COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF NATIONAL DEVELOPMENT.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS.

BULLETIN No. 48.

PERMIAN FORAMINIFERA OF AUSTRALIA

BY

IRENE CRESPIN.

Issued under the Authority of Senator the Hon. W. H. Spooner, Minister for National Development.
1958.

By Authority:
A. J. ARTHUR, Commonwealth Government Printer, Canberra.
(Printed in Australia.)

422/58.

COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF NATIONAL DEVELOPMENT.

Minister : SENATOR THE HON. W. H. SPOONER, M.M.

Secretary : H. G. RAGGATT, C.B.E.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS.

Director : P. B. NYE, O.B.E.

Deputy Director : J. M. RAYNER.

This Bulletin was prepared in the Geological Section.

Chief Geologist : N. H. FISHER.

Issued : 15th August, 1958.

CONTENTS.

TABLES.

MAP.

SUMMARY.

One hundred and six species of Permian foraminifera belonging to forty-six genera are discussed. Four new genera, *Sacculinella, Hyperamminita, Pseudohyperammina,* and *Giraliarella* are named, all belonging to the group of arenaceous foraminifera. Fifty-two new species are described. They include eighteen from the family Lagenidae.

Arenaceous foraminifera, especially the genera *Ammodiscus, Hyperammina, Reophax, Thurammina,* and *Thuramminoides,* are characteristic of the majority of surface samples. Calcareous perforate genera of the Lagenidae, such as *Nodosaria, Dentalina, Lingulina, Frondicularia,* and *Geinitzina,* dominate the assemblages in subsurface samples. The genera *Lenticulina* (*Astacolus*) and *Rectoglandulina* have been recognized for the first time in the Permian rocks of Australia. Calcareous imperforate genera include both free and adherent forms, such as *Hemigordius, Flectospira, Streblospira, Calcitornella, Plummerinella, Orthovertella,* and *Trepeilopsis.* The Rotaliidae are represented by one genus, *Spirillina.*

Distinctive assemblages of foraminifera have enabled certain widely-separated rock units to be correlated. The suggested correlations are:

Fossil Cliff Formation, Callytharra Formation, and *Nura Nura Member* of the *Poole Sandstone,* all in Western Australia, with *Cattle Creek Formation* in Queensland, *Dalwood Group* ("Lower Marine Series") in New South Wales, and *Darlington Limestone* in Tasmania; *Byro Group* and *Noonkanbah Formation* in Western Australia with *Mantuan Productus Bed* in Queensland and *Branxton Subgroup* (lower part of "Upper Marine Series") in New South Wales.

Species known to occur in the Pennsylvanian of America and the Permian of Europe have been recognized and described; but the relationship between Australian Permian beds and European stages is by no means clear, and correlations on foraminiferal evidence can safely be made only within the continent.

INTRODUCTION.

Since the publication of "Foraminifera in the Permian Rocks of Australia" (Crespin, 1947), Permian stratigraphy throughout the continent has received considerable attention from geologists engaged primarily in the search for oil and coal, but the only further publications on foraminifera have been by Crespin and Belford (1957) and Ludbrook (1957). Many stratigraphical sections have been closely studied, and the results of this work have led to the re-organization of ideas on the age and stratigraphical position of certain formations. In particular the Permian sequence in Western Australia has been mapped in some detail by geologists of the Bureau of Mineral Resources, oil companies, and the University of Western Australia, and large numbers of specimens have been examined by the author from both surface and subsurface sequences. In New South Wales, both coal and oil search have proved sources of prolific subsurface microfaunas in the Permian rocks. Surface mapping in the Hunter River area has also yielded good assemblages of arenaceous foraminifera.

Investigations in Western Australia revealed that the beds from which Chapman and Parr (1937) described "fusulinids" (*Neoschwagerina* and *Verbeekina*) are not Permian but Triassic, and that the "fusulinids" are probably fish remains (Brunnschweiler, 1954).

No rocks from New Guinea have been examined during the present work; two genera of Permian foraminifera (*Pachypholia* and *Geinitzina*) have been recorded from a limestone near Kuta, in the Western Highlands (Glaessner et al., 1950; Rickwood, 1955).

Nearly all the species included below have been studied by myself. Some I have been unable to examine personally; they are included, for completeness' sake, but are described, if at all, by quotations from the original authors.

During the preparation of this Bulletin, Dr. P. J. Coleman, Geology Department, University of Sydney, handed me an unfinished and undated manuscript by the late W. J. Parr and H. J. Ward on the "Permian Foraminifera of the Callytharra Limestone", Western Australia. Coleman has not been able to find the specimens described in that paper; but from some of the descriptions it would seem that certain new species described in this Bulletin were recognized by Parr. Where it has been possible to recognize these forms, Parr's comments on them have been incorporated in the description of species.

PREVIOUS REFERENCES.

Foraminifera were first recorded in the Permian rocks of Australia by Professor T. Rupert Jones, who, in 1882, listed forms from the Piper River area, Tasmania, in his Catalogue of Fossil Foraminifera in the British Museum,

Thomas Stephens (1889) published a note in the Proceedings of the Royal Society of Tasmania on the discovery by Etheridge of Permo-Carboniferous foraminifera in a limestone near Lilydale ("Lilydale" and "Piper River" are references to the same bed); Etheridge commented that this was the first record of foraminifera of this age in Australia. Howchin later (1894) described four species from thin sections of this limestone.

Howchin (1895) described three new species of foraminifera from the "Carboniferous" beds of the Irwin River area, Western Australia. These species, together with those described by Chapman and Howchin (1905) from the Permo-Carboniferous of New South Wales, were for many years the only described forms available for use in Permian stratigraphic correlation in Australia. The determinations given by Chapman and Howchin in 1905 were revised by these writers in collaboration with Parr in 1934; as a result certain forms were proved not to be foraminifera and others were renamed.

In 1907, R. Etheridge, Jr., listed Permian foraminifera from a bore at Port Keats, Northern Territory.

In 1941 Crespin and Parr described one new genus and four new species of arenaceous foraminifera from the Permian rocks of New South Wales. In 1942 Parr published descriptions of twelve new species from the North-West Division of Western Australia.

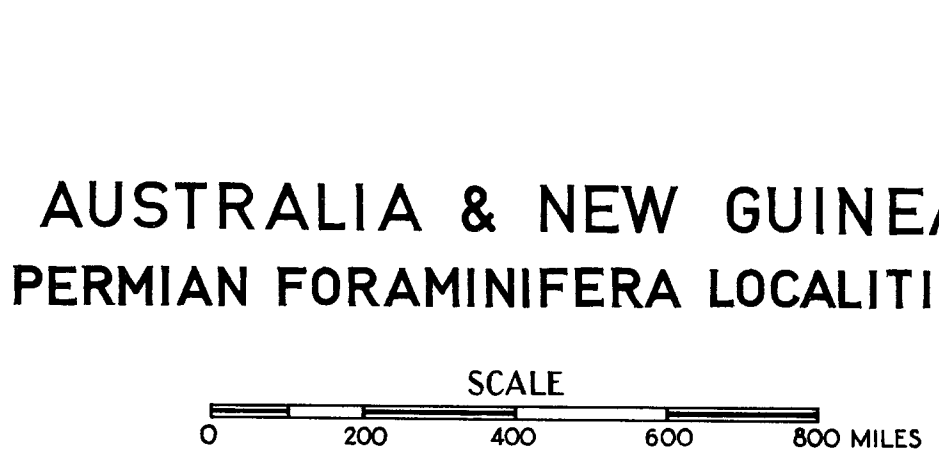
Permian foraminifera were recorded by Crespin (1943) from a bore at Coorabin, southern New South Wales, and from Oonah, north-western Tasmania (1944). In 1945, she published descriptions of several species, including four new ones from eastern Australia, and in 1947 summarized all available information regarding the distribution of Permian foraminifera in Australia. Crespin and Belford (1957) described two new genera and four new species of foraminifera from the Permian of Western Australia.

References to the occurrence of foraminifera in the Permian rocks of Australia have been given by the following:—Banks (1952, 1956, 1957), Banks et al. (1955a, 1955b), Condon (1954), Crespin (1939, 1947, 1950), Fairbridge (1952, 1953), Fletcher (1939), Guppy et al. (1950, 1952, 1958), Hill (1955, 1957), Johnston (1888), Ludbrook (1957), Osborne (1949), Raggatt (1936, 1939), Raggatt and Crespin (1940, 1941), Raggatt and Fletcher (1937), Reynolds (1956), Sturmfels (1950), Teichert (1941, 1951, 1952), Voisey (1938), Wade (1938), and Webb (1956). Many references to Permian foraminifera are to be found in unpublished reports of the Bureau of Mineral Resources, Geology and Geophysics.

SOURCES OF MATERIAL.

Extensive collections of Permian rocks from all parts of Australia, especially from Western Australia and New South Wales, have been available for micropalaeontological examination. They have been made by geologists of the Bureau, State Geological Surveys, Departments of Geology at the various

AUSTRALIA & NEW GUINEA
PERMIAN FORAMINIFERA LOCALITIES



NORTH NEW GUINEA BASIN
PAPUA BASIN
AURE TROUGH
CAPE VOGEL BASIN
PORT MORESBY
DARWIN
BONAPARTE GULF BASIN
10
FITZROY BASIN
ORD BASIN
BARKLY BASIN
CARPENTARIA BASIN
LAURA BASIN
9
8
6
7
CANNING BASIN
GEORGINA BASIN
BOWEN BASIN
MARYBOROUGH BASIN
5
CARNARVON BASIN
AMADEUS BASIN
GREAT ARTESIAN BASIN
4
ROMA-SPRINGSURE BASIN
BRISBANE
CLARENCE BASIN
PERTH BASIN
EUCLA BASIN
TORRENS BASIN
PERTH
2
1
SYDNEY BASIN
SYDNEY
11
ADELAIDE BASIN
ADELAIDE
MURRAY BASIN
3
CANBERRA
MELBOURNE
GIPPSLAND BASIN
TASMANIA BASIN
HOBART

- ✕ Outcrop Localities
- ● Bores

1 Kurrajong, Dural, & Kulnura
2 BMR Coal Bores, Hunter River
3 Coorabin J
4 Arcadia
5 Giralia
6 BMR 1
7 Nerrima 1 (FKO & AFO)
8 Myroodah 1 (AFO)
9 Roebuck 1 & Dampier Downs 1
10 Port Keats No. 3
11 Minlaton No.1

Bureau of Mineral Resources, Geology & Geophysics, April '57

G 45/9

Universities, and private companies engaged in the search for oil and coal over a period of many years. The main collections are:

1. Collections made by H. G. Raggatt, E. A. Rudd, and G. D. Osborne on behalf of Oil Search Limited, in the Carnarvon Basin (Western Australia), Springsure area (Queensland), and Hunter River area (New South Wales), between 1932 and 1938.

2. Samples from bores drilled by subsidiary companies of Oil Search Limited at Arcadia and Hutton Creek (Queensland), and at Kulnura (Sydney Basin, New South Wales), between 1937 and 1939.

3. Collections made by K. Washington Gray on behalf of Commonwealth Oil Refineries, in the Carnarvon Basin, Springsure area, and Hunter River area, during 1935 and 1936.

4. Collections made by L. Waterford on behalf of Freney Kimberley Oil Company in the Gascoyne area of the Carnarvon Basin, in 1937, and samples from Freney Kimberley Oil Company's No. 1 Bore at Nerrima in the Fitzroy Basin, Western Australia, in 1941.

5. Extensive collections made by geologists of the Bureau of Mineral Resources in the Carnarvon, Fitzroy, and Canning Basins, between 1949 and 1956. These include samples from BMR. No. 1 Bore, Jurgurra Creek, Canning Basin. Small collections were made in Tasmania in 1944 and 1953.

6. Cores and cuttings from West Australian Petroleum Proprietary Limited's Giralia No. 1 Bore, Carnarvon Basin, in 1954.

7. Cores and cuttings from Associated Freney Oilfields Nerrima No. 1 Bore and Myroodah No. 1 Bore, Fitzroy Basin, in 1956.

8. Bores drilled in the Hunter River area, by the Bureau of Mineral Resources in collaboration with the Geological Survey of New South Wales and the Joint Coal Board between 1952 and 1954.

9. Small collections submitted by the Geological Survey of New South Wales during 1952 and 1956.

10. Small collections made available by the Geological Departments of the Universities of Queensland, Tasmania, and Western Australia.

11. Samples from Kurrajong Heights Bore No. 1 and Dural East Bore No. 1, Sydney area, drilled by Australian Oil and Gas Corporation Limited.

SUMMARY OF PERMIAN STRATIGRAPHY, WITH CHARACTERISTIC FORAMINIFERA.

Permian marine sediments crop out extensively in all Australian States except Victoria and South Australia. They have recently been recorded in a bore in Yorke Peninsula, South Australia (Ludbrook, 1957).

The summary below deals only with areas and rock units in which foraminifera have been found. No attempt has been made to relate the rock units to the subdivisions of the international geological time-scale on foraminiferal evidence. The terms Lower, Middle, and Upper Permian are eschewed

because Australian palaeontologists and stratigraphers have not reached agreement on their significance in the Australian succession; and the problem of the Permo-Carboniferous boundary, here as elsewhere, remains unsolved (see Hill, 1957, p. 6: she prefers to call the Queensland succession Permo-Carboniferous for this reason).

Various workers in the macrofossils have related parts of the Australian succession to European stages, and their correlations are noted below. But the foraminifera, in the absence of the fusulinids, do not provide independent corroboration of these views, and they are therefore described in relation to rock units only.

QUEENSLAND.

Permian rocks are widely distributed in eastern Queensland; the most important are those in the Bowen Syncline, which is 400 miles long and up to 150 miles wide (Bryan and Jones, 1956). The only deposits studied for foraminifera are those in the Springsure area, which is on the eastern margin of the Great Artesian Basin (Hill, 1955), and the coalfield area near Collinsville in the north-eastern part of the Bowen Basin. Beds of the Cattle Creek Formation and the Mantuan *Productus* Bed of the Springsure area have yielded excellent assemblages of calcareous species. Small assemblages have been found in bores drilled for oil, such as the Arcadia and Morella Bores. The only published work on the Permian foraminifera of Queensland is by Crespin (1945, 1947).

The stratigraphical sequence in the Springsure area (Hill, 1955, 1957) is shown in Table I. The Dilly Beds crop out only in the core of the Springsure anticline, where about 2,000 feet of sediments are exposed. The Cattle Creek Formation is about 500 feet thick at the type locality; the beds consist of black to dark grey shales with gypsum, marls, and thin marly limestone. Webb (1956) suggests that, from evidence outside the Springsure area, the Dilly Beds may form the lower part of the Cattle Creek Formation. The Ingelara Formation ranges from 90 feet to about 500 feet in thickness and consists of shale, marl, calcareous sandstone, and thin beds of fossiliferous limestone. The Mantuan *Productus* Bed contains beds of limestone and marl which are richly fossiliferous (Hill, 1957).

Hill places the Springsure sequence in the Permo-Carboniferous, for reasons quoted above. The suggested correlation with European Stages (Hill, 1955) is as follows: The Dilly Beds, Staircase Sandstone and Cattle Creek Formation are included in the Sakmarian; the Aldebaran Sandstone, Ingelara Formation, Catherine Sandstone, Mantuan *Productus* Bed, and Bandanna Formation, arranged in ascending stratigraphical sequence, are included in the Artinskian-Kungurian.

Foraminifera have been found in the Cattle Creek Formation, Ingelara Formation, and Mantuan *Productus* Bed. The characteristic species of the formations are shown in Table I. Localities listed by Crespin in 1947 are now included in the Cattle Creek Formation rather than the Dilly Beds; no foraminifera have been found recently in material from the latter formation.

TABLE I.—QUEENSLAND: SPRINGSURE AREA—CHARACTERISTIC SPECIES.

Rock Units.	Foraminifera.
Bandanna Formation	.. ..
Mantuan *Productus* Bed	*Frondicularia aulax* sp. nov. *Frondicularia hillae* sp. nov. *Frondicularia sutilis* sp. nov. *Frondicularia woodwardi* Howchin *Geinitzina caseyi* sp. nov. *Geinitzina striatosulcata* sp. nov. *Geinitzina triangularis* Chapman and Howchin *Lenticulina (Astacolus) initialis* sp. nov.
Catherine Sandstone	.. ..
Ingelara Formation	*Ammodiscus oonahensis* sp. nov. *Ammodiscus multicinctus* Crespin and Parr *Dentalina grayi* Crespin *Frondicularia woodwardi* Howchin *Geinitzina striatosulcata* sp. nov. *Geinitzina triangularis* Chapman and Howchin *Reophax minutissimus* Plummer
Aldebaran Sandstone	.. ..
Cattle Creek Formation	*Ammobaculites woolnoughi* Crespin and Parr *Ammodiscus multicinctus* Crespin and Parr *Calcitornella stephensi* (Howchin) *Earlandia condoni* sp. nov. *Frondicularia aulax* sp. nov. *Frondicularia hillae* sp. nov. *Frondicularia limpida* sp. nov. *Frondicularia woodwardi* Howchin *Geinitzina triangularis* Chapman and Howchin *Geinitzina striatosulcata* sp. nov. *Nodosaria irwinensis* Howchin *Nodosaria springsurensis* Crespin *Nodosaria tereta* sp. nov. *Rectoglandulina cerocoldensis* (Crespin) *Sacculinella australae* sp. nov.
Staircase Sandstone	.. ..
Dilly Beds	.. ..

NEW SOUTH WALES.

Permian rocks in New South Wales crop out mainly within a radius of 200 miles north, south and west of Sydney. The stratigraphy of all areas has been closely studied because of the coal deposits throughout the sequence. Extensive marine sediments are associated with the northern coalfields in the central Hunter River Valley; smaller outcrops occur in the southern coalfields south of Sydney towards Nowra and Jervis Bay, and in the western area around Lithgow and along the Victoria Pass section of the Mitchell Highway. Marine Permian rocks have been proved to be widespread in the Hunter River area (Reynolds, 1956) and in the Sydney Basin (Raggatt and Crespin, 1940,

1941), where they occur at considerable depth. Small subsurface sections are known in the southern part of the Riverina at Coorabin (Crespin, 1943; Sturmfels, 1950).

Chapman and Howchin (1905) published the first work on Permian foraminifera in New South Wales; Crespin and Parr described arenaceous species in 1941 and Crespin published contributions in 1943, 1945, and 1947.

The stratigraphy of the Hunter River area has been studied in considerable detail and the most recent views on the sequence are to be found by Hanlon and Booker in Hill (1955). The foraminifera have not been completely studied from the individual formations, but rather from within the two main lithological groups, the Dalwood Group (the "Lower Marine Series" of earlier workers) and the Maitland Group ("Upper Marine Series"), and the two divisions of the latter, the Branxton Subgroup and the Mulbring Subgroup.

A comprehensive, but nevertheless tentative, correlation of the Permian deposits of New South Wales with European Stages was given by David (1950). He suggested that the lower part of the "Lower Marine Series" may be correlated with the Sakmarian, the upper part, and the lower part of the "Upper Marine Series" (Branxton Subgroup), with the Artinskian, and the upper part of the "Upper Marine Series" (Mulbring Subgroup) with the Kungurian. Teichert and Fletcher (1943), writing on the occurrence of the ammonite *Adrianites* (*Neocrinites*) *meridionalis*, suggested that the lower part of the Upper Marine (Branxton Subgroup) should be correlated with the Artinskian, and Teichert (1953), on the basis of *Pseudogastrioceras pokolbinense*, confirmed an Artinskian age for the upper part of the Dalwood Group.

Table II. shows the stratigraphical sequence in the Hunter River area with the characteristic foraminifera that have been found in the surface exposures of the Dalwood and Maitland Groups. Arenaceous forms dominate the beds of both the Mulbring and Branxton Subgroups of the Maitland Group; calcareous species are rare in the Mulbring beds but more common in those of the Branxton Subgroup and Dalwood Group.

TABLE II.—NEW SOUTH WALES: HUNTER RIVER AREA—CHARACTERISTIC SPECIES IN SURFACE EXPOSURE.

Rock Units.	Foraminifera.
Newcastle Coal Measures	.. ..
Tomago Coal Measures	.. ..
Maitland Group— Mulbring Subgroup	*Ammobaculites woolnoughi* Crespin and Parr *Ammodiscus multicinctus* Crespin and Parr *Digitina recurvata* Crespin and Parr *Hyperammina fletcheri* sp. nov. *Hyperammina hebdenensis* sp. nov. *Rectoglandulina serocoldensis* (Crespin) *Reophax subasper* Parr *Textularia bookeri* sp. nov. *Thuramminoides teicherti* (Parr) *Tolypammina undulata* Parr *Trochammina pulvilla* Crespin and Parr

TABLE II.—NEW SOUTH WALES: HUNTER RIVER AREA—CHARACTERISTIC SPECIES IN SURFACE EXPOSURE—*continued.*

Rock Units.	Foraminifera.
Maitland Group—*continued.* Branxton Subgroup	*Ammobaculites woolnoughi* Crespin and Parr *Ammodiscus multicinctus* Crespin and Parr *Digitina recurvata* Crespin and Parr *Frondicularia parri* Crespin *Frondicularia woodwardi* Howchin *Geinitzina triangularis* Chapman and Howchin *Hyperammina hebdenensis* sp. nov. *Lingulina antiqua* Chapman and Howchin *Nodosaria raggatti* sp. nov. *Rectoglandulina serocoldensis* (Crespin) *Thuramminoides teicherti* (Parr) *Trochammina pulvilla* Crespin and Parr
Dalwood Group	*Ammobaculites woolnoughi* Crespin and Parr *Calcitornella stephensi* (Howchin) *Digitina recurvata* Crespin and Parr *Earlandia condoni* sp. nov. *Frondicularia woodwardi* Howchin *Geinitzina triangularis* Chapman and Howchin *Hemigordius schlumbergi* (Howchin) *Hyperammina fletcheri* sp. nov. *Nodosaria tereta* sp. nov. *Nodosaria irwinensis* Howchin *Orthovertella protea* Cushman and Waters *Streblospira australae* Crespin and Belford *Textularia bookeri* sp. nov. *Trepeilopsis australiensis* sp. nov. *Trochammina pokolbinensis* sp. nov.

Foraminifera from subsurface sections in the Hunter River area are listed in Table III. It has been almost impossible to divide the Maitland Group into its sub-groups on the basis of the foraminifera; consequently a general list of species found in these sections is given under Maitland Group.

TABLE III.—NEW SOUTH WALES: HUNTER RIVER AREA—CHARACTERISTIC SPECIES OF SUB-SURFACE SEQUENCE.

Rock Units.	Foraminifera.
Newcastle Coal Measures	.. ..
Tomago Coal Measures	.. ..
Maitland Group	*Ammodiscus multicinctus* Crespin and Parr *Ammobaculites woolnoughi* Crespin and Parr *Dentalina grayi* Crespin *Digitina recurvata* Crespin and Parr *Frondicularia aulax* sp. nov. *Frondicularia parri* Crespin *Frondicularia woodwardi* Howchin *Hyperammina expansa* (Plummer) *Hyperammina hebdenensis* sp. nov. *Lingulina antiqua* Chapman and Howchin *Nodosaria raggatti* sp. nov. *Pelosina hemisphaerica* Chapman and Howchin *Rectoglandulina serocoldensis* (Crespin) *Reophax tricameratus* Parr *Thurammina phialaeformis* sp. nov. *Thuramminoides teicherti* (Parr) *Thuramminoides sphaeroidalis* Plummer *Tolypammina undulata* Parr *Trochammina pulvilla* Crespin and Parr

TASMANIA.

During recent years advances have been made in the understanding of the Permian System in Tasmania. Amongst people who have contributed to these advances are Banks and his collaborators (1952, 1955, 1956, 1957), Bradley (1954), Brill and Hale (1954), Brown (1953), Carey (1947), Crespin (1944), Crockford (1951), Fairbridge (1949), Hill (1955), Lewis (1946), McKellar (1957), Prider (1948), Voisey (1938, 1949), and Wells (1957).

Permian rocks occur from Wynyard in the north-west to the south-eastern limits of the State, from Point Hibbs and the Henty River on the west coast to Coles Bay and Maria Island in the east, and from the north coast to the south coast. As deposited, they probably covered the greater part of the State except perhaps the north-western corner and some islands in the present position of the east coast. The Permian rocks are thickest in the south-east, but even there they reach only about 2,300 feet.

Three sections in different regions of the State have been recently studied by geologists:

(*a*) Deloraine-Cressy section of the north-western and western parts by Wells (1957) and McKellar (1957);

(*b*) the Hobart/Woody Island section in the south-eastern and southern part by Banks and Hale (1957); and

(*c*) the Elephant Pass/St. Mary's section in the north-eastern part by K. G. Brill (unpublished).

Foraminifera have been studied only from isolated samples from the different sections. However, evidence based on the abundant occurrence of *Calcitornella stephensi* supports the correlation of the Brumby Formation of the Golden Valley Group of the Deloraine-Cressy section with the Darlington Limestone of the Hobart/Woody Island section. Foraminifera have been examined from the Gray Limestone of the Elephant Pass/St. Mary's section and the Berriedale Limestone of the Hobart/Woody Island section, which are stratigraphically higher than the Darlington Limestone, but more material is necessary to confirm the correlation of these two formations on the basis of the foraminifera. Crespin (1944) recorded foraminifera from a section near Oonah in the north-western region in beds of the Quamby Mudstone, which is considered (McKellar, 1957; Wells, 1957) to represent the lowest part of the Permian marine sequence in Tasmania.

SOUTH AUSTRALIA.

The recent discovery (Ludbrook, 1957) of Permian foraminifera in the Minlaton bore, on Yorke Peninsula, gives the first evidence of the occurrence of marine Permian rocks in South Australia. The foraminifera-bearing beds underlie 500 feet of fluvio-glacial sands and glacial boulder clay. The assemblage of foraminifera consists entirely of arenaceous species and Ludbrook suggests a correlation with the Mulbring Subgroup, Maitland Group, of the Hunter River area, New South Wales.

WESTERN AUSTRALIA.

Considerable detailed stratigraphical work has been undertaken in Western Australia, especially since 1949, and the following sedimentary basins have been recognized (Hill, 1955). They are:—

Collie Basin.
Perth Basin, including Irwin Basin.
Carnarvon Basin.
Canning (including Fitzroy) Basin.
Bonaparte Basin (in part).

Many lithological units have been defined within these basins. The main contributions to this work have been made by Condon (1954), Clarke, Prendergast, Teichert and Fairbridge (1951), Fairbridge (1952, 1953), Johnson, De La Hunty and Gleeson (1954), Raggatt (1936), Raggatt and Fletcher (1937), Guppy, Cuthbert and Lindner (1950), Guppy, Lindner, Rattigan and Casey (1952, 1958), Teichert (1941, 1947, 1950, 1952), Traves (1955), and Traves, Casey and Wells (1957).

Permian foraminifera were first described from Western Australia by Howchin (1895) from Fossil Cliff, Irwin River. Parr (1942) described several new forms from the Wandagee area, Carnarvon Basin. No other species were described until recently when Crespin and Belford (1957) recorded two new genera and four new species from deposits in the Carnarvon and Canning Basins.

The stratigraphical units in the Permian of the Irwin and Carnarvon Basins and the characteristic foraminifera found in them are summarized separately, but the Fitzroy and Canning Basins are discussed together.

The Collie Basin is a small area in the south-west of the State in which no marine beds have been discovered (Fairbridge, 1952). The record by Chapman (1907) of a small stunted foraminiferal fauna in the beds at Collie is not regarded as authentic either by the late W. J. Parr or the writer.

Irwin Basin.

In the Irwin Basin, about 250 miles north of Perth, Permian sediments crop out over an area of 200 square miles between 28° 30′ and 29° 30′ S. (Teichert and Glenister, 1952); they occur in the valleys of the Irwin and Lockier Rivers, in which Jurassic sediments and Recent sands form the margin to the north, south, and west. Precambrian rocks occur on the eastern margin. References to the stratigraphy of the area have been made by Clarke et al. (1951), Fairbridge (1952, 1953), Johnson, De La Hunty and Gleeson (1954), Teichert (1941), and Teichert and Glenister (1952). Although seven formations have been mapped in the Basin, foraminifera have, so far, been recorded only from the lower beds in the sequence.*

It is agreed that the Nangetty Glacials and Holmwood Shale are to be correlated with the Sakmarian (Teichert and Glenister, 1952) and that the Fossil Cliff Formation (Teichert, 1941) is equivalent of basal Artinskian. Foraminifera have not been found in beds higher than the Fossil Cliff Formation.

* See postscript, p. 206.

The formations, arranged in descending stratigraphical sequence, together with characteristic foraminifera, are shown in Table IV.

TABLE IV.—WESTERN AUSTRALIA: IRWIN BASIN—CHARACTERISTIC SPECIES.

Rock Units.	Foraminifera.
Wagina Sandstone (Freshwater)	..
Carynginia Shale	..
Irwin River Coal Measures (Freshwater)	..
High Cliff Formation	..
Fossil Cliff Formation	*Calcitornella elongata* Cushman and Waters *Calcitornella stephensi* (Howchin) *Frondicularia woodwardi* Howchin *Geinitzina triangularis* Chapman and Howchin *Hemigordius schlumbergi* (Howchin) *Nodosaria irwinensis* Howchin *Nodosaria tereta* sp. nov. *Hyperammina callytharraensis* sp. nov. *Stacheia dickinsi* sp. nov. *Trepeilopsis australiensis* sp. nov.
Holmwood Shale	..
Nangetty Glacials	*Hemigordius schlumbergi* (Howchin) *Hyperammina elegantissima* Plummer

Carnarvon Basin.

The Carnarvon Basin is situated along the western margin of the Precambrian Shield, between 21° 30′ and 28° 00′ S. It covers an area of about 40,000 square miles, and extends from Onslow in the north to the Murchison River in the south, and inland for about 130 miles (Condon, 1954; Teichert, 1952). Marine Permian rocks are extensively exposed in the area south of latitude 23° 15′ S., and more than 3,000 feet of sediments have been proved by boring. Geologists of the Bureau of Mineral Resources, the Geological Survey of Western Australia, and private companies engaged in the search for oil, have carried out detailed surveys of the area. Published records of this work are given by Condon (1954), Fairbridge (1953), Raggatt (1936), Raggatt and Fletcher (1937), Teichert (1941, 1947, 1950, 1952) and Thomas and Dickins (1954). Many lithological units have been mapped in both the central and south-eastern portions of the Basin.

It is generally agreed that the Callytharra Formation and the formations of the succeeding Byro Group (Coyrie Formation to Baker Formation), with the possible exception of the topmost formation, the Baker Formation, are to be correlated with the Artinskian, and the Coolkilya Greywacke with the Kungurian (Condon, 1954; Hill, 1955; Thomas and Dickins, 1954). The foraminiferal assemblage suggests that the Baker Formation may be within the topmost Artinskian.

The formations in the central portion of the Basin, together with the characteristic foraminifera of the beds, are given in descending stratigraphical sequence in Table V. Except in the Callytharra Formation, the foraminiferal assemblages in outcrop material are dominated by arenaceous species.

TABLE V.—WESTERN AUSTRALIA: CARNARVON BASIN—CHARACTERISTIC SPECIES OF SURFACE EXPOSURES.

Rock Units.	Foraminifera.
Coolkilya Greywacke	*Hyperammina acicula* (Parr)
Baker Formation	*Ammodiscus nitidus* Parr *Hyperammina expansa* (Plummer) *Hyperammina acicula* (Parr) *Reophax subasper* Parr *Thurammina phialaeformis* sp. nov. *Thuramminoides sphaeroidalis* Plummer
Norton Greywacke	.. ..
Wandagee Formation	*Ammobaculites wandageensis* sp. nov. *Ammodiscus nitidus* Parr *Ammodiscus wandageeensis* Parr *Hyperammina acicula* (Parr) *Hyperammina coleyi* Parr *Hyperammina elegans* (Cushman and Waters) *Hyperamminita rudis* (Parr) *Giraliarella rhomboidalis* sp. nov. *Proteonina arenosa* sp. nov. *Reophax subasper* Parr *Reophax emaciatus* Plummer *Reophax tricameratus* Parr *Thurammina phialaeformis* sp. nov. *Tolypammina undulata* Parr *Trochammina subobtusa* Parr
Quinnanie Shale	*Ammobaculites woolnoughi* Crespin and Parr *Ammodiscus wandageeensis* Parr *Ammodiscus nitidus* Parr *Glomospira adhaerens* Parr *Hyperammina acicula* (Parr) *Hyperammina coleyi* Parr *Psammosphaera pusilla* Parr *Reophax subasper* Parr *Reophax tricameratus* Parr *Thurammina phialaeformis* sp. nov. *Thuramminoides teicherti* (Parr) *Tolypammina undulata* Parr *Trochammina subobtusa* Parr
Cundlego Formation	*Ammobaculites woolnoughi* Crespin and Parr *Ammobaculites wandageensis* sp. nov. *Ammodiscus nitidus* Parr *Glomospirella nyei* sp. nov. *Hemigordius harltoni* Cushman and Waters *Hyperammina acicula* (Parr) *Hyperammina coleyi* Parr *Hyperammina expansa* (Plummer) *Lugtonia thomasi* sp. nov. *Nodosaria raggatti* sp. nov. *Pseudohyperammina radiostoma* sp. nov. *Reophax ellipsiformis* sp. nov. *Reophax subasper* Parr *Spiroplectammina carnarvonensis* sp. nov. *Streblospira meandrina* Crespin and Belford *Trochammina subobtusa* Parr

422/58.—2

TABLE V.—WESTERN AUSTRALIA: CARNARVON BASIN—CHARACTERISTIC SPECIES OF SURFACE DEPOSITS—*continued.*

Rock Units.	Foraminifera.
Bulgadoo Shale	*Ammobaculites eccentrica* sp. nov. *Ammobaculites wandageensis* sp. nov. *Ammodiscus nitidus* Parr *Hemigordius harltoni* Cushman and Waters *Hyperammina acicula* (Parr) *Hyperammina coleyi* Parr *Hyperammina elegans* (Cushman and Waters) *Hyperammina expansa* (Plummer) *Nodosaria raggatti* sp. nov. *Pelosina hemisphaerica* Chapman and Howchin *Rectoglandulina serocoldensis* (Crespin) *Reophax ellipsiformis* sp. nov. *Reophax emaciatus* Plummer *Sacculinella australae* sp. nov. *Spiroplectammina carnarvonensis* sp. nov. *Thurammina phialaeformis* sp. nov. *Thuramminoides sphaeroidalis* Plummer *Trochammina subobtusa* Parr
Mallens Greywacke	*Ammodiscus nitidus* Parr *Hyperammina acicula* (Parr) *Thuramminoides sphaeroidalis* Plummer
Coyrie Formation	*Ammodiscus nitidus* Parr *Ammobaculites wandageensis* sp. nov. *Hyperammina acicula* (Parr) *Hyperammina coleyi* Parr *Hyperammina elegans* (Cushman and Waters) *Hyperammina fusta* sp. nov. *Reophax ellipsiformis* sp. nov. *Reophax fittsi* (Warthin) *Reophax minutissimus* Plummer *Reophax tricameratus* Parr *Sacculinella australae* sp. nov. *Spiroplectammina carnarvonensis* sp. nov. *Textularia improcera* sp. nov. *Thurammina phialaeformis* sp. nov. *Thuramminoides sphaeroidalis* Plummer
Wooramel Sandstone	.. ..
Callytharra Formation	*Ammobaculites eccentrica* sp. nov. *Ammobaculites wandageensis* sp. nov. *Calcitornella heathi* Cushman and Waters *Calcitornella stephensi* (Howchin) *Earlandia condoni* sp. nov. *Frondicularia hillae* sp. nov. *Frondicularia woodwardi* Howchin *Geinitzina triangularis* Chapman and Howchin *Glomospirella nyei* sp. nov. *Hemigordius schlumbergi* (Howchin) *Hyperammina callytharraensis* sp. nov. *Hyperammina elegantissima* Plummer *Hyperammina hadzeli* sp. nov. *Nodosaria tereta* sp. nov. *Nodosaria irwinensis* Howchin *Giraliarella angulata* sp. nov. *Placopsilina wooramelensis* sp. nov. *Tetrataxis conica* Ehrenberg *Orthovertella protea* Cushman and Waters *Trepeilopsis australiensis* sp. nov.
Upper Lyons Group	*Calcitornella stephensi* (Howchin) *Reophax tricameratus* Parr

Only in one bore in the Carnarvon Basin, namely West Australian Petroleum Proprietary Limited's Giralia No. 1 Bore, have Permian foraminifera been found. Two distinct foraminiferal assemblages, each dominated by calcareous species, were discovered in the Permian sediments in this bore; these are shown in Table VI.

TABLE VI.—WESTERN AUSTRALIA: CARNARVON BASIN—CHARACTERISTIC SPECIES OF SUB-SURFACE SEQUENCES.

Probable Equivalent Surface Lithological Units.	Foraminifera.
Byro Group— Cundlego Formation—Bulgadoo Shale	*Ammodiscus nitidus* Parr *Flectospira prima* Crespin and Belford *Frondicularia woodwardi* Howchin *Hemigordius harltoni* Cushman and Waters *Hyperammina elegans* (Cushman and Waters) *Hyperammina expansa* (Plummer) *Nodosaria conico-densestriata* Paalzow *Nodosaria crassula* sp. nov. *Nodosaria decoris* sp. nov. *Nodosaria raggatti* sp. nov. *Nodosaria springsurensis* Crespin *Nodosaria striatella* Paalzow *Rectoglandulina serocoldensis* (Crespin) *Reophax ellipsiformis* sp. nov. *Thurammina phialaeformis* sp. nov.
Callytharra Formation	*Calcitornella stephensi* (Howchin) *Earlandia condoni* sp. nov. *Geinitzina striatosulcata* sp. nov. *Geinitzina triangularis* Chapman and Howchin *Giraliarella angulata* sp. nov. *Hyperammina elegantissima* Plummer *Spirillina papillo-dentata* sp. nov. *Streblospira australae* Crespin and Belford *Tetrataxis conica* Ehrenberg

Canning Basin.

