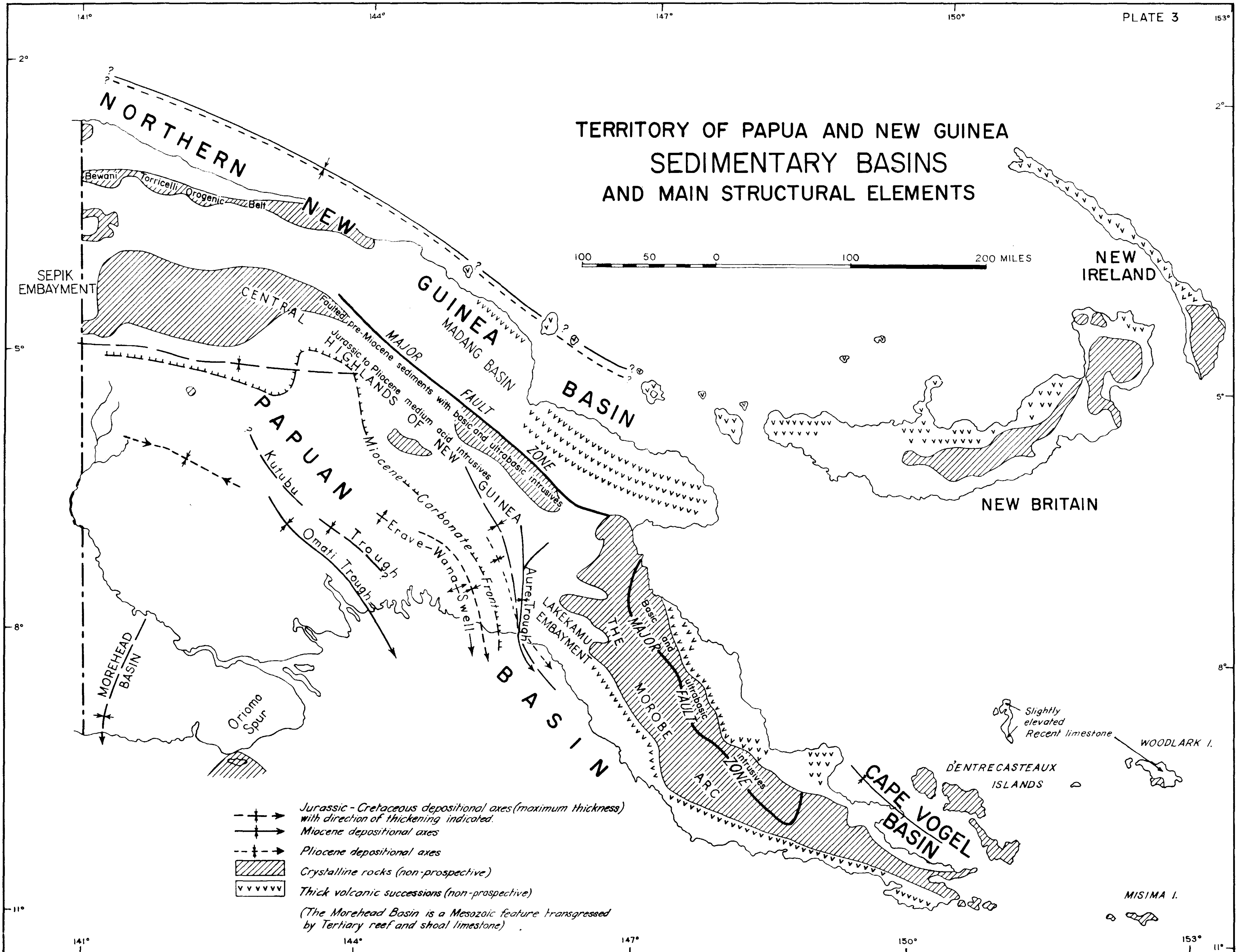