The Canning Basin is defined by Traves, Casey and Wells (1957) as the sedimentary basin between the Kimberley and Pilbara areas of Precambrian rocks; it extends north-westwards on to the present continental shelf and is bounded on the east by the Precambrian rocks near the Northern Territory border. Individual downwarps in the floor of the basin may be sufficiently large to justify separate names within the Canning Basin: the first of these areas recognized is the Fitzroy Basin in the north.

Permian rocks are widely distributed in the Canning Basin. The Canning Basin covers about 190,000 square miles in the Kimberley, north-west and north-central districts of Western Australia. Main outcrop areas of Permian rocks are in the Fitzroy Basin, between the Fenton and Pinnacle faults (Guppy et al., 1952, 1958), and around the north-east and south-west margins of the Canning Basin; the central part of the Basin is covered by sand and Mesozoic sediments.

The general opinion regarding the correlation of the beds of the Canning Basin with European Stages, based on evidence of the larger fossils, is that the Nura Nura Member of the Poole Sandstone is the equivalent of the lower Artinskian; the Noonkanbah Formation of the Artinskian; the lower part (Lightjack Member) of the Liveringa Formation, of the Artinskian and part of the Kungurian, and the upper part (Hardman Member) of the Tartarian (Hill, 1955; Thomas and Dickins, 1954; Teichert, 1941).

Foraminifera occur in the Nura Nura Member of the Poole Sandstone, the Noonkanbah Formation, and the Liveringa Formation, but they are most common in subsurface sections of the Noonkanbah Formation. They have also been found in surface samples from the Dora Shale in the southern part of the Canning Basin, which is an equivalent of the Noonkanbah. Recently foraminifera were discovered in subsurface beds referable to the Grant Formation. The characteristic species in the surface outcrop are shown in Table VII.

TABLE VII.—WESTERN AUSTRALIA: CANNING BASIN—CHARACTERISTIC SPECIES OF SURFACE EXPOSURES.

Rock Units.	Foraminifera.
Liveringa Formation (Hardman Member) ..	*Ammodiscus nitidus* Parr *Hyperammina fusta* sp. nov. *Reophax subasper* Parr *Reophax tricameratus* Parr
Noonkanbah Formation..	*Ammodiscus erugatus* sp. nov. *Ammodiscus nitidus* Parr *Digitina recurvata* Crespin and Parr *Hyperammina acicula* (Parr) *Hyperammina coleyi* Parr *Hyperammina elegans* (Cushman and Waters) *Hyperammina expansa* (Plummer) *Hyperamminita rudis* (Parr) *Flectospira prima* Crespin and Belford *Pelosina hemisphaerica* Chapman and Howchin *Reophax ellipsiformis* sp. nov. *Reophax emaciatus* Plummer *Reophax subasper* Parr *Reophax tricameratus* Parr *Thurammina phialaeformis* sp. nov. *Thuramminoides sphaeroidalis* Plummer *Trochammina subobtusa* Parr
Poole Sandstone (Nura Nura Member) ..	*Ammodiscus nitidus* Parr *Calcitornella stephensi* (Howchin) *Hemigordius schlumbergi* (Howchin) *Hyperammina expansa* (Plummer)
Grant Formation	.. ..

Foraminifera found in subsurface sections, correlated with surface stratigraphical units, are given in Table VIII.

TABLE VIII.—WESTERN AUSTRALIA: CANNING BASIN—CHARACTERISTIC SPECIES OF SUB-SURFACE SEQUENCES.

Equivalent Rock Units.	Foraminifera.
Liveringa Formation (Lightjack Member) ..	*Ammodiscus erugatus* sp. nov. *Rectoglandulina serocoldensis* (Crespin)
Noonkanbah Formation..	*Ammodiscus erugatus* sp. nov. *Ammodiscus nitidus* Parr *Calcitornella heathi* Cushman and Waters *Calcitornella stephensi* (Howchin) *Calcivertella palata* sp. nov. *Dentalina grayi* Crespin *Dentalina habra* sp. nov. *Dentalina nerrimaensis* sp. nov. *Earlandia condoni* sp. nov. *Flectospira prima* Crespin and Belford *Frondicularia impolita* sp. nov. *Frondicularia semicostula* sp. nov. *Frondicularia woodwardi* Howchin *Geinitzina caseyi* sp. nov. *Geinitzina striatosulcata* sp. nov. *Geinitzina triangularis* Chapman and Howchin *Glomospirella nyei* sp. nov. *Hemigordius harltoni* Cushman and Waters *Hyperammina elegans* (Cushman and Waters) *Hyperammina expansa* (Plummer) *Nodosaria fisheri* sp. nov. *Nodosaria raggatti* sp. nov. *Nodosaria spiculata* sp. nov. *Plummerinella kimberleyensis* sp. nov. *Psammosphaera pusilla* Parr *Pseudohyperammina radiostoma* sp. nov. *Rectoglandulina serocoldensis* (Crespin) *Sacculinella australae* sp. nov. *Streblospira kimberleyensis* Crespin and Belford *Streblospira meandrina* Crespin and Belford *Thurammina phialaeformis* sp. nov.
Poole Sandstone (Nura Nura Member) ..	*Ammodiscus nitidus* Parr *Calcitornella stephensi* (Howchin) *Geinitzina triangularis* Chapman and Howchin *Nodosaria tereta* sp. nov.
Grant Formation	*Hyperammina expansa* (Plummer) *Nodosaria tereta* sp. nov. *Reophax fittsi* (Warthin) *Tetrataxis* sp. *Thuramminoides sphaeroidalis* Plummer

Bonaparte Basin.

Except for small mesa-cappings of Lower Cretaceous sediments and areas of alluvium, Permian rocks occupy the entire coastal strip, about 35 miles wide, extending from the Fitzmaurice River in the south to the Daly River in the north (Noakes, Opik and Crespin, 1952; Traves, 1955). Foraminifera were recorded from a bore, Bore No. 3, at Port Keats by Etheridge (1907), and Crockford (1943) described bryozoa from the same bore. Few specimens of foraminifera have been found in the Basin since Etheridge's discoveries.

Etheridge recorded and figured (plate XII., fig. 13) *Calcitornella stephensi* (Howchin) in samples between 554 feet and 574 feet in the bore and there seems little doubt that figure 12 on the same plate represents *Ammodiscus nitidus* Parr. Fragments of *Hyperammina* were present in samples from "Coolshil" Hills, Port Keats area.

NOTES ON THE FORAMINIFERAL ASSEMBLAGES, WITH POSSIBLE CORRELATIONS OF THE PERMIAN ROCKS IN AUSTRALIA.

Correlations are based primarily on the occurrence of calcareous species, the majority of which are restricted both stratigraphically and geographically. Although these assemblages include a general list of species, many of the species have only been found in certain localities, but may be found elsewhere when more detailed field work is carried out. Eight assemblages are discussed.

1. An assemblage containing *Calcitornella stephensi, Frondicularia woodwardi, Earlandia condoni, Geinitzina triangularis, Giraliarella angulata, Hemigordius schlumbergi, Nodosaria tereta, N. irwinensis, Streblospira australae, Stacheia dickinsi, Tetrataxis conica, Trepeilopsis australiensis, Hyperammina callytharraensis,* and *H. hadzeli,* is characteristic of the beds of the Callytharra Formation of the Carnarvon Basin. Certain of these species occur in the following formations, which are regarded as stratigraphically equivalent: the Fossil Cliff Formation, Irwin Basin, and the Nura Nura Member of the Poole Sandstone, Fitzroy Basin, Western Australia; the Cattle Creek Formation, Springsure area, Queensland; the Dalwood Group, Hunter River area, New South Wales; the Darlington Limestone and lower part of the Gray Limestone, Tasmania.

Nodosaria tereta, N. irwinensis, Earlandia condoni, and *Trepeilopsis australiensis* are restricted to beds within the above formations in both eastern and Western Australia. *Giraliarella angulata, Stacheia dickinsi, Hyperammina callytharraensis, H. hadzeli,* and *Tetrataxis conica* have not yet been discovered outside the Callytharra Formation. *Hemigordius schlumbergi* occurs only in the Fossil Cliff Formation and Nangetty Glacials, in the beds of the Callytharra Formation, and in Giralia No. 1 Bore in beds regarded as the equivalent of that formation; in the Nura Nura Member, Poole Sandstone; and at an unnamed locality (OS.264) in the Dalwood Group of the Hunter River area.

Hitherto *Calcitornella stephensi* was considered to be restricted to the beds of the Callytharra Formation and its correlatives, in which it occurs abundantly in all limestones. Recent examination of more extensive collections of rocks, however, indicates that the species is found in stratigraphically higher formations, especially in the subsurface beds of the Noonkanbah Formation of Western Australia and in the limestones of the Mantuan *Productus* Bed of Queensland. Although *C. stephensi* is not a restricted species outside the Carnarvon Basin, its importance as the characteristic species of the assemblage given above must be considered.

Geinitzina triangularis and *Frondicularia woodwardi* are also characteristic species of the above assemblage, but they are also found in the stratigraphically higher formations both in Western and eastern Australia. Both are equally common in the Callytharra Formation and its correlatives, but *G. triangularis* is less common in the younger formations.

Streblospira australae occurs abundantly in the tough limestones of the Callytharra Formation and in Giralia No. 1 Bore in beds regarded as equivalent of the Callytharra. It was recently found at an unnamed locality (OS.264 of Dr. G. D. Osborne) in the Dalwood Group of the Hunter River area, and the form is likely to be of considerable value in the correlation of the Permian deposits of eastern and Western Australia. *Tetrataxis conica* has only been found in the Callytharra. A species not included in the above assemblage is *Spirillina papillo-dentata,* which has only been discovered in Giralia No. 1 Bore, in beds regarded as the equivalent of the Callytharra Formation. Further work on surface sediments of the Callytharra Formation may reveal this species to be of zonal value.

The distribution of some of the more important species in this assemblage, both in surface and subsurface deposits, is shown in Table IX.

TABLE IX.—DISTRIBUTION OF SPECIES IN ASSEMBLAGE 1.

Foraminifera.	Formations.						
	1.	2.	3.	4.	5.	6.	7.
Calcitornella stephensi	X	X	X	X	X	X	X
Earlandia condoni	..	X	..	X	X	X	..
Giraliarella angulata	..	X	..	..	..	..	..
Hemigordius schlumbergi ..	X	X	X	..	X	..	..
Nodosaria tereta	X	X	X	X	X	X	..
Nodosaria irwinensis	X	X	..	X	X	X	X
Streblospira australae ..	..	X	..	..	X	..	..
Trepeilopsis australiensis ..	X	X	..	..	X	X	..
Tetrataxis conica	..	X	..	..	..	..	..

1. Fossil Cliff Formation, Irwin Basin, Western Australia.
2. Callytharra Formation, Carnarvon Basin, Western Australia.
3. Nura Nura Member, Poole Sandstone, Fitzroy Basin, Western Australia.
4. Cattle Creek Formation, Springsure area, Queensland.
5. Dalwood Group, Hunter River area, New South Wales.
6. Gray Limestone, east coast, Tasmania.
7. Darlington Limestone, Tasmania.

2. An assemblage including *Flectospira prima, Frondicularia parri, F. woodwardi, Geinitzina caseyi, G. striatosulcata, Hemigordius harltoni, Nodosaria raggatti, N. spiculata, Rectoglandulina serocoldensis, Streblospira kimberleyensis, S. meandrina, Ammodiscus nitidus, Hyperammina expansa, Pseudohyperammina radiostoma, Sacculinella australae, Reophax ellipsiformis, Thurammina phialaeformis,* and *Thuramminoides sphaeroidalis* is prominent in subsurface beds of the Noonkanbah Formation of the Fitzroy Basin. Many of the species are restricted in the Carnarvon Basin to formations stratigraphically higher than the Callytharra Formation.

Streblospira kimberleyensis is, so far, restricted to the subsurface beds of the Noonkanbah Formation. *Streblospira meandrina, Hemigordius harltoni,*

Nodosaria raggatti, and *Pseudohyperammina radiostoma*, although characteristic of the Noonkanbah assemblage, are found in different formations of the Byro Group of the Carnarvon Basin. *S. meandrina* is recorded from the beds of the Cundlego Formation; *P. radiostoma*, *Hemigordius harltoni*, and *N. raggatti* are found in the Bulgadoo Shale, the latter species being fairly common at individual localities. *Frondicularia parri*, although described from subsurface beds in New South Wales probably equivalent to the Maitland Group, is characteristic of the subsurface sediments of the Noonkanbah Formation and of the section in the Giralia Bore, Carnarvon Basin, in beds equivalent of the Byro Group. *Sacculinella australae* is present in both the Bulgadoo Shale and Coyrie Formation. The only record of *Flectospira prima* in the Carnarvon Basin is also in the Permian upper foraminiferal zone in the Giralia Bore.

The arenaceous species *A. nitidus*, *H. expansa*, *R. ellipsiformis*, *T. phialaeformis*, and *T. sphaeroidalis*, although recorded from the underlying Callytharra Formation, are characteristic of the formations of the Byro Group and occur commonly in the Cundlego Formation, Bulgadoo Shale, and Coyrie Formation. The foraminifera indicate a close correlation between the Noonkanbah Formation and the Byro Group of Western Australia.

N. raggatti, *F. parri*, *H. expansa*, *T. phialaeformis*, and *T. sphaeroidalis* are well represented in bores in the Hunter River area, in beds included in the Maitland Group. A long-distance correlation of these beds with those of the Noonkanbah Formation and Byro Group is suggested.

As regards other species in this assemblage, *Geinitzina caseyi* is, at present, restricted in Western Australia to the Noonkanbah Formation; but it is found in the Mantuan *Productus* Bed of Queensland. *G. striatosulcata*, which is common in the Noonkanbah Formation, occurs in the lower foraminiferal zone in the Giralia Bore in beds regarded as equivalent of the Callytharra Formation.

3. A persistent assemblage consisting almost entirely of arenaceous species occurs throughout the formations of the Byro Group, Carnarvon Basin, and in the Noonkanbah Formation of the Fitzroy Basin. The species include *Ammodiscus nitidus*, *A. wandageeensis*, *Hyperammina acicula*, *H. coleyi*, *H. expansa*, *Hyperamminita rudis*, *Reophax ellipsiformis*, *R. subasper*, *R. tricameratus*, *Thurammina phialaeformis*, *Thuramminoides sphaeroidalis*, *T. teicherti*, *Tolypammina undulata*, and *Trochammina subobtusa*. The abundance of tests of these species varies in beds of the different formations, and is probably due to ecological factors. Some of these species range upwards from the Callytharra Formation but none of them are abundant in that Formation. Tests of *H. acicula* and *H. coleyi* are predominant in the Wandagee area, one bed in the Quinnanie Shale consisting almost entirely of *H. coleyi*. *T. sphaeroidalis* is very common in the Bulgadoo Shale and Coyrie Formation. *A. wandageeensis*, with its unusually large test, has only been found in the Wandagee Formation and Quinnanie Shale. *H. rudis*, although ranging upwards from the Callytharra in the Carnarvon Basin, is very common in an outcrop of the upper part of the Noonkanbah Formation, at Jurgurra Creek,

Fitzroy Basin. Because of their very wide distribution in both the Byro Group and the Noonkanbah Formation, *Ammodiscus nitidus, Hyperammina acicula,* and *H. coleyi* are not included in the following distribution Table (Table X.).

Not included in the above assemblage, but listed in Table X., are *Spiroplectammina carnarvonensis* and *Ammobaculites wandageensis,* which though locally abundant in the Carnarvon Basin, are not widely distributed. *S. carnarvonensis* occurs with the assemblage in the Cundlego, Coyrie and Bulgadoo. *A. wandageensis* is found in the Cundlego, Wandagee and Bulgadoo with a rare occurrence in the Noonkanbah of the Fitzroy Basin.

TABLE X.—DISTRIBUTION OF SPECIES IN ASSEMBLAGES 2 AND 3 IN WESTERN AUSTRALIA.

Foraminifera.	Formations.									
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Ammodiscus erugatus	..	..	..	..	..	..	..	..	X	X
Ammodiscus wandageeensis	..	..	..	..	X	X	..	..	..	..
Ammobaculites woolnoughi	..	..	X	X	X	..	..	X	..	..
Ammobaculites wandageensis	X	..	X	X	..	X	..	..	X	..
Flectospira prima	..	..	..	..	..	..	..	X	X	..
Frondicularia parri	..	..	..	..	..	..	..	X	X	..
Frondicularia impolita	..	..	..	..	..	..	..	..	X	..
Frondicularia semicostula	..	..	..	..	..	..	..	..	X	
Geinitzina caseyi	..	..	..	..	..	..	..	..	X	
Geinitzina striatosulcata	..	..	..	..	..	..	..	..	X	..
Hemigordius harltoni	..	..	X	X	..	..	..	X	X	..
Hyperammina elegans	X	..	X	X	X	X	..	..	X	..
Hyperammina expansa	..	..	X	..	..	..	X	..	X	..
Hyperammina fusta	X	..	..	..	..	..	..	..	X	X
Hyperamminita rudis	X	..	X	..	..	X	..	..	X	..
Nodosaria raggatti	..	..	X	X	..	..	..	X	X	..
Nodosaria springsurensis	..	..	..	..	..	..	..	X	..	..
Nodosaria spiculata	..	..	..	..	..	..	..	X	X	..
Pseudohyperammina radiostoma	..	..	X	..	..	..	..	..	X	..
Plummerinella kimberleyensis	..	..	..	..	..	..	..	..	X	..
Rectoglandulina serocoldensis	..	..	X	..	..	..	..	..	X	X
Reophax ellipsiformis	X	..	X	X	..	..	..	X	X	..
Reophax tricameratus	X	..	..	..	X	X	..	..	X	..
Reophax belfordi	..	..	..	..	..	..	..	X	..	..
Sacculinella australae	X	..	X	..	..	..	..	X	X	..
Streblospira kimberleyensis	..	..	..	..	..	..	..	..	X	..
Streblospira meandrina	..	..	..	X	..	..	..	..	X	..
Spiroplectammina carnarvonensis	X	..	X	X	..	..	..	X	..	..
Textularia improcera	X	..	..	..	..	..	X	..	..	..
Thurammina phialaeformis	X	..	X	..	X	X	X	X	X	..
Thuramminoides sphaeroidalis	X	X	X	..	..	..	X	..	X	..
Trochammina subobtusa	..	..	X	X	X	X	..	..	X	..

Carnarvon Basin.

1. Coyrie Formation. 2. Mallens Greywacke. 3. Bulgadoo Shale. 4. Cundlego Formation. 5. Quinnanie Shale. 6. Wandagee Formation. 7. Baker Formation. 8. Giralia No. 1 Bore between 420 feet and 660 feet.

Fitzroy Basin.

9. Noonkanbah Formation (surface and subsurface). 10. Liveringa Formation (surface and subsurface).

4. Arenaceous species are predominant also in the surface deposits of the Mulbring and Branxton Subgroups of the Maitland Group, Hunter River area, New South Wales. They include *Ammodiscus multicinctus, Ammobaculites woolnoughi, Hyperammina hebdenensis, H. fletcheri, Digitina recurvata, Reophax subasper, Textularia bookeri, Thurammina phialaeformis, Thuramminoides sphaeroidalis, Tolypammina undulata,* and *Trochammina pulvilla. A. multicinctus* occurs commonly in some beds, especially in the Mulbring Subgroup. *A. woolnoughi, D. recurvata,* and *T. bookeri* are also recorded from the stratigraphically lower Dalwood group. *D. recurvata* is very common in the Victoria Pass section, Mitchell Highway, on the edge of the western coalfields, in beds of the Capertee Group, probably the equivalent of the Branxton Subgroup. *Thurammina phialaeformis* and *Thuramminoides sphaeroidalis* are characteristic species of the Byro Group and Noonkanbah Formation, Western Australia. *H. hebdenensis* is very common in the Mulbring Subgroup, occurring in great abundance at the type locality at Hebden.

5. Calcareous species are characteristic of the subsurface deposits of the Maitland Group in the Hunter River area, and include such species as *Dentalina grayi, Frondicularia aulax, F. parri, F. woodwardi, Lingulina antiqua, Nodosaria raggatti,* and *Rectoglandulina serocoldensis.* Calcareous forms are scarce in outcrops of the Mulbring Subgroup, the only available record being *R. serocoldensis* from the beds at the Saw Mill, Mulberry Creek, west of Mulbring. The species *F. parri, F. woodwardi, N. raggatti,* and *L. antiqua* have been found only in surface beds of the Branxton Subgroup. However, the lithological differences between the Mulbring Subgroup and the Branxton Subgroup have been recognized by field geologists in subsurface sections and evidence suggests that the above species, typical of the Branxton Subgroup, range in subsurface deposits, at least, into the stratigraphically higher beds of the Mulbring Subgroup.

6. A small assemblage of species dominated by the calcareous form *Frondicularia parri* is present in subsurface sections in the Sydney area, New South Wales, in beds referable to the Maitland Group. *F. parri* has been found in the Hunter river area, where it is not common. However, it occurs commonly in the Kulnura Bore, 44 miles north of Sydney, and in the Dural East No. 1 Bore, 15 miles north-west of Sydney.

7. A distinctive assemblage of calcareous species is present in the limestone of the Mantuan *Productus* Bed, Reid's Dome, near Springsure, Queensland. The species include *Frondicularia aulax, F. woodwardi, Geinitzina caseyi, G. triangularis, Lenticulina (Astacolus) initialis,* and *Rectoglandulina serocoldensis.* Of these, the most important is *L. (A.) initialis,* which is common and which gives the first record of the subgenus *Astacolus* in the Permian of Australia. Although *R. serocoldensis* was described from the Springsure area (Crespin, 1945), it is prominent in the Noonkanbah and Liveringa Formations of the Fitzroy Basin, and also occurs in the Branxton Subgroup, Hunter River area. *F. woodwardi, G. caseyi,* and

G. triangularis are also typical Noonkanbah species, and it is suggested that the Mantuan *Productus* Bed can be correlated with the Noonkanbah Formation and the Branxton Subgroup. Arenaceous foraminifera are not common in the deposits of the Springsure area, conditions of deposition being unfavourable for their existence.

8. A unique assemblage of arenaceous species is found in the deposits near Oonah, north-west Tasmania. The species include *Ammodiscus oonahensis, Digitina recurvata, Hippocrepinella biaperta, Pelosina ampulla,* and *?Thuramminoides sphaeroidalis.* All tests are unusually large and distorted and the majority are finely arenaceous. The most interesting and abundant species is *Hippocrepinella biaperta,* with apertural openings at both ends of the test. This assemblage, which occurs in beds in the lowest part of the Permian sequence in Tasmania, cannot be correlated with deposits outside the State.

PALAEOECOLOGY.

Interpretation of the palaeoecology of the foraminifera in the Permian rocks of Australia is beset with difficulties. Assemblages differ within short distances in outcrop material, but some uniformity in conditions of sedimentation is shown in subsurface deposits over a wide area. Certain genera, especially amongst the calcareous imperforate group, are restricted to the Upper Palaeozoic, and their palaeoecology can be suggested only by information derived from associated fossil forms other than the foraminifera. Again, calcareous species are extremely rare in assemblages in surface deposits of the Maitland Group, the Byro Group, and the Noonkanbah Formation, whereas subsurface sediments referred to these formations are characterized by abundant calcareous tests, especially of the genera *Nodosaria* and *Frondicularia.* It has been suggested that this absence may be due to leaching out of the calcareous tests in the outcrop material, but more probably they could not exist under conditions in which arenaceous tests could thrive in such extraordinary abundance.

The Permian foraminifera in Australia can be referred generally to three groups:

1. Arenaceous genera, including long-ranging forms such as *Ammodiscus, Ammobaculites, Hippocrepinella, Hyperammina, Proteonina, Psammosphaera, Reophax, Spiroplectammina, Thurammina,* and *Trochammina,* and restricted genera such as *Digitina, Giraliarella, Pseudohyperammina, Hyperamminita,* and *Thuramminoides.*

2. Calcareous perforate genera, including *Dentalina, Frondicularia, Geinitzina, Lenticulina, Lenticulina* (*Astacolus*), *Lingulina, Nodosaria,* and *Rectoglandulina.* Of these *Geinitzina* is the only genus restricted to the Upper Palaeozoic.

3. Calcareous imperforate genera such as *Calcitornella, Flectospira, Hemigordius, Orthovertella, Plummerinella, Streblospira,* and *Trepeilopsis.* These genera are restricted to the Upper Palaeozoic.

1. Of the arenaceous genera which range from the Upper Palaeozoic to Recent, those that occur abundantly throughout the Permian in Australia are *Ammodiscus, Hyperammina,* and *Thurammina.* The others, *Ammobaculites, Hippocrepinella, Proteonina, Psammosphaera, Reophax* and *Spiroplectammina,* although widely distributed, are common only at individual localities. All these genera are known to thrive in cold water where temperature most probably has more control than depth (Galloway, 1933). The genus *Hippocrepinella,* described from the cold waters of the South Atlantic, occurs in considerable abundance in the Quamby Mudstone at Oonah, Tasmania, which is the lowest marine formation of the Permian yet known in that State. The abundance of this cold-water form in the Quamby Mudstone, together with other cold-water genera, may indicate that the cold temperatures of the preceding glacial period, during which the Stockton Tillite was deposited, still influenced the marine faunas in the formation, the Quamby Mudstone, immediately following. The presence of delicate tests of arenaceous forms in the glacial deposits of the Nangetty area, Irwin Basin, and of the Grant Formation, Fitzroy Basin, suggests the most extreme environment under which arenaceous foraminifera existed. The robust forms of other localities would indicate cool but not cold waters.

Three occurrences of arenaceous foraminifera are outstanding. At a locality 5½ miles west-south-west of Wandagee Homestead, Carnarvon Basin, innumerable well-preserved tests of *Hyperammina coleyi* Parr occur in an outcrop of the Quinnanie Shale. At a locality 4.6 miles south-west of Moogoree Homestead, 320 feet above the base of the Coyrie Formation, well-preserved tests of *Hyperammina* and *Thuramminoides* occur abundantly in association with other arenaceous genera. A third locality is at Hebden, Hunter River area, where a deposit in the Mulbring Subgroup contains countless fragments of tests of *Hyperammina hebdenensis* sp. nov. The exact environment for such accumulations of tests of one or more genera is uncertain. At least the water must have been cool to cold, but not necessarily deep; but the controlling factor was more probably turbidity, as Stainforth (1952) concluded.

Parr (1941) suggested that the deposits in the Wandagee area were laid down in seas of no great depth, possibly cool and moderately shallow. They may have been laid down not very far off-shore, in a bay or gulf where there was some outlet to the open sea (Phleger, 1954).

2. The calcareous, perforate genera of the Lagenidae, such as *Nodosaria, Dentalina,* and *Frondicularia,* thrive in moderately shallow warm to temperate waters of the open-sea type. It must be assumed that the associated but restricted genus *Geinitzina* must have thrived under similar ecological conditions. *Nodosaria* and *Dentalina,* although widely distributed bathymetrically, are more common in warm to temperate shallow water usually between 100 and 500 fathoms; *Frondicularia* is almost restricted to these bathymetrical limits.

Nodosaria, Dentalina, Frondicularia, and *Geinitzina* dominate the foraminiferal assemblage in beds of the Cattle Creek Formation and Mantuan *Productus* Bed of the Springsure area, Queensland. Tests of arenaceous foraminifera are

exceedingly rare at any of the localities. However, bryozoa are very common and their presence gives some indication of conditions at time of sedimentation. Bryozoa thrive in clear, moderately shallow to moderately deep, temperate waters in which there must be adequate circulation. This suggests open sea, probably in the vicinity of reefs. Crockford (1951) discussed some of the problems relating to the distribution of bryozoa in the Permian deposits of Australia.

Frondicularia, Geinitzina and *Nodosaria* dominate the assemblage of calcareous perforate foraminifera in the Fossil Cliff Formation and the Callytharra Formation. Bryozoa are common in the sediments. Tests of arenaceous foraminifera, especially *Hyperammina,* are frequently present in the Callytharra beds. The assemblage suggests open-gulf conditions with temperate waters. In subsurface sections, as in Giralia No. 1 Bore, in the Nerrima Bores, Myroodah and Jurgurra Creek Bores, and in several bores in the Hunter River area, numerous tests of arenaceous foraminifera are associated with the above calcareous perforate genera. Bryozoa are present but are not characteristic. Ostracoda are fairly numerous and may give some palaeoecological evidence of conditions during sedimentation. According to Phleger (1954), this group of microfossils is characteristic of conditions where open-sea water is readily available, as in the open-gulf facies.

3. The calcareous imperforate genera *Hemigordius, Calcitornella, Trepeilopsis, Plummerinella, Orthovertella, Streblospira,* and *Flectospira* are all restricted to the Upper Palaeozoic and consequently little is known of the ecological conditions under which they survived. *Calcitornella, Trepeilopsis,* and *Plummerinella* are usually attached to bryozoa, brachiopod shells or productid spines, and the association with bryozoa suggests temperate to warm clear water in which adequate circulation prevailed.

Dr. J. A. Waters, who for many years studied the calcareous imperforate genera in the Pennsylvanian and Permian of Texas, in a personal communication gave some striking observations on the environment of *Calcitornella* and *Hemigordius,* which, he states, have been confirmed by later workers. Those primitive genera tolerate a very precise environment, and with any change of depth, pressure, temperature, or salinity, migrated with the advance or retreat of the Permian and Pennsylvanian seas, which were shallow and constantly changing. Provided no distinct unconformities existed, this migration resulted in a considerable vertical range of different genera. This wide vertical range of *Calcitornella* and *Hemigordius* is well illustrated in the subsurface sediments of the Fitzroy Basin, where these two genera are found in both the Nura Nura Member of the Poole Sandstone and in the overlying Noonkanbah Formation. In the Carnarvon Basin *Calcitornella* and *Hemigordius* are restricted to the Callytharra Formation, which on the evidence of the larger fossils was deposited in open-sea conditions, but in warm to temperate moderately shallow water. Their association also with numerous tests of *Nodosaria* and *Frondicularia* would support this conclusion.

Waters further suggested that the shallow seas as found in the Pennsylvanian and Permian of Texas were not always connected, and when they finally became a continuous sea again, the foraminifera were enabled to migrate into younger sediments, even though they were not present in the intermediate beds. Such conditions may have prevailed in the most northerly part of the Carnarvon Basin, where Permian sediments do not crop out, and have been studied only in the subsurface section of the Giralia Bore. *Calcitornella*, *Nodosaria* and *Frondicularia* are abundant in the lower zone of Permian foraminifera in the bore, which is considered to be the equivalent of the Callytharra Formation; *Hemigordius* occurs with numerous tests of *Nodosaria* and *Frondicularia* in the upper zone, which is considered to be the equivalent of part of the Byro Group. The two zones are separated by more than 2,000 feet of sediments, chiefly carbonaceous, in which an occasional test of *Hyperammina* was found. The return, after a considerable period, of ecological conditions suitable for the re-appearance of genera prominent in the lower zone, suggests that for the period during which more than 2,000 feet of carbonaceous sediments were deposited, the region became almost completely barred from the clear waters of the open sea. It seems, too, that the beds in the upper zone were deposited in an open gulf, in moderately shallow, warm to temperate water, rather than in the cool waters as indicated by the abundant arenaceous tests found in the surface beds of the Byro Group in the central part of the Basin.

The abundance of *Calcitornella, Hemigordius,* and *Plummerinella* in the subsurface beds of the Noonkanbah Formation, between limiting depths, supports Waters' view of the necessity of a precise environment for these primitive forms.

COMMENTS ON GENERA AND SPECIES.

Many of the new forms, both genera and species, have been described from subsurface material. Some of them have been found in subsurface material only; others have been present in rocks from both surface and subsurface, but the poor preservation of those from surface material did not permit their designation as type specimens. Furthermore, many new species have been found, but specimens suitable as holotypes have not been available.

Glaessner (1945, p. 200), in his discussions on the Carboniferous and Permian microfaunas states: "In the later Permian the Fusulinidae disappeared and hyaline perforate lagenid foraminifera began to occur in considerable numbers, foreshadowing the greater abundance and dominance of this group during most of the Mesozoic era". He states also: "The essential features of the late Palaeozoic microfaunas can be summarized as follows: Arenaceous foraminifera (Astrorhizidae and Lituolidae) occur in some variety, with a number of Recent genera well represented or even dominant among them. The spectacular rise of the Endothyridae, particularly the Fusulinidae, characterizes

this period, which is also marked by the first appearance of the Trochamminidae, primitive Ophthalmidiidae and Lagenidae. They become more widely distributed towards the end of the period."

The outstanding features of the Australian Permian foraminifera indicated by this survey are:

1. The apparent absence of fusulinid foraminifera in the Permian rocks of Australia.
2. The remarkable development of certain genera of the family Lagenidae in both eastern and western Australia.
3. The development of calcareous imperforate genera, including encrusting forms, of the family Ophthalmidiidae in certain formations on both sides of the continent.
4. The abundance of arenaceous foraminifera throughout the Permian sequences.
5. The interesting new genera in the Western Australian assemblages.
6. The presence of species closely related to those described from the Permian and Pennsylvanian of the United States.

The following comments are relevant to the six outstanding features mentioned above.

1. Up to the present fusulinid foraminifera have not been found in the Permian rocks of Australia, although they occur in some abundance in the island of Timor to the north-west of Western Australia. As already indicated, the record of *Fusulina* in Western Australia (Chapman and Parr, 1937) has been proved incorrect (Brunnschweiler, 1954); the figured specimens represent probable fish remains.

2. Probably the most interesting and important result of recent work is the discovery of a remarkable development of certain genera of the family Lagenidae in the Permian assemblages in Australia. Hitherto, only three species of *Nodosaria* (*N. irwinensis* Howchin, *N. serocoldensis* Crespin, *N. springsurensis* Crespin), one species of *Dentalina* (*D. grayi* Crespin), two species of *Frondicularia* (*F. parri* Crespin, *F. woodwardi* Howchin), probably two species of *Lingulina* (*L. antiqua* Chapman and Howchin, doubtfully *L. davidi* Chapman and Howchin) and one of *Geinitzina* (*G. triangularis* Chapman and Howchin) had been described from the Permian of Australia. In this Bulletin nine species of *Nodosaria,* including six new forms, four species of *Dentalina* with two new forms, eight species of *Frondicularia* with six new forms, one new species of *Lenticulina* (*Astacolus*), a genus not previously found in the Permian, two species of *Lingulina,* and three species of *Geinitzina* including two new forms, are described. The form described by Crespin as *Nodosaria serocoldensis* is now placed in the synonymy of *Rectoglandulina serocoldensis.* Many of the tests of the Nodosariinae are beautifully preserved and it is remarkable that the genera *Nodosaria, Rectoglandulina, Dentalina, Frondicularia, Lingulina,* and *Lenticulina* (*Astacolus*) should show little

morphological change from Permian to Recent times. In some species, both the microspheric and megalospheric generations have been observed, and where possible specimens of the two forms have been figured. Ornamented tests of *Nodosaria, Dentalina,* and *Frondicularia* are a striking feature of the many specimens of these genera examined.

The genus *Geinitzina* appears to be restricted to the lower part of the Permian sequence in Australia and is represented by both smooth and ornamented species; both types are especially common in subsurface sections in the Fitzroy and Canning Basins and in the Giralia Bore in the Carnarvon Basin. The subgenus *Astacolus* has not been previously recorded in beds older than the Jurassic.

Cummings (1955) seems to imply that genera of the subfamily Nodosariinae are not found in the Upper Palaeozoic, but some are undoubtedly present in the Permian microfaunas of Australia.

3. Calcareous, imperforate genera, including *Calcitornella, Plummerinella, Orthovertella, Trepeilopsis, Hemigordius* and *Earlandia,* are especially common in the beds of the Fossil Cliff Formation, Irwin Basin, the Callytharra Formation, Carnarvon Basin, and the Noonkanbah Formation, Canning Basin, Western Australia; the Cattle Creek Formation, Springsure area, Queensland; the Dalwood Group, Hunter River area, New South Wales; and the Darlington Limestone, Tasmania. All the above genera are restricted to the Upper Palaeozoic.

The genus *Earlandia* is recorded from the Lower Permian of Australia for the first time and is apparently restricted to this part of the Permian sequence. It almost certainly belongs to the group of calcareous imperforate foraminifera. Cummings (1955) places it in his new family Earlandiidae, suggesting that this family may be regarded as the Upper Palaeozoic analogy of the Hyperammininae. Plummer (1930) included *Earlandia* in the family Hyperamminidae.

4. Arenaceous foraminifera are characteristic of all Permian assemblages in Australia, especially in beds above those in the lower part of the Lower Permian sequence. The genera include *Ammodiscus, Ammobaculites, Digitina, Hyperammina, Reophax, Spiroplectammina, Textularia, Thurammina,* and *Thuramminoides.* A few broken tests of *Hyperammina* are often the only foraminiferal remains in many of the sediments; in certain beds in the Wandagee area, Western Australia, and in the Hunter River area, New South Wales, tests of this genus occur in great abundance. *Ammodiscus* and *Thuramminoides* are also very common genera and at times one of them may be the only form found in a sample. The position of *Hyperammina* is discussed later in this section.

5. Four new genera have been discovered in the Lower Permian deposits of Western Australia during this investigation. Further collections in eastern Australia may reveal them there. The genera are *Giraliarella, Hyperamminita,*

Pseudohyperammina, and *Sacculinella. Giraliarella* has been found in deposits in the Carnarvon and Fitzroy Basins. *Pseudohyperammina,* with its remarkable radiate aperture, is characteristic of subsurface sections of the Noonkanbah Formation of the Canning Basin; a few poorly preserved specimens have been found in surface exposures in the Carnarvon Basin. *Sacculinella,* with its striking apertural opening, is found in surface and subsurface sections. The genus *Hyperamminita* has been created for the coarse arenaceous form described by Parr (1942) as *Hyperammina? rudis* from the Wandagee area, Carnarvon Basin.

The discovery of the Recent genus *Hippocrepinella* in the Permian rocks of Tasmania, where it occurs in abundance in beds of the Quamby Mudstone at Oonah, is rather striking, as it is the first definite record of this primitive genus in pre-Recent strata. Miller and Swineford (1957) have tentatively identified a specimen from the Nodulose Zone of the Haskell Limestone (Upper Pennsylvanian) of Kansas as *Hippocrepinella?*. They suggest that because of the flexibility of the test of this primitive form (*See* Cushman, 1950, p. 74), "it is possibly correct to assume that the genus may be found in older sediments".*

6. Several arenaceous and calcareous imperforate forms in the Australian Permian are referable to species described from the Permian and Pennsylvanian of Texas. The arenaceous species include *Hyperammina elegantissima* Plummer, *H. elegans* (Cushman and Waters), *H. expansa* (Plummer), *Reophax fittsi* (Warthin), *R. asper* Cushman and Waters, *R. minutissimus* Plummer, *R. emaciatus* Plummer, *Ammovertella inclusa* (Cushman and Waters) and *Thuramminoides sphaeroidalis* Plummer, which are characteristic of the Pennsylvanian. The calcareous imperforate species are *Calcitornella elongata* Cushman and Waters, *C. heathi* Cushman and Waters and *Hemigordius harltoni* Cushman and Waters. In view of the variation of shape within these species, it seems impossible to separate the Australian forms from them.

Permian foraminifera occur in Australia not only in siltstones, shales, and sandstones, but also in unsilicified limestones, with no suggestion of secondary silicification, which according to Cummings (1955) is a characteristic form of preservation of the foraminiferal tests in the very altered limestones of the British Lower Carboniferous. The palaeoecological environment of Australian Permian foraminiferal assemblages seems to be entirely different from that under which the Lower Carboniferous sediments of Europe were laid down. This point is clearly illustrated in the number of calcareous genera and specimens that are present in the Australian assemblages and in the absence, up to the present, of *Fusulina* in the Australian region. The absence of Fusulinidae could indicate late Permian age (Glaessner, 1945, p. 200), but this does not agree with the evidence of the macro-fossils.

Fusulines belong to the group of large benthonic foraminifera and apparently thrived in moderately warm shallow water in the vicinity of reefs and in waters not deeper than 30 fathoms or 180 feet (Elias, 1937). This depth is approximately equivalent to the sublittoral zone of the present seas.

* See also p. 206.

Fusulines are found chiefly in limestones, calcareous shales and calcareous sandstones (Dunbar in Cushman, 1950). The apparent absence of this group of foraminifera in the Permian deposits of Australia may be due to the unfavorable bathymetric and climatic conditions suitable for the deposition of limestones, which are very restricted in distribution and thickness in the Australian Permian.

Hyperammina and Hyperamminoides.

Comments on the generic standing of *Hyperammina* Brady 1878 and *Hyperamminoides* Cushman and Waters 1928 have recently been made by Conkin (1954, 1956) and Cummings (1955). Cushman and Waters (1928a) proposed a name *Hyperamminella,* with *Hyperammina elegans* Cushman and Waters as the type species, but this name was found to be pre-occupied by *Hyperamminella* de Folin, 1881. They then (1928c) proposed the name *Hyperamminoides,* giving three points of difference between that genus and *Hyperammina.* These differences were that *Hyperamminoides* had a constricted aperture, a siliceous test, and a tapering test.

Conkin (1954) contended that, with little modification, Brady's generic description of *Hyperammina* could include *Hyperamminoides.* These modifications are: " (1) the second chamber may be non-tapering, may taper towards the proloculus, or in a few species taper towards the aperture and the proloculus (hour-glass tapering); (2) aperture may be moderately or strongly constricted; and (3) exterior may be marked by transverse constrictions of varying strength ". Conkin illustrated " hour-glass tapering " with the megalospheric form of *Hyperamminoides acicula* described by Parr (1942, p. 105, pl. 1, fig. 5) from the Wandagee area, Western Australia, and points (2) and (3) with Brady's species *Hyperammina subnodosa* (1884, pp. 259-260, pl. 23, figs. 11, 12) and *H. fragilis* (1884, pp. 258-259, pl. 23, fig. 3). Conkin (1956) also considers that both genera had siliceous tests.

Plummer (1945) in recognizing the two genera, stated that the fundamental difference between them was in the form of the second chamber. In *Hyperammina* it increased in diameter very slowly or almost imperceptibly and attained considerable length. In *Hyperamminoides,* the diameter of the second chamber, especially during its earliest stage, increases rapidly, tests are generally proportionately shorter and stouter than in *Hyperammina,* and complete mature specimens are often abundant. She also considered that a common difference between the tests of the two genera lay in the outer-wall texture, although this is not a diagnostic feature; in species of *Hyperammina,* the form of the proloculus is one of the most critical of specific characters, and the numerous broken tubes found in many washed samples are difficult to identify.

Cummings (1955) states that the relationship of *Hyperammina* and *Hyperamminoides* is rather obscure. He says that examination of type material of *Hyperammina* in the British Museum (Natural History) shows that this form

has a calcareous or ferrugino-calcareous cement, whereas the wall of *Hyperamminoides* is stated to have a siliceous cement. He considers that such a fundamental difference cannot be regarded as mere specific variation as suggested by Conkin (1956). However, he has noted that tests of *Hyperammina* often undergo secondary silicification in Palaeozoic sediments, and for the present, on the ground that *Hyperamminoides* is based on secondary silicified specimens of *Hyperammina,* includes it within the genus *Hyperammina.*

Conkin (1956) commented that his reference to specific variation was not one between siliceous and calcareous cement but variation in proportion of siliceous cement to cemented grains.

After studying innumerable tests, I agree with Conkin in using *Hyperammina* rather than *Hyperamminoides,* for the following reasons:—

1. The difference in the shape of the proloculus is neither a definite generic nor a specific character. This point is well illustrated in the figures of both the microspheric and megalospheric forms, and again in Parr's figures of *H. acicula.* The microspheric form shows a greater increase than the megalospheric test. Further illustrations of this are given by Cushman and Waters in their figures of "*Hyperamminella*" *elegans* (1928a, pl. 2, figs. 3, 4) which later (1928c) became the genotype of *Hyperamminoides.* The same features are present in the figures of "*Hyperamminoides*" *proteus* (Cushman and Waters) (1928a, pl. 22, figs. 5, 6). The amount of increase in width of the test is surely a specific rather than a generic character.

2. Plummer (1945) remarks that the tests of *Hyperammina* are mostly much longer than those of *Hyperamminoides.* Evidence against this view is shown in the two species described by Parr (1942) from Western Australia. The tests of "*Hyperamminoides*" *acicula* are up to 20 millimetres long; the greatest length of *Hyperammina coleyi* is given as 9 millimetres.

3. Cummings (1955) found that the test of *Hyperammina* had calcareous or ferrugino-calcareous cement, but no species with calcareous cement were found during the present investigation. The tests were persistently siliceous, as found by Conkin (1956). As already commented here, there seems to be little or no evidence of secondary silicification of arenaceous tests in the Australian Permian or in the rocks in which the foraminifera are found.

Comments on the Arenaceous Genera.

Tests of certain foraminifera from Western Australia have been referred to the new genus *Lugtonia* of Cummings (1955). All features are similar to this form, but the wall of the test though polished is definitely arenaceous, quartz grains of varying sizes being set in a siliceous cement. Cummings placed the genus in his new family Earlandiidae as he regards the present siliceous test as secondary to granular calcareous structure. However, for the present the Western Australian specimens are included in the Reophacidae.

The remark by Cummings (1956, p. 214) regarding the validity of the genus *Digitina* Crespin and Parr (1941) requires some comment. Cummings suggests that the genus is synonymous with *Mooreinella* Cushman and Waters (1928), a genus included in the family Trochamminidae. A very complete study of *Digitina* was made by Crespin and Parr during the preparation of the description of the genus. Parr was convinced that the form was generically new and that it would eventually prove to be an ancestral form of the Verneuilinidae. At the same time he felt certain that *Climmacammina* and *Cribrostomum* were not Textulariidae. This latter idea has been confirmed by Cummings (1956), who has placed these two genera in a new family Palaeotextulariidae.

In thin section, the initial chambers of *Digitina* show a trochoid spiral arrangement passing into an irregular biserial series. The aperture is quite distinct from that found in *Mooreinella,* which is round and subterminal; that of *Digitina* is an arched slit at the base of the last formed chamber and is definitely not subterminal.

SYSTEMATIC DESCRIPTIONS.

One hundred and three species are discussed in this section. They include 52 new species and four new genera.

The new genera are: *Sacculinella, Hyperamminita, Pseudohyperammina,* and *Giraliarella.*

The new species are: *Hippocrepinella biaperta, Proteonina arenosa, Thurammina phialaeformis, Pelosina ampulla, Sacculinella australae, Hyperammina callytharraensis, H. fletcheri, H. fusta, H. hadzeli, H. hebdenensis, Pseudohyperammina radiostoma, Giraliarella travesi, G. angulata, G. rhomboidalis, Earlandia condoni, Reophax belfordi, R. ellipsiformis, Lugtonia thomasi, Ammodiscus erugatus, A. oonahensis, Glomospirella nyei, Ammobaculites eccentrica, A. wandageensis, Spiroplectammina carnarvonensis, Textularia bookeri, T. improcera, Calcivertella palata, Plummerinella kimberleyensis, Trepeilopsis australiensis, Trochammina laevis, T. pokolbinensis, Placopsilina wooramelensis, Stacheia dickinsi, Lenticulina (Astacolus) initialis, Dentalina habra, D. nerrimaensis, Nodosaria crassula, N. decoris, N. fisheri, N. spiculata, N. raggatti, N. tereta, Frondicularia aulax, F. hillae, F. impolita, F. limpida, F. semicostula, F. sutilis, Geinitzina caseyi, G. striato-sulcata,* and *Spirillina papillo-dentala.*

The depository of types and figured specimens is shown by the following abbreviations: C.P.C.—Commonwealth Palaeontological Collection. U.Q.—University of Queensland Collection. U.W.A.—University of Western Australia Collection. U.Tas.—University of Tasmania Collection.

A list of localities is given on page 121. Each locality is numbered, this number being used in the list of occurrences of the different species. The locality list is not exhaustive but will serve to show the wide distribution of many of the species. Field numbers of rock samples available in the Bureau collections are given after each locality.

Family Rhizamminidae.

Genus Hippocrepinella Heron-Allen and Earland, 1932.

Hippocrepinella biaperta sp. nov.

(Plate 1, figures 1-8.)

Diagnosis: Free, elongate, finely siliceous, tubular form with apertural openings at both ends of the test.

Holotype: Test free, elongate, somewhat compressed through compaction of sediments, consisting of a single tube with constrictions at both ends of test, the sides of the test between constrictions being almost parallel. Test irregularly distorted horizontally giving it a wrinkled appearance. Wall thin, composed of very fine siliceous material, smooth, slightly polished, white. Apertures, broad rounded openings at constricted ends of test, and surrounded by thickened lips.

Paratypes: A: Test is more compressed and slightly narrower than holotype. Apertures are almost completely circular in shape. Distortions of test as in holotype. B: Test much distorted with apertures slightly ovate in shape. C: Test very gently curved and with few distortions and with sides of test between apertural constrictions almost parallel. Apertural opening at proximal end compressed but a neck-like constriction surrounds opening at distal end. D: Test tapers gently with greatest width in upper third, then sloping towards constriction around apertural opening.

Dimensions:

—	Length.	Maximum width.	Apertural diameter.
	mm.	mm.	mm.
Holotype	1.25	0.60	0.20
Paratype A	1.25	0.50	0.15
Paratype B	1.15	0.50	0.15
Paratype C	2.00	0.50	0.10
Paratype D	1.75	0.30	0.10

Occurrences: Holotype (C.P.C. 2351) and Paratypes A-D (C.P.C. 2352-5) from road cutting near Oonah, north-west Tasmania, 23 miles west of Waratah on main Somerset-Waratah Road, Quamby Mudstone (locality 51).

Other material: locality 54, Golden Valley Group; 159 (580-600 feet), 160 (30-50 feet), Noonkanbah Formation.

Observations: *H. biaperta* with its variable size and shape shows some resemblance with the Recent species *H. hirudinea* Heron-Allen and Earland 1932, the type species of the genus. As with that species, the specific characters remain fairly constant. However, *H. biaperta* differs from *H. hirudinea* in the thickened lip around the apertural opening and the broad circular apertural opening. The variations within the species are illustrated on Plate 1. The species is common at the type locality in Tasmania.

A specimen of the genus showing apertural openings at either end of the test was found in Giralia No. 1 Bore, Carnarvon Basin, at 3,220-3,240 feet. It was not well enough preserved for specific determination.

Family SACCAMMINIDAE.

Subfamily PSAMMOSPHAERINAE.

Genus PSAMMOSPHAERA F. E. Schulze, 1875.

PSAMMOSPHAERA PUSILLA Parr.

(Plate 2, figures 4, 5.)

Psammosphaera pusilla Parr, 1942, p. 106, pl. 1, figs. 6, 7; Crespin, 1947, lists.

"Test very small, spherical, consisting of a single chamber; wall comparatively thick, formed of fine quartz grains, very firmly cemented, the cement apparently siliceous; surface smoothly finished."

Dimensions of figured specimens: Diameter of Hypotype A, 0.35 mm.; Hypotype B, 0.31 mm.

Occurrence: Hypotype A (C.P.C. 2357) from south side of Minilya River, near Coolkilya Pool, Wandagee Station, Quinnanie Shale (locality 104). Hypotype B (C.P.C. 2358) from Associated Freney Oilfields Nerrima No. 1 Bore at 150 feet (Noonkanbah Formation) (locality 155).

Other material: Bulgadoo Shale 87, 89; Noonkanbah Formation 157, 158 (various depths).

Observations: This very small form is not common in the Permian of Western Australia. Hypotype B, from the Fitzroy Basin, is compressed, but shows the characteristic smooth surface of the test.

Subfamily SACCAMMININAE.

Genus PROTEONINA Williamson, 1858.

PROTEONINA ARENOSA sp. nov.

(Plate 2, figures 6, 7.)

Diagnosis: Globular test composed of large and small angular quartz grains, and a short apertural neck.

Holotype: Test stout, globular, roughly textured, unilocular, composed of coarse angular quartz grains of irregular size, cemented together with fine insoluble cement. Aperture a small opening at end of short protuberance, between a group of coarse angular quartz grains.

Paratype: Test similar in structure to holotype but smaller and with the angular quartz grains set deep in the siliceous cement. Aperture as in holotype.

Dimensions: Diameter of holotype, 1.20 mm.; paratype, 1.00 mm.

Occurrence: Holotype (C.P.C. 2359) and paratype (C.P.C. 2360) from Wooramel River, 2¼ miles west of junction with Madeline Creek, Madeline Formation (locality 82).

Other material: Localities 83 (Madeline Formation) and 112 (Wandagee Formation).

Observations: *P. arenosa* shows some resemblance with *P. cervicifera* described by Cushman and Waters (1928a) from the Strawn Group (Pennsylvanian) of San Saba County, Texas. The difference is in the long cylindrical apertural neck of the American species and in the less coarse and more evenly sized quartz grains which compose the test.

Genus THURAMMINA Brady, 1879.

THURAMMINA PHIALAEFORMIS sp. nov.

(Plate 3, figures 6-8.)

Thurammina papillata Chapman and Howchin (*non* Brady), 1905, page 9, plate 11, figure 13; Chapman, Howchin and Parr, 1934, page 183; Parr (*non* Brady), 1942, page 107, plate 1, figure 8; Crespin, 1947, lists.

Diagnosis: Single-chambered globular test composed of moderately coarse quartz grains with numerous and irregularly scattered apertures with nipple-like projections.

Holotype: Test medium-sized, globular, consisting of a single undivided chamber. Wall composed of moderately coarse quartz grains, firmly cemented. Surface rough. Apertures as openings at end of nipple-like projections scattered irregularly over test. Test brown.

Paratypes: A: Test smaller than holotype, globular, with apertures at open end of long projections. Surface smoother than in holotype. B: Test compressed through compaction of sediments and showing three apertural openings.

Dimensions: Diameter of holotype, 1.10 mm.; paratype A, 1.00 mm.; paratype B (compressed), 1.20 mm.

Occurrence: Holotype (C.P.C. 2361) and paratype A (C.P.C. 2362), Minilya River, ¼ mile upstream from Wandagee Homestead (locality 90), Bulgadoo Shale. Paratype B (C.P.C. 2363), 1½ miles east-south-east of Cundlego Crossing, Minilya River, 65 feet below top of Bulgadoo Shale, locality 88.

Other material: Locality 11, Aldebaran Creek Group. 16, Dalwood Group; 141 (26-50 feet), Maitland Group. 66, Callytharra Formation; 79, Coyrie Formation; 87, 89, 94, Bulgadoo Shale; 105 Quinnanie Shale; 113, Wandagee Formation; 115, Baker Formation; 126, 156 (129 feet), 157 (150-490 feet), 158 (1,525-2,145 feet), 159 (83-500 feet), 160 (30-50 feet), Noonkanbah Formation.

Observations: The form referred to Brady's Recent species *Thurammina papillata* by Chapman and Howchin (1905), Chapman, Howchin and Parr (1934) and Parr (1942) is undoubtedly a new species. Parr noticed differences between the Permian form from Western Australia and the Recent one when he stated that "Palaeozoic examples of *Thurammina* seem to be more coarsely built generally than Recent specimens and also vary more in form than do the specimens found in any Recent single dredging". The differences between the two species are the coarse shell wall of *T. phialaeformis* and the long protuberances at the end of which are large rounded apertures. The specimens recorded as *T. papillata* Brady by Moreman (1930) from the Silurian of Oklahoma most probably represent a new species.

T. phialaeformis is common in some of the Permian sediments in Western Australia but less common in eastern Australia. The shape of the tests varies considerably, especially after compression. Three specimens are figured to illustrate this feature. The species closely resembles *T. texana* Cushman and Waters, but differs in the slightly rougher surface of the test.

Genus THURAMMINOIDES Plummer, 1945.

THURAMMINOIDES SPHAEROIDALIS Plummer.

(Plate 3, figures 9-11; plate 31, figures 1, 2.)

Thuramminoides sphaeroidalis Plummer, 1945, p. 218, pl. 15, figs. 4-10.

Description of holotype, abridged: "Finely arenaceous, white to pale-gray sphaeroidal tests. Shell wall composed of uniformly very fine quartz grains, bound by insoluble cement. Inside wall displays reticulate pattern. Presence of apertural protuberances exceedingly variable; many tests are devoid of them, others have one to many . . . "

Hypotypes: A: Test moderately compressed, with broadly rounded periphery. Wall finely arenaceous, composed of uniformly very fine quartz grains in insoluble cement. Hypotype B: Test more compressed than hypotype A with several minute apertural openings on surface: Hypotype C: Test large, compressed; wall smooth, slightly polished. Hypotypes D and E: Horizontal sections illustrating thickness of wall and the finely arenaceous material composing test suggesting labyrinthic structure. A few apertural openings occur on the inner wall of cavity.

Dimensions: Max. diameter of test—Hypotype A, 1.4 mm.; Hypotype B, 1.00 mm.; Hypotype C, 2.50 mm.; Hypotype D, 0.77 mm.; Hypotype E, 0.39 mm.

Occurrence: Hypotype A (C.P.C. 2364), 2¼ miles south-east of Donnelly's Well, Williambury Station, Mallens Greywacke (locality 85). Hypotype B (C.P.C. 2365), Minilya River, 3½ miles north-west of Wandagee homestead, Bulgadoo Shale (locality 91). Hypotype C (C.P.C. 2366), B.M.R. No. 1 Bore, Jurgurra Creek, at 390-400 feet, Noonkanbah Formation. Hypotypes D and E (C.P.C. 2885 and 2886), Mt. Sandiman Station, 3.0 miles east-south-east of Merlinleigh Homestead, Bulgadoo Shale (locality 97).

Other Material: 51, Quamby Mudstone. 137 (34-39 feet), Maitland Group: 48, Capertee Group. 66, 67, 68 Callytharra Formation; 79, 80, Coyrie Formation; 86, 87, 88, 89, 95, 97, Bulgadoo Shale; 115, 116, 117 Baker Formation; 126, 127, 158 (2,255-60 feet), 159 (300-400 feet), Noonkanbah Formation.

Observations: T. sphaeroidalis, with its finely arenaceous, white or pale grey, wholly or partly compressed test, is one of the commonest forms in the Permian assemblages of Australia, especially in Western Australia. The variability of size noted by Plummer (1945) in the American forms is a feature of the Australian specimens, in which the diameter ranges from 0.39 mm. to 2.50 mm. Thin sections of this species from the Carnarvon Basin show small pit-like structures on the inner surface, which do not appear to extend to the outer wall. None of the numerous tests examined gives any indication of being completely circular in the original state, as is *T. teicherti* (Parr).

The specimen figured by Chapman and Howchin (1905) as the Lower Cretaceous species *Ammodiscus milletianus* Chapman may possibly be referable to *T. sphaeroidalis.*

THURAMMINOIDES TEICHERTI (Parr).

(Plate 3, figures 12, 13.)

Crithionina teicherti Parr 1942, p. 107, pl. 1, figs. 9, 10; Crespin, 1947, lists.

"Test free, comparatively large, spherical, thick-walled but variable in this respect, central cavity large, connected with the outside surface by numerous moderately-sized pits which extend irregularly through the thickness of the shell wall and reach the exterior surface through minute openings; wall composed of fine sandy material fairly well cemented, with a thin compact surface layer."

Dimensions: Diameter of Hypotype A, 2.20 mm.; Hypotype B, 2.00 mm.

Occurrence: Hypotypes A and B (C.P.C. 2367, 2368), south side of Minilya River near Coolkilya Pool, Wandagee Station, Quinnanie Shale (locality 104).

Other material: 28, Branxton Subgroup; 41, 46, 47, Mulbring Subgroup. 106, Quinnanie Shale.

Observations: The species of Parr described under *Crithionina teicherti* almost certainly belongs to the genus *Thuramminoides* Plummer, 1945. (The only previous record of the genus *Crithionina* as a fossil was made by Moreman

(1930) from the Silurian of America, and the generic standing of this form is doubtful). It is similar to *Thuramminoides* in the uniformly very fine quartz grains of the shell wall and its labyrinthic character. The apertural protuberances are variable in that genus but several are present in *T. teicherti*. The species closely resembles *T. sphaeroidalis* Plummer, which is common in the Permian of Australia, but that species has a very fine wall structure and a usually very smooth test.

Genus Pelosina Brady, 1879.

Pelosina hemisphaerica Chapman and Howchin.

(Plate 2, figures 8-10.)

Pelosina hemisphaerica Chapman and Howchin, 1905, p. 6, pl. 12, figs. 2a, b; Chapman, Howchin and Parr, 1934, p. 183; Crespin, 1947, lists.

"Test somewhat irregularly flask-shaped, flattened on one side, convex on the other. Aperture a short, but probably originally prolonged, tubular neck. Structure of test apparently composed of fine sandy mud, in which are embedded various coarser bodies, such as fragments of shells, sand-grains, and other foraminiferal tests."

Dimensions of figured specimens: Hypotype A—length, 1.10 mm.; width, 1.75 mm. Hypotype B—length, 0.90 mm.; width, 1.65 mm. Hypotype C—length, 1.20 mm.; width, 1.20 mm.

Occurrence: Hypotype A (C.P.C. 2369), Nannigo Dam, Middalya Station, top of Bulgadoo Shale (locality 87). Hypotype B (C.P.C. 2370), BMR Bore 11 (T), Pond's Creek at 26-50 feet, Maitland Group (locality 144). Hypotype C (C.P.C. 2371), Freney Kimberley Oil Company, Nerrima No. 1, at 129 feet, Noonkanbah Formation (locality 156).

Other material: 51, 52 Quamby Mudstone. 90, Bulgadoo Shale; 115, Baker Formation; 123, Nura Nura Member; 126, 160 (30-50 feet), Noonkanbah Formation.

Observations: P. hemisphaerica was described by Chapman and Howchin (1905) from Wollong, Hunter River area, New South Wales, in beds equivalent of the Branxton Subgroup. It is widely distributed in the Permian rocks of Australia, and although Chapman and Howchin recorded it from the stratigraphically older beds at Pokolbin, all the recent records are from deposits approximately stratigraphically equivalent with the one at Wollong.

Pelosina ampulla sp. nov.

(Plate 3, figures 1-3.)

Diagnosis: A flasked-shaped, single-chambered form with smooth, finely siliceous test and a short apertural neck.

Holotype: Test free, flask-shaped semi-circular in cross section, consisting of single chamber which has greatest width at top of lower third. Wall siliceous, smooth, thick, composed of very fine quartz grains. Aperture at end of short neck.

Paratypes: A: Test slightly compressed, convex on one surface and flattened on other. Aperture oval-shaped at end of protruding neck. B: Test larger than holotype and much compressed, with long apertural neck.

Dimensions: Length of holotype, 1.35 mm.; greatest width, 1.10 mm. Length of paratype A, 1.80 mm.; greatest width, 1.30 mm. Length of paratype B, 1.70 mm.; greatest width, 1.00 mm.

Occurrence: Holotype (C.P.C. 2372) and paratypes A and B (C.P.C. 2373, 2374), from Oonah, 23 miles north of Waratah on main Somerset-Waratah road, north-west Tasmania, Quamby Mudstone (locality 51).

Other material: Localities 79, 80, Coyrie Formation; 87, 90, Bulgadoo Shale.

Observations: P. ampulla differs from *P. hemisphaerica* Chapman and Howchin in its fine, smooth siliceous test. It is common in the Oonah deposits in Tasmania, where, because of compaction of sediments, it assumes various shapes; but the tests always retain the characteristic smooth finish. Variations in form at the type locality are shown in the figured specimens.

Genus SACCULINELLA gen. nov.

Test free, short, stout, sack-like, consisting of one ovate chamber, rounded at initial end and with a broad apertural opening. Wall finely arenaceous, composed of minute sand grains in siliceous cement. Surface smooth to moderately rough, inside surface rough. Aperture a large opening surrounded by a strong thickened lip.

Type species: Sacculinella australae sp. nov. from Minilya River, ¼ mile upstream from Wandagee Homestead, Carnarvon Basin, Western Australia.

The affinities of this genus are with the family Saccamminidae, the genera of which are typically single-chambered, but it cannot be compared with any recorded genus. It bears some resemblance to the Recent genus *Urnulina* but differs in the thickened apertural lip. The genotype is slightly distorted but it gives an indication of the ovate character of the single chamber.

SACCULINELLA AUSTRALAE sp. nov.

(Plate 3, figures 4-5.)

Diagnosis: Sack-like, with a thickened lip surrounding the apertural opening. Test finely siliceous.

Holotype: Test free, short, sack-like, consisting of one ovate chamber which is somewhat compressed by compaction of sediments. Initial end rounded, the

width of the chamber then becoming almost uniform and constricted towards apertural opening. Wall thin, composed of very small quartz grains in siliceous cement. Aperture a large opening surrounded by broad thickened lip.

Paratypes: A: Test compressed through compaction of sediments, similar in shape to holotype but slightly more constricted towards apertural opening. Wall finely arenaceous composed of fine angular quartz grains with fine horizontal bands of black carbonaceous material. B: Thickened lip shows definite rounded outline. Wall very finely arenaceous with a few coarse quartz grains and flakes of mica. C: Test broadest at top of lower third, then gradually tapering to apertural end. Aperture large with thickened lip rolled back to show rough surface on inside wall of test. D: Test large, distorted, and crushed, but with characteristic thickened lip surrounding aperture.

Dimensions:

—	Length.	Maximum Width.	Width of Aperture.
	mm.	mm.	mm.
Holotype	0.80	0.60	0.50
Paratype A	0.80	0.70	0.40
Paratype B	0.90	0.70	0.50
Paratype C	1.30	1.00	0.50
Paratype D	1.20	1.10	0.60

Occurrence: Holotype (C.P.C. 2375), Minilya River, $\frac{1}{4}$ mile upstream from Wandagee Homestead, Bulgadoo Shale (locality 90). Paratype A (C.P.C. 2376), 4.6 miles south-west of Moogooree Homestead, 320 feet above base of Coyrie Formation (locality 79). Paratypes B and C (C.P.C. 2377, 2378), B.M.R. No. 1 Bore, Jurgurra Creek, at 30-50 feet, Noonkanbah Formation (locality 159). Paratype D (C.P.C. 2379), Giralia No. 1 Bore at 650-660 feet, equivalent of Byro Group (locality 153).

Other material: Locality 2, Cattle Creek Formation. 87, Bulgadoo Shale.

Observations: This small finely arenaceous form cannot be compared with any other described genus. Unfortunately all available specimens are somewhat flattened, but the holotype, although slightly distorted, gives evidence of an ovate to globular single chamber.

Family HYPERAMMINIDAE.

Subfamily HYPERAMMININAE.

Genus HYPERAMMINA Brady, 1878.

HYPERAMMINA ACICULA (Parr).

(Plate 5, figure 11; plate 6, figure 7.)

Hyperamminoides acicula Parr, 1942, p. 105, pl. 1, figs. 4, 5; pl. 2, fig. 4. Crespin, 1944, p. 59; 1945, p. 24, pl. 3, fig. 1; 1947 (pars), p. 21, pl. 1, fig. 1, *non* pl. 12, figs. 19, 20. Conkin, 1954, p. 168.

"Test elongate, tapering, sometimes at first slightly curved, very narrow at initial end and from there gradually widening; tube constricted at irregular

intervals but not septate, constrictions strongest in early part of the shell; wall thick, composed of comparatively small quartz grains set in abundant siliceous cement; exterior smooth; apertural end not constricted; aperture circular, formed by open end of tube."

Dimensions of figured specimens: Hypotype A—length 6.00 + mm.; max. diameter, 1.00 mm. Hypotype B—length 3.00 + mm.; max. diameter, 1.00 mm.

Occurrence: Hypotype A (C.P.C. 2380), south side of Minilya River, near Coolkilya Pool, Wandagee Station, (type locality) Quinnanie Shale (locality 105). Hypotype B (C.P.C. 2381), 4.8 miles south-west of Moogooree Homestead, Williambury Station, 405 feet above base of Coyrie Formation (locality 79).

Other material: Locality 102, Cundlego Formation; 86, 88, 90, 96, 97, Bulgadoo Shale; 110, 113, Wandagee Formation; 85, Mallens Greywacke; 115, Baker Formation; 118, Coolkilya Greywacke; 126, 159 (30-60 feet), Noonkanbah Formation.

Observations: According to Parr *H. acicula* is a slender species in which the megalospheric form has a small ovoid proloculus and the microspheric form a slender delicate initial portion. The length of the holotype is 11 mm. with the greatest diameter 1.30 mm., a complete specimen from Jimba Jimba Homestead, Gascoyne area, having a length of 16 mm. No complete specimens have been obtained during this investigation.

Many records have been given previously of this species in the Permian rocks of Australia, but a close study of the shell wall of many tests of *Hyperammina* suggests that this species is not as common as previously considered. *H. acicula* seems to be characteristic of the Western Australian assemblages. The species differs from the American *H. protea* (Cushman and Waters) in its tremendous length and from *H. coleyi* Parr in the smoother finish of the outer shell wall.

Hyperammina callytharraensis sp. nov.

(Plate 4, figures 1-5.)

Diagnosis: Short, slightly sinuous test of almost uniform width; aperture at the end of a smooth constricted neck.

Holotype: Test complete, elongate, straight, short for genus, almost circular, consisting of proloculus followed by a tubular second chamber which is not constricted immediately above the proloculus, then broadening outwards and again tapering towards apertural opening to form a neck-like tube. Wall moderately thin, with roughened surface consisting of coarse angular quartz grains in considerable cement. Aperture rounded at open end of constricted neck which is smoothly finished.

Paratypes: A: Test incomplete, flattened through compaction of sediments but with neck-like apertural opening pronounced. B: Test incomplete, elongate, straight, with tubular second chamber, with sides of test almost parallel, and tapering at both ends. Wall rough with quartz grains less prominent in tapering portion. Aperture rounded with thickened lip at open end of tube. C: Test incomplete, somewhat constricted, and with long protruding apertural neck. D: Test complete with distinct apertural neck.

Dimensions:

	Length.	Maximum Width.	Width of Aperture.
	mm.	mm.	mm.
Holotype	2.20	0.60	0.50
Paratype A	1.75	0.60	0.20
Paratype B	2.00	0.50	0.20
Paratype C	2.00+	0.60	0.20
Paratype D	3.50	0.60	0.20

Occurrence: Holotype (C.P.C. 2382) and paratype C (C.P.C. 2385), Callytharra Springs, 22-35 feet above base of Callytharra Formation (locality 70). Paratype A (C.P.C. 2383), section near Salt Gully, Callytharra Formation (locality 71). Paratype B (C.P.C. 2384), Wyndham Gap, Bidgemia Station, near base of Callytharra Formation (locality 67). Paratype D (C.P.C. 2386), Callytharra Springs, 180-230 feet above base of Callytharra Formation (locality 70).

Other material: Locality 68, Callytharra Formation; 134, Fossil Cliff Formation.

Observations: Numerous specimens of *H. callytharraensis* are present in beds of the Callytharra Formation, the majority of them showing the typical long neck-like apertural opening. *H. callytharraensis,* with its short test, and tubular second chamber tapering at both the initial and apertural ends, shows little resemblance to any described species of the genus. Parr had recognized this form as new.

Hyperammina coleyi Parr.

(Plate 6, figures 5, 6; plate 7, figures 3-5; plate 33, figures 1, 2.)

Hyperammina coleyi Parr, 1942, p. 104, pl. 2, fig. 3; Crespin, 1947, lists; Conkin, 1955, p. 167.

"Test elongate, cylindrical, consisting of sub-globular proloculus and long slender tubular chamber of lesser diameter than proloculus, widest in middle portion, occasionally slightly constricted at irregular intervals; wall thick, composed of medium-sized grains firmly cemented, surface rough, interior not smoothly finished; aperture circular, formed by open end of tube."

Dimensions of figured specimens:

	Length.	Width.	Proloculus.
	mm.	mm.	mm.
Hypotype A	6.00	0.75	1.00
Hypotype B	4.00	0.75	1.00
Hypotype C	3.50	0.50	0.75
Hypotype D	3.00	0.50	0.60
Hypotype E	Thickness of wall, 0.20 mm.		

Occurrence: Hypotype A (C.P.C. 2388), south side, Minilya River near Coolkilya Pool, Wandagee Station (type locality, Quinnanie Shale) (locality 105). Hypotype B (C.P.C. 2389), 4.8 miles south-west of Moogooree Homestead, Williambury Station, 405 feet above base of Coyrie Formation (locality 79). Hypotypes C, D and E (C.P.C. 2390, 2391, 2392), Callytharra Springs, 180-230 feet above base of Callytharra Formation (locality 70). Hypotypes F and G (C.P.C. 2887, 2888), 5½ miles west-south-west of Wandagee Homestead, Wandagee Station, Quinnanie Shale (locality 106).

Other material: Locality 66, Callytharra Formation; 87, Bulgadoo Shale; 101, Cundlego Formation; 108, Wandagee Formation; 119, ?Baker Formation; 130, Dora Shale; 151 (30-60 feet), Noonkanbah Formation.

Observations: Parr stated that *H. coleyi* shows some resemblance to *H. bulbosa* (Cushman and Waters, 1927) but differs in the shape of the proloculus, which is flattened on one side and is much smaller than the American species, as well as having a much rougher surface. *H. coleyi* differs from *H. acicula* (Parr) in its coarse wall texture, *H. acicula* being comparatively smooth. The wall of *H. coleyi* is thick (see plate 7, figure 5; plate 33, figures 1, 2). Hypotypes A to E are figured to show the variation in the shape of the proloculus. Hypotypes B and D exhibit a slight curvature of the tubular second chamber. Hypotype C shows the variation in the outline of the tubular second chamber, due to transverse constrictions during growth especially near the apertural opening. The numerous rather coarsely arenaceous fragments of *Hyperammina* which occur throughout the Permian of Western Australia suggest that *H. coleyi* is more common than *H. acicula.*

HYPERAMMINA ELEGANS (Cushman and Waters.)

(Plate 5, figures 1-5.)

Hyperamminella elegans Cushman and Waters, 1928a, p. 36, pl. 4, figs. 3, 4.

Hyperamminoides elegans, Cushman and Waters, 1928c, p. 112; 1930, p. 175, pl. 10, figs. 8, 9.

Hyperammina elegans, Conkin, 1955, p. 168.

" Test elongate, tapering, microspheric form very pointed at initial end and rapidly enlarging, megalospheric form with large bulbous proloculum and

breadth of chamber not greatly increasing towards aperture; interior of tubular chamber slightly constricted but not divided; wall siliceous, very finely grained, exterior smooth and polished; aperture at constricted end of tubular chamber, rounded or elliptical."

Dimensions of figured specimens: Hypotype A (form B), length, 8.00 mm.; max. width, 1.50 mm. Hypotype B (form B), length 6.00 mm.; max. width 1.00 mm. Hypotype C (form A), length 2.00 mm.; max. width, 1.00 mm. Hypotype D (form A), length 3.10 mm.; max. width, 1.00 mm. Hypotype E, width of wall 0.25 mm.

Occurrence: Hypotypes A, B, C, D, E (C.P.C. 2393, 2394, 2395, 2396, 2611), 4.6 miles south-west of Moogooree Homestead, 320 feet above base of Coyrie Formation (locality 79).

Other material: Locality 53, Golden Valley Group. 65, Callytharra Formation; 86, 93, 97, Bulgadoo Shale; 114, Wandagee Formation; 127, 158 (1495-1500 feet), 160 (30-50 feet), Noonkanbah Formation.

Observations: All the figured specimens from Western Australia have the characteristic finely siliceous, smooth and polished test of *H. elegans,* described from the Strawn (Middle Pennsylvanian) of Texas. Hypotypes A and B, somewhat flattened through compaction of sediments, are microspheric forms which taper rather more sharply in the initial portion of the test than in the later part and which show the characteristic constrictions during growth. Cushman and Waters give the length of their largest specimens as 5 mm. with a maximum width of nearly 1.00 mm. The width agrees with that of the Western Australian specimens but the length of the Australian forms is greater, the longest specimen, which is broken at both ends, measuring 8.00 mm. Hypotype E (Pl. 5, fig. 5) gives a splendid illustration of the rounded lip surrounding the apertural opening.

Hyperammina elegantissima Plummer.

(Plate 7, figures 8-10.)

Hyperammina elegantissima Plummer, 1945, p. 222, pl. 15, figs. 17-25.