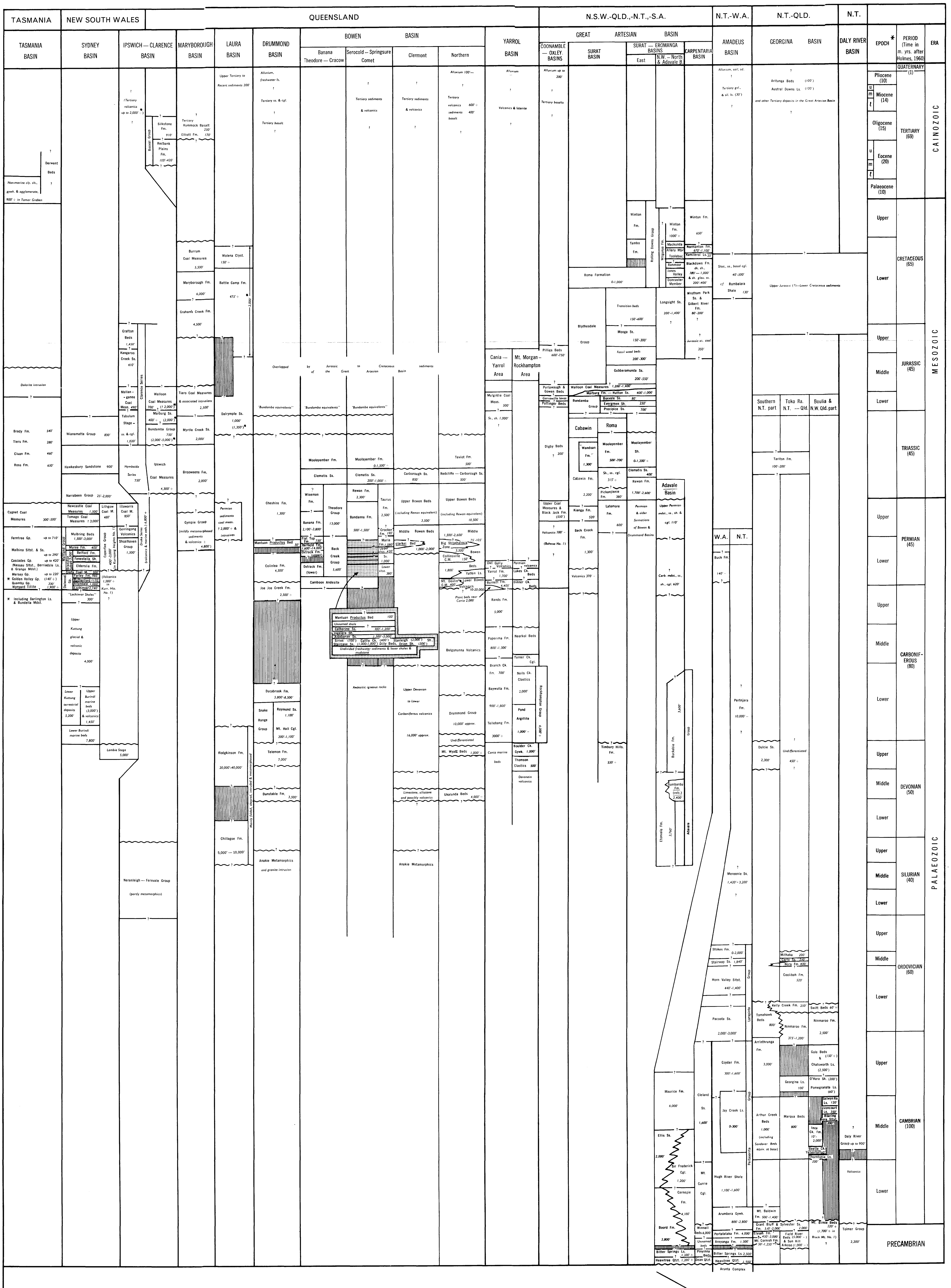