Abridged description of holotype: "Slender, usually rather glossy, smooth test with a very narrow rounded initial extremity, and straight to arcuate, gradually expanding tubular chamber, which is only rarely separated from megalosphere by faint constricting. Microspheric form finely tapering. Shell wall composed of minute siliceous granules, is thin, so that most tests are strongly compressed or otherwise deformed, but considerable proportion of siliceous cement makes them unusually rigid for size. Oral extremity somewhat constricted around circular terminal aperture."

Dimensions of figured specimens: Hypotype A—length 3.00 + mm.; max. width, 0.15 mm. Hypotype B—length, 1.50 + mm.; max. width, 0.10 mm. Hypotype C—length, 0.75 + mm.; max. width, 0.20 mm.

Occurrence: Hypotypes A and B (C.P.C. 2397, 2398), Giralia No. 1 Bore at 3,220-3,240 feet, Core 67, equivalent of Callytharra Formation. Hypotype C (C.P.C. 2399), from same bore at 3,115-3,120 feet, Core 66.

Other material: Locality 70, Callytharra Formation; 133, Nangetty Glacials.

Observations: These delicate glossy tests of *Hyperammina* are almost certainly identical with *H. elegantissima* described from the Strawn (Middle Pennsylvanian) of Texas. All specimens are strongly compressed or otherwise deformed, as mentioned in the type description. Hypotype C is a fragment showing a small globular proloculus followed by a second chamber of uniform width.

HYPERAMMINA EXPANSA (Plummer).

(Plate 4, figures 9-11.)

Hyperamminoides expansus Plummer, 1945, p. 223, pl. 16, figs. 1-6.

"In this species the diagnostic feature of the genus is expressed to an exaggerated degree in the short and very widely expanding second chamber, transversely marked by sharp growth constrictions. Proloculum generally not distinctly set off by any constriction but, rather, forms the broad rounded initial extremity of megalospheric test and more sharply pointed extremity of microspheric test. Very finely arenaceous shell wall, composed of minute siliceous granules, carries an abundance of siliceous cement and externally is smoothly finished but internally rough and irregularly pustulate. Character of oral extremity as originally existed questionable. Aperture probably a small rounded opening in constructed end of second chamber, which was too thin and fragile for preservation."

Dimensions of figured specimens:

—	Length.	Maximum Width.	General Angle of Expansion.
	mm.	mm.	degrees.
Hypotype A	0.61	0.57	67
Hypotype B	0.72	0.72	circ. 14
Hypotype C	0.88	0.37	22

Occurrence: Hypotypes A and B (C.P.C. 2400, 2401), 1½ miles east-south-east of Cundlego Crossing, Minilya River, 65 feet below top of Bulgadoo Shale (locality 88). Hypotype C (C.P.C. 2402), Bruten's Yard area, 10 feet below top of Noonkanbah Formation (locality 126).

Other material: Locality 143 (53-75 feet), Maitland Group. 93, Bulgadoo Shale; 117, Baker Formation; 153 (560-70 feet), equivalent Byro Group; 155 (2,543-55 and 2,648-57 feet), ? Grant Formation; 123, Nura Nura Member; 156 (129 feet), 159 (494 feet), Noonkanbah Formation.

422/58.—4

Observations: This unusual form of *Hyperammina* was described by Plummer (1945) from the Pennsylvanian of Texas. The variation in shape exhibited in the Texan specimens is also apparent in the Australian forms. Hypotypes A and B are typical of the species but Hypotype C shows an elongate almost circular test with a few growth constrictions.

HYPERAMMINA FLETCHERI sp. nov.

(Plate 6, figures 1-4.)

Diagnosis: Test elongate, irregular-shaped, thin, arenaceous, composed of quartz grains and small crystals of tourmaline in siliceous cement.

Holotype: Test complete, elongate, thin, slightly curved, compressed through compaction of sediments, and consisting of small proloculus followed by a tubular second chamber of almost uniform width throughout, and with a few irregular constrictions. Wall smooth, thin, polished, composed of fine quartz grains and small crystals of tourmaline in a siliceous cement. Inner wall smooth. Aperture at open end of tube, surrounded by a slightly thickened lip.

Paratypes: A: Test incomplete, straight, thin with a sinuous outline and thickened lips surrounding apertural opening. B: Test incomplete, not compressed but showing circular shape of second chamber; wall very thin, almost transparent with inner wall very smooth. C: Test incomplete, larger than holotype, sinuous outline pronounced, tapering towards apertural opening where thickened lip present.

Dimensions: Holotype—length 3.00 mm.; width of second chamber, 0.30 mm. Paratype A—length, 2.50 + mm.; width, 0.30 mm. Paratype B—length, 1.75 + mm.; width, 0.50 mm. Paratype C—length, 2.50 + mm.; width, 0.75 mm.

Occurrence: Holotype (C.P.C. 2403) and paratypes A-C (C.P.C. 2404, 2405, 2406), road cutting, 9 miles south of Singleton on New England Highway, Mulbring Subgroup (locality 35).

Other material: Locality 17, Dalwood Group; 34, 39, Mulbring Subgroup; 48, Capertee Group.

Observations: H. fletcheri is very common at the type locality in beds formerly known as the "Crinoidal Shales". It is distinguished from other described species of *Hyperammina* by its thin, finely arenaceous test, composed of small quartz grains and elongate crystals of tourmaline. The delicate structure of the test is well shown in paratype B, which is not compressed. The slightly curved test of the holotype is unusual, but this specimen was selected as the holotype because the test was complete with both the proloculus and aperture present.

The species is named after Mr. H. O. Fletcher of the Australian Museum, Sydney, who has contributed much to the palaeontology of the Permian deposits of Australia.

HYPERAMMINA FUSTA sp. nov.

(Plate 4, figures 6-8.)

Diagnosis: Test short, with proloculus gradually merging into the very slightly narrower tubular second chamber. Wall finely arenaceous.

Holotype: Test very short, complete, club-shaped, very slightly compressed with rounded initial portion which merges very gradually into a slightly narrow tubular second chamber constricted at the base of middle third and broadening in upper third, then tapering to a long neck towards apertural opening. Wall thin, finely arenaceous but not polished, composed almost entirely of small quartz grains with a few flakes of white mica in siliceous cement. Aperture a rounded opening at end of neck-like tube.

Paratypes: A: Test short, complete, partly compressed, with globular proloculus which passes gradually into tubular second chamber which in turn widens in middle third then tapers to apertural opening. Wall thin, finely arenaceous, with mica flakes in fine siliceous cement. Aperture at end of rounded neck; surrounded by a thickened lip. B: Test short, compressed, with proloculus arrow-shaped at initial extremity, then passing into tubular second chamber which gradually expands towards apertural opening.

Dimensions:

—	Length.	Width at Proloculus.	Width at Middle Third.
	mm.	mm.	mm.
Holotype	1.50	0.30	0.50
Paratype A	1.20	0.50	0.50
Paratype B	1.20	0.20	0.30

Occurrence: Holotype (C.P.C. 2407) and paratypes A and B (C.P.C. 2408, 2409), 4.6 miles south-west of Moogooree Homestead, 320 feet above base of Coyrie Formation (locality 79).

Other material: Locality 120, ? Callytharra Formation; 130, Dora Shale; 159 (480-500 feet), 160 (30-50 feet), Noonkanbah Formation; 132, Hardman Member.

Observations: H. fusta, with its small club-like shape and almost uniform width of the test from proloculus to base of apertural portion, is the smallest species of the genus found in Australia. Its size is similar to that of *H. bulbosa* Cushman and Waters, but other features do not resemble this or any other described species.

HYPERAMMINA HADZELI sp. nov.

(Plate 5, figures 6-10.)

Diagnosis: Proloculus small, followed by a long tubular second chamber, which expands rapidly towards the apertural opening. Test finely arenaceous.

Holotype: Test elongate, straight, tapering, proloculus flattened, followed by a tubular second chamber which expands gently in lower and middle thirds

but rapidly in upper third where it expands into a large rounded opening. Early portion of test compressed. Wall thin, finely arenaceous with considerable cement. Surface smooth, polished, inner surface rather rough. White. Aperture large, rounded opening at end of second chamber.

Paratypes: A: Larger than holotype with wider apertural opening, slightly depressed. B: Similar to holotype but tapering more gently with shell wall thickened on one side. C: Test with small proloculus and second chamber expanding moderately rapidly to apertural opening. D: Minute proloculus with second chamber expanding rapidly.

Dimensions:

	Length.	Width at Proloculus.	Width at Apertural Opening.
	mm.	mm.	mm.
Holotype	1.80	0.30	0.60
Paratype A	3.00	0.30	0.80
Paratype B	1.60	0.10	0.70
Paratype C	1.50	0.10	0.60
Paratype D	1.50	0.10	0.80

Occurrence: Holotype (C.P.C. 2410) and paratypes A-D (C.P.C. 2411, 2412, 2413, 2414), Callytharra Springs, 180-230 feet above base of Callytharra Formation (Locality 70).

Observations: Numerous specimens of this form are present at Callytharra Springs and the four paratypes are figured to show the variation in shape within the species. *H. hadzeli* shows some resemblance to *H. expansa* (Plummer) but differs from that species in the greater length of the test and the absence of the sudden broad angle of expansion of the second chamber. Like *H. expansa, H. hadzeli* gives no indication of the character of the oral extremity.

The species is named after Mr. F. Hadzel, Bureau of Mineral Resources, who prepared the illustrations for this work.

Hyperammina hebdenensis sp. nov.

(Plate 6, figures 8-12.)

Hyperamminoides sp. cf. *proteus* Crespin and Parr, 1941 (*non* Cushman and Waters, 1928a), p. 301, pl. 12, figs. 4*a*, *b*; 5*a-c*.

Hyperamminoides acicula Parr, Crespin, 1947 (pars), p. 21, pl. 2, figs. 19, 20.

Diagnosis: Proloculus large, bulbous, followed by a straight tubular second chamber of almost uniform width, a slightly roughened test and moderately thin shell wall.

Holotype: Test incomplete, straight, broad, compressed during compaction of sediments, with large rounded bulbous proloculus followed by a narrower,

incomplete, tubular second chamber of almost uniform width. Wall comparatively thin, composed of numerous moderately fine angular quartz grains in siliceous cement. Surface somewhat roughened; inner wall smooth. Aperture not observed.

Paratypes: A: Test incomplete but showing tubular second chamber tapering slightly towards apertural opening which is surrounded by a thick rounded lip. B: Test with a pointed proloculus, followed by portion of straight tubular second chamber. C: Portion of tubular second chamber, showing average width of species when compressed, and constrictions towards apertural opening. D: Test broken, showing internal features of shell, smooth inner surface of shell wall, and moderately thin shell wall.

Dimensions:

—	Length.	Maximum Width of Second Chamber.
	mm.	mm.
Holotype	1.50+	0.75
Paratype A	1.50+	0.75
Paratype B	2.10	0.75
Paratype C	5.00+	2.00
Paratype D	4.00+	0.60

Thickness of shell wall in Paratype D, 0.15 mm.

Occurrence: Holotype (C.P.C. 2415) and paratypes A and B (C.P.C. 2416, 2417), gully at Hebden, Port. 148, Ph. Liddell, Cty. Durham, Mulbring Subgroup. Paratypes C and D (C.P.C. 2418, 2603), BMR Bore No. 2 (S), Mt. Arthur, Maitland Group at 55-60 feet.

Other Material: Localities 17, 19, Dalwood Group; 26, 27, 28, 29, Branxton Subgroup; 36, 38, 39, 41, 42, 43, Mulbring Subgroup; 142 (26-50 feet), 132 (60-80 feet), 150 (3,865-4,490 feet), Maitland Group; 48, Capertee Group.

Observations: Although *H. hebdenensis* is exceedingly common at Hebden, the type locality, no complete tests have been found and only remains of megalospheric forms were recognized. Many of the fragmentary tests were covered with the encrusting form *Tolypammina undulata* Parr. All specimens were compressed but they showed the typical moderately thin wall and smoothly finished inner wall. Because of the fragmentary character of the specimens, the length of the species is uncertain. The longest fragment observed by me measured 5.00 mm., the specimen being present in BMR Bore No. 2 (S), Mt. Arthur. However, Reynolds (1956) recorded a specimen measuring 17 mm. from 265 feet in BMR Bore 76 (T), Parnell's Creek. The average width of the fragments was between 0.60 mm. and 0.75 mm. The persistent fragmentary condition of the species at Hebden may be due to the disturbance of the sediments, as the beds are faulted against the stratigraphically higher Tomago Coal Measures. The species is common in the Hunter River area.

Crespin (1947, and *in* Reynolds, 1956) placed this species in *H. acicula* (Parr), described from Western Australia, but during the preparation of the present work the examination of all available tests of *Hyperammina* from all parts of Australia indicates that the thin wall structure, the smooth inner wall, the thick rounded lip surrounding the aperture, and the almost uniform width of the test, distinguish *H. hebdenensis* from other described species of the genus. The wall, though thin, is not as delicate as that found in *H. fletcheri*.

Genus HYPERAMMINITA gen. nov.

Test elongate, cylindrical, consisting of a tubular chamber closed at one end and of almost the same diameter throughout. Wall thick, composed of large angular to subangular quartz grains firmly cemented. Surface very rough. Aperture at open end of tube.

Type species *Hyperammina* (*?*) *rudis* Parr from east of Coolkilya Paddock, Wandagee Station, Carnarvon Basin, Western Australia.

Parr (1942), when referring *H.* (*?*) *rudis* to the genus *Hyperammina*, stated that "while one end of the tube of this species is closed, there is no distinct proloculus and it is accordingly doubtful whether it is properly referable to *Hyperammina*. The very coarsely built test is unlike that found in typical Hyperamminae". He suggested that most probably the form represented a new genus. Numerous specimens have been found in the deposits of the Carnarvon Basin and there is little doubt that they are closely related to the family Hyperamminidae.

HYPERAMMINITA RUDIS (Parr).

(Plate 6, figure 13; plate 7, figures 1, 2.)

Hyperammina (*?*) *rudis* Parr 1942, p. 105, pl. 1, fig. 3; Crespin, 1947, lists.

The description of the species as given by Parr has been quoted for the description of the genus.

Dimensions of figured specimens: Hypotype A—length, 2.75 mm.; width, 0.70 mm. Hypotype B—length, 1.70 + mm.; width, 0.80 mm. Hypotype C—length, 2.45 mm.; width, 0.87 mm.

Occurrence: Hypotype A (C.P.C. 2419), 16 miles north-north-west of Bidgemia Homestead, top of Wandagee Formation (locality 114). Hypotype B (C.P.C. 2420), Wooramel River 2½ miles west of junction with Madeline Creek, Madeline Formation (locality 82). Hypotype C (C.P.C. 2524), BMR Water Bore, Jurgurra Creek, at 30-50 feet, Noonkanbah Formation.

Other Material: Locality 70, Callytharra Formation; 93, Bulgadoo Shale; 128, Noonkanbah Formation.

Observations: This striking form is apparently restricted to the Permian deposits. Hypotype C is a small but complete specimen; most other tests are fragmentary.

Genus PSEUDOHYPERAMMINA gen. nov.

Test free, straight, broadly elongate, probably ovate. Initial portion not available, test consisting only of an undivided chamber. Wall thin, smooth, polished, finely arenaceous with much cement, white. Aperture terminal, ovate, with a thickened lip surrounded by radially arranged elongate grooves which continue down to shoulder in upper third of test.

Type species *Pseudohyperammina radiostoma* sp. nov. from Associated Freney Oilfields Nerrima No. 1 Bore, Fitzroy Basin, Western Australia at 470 feet.

The affinities of this genus with the family Hyperamminidae seem certain, but it differs from the genus *Hyperammina* in the thickened lip around the apertural opening and radially arranged elongate grooves which surround it. No complete specimens have been available for study, the very thin wall permitting ready compression of the test in the sediments. From the persistent ovate shape of the aperture even in the less compressed tests, it seems certain that the test of the new genus was ovate in shape.

PSEUDOHYPERAMMINA RADIOSTOMA sp. nov.

(Plate 8, figures 1-7.)

Diagnosis: Test smooth, tapering, arenaceous; apertural opening surrounded by radially arranged elongate grooves.

Holotype: Test free, straight, broadly elongate, gently tapering. Initial portion broken, test consisting only of one undivided chamber which tapers sharply in lower third, is almost parallel-sided in middle, and again slopes sharply to apertural end. Wall thin, smooth, polished, finely arenaceous, with much cement, white. Aperture terminal, central, ovate, with thickened lip, surrounded by radially arranged elongate grooves which continue almost down to shoulder of test in upper part of upper third.

Paratypes: A: Test smaller than holotype and tapering more acutely from the shoulder. Grooves are situated right on shoulder rather than around apertural opening as in holotype. B: Apertural portion of test not so crushed as in other specimens: the curved appearance suggests that original test was probably ovate in shape. C: Test with ovate aperture surrounded by thickened lip and with the radially arranged grooves not extending on to shoulder. Test tapers more strongly than in holotype. D: Test shorter than holotype and almost complete. Sides of test parallel in middle third. E: Test almost complete, with sides tapering gently for most of the test, but sharply at initial end. F: Test showing ovate-shaped aperture with thickened lip and deep radial grooves.

Dimensions: Holotype—length, 1.25 mm.; greatest width in lower third, 0.60 mm.; greatest width in upper third, 0.80 mm.; width of aperture, 0.20 mm. Paratype A—length, 0.85 + mm. Paratype B—length, 1.25 + mm. Paratype C—length, 1.48 mm. Paratype D—length, 1.29 mm. Paratype E—length, 1.86 mm. Paratype F—width of aperture, 0.10 mm.

Occurrence: Holotype (C.P.C. 2421) and paratypes C and D (C.P.C. 2424, 2425) from Associated Freney Oilfields Nerrima No. 1 Bore, at 470 feet, Noonkanbah Formation. Paratypes A and B (C.P.C. 2422, 2423) from Freney Kimberley Oil Company Nerrima No. 1 Bore, 129 feet, Noonkanbah Formation. Paratype E (C.P.C. 2426) from same locality as holotype but at 490 feet. Paratype F (C.P.C. 2427), $1\frac{1}{3}$ miles south-west of Nalbia Dam, Wandagee Station, Bulgadoo Shale (locality 93).

Observations: Many tests of *Pseudohyperammina radiostoma* have been available for study from cores and cuttings from bores in the Canning Basin, but only one specimen has been found in outcrop material from the Carnarvon Basin. All tests are almost flat, owing to compression during fossilization.

Genus GIRALIARELLA gen. nov.

Test free, elongate, gently tapering, sharply angulate, triangular to quadrate in shape, composed of an indefinite proloculus and an elongate, non-septate but gently constricted second chamber; shell wall finely arenaceous, composed chiefly of siliceous cement. Surface covered with very fine growth-lines but smoothly finished. Aperture circular to semicircular in rounded surface of final portion of second chamber.

Type Species: Giraliarella angulata sp. nov. from Giralia No. 1 Bore, Carnarvon Basin, Western Australia, at 3,115-3,120 feet (Core 66).

This new genus, with its long angulate finely siliceous test, is unique amongst the foraminifera and is easily recognized. It is closely allied to the genus *Hyperammina,* and until further evidence is available is placed in the family Hyperamminidae. The initial portion of this form has not been found, but it consists most probably of a minute proloculus. The genus has been named after the locality from which it was discovered.

GIRALIARELLA ANGULATA sp. nov.

(Plate 9, figures 1-5.)

Diagnosis: Test elongate, tapering, sharply angulate, may be triangular to quadrate.

Holotype: Test incomplete, elongate, gently tapering, sharply angulate; initial portion missing but test consisting of a second chamber, triangular in the lower third with very sharp ridges, then becoming quadrate but still

sharply ridged. Fine constrictions between angulated faces but non-septate. Wall finely arenaceous, composed almost entirely of siliceous cement. Surface covered with very fine growth-lines which slope upwards towards deep furrow and downwards towards angulate ridge of test; smoothly finished. Aperture semicircular opening on rounded face of the end of the test.

Paratype: Test incomplete, very sharply angular in lower portion, but one ridge bifurcating in upper third, making the final portion of test quadrate. Aperture irregularly rounded opening.

Dimensions:

—	Length.	Width at Apertural End.	Width at Initial End.
Holotype	1.60+	0.20	0.10
Paratype A	0.80+	0.15	0.10

Occurrence: Holotype (C.P.C. 2428) and paratype (C.P.C. 2429), Giralia No. 1 Bore, at 3,115-3,120 feet (Core 66) equivalent of Callytharra Formation (locality 153).

Other material: 153 (3,220-3,240 feet), 62, Callytharra Formation.

Observations: Broken tests of *G. angulata* are numerous in Cores Nos. 66 and 67 in Giralia No. 1 Bore, where they are associated with another new form, *Streblospira australae* Crespin and Belford (1957). Tests have been found in material from one outcrop only, but they were not well enough preserved for descriptive purposes.

Giraliarella travesi sp. nov.

(Plate 9, figures 6-8.)

Diagnosis: Small; test elongate, straight, sharply angulate, quadrate: smooth thick lip surrounding aperture.

Holotype: Test small, complete, elongate, straight, sharply angulate, gently curved at initial portion then becoming quadrate in shape. Indefinite proloculus followed by a second chamber which is sharply quadrate with deep longitudinal furrows and sharp edges. A few fine constrictions between angulate faces, but non-septate. Wall finely arenaceous, with minute quartz grains in considerable siliceous cement. Surface smooth in initial portion then covered with very fine growth-lines which slope upwards towards deep furrows and downwards towards sharp edge of test. Aperture rounded, central, surrounded by a smooth thick lip which retains quadrate shape.

Dimensions: Length of holotype, 0.40 mm.; width, 0.10 mm.

Occurrence: Holotype (C.P.C. 2431), Associated Freney Oilfields Myroodah No. 1 Bore, at 2,140-2,145 feet, Noonkanbah Formation.

Observations: *G. travesi* differs from *G. angulata* in its small size, the almost uniform width of the test, and the thick smooth lip which surrounds the aperture. Only one specimen has been found, but this was excellently preserved and clearly distinct from *G. angulata.*

The species is named after Mr. D. M. Traves, who has been closely associated with geological investigations in the Fitzroy, Canning, and Bonaparte Basins for many years.

GIRALIARELLA RHOMBOIDALIS sp. nov.

(Plate 9, figures 9, 10.)

Diagnosis: Rhomboid in cross section, with acute ridges in longer axis and rounded ones on shorter axis. Test deeply sulcate between ridges.

Holotype: Test broadly elongate, slightly compressed, straight, tapering gently, acutely angulate, with minute portion of initial end broken. Rhomboid in cross section, acutely ridged along longer axis, giving a frilled effect, and gently rounded in the upper part of the shorter axis. Deeply sulcated between ridges. Wall finely arenaceous. Surface smooth, almost polished, white. Aperture an ovate-shaped opening with sharp edge, central.

Dimensions: Length of Holotype, 1.00 mm.; width in lower third, 0.20 mm.; width in upper third, 0.40 mm.

Occurrence: Holotype (C.P.C. 2432), 1.9 miles west of south of Merlinleigh Homestead, upper part of Wandagee Formation (locality 114).

Other material: Locality 160 (30-50 feet), Noonkanbah Formation.

Observations: This species is much broader and more compressed than *G. angulata* and the surface is smooth, with no suggestion of growth lines between the ridges. It is larger than *G. travesi* and the aperture is sharply ovate rather than thick and rounded as in that species.

Family EARLANDIIDAE.

Genus EARLANDIA Plummer 1930.

EARLANDIA CONDONI sp. nov.

(Plate 23, figures 6-8.)

Diagnosis: Test elongate, slender, straight or gently curved, calcareous, imperforate, consisting of a large globular proloculus, followed by a long tubular chamber and with a rounded aperture at end of tube.

Holotype: Test free, elongate, slender, very slightly curved, consisting of a large globular proloculus followed by a long, rounded tubular second chamber almost uniform in width in lower and middle thirds then tapering gently to

apertural opening. Faint constrictions at irregular intervals, but not septate. Shell wall comparatively thick, calcareous, imperforate, smoothly finished, slightly translucent. Aperture round at open end of tube.

Paratypes: A: Globular proloculus followed by rounded tubular second chamber, compressed at apertural opening. B: Tubular second chamber slightly curved, and broken, suggesting longer test than holotype.

Dimensions:

—	Length.	Width of Proloculus.	Width of Tubular Second Chamber.
	mm.	mm.	mm.
Holotype	1.10	0.15	0.10
Paratype A	0.85	0.15	0.09
Paratype B	0.95	0.15	0.15

Occurrence: Holotype (C.P.C. 2433), Giralia No. 1 Bore, at 3,115-3,120 feet (Core 66), equivalent of Callytharra Formation (locality 151). Paratypes A and B (C.P.C. 2434, 2435), Callytharra Springs, 22 feet above base of Callytharra Formation (locality 70).

Other material: 3, Cattle Creek Formation. 25, Dalwood Group. 58, Gray Limestone. 61, Calytharra Formation.

Observations: Complete tests of this interesting form are comparatively rare, but broken tests are common, especially in the Callytharra area, Western Australia, where it is apparently restricted to beds of the Callytharra Formation. Parr, in his unfinished paper on the Callytharra foraminifera, recognized this form as unusual and suggested that it is isomorphous with the arenaceous genus *Hyperammina*. Topotype specimens of the genus from the Pennsylvanian of Texas have been available for reference.

The species is named after Mr. M. A. Condon, who has directed the Bureau's geological work in the Carnarvon Basin since 1949.

Family Reophacidae.

Subfamily Reophacinae.

Genus Reophax Montfort 1808.

Reophax asper Cushman and Waters.

(Plate 10, figures 1-4.)

Reophax asperus Cushman and Waters, 1928a, p. 37, pl. 4, fig. 7.

Reophax asper, Cushman and Waters, 1930, p. 37, pl. 2, fig. 10; Plummer, 1945, p. 226, pl. 17, fig. 23.

" Test elongate, somewhat tapering, generally rounded in section, chambers several, somewhat obscure; sutures not deeply depressed; wall arenaceous, composed of siliceous grains of angular shape, firmly cemented; aperture small, rounded."

Dimensions of figured specimens:

—	Length.	Maximum Width.
	mm.	mm.
Hypotype A	1.60	0.50
Hypotype B	1.90	0.60
Hypotype C	0.70	0.20
Hypotype D	0.90	0.20

Occurrence: Hypotype A and B (C.P.C. 2436, 2437) from Victoria Pass Section, Mitchell Highway, Capertee Group. Hypotype C (C.P.C. 2438), Aldebaran Creek, 4 miles north-east of Mt. Catherine, 30 miles west of Rolleston, Springsure area, Aldebaran Creek Group. Hypotype D (C.P.C. 2439), road between Maitland and Greta, Dalwood Group.

Observations: R. asper, with its very coarse arenaceous test, is well represented in the Permian deposits of eastern Australia. It differs from *R. subasper* Parr in its straight test and the almost uniform size of the chambers. In *R. subasper,* the penultimate chamber is unusually large.

Reophax belfordi sp. nov.

(Plate 10, figures 8-11.)

Diagnosis: Test small, slender, tapering, irregularly elongated and composed of small angular quartz grains.

Holotype: Test small, slender, elongate, almost straight, tapering, consisting of proloculus composed of small angular quartz grains, followed by five chambers, slightly inflated and increasing gradually in size to final chamber. Sutures distinct, depressed, giving the chambers a lobate appearance. Wall coarsely arenaceous, composed of quartz grains of varying sizes, many of them large for size of test, in siliceous cement. Surface very rough. Aperture simple opening in constricted area of final chamber.

Paratypes: A: Test small, initial end composed of a group of angular quartz grains of varying sizes, the test then rapidly expanding until final chamber. Sutures, except final one, indistinct. B: Test more sinuous in outline than holotype. Wall composed of coarse grains of quartz and other minerals. C: Test elongate, sinuous, probably microspheric, with minute angular quartz grains at initial portion. Sutures indistinct, probably eight chambers.

Dimensions:

—	Length.	Maximum Width.
	mm.	mm.
Holotype	0.90	0.25
Paratype A	0.70	0.15
Paratype B	0.80	0.15
Paratype C	0.80	0.20

Occurrence: Holotype (C.P.C. 2440) and paratypes A-C (C.P.C. 2441, 2442, 2443), Giralia No. 1 Bore, at 550-560 feet, equivalent to Byro Group. Also at 560-570 feet, 620-630 feet.

Observations: R. belfordi is one of the smallest known species of the genus from the Permian rocks of Australia. The most striking feature is the sharp angular quartz grains of varying sizes which compose this very small test. The species resembles *R. expatiatus* Plummer from the Strawn (Pennsylvanian) beds of Texas, but *R. belfordi* does not increase so rapidly in width as that species and also has more chambers, three being the recognized number in American species. *R. belfordi* also differs from *R. asper* in its small size and definite tapering test.

The species is named after Mr. D. J. Belford of the Bureau of Mineral Resources, who has given the writer generous assistance in the preparation of this work.

Reophax ellipsiformis sp. nov.

(Plate 11, figures 1-4.)

Diagnosis: Test coarsely arenaceous, ellipsoidal, almost bilaterally symmetrical along direction of longitudinal axis, tapering regularly to initial and to apertural end from broad central portion of test, and with a well-defined apertural tube.

Holotype: Test small, compressed, straight axis, ellipsoidal, almost bilaterally symmetrical along longitudinal axis with length approximately twice the width. Periphery subrounded. Initial portion blunt and well defined, with sides expanding gradually to central portion of test and tapering equally to apertural end and finishing with a neck-like tube. No visible sutures. Wall moderately thick. Surface coarsely arenaceous, composed of angular and rounded quartz grains of varying sizes in siliceous cement. Aperture rounded opening at end of short neck.

Paratypes: A: Test similar to holotype but somewhat more compressed and slightly crushed in central portion. Wall coarsely arenaceous with grains of quartz and other minerals in siliceous cement. Aperture prominent at end of short neck. B: Smaller than holotype but showing characteristic ellipsoidal shape, with blunt initial end and short but well-defined apertural tube. C: Test regularly ellipsoidal as holotype. Apertural neck not so prominent but complete.

Dimensions:

—	Length.	Maximum Width.
	mm.	mm.
Holotype	1.10	0.80
Paratype A	1.10	0.80
Paratype B	1.00	0.60
Paratype C	0.90	0.50

Occurrence: Holotype (C.P.C. 2444), 4.6 miles south-west of Moogooree Homestead, 320 feet above base of Coyrie Formation (locality 79). Paratype A (C.P.C. 2445), Giralia No. 1 Bore, at 560-570 feet, equivalent of Byro Group. Paratype B (C.P.C. 2446), Minilya River, ¼ mile upstream from Wandagee Homestead, Bulgadoo Shale (locality 90). Paratype C (C.P.C. 2447), 2¼ miles south-east of Donnelly's Well, Williambury Station, base of Bulgadoo Shale (locality 86).

Other material: 80, Coyrie Formation; 97, Bulgadoo Shale; 100, Cundlego Formation; 153 (410-420, 440-450, 620-630, 650-660 feet), equivalent of Byro Group; 127, Noonkanbah Formation.

Observations: Reophax ellipsiformis is remarkably uniform in shape, with the width of the test approximately half the length. The persistent sub-rounded periphery suggests that the test is naturally a compressed one rather than that compression is due to compaction of sediments. The species differs from *R. fittsi* (Warthin) in its bilaterally symmetrical and compressed test and in the absence of distinct chambers which, according to Warthin (1930), number four to six and which are separated by slightly depressed sutures. A specimen figured by Plummer (1945, plate 17, figure 11) as *R. fittsi* somewhat resembles *R. ellipsiformis,* but she commented that this test was unusually coarse for the species and the axis is untypically straight.

Reophax emaciatus Plummer.

(Plate 11, figures 5, 6.)

Reophax emaciatus Plummer, 1945, p. 227, pl. 17, figs. 18-22.

"Test flattened, spatulate, straight, bluntly pointed at initial end, and constricted at apertural end. Separate elongate chambers that overlap by about one-half, obscure with sutures faintly constricted. First two or three chambers broaden rapidly. Shell wall thin and usually flattened by sedimentary compaction so that combination of clear quartz grains in clear siliceous cement makes some tests translucent. Aperture a large opening at end of short neck."

Dimensions of figured specimens: Hypotype A—length, 1.50 mm.; max. width, 0.60 mm. Hypotype B—length, 1.25 mm.; max. width, 0.50 mm.

Occurrence: Hypotype A (C.P.C. 2448), section south of Grant Range, 375 feet below top of Noonkanbah Formation (locality 127). Hypotype B (C.P.C. 2449), from Giralia No. 1 Bore, at 560-570 feet, equivalent of Byro Group.

Other material: Locality 80, Coyrie Formation; 87, Bulgadoo Shale; 113, Wandagee Formation.

Observations: Mrs. Plummer described this species from the non-calcareous Strawn Shale (Pennsylvanian) of San Saba County, Texas, and specimens from this locality have been available for examination. Those from Western Australia

seem to be identical with the Texan species. *R. emaciatus* differs from *R. fittsi* (Warthin) in its much more elongate and less tapering test, its straight axis of growth and broad apertural extremity.

REOPHAX FITTSI (Warthin).

(Plate 11, figures 7-9.)

Nodosinella ? fittsi Warthin, 1930, p. 27, pl. 2, fig. 7.

Reophax fittsi, Plummer, 1945, p. 228, pl. 17, figs. 10-17; Cummings, 1955, p. 227.

" Test carrot-shaped, consisting of from four to six chambers, circular in cross section, uniserially arranged, regularly increasing; sutures slightly depressed, somewhat obscure; wall coarsely arenaceous except near aperture where the secreted cement predominates; surface rough; aperture terminal, rounded, with a faintly produced neck."

Dimensions of figured specimens: Hypotype A—length 1.38 mm.; max. width, 0.79 mm. Hypotype B—length, 1.18 mm.; max. width, 0.64 mm. Hypotype C—length, 2.02 mm.; max. width, 0.96 mm.

Occurrence: Hypotypes A and B (C.P.C. 2450, 2451), Roebuck Bay No. 1 Bore, Canning Basin, at 2,543-2,555 feet (Core No. 31), ? Grant Formation (locality 155). Hyotype C (C.P.C. 2452), 4.6 miles south-west of Moogooree Homestead, 320 feet above base of Coyrie Formation (locality 79).

Observations: The figured specimens referred to *R. fittsi* from Western Australia illustrate the coarsely arenaceous test of the species described by Warthin. Hypotype A is an excellently preserved specimen which shows the circular cross-section. Hypotype C closely resembles Plummer's figure 17, plate 17, which she suggests may be a microspheric form. However, figure 11 on the same plate, which she comments is unsually coarse and straight for the species, shows some similarity with the new species *R. ellipsiformis* from Western Australia. *R. fittsi* somewhat resembles *R. tricameratus* Parr but differs in having more chambers and a slightly produced apertural neck.

REOPHAX MINUTISSIMUS Plummer.

(Plate 10, figures 5-7.)

Reophax minutissimus Plummer, 1945, p. 230, pl. 17, figs. 25-30.

" Small and only moderately rough, slender test, which is almost consistently wholly compressed, comprised of 6 to 8 gradually enlarging, short, inflated and moderately embracing chambers separated by sharply incised transverse sutures. In general, chambers measure in length about two-thirds their breadth, though somewhat more elongate chambers are frequent. Considerable siliceous cement lends a gloss to wall but does not envelop all the larger grains. Aperture of collapsed tests is an elongate opening at end of constricted septal face of final chamber, but original form was undoubtedly round in a circular septal face."

Dimensions of figured specimens:

—	Length.	Width of Final Chamber.
	mm.	mm.
Hypotype A	0.90	0.20
Hypotype B	0.55	0.15
Hypotype C	0.85	0.20

Occurrence: Hypotypes A, B and C (C.P.C. 2453, 2454, 2455), Aldebaran Creek, 4 miles north-east of Mt. Catherine, 30 miles west of Rolleston, Aldebaran Creek Group (locality 13).

Other material: Locality 79, Coyrie Formation; 153 (560-570 feet), equivalent of Byro Group.

Observations: Specimens of *Reophax minutissimus* from the Pennsylvanian of San Saba County, Texas, have been available for comparison with the Australian specimens. All tests from Aldebaran Creek, Springsure Area, Queensland, were crushed, but a complete one showed six chambers.

REOPHAX SUBASPER Parr.

(Plate 11, figures 10, 11.)

Reophax subasper Parr, 1942, p. 109, pl. 1, fig. 12; Crespin 1947 (lists).

"Test consisting of up to seven chambers rapidly increasing in size as added, early chambers indistinct, usually arranged in a curved series, later chambers larger and more distinct, in nearly a straight line; wall built of coarse quartz grains, firmly cemented, surface rough, aperture a small opening between three or more sand grains at end of the final chamber."

Dimensions of figured specimens: Hypotype A—length, 1.30 mm.; greatest width, 0.60 mm. Hypotype B—length, 1.10 mm.; greatest width, 0.40 mm.

Occurrence: Hypotype A (C.P.C. 2456), 3.5 miles south of Paddy's Outcamp, Middalya Station, Baker Formation (locality 115). Hypotype B (C.P.C. 2457), west bank of railway cutting, west of Minimbah, Mulbring Subgroup (locality 41).

Other material: Locality 82, Madeline Formation; 104, Cundlego Formation; 105, Quinnanie Shale (type locality); 127, Noonkanbah Formation; 132, Liveringa Formation.

Observations: This form is closely related to *R. asper* Cushman and Waters from the Pennsylvanian of Texas. However, the Australian species is distinguished from that form in the greater width of the final chamber and in the more acutely tapering test.

REOPHAX TRICAMERATUS Parr.

(Plate 11, figures 12, 13.)

Reophax tricameratus Parr, 1942, p. 109, pl. 1, fig. 13; Crespin, 1947, lists; Crespin, in Reynolds, 1956, lists.

"Test composed of a few (typically three) chambers, increasing rapidly in size as added, the last-formed chamber making up about half the length of the test; axis of test straight or slightly curved; wall composed of medium-sized sand grains, firmly cemented; surface rough; apertural end slightly produced; aperture terminal."

Dimensions of figured specimens: Hypotype A—length, 1.50 mm.; width of apertural chamber, 1.00 mm. Hypotype B—length, 1.30 mm.; width of apertural chamber, 0.80 mm.

Occurrence: Hypotype A (C.P.C. 2458), 4.8 miles south-west of Moogooree Homestead, 405 feet above base of Coyrie Formation (locality 79). Hypotype B (C.P.C. 2459), right bank of creek flowing into Gascoyne River, 2 miles east of K.39 Trig., Wandagee Formation (locality 112).

Other material: 63, Lyons Group; 66, Callytharra Formation; 82, Madeline Formation; 105, Quinnanie Shale (type locality); 126, 127, Noonkanbah Formation; 132, Liveringa Formation; 145 (53-75 feet), Maitland Group.

Observations: R. tricameratus is comparatively rare in the Permian of Australia and tests are mostly incomplete. Parr in describing the species said that only one complete specimen and six crushed ones were available to him. *R. tricameratus* differs from *R. fittsi* (Warthin) in its very inflated apertural chamber and in its very coarse arenaceous test.

Genus LUGTONIA Cummings, 1955.

LUGTONIA THOMASI sp. nov.

(Plate 7, figures 6, 7.)

Diagnosis: Six inflated chambers, which gradually increase in size. Test arenaceous, polished, with large rounded aperture.

Holotype: Test complete, straight, tapering, slightly distorted owing to compaction of sediments. Test consists of six chambers of unequal size and almost circular in cross section, with large apertural chamber. Sutures distinct, straight, depressed, giving lobate appearance to margin of test. Wall thick, finely arenaceous, composed chiefly of regular-sized quartz grains in considerable cement, giving the test a smooth, polished appearance. Aperture simple, large, circular opening in centre of last-formed chamber.

Paratype: Test incomplete, consisting of five chambers, the initial one missing. The last-formed chamber strongly inflated owing to deeply depressed suture. Wall arenaceous, smoothly finished. Aperture closed through silicification.

Dimensions: Holotype—length, 2.20 mm.; width of apertural chamber, 0.10 mm. Paratype— length, + 2.00 mm.; width of apertural chamber, 0.90 mm.

Occurence: Holotype (C.P.C. 2460) and paratype (C.P.C. 2461), 1¼ miles south-west of Nalbia Dam, Wandagee Station, Bulgadoo Shale (locality 93).

Observations: This form, with its tapering test composed of inflated chambers arranged in uniserial pattern and its large aperture, is placed in the genus *Lugtonia* Cummings 1955. Reasons for this are given on page 35. *L. thomasi* somewhat resembles *L. elongata* Cummings from the Carboniferous of Scotland, with its large inflated last-formed chamber, distinct sutures and rounded open aperture, but differs from that species in the lesser inflation of the earlier chambers.

The species is named after Mr. G. A. Thomas of the Bureau of Mineral Resources, who collected the material containing this new form and who has made contributions to Permian stratigraphy and palaeontology in Australia.

Family Ammodiscidae.

Genus Ammodiscus Reuss, 1861.

? Ammodiscus anceps (Brady).

Trochammina anceps Brady, 1876, p. 76, pl. 3, figs. 8*a, b*.

Ammodiscus anceps, Chapman and Howchin, 1905, p. 11, pl. 3, fig. 1.

Trochamminoides anceps, Chapman, Howchin and Parr, 1934, p. 187.

Ammodiscus anceps (Brady), Branson, 1948, p. 3.

Observations: No specimens of this form, figured by Chapman and Howchin (1905) from Pokolbin, Hunter River area, New South Wales (Dalwood Group), have been available for examination. Consequently, its exact generic position cannot be proved.

Ammodiscus erugatus sp. nov.

(Plate 12, figures 1-3.)

Diagnosis: Test smooth, arenaceous, consisting of about four to six whorls. Rounded periphery and distinct spiral sutures.

Holotype: Test microspheric, planispiral, circular, consisting of a minute proloculus, followed by an elongate tubular chamber circular in cross-section, and gradually increasing in diameter. Periphery rounded. Number of whorls six, the first five increasing very gently in size, the last whorl broad and slightly overlapping the previous one. Spiral suture distinct, but not depressed, composed of transparent siliceous material. Wall smooth, finely arenaceous, with little visible cement. Aperture large, rounded, at open end of tube.

Paratypes: A: Test slightly compressed, but four whorls, smooth surface, distinct spiral suture and rounded aperture well shown. B: Test circular with four whorls and rounded periphery; surface slightly worn, giving a roughened appearance.

Dimensions: Holotype—max. diameter, 0.47 mm.; thickness, 0.12 mm. Paratype A—max. diameter, 0.47 mm.; thickness, 0.09 mm. Paratype B—max. diameter, 0.45 mm.; thickness, 0.09 mm.

Occurrence: Holotype (C.P.C. 2462), Associated Freney Oilfields, Myroodah No 1 Bore, Fitzroy Basin, at 870-875 feet, Liveringa Formation. Paratype A (C.P.C. 2463) from same bore at 890-895 feet, Liveringa Formation. Paratype B (C.P.C. 2464) from outcrop at Jurgurra Creek, near BMR No 1 Bore, Jurgurra Creek, Noonkanbah Formation.

Other material: locality 126, Noonkanbah Formation.

Observations: Ammodiscus erugatus is readily distinguished from other described species from the Permian of Australia by the rounded tube of the last-formed chamber and few whorls comprising the test. The surface of the last whorl of Paratype B, which is from a surface deposit, is slightly weathered, giving it a roughened appearance.

AMMODISCUS MULTICINCTUS Crespin and Parr.

(Plate 12, figures 4-6.)

Ammodiscus multicinctus Crespin and Parr, 1941, p. 303, pl. 12, figs. 1*a, b;* Crespin 1947, p. 22, pl. 2, fig. 18, also lists. Reynolds, 1956, p 14, 16, fig. 1.

"Test planispiral, circular, with parallel sides, consisting of about six whorls, the coiled chamber nearly circular in section increasing slowly and regularly in diameter and constricted at short, fairly regular intervals, giving a lobulated periphery and undulate surface; wall moderately thick, coarsely arenaceous, the sand grains cemented with a small proportion of cement giving a roughened surface; spiral suture distinct; aperture generally circular, at end of the tubular chamber."

Dimensions of figured specimens: Holotype (refigured)—diameter, 1.00 mm.; thickness, 0.17 mm. Hypotype A, diameter, 0.53 mm.; thickness, 0.11 mm. Hypotype B—diameter, 0.37 mm.; thickness, 0.05 m.

Occurrence: Holotype (C.P.C. 149) from railway cutting immediately west of Farley Station, Hunter River area, Dalwood Group (locality 19). Hypotype A (C.P.C. 2465), road cutting, Branxton-Singleton road, New England Highway, 9 miles from Singleton, Mulbring Subgroup (locality 35). Hypotype B (C.P.C. 2466), BMR Bore No. 14 (T), Pond's Creek, at 53-75 feet, Maitland Group.

Other material: localities 1, 4, Cattle Creek Formation; 5, 7, 8, Ingelara Formation; 11, 12, 14, Aldebaran Creek Group. 135 (1,800-2,390 feet), 18, Dalwood Group; 28, 30, Branxton Subgroup; 27, 34, 39, 40, 41, 44, Mulbring

Subgroup; 146 (343-387 feet), Maitland Group; 148 (4,760 feet), 149 (4,513-23 feet, 4,562-78 feet), 150 (3,957-5,450 feet), ? Maitland Group; 48, Capertee Group. 51, Quamby Mudstone; 61.

Observations: The holotype is the microspheric form of the species and is not very common. A smaller test, however, is very common in certain surface and subsurface rocks, especially in the Hunter River area of New South Wales. The majority of the tests are crushed or distorted and perfect specimens are difficult to obtain. *Ammodiscus ovalis* Chapman (Chapman, Howchin, & Parr, 1934) may represent a distorted specimen of *A. multicinctus*.

AMMODISCUS NITIDUS Parr.

(Plate 12, figures 7-9.)

Cornuspira involvens, Etheridge, 1907 (*non* Reuss), pl. 12, fig. 12.

Ammodiscus nitidus Parr, 1942, p. 103, pl. 1, figs. 1*a, b*; Crespin, 1947, p. 22, and lists.

"Test small, free, composed of minute proloculus and an elongate, tubular chamber, almost semicircular in section and slowly increasing in diameter, often transversely ridged, number of whorls usually seven or eight, each whorl overlapping to a considerable extent its predecessor; spiral suture only slightly depressed; wall thin for its genus, composed of very small quartz grains with little visible cement; shell surface comparatively smooth; aperture semicircular, formed by open end of tube."

Dimensions of figured specimens: Hypotype A—diameter, 0.51 mm.; thickness, 0.11 mm. Hypotype B—diameter, 0.46 mm.; thickness, 0.09 mm. Hypotype C—diameter, 0.57 mm.; thickness, 0.12 mm.

Occurrence: Hypotype A (C.P.C. 2467), east of Coolkilya Paddock, Wandagee Station, Wandagee Formation (locality 108, type locality). Hypotype B (C.P.C. 2468), 1.9 miles west of south of Merlinleigh Homestead, upper part of Wandagee Formation (locality 112). Hypotype C (C.P.C. 2469), section south of Grant Range, 375 feet below top of Noonkanbah Formation (locality 126).

Other material: Localities 66, 67, 68, 70, 72, Callytharra Formation; 79, Coyrie Formation; 83, 84, Madeline Formation; 85, Mallens Greywacke; 86, 89, 90, 92, 94, 95, 96, 97, Bulgadoo Shale; 98, Warrawarringa Formation; 101, 102, 104, Cundlego Formation; 115, Baker Formation; 123, 153 (450-3120 feet), 154 (1545-1555 feet), Nura Nura Member; 126, 156 (69-272 feet), 159 (180-200 feet), Noonkanbah Formation; 130, 131, Dora Shale. 163 (555-574 feet).

Observations: A. nitidus is common in the Permian rocks of Western Australia and is apparently restricted to the western side of the continent. Parr noted that the central portion of the test is very thin and often broken away. When this happens, the initial portion frequently becomes attached to mica

flakes. *A. nitidus* differs from *A. multicinctus* Crespin and Parr in its comparatively smooth surface of the test, the absence of fine constrictions, and the thin shell wall.

Ammodiscus oonahensis sp. nov.

(Plate 12, figures 10, 11.)

Diagnosis: Test large, last-formed whorl very broad, with strong constrictions; each whorl slightly overlaps preceding one.

Holotype: Test large, megalospheric, planispiral, circular in outline, small proloculus, followed by a long undivided tubular chamber closely coiled in single plane. Tube thick-walled, slowly increasing in diameter as it lengthens; last whorl very broad, 3 or 4 times width of preceding whorl, with constrictions giving periphery a lobulate appearance. Six whorls, each one slightly overlapping preceding one, making tests slightly biconcave; spiral sutures very slightly depressed. Test smooth with wall composed of very fine quartz grains in siliceous cement. Aperture a semicircular opening at end of tubular chamber.

Paratype: Test large, microspheric, biconcave, circular, minute proloculus followed by a long undivided tubular chamber closely coiled in one plane; eight whorls, each whorl slightly overlapping the preceding one. Last whorl very broad and thick, three or four times width of preceding one; periphery lobulate.

Dimensions: Holotype (form A)—diameter, 1.46 mm.; thickness of last whorl, 0.25 mm.; width of last whorl, 0.37 mm. Paratype (form B)—diameter, 1.92 mm.; thickness of last whorl, 0.31 mm.; width of last whorl, 0.26 mm.

Occurrence: Holotype (C.P.C. 2470) and paratype (C.P.C. 2471) from Oonah, 23 miles north of Waratah on main Somerset-Waratah road, north Tasmania, Quamby Mudstone (locality 51).

Other material: Locality 14, Aldebaran Creek Group. 52, Golden Valley Group.

Observations: Ammodiscus oonahensis is unique amongst described species of the genus, with its very broad last whorl and its strongly lobulate periphery. It resembles *A. multicinctus* Crespin and Parr from the Permian of New South Wales in its lobulate periphery, but differs from that species in its finely arenaceous biconcave test and strong overlap of whorls. It differs from *A. semiconstrictus* Cushman and Waters from the Pennsylvanian of Oklahoma in its overlapping and fewer whorls and very slightly depressed sutures.

Ammodiscus wandageeensis Parr.

(Plate 12, figure 12.)

Ammodiscus wandageeensis Parr, 1942, p. 102, pl. 11, fig. 1; Crespin, 1947, lists.

"Test large, free, planispiral, composed of a small globular proloculus, followed by a long undivided tubular chamber, closely coiled in single plane,

the tube fairly thick-walled, almost circular in section and slowly increasing in diameter as it lengthens; number of whorls usually six or seven; spiral suture strongly depressed; wall coarsely arenaceous with a rough surface and little visible cement; aperture formed by the rounded open end of the chamber."

Dimensions of figured specimen: Diameter, 4.50 mm.; thickness, 0.60 mm.

Occurrence: Hypotype (C.P.C. 2472), south side of Minilya River, near Coolkilya Pool, Wandagee Station (type locality), Quinnanie Shale (locality 105).

Other material: 106, 107, Quinnanie Shale; 111, Wandagee Formation; 121, ? Baker Formation.

Observations: The figured specimen of *A. wandageeensis* is from the type locality for the species on Wandagee Station. The holotype has a diameter of 6.00 mm. and a thickness of 0.60 mm. It has not been recorded outside the Wandagee area.

Genus GLOMOSPIRA Rzehak, 1888.

GLOMOSPIRA ADHAERENS Parr.

(Plate 13, figures 6, 7.)

Glomospira adhaerens Parr, 1942, p. 103, pl. 1, fig. 2; Crespin, 1947, lists.

"Test usually attached, early portion coiled planispirally after which tubular second chamber increases in diameter and winds rather irregularly over the early portion to form a subglobular heap, finally in some specimens extending as a straight or curved tube adherent to the object of attachment; wall composed of fine quartz grains firmly cemented to form a comparatively smooth surface; aperture formed by open end of tube."

Dimensions: Hypotype A—diameter, 0.50 mm.; thickness of tube, 0.07 mm. Hypotype B—diameter, 0.50 mm.

Occurrence: Hypotypes A and B (C.P.C. 2473, 2474) from Giralia No. 1 Bore at 3,115-3,120 feet (Core 66), equivalent of Callytharra Formation.

Other material: Locality 105 (type locality), Quinnanie Shale; 73, Callytharra Formation.

Observations: Specimens of *Glomospira adhaerens* suitable for illustration have been difficult to obtain. Hypotype A represents an unattached form.

Genus GLOMOSPIRELLA Plummer, 1945.

GLOMOSPIRELLA NYEI sp. nov.

(Plate 13, figures 1-5.)

Diagnosis: A finely arenaceous tubular chamber, which, after coiling itself in different directions in the initial portion, becomes planispiral for two or three whorls. Spiral suture distinct and periphery rounded.

Holotype: Test small, irregularly discoidal, slightly compressed, consisting of a minute proloculus followed by a tubular second chamber of almost consistent diameter, except near apertural end when it enlarges. The tubular chamber winds back and forth on itself in an irregular manner, finally becoming planispiral for one whorl. Spiral suture distinct, sometimes depressed. Wall finely arenaceous, somewhat roughened. Aperture at open end of tube.

Paratypes: A: Test small, irregularly discoidal, consisting of a long undivided rounded tube. In initial stage, the tube winds in different directions upon itself throughout two or three volutions, the dorsal surface becoming completely planispiral for one whorl. Tube of almost uniform thickness. Periphery rounded. Spiral suture distinct, thickened, composed of transparent siliceous material. Wall finely arenaceous with much cement. Surface very slightly roughened and polished. Aperture at end of open tube. B: Initial portion of tubular second chamber depressed, then forming planispiral volutions of irregular size, the tube in the last-formed volution being broad. Spiral suture distinct. C: Test shows the characteristic coiling of the tubular second chamber in the initial portion, followed by two planispiral whorls. Preservation gives the whole test a smooth appearance. D: Test irregularly discoidal, flattened. Initial portion of tube coiled on itself, but not so strongly as in holotype. Spiral suture irregular, thickened, transparent. Wall finely arenaceous; surface slightly roughened, polished.

Dimensions: Holotype—diameter, 0.40 mm.; thickness of tube in final planispiral whorl, 0.10 mm. Diameter of paratype A, 0.27 mm.; paratype B, 0.20 mm.; paratype C, 0.24 mm.; paratype D, 0.57 mm.

Occurrence: Holotype (C.P.C. 2475) from Cundlego Crossing, Minilya River, Cundlego Formation (locality 100). Paratypes A (U.Q.F. 23211) and D (C.P.C. 2478), 45 chains at 124° from Scottville end of Collinsville-Scottville railway line, Ph. Springlands, County Drake, 20 feet above basal conglomerate of the "Middle Bowen Marine Series" (locality 15). Paratype B (C.P.C. 2476), Callytharra Springs, 180-230 feet above base of Callytharra Formation (locality 70). Paratype C (C.P.C. 2477), Giralia No. 1 Bore, at 3,115-3,120 feet, equivalent of Callytharra Formation (locality 145).

Other material: Locality 145 (3,220-3,240 ft.); 155 (2,543-55 ft.), ? Grant Formation; 154 (1,545-55 ft.), Nura Nura Member; 156 (129 ft.), 157 (494 and 595 ft.), Noonkanbah Formation.

Observations: This small species of *Glomospirella* shows the typical planispiral character of the last whorls, which, according to Plummer (1945), distinguishes the genus from *Glomospira*. The species resembles *Glomospirella umbilicata* (Cushman and Waters) in its method of coiling, but is smaller than that species. *Glomospirella nyei* is found at widely separated localities in Australia. Several tests were present at Scottville in Queensland and it is well represented in beds of the Callytharra Formation in Western Australia.

The species is named after Mr. P. B. Nye, lately Director of the Bureau of Mineral Resources, Geology and Geophysics.

Genus TOLYPAMMINA Rhumbler, 1895.

TOLYPAMMINA UNDULATA Parr.

(Plate 19, figures 7, 8.)

Tolypammina undulata Parr, 1942, p. 104, pl. 2, fig. 2; Crespin, 1947, lists.

"Test adherent, tubular, earliest portion apparently a small planispiral coil of about one whorl after which tube winds from one side to the other or irregularly meanders over the object of attachment, the tube and undulations meanwhile gradually increasing in size; wall formed of sand grains set in abundant cement; surface comparatively smooth; aperture formed by open end of tube."

Dimensions of figured specimens: Diameter of tube of Hypotype A, + 0.16 mm.; Hypotype B, 0.13 mm.

Occurrence: Hypotype A (C.P.C. 2479) from most north-easterly outcrop of Maituan *Productus* Bed, Reid's Dome Structure, 2.3 miles south-south-east of Stringwood (locality 10). Hypotype B (C.P.C. 2481) from gully at Hebden, Portion 148, Parish Liddell, County Durham, Mulbring Subgroup (locality 40).

Other material: Locality 34, Mulbring Subgroup; 144 (70-80 feet), Maitland Group; 47, Wandrawandian Siltstone; 97, Bulgadoo Shale; 105 (type locality), 106, Quinnanie Shale; 119, ? Baker Formation.

Observations: Parr commented on the difficulty in distinguishing between different adherent forms which are common in the Wandagee beds, Carnarvon Basin. *Tolypammina undulata* differs from his species *Glomospira adhaerens* in the regular increase in the diameter of the tube as it lengthens and by the thicker tube wall which is more smoothly finished. *T. undulata* is very common in beds in a gully at Hebden, Hunter River area, where it winds back and forward on innumerable broken tests of *Hyperammina hebdenensis* sp. nov. The specimen identified as *Tolypammina vagans* (Brady) by Chapman, Howchin and Parr (1934) may be referable to *T. undulata.*

Genus AMMOVERTELLA Cushman, 1928.

AMMOVERTELLA INCLUSA (Cushman and Waters).

(Plate 18, figure 5.)

Psammophis inclusus Cushman and Waters, 1927, p. 148, pl. 26, fig. 12.

Tolypammina inclusa, Galloway and Ryniker, 1930, p. 11, pl. 1, figs. 12, 13.

Ammovertella inclusa, Cushman and Waters, 1930, p. 44, pl. 7, fig. 13; Ireland, 1956, p. 853, text fig. 5, figs. 6-14.

Observations: The variation in method of coiling in *A. inclusa* (Cushman and Waters) is well illustrated by Ireland (1956). The finely arenaceous but roughened character of the wall of the test and the swinging back of the last

part of the tubular chamber across the test indicate that the form from Western Australia belongs to this species described from the Pennsylvanian of Texas. Ireland notes that the species ranges up to the Permian.

The figured specimen (C.P.C. 2480) is from Callytharra Springs, Carnarvon Basin, 0-12 feet above the base of the Callytharra Formation (GW. 74). The diameter of the test is 1.01 mm. and the width of the tubular chamber, 0.18 mm.

Family Lituolidae.

Genus Haplophragmoides Cushman, 1910.

? Haplophragmoides neocomianus (Chapman).

Haplophragmium emaciatum Chapman and Howchin (*non* Brady) 1905, p. 7, pl. 1, figs. 10*a, b*.

Haplophragmoides neocomianus (Chapman, 1894), Chapman, Howchin and Parr, 1934, p. 187; Crespin, 1947, lists.

Observations: Chapman and Howchin (1905) identified a specimen from the Permian of the Hunter River area, New South Wales as *Haplophragmium emaciatum* Brady but later in their revision of the fauna with Parr (1934) referred it to the Lower Cretaceous species *Haplophragmoides neocomianus* (Chapman). It seems unlikely that this European Neocomian species would make its earliest appearance in the Permian of Australia. Unfortunately Chapman and Howchin's specimen has not been available for examination. However, the figures of the Permian form given by Chapman and Howchin (1905, pl. 1, figs. 10*a, b*), although very depressed, do not have the sharp periphery shown in the figures of *H. neocomianus* (Chapman, 1894).

Genus Ammobaculites Cushman, 1910.

Ammobaculites eccentrica sp. nov.

(Plate 14, figures 4-9.)

Diagnosis: Test minute, arenaceous, consisting of numerous small chambers in planispiral portion, the uniserial chambers being eccentric in growth.

Holotype: Test minute, evolute, coiled in early portion, later becoming uniserial, coiled portion consisting of seven slightly inflated chambers gradually increasing in size, followed by two rapidly broadening chambers in uncoiled part which are asymmetrical to the coiled portion. Periphery rounded, with central portion of test slightly depressed. Sutures distinct, depressed, giving lobate appearance to coiled portion. Wall finely arenaceous with a few larger quartz grains. Aperture a small opening at base of last-formed chamber.

Paratypes: A: Planispiral portion of test only, consisting of nine chambers which gradually increase in size, the last chamber becoming asymmetrical. Slightly umbilicate in central region. Sutures distinct, depressed. Wall finely

arenaceous consisting of small quartz grains in siliceous cement. Aperture small opening at base of last-formed chamber. B: Planispiral portion followed by uncoiled chambers which appear to be biserial, with aperture in centre of last-formed chamber. The biserial portion illustrates the eccentric growth of the uncoiled chambers.

Dimensions: Holotype—length, 0.30 mm.; diameter of planispiral portion, 0.15 mm. Paratype A—length, 0.25 mm.; diameter of planispiral portion, 0.10 mm. Paratype B—length, 0.33 mm.; diameter of planispiral portion, 0.15 mm.

Occurrence: Holotype (C.P.C. 2482) and paratypes A and B (C.P.C. 2483, 2484) from Callytharra Springs, 180-230 feet above base of type section, Callytharra Formation (locality 70).

Other material: Locality 70, Callytharra Formation; 97, Bulgadoo Shale; 153 (3,115-20 feet), equivalent of Callytharra Formation.

Observations: This minute species of *Ammobaculites* exhibits its eccentric growth immediately the planispiral portion passes into the uncoiled series, and appears to be quite distinct from any described form. Many specimens have been available for study but the majority of them were still in the planispiral stage. *A. eccentrica* shows some resemblance to *A. minuta* Waters, in the smallness of the test and in the numerous chambers in the coiled portion.

Ammobaculites wandageensis sp. nov.

(Plate 14, figures 1-3.)

Diagnosis: Test arenaceous, consisting of four chambers in planispiral portion and three or four in uniserial portion.

Holotype: Test complete, small, very slightly compressed through compaction of sediments, closely coiled in early portion then becoming straight and uniserial. Planispiral portion consisting of four inflated chambers followed by four chambers in uniserial portion, the first of these chambers being narrow but the other three almost rectangular in shape. Sutures depressed, distinct. Wall arenaceous, composed of small quartz grains firmly cemented. Aperture central, small circular opening at top of last-formed chamber.

Paratypes: A: Test incomplete, final uniserial chamber missing, but specimen is uncrushed, showing the typical inflated four chambers in the planispiral portion and the rounded chambers of the uniserial portion. B: Test complete, slightly compressed, with three chambers in uniserial portion, the first one being narrow, the following three almost rectangular in shape.

Dimensions:

—	Length.	Diameter of Coiled Portion.	Diameter of Uniserial Part.
	mm.	mm.	mm.
Holotype	0.70	0.15	0.15
Paratype A	0.30+	0.15	0.10
Paratype B	0.55	0.15	0.10

Occurrence: Holotype (C.P.C. 2485) and paratypes (C.P.C. 2486, 2487), Cundlego Crossing, Minilya River, Wandagee Station, Cundlego Formation (locality 100).

Other material: Locality 79, Coyrie Formation: 86, Bulgadoo Shale; 160 (30-50 ft.), Noonkanbah Formation.

Observations: A. wandageensis differs from *A. inconspicua* Cushman and Waters in the small number of chambers in both the coiled and uncoiled portions of the test. The species is common at the type locality.

AMMOBACULITES WOOLNOUGHI Crespin and Parr.

(Plate 14, figures 10, 11.)

Ammobaculites woolnoughi Crespin and Parr, 1941, p. 304, pl. 12, figs. 2*a*, *b*, 3*a*, *b*; Parr, 1942, p. 108, pl. 1, fig. 11; Crespin, 1945, p. 25, pl. 3, fig. 4; *ibid.*, 1947, p. 22, pl. 1, fig. 4; pl. 2, figs. 16, 17.

Endothyranella woolnoughi, Branson, 1948, p. 14.

"Test crozier-shaped, with the early portion closely coiled and consisting of a single whorl of five or six inflated chambers, in rectilinear series, frequently gradually increasing in size as added; slightly compressed; sutures depressed; wall coarsely arenaceous with a rough surface; aperture terminal and nearly circular."

Dimensions of figured specimens: Hypotype A—length, 1.30 mm.; width, 0.60 mm. Hypotype B—length, 1.75 mm.: width, 0.50 mm.

Occurrence: Hypotype A (C.P.C. 2488), Farley road, 300 yards north-east of Farley Station, Dalwood Group (type locality, locality 20). Hypotype B (C.P.C. 2489), Bore at Stanford Main Colliery No. 2, Coongewai at 769 feet, Cessnock Sandstone (locality 140).

Other material: Locality 1, Cattle Creek Formation; 13, Aldebaran Creek Group. 135 (2335-40 ft.), 18, Dalwood Group; 26, 28, Branxton Subgroup; 36, 37, 41, Mulbring Subgroup; 48, Capertee Group; 49, Wandrawandian Siltstone. 51, Quamby Mudstone. 88, Bulgadoo Shale; 103, Cundlego Formation; 105, Quinnanie Shale; 153 (430-40 ft.) equivalent of Eyro Group.

Observations: Hypotype B represents one of the most excellently preserved specimens of this species. It shows the typical rounded test, the only tests available at the time of the type description being compressed. The uncoiled portion of the test is straight with the height of the chambers being almost uniform. It is probable that the specimen figured from Pokolbin, New South Wales, by Chapman and Howchin (1905, pl. 1, fig. 5) as *Haplophragmium agglutinans* d'Orb., and later referred to *Ammobaculites* sp. by Chapman, Howchin and Parr (1934), is referable to *A. woolnoughi.*

The writer disagrees with Branson's (1948) placing of the form *Ammobaculites woolnoughi* in the genus *Endothyranella.* This latter genus is characterized by its finely arenaceous test with a large amount of siliceous

cement. *A. woolnoughi* is comparatively coarsely arenaceous, the test being composed of angular quartz grains cemented together with little obvious siliceous material.

Genus ENDOTHYRA Phillips, 1846.

? ENDOTHYRA cf. BOWMANI Phillips.

Endothyra bowmani Phillips, Chapman and Howchin 1905, p. 12, pl. 1, figs. 13 a, c.

Endothyra cf. *bowmani,* Chapman, Howchin and Parr, 1934, p. 183 (list).

Observations: No specimens have been available for comment.

? ENDOTHYRA MACELLA (Brady).

Endothyra macella (Brady), Chapman and Howchin, 1905, p. 12; Chapman, Howchin and Parr, 1934, p. 184 (list).

Observations: No specimens have been available for comment.

Family TEXTULARIIDAE.

Subfamily SPIROPLECTAMMININAE.

Genus SPIROPLECTAMMINA Cushman, 1927.

SPIROPLECTAMMINA CARNARVONENSIS sp. nov.

(Plate 22, figures 7-9.)

Diagnosis: Test small, short, arenaceous, consisting of four planispiral chambers then becoming biserial with three or four chambers on either side of median sutural line.

Holotype: Test short, elongate, very slightly compressed, consisting of four chambers in planispiral portion, later becoming biserial in which four chambers are on one side of the median line and three on the other. Chambers slightly inflated, giving the periphery a lobate appearance, last-formed chamber globular. Sides of test almost parallel. Sutures distinct, depressed, those in the biserial portion being almost at right angles to periphery. Wall arenaceous, surface rough, composed of small quartz grains with little visible cement. Aperture an elongate opening at base of margin of last-formed chamber.

Paratypes: A: Test similar to holotype but with last-formed chamber broken. B: Test compressed in biserial portion but the chambers of both planispiral and biserial portions distinctly lobate.

Dimensions: Holotype—length, 0.80 mm.; width, 0.30 mm. Paratype A—length, 0.50 mm.; width, 0.30 mm. Paratype B—0.70 mm.; width, 0.50 mm.

Occurrence: Holotype (C.P.C. 2490) and paratype A (C.P.C. 2491) from Minilya River, ¼ mile upstream from garden outcamp, Wandagee Station, Bulgadoo Shale (locality 92). Paratype B (C.P.C. 2492) from Giralia No. 1 Bore, at 420-440 feet, equivalent of Byro Group (locality 153).

Other material: locality 51, Quamby Mudstone. 79, Coyrie Formation; 89, Bulgadoo Shale; 102, Cundlego Formation.

Observations: Spiroplectammina carnarvonensis closely resembles *S. clavata* Cushman and Waters from the Graham Formation (Pennsylvanian) of Texas, both in size and shape, but it differs in its coarser and slightly wider test. The specimens from Oonah, Tasmania, are larger than the holotype and more compressed, but the characteristic lobate periphery is present. The genus *Spiroplectammina* is rare in the Permian rocks of Australia.

Subfamily TEXTULARIINAE.

Genus TEXTULARIA Defrance, 1824.

TEXTULARIA BOOKERI sp. nov.

(Plate 15, figures 1-7.)

Textularia eximia Crespin and Parr, 1941 (*non* Eichwald, 1860), p. 305, pl. 13, figs. 7*a-c*, 8*a-c*; Crespin, 1947, lists, pl. 2, figs. 23, 24.

Textularia "eximia", Cummings, 1956, p. 213.

Diagnosis: Test very gently curved, coarsely arenaceous, consisting of five to six biserial chambers in the megalospheric form and eight to nine in the microspheric form. Aperture a semicircular opening at base of last-formed chamber.

Holotype: Test megalospheric, elongate, tapering, very gently curved, consisting of six slightly inflated biserial chambers, which gradually increase in width and height. Proloculus consisting of small quartz grains. Test slightly depressed along median sutural line. Periphery lobate. Sutures at right angles to periphery, almost straight, distinct, depressed. Wall arenaceous. Surface rough, composed of moderately coarse quartz grains with numerous flakes of black mica and with little visible cement. Aperture a small semicircular opening at inner margin of last-formed chamber.

Paratypes: A: Test smaller than holotype with proloculus composed of small quartz grains, followed by a biserial series of five chambers. Sides of test gradually expanding in width towards last-formed chamber, which is large and inflated. B: Test slightly deformed, with proloculus formed of small quartz grains, followed by six biserial chambers. C: Test curved and somewhat narrower than holotype. Proloculus broken, followed by seven biserial chambers, gradually increasing in size. D: Test microspheric, consisting of eight biserial chambers, early ones small, others enlarging fairly rapidly. E: Test small with small proloculus and with chambers expanding more rapidly in width than in holotype. Coarsely arenaceous.

Dimensions:

—	Length.	Maximum Width.
	mm.	mm.
Holotype	1.40	0.69
Paratype A	0.90	0.50
Paratype B	1.30	0.60
Paratype C	1.50	0.50
Paratype D	1.80	0.67
Paratype E	1.00	0.30

Occurrence: Holotype (C.P.C. 153) and paratype D (C.P.C. 152) from large railway cutting about 4 chains west of Farley Station, Dalwood Group (locality 19). Paratypes A, B, C, and E (C.P.C. 2493, 2494, 2495, 2496) from Maitland road, south side of Greta, Dalwood Group (locality 21).

Other material: Locality 26, Branxton Subgroup; 34, 41, Mulbring Subgroup; 48, Capertee Group.

Observations: Crespin and Parr (1941) referred this form to *T. eximia* Eichwald. Cummings (1956) considered the genus to be *Textularia* sensu stricto, but doubted the reference to *T. eximia*. *T. bookeri* differs from *T. eximia* in its coarse wall structure and semicircular aperture, although the number of chambers in the megalospheric form is similar to those in *T. eximia*. The persistent coarseness of the test is similar to *T. cornuta* Waters, but the New South Wales species is larger and less depressed than the American one. The variation of shape within the species is shown in the figured specimens.

The species is named after Dr. F. W. Booker, Government Geologist of New South Wales, who has made considerable contributions to the Permian geology of that State.

TEXTULARIA IMPROCERA sp. nov.

(Plate 15, figures 8, 9.)

Diagnosis: Test small, stout, arenaceous, consistng of a small proloculus, followed by four biserial chambers.

Holotype: Test short, stout, ovate, biserial, consisting of a small rounded proloculus, followed by four biserial chambers. Periphery rounded. Sutures distinct, thick. Wall arenaceous, composed of medium-sized angular quartz grains in siliceous cement; surface rough but slightly translucent. Aperture small, rounded opening at base of last-formed chamber.

Paratype: Test slightly depressed with small proloculus, followed by four biserial chambers.

Dimensions: Holotype—length, 0.80 mm.; max. width, 0.40 mm. Paratype —length, 0.90 mm.; max. width, 0.50 mm.

Occurrence: Holotype (C.P.C. 2497) and paratype (C.P.C. 2498), Williambury Station, 4.8 miles south-west of Moogooree Homestead, 405 feet above base of Coyrie Formation (locality 79).

Other material: Localities 79, Coyrie Formation; 117, Baker Formation.

Observations: This small stout species of *Textularia* is different from any described Permian forms. It is very common at the type locality but most tests are distorted.

Family VERNEUILINIDAE.

Genus DIGITINA Crespin and Parr, 1941.

DIGITINA RECURVATA Crespin and Parr.

(Plate 15, figures 10, 11.)

Digitina recurvata Crespin and Parr, 1941, p. 306, pl. 13, figs. 9*a*, *b*; 10*a*, *b*. Crespin, 1947, lists, pl. 2, fig. 23. Cummings, 1956, p. 214.

"Test free, elongate, curved, generally almost circular in cross section, early chambers arranged irregularly in the form of a cone, later chambers biserial; wall coarsely arenaceous, consisting of a single layer; interior of chamber undivided; aperture an arched slit set in a re-entrant angle at base of last-formed chamber."

Dimensions of figured specimens: Hypotype A—length, 1.73 mm.; max. diameter, 0.61 mm. Hypotype B—length, 1.55 mm.; max. diameter, 0.60 mm.

Occurrence: Hypotypes A and B (C.P.C. 2499, 2500) from foot of Victoria Pass, Mitchell Highway, Capertee Group (type locality) (locality 48).

Other material: Localities 17, 19, 22, 23, Dalwood Group; 28, 31, 33, Branxton Subgroup; 27, 38, 39, 41, 44, Mulbring Subgroup; 144 (25-50 feet), 148 (759-771 feet), 149 (4,667-6,019 feet), 152 (4,656-65, 4,750-5 feet), Maitland Group. 48, Quamby Mudstone. 112, Wandagee Formation; 126, Noonkanbah Formation.

Observations: Comments on the generic standing of *Digitina* have been discussed on p. 36. *D. recurvata* is widely distributed in the Australian Permian rocks.

Family OPHTHALMIDIIDAE.

Genus HEMIGORDIUS Schubert, 1908.

HEMIGORDIUS HARLTONI Cushman and Waters.

(Plate 16, figures 1-6; plate 31, figure 6.)

Hemigordius harltoni Cushman and Waters, 1928a, p. 43, pl. 5, figs. 8, 9; *ibid.*, 1930, p. 60, pl. 5, figs. 2, 3.

"Test compressed, circular in outline in side view, with the early stages coiled in varying planes, the later ones becoming planispiral, a proloculum and second chamber consisting of an elongate undivided tube, the middle portion

of test on either side with a secondary growth of material largely concealing the structure; wall calcareous, imperforate, smooth; aperture, a rounded opening formed by the open end of tubular chamber."

Dimensions of figured specimens:

	Diameter of Test.	Diameter of Proloculus.
	mm.	mm.
Hypotype A	0.78	0.07
Hypotype B	0.55	0.37
Hypotype C	0.49	0.11
Hypotype D	0.37	0.10
Hypotype E	0.42	..
Hypotype F	0.35	..
Hypotype G	0.35	..

Occurrence: Hypotypes A and B (C.P.C. 2501, 2502) from Giralia No. 1 Bore, at 620-630 feet (Core No. 9), equivalent of Byro Group. Hypotypes C and D (C.P.C. 2503, 2504) from BMR. Water Bore, Jurgurra Creek, at 162-163 feet, Noonkanbah Formation. Hypotypes E, F, G (C.P.C. 2613, 2614, 2615) from BMR. No. 1 Bore, Jurgurra Creek at 494 feet (Core No. 5), Noonkanbah Formation.