PLATE I
SEDIMENTARY BASINS OF AUSTRALIA AND NEW GUINEA
NORTHERN NEW GUINEA BASIN
PAPUAN BASIN
MOREHEAD BASIN
CAPE VOGEL BASIN
ARAFURA SEA
TIMOR SEA
CORAL SEA
LOWER PALAEOZOIC SEDIMENTS
DARWIN-BATHURST ISLAND MESOZOIC SEDIMENTS
BONAPARTE GULF BASIN
DALY RIVER BASIN
LAURA BASIN
CARPENTARIA BASIN
A ARGYLE-ROSEWOOD BASINS
B HARDMAN BASIN AND EXTENSION
C LOWER CAMBRIAN VOLCANICS
ORD BASIN
GEORGINA BASIN
FITZROY BASIN
CANNING BASIN
SOUTH CANNING BASIN
WISO BASIN
SOUTH NICHOLSON BASIN
1 BUNDOCK 2 CLARKE RIVER AND 3 STAR BASINS
UPPER PALAEOZOIC SEDIMENTS
NGALIA BASIN
GREAT ARTESIAN BASIN
DRUMMOND BASIN
1 ONSLOW BASIN
2 MERLINLEIGH BASIN
3 GASCOYNE BASIN
4 BIDGEMIA BASIN
5 BYRO BASIN
STYX BASIN
AMADEUS BASIN
ADAVALE BASIN
BOWEN BASIN
YARROL BASIN
MARYBOROUGH BASIN
CARNARVON BASIN
EROMANGA BASIN
SURAT BASIN
ESK RIFT
OFFICER BASIN
IPSWICH-CLARENCE BASIN
EUCLA BASIN
LAKE FROME EMBAYMENT
PERTH BASIN
COONAMBLE BASIN
DEVONIAN SEDIMENTS
OXLEY BASIN
LORNE BASIN
COLLIE, MUJA AND WILGA BASINS
Great Australian Bight
PIRIE-TORRENS BASIN
MURRAY BASIN
SYDNEY BASIN
ST VINCENT BASIN
OTWAY BASIN
GIPPSLAND BASIN
BASS BASIN
TASMANIA BASIN
INDIAN OCEAN
SOUTH PACIFIC OCEAN
MILES
100 0 100 200 300 400 500
Main basins
Subdivisions of basins
Basins under main basins
Other basins and provinces
Boundaries indicated by geophysical anomalies
Mainly non-prospective for petroleum