Other material: Locality 91, Bulgadoo Shale; 153 (550-70, 670-80 feet) equivalent of Byro Group; 156 (129 feet), 158 (1,524-50 feet), 159 (440-50 feet), Noonkanbah Formation.

Observations: The specimens of *Hemigordius,* which are common in the Noonkanbah Formation of Western Australia, are referred to *H. harltoni* Cushman and Waters, 1928, from the Pennsylvanian of Texas. The external features of the Western Australian form closely resemble those shown by Cushman and Waters (1928, 1930), and the thin shell wall seen in section is characteristic. However, the coiling of the tubular second chamber in varying directions immediately following the proloculus (Cushman and Waters, 1928, pl. 5, fig. 9) has not been observed in the Western Australian specimens.

Both megalospheric and microspheric specimens are figured in the present work. As noted by Cushman and Waters, the megalospheric tests are thicker in the middle than the microspheric ones. Cushman and Waters give the diameter of full-grown specimens as up to 1.00 mm. The largest one noted amongst the Western Australian tests measured 0.78 mm.

H. harltoni differs from *H. schlumbergi* (Howchin) in its deeply incised spiral suture, and in the thinness of the shell wall. The difference in this structure is shown on Plate 31, figures 4, 5, and 6. *H. harltoni* is apparently restricted to beds stratigraphically higher than those in which *H. schlumbergi* is found. Up to the present it has only been found in the Noonkanbah Formation of the Fitzroy and Canning Basins and in the Bulgadoo Shale, Carnarvon Basin, and its possible equivalent in the Giralia Bore. *H. schlumbergi* has not

been found above the Callytharra Formation of the Carnarvon Basin, the Fossil Cliff Formation in the Irwin Basin, and the Nura Nura Member of the Poole Sandstone in the Fitzroy Basin.

HEMIGORDIUS SCHLUMBERGI (Howchin).

(Plate 16, figures 7-9; plate 21, figures 4, 5.)

Cornuspira schlumbergi Howchin MS., 1893, p. 3336; 1895, p. 195; pl. 10, figs. 1-3.

Hemigordius schlumbergi, Schubert, 1908, p. 381; Cushman, 1928a, p. 16, pl. 53, figs. 5-7; 1950, p. 192, pl. 15, fig. 7; key, pl. 16, figs. 6-7; Crespin, 1947, lists.

"Test discoidal, flat or biconvex, convoluted; consisting of a non-septate tube, slightly increasing in diameter, but with varying dimensions. Initial end of chamber spherical, and of greater diameter than tube. Convolutions, about five in number, more or less asymmetrical, particularly in the earlier growth. Test-walls investing, each successive whorl enclosing all the preceding by alar extensions over the lateral surface of shell. Periphery rounded and somewhat irregular in outline. Septation obscured exteriorly by lamination of shell-walls, except near the orifice, where a sutural depression is visible for about half the length of final convolution. Transverse section of tube round or with slight vertical compression. Aperture formed by open end of tube, more or less constricted at vent."

Dimensions of figured specimens: Diameter—Hypotype A, 0.95 mm.; Hypotype B, 1.00 mm.; Hypotype C, 0.80 mm.; Hypotype D, 0.74 mm.; Hypotype E, 0.94 mm. Maximum diameter of proloculus in Hypotype D, 0.11 mm.

Occurrence: Hypotypes A, B, D, E, (C.P.C. 2505, 2506, 2508, 2509) from Fossil Cliff, Fossil Cliff Formation (type locality), (locality 134). Hypotype C (C.P.C. 2507), section near mouth of Salt Gully, Callytharra Springs area, Callytharra Formation (locality 71).

Other material: Locality 25, Dalwood Group. 53, Golden Valley Group. 67, 68, 70, 73, 74, Callytharra Formation; 124, Nura Nura Member; 133, Nangetty Glacials.

Observations: H. schlumbergi, which is the type species of the genus *Hemigordius,* occurs in a restricted stratigraphical horizon in the Permian in Australia. In Western Australia, it is found in the Nangetty Glacials, Callytharra Formation, Fossil Cliff Formation and Nura Nura Member of Poole Sandstone; in New South Wales it is restricted to the Dalwood Group, Hunter River area, and in Tasmania to the Golden Valley Group.

Hypotype A is a typical specimen of the species, but Hypotype B shows an unusual development of the apertural opening. The weathered test of Hypotype C reveals the complicated internal structure. Hypotypes D and E illustrate the thickness of the shell wall.

Genus ORTHOVERTELLA Cushman and Waters, 1928.

ORTHOVERTELLA PROTEA Cushman and Waters.

(Plate 18, figures 7-9.)

Orthovertella protea Cushman and Waters, 1928a, p. 45, pl. 6, figs. 3, 4; 1930, p. 64, pl. 5, figs. 10-13; Plummer, 1930, p. 20, pl. 1, figs. 4*a, b*.

"Test small, consisting of a close coiled young, the coils in constantly changing planes and later portion becoming uncoiled and nearly straight, consisting of a proloculum and tubular, undivided second chamber of nearly even diameter; wall smooth, calcareous, imperforate; sutures well marked; aperture formed by open end of tubular chamber, not constricted, without tooth."

Dimensions of figured specimens: Hypotype A—length, 0.95 mm.; diameter, 0.60 mm. Hypotype B—length, 1.00 mm.; diameter, 0.50 mm.

Occurrence: Hypotype A (C.P.C. 2509), from Callytharra Springs, 10 feet above base of Callytharra Formation (locality 70). Hypotype B (C.P.C. 2510), from Freney Kimberley Oil Company No. 1 Bore, Nerrima, at 129 feet, Noonkanbah Formation.

Other material: Locality 24, Dalwood Group. 58, Gray Limestone. 153 (3,115-20 ft.) equivalent of Callytharra Formation; 159 (494 ft.), Noonkanbah Formation.

Observations: The figured specimens show the typical irregularly coiled early portion of the tubular second chamber, later becoming straight. Sections were prepared of the form, but because of the coiled character of the second chamber, the proloculus was not observed.

Genus CALCITORNELLA Cushman and Waters, 1928.

CALCITORNELLA ELONGATA Cushman and Waters.

(Plate 17, figures 1-3.)

Calcitornella elongata Cushman and Waters, 1928a, p. 47, pl. 6, fig. 5; 1930, p. 65, pl. 5, figs. 14, 15; pl. 6, fig. 5. Cushman, 1930, p. 81, pl. 11, fig. 7; 1933, p. 160, pl. 15, fig. 13.

"Test elongate, attached, consisting of a close coiled early portion and an elongate later growth, tubular chamber bending back and forth on itself along a nearly straight axis, attached side conforming to the surface to which it is attached, outer surface convex and the structure obscured; sutures very distinct on attached side; wall calcareous, imperforate, more or less roughened and irregular on the outer surface; aperture formed by open end of tubular chamber."

Dimensions of figured specimens: Length of hypotype A, 1.80 mm.; length of hypotype B, 1.20 mm.

Occurrence: Hypotypes A and B (C.P.C. 2511, 2512) from Fossil Cliff, Fossil Cliff Formation (locality 134).

Other material: Locality 153 (3,115-20 ft.), equivalent of Callytharra Formation.

Observations: Although the attached surface has not been available for observation, the external characters of the figured specimens compare closely with those shown by Cushman and Waters (1930, plate 6, figure 1). A well preserved apertural opening is present in hypotype B. The species was described from the Graham Formation, Pennsylvanian, of Texas.

CALCITORNELLA HEATHI Cushman and Waters.

(Plate 13, figures 8-11; plate 19, figure 11.)

Calcitornella heathi Cushman and Waters, 1928a, p. 48, pl. 6, figs. 8*a*, *b*; 1928c, p. 371, pl. 49, figs. 7-9; 1930, p. 65, pl. 6, figs. 2, 3.

"Test attached, compressed and scalelike, ventral side conforming to surface to which attached, dorsal side irregular and earlier coils obscured; consisting of a proloculum and elongate tubular second chamber, early portion definitely spiral, later ones bending back and forth about the periphery of the earlier ones, often partially involute; sutures distinct on ventral side; wall calcareous, imperforate, exterior roughened; aperture formed by open end of tubular chamber."

Dimensions of figured specimens: Diameter of hypotype A, 0.50 mm.; hypotype B, 0.75 mm.; hypotype C, 1.00 mm.; hypotype D, 0.80 mm.

Occurrence: Hypotypes A and B (C.P.C. 2513, 2514) from Callytharra Springs, 20 feet above base of Callytharra Formation (locality 70). Hypotypes C and D (C.P.C. 2515, 2516) from B.M.R. No. 1 Bore, Jurgurra Creek at 494 feet, Noonkanbah Formation.

Other material: Locality 153 (3,115-20 ft.), equivalent of Callytharra Formation.

Observations: This scale-like species of *Calcitornella* has the characteristic structure of *C. heathi* Cushman and Waters from the Graham Formation, Pennsylvanian, of Texas. The species is common in samples from the Noonkanbah Formation in BMR. No. 1 Bore, Jurgurra Creek. An attached portion of a test with *Calcitornella stephensi* is also figured (C.P.C. 2612).

CALCITORNELLA STEPHENSI (Howchin).

(Plate 17, figures 4-8; plate 32, figures 1, 2, 4, 9.)

Cornuspira sp. Jones, 1882, p. 6.

Nubecularia lucifuga Defrance var. *stephensi* Howchin, 1894 (1893), p. 245, pls. 9*a*, 10*a*.

Nubecularia stephensi, Chapman and Howchin, 1905, p. 5, pl. 1, figs. 1, 2; pl. 3, figs. 3, 4; pl. 5, figs. 1, 4.

Placopsilina tenuitesta, Chapman and Howchin, 1905, p. 8, pl. 3, fig. 9.

Nubecularia stephensi, Etheridge, 1907, p. 13, pl. 12, fig. 11.

Calcitornella stephensi, Chapman, Howchin and Parr, 1934, p. 187; Parr, 1942 (*non* Howchin, 1894), p. 108; Crespin, 1945, p. 25, pl. 3, fig. 3; 1947, pl. 1, fig. 3, lists; 1950, p. 68.

Ammovertella stephensi, Branson, 1948, p. 6.

"Initial chamber, globular. Subsequent chambers, elongated and slightly inflated. Chambers arranged, either on a spiralline plan, in rectilinear order, or in irregular acervuline masses. Walls of the test, thin, uniform in thickness, and sharply defined in outline. Septal divisions marked on exterior surface by sunken lines."

Dimensions of figured specimens: Length of hypotype A, 1.12 mm.; diameter, 0.60 mm. Max. diameter, hypotype B, 0.90 mm.; hypotype C, 1.00 mm.; hypotype D, 0.31 mm.; hypotype E, 0.84 mm.; hypotype F, 1.04 mm.; hypotype G, 1.17 mm.

Occurrences: Hypotype A (C.P.C. 2517) from Fossil Cliff, Fossil Cliff Formation (locality 134). Hypotypes B, C, G (C.P.C. 2518, 2519, 2891), from Callytharra Springs, 10-22 feet above base of Callytharra Formation (locality 70). Hypotype D (U.W.A. 27687), Middalya Station, half-way between K.55 Trig. and Mongie Well, 1 mile east-north-east of K.55, Callytharra Formation (locality 75). Hypotype E (U.Tas. 50203), hill immediately east of main road between Karoola and Bangor, just north of road bridge over Piper River, 5½ miles from Karoola, Darlington Limestone (locality 55). Hypotype F (C.P.C. 2890), from Pokolbin, Dalwood Group (locality 16).

Other material: Locality 1, Cattle Creek Formation; 14, Aldebaran Creek Group. 16, 17, 22, 24, 25, Dalwood Group. 54, Golden Valley Group; 56, 57, Darlington Limestone. 63, 64, Lyons Group; 67, 68, 69, 71, 73, 74, 76, 77, 78, Callytharra Formation; 125, Nura Nura Member; 156 (59, 89, 129 feet), Noonkanbah Formation; 161 (1860 feet). 163 (544, 574 feet), Port Keats Group.

Observations: Chapman and Howchin (1905), when they recognized the varietal form of Howchin (1894) as a distinct species, added a further description of the species "that the shell had a fairly thin uniform character of shell wall and a tendency in shorter individuals to increase on a milioline plan". This wall is also imperforate and calcareous.

Calcitornella stephensi differs from *C. heathi* in its broader and more rounded tubular second chamber and in its more meandering habits. The

test is found attached to shell fragments, entwined on fronds of bryozoa and around productid spines. It is whitish, and the walls of the attached surface are distinctly defined. Its occurrence in the Wandagee beds of the Carnarvon Basin recorded by Parr (1942) is incorrect; Parr informed the writer that he had made an error in diagnosis, and also corrected this error in his unpublished manuscript, suggesting that the species to which he referred was possibly an *Ammovertella.*

Branson (1948) places *Calcitornella stephensi* in the genus *Ammovertella.* All available references to this genus indicate that the wall is arenaceous. Parr, in his unfinished manuscript, insists that the wall of *Calcitornella* is calcareous with the surface at times granulate. I agree with this view after examining many tests of the form, which is extremely common in beds of the Callytharra Formation and Fossil Cliff Formation of Western Australia, the Dalwood Group of New South Wales, and Darlington Limestone of Tasmania.

Genus CALCIVERTELLA Cushman and Waters, 1928.

CALCIVERTELLA PALATA sp. nov.

(Plate 18, figure 6.)

Diagnosis: Test attached, calcareous, imperforate, with tubular second chamber winding back and forth in a zigzag manner, later becoming straight.

Holotype: Test attached, consisting of a minute proloculus, followed by a tubular second chamber which is closely coiled in early portion and later more loosely coiled and winding back and forth in a zigzag manner, finally becoming straight. Tubular second chamber very gradually increasing in diameter. Wall smooth, calcareous, imperforate, white. Aperture broken but apparently at end of open tube.

Dimensions: Length of holotype, 0.70 mm.; diameter of tubular chamber in straight portion, 0.16 mm.

Occurrence: Holotype (C.P.C. 2520) from Freney Kimberley Oil Company Nerrima No. 1 Bore, at 129 feet, Noonkanbah Formation. Also at 59 feet.

Observations: C. palata closely resembles *Calcivertella adherens* Cushman and Waters, but differs from it in the more closely coiled early portion of the tubular chamber, the greater length between bends, and the more gradual increase in width of the chamber. Several fragments of this form are present in the Nerrima Bore at 129 feet.

Genus PLUMMERINELLA Cushman and Waters, 1928.

PLUMMERINELLA KIMBERLEYENSIS sp. nov.

(Plate 19, figures 9, 10.)

Diagnosis: Test attached, the attached surface showing a complex structure in which tubular second chamber is incompletely divided by small projections from outer portion of previous whorl.

Holotype: Test attached, flattened, consisting of a proloculus followed by a tubular second chamber, in which early portion is planispiral, closely coiled, later becoming more loosely coiled and spreading out over surface of attachment. Early planispiral stage followed by three more or less regular coils. Structure of later part of chamber very complex: incompletely divided by small projections from outer portion of previous whorl, but few extend completely across whorl. Sutures clear on attached surface. Shell wall becomes thicker in adult stage. Wall roughened on dorsal side, calcareous, imperforate. Aperture an opening at end of the chamber.

Paratype: The attached surface shows wall of tubular second chamber thickening rapidly in last three whorls.

Dimensions: Diameter of holotype, 0.60 mm.; diameter of paratype, 0.90 mm.

Occurrence: Holotype (C.P.C. 2521) and paratype (C.P.C. 2604) from BMR. No. 1 Bore, Jurgurra Creek, at 494 feet, Noonkanbah Formation.

Observations: The complexity of the structure of the genus *Plummerinella,* stressed by Cushman and Waters (1928), is apparent in this new species *P. kimberleyensis.* The species differs from *P. complexa* Cushman and Waters, the type species, in the more regular arrangement of the convolutions, with the last-formed portion remaining compact rather than spreading out on the attached surface in that species. The volutions, as well as bending back and forth, coil upon themselves, giving the appearance of a complex structure. Cushman and Waters, in the figure of *P. complexa* (1928a, pl. 6, fig. 6), show incomplete projections in several chambers resembling those observed in *P. kimberleyensis,* but no mention is made of them in the description. As stated by Cushman and Waters, this genus can be easily overlooked from the outer surface, which gives no indication of the complex structure seen on the attached surface.

Genus Apterinella Cushman and Waters, 1928.

Apterinella sp.

Observations: Several tests of this genus were observed in the beds of the Callytharra Formation, but none was suitable for illustration. The species *Apterinella* cf. *grahamensis* recorded by Crespin (1947) is now regarded as *Apterinella* sp.

Genus Trepeilopsis Cushman and Waters, 1928.

Trepeilopsis australiensis sp. nov.

(Plate 18, figures 1-4; plate 22, figures 3, 5-8.)

Trepeilopsis grandis, Chapman (*non* Cushman) in Raggatt, 1936, p. 126; Crespin, 1947, lists.

Diagnosis: Undivided tubular chamber which coils itself in a close helical spiral around a productid spine.

Holotype: Test elongate, consisting of a long, undivided tubular chamber in a tight helical spiral around a productid spine. Proloculus not observed. Test almost completely covered with thin white shell deposit of calcium carbonate. This material is partly worn away, thus showing portion of the tubular chamber, which appears as amorphous calcite replaced by crystalline silica. Tubular chamber, which follows a small proloculus, narrow and closely coiled backwards and forwards in early portion, but later gradually extending in width, with more open coils, which are almost at right angles to direction of productid spine. Wall calcareous, imperforate, shell deposits where present having a roughened surface. Aperture not visible.

Paratypes: A: Shell deposit removed to show structure of test. Proloculus broken but long tubular second chamber clearly seen closely coiled around productid spine. Early portion rather narrow but increasing gradually in width. After at least nine volutions at right angles to the spine, tubular chamber bends back and is attached to one side of the test for its full length. Shell material present between coils. B: The long tubular second chamber encrusts a productid spine, gradually increasing in width and becoming very broad over last two volutions, then bending back over length of test. C: Test shorter than holotype and possibly a youthful specimen: the tubular chamber has not yet bent back down the length of the test. Aperture a large semi-circular opening at end of tube. D, E, F, G, and H are sections showing the characteristic method of coiling.

Dimensions: Holotype: length, 1.31 mm.; max. width, 0.42 mm. Paratype A—length, 0.90 mm.; max. width, 0.40 mm. Paratype B—length, 1.60 mm.; max. width, 0.55 mm. Paratype C—length, 0.59 mm.; width at initial end, 0.14 mm.; width at apertural end, 0.37 mm. Paratype D—length, 0.48 mm. Paratype E—length, 0.56 mm. Paratype F—length, 0.39 mm. Paratype G—length 0.32 mm. Paratype H—length, 0.92 mm.

Occurrence: Holotype (C.P.C. 2606) and paratypes A, D, E, and H (C.P.C. 2607, 2892, 2893, 2894) from Callytharra Springs, 22-41 feet above base of Callytharra Formation (locality 70). Paratype B (C.P.C. 2608), section near mouth of Salt Gully, Callytharra Springs, Callytharra Formation (locality 71). Paratype C (C.P.C. 2609), Fossil Cliff, Fossil Cliff Formation. Paratypes F and G (U.W.A. 38423), Middalya Station, half-way between K.55 Trig and Mongie Well, 1 mile east-north-east of K.55, Callytharra Formation.

Other material: Locality 25, Dalwood Group. 58, Gray Limestone. 67, 74, 77, 78, Callytharra Formation.

Observations: This species has been previously referred to by Chapman and myself as *Trepeilopsis grandis* Cushman and Waters from the Pennsylvanian of Texas. Numerous specimens have been available for study at the type locality of *T. australiensis* and there is little doubt that the two species are distinct. In all specimens which encrust productid spines, the tubular second chamber is very closely coiled and is narrow in the early portion, becoming broader towards the end of the volutions. The coils are at right angles to the direction of the

spine, whereas the tubular chamber in *T. grandis* coils at quite a sharp angle. *T. australiensis* shows some resemblance to *T. mississippiana* Cooper from the Mississippian of Illinois, but that species has few volutions. Cushman and Waters considered the genus *Trepeilopsis* to have an arenaceous test, but all the Australian specimens are calcareous imperforate. This view is supported in a personal communication from the late Mrs. Plummer.

Genus FLECTOSPIRA Crespin and Belford, 1957.

FLECTOSPIRA PRIMA Crespin and Belford.

(Plate 20, figures 14-17.)

Flectospira prima Crespin and Belford, 1957, p. 76, pl. 12, figs. 11-19.

" Test free, small, planispiral, compressed, evolute, each whorl of undivided tubular second chamber slightly overlapping preceding one, and with each whorl gradually increasing in width with growth. Periphery rounded. Spiral sutures distinct, depressed. Wall of test deeply incised at each loop of tubular chamber, giving the periphery, in edge view, a lobate appearance. Wall calcareous, imperforate. Aperture large, rounded and open, at end of tube."

Dimensions: Holotype—diameter 0.33 mm.; thickness of periphery, 0.09 mm.; diameter of proloculus, 0.046 mm. Paratype A—diameter, 0.31 mm.; thickness of periphery, 0.11 mm.

Occurrence: Holotype (C.P.C. 2275) and paratype A (C.P.C. 2276), Giralia No. 1 Bore, at 560-570 feet, equivalent of Byro Group. Other material: locality 129, 157 (45 feet), 158 (1,525-2,120 feet), Noonkanbah Formation.

Observations: The holotype and paratype A of this interesting new form are figured here. The species is well represented in the Myroodah Bore section.

Genus STREBLOSPIRA Crespin and Belford, 1957.

STREBLOSPIRA AUSTRALAE Crespin and Belford.

(Plate 20, figures 10-13; plate 22, figure 1.)

Streblospira australae Crespin and Belford, 1957, p. 75, pl. 12, figs. 10-13.

" Test free, minute, involute, globular, only last whorl of undivided tubular second chamber visible, greatest width at margin of last formed whorl. Very slightly depressed in axial region. Periphery broadly rounded. Wall thin, calcareous, imperforate, specimens usually infilled with matrix. Outer wall is eroded away, clearly revealing the characteristic structure of the test. Aperture not observed."

Dimensions: Holotype—max. diameter, 0.33 mm.; max. thickness, 0.31 mm. Paratype—max. diameter, 0.31 mm.; max. thickness, 0.27 mm.

Occurrence: Holotype (C.P.C. 2268) and paratype (C.P.C. 2269) from Giralia No. 1 Bore, at 3,115-3,120 feet (Core No. 66) equivalent of Callytharra

Formation. Hypotype A (Univ. W. Aust. No. 37687), Middalya Station, halfway between K.55 Trig. and Mongie Well, 1 mile east-north-east of K.55, Callytharra Formation.

Observations: *S. australae* is distinguished from *S. meandrina* and *S. kimberleyensis* by its minute globular test and its very rapid change in plane of coiling. It occurs abundantly in Giralia No. 1 Bore at the depths of 3,115-3,120 feet and at 3,220-3,240 feet and in a limestone from Middalya Station. The only record of the species in eastern Australia is in a sample collected by the late Dr. G. D. Osborne from a locality in the Dalwood Group in the Hunter River area, New South Wales. The rock specimen was labelled "OS. 264, *Fenestella, Spirifera* Shales".

STREBLOSPIRA KIMBERLEYENSIS Crespin and Belford.

(Plate 20, figures 6-9.)

Streblospira kimberleyensis Crespin and Belford, 1957, p. 75, pl. 11, figs. 13-21.

"Test free, minute, not fully involute, asymmetrical, compressed, slightly depressed in axial region, early whorls of undivided tubular second chamber visible. Periphery broadly rounded, lobate on edge view, where zigzag coiling is also visible. Whorls strongly overlapping but all visible. Wall calcareous, imperforate, white. Aperture not seen."

Dimensions: Holotype—max. diameter, 0.37 mm.; min. diameter, 0.32 mm.; thickness, 0.15 mm. Paratype A—max. diameter, 0.40 mm.; min. diameter, 0.35 mm.; thickness, 0.17 mm.

Occurrence: Holotype (C.P.C. 2296) and Paratype A (C.P.C. 2297), in Freney Kimberley Oil Company Nerrima No. 1 Bore, at 129 feet, Noonkanbah Formation. Other material; locality 157 (470, 480, and 490 feet) and 158 (2,140-2,145 feet and 2,245-2,250 feet), Noonkanbah Formation.

Observations: The aperture is not shown in the two figured specimens, but in Paratype B, illustrated in Crespin and Belford (1957), it is shown as a simple rounded aperture at the end of the tube.

STREBLOSPIRA MEANDRINA Crespin and Belford.

(Plate 20, figures 1-5.)

Streblospira meandrina Crespin and Belford, 1957, p. 74, pl. 11, figs. 1-12.

"Test free, minute, involute, asymmetrical, slightly flattened with a distinct axial depression, and consisting of an undivided tubular second chamber. Periphery broadly rounded. Only the last whorl visible, showing the characteristic zigzag structure of the test. Wall thin, calcareous, imperforate, white. Test infilled with matrix, with wall partially eroded away. Aperture not observed."

Dimensions: Holotype—max diameter, 0.30 mm.; min. diameter, 0.27 mm.; thickness, 0.19 mm. Paratype—max. diameter, 0.33 mm.; min. diameter, 0.30 mm.; thickness, 0.20 mm.

Occurrence: Holotype (C.P.C. 2289) and paratype (C.P.C. 2290), Freney Kimberley Oil Company Nerrima No. 1 Bore, at 129 feet, Noonkanbah Formation. Other material; locality 101, Cundlego Formation; 157 (490 feet), 158 (2,140-5 feet), 159 (440-494 feet), Noonkanbah Formation.

Observations: The intricate internal structure of the test of this species is seen in all available specimens, but the angular change in the plane of coiling varies somewhat. The species is especially common in a core at 129 feet in the Freney Kimberley Oil Company Nerrima No. 1 Bore.

Family TROCHAMMINIDAE.

Subfamily TROCHAMMININAE.

Genus TROCHAMMINA Parker and Jones, 1859.

TROCHAMMINA LAEVIS sp. nov.

(Plate 21, figures 1-4.)

Diagnosis: Smooth test in which chambers increase rapidly in size, especially in last whorl.

Holotype: Test smooth, trochoid, compressed, partially through compaction of sediments, consisting of three whorls on dorsal side, initial whorl consisting of minute chambers which increase gradually in size in second whorl, then rapidly in final whorl, in which seven large chambers are present. Six chambers on ventral side, some slightly inflated and others crushed. Distinct umbilical depression present. Periphery rounded. Sutures distinct, straight. Wall finely arenaceous, smooth, polished, composed almost entirely of siliceous cement. Aperture at base of last-formed chamber on margin of ventral side.

Paratype: Test irregular in outline and compressed, with the chambers of the last whorl unusually large.

Dimensions: Diameter of holotype, 0.90 mm.; paratype, 1.00 mm.

Occurrence: Holotype (C.P.C. 2522) and paratype (C.P.C. 2523) from section through Mt. Hope, 24 miles south-east of Springsure, Aldebaran Creek Group.

Observations: Trochammina laevis resembles *T. subobtusa* Parr in its finely arenaceous test, but differs from it in having six chambers in the last-formed whorl, only four being present in *T. subobtusa.* It differs from *T. arenosa* Cushman and Waters in its smooth test and in the more numerous chambers in a whorl. Many crushed specimens are present at the type locality.

TROCHAMMINA POKOLBINENSIS new name.

(Plate 22, figures 5-6.)

Truncatulina haidingeri Chapman and Howchin, 1905 (*non Rotalina haidingeri* d'Orb., 1846), p. 18, pl. 3, figs. 3*a-c*;

Ammodiscus planoconvexus Chapman, Howchin and Parr, 1934, p. 186; Crespin, 1947, lists; Branson, 1948, p. 4.

" Test planoconvex, periphery sub-acute; proloculum large, tubular chamber increasing rather quickly in diameter, forming two to two and a half coils, obliquely flattened in section and on the convex side of the test overlapping the earlier coils; suture on flat side depressed; wall comparatively thick, composed of small sand grains, firmly cemented, surface not smoothly finished; aperture oblique, formed by end of the tubular chamber."

Amended description: Test planoconvex, flat on dorsal surface, convex on ventral side, which is somewhat distorted. Initial portion on dorsal side indefinite, last whorl consisting of nine chambers. Sutures indistinct. Chambers on ventral side indistinct. Periphery acute. Wall arenaceous, with quartz grains in siliceous cement. Aperture, an opening at base of last chamber, on margin of periphery.

Dimensions of hypotype: Diameter, 0.56 mm.; thickness, 0.16 mm.

Occurrence: Hypotype (C.P.C. 2524) from Pokolbin (type locality), Dalwood Group.

Observations: Chapman, Howchin and Parr (1934) in their revision of the Permian Foraminifera of New South Wales (Chapman and Howchin, 1905) renamed the form *Truncatulina haidingeri* (d'Orb.) *Ammodiscus planoconvexus* sp. nov., giving a description of the species. They commented, however, on the close affinities of this form with the genus *Trochammina*. With the discovery of another test in the Parr Collection at the Bureau of Mineral Resources, there seems little doubt that it belongs to the genus *Trochammina* rather than *Ammodiscus*. Consequently an amended description, based on the second specimen, is given above.

The determination of the form as a *Trochammina* has necessitated a new name for the species as *T. planoconvexa* is pre-occupied. The name *Trochammina pokolbinensis* is here proposed.

TROCHAMMINA PULVILLA Crespin and Parr.

(Plate 22, figures 1-4.)

Trochammina pulvillus Crespin and Parr, 1941, p. 308, pl. 12, figs. 6*a-c*. Crespin, 1947, lists; *in* Reynolds, 1956, lists.

" Test small, trochoid, almost circular in outline, the under surface umbilicate, spire low, consisting of about three whorls, the last consisting of six slightly inflated chambers and forming the greater part of the test, sutures straight or a little curved, distinct and depressed; wall arenaceous, moderately thick, with

the surface slightly rough; aperture narrow, curved at the base of the last-formed chamber and opening into the umbilical depression."

Dimensions: Diameter of hypotype A, 0.60 mm.; height, 0.22 mm. Diameter of hypotype B, 0.50 mm.; height, 0.21 mm.

Occurrence: Hypotype A (C.P.C. 2525) from foot of Victoria Pass, Mitchell Highway, Capertee Group (type locality). Hypotype B (C.P.C. 2526), John Brown's Reservoir section, Mulbring-Buchanan Road, Richmond Vale, by eastern spillway, Mulbring Subgroup. Other material: Localities 28, Branxton Subgroup; 40, Mulbring Subgroup; 141 (20-26 feet), 142 (74 feet), 143 (0-37 feet), 144 (26-50 feet), Maitland Group.

Observations: Hypotype A, from the type locality, is very similar to the holotype. Hypotype B shows the minute chambers in the initial coil and the well-shaped chambers in the second whorl.

Trochammina subobtusa Parr.

(Plate 21, figures 5-6.)

Trochammina subobtusa Parr, 1942, p. 109, pl. 1, figs. 14*a-c*; Crespin, 1947, lists.

"Test subglobose, trochoid, spire low, under side umbilicate, composed of three whorls; chambers strongly inflated, with four in the last-formed whorl, the chambers of which are so much larger than those in the preceding whorl that they form the greater part of the test; sutures distinct and depressed; wall finely arenaceous, with the surface smoothly finished but not polished; aperture an arched slit at the base of the last-formed chamber, opening into the umbilical depression."

Dimensions: Diameter of hypotype, 0.41 mm.

Occurrence: Hypotype (C.P.C. 2527), Cundlego Crossing, Minilya River, Wandagee Station, Cundlego Formation. Other material: Locality 82, Madeline Formation; 92, Bulgadoo Shale; 105, Quinnanie Shale; 113, Wandagee Formation; 127, Noonkanbah Formation.

Observations: All tests available in the Bureau Collection are crushed. However, the figured specimen shows most of the characteristics of the species.

Subfamily Tetrataxinae.

Genus Globivalvulina Schubert, 1920.

Globivalvulina bulloides (Brady).

Valvulina bulloides Brady, 1876, p. 89, pl. 4, figs. 12-15; Chapman and Howchin, 1905, p. 13, pl. 1, figs. 9*a-c*.

Globivalvulina bulloides, Chapman, Howchin and Parr, 1934, p. 188; Crespin, 1947, lists.

Observations: No comments can be given on this species as no specimens have been available for examination.

Genus TETRATAXIS Ehrenberg, 1843.

TETRATAXIS CONICA Ehrenberg.

(Plate 23, figures 1-5; plate 31, figure 3.)

Tetrataxis conica Ehrenberg, 1843, p. 106; 1854, p. 24, pl. 37, fig. 12. Möller, 1879, p. 71, pl. 2, figs. 3*a-g*; pl. 7, figs. 1, 2, text fig. 30. Cushman, 1927, p. 42, pl. 6, fig. 3. Cushman and Waters 1930, p. 75, pl. 7, figs. 2*a*, *b*, 4, 5*a*, *b*. Chapman (in Raggatt), 1936, p. 126. Crespin, 1947, lists.

"Shell, more or less conical, flat or a little concave on bottom side. Aperture divided into 4 or, in exceptional cases, 3 or 5 parts. Top of shell more or less pointed, sometimes a little rounded or shifted to one side. Vertex angle varies between 70°-85°. Chambers very flat, trapezoidal, more or less distinctly spirally arranged and not divided into cells. Every whorl has 4, or rarely 3, such chambers, which on the bottom part of shell are separated by more or less distinct, arched, radial furrows. On top part, the separations between those chambers are less distinct, a direct connection between chambers missing. Only connections, if they are so, are made through pores in the chamber wall. All chambers provided with septal openings towards central cavity, occupying about a quarter or less of entire interior of shell. Septal openings about 0.045 mm. high and 0.075 mm. wide. Chamber walls not of same thickness throughout, outside wall not more than 0.037 mm. thick, inside wall (or bottom walls) of each round of chambers are 0.1 mm. thick. Pores of last group, 0.012-0.018 mm. Besides radial furrows of chambers previously mentioned, the indentations between each round of chambers and the oblique grooves of outer chamber walls, the surface shows more or less distinct radial striae. Measurements of shell vary according to age of individuals."

Dimensions of figured specimens: Hypotype A—height, 0.49 mm.; width at base, 0.44 mm.; angle of cone, 68° app. Hypotype B—height, 0.56 mm.; width at base of test, 0.77 mm.; angle of cone, 73° app. Hypotype C—height, 0.39 mm.

Occurrence: Hypotypes A (C.P.C. 2528) and C (C.P.C. 2895) from Giralia No. 1 Bore, at 3,115-3,120 feet (Core No. 66), equivalent of Callytharra Formation. Hypotype B (C.P.C. 2529), Wyndham Gap, Bidgemia Station, Callytharra Formation, locality 67. Other material: localities 68, 70, Callytharra Formation.

Observations: The description of the species quoted above is a translation of that given by Möller (1879). Ehrenberg (1843) did not give a type description and his figure is very poor. On the other hand, Möller's description is detailed and his illustrations superb. Several specimens of *Tetrataxis conica* were found in Core No. 66 from the Giralia No. 1 Bore and they show the variation in size and shape mentioned by Möller. The species has also been found in China and Japan (Schwager, 1883).

TETRATAXIS sp.

Observations: Two specimens of this genus were discovered in a core from Dampier Downs Bore No. 1, Fitzroy Basin. The wall of the tests is thin and fragile, the periphery is sharp and the central portion is gently conical. At present this form cannot be definitely referred to any described species. The beds in which the tests were found are referable to the Grant Formation.

Genus RUDITAXIS Schubert, 1920.

RUDITAXIS sp. cf. RHAETICA (Chapman).

Lituola cf. *rhaetica* Chapman and Howchin, 1905, p. 9, pl. 1, fig. 7; pl. 3, fig. 7.
Ruditaxis sp. cf. *rhaetica* Chapman, Howchin and Parr, 1934, p. 188.

Observations: No comments can be given on this species as no specimens have been available for examination.

Family PLACOPSILINIDAE.

Subfamily PLACOPSILININAE.

Genus PLACOPSILINA d'Orbigny, 1850.

PLACOPSILINA WOORAMELENSIS sp. nov.

(Plate 19, figures 4-6.)

Diagnosis: Finely arenaceous encrusting form consisting of approximately five visible chambers of varying shapes and arranged in a linear series.

Holotype: Test originally attached. Unattached surface with chambers coiled in early portion then followed by five visible chambers arranged in a linear series and vaying in shape with some almost circular and others subrectangular. Chambers indefinite on attached surface which appears hollow after becoming detached from object on which it was encrusted. Wall composed of fine quartz grains closely cemented together; surface comparatively rough. Aperture not visible.

Paratype: Test attached, consisting of several indefinite chambers, which encircle a fragment of bryozoa. Surface rough; wall finely arenaceous.

Dimensions: Length of holotype, 0.90 mm. Length of paratype, 0.80 + mm.

Occurrence: Holotype (C.P.C. 2530) and paratype (C.P.S. 2616), Callytharra Springs, 22-25 feet above base of type section for Callytharra Formation (locality 70).

Observations: Numerous incomplete specimens of *Placopsilina wooramelensis* are present in the bryozoal limestone at the type section for the Callytharra Formation and all are attached to fragments of bryozoa. It has not

been possible to observe the aperture or the coiled initial stage. The species shows little resemblance to *P. ciscoensis* Cushman and Waters from the Graham Formation (Pennsylvanian) of Texas. The majority of chambers in that form are hemispherical and more loosely arranged than in the Western Australian form. The specific name was suggested by Parr in his unfinished manuscript on the foraminifera from Callytharra Springs.

Subfamily POLYPHRAGMINAE.

Genus STACHEIA Brady, 1876.

STACHEIA DICKINSI sp. nov.

(Plate 19, figures 1-3.)

Diagnosis: Adherent, coiling, attached to productid spines; wall generally covered with outer calcareous, imperforate layer, white.

Holotype: Test adherent, elongate, embracing productid spine, early chambers arranged in almost a helical spiral, later becoming irregularly coiled around spine. Wall arenaceous, the outer imperforate layer almost completely worn away, showing coiling character of chambers. Aperture not observed.

Paratypes: A, B: Test covered with secondary growth of imperforate material but irregular coiling around productid spine visible.

Dimensions:

—	Length.	Maximum Width.
	mm.	mm.
Holotype	1.00	0.30
Paratype A	1.60	0.50
Paratype B	1.10	0.20

Occurrence: Holotype (C.P.C. 2531) from Giralia No. 1 Bore, at 3,115-3,120 feet (Core No. 66), equivalent of Callytharra Formation. Paratypes A and B (C.P.C. 2532, 2533) from Fossil Cliff section, Fossil Cliff Formation (locality 134).

Observations: Fragmentary specimens of this species are also found in the beds of the Callytharra Formation, Carnarvon Basin. The form described by Chapman and Howchin as *Stacheia simulans* (1905, p. 11, pl. 2, fig. 4) is not a foraminifer (Chapman, Howchin and Parr, 1934, p. 183).

The species is named after Mr. J. M. Dickins of the Bureau of Mineral Resources, who has made contributions to the Permian stratigraphy and palaeontology of Western Australia.

Family LAGENIDAE.

Genus LENTICULINA Montfort, 1804.

Subgenus ASTACOLUS Montfort, 1808.

LENTICULINA (ASTACOLUS) INITIALIS sp. nov.

(Plate 24, figures 1-3.)

Diagnosis: Small, compressed, with initial portion involute, adult chambers becoming evolute, periphery rounded and wall smooth and polished.

Holotype: Test free, small, planispiral, initial portion involute, adult chambers becoming evolute but extending back to early coils. Periphery rounded. Initial portion indistinct, but eight chambers in last whorl, gradually increasing in size. Sutures distinct, gradually thickening with growth of test, gently curved in early portion but later ones becoming strongly bent, the thickened portion suggesting position of previous aperture. Wall smooth, polished, calcareous, finely perforate. Aperture radiate on curved face of last chamber.

Paratypes: A: Test more elongate than holotype with eleven chambers in last whorl. Shape of chambers gradually becomes more elongate, giving a long face to apertural chamber. Suture in last chamber less bent than in holotype but slightly thickened. Aperture radiate and slightly protruding at top end of apertural face. B: Test completely evolute, only seven chambers visible, the apertural chamber larger, giving test an ovate appearance. Sutures distinct and irregular. Aperture radiate on rounded face of last chamber.

Dimensions:

—	Length.	Maximum Width.	Thickness.
	mm.	mm.	mm.
Holotype	0.50	0.36	0.14
Paratype A	0.54	0.31	0.11
Paratype B	0.42	0.32	0.16

Occurrence: Holotype (U.Q. 22766) and paratypes (U.Q. 22767, 22768), most north-easterly outcrop of Mantuan *Productus* Bed, Reid's Dome Structure, 2.3 miles south-south-west of Springwood, 32 miles south-east of Springsure.

Observations: Many specimens of this form have been available for study, exhibiting considerable variation in shape, which seems to be a feature of the subgenus. Some of this variation is shown in the figured specimens.

Lenticulina (Astacolus) initialis is apparently a primitive form of the genus in that it does not show any indication of the apertural chamberlets which are characteristic of later species of the genus. The apertural radiae seem to be formed directly in the chamber wall. This Permian species shows some resemblance to *A. aphrostus* of Loeblich and Tappan (1950) from the Jurassic of South Dakota, which also varies widely in the shape of the test. There seems little doubt that this form, from the Permian of Queensland,

belongs to the subgenus *Astacolus* which, according to Glaessner (1945) and Bartenstein (1948), is the name given to tests which become evolute in the adult stage and have an aperture of the *Lenticulina* type. The earliest record of this subgenus has previously been from the Triassic.

LENTICULINA sp.

Observations: One small test of the genus *Lenticulina* was discovered at a locality on Elephant Pass, Tasmania, about $5\frac{1}{2}$ miles south-east of St. Mary's, 213 feet above the base of the Permian section, and about the base of the Gray Limestone. This occurrence of the genus is the earliest recorded.

Genus DENTALINA d'Orbigny, 1826.

DENTALINA BRADYI Spandel.

Dentalina bradyi Spandel, 1901, p. 16, text-fig. 9.

Nodosaria (Dentalina)? bradyi, Chapman and Howchin, 1905, p. 15, pl. 2, fig. 12.

Dentalina bradyi, Chapman, Howchin, and Parr, 1934, p. 184; Crespin, 1947, lists.

Nodosinella bradyi, Branson, 1948, p. 33.

Observations: Chapman and Howchin found only one specimen of this form in the limestone at Wollong, Hunter River area, New South Wales, and no other specimens have been discovered.

DENTALINA GRAYI Crespin.

(Plate 24, figures 4, 5.)

Dentalina grayi Crespin, 1945, p. 27, pl. 3, fig. 8; 1947, pl. 1, fig. 3, lists; *in* Reynolds, 1956, lists.

"Test small, elongate, slender, gently curved and tapering, with greatest width in apertural chamber. Chambers seven, slightly inflated and gradually increasing in size towards apertural end. Sutures distinct, straight, depressed. Aperture terminal, radiate."

Dimensions: Holotype—length, 0.75 mm.; greatest width, 0.17 mm. Hypotype—length, 0.80 mm.

Occurrence: Holotype (C.P.C. 278), lower part of the exposure in Argus's Selection, Springsure area, Inglelara Formation (locality 8). Hypotype (C.P.C. 2537), Freney Kimberley Oil Company Nerrima No. 1 Bore, at 69 feet, Noonkanbah Formation. Other material: localities 137 (135-139 feet), 138 (1,317-1,326 feet), 146 (60-80 feet), Maitland Group. 156 (560-570 feet), equivalent of Byro Group.

Observations: The holotype is re-figured here. The test of the hypotype is not quite so strongly curved as the holotype, but all other characters are identical.

DENTALINA HABRA sp. nov.

(Plate 24, figures 6, 7.)

Diagnosis: Test gently curved, each of the five chambers becoming more attentuated than preceding one.

Holotype: Test elongate, slender, gently curved, tapering, consisting of five chambers. Small spine at end of initial chamber. Other chambers elongate, attenuated, gently lobate, the upper half of the last formed one sloping rather sharply to aperture. Sutures straight, distinct, thick, depressed. Wall calcareous, thin, surface slightly roughened. Aperture terminal, projection at end of short neck, non-radiate.

Paratype: Test elongate, tapering, with five chambers rather more attenuated than in holotype and slightly narrower. Spine at initial end, broken. Wall calcareous, thin, surface slightly roughened. Aperture projecting at end of attenuated last formed chamber, non-radiate.

Dimensions: Holotype—length, 1.25 mm.; width at initial end, 0.08 mm.; width of last formed chamber, 0.14 mm. Paratype—length, 1.00 mm.; width at initial end, 0.05 mm.; width of last formed chamber, 0.12 mm.

Occurrence: Holotype (C.P.C. 2538), Freney Kimberley Oil Company Nerrima No. 1 Bore, at 69 feet, Noonkanbah Formation. Paratype (C.P.C. 2539), Giralia No. 1 Bore, at 560-570 feet (Core No. 14), equivalent of Byro Group.

Observations: This delicate species differs from *D. grayi* Crespin in its more attenuated chambers. The gentle curve of the test and attenuated chambers show some resemblance to *D. fragilis* Terquem from the Lias, but the chambers of *D. habra* are less constricted at the sutures.

DENTALINA NERRIMAENSIS sp. nov.

(Plate 24, figures 10, 11.)

Diagnosis: Slender, tapering; chambers become attenuated with growth; whole test covered with fine delicate striae.

Holotype: Test megalospheric, elongate, tapering, gently curved, consisting of five chambers. Initial chamber slightly inflated but same size as two following chambers; fourth and fifth chambers becoming attenuated, but expanding very gently in width. Sutures straight, indistinct, slightly depressed towards apertural chamber. Wall calcareous, thin, surface covered with fine unbroken striae, which continue from initial chamber up to the aperture. Width between striae about twice that of rib. Whole of test has slightly roughened appearance. Aperture terminal, radiate.

Paratype: Test microspheric, incomplete, elongate, tapering, short spine at initial end followed by four minute chambers, last four chambers increasing

rapidly in height and becoming attenuated. Sutures straight, indistinct. Surface of test covered with fine unbroken striae and slightly rough. Apertural chamber broken.

Dimensions: Holotype—length, 0.69 mm.; max. width, 0.12 mm. Paratype —length, 0.83 mm.; max. width, 0.13 mm.

Occurrence: Holotype (C.P.C. 2540) and paratype (C.P.C. 2541) from Freney Kimberley Oil Company Nerrima No. 1 Bore, at 69 feet, Noonkanbah Formation.

Observations: This finely striated species of *Dentalina* cannot be compared with any described Permian form. Unfortunately the excellently preserved but incomplete test of the paratype (microspheric form) was broken during examination.

Genus Nodosaria Lamarck, 1812.

Nodosaria tereta sp. nov.

(Plate 26, figures 1-4; plate 31, figures 9, 10, 12.)

Diagnosis: Seven to twelve chambers, which gradually increase in size; straight sides; aperture non-radiate.

Holotype: Test small, megalospheric, straight, gently tapering, consisting of a small globular proloculus, followed by nine chambers which gradually increase in size, width being greater than height. Sutures straight, thick, distinct, the last one slightly depressed. Wall calcareous, perforate, thick; surface smooth and polished. Aperture terminal, circular, non-radiate.

Paratypes: A: Test smaller than holotype, consisting of a small globular proloculus followed by seven chambers gradually increasing in size. Surface polished. B: Test microspheric, initial chambers broken but nine present, gradually increasing in size. Apertural chamber large and globular. C: Test microspheric, large for species, initial end broken but twelve chambers present. Early ones small but gradually increasing in size with last five chambers rather lobate.

Dimensions: Holotype—length, 0.65 mm.; width of proloculus, 0.09 mm.; width of apertural chamber, 0.18 mm. Length of paratype A, 0.41 mm.; paratype B, 0.60 mm.; paratype C, 1.03 mm.; paratype D, 0.78 mm.; paratype E, 0.93 mm.; paratype F, 1.43 mm.

Occurrence: Holotype (C.P.C. 2542), Callytharra Springs, at 0-12 feet above base of Callytharra Formation (locality 70). Paratype A (C.P.C. 2543), Fossil Cliff, Irwin River, Fossil Cliff Formation (locality 134). Paratype B, Freney Kimberley Oil Company Bore No. 1 Nerrima, at 129 feet, Noonkanbah Formation. Paratype C (C.P.C. 2574), section near Salt Gully, Callytharra Springs area, Callytharra Formation (locality 71). Paratypes D, E, F (C.P.C. 2898, 2899, 2900), Pokolbin, Hunter River area, Dalwood Group.

Other material: locality 1, Cattle Creek Formation; 12, Aldebaran Creek Group. 25, Dalwood Group. 58, Gray Limestone. 66, 68, 70, 73, Callytharra Formation; 153 (3,115-3,120 and 3,220-40 feet), equivalent of Callytharra Formation; 155 (2,543-2,605 and 2,648-2,657 feet) ?Grant Formation; 154 (1,545-55 feet), Nura Nura Member; 159 (494 feet), Noonkanbah Formation.

Observations: N. tereta shows some resemblance to *N. cushmani* Paalzow 1935, but differs from that form in the straight sides of the test and the gradual increase in size of the chambers. The chambers in *N. cushmani* are inflated and increase more rapidly in both width and height.

N. tereta is very common at the type locality of Callytharra Springs and is a characteristic species of assemblages, equivalent of those in the Callytharra Formation, in Western and eastern Australia. The figured specimens illustrate some of the wide variation in shape of the chambers in this species.

NODOSARIA CONICO-DENSESTRIATA Paalzow.

(Plate 26, figures 5, 6.)

Nodosaria conico-densestriata Paalzow 1935, p. 38, pl. 4, figs. 21-23.

"Test pointed towards beginning but increases evenly. Surface from the beginning to aperture covered with fine compact ribs. Shell begins with small initial chamber, the successive chambers increasing moderately in width as in height. Last chamber comes to slight point bearing apertural opening. Sutures indistinct at beginning, stronger and more distinct in younger chambers. Length of shell varies from 0.6 mm. to 1.0 mm."

Hypotypes: Test elongate, tapering, erect, initial end broken but nine chambers visible. Chambers gradually increasing in size and becoming very slightly inflated, the last-formed one being large and inflated. Sutures distinct, the last one depressed. Wall calcareous, thick. Surface covered with strong, gently rounded, continuous ribs which extend just over suture of last-formed chamber. Aperture central, radiate.

Dimensions: Length of hypotype A 1.35+ mm.; width of apertural chamber, 0.37 mm. Length of hypotype B 1.07+ mm.; width of apertural chamber 0.27 mm.

Occurrence: Hypotypes A and B (C.P.C. 2546, 2547) from Giralia No. 1 Bore, at 620-630 feet (Core No. 15), equivalent of Byro Group. Also at 550-560 feet in the same bore.

Observations: The specimens from Giralia No. 1 Bore are regarded as conspecific with *N. conico-densestriata* described by Paalzow from the Permian of Ost-Thüringen, Germany. A translation of the original description is given above. The variation from the type figures of this species are so slight that it seems inadvisable to create a new species for the Western Australian form. The ribs of the latter specimens just pass over the last suture on to the base

of the last-formed chamber as shown in Paalzow's figures, but in his description he states that they extend up to the aperture. Some of the broken specimens show the ribs extending almost up to the aperture.

Nodosaria crassula sp. nov.

(Plate 26, figures 6, 7, 8.)

Diagnosis: Test short, stout, consisting of four chambers and covered with 16 coarse ribs which do not extend over the last-formed chamber.

Holotype: Test short, elongate, stout, very gently tapering, consisting of four chambers, slightly lobate, with a spine at initial end and with last-formed chamber globular to cone-shaped. Sutures distinct, depressed. Wall calcareous, perforate, surface covered with sixteen coarse, continuous, rounded ribs, which commence at the initial chamber and extend for a short distance over the last-formed chamber, which then becomes smooth. Area between ribs furrowed. Aperture central, terminal, radiate.

Paratype: Similar to holotype but test shorter.

Dimensions: Holotype—length, 1.20 mm.; width at initial chamber, 0.25 mm.; width of apertural chamber, 0.50 mm. Paratype—length, 1.15 mm.

Occurrence: Holotype (C.P.C. 2548) from Giralia No. 1 Bore, at 660-670 feet, equivalent of Byro Group. Paratype (C.P.C. 2549) from same bore at 420-440 feet. Also at 620-630 feet in the same bore, equivalent of Byro Group.

Observations: This species closely resembles *N. striatoclavata,* figured by Spandel (1898) but not described, from the Permian of Germany. However, the Western Australian form differs in the smooth upper portion of the apertural chamber and what appear to be much stronger ribs.

Nodosaria decoris sp. nov.

(Plate 26, figures 9, 10.)

Diagnosis: Elongate, slender; test covered with sharp striae. Aperture protruding, rounded, non-radiate.

Holotype: Test elongate, slender, gently tapering, straight, consisting of proloculus, followed by five chambers, which increase in height during growth and becoming slightly lobate. Sutures distinct, somewhat depressed. Wall calcareous, surface covered with sharp striae, some of which extend from the initial end to base of aperture. Six striae present in initial portion with an alternating set commencing immediately above second suture until twelve are present on last formed chamber. Aperture terminal protruding, with a thickened central band, rounded, non-radiate.

Paratype: Similar to holotype, but with striae not so prominent on last-formed chamber.

Dimensions: Length of holotype, 0.95 mm.; length of paratype, 0.80 mm.

Occurrence: Holotype (C.P.C. 2550) and paratype (C.P.C. 2551) from Giralia No. 1 Bore, at 560-570 feet (Core No. 14), equivalent of Byro Group. Also in same bore at 620-630 feet (Core No. 15).

Observations: This beautiful species is included in the genus *Nodosaria,* but the protruding, non-radiate aperture with the thickened band seems to indicate that it may represent a new genus. However, with the few specimens available the erection of a new genus at this stage could not be justified. No comparison can be made with any described Permian species.

NODOSARIA FISHERI sp. nov.

(Plate 25, figures 1-3.)

Diagnosis: Small, straight, seven to twelve chambers. Surface of test hispid; delicate striae cover sutural area, extending very slightly over chambers immediately above and below sutural line. Aperture thick, rounded, non-radiate.

Holotype: Test small, megalospheric, elongate, tapering, straight, slender, consisting of a small globular proloculus, followed by seven chambers. Early chambers slightly wider than high, then gradually increasing in height, the apertural chamber being somewhat elongate and lobate. Sutures distinct, somewhat depressed, especially in the younger portion of the test. Wall calcareous. Surface hispid, and with delicate striae covering the sutural line and extending very slightly over on to the chambers above and below the line. Aperture protruding, rounded with thickened rim, non-radiate.

Paratypes: A: Test small, microspheric, ten chambers present with at least two of the earliest ones broken. Sutures indistinct in lower and middle thirds covered with delicate striae, the later ones becoming distinct and depressed, with the striae still present and extending very slightly over the chambers above and below the line. Surface hispid. B: Test small, megalospheric, consisting of globular proloculus, followed by six chambers gradually increasing in width. Surface hispid, with delicate striae extending across sutural area.

Dimensions: Holotype—length, 0.54 mm.; max. width, 0.09 mm. Length of paratype A, 0.60 mm.; length of paratype B, 0.37 mm.

Occurrence: Holotype (C.P.C. 2552) and paratypes (C.P.C. 2553, 2554) from Freney Kimberley Oil Company Nerrima No. 1 Bore at 129 feet, Noonkanbah Formation. Also locality 159 (490 feet), Noonkanbah Formation.

Observations: This unusual species is distinguished from other described species of Permian Nodosarians by its protruding non-radiate aperture, its hispid surface and the delicate striae which are present in the sutural line area. The holotype and paratype A are partly infilled with pyrite, which accentuates the characters of the species. The species is named after Dr. N. H. Fisher, Chief Geologist of the Bureau of Mineral Resources, Geology and Geophysics.

NODOSARIA IRWINENSIS Howchin.

(Plate 25, figures 4-8; plate 31, figures 8-11.)

Nodosaria sp., Howchin, 1894, p. 366.

Nodosaria irwinensis Howchin, 1895, p. 196, pl. 10, figs. 7-8.

Nodosaria (*Dentalina*) *labiata* Chapman and Howchin, 1905 (*non D. labiata* Spandel, 1898), p. 16, pl. 3, fig. 4.

Nodosaria irwinensis, Chapman, Howchin and Parr, 1934, p. 184; Crespin, 1947, p. 20, lists; Branson, 1948, p. 32.

"Test elongate, straight, or very slightly arcuate, tapering. Segments about eight in number. The shell either slightly inflated near centre or gradually increasing in size. Chambers of greater width than length. Sutural lines straight, thick and slightly depressed. Surface of test ornamented with numerous, closely set, longitudinal and continuous costae. Length 1/33 in."

Dimensions of figured specimens: Length of hypotype A 1.00 mm.; hypotype B 0.80 mm.; hypotype C 0.82 mm.; hypotype D 0.75 mm.; hypotype E 1.00 mm.; hypotype F 0.85 mm.; hypotype G 0.87 mm.

Occurrence: Hypotypes A and B (C.P.C. 2555, 2556), Fossil Cliff, Irwin River, Fossil Cliff Formation (locality 184). Hypotypes C, D, E, G (C.P.C. 2557, 2558, 2559, 2897), Callytharra Springs, 22-35 feet above base of Callytharra Formation (locality 70). Hypotype F (C.P.C. 2896), Pokolbin, Dalwood Group (locality 16).

Other material: Locality 1, Cattle Creek Formation. 58, Gray Limestone; 60, Berriedale Limestone. 68, 71, 72, 73, Callytharra Formation.

Observations: Howchin made a further comment: "*N. irwinensis* is of very short length, narrow chambers and banded sutures". The many specimens examined from the type locality at Fossil Cliff, Irwin River, both by the writer and by Parr (unpublished manuscript), are unlike those figured by Howchin. Most tests are not constricted at the suture-lines, and the striae are flatly rounded with an equal distance between the striae. In no specimen do the striae extend beyond the lower half of the last-formed chamber, and the aperture is circular, sometimes with a thickened lip, and situated in a depression at the end of the test. Parr commented that the specimens which are so abundant at Callytharra Springs indicate the variation within the species, these forms being more like Howchin's type figures. At that locality, too, the tests are usually more slender and are ornamented with fine, sharp, numerous striae which extend from the initial end to the aperture. They also show greater irregularity of outline, with the sutures comparatively strongly depressed. The figured specimens show the range of variation. It is quite possible that many of the specimens examined from Fossil Cliff may represent a new species, with Howchin's figures and the numerous specimens at Callytharra Springs being typical *N. irwinensis*. But with the wide variation within the species from different deposits, it seems safer at present to regard them all as one species.

NODOSARIA PYRAMIDIS (Chapman and Howchin).

Monogenerina pyramidis Chapman and Howchin, 1905, p. 13, pl. 3, fig. 5.

Nodosaria pyramidis, Chapman, Howchin and Parr, 1934, p. 185; Crespin, 1947, lists.

Monogenerina pyramidis, Branson, 1948, p. 27.

Observations: Chapman and Howchin (1905) described this species from a thin section of a rock from Pokolbin, New South Wales. After re-examination of the section, Chapman, Howchin and Parr (1934) decided that the wall structure was calcareous and referred the genus to *Nodosaria,* rather than to the arenaceous form *Monogenerina.* No free specimens of this form have been found, so that no comparison can be made with any known species.

NODOSARIA RAGGATTI sp. nov.

(Plate 27, figures 1-5.)

Diagnosis: Test short, smooth, aperture radiate.

Holotype: Test megalospheric, short, stout, tapering, consisting of globular proloculus, followed by six slightly inflated chambers, which gradually increase in width and height, the last-formed chambers being distinctly lobate. Sutures distinct, straight, depressed. Wall calcareous, perforate; surface smooth. Aperture terminal, radiate.

Paratypes: A: Test megalospheric, small, short, stout, consisting of proloculus, followed by four slightly inflated chambers. B: Test more slender than holotype, consisting of proloculus, followed by five chambers, very slightly inflated and gradually increasing in size. Apertural chamber elongate, lobate. C: Test microspheric, initial end pointed, test consisting of nine chambers, the last three increasing rather rapidly in size. Sutures, distinct, the last one strongly depressed. D: Test megalospheric, with small proloculus, followed by seven chambers, the apertural one being rather attenuated.

Dimensions: Length of holotype, 0.80 mm.; width at proloculus, 0.11 mm.; max. width, 0.20 mm. Length of paratype A, 0.55 mm.; paratype B, 0.60 mm.; paratype C, 0.80 mm.; paratype D, 0.90 mm.

Occurrence: Holotype (C.P.C. 2560) and paratype A (C.P.C. 2561), Minilya River, $\frac{1}{4}$ mile upstream from Wandagee Homestead, Bulgadoo Shale (locality 90). Paratypes B and C (C.P.C. 2562, 2563), Giralia No. 1 Bore, at 620-630 feet (Core No. 14), equivalent of Byro Group. Paratype D (C.P.C. 2564) from Freney Kimberley Oil Company Nerrima No. 1 Bore, at 129 feet, Noonkanbah Formation.

Other material: locality 26, Branxton Subgroup; 140 (456-60 feet), 145 (55-75 feet), Maitland Group. 92, Bulgadoo Shale; 101, Cundlego Formation; 159 (494 feet), 160 (160-70 feet), Noonkanbah Formation.

Observations: *N. raggatti,* which is very common at the type locality, is distinguished from *N. tereta* by its radiate aperture, few chambers, and the more regular increase in the size of the chambers. The tests show considerable variation in length and width and this is illustrated by the figured specimens. It differs from *N. cushmani* Paalzow in its radiate aperture and less inflated chambers.

This species is named after Dr. H. G. Raggatt, who, during his geological investigations in the Carnarvon Basin in 1935, collected the sample containing the type specimen.

NODOSARIA SPICULATA sp. nov.

(Plate 25, figures 10-12.)

Diagnosis: Minute; two to four slightly inflated chambers with initial chamber sharply pointed and with the apertural chamber attenuated.

Holotype: Test minute, straight, consisting of three chambers slightly inflated. Initial chamber elongate-ovate, sharply pointed with a short spine; second chamber approximately the same height as the initial chamber but less broad; apertural chamber attenuated and tapering rather acutely to apertural opening. Sutures distinct, incised. Wall calcareous, smooth. Aperture central, terminal, radiate opening.

Paratypes: A: Test minute, consisting of two chambers, an attenuated initial one with a sharp spine, and a second attenuated apertural one, which tapers towards central radiate apertural opening. B: Test minute, but larger than holotype and paratype A, consisting of four chambers. Initial chamber with sharp, short spine, followed by two slightly inflated and attenuated chambers of almost equal size which in turn are followed by a slightly broader but attenuated chamber tapering towards radiate apertural opening.

Dimensions: Holotype—length, 0.49 mm.; max. width of initial chamber, 0.12 mm.; max. width of apertural chamber, 0.12 mm. Paratype A—length, 0.37 mm.; length of initial chamber, 0.19 mm.; length of apertural chamber, 0.18 mm. Length of paratype B, 0.55 mm.

Occurrence: Holotype (C.P.C. 2534) and paratypes (C.P.C. 2535, 2536) from B.M.R. No. 1 Bore, Jurgurra Creek, in upper 12 feet of Core 5 at 480-500 feet, Noonkanbah Formation. Also at 440-450 feet in Giralia No. 1 Bore, equivalent of Byro Group.

Observations: Tests of this minute and distinctive species of *Nodosaria* are moderately numerous in the upper 12 feet of Core No. 5 in B.M.R. No. 1 Bore, Jurgurra Creek, two-chambered and three-chambered specimens being the commonest forms. The apiculate initial chamber and attenuated apertural chamber are constant features in all specimens. The only described Permian form that has any resemblance to *N. spiculata* is *Dentalina bradyi* Spandel (1901), which differs in the asymmetrical position of its aperture and the globular initial chamber. Several species of Tertiary Nodosarians show the typical three or four chambers and apiculate initial chamber.

NODOSARIA SPRINGSURENSIS Crespin.

(Plate 26, figures 11, 12.)

Nodosaria springsurensis Crespin, 1945, p. 26, pl. 2, fig. 5; 1947, pl. 1, fig. 5, lists.

"Test elongate, gently tapering, greatest width near apertural end, circular in transverse section. Chambers, six; sutures distinct, depressed. Test covered with about 16 raised longitudinal costae, which extend over the length of the shell. Aperture central, terminal, radiate."

Dimensions: Holotype—length, 1.62 mm.; greatest width, 0.39 mm. Length of hypotype, 3.00 mm.

Occurrence: Holotype (C.P.C! 295), Cattle Creek below Waterfall, south-east of Springsure, Cattle Creek Formation. Hypotype (C.P.C. 2567) from Giralia No. 1 Bore, at 560-570 feet (Core No. 14), equivalent of Byro Group. Also in the same bore at 620-630 feet (Core No. 15).

Observations: The hypotype from the Giralia No. 1 Bore, Western Australia, consists of eight chambers, and the sutures are slightly more depressed than in the holotype from the Springsure area, Queensland, giving the chambers rather a lobate appearance, but there seems little doubt that the Giralia specimens belong to *N. springsurensis.*

NODOSARIA STRIATELLA (Paalzow).

(Plate 25, figure 9.)

Dentalina striatella Paalzow, 1935, p. 38, pl. 4, fig. 24.

"Test only very slightly curved, beginning with a large spherical initial chamber, followed by a number of slightly broader chambers. Sutures are usually not depressed and distinctly seen through shell wall. They are more depressed on the younger chambers. Aperture sharp, slightly to one side. The whole test is strongly ornamented with very close and very fine striae. Length, 1.4 mm."

Hypotype: Test elongate, almost straight, very gently tapering, consisting of eight chambers, gradually increasing in height and very gradually in width, the last-formed chamber large and lobate, initial chamber with spine attached. Sutures distinct, slightly depressed, with the last one strongly so. Wall calcareous, surface covered with numerous fine striae which extend unbroken from initial chamber up to aperture. Aperture central, terminal, radiate.

Dimensions: Hypotype, length, 1.036 mm.; width at initial chamber, 0.12 mm.; width of last chamber, 0.24 mm.

Occurrence: Hypotype (C.P.C. 2568) from Giralia No. 1 Bore, at 560-570 feet (Core No. 14), equivalent of Byro Group.

Observations: There seems little doubt that this specimen is identical with that figured by Paalzow from the Permian of Germany. The very slightly irregular shaped chambers and slightly bent test are also present. This bend

is regarded as an abnormality, and with the aperture almost central, it appears that the form should be referred to the genus *Nodosaria* rather than to *Dentalina*.

Genus RECTOGLANDULINA Loeblich and Tappan, 1955.

RECTOGLANDULINA SEROCOLDENSIS (Crespin).

(Plate 27, figures 6-10.)

Nodosaria serocoldensis Crespin, 1945, pl. 3, figs. 6, 7; 1947, p. 21, pl. 1, figs. 6, 7.

"Test elongate, smooth, tapering, greatest width in apertural chamber, circular in transverse section. Chambers six, apertural chamber large, others gradually decreasing in size. Sutures, indistinct, straight. Aperture small, central, radiate, terminal."

Dimensions: Holotype—length, 1.02 mm.; max. width, 0.43 mm. Paratype —length, 1.21 mm.; max. width, 0.42 mm. Length of hypotype A, 0.90 mm.; hypotype B, 0.80 mm.; hypotype C, 0.75 mm.

Occurrence: Holotype (C.P.C. 276) and paratype (C.P.C. 277), Cattle Creek below Waterfall, south-east of Springsure, Cattle Creek Formation (locality 1). Hypotype A (C.P.C. 2565), Minilya River, quarter mile upstream from Wandagee Homestead, Bulgadoo Shale (locality 90). Hypotypes B and C (C.P.C. 2566, 2610) from Associated Freney Oilfields Myroodah No. 1 Bore, 860-865 feet, Liveringa Formation.

Other material: 12, 14, Aldebaran Creek Group. 45, Mulbring Subgroup. 146 (57-80 feet), 151 (3846-84 feet), Maitland Group. 129, 158 (1145-2250 feet), 160 (160-170 feet), Noonkanbah Formation; 158 (840-945 feet), Liveringa Formation.

Observations: The holotype and paratypes of *Rectoglandulina serocoldensis* (Crespin) 1945 from Queensland are refigured here together with specimens from Western Australia to show the variation of shape within the species. A re-examination of the paratype indicates that the test is a microspheric form consisting of ten chambers, six of the initial ones being minute. This species is now placed in the new genus *Rectoglandulina* Loeblich and Tappan, 1955, in which the chambers are increasing rapidly in diameter and overlapping and with sutures horizontal and not strongly depressed. Some of the specimens show some similarity with another new genus, *Pseudonodosaria* Loeblich and Tappan 1955, in which the chambers are strongly embracing in the early portion, becoming less embracing and separated by constricted sutures, but not enough evidence is at present available to separate the present specimens into two genera. *R. serocoldensis* with its characteristic variation in shape is present commonly in beds of the Liveringa Formation and of the Noonkanbah Formation in the Myroodah Bore, Fitzroy Basin.

Genus LINGULINA d'Orbigny, 1826.

LINGULINA ANTIQUA (Chapman and Howchin).

(Plate 24, figure 8.)

? Pleurostomella antiqua Chapman and Howchin, 1905, p. 14, pl. 2, fig. 5.

Nodosaria ? antiqua, Chapman, Howchin and Parr, 1934, p. 185; Crespin, 1947, lists.

Monogenerina antiqua, Branson, 1948, p. 20.

Lingulina antiqua, Crespin *in* Reynolds, 1956, lists.

"Test smooth, compressed, slender, tapering; sutures of chambers strongly marked. Earlier segments small, rapidly increasing in size. Length 1 mm."

Hypotype: Test complete, slender, tapering, consisting of nine chambers with spine at initial end. The first eight chambers increase very gradually in size, with the last one becoming very broad and occupying the upper third of the shell, with greatest width towards the apertural end. Sutures straight, indistinct, wall calcareous, smooth. Aperture terminal, elongate, radiate.

Dimensions: Hypotype—length, 1.40 mm.; height of last chamber, 0.30 mm.; greatest width, 0.25 mm.

Occurrence: Hypotype (C.P.C. 2569), B.M.R. Bore No. 1 (S), State Reserve, Ravensworth, at 746 feet, Maitland Group. *Other material:* locality 30, Branxton Subgroup; 137 (45-55 feet), 146 (52-60 feet), Maitland Group.

Observations: Several tests of this species have been found in subsurface section in the Hunter River area but all except the hypotype described above have been crushed or broken. Chapman and Howchin's holotype specimen was also a broken test. The gently compressed test with the well-preserved, slit-like apertural opening shown in the hypotype are features which indicate that this form should be included in the genus *Lingulina* rather than *Nodosaria* as suggested by Chapman, Howchin and Parr (1934). Furthermore, the above features shown in the complete specimen do not support its inclusion in the genus *Monogenerina* as indicated by Branson (1948).

LINGULINA DAVIDI Chapman, Howchin and Parr.

Bulimina affinis Chapman and Howchin (*non* d'Orbigny), 1905, p. 14, pl. 2, fig. 7.

Lingulina davidi Chapman, Howchin and Parr, 1934, p. 185; Crespin, 1947, lists.

"Test rectilinear, sub-pyriform, slightly compressed, initial end acute, apertural end bluntly pointed; beginning with a small globular proloculum, followed by four or five chambers which increase rapidly in size as added, sutures distinct, slightly depressed in the later part of the shell; wall calcareous, perforate. Aperture radiate."

Observations: No specimens of this form have been available for examination. The holotype came from Wollong, Hunter River area, New South Wales, from beds of the Branxton Subgroup.

LINGULINA sp.

(Plate 24, figure 9.)

Observations: This form (C.P.C. 2570) is included in the genus *Lingulina* because of its strong compression, the parallel sides of the rectilinear portion of the test and the coiling of the initial portion. It is also referable to the microspheric form of the genus. Only one specimen has been found, in a subsurface sample from Bore No. 1 (S.C.) St. Helier's, at 45′ 6″ to 55′ 6″, Hunter River area, New South Wales, Maitland Group. Schwager (1883) recorded a specimen of *Lingulina* from the Carboniferous of China, but the earliest record of the genus in Australia is in the Permian.

Genus FRONDICULARIA Defrance, 1824.

FRONDICULARIA AULAX sp. nov.

(Plate 28, figures 1-4.)

Frondicularia woodwardi, Crespin, 1945 (*non* Howchin), pl. 3, fig. 13; 1947, pl. 1, fig. 13.

Diagnosis: Test straight, tapering, consisting of proloculus followed by six or seven chambers in megalospheric form and by sixteen in microspheric form; pronounced furrow along median line.

Holotype: Test elongate, straight, gently tapering, compressed, of uniform thickness, consisting of globular proloculus, followed by seven uniserial chambers which gradually increase in width and height, the last chamber being somewhat inflated. Test with strong furrow along median line, extending from proloculus to the last-formed chamber. Periphery rounded. Sutures distinct consisting of transparent thickened shell matter, strongly arched in early portion of test, then gradually becoming straight and with a neck-like appearance at the position of the early apertural openings. Wall calcareous: surface smooth, translucent. Aperture central, radiate, protruding.

Paratypes: A: Test small, consisting of globular proloculus, followed by six uniserial chambers gradually increasing in size. Furrow along median line pronounced. B: Larger than holotype, consisting of globular proloculus followed by ten uniserial chambers, the last four chambers rapidly increasing in width and height, the last-formed chamber becoming lobate. C: Test microspheric, with initial portion beginning with a spine, then followed by sixteen uniserial chambers, the first five minute, the other eleven gradually increasing in size, with furrow along median line. Last-formed chamber slightly shouldered. Sutures distinct, thickened.

Dimensions:

	Length.	Maximum Diameter.
	mm.	mm.
Holotype	1.50	0.30
Paratype A	0.90	0.20
Paratype B	1.90	0.40
Paratype C	1.50	0.20

Occurrence: Holotype (C.P.C. 2571) and paratypes A and B (C.P.C. 2572, 2573), watershed between Little Gorge and Cabbage Tree Creeks, Springsure area, Cattle Creek Formation (locality 4). Paratype C (C.P.C. 2574), north bank of Cattle Creek, below waterfall, Springsure area, Cattle Creek Formation. Other material: 2, Cattle Creek Formation; 10, Mantuan *Productus* Bed. 137 (115-138 feet), 145 (53-75 feet), Maitland Group. 53, Golden Valley Group.

Observations: Frondicularia aulax, with its rounded periphery and strong median furrow, is distinct amongst the Australian Permian Frondicularians. The tests show considerable variation in size. One complete test measures 2.50 mm., but broken ones probably reached 3.00 mm. Furthermore, specimens from the Mantuan *Productus* Bed, Springsure area, tend to develop spines along either side of the deep median furrow, but not enough specimens have been available to prove whether this character is of specific or varietal significance.

This species differs from *F. woodwardi* Howchin in its deep median furrow and the neck-like shape of the arched portion of the sutures along the median line, and its very rounded periphery. *F. aulax* shows some resemblance to *Spandelina excavata* Cushman and Waters but differs in the shape of the aperture, which, in that form, is narrowly elliptical and non-radiate, and the shape of the chambers, which are slightly inflated. The point of resemblance lies in the deep excavation along the median line.

Frondicularia hillae sp. nov.

(Plate 28, figures 5-8.)

Diagnosis: Much compressed, strongly tapered test covered with irregular strong striae.

Holotype: Test megalospheric, elongate, much compressed, uniformly thick, strongly tapering, greatest width in last-formed chamber which slopes acutely to aperture. Slightly depressed along median axis. Periphery angulate. Test consists of small globular proloculus, followed by seven uniserial rectilinear chevron-shaped chambers. Sutures indistinct, slanting obliquely towards median line and partly obscured by surface ornament. Wall calcareous; surface ornamented with irregular, sometimes discontinuous, strong striae which anastomose or divide. About four striae on proloculus on one side of test and about twelve on apertural chamber and extending to shoulder of that chamber and to base of aperture. Aperture terminal, radiate, protruding.