Bureau of Mineral Resources Geology and Geophysics August 1963

P/18

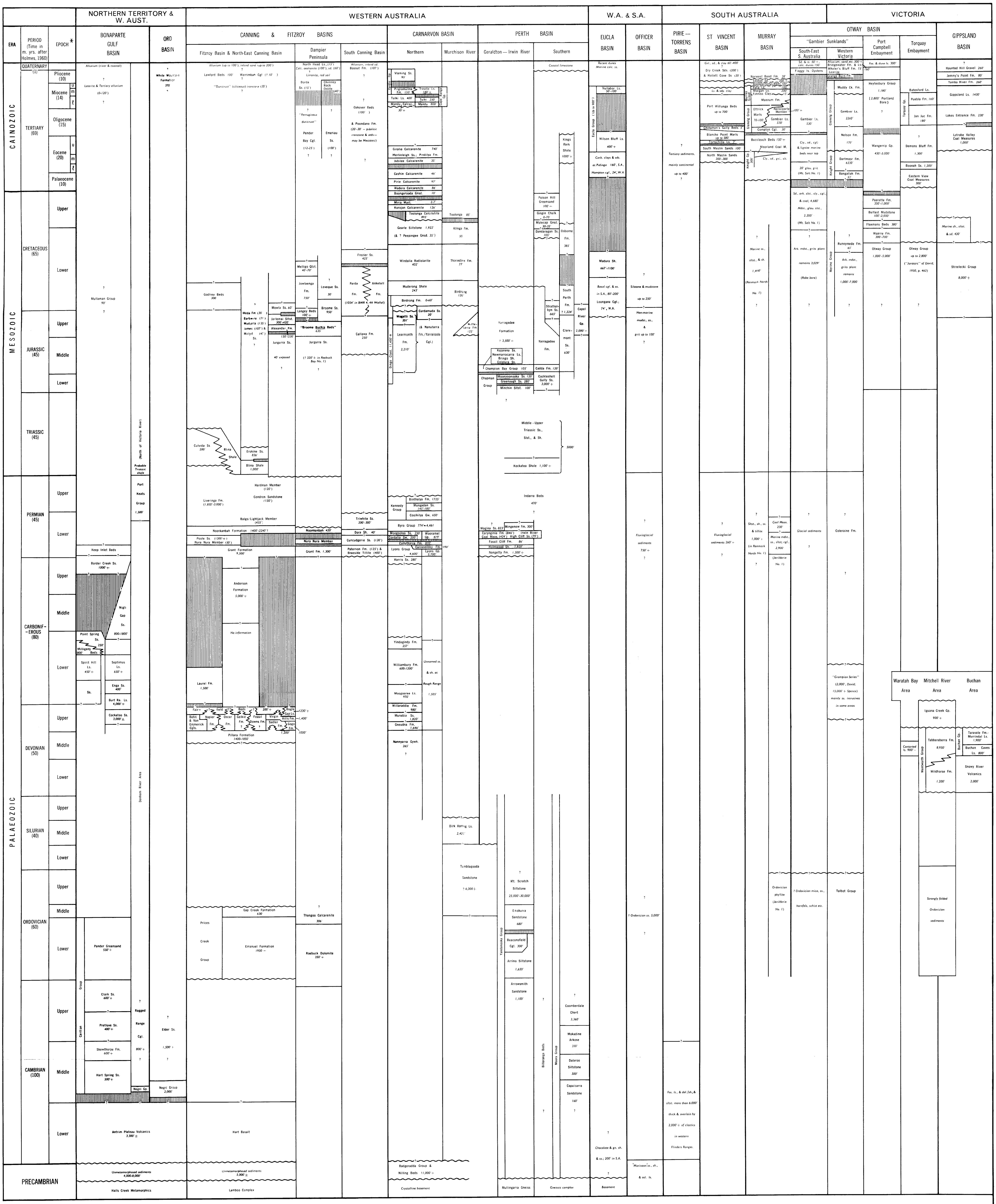


Tasmania Basin	Sydney Basin	Ipswich — Clarence Basin	Maryborough Basin	Laura Basin	Drummond Basin	Bowen Basin	Yarrol Basin	Great Artesian Basin	Amadeus Basin	Georgina Basin	Daly River Basin
Main reference Spry, A., & Banks, M. R., 1962	Main references Booker, F. W., 1960; David, T. W. E., 1950; Hanlon, F. N., Joplin, G. A. & Noakes, L. C., 1953 Vallance, H. B., Veevers, J. J., 1960	Main references David, T. W. E., 1950; Hill, D. & Denmead, A. K., 1960 * Mainly from McElroy, C. T., 1959, in a report by R. E. Relph in the Casino seismic subsidy application of Mid Eastern Oil N.L.	Main references Hill, D. & Denmead, A. K., 1960 Siller, C. W., 1961	Main contributor Lucas K. G. Main references Hill & Denmead, 1960 Lucas, K. G., 1962 M.A.P.L., 1962 * From Cabot—Blueberry Marina No. 1	Main contributor Dickins, J. M. Main references Hill, 1957 Hill & Denmead, 1960; Malone, et al., (in press) Veevers, et al., (in press)	Main contributor Dickins, J. M. Main references G. S. Q., 1960 — Hill, 1957 Hill & Denmead, 1960; Reid, 1929, 1930 and reports of B.M.R.—G.S.Q. field parties (1960-1963)	Main contributor Dickins, J. M. Main references Driscoll, 1960; Hill & Denmead, 1960 Maxwell, 1953	Main references Table 5 and the section on "Adavale Basin" in the text	Main contributors A. T. Wells, L. C. Ranford & D. J. Forman Main references Prichard and Quinlan, 1962	Main contributor K. G. Smith Main references Opik, A. A., in Hill, D., & Denmead, A. K., 1960; Smith, K. G., Vine, R. R., & Milligan, E. N., 1961	Main contributor M. A. Randal Main references Noakes, L. C., 1949