Paratypes: A: Test smaller than holotype, consisting of globular proloculus, followed by five chambers gradually increasing in size. Arrangement of striae similar to that in holotype. B: Test microspheric, large, compressed, consisting of approximately fourteen chambers. Test covered with strong striae which increase rapidly in number in the upper third. Apertural chamber broken. C: Test smaller than holotype but characteristic ornament excellently preserved. A minute transparent frill of calcareous material surrounds the initial portion of the test.

Dimensions: Holotype—length, 0.90 mm.; width at initial end, 0.10 mm.; width at apertural chamber, 0.30 mm.; length of paratype A, 0.75 mm.; paratype B, 1.75+ mm.; paratype C, 0.70 mm.

Occurrence: Holotype (C.P.C. 2575) and paratype A (C.P.C. 2576), north bank of Cattle Creek, below waterfall south-east of Springsure, Cattle Creek Formation (locality 1). Paratype B (U. Tas. 28000), west bank of Don River, 5 yards upstream from bridge over river from main road to Barrington and Sheffield, Golden Valley Group (locality 53). Paratype C (C.P.C. 2577), 1.5 miles west-north-west of Coordewandy Homestead, Carnarvon Basin, 132 feet above base of Callytharra Formation (locality 66). *Other material:* locality 10, Mantuan *Productus* Bed; 137 (44-66 and 108 feet) Maitland Group.

Observations: Variation in the size of different tests of this species is shown in the figured specimens. The characteristic shape and striated test of *F. hillae* shows resemblance to species of *Frondicularia* found in the Mesozoic and Tertiary.

The species is named after Dr. Dorothy Hill, University of Queensland, who has made many outstanding contributions to the Permian palaeontology of Australia.

Frondicularia impolita sp. nov.

(Plate 28, figures 9-12.)

Diagnosis: Test small, flattened, consisting of seven or eight chambers. Surface rough and almost hispid.

Holotype: Test small, elongate-hexagonal, flat, consisting of seven chambers of almost equal height and width until last-formed chamber, which is larger. Initial portion of test broadens rapidly, after which the sides of the periphery become almost straight, the last-formed chamber tapering sharply to the aperture. Sutures distinct, depressed, strongly arched. Wall calcareous; surface rough, hispid in initial portion.

Paratypes: A: Similar to holotype but slightly smaller and with early portion strongly hispid. B: Test larger than holotype, consisting of small proloculus followed by eight chambers of almost equal size. Sutures depressed, especially in upper third. C: Test microspheric, longer and narrower than holotype, with sharp spine at initial end, followed by twelve chambers gradually increasing in size. Five minute chambers in initial portion with small sutures

gently chevron-shaped. Surface roughened to hispid in lower third and lower portion of middle third, continuing to be slightly rough in upper middle and upper third, becoming translucent towards last-formed chamber.

Dimensions:

—	Length.	Maximum Width.
	mm.	mm.
Holotype	0.40	0.15
Paratype A	0.30	0.15
Paratype B	0.60	0.15
Paratype C	0.50	0.20

Occurrence: Holotype (C.P.C. 2578) and paratypes (C.P.C. 2579, 2580, 2592) from Freney Kimberley Oil Company Nerrima No. 1 Bore, at 129 feet, Noonkanbah Formation.

Observations: This small species, with its roughened surface and strongly depressed sutures, is very distinctive. It shows some resemblance to *F. minutissima* Paalzow 1935, from the Permian of Germany, but in that form the sutures are not depressed and not so strongly arched as in *F. impolita.* Several specimens are present at the depth of 129 feet in the Nerrima Bore.

FRONDICULARIA LIMPIDA sp. nov.

(Plate 29, figures 1-2.)

Diagnosis: Test smooth, transparent, gradually increasing in width until last-formed chamber, when it slopes sharply to the apertural opening.

Holotype: Test incomplete, initial portion broken, elongate, tapering, compressed, consisting of at least seven uniserial chambers. Test gradually increasing in width until last-formed chamber, when it slopes rapidly to the apertural end. Chambers gradually increasing in width and height. Periphery subacute, but rounded on last-formed chamber. Sutures strongly arched, thick, indistinct, the last one depressed. Wall thin, calcareous, translucent, smooth. Aperture central, radiate.

Paratype: Test complete, smaller than holotype, compressed, consisting of a small globular proloculus with a minute spine attached, followed by seven uniserial chambers. Test tapers sharply in initial portion, then gradually widening until last-formed chamber, then slopes rapidly to aperture.

Dimensions: Length of holotype, 0.74 + mm.; width of test, 0.31 mm. Length of paratype 0.55 mm.; width, 0.22 mm.

Occurrence: Holotype (C.P.C. 2581), north bank of Cattle Creek below waterfall, south-east of Springsure, Cattle Creek Formation (locality 1). Paratype (C.P.C. 2582), Giralia No. 1 Bore, at 3,115-3,120 feet (Core No. 66), equivalent of Callytharra Formation.

Observations: This flat smooth species of *Frondicularia* shows no resemblance to any described Permian species. Several tests were present in the Springsure material, but all were broken. A poorly preserved microspheric test was observed.

FRONDICULARIA PARRI Crespin.

(Plate 29, figures 3-7.)

Frondicularia parri Crespin, 1945, p. 27, pl. 3, figs. 9-11; 1947, p. 21, pl. 1, figs. 9-11.

"Test elongate, compressed, with greatest width near apertural end; earlier portion tapering sharply, sides of later portion almost parallel. Aboral end subacute. Peripheral margin rounded. Chambers ten. Sutures distinct, marked by clear shell matter, acutely arched along median line. Wall ornamented with distinct irregular longitudinal costae, extending over whole of test. Aperture small, terminal."

Dimensions:

	Length.	Maximum Width.
	mm.	mm.
Holotype	0.80	0.28
Hypotype A	0.46	0.29
Hypotype B	0.80	0.15
Hypotype C	1.16	0.20
Hypotype D	0.70	0.20

Occurrence: Holotype (C.P.C. 279) and Hypotype A (C.P.C. 2586) from Kulnura Bore, ¾ miles south of Kooree Trig. Station, Ph. Kooree, Cty. Northumberland, Sydney, at 4,203 feet, Maitland Group. Hypotypes B and C (C.P.C. 2583, 2584), Freney Kimberley Oil Company Nerrima No. 1 Bore, at 129 feet, Noonkanbah Formation. Hypotype D (C.P.C. 2585), Giralia No. 1 Bore, at 620-630 feet (Core No. 15), equivalent of Byro Group.

Other material: Locality 31, Branxton Subgroup; 37 (108 feet), 144 (26-50 feet) Maitland Group; 150 (4,184-4,578 feet), 151 (4,123, 4,173, 4,268 feet), Maitland Group. 58, Gray Limestone. 157 (480 feet), 159 (580-600 feet), Noonkanbah Formation.

Observations: The extreme variation of shape within a species is excellently illustrated in the figures of *F. parri.* The striae in the specimens from Western Australia are slightly finer than those from New South Wales but the characteristic bifurcation along the median line is present in specimens from the widely separated localities.

FRONDICULARIA SEMICOSTULA sp. nov.

(Plate 29, figures 8, 9.)

Diagnosis: Test short, moderately stout, compressed, covered with strong rounded ribs which do not extend over last-formed chamber.

422/58.—8

Holotype: Test small, moderately stout, compressed, tapering, consisting of a small spine at initial end, followed by six chambers increasing very gradually in size. Test gradually increasing in width, the sides almost parallel until shoulder of last-formed chamber, then sloping sharply to apertural opening. Periphery rounded. Sutures indistinct, very gently arched. Wall calcareous; surface up to top of middle third, covered with eight strong, rounded ribs, the two inner ones sloping towards median line, the others extending unbroken and straight to base of last-formed chamber. Aperture small, central, radiate.

Paratype: Test a little smaller than holotype. All other characters similar.

Dimensions: Holotype—length, 0.70 mm.; max. width, 0.20 mm. Paratype —length, 0.50 mm.; max. width, 0.15 mm.

Occurrence: Holotype (C.P.C. 2587) and paratype (C.P.C. 2588), Associated Freney Oilfields Myroodah No. 1 Bore, at 1,585-1,590 feet, Noonkanbah Formation.

Observations: This species shows a slight resemblance to *F. parri* Crespin but differs in the small number of coarse, rounded ribs which do not extend over the last chamber and which for the most part extend unbroken over the remainder of the test.

FRONDICULARIA SUTILIS sp. nov.

(Plate 27, figures 11, 12.)

Diagnosis: Test elongate, tapering, sutures prominent and very oblique.

Holotype: Test incomplete, upper part present only, moderately large, elongate, tapering, compressed. The portion of the test present tapers gradually with greatest width at base of last-formed chamber, then sloping acutely to aperture. Six uniserial chambers present, all of them almost equal in height, the last-formed one being slightly larger. Periphery subrounded. Sutures very distinct, thickened, translucent, very oblique, discontinuous along median line in position of apertural openings of earlier chambers. Wall calcareous; surface smooth, polished, transparent. Aperture prominent, central, radiate.

Paratype: Test incomplete, but initial and later chambers present, consisting of globular proloculus followed by seven chambers of almost equal height and width, with probably only final chamber missing. Sutures very distinct, and shaped as in holotype.

Dimensions: Holotype—length, 0.80 + mm.; width at base of last-formed chamber, 0.40 mm. Paratype—length, 1.00 + mm.; width of proloculus, 0.10 mm.; width of last complete chamber, 0.35 mm.

Occurrence: Holotype (U.Q. 22769) and paratype (U.Q. 22770), most north-easterly outcrop of Mantuan *Productus* Bed in Reid's Dome, 2.3 miles south-south-west of Springwood and 32 miles south-south-east of Springsure (locality 10).

Observations: It is unfortunate that no complete specimen of this very fine species of *Frondicularia* was obtained. The limestone in which many

fragments were found was very hard and complete tests of the numerous foraminifera in it were difficult to extract. However, the two figured fragments give an excellent idea of the species. *F. sutilis* shows some resemblance with the Upper Cretaceous form *F. archiaciana* d'Orbigny, especially in the shape of the sutures.

Frondicularia woodwardi Howchin.

(Plate 29, figures 10-12.)

Frondicularia sp. Howchin, 1894, p. 336.

Frondicularia woodwardi Howchin, 1895, p. 197, pl. 10, figs. 4-6; Chapman and Howchin, 1905, p. 16, pl. 3, fig. 3; Chapman, Howchin and Parr, 1934, p. 184; Crespin, 1945, p. 28, pl. 3, fig. 12; 1947, p. 21, pl. 1, fig. 12.

"Test elongate, tapering, compressed and subject to considerable variation in external form. Oral end broad, rounded and regularly curved. Aboral extremity obtusely pointed. Peripheral margins rounded. Segments from seven to ten in number, gradually increasing in size, acutely arched. Final chamber relatively large, inflated and lobulated. Sutures flush, marked by clear shell substance. Length of shell twice or three times breadth."

Dimensions of figured specimens: Hypotype A, length, 1.14 mm.; max. width, 0.27 mm.; thickness, 0.18 mm. Hypotype B, length, 0.58 mm.; max. width, 0.18 mm. Hypotype C, length, 0.88 mm.; max. width, 0.25 mm.

Occurrence: Hypotype A (C.P.C. 2589), Fossil Cliff, Irwin River (type locality), Fossil Cliff Formation. Hypotype B (C.P.C. 2590), Freney Kimberley Oil Company, Nerrima No. 1 Bore, at 129 feet, Noonkanbah Formation. Hypotype C (C.P.C. 2591), from north bank of Cattle Creek, south-east of Springsure, Queensland, Cattle Creek Formation (locality 1).

Other material: Locality 2, 3, Cattle Creek Formation; 7, Ingelara Formation; 10, Mantuan *Productus* Bed; 14 Aldebaran Creek Group. 16, 19, Dalwood Group; 26, 31, Branxton Subgroup; 137 (64-110 feet), 142 (74 feet), 144 (26-50 feet), 145 (75-107 feet), Maitland Group. 53, Golden Valley Group; 58 Gray Limestone. 66, 67, 68, 73, Callytharra Formation; 153 (560-70, 620-30 feet), equivalent of Byro Group; 153 (3,115-3,120 feet) equivalent of Callytharra Formation; 134, 135, Fossil Cliff Formation; 156 (59, 69, 129, 272 feet), 159 (494, 580-600 feet), Noonkanbah Formation; 158 (860-870 feet), Liveringa Formation; 161 (1,860 feet); 162.

Observations: Additional features to be added to the type description are the smooth polished surface of the test, the short terminal, slit-like radiate aperture and a very slight depression along the median longitudinal axis, which, though not prominent, is present in specimens from the type locality at Fossil Cliff. Three hypotypes are figured to illustrate the variation in shape mentioned by Howchin.

F. woodwardi was the first species of the genus to be described from the Upper Palaeozoic. It is widely distributed in the Permian rocks of Australia

and it has a considerable stratigraphical range. Many specimens were present in the limestone collected by the late Dr. G. D. Osborne from the Dalwood Group, Hunter River area (OS.264).

Genus GEINITZINA Spandel, 1901.

GEINITZINA CASEYI sp. nov.

(Plate 30, figures 1-3.)

Diagnosis: Test compressed, shield-shaped, slightly biconvex, consisting of seven to eight uniserial chambers; surface smooth, polished.

Holotype: Test small, tapering, very compressed, slightly biconvex, shield-shaped, with greatest width at base of last-formed chamber, expanding sharply at initial portion, then tapering gently to base of last-formed chamber, finally sloping sharply in direction of aperture. Test consists of a globular proloculus, followed by eight uniserial chambers arranged in a rectilinear series. Periphery acute. Sutures distinct, chevron-shaped, with thickening along longitudinal median axis. Wall calcareous; surface smooth, polished, translucent. Aperture central, terminal, radiate, with a slight neck.

Paratypes: A: Test slightly shorter than holotype. Other features similar. E: Test small and stouter than Paratype A, consisting of a minute proloculus, followed by seven uniserial chambers. First two sutures almost arc-shaped, others becoming straighter than those in holotype.

Dimensions: Holotype—length, 0.67 mm.; max. width, 0.35 mm.; thickness of test, 0.18 mm. Paratype A—length 0.40 mm.; max. width, 0.30 mm. Paratype B—length, 0.47 mm.; width, 0.30 mm.

Occurrence: Holotype (C.P.C. 2593) and paratypes A and B (C.P.C. 2594, 2595), BMR No. 1 Bore, Jurgurra Creek, at 494 feet, Noonkanbah Formation.

Other material: Locality 10, Mantuan *Productus* Bed. 156 (59 feet), Noonkanbah Formation.

Observations: Many specimens of this new species were found at the type locality. The shield-like shape, the biconvex test, and the acute periphery are constant in all specimens. It cannot be compared with any described species of *Geinitzina*.

The species is named after Mr. J. N. Casey of the Bureau of Mineral Resources, who has carried out extensive geological investigations in the Canning Basin.

GEINITZINA STRIATOSULCATA sp. nov.

(Plate 30, figures 4-7.)

Diagnosis: Test cuneiform, with large last-formed chamber; margin of apertural portion almost at right angles to longitudinal median axis. Test covered with very fine striae which diverge from a deep sulcus which extends along the median line.

Holotype: Test large for genus, compressed, cuneiform, with greatest width in last-formed chamber and with a depression along longitudinal median axis. Test tapers gently towards apertural chamber, the margin of that chamber being almost at right angles to the early part of the test. Test consists of globular proloculus followed by seven uniserial chambers which gradually increase in width and height, the last formed one being almost rectangular in shape. Periphery rounded. Sutures distinct, arcuate in early portion, later becoming almost straight and thickening along longitudinal median axis. Wall calcareous; surface covered with numerous fine elongate striae, which diverge outwards to the periphery from either side of sulcate median line. Shouldered portion of the apertural chamber smooth. Aperture elongate, radiate, slit in centre of last-formed chamber.

Paratypes: A: Test megalospheric, shorter than holotype but with globular proloculus followed by seven uniserial chambers. Aperture slightly protruding. B: Test microspheric, longer than holotype, initial portion broken, test tapering rather sharply from initial end to apertural chamber. Periphery rounded but slightly acute in initial portion. Fifteen chambers with at least seven in lower third. Sulcate along median axis. Aperture very slightly protruding. C: Test microspheric, large, initial portion broken, but seventeen chambers visible. Test tapering sharply in initial end becoming wider and with almost parallel sides in the middle and upper thirds. Sulcus becoming more pronounced towards apertural chamber.

Dimensions:

—	Length.	Maximum Width.	Thickness.
	mm.	mm.	mm.
Holotype	1.00	0.35	0.22
Paratype A	0.85	0.50	0.24
Paratype B	1.30+	0.50	0.25
Paratype C	1.50	0.60	0.27

Occurrence: Holotype (C.P.C. 2596) and paratypes A and B (C.P.C. 2597, 2598), Freney Kimberley Oil Company, Nerrima No. 1 Bore, 129 feet, Noonkanbah Formation. Paratype C (C.P.C. 2599), BMR No. 1 Bore, Jurgurra Creek, at 494 feet, Noonkanbah Formation.

Other material: Locality 3, Cattle Creek Formation; 7, Ingelara Formation; 10, Mantuan *Productus* Bed. 153 (3,115-3,120 feet), equivalent of Callytharra Formation; 156 (59 feet), Noonkanbah Formation.

Observations: Geinitzina striatosulcata is a striking species with its deeply sulcate longitudinal median axis and its numerous delicate striae. It cannot be compared with any described species of *Geinitzina*. The striations in *Spandelina fissicostata* Cushman and Waters (1928d) are fewer and coarser than in the present species. *Geinitzina ciscoensis* Cushman and Waters, which is a

smooth form, has a strong depression along the median axis. *G. striatosulcata* shows considerable variation in shape and size of tests, but the straight shouldered portion of the apertural chamber is characteristic.

GEINITZINA TRIANGULARIS Chapman and Howchin.

(Plate 30, figures 8-11; plate 31, figure 8.)

Geinitzina triangularis Chapman and Howchin, 1905, p. 16, pl. 2, figs. 9*a, b*; 10.

Geinitzina postcarbonica Chapman and Howchin (*non* Spandel), 1905, p. 17, pl. 4, fig. 5.

Geinitzina chapmani Schubert, 1915, p. 58, pl. 39, (1), fig. 4; text figs. 1-5.

Geinitzina triangularis, Chapman, Howchin and Parr, 1934, p. 180, text figs. 1-5. Crespin, 1945, p. 29, pl. 3, figs. 14, 15; 1947, p. 21, pl. 1, figs. 14, 15.

"Test sub-triangular or triangular, compressed, decidedly hollowed along the median longitudinal axis. Primoidal chamber globular, the remainder crescentic or feebly chevroned one within the other. More rarely the shells exhibit a flabelline commencement."

Dimensions of figured specimens:

	Length.	Maximum Width.	Thickness.
	mm.	mm.	mm.
Hypotype A	0.73	0.55	0.14
Hypotype B	0.75	0.35	0.15
Hypotype C	0.80	0.30	0.18
Hypotype D	0.80	0.45	0.18
Hypotype E	0.56	..	..

Occurrence: Hypotype A (C.P.C. 285), Pokolbin, Dalwood Group. Hypotype B (C.P.C. 2600), most north-easterly outcrop of Mantuan *Productus* Bed, Reid's Dome, 2.3 miles south-south-west of Springwood and 32 miles south-east of Springsure. Hypotypes C and E (C.P.C. 2601, 2901), Fossil Cliff, Fossil Cliff Formation. Hypotype D (C.P.C. 2602) from Giralia No 1 Bore, at 3,220-3,240 feet, equivalent of Callytharra Formation.

Other material: Locality 1, 2, 3, Cattle Creek Formation; 7, 9, Ingelara Formation; 14, Aldebaran Creek Group. 22, 25, Dalwood Group; 30, 32, Branxton Subgroup. 57, Darlington Limestone. 66, 67, 68, 70, 73, 76, Callytharra Formation; 153 (3,115-3,120 and 3,220-40 feet), equivalent of Callytharra Formation; 134, 135, Fossil Cliff Formation; 156 (56, 69 and 129 feet), 159 (494 feet), 161 (1,860 feet), Noonkanbah Formation.

Observations: Chapman, Howchin and Parr (1934) discuss at length the genus *Geinitzina* Spandel and its relationship with *Spandelina* Cushman and showed the variation within the species *G. triangularis.* Cushman (1928, 1933, 1950) placed the genus in the family Textulariidae, stating that the tests were

finely arenaceous. However, Chapman and Howchin (1905) considered it to be calcareous, placing the genus in the family Lagenidae, and with Parr (1934) confirmed this position.

Chapman, Howchin and Parr (1934) revised the determination of *Geinitzina postcarbonica* Spandel (Chapman and Howchin 1905), placing it in the synonomy of *G. triangularis.* Schubert (1915) in this paper on the foraminifera of the younger Palaeozoic of Timor, described a new species of *Geinitzina, G. chapmani,* and included the figures of *G. postcarbonica* of Chapman and Howchin (1905) in its synonymy. It is considered by the writer that *G. chapmani* should come within the variable species *G. triangularis.*

G. triangularis is widely distributed in the Permian rocks of Australia, but it is restricted to the lower part of the sequence. The variation in shape is illustrated in the figured specimens.

Family ROTALIIDAE.

Subfamily SPIRILLININAE.

Genus SPIRILLINA Ehrenberg, 1843.

SPIRILLINA PAPILLO-DENTATA sp. nov.

(Plate 16, figures 10, 11.)

Diagnosis: Closely coiled on dorsal surface with grooves radiating and extending from wall of preceding whorl. Ventral surface flat and covered with papillae.

Holotype: Test minute, circular, compressed, with a coiled spiral visible on the dorsal side and with a flat papillate surface covering the coil on the ventral side. The dorsal side shows a minute globular proloculus, followed by a closely coiled unbroken chamber of at least nine whorls, the early ones too minute to distinguish, then gradually enlarging; whorls slightly overlapping on ventral side. Dorsal side gently concave and ornamented with fine conspicuous grooves which radiate from the inner side of the preceding whorl. The ventral side is flat and covered with small papillae. Periphery rounded. Wall calcareous, translucent, imperforate. Aperture crescentic at open end of tube.

Dimensions: Diameter of holotype, 0.55 mm.; thickness, 0.092 mm.

Occurrence: Holotype (C.P.C. 2605), Giralia Bore No. 1, at 3,115-3,120 feet (Core No. 66) equivalent of Callytharra Formation.

Observations: S. papillo-dentata closely resembles *S. concavo-convexa* Galloway and Ryniker, 1930, from the Lower Permian of Oklahoma, the only species of *Spirillina* recorded from the Upper Palaeozoic. The Western Australian form differs from that species in the flat, papillate ventral surface and the slightly concave dorsal surface. The papillate ventral surface is similar to that found in the Recent species *S. tuberculata* Brady. Many specimens were present in Core No. 66, Giralia Bore No. 1, but most of them were crushed or distorted.

ACKNOWLEDGMENTS.

The assistance of many people in the preparation of this Bulletin is gratefully acknowledged. Amongst these are Dr. Dorothy Hill, University of Queensland, and Mr. A. K. Denmead, Chief Government Geologist of Queensland; Dr. F. W. Booker, Government Geologist, New South Wales, Mr. H. O. Fletcher, Australian Museum, Sydney, and Dr. P. J. Coleman, Geology Department, University of Sydney; Mr. M. R. Banks, Geology Department, University of Tasmania; and Dr B. F. Glenister, Geology Department, University of Western Australia. Appreciation is extended to West Australian Petroleum Pty. Ltd., Associated Freney Oilfields Ltd. and Australian Oil and Gas Corporation for permission to use foraminiferal material from their bores in Western Australia and New South Wales. Two colleagues in the Bureau of Mineral Resources deserve special thanks: D. J. Belford, who prepared thin sections and photographed foraminifera, and Frank Hadzel, who drew the beautiful illustrations shown in the plates.

LOCALITIES OF DESCRIBED SPECIMENS.

SURFACE.

QUEENSLAND.

Springsure Area.

Cattle Creek Formation.

1. Cattle Creek, below waterfall.
2. Cattle Creek, 2 ml. upstream from junction with Consuelo Creek.
3. *Eurydesma* Bed, north-east flank of Reid's Dome, 140 ch. SE. of Serocold Trig.
4. Watershed between Little Gorge and Cabbage Tree Creeks.

Ingelara Formation.

5. Dry Creek, Ingelara Property.
6. Between Sandy and Dry Creeks, S. end of Serocold Anticline.
7. 3 ml. from Cracow on Theodore Rd.
8. Argus's Selection.
9. 2.5 ml. from Mantuan Downs on Springsure Rd.

Mantuan Productus *Bed.*

10. Most NE. outcrop, Reid's Dome, 2.3 ml. SSW. of Springwood.

Aldebaran Creek Group, undifferentiated.

11. Staircase Creek, just below Rolleston Rd. crossing.
12. Staircase Creek, base of Mt. Sirius.
13. Aldebaran Creek, 4 ml. NE. of Mt. Catherine.
14. Mt. Hope section, 24 ml. SE. of Springsure.

"*Middle Bowen Marine Series*".

15. 45 ch. at 124° from Scottville railway terminus, Springlands.

NEW SOUTH WALES.

Hunter River Area.

Dalwood Group.

16. Pokolbin.
17. Allandale Railway Station.
18. Main North Rd. W. of Allandale turnoff.
19. Railway cutting W. of Farley Station.
20. 300 yards NE. of Farley Station on Farley Rd.
21. Maitland Rd., south side of Greta.
22. Cranky Corner.
23. Harpers Hill section.
24. Jacksons Hill section.
25. G. D. Osborne Collection "locality OS 264".

Branxton Subgroup.

26. Railway cutting S. of Branxton Station, near bridge.
27. Fosters Bridge section, W. side Mulberry Creek.
28. Railway cutting W. of Pothanna Siding, 20 ft. above *Fenestella* Shale.
29. Neath opencut, Cessnock.
30. Wollong.
31. Cutting N. side of railway bridge, ¼ ml. E. of Muswellbrook.
32. Left bank Loders Creek, ¼ ml. NW. of Broke turnoff.
33. Abbey Green, S. of road in small creek off Loders Creek.

Mulbring Subgroup.

34. 7 ml. S. of Singleton, junction of New England Hwy. and Minimbah Stock Route.
35. 9 ml. S. of Singleton, New England Hwy.
36. McDougalls Hill, near Singleton.
37. Jerrys Plains, near Singleton.
38. Left bank Hunter River, Long Point, near Singleton.
39. John Brown's Reservoir, Eastern spillway, Mulbring-Buchanan Rd.
40. Hebden, portion 148, parish Liddell.
41. Railway cutting immediately W. of Minimbah.
42. Box Tree Hill cutting, Goorangoola Rd
43. Mt. Thorley, Warkworth Rd.
44. Pelaw-Richmond Main railway section.
45. Saw Mill, Mulberry Creek.
46. Cutting E. of Minimbah Station.
47. Padulla Siding, Muswellbrook-Singleton Railway.

Sydney Area.

Capertee Group.

48. Victoria Pass section, Mitchell Hwy.

Southern Area.

Wandrawandian Siltstone.

49. Princes Hwy, near Tomarong.

Berry Shale.

50. Nowra Hill.

TASMANIA.

Quamby Mudstone.

51. Road Cutting, Oonah, 23 ml. W. of Waratah on Somerset-Waratah Rd.
52. Mouth of Tasmanite adit, Latrobe (Bakes Oil Shale Member).

Golden Valley Group.

53. West bank Don River, 5 yds. upstream from Barrington Rd. bridge.
54. Quamby Brook, 10 ml. S. of Deloraine.

Darlington Limestone.

55. Hill E. of Karoola-Bangor Rd., just N. of bridge over Piper R., ½ ml. from Karoola. ("Lilydale.")
56. *Eurydesma* Bed, Woody Island.
57. Sandy Bay Shoreline, Hobart.

Gray Limestone.

58. Elephant Pass, 5½ ml. SE. of St. Marys.

Berriedale Limestone.

59. Rathbones Quarry, Mt. Nassau.
60. Upper Berriedale Quarry.

Formation unknown.

61. 3.15 ml. SE. of Sassafras, 48 miles from Launceston.
62. Mt. Sedgwick.

WESTERN AUSTRALIA (Field sample nos. refer to Bureau of Mineral Resources' collection).

Carnarvon Basin.

Lyons Group.

63. Dairy Creek Station, 16½ ml. S. of homestead (GW 10).
64. Kialiwibri Creek, 17 ml. SE. of Winning Homestead (ML 110).

Callytharra Formation.

65. 3.5 ml. at 143° from Thambrong Pool, Williambury Station (CT59, CT349).
66. 1.5 ml. WNW. of Coordewandy Homestead (WB203, WB204, WB206).
67. Wyndham Gap, Bidgemia Station (COR94, COR96, COR98).
68. Pells Range (GW114, 116, 117, 119, 120, 123, 125).
69. Pells Crossing, Gascoyne Jctn-Meekatharra Rd.
70. Callytharra Springs (GW74, 82, 84, 85, 86, 138, PAC1).
71. Section near mouth of Salt Gully (COR115).
72. 29 ml. S. of W. of Dairy Creek Homestead (GW51).
73. Arthur River, 18 ml. ENE. of Bidgemia Homestead (G192)
74. 2 ml. W. of Carey Downs turnoff, Byro-Glenburg Rd.
75. 1 ml. ENE. of K55 trig., Middalya Station.
76. Lyndon River, 15½ ml. SE. of Winning Homestead (ML100).
77. 5 ml. NE. of Dairy Creek, near Minginew Homestead.
78. 12 ml. S. of Lyons River Homestead (GW192?).

Coyrie Formation.

79. 4.4-4.8 ml. SW. of Moogooree Homestead (ML7, ML10, G239, G240).
80. 9 ml. WSW. of Williambury Homestead (MG148).
81. Well, 15 ml. E. of S. of Bidgemia Homestead (GW56).

Madeline Formation.

82. Wooramel River, 2¼ ml. W. of Madeline Creek (WB83).
83. 4½ ml. E. of S. of Callytharra Springs (WB12, WB61).
84. 8¼ ml. ENE. of Callytharra Springs (WB85).

Mallens Greywacke.

85. 2¼ ml. SE. of Donnelly's Well, Williambury Station (G308).

Bulgadoo Shale.

86. 2¼ ml. SE. of Donnelly's Well, Williambury (G309, 310, MG235).
87. Nannigo Dam, Middalya Station (MG101).
88. 1½ ml. ESE. of Cundlego Crossing, Minilya River (G211).
89. Yearlit Dam, Wandagee Station (MG109).
90. Minilya River, ¼ ml. upstream from Wandagee Homestead (PR136, 138, 139, 141, OS123, 125).
91. Minilya R. 3½ ml. NW. of Wandagee Homestead (ML74).
92. Minilya River, ¼ ml. upstream from Garden Outcamp, Wandagee Stn (COR134).
93. 1-1½ ml. SW. of Nalbia Dam, Wandagee Station (CT76, 77).
94. 3 ml. at 231° from Burna Burna Hill, Wandagee-Mia Mia Rd.
95. Barrabiddy Dam, Wandagee Station (MG110).
96. 4 ml. SSE. of Barrabiddy Outcamp, Wandagee Stn. (MG188).
97. 3 ml. ESE. of Merlinleigh Homestead (G352).
98. 12 ml. S. of Lyons River Homestead.

Warrawarringa Formation.

99. ¼ ml. NW. of Bogadi Outcamp (WB101).

Cundlego Formation.

100. Cundlego Crossing, Minilya River.
101. 6,500 ft. SE. of Cundlego Crossing (G241).
102. Gascoyne River, right bank, 2 ml. below Bidgemia Homestead (COR105).
103. Gascoyne River, left bank, opposite hotel (COR107).
104. Gascoyne River, left bank, ¼ ml. below hotel (COR108).

Quinnanie Shale.

105. Minilya River, south bank, near Coolkilya Pool.
106. Coolkilya Paddock, extreme SE. end, Wandagee Station.
107. 5½ ml. WSW. of Wandagee Homestead (MG243).

Wandagee Formation.

108. East flank Minilya Syncline, on Minilya R., 7 ml. N. of W. of Wandagee Homestead (G243).
109. E. of Coolkilya Paddock, Wandagee Station.
110. 5½ ml. WSW. of Wandagee Homestead (MG241).
111. Nalbia Paddock, 110 ch. E. of Wandagee Hill Trig.
112. 2 ml. E. of K39 Trig., on right bank of creek (COR 114).
113. 1.9 ml. W. of S. of Merlinleigh Homestead (G327).
114. 16 ml. NNW. of Bidgemia Station (G321).

Baker Formation

115. 16 ml. NNW. of Bidgemia Station (G323).
116. 3.5 ml. S. of Paddy's Outcamp, Middalya Station (MG179).
117. Southern Cross Bore section, 1.2 ml. SSE. of Syera Well, Middalya Station (ML112).

Coolkilya Greywacke.

118. S. end of Middalya Station, 3.7 ml. SW. of Muderong Bore (MG225).

Formation Doubtful.

119. Minilya Rd. Coolkilya Flat, E. limb of Minilya Syncline, N. of Wandagee Hill (Baker?)
120. 1 ml. below Wyndham Gap, Bidgemia Station (Callytharra?) (OS101).
121. Coolkilya Flat, 1 ml. S. of Wandagee-Garden Rd. and 1 ml. E. of telephone line.
122. 8 ml. S. of Arthur River Station Outcamp.

Canning Basin.

Nura Nura Member of Poole Sandstone.

123. 1 ml. NW. Liveringa Homestead.
124. 1.6 ml. SW. of Paradise, Mt. Wynne Dome.
125. Low scarp S. of Hill "G", S. of road, Grant Range.

Noonkanbah Formation.

126. Brutens Yard (KNF76C, KNF85B, KNF87B, KNF88A).
127. South of Grant Range (KNA39A).
128. Outcrop near BMR No. 1 Bore, Jurgurra Creek.
129. Mount Marmion section.

Dora Shale.

130. N. end of Lake Dora.
131. Scotts Bluff, Lake Blanche.

Liveringa Formation, Hardman Member.

132. Foot of Mt. Hardman.

Irwin Basin.

Nangetty glacials.

133. Mullewa Creek, E. of Newton's Tank, Nangetty Station.

Fossil Cliff Formation.

134. Fossil Cliff.
135. Becketts Gully.

SUBSURFACE.

QUEENSLAND.

136. Arcadia Bore.

NEW SOUTH WALES.

137. BMR No. 1 (S.C.) St. Heliers.
138. BMR No. 1 (S) Ravensworth.
139. BMR No. 2 (S) Mt. Arthur.
140. BMR No. 3 (S) Edinglassie.
141. BMR No. 4 (T) Ponds Creek.
142. BMR No. 6 (S) Ponds Creek.
143. BMR No. 10 (T) Ponds Creek.
144. BMR No. 11 (T) Ponds Creek.
145. BMR No. 14 (T) Ponds Creek.
146. BMR No. 76 (T) Parnells Creek.
147. Stanford Main No. 1 Colliery Bore.
148. Stanford Main No. 2 Colliery Bore, Coongewai.

Sydney Area.

149. Balmain Colliery Bore.
150. Dural East No. 1.
151. Kulnura Bore (¾ ml. S. of Kooree Trig.).
152. Kurrajong Heights No. 1.

WESTERN AUSTRALIA.

Carnarvon Basin.

153. WAPET Giralia No. 1.

Canning Basin.

154. WAPET Dampier Downs No. 1.
155. WAPET Roebuck Bay No. 1.
156. FKO Nerrima No. 1.
157. AFO Nerrima No. 1.
158. AFO Myroodah No. 1.
159. BMR No. 1 Jurgurra Creek.
160. BMR Water Bore, Jurgurra Creek.
161. Derby Town Bore.
162. Dusty Creek Bore, 10 ml. NW. of Christmas Creek Station.

NORTHERN TERRITORY.

163. No. 3 Bore, Port Keats.

BIBLIOGRAPHY.

BANKS, M. R., 1952.—Permian, Triassic and Jurassic rocks in Tasmania. *XIXième Cong. int. géol., Alger, Symp. Gondwanald,* 63-88.

BANKS, M. R., 1956.—The Permian System in Tasmania. *XXth int. geol. Cong., Mexico, Resum. Trab. Present.* p. 381.

BANKS, M. R., 1957.—The stratigraphy of Tasmanian limestones. *In* Hughes, *Geol. Surv. Tas. Min. Resour.* 10, 39-85.

BANKS, M. R., and HALE, G. E. A., 1957.—A type section for the Permian System in the Hobart area. *Pap. Roy. Soc. Tas.,* 91, 41-64.

BANKS, M. R., and YAXLEY, M. L., 1955.—The Permian rocks of Woody Island, Tasmania. *Ibid.,* 89, 218-229.

BANKS, M. R., LOVEDAY, J. L., and SCOTT, D. L., 1955.—Permian varves from Wynyard, Tasmania. *Pap. Roy. Soc. Tas.,* 89, 203-218.

BARTENSTEIN, H., 1948.—Entwicklung der Gattung *Lenticulina* (*Lenticulina*) Lamarck 1804 mit ihren unteren Gattungen. *Senckenbergiana,* 29 (1/1), 41-.65.

BRADLEY, J., 1954.—The geology of the West Coast Range of Tasmania. *Pap. Roy. Soc. Tas.,* 88 (for 1953), 193-243.

BRADY, H. B., 1876.—A monograph of Carboniferous and Permian Foraminifera (the genus *Fusulina* excepted). *Palaeontogr. Soc. Monogr.* 30, 1-66.

BRADY, H. B., 1884.—Report on the foraminifera dredged by H.M.S. "Challenger" during the years 1873-1876. *Rept. Voy. Challenger, Zoology,* 9.

BRANSON, C. C., 1948.—Bibliographic index of Permian invertebrates. *Mem. geol. Soc. Amer.* 26.

BRILL, K. G., and HALE, G. E., 1954.—Geological map of the north-western end of Tasman peninsula—a revision. *Pap. Roy. Soc. Tas.,* 88 (for 1953), 279-284.

BROWN, I. A., 1953.—Permian Spirifers from Tasmania. *J. Roy. Soc. N.S.W.,* 86, 55-63.

BRUNNSCHWEILER, R. O., 1954.—Mesozoic stratigraphy and history of the Canning Desert and Fitzroy Valley, Western Australia. *J. geol. Soc. Aust.,* 1, 35-54.

BRYAN, W