* Apart from in the Cainozoic, epochs have been divided approximately according to the ages given by Kulp (1960), and according to J. Gilbert-Tomlinson and P. J. Jones of the Bureau of Mineral Resources. The epochs of the Cainozoic have been divided after Holmes (1960). Except for the Quaternary and Pliocene which have been arranged to allow extra space for the Quaternary, the vertical scale for time units is 1 inch equals 20 million years. The correlation of the Permian formations has been done by J. M. Dickins.

Unconformity — angular or nonconformity	〰〰〰	(older strata deformed and eroded)	After Twenhofel, 1950, p. 561
— disconformity	‖‖‖‖‖‖	(non-deposition or erosion only)	After Twenhofel, 1950, p. 561
Approximate limits	——?——		
Limits not known	?		
Interfingering, interlensing, etc.	(interfingering line)		

Notes :
1. All references used to prepare this chart, whether quoted here or not, will be in a record (in preparation) on the sedimentary basins of Australia.
2. The chart should be used for comparison of the main stratigraphic divisions of the basins rather than for correlation.
3. The chart was compiled by M. A. Reynolds, Bureau of Mineral Resources, Geology and Geophysics, June 1963.



* Apart from in the Cainozoic, epochs have been divided approximately according to the ages given by Kulp (1960), and according to J. Gilbert-Tomlinson and P. J. Jones of the Bureau of Mineral Resources. The epochs of the Cainozoic have been divided after Holmes (1960). Except for the Quaternary and Pliocene which have been arranged to allow extra space for the Quaternary, the vertical scale for time units is 1 inch equals 20 million years. The correlation of the Permian formations has been done by J. M. Dickins.

Main contributor *Jones, P. J.* Main references *Opik, 1959* *Traves, 1955*	Main contributors *Jones, P. J. & Dickins, J. M.* Main references *Veevers & Wells, 1961* *McWhae, et al., 1958*	Main contributor *Dickins, J. M.* Main references *Condon, 1954* *McWhae, et al., 1958* *Glaessner, 1959*	Main contributor *Dickins, J. M.* Main references *McWhae, et al., 1958*	Main references *McWhae, et al., 1958* *Glaessner & Parkin, 1958*	Main references *Glaessner & Parkin, 1958,* *Leslie, R. B., 1961*	Main references *Dalgarno & Johnson, 1962;* *Glaessner & Parkin, 1958, p. 117;* *Sprigg, 1958*	Main references *Glaessner & Parkin, 1958* *Glaessner, 1959* *Reynolds, M. A., 1953;* *Steel, T. M., 1962*	Main references *Glaessner, 1959* *Ludbrook in Glaessner & Parkin, 1958*	References for Otway Basin *Boutakoff, N., & Sprigg, R. C., 1953; Evans 1962/57* *Glaessner, M. F., 1953; 1959 McQueen, A. F., 1961* *Raggatt, H. G. & Crespin, I., 1954; Sprigg, R. C., 1963* *Also details of a correlation of the Otway Basin supplied by the Manager of the Frome — Broken Hill Co. Pty. Ltd.*	Main references *Ingram, F. T., 1962, 1963;* *Webb, E. A., 1961*

Unconformity — angular or nonconformity (older strata deformed and eroded)
— disconformity (non-deposition or erosion only)
After Twenhofel, 1950, p. 561
Approximate limits
Limits not known
Interfingering, interlensing, etc.

Notes : 1. All references used to prepare this chart, whether quoted here or not, will be in a record (in preparation) on the sedimentary basins of Australia.

2. The chart should be used for comparison of the main stratigraphic divisions of the basins rather than for correlation.

3. The chart was compiled by M. A. Reynolds, Bureau of Mineral Resources, Geology and Geophysics, June 1963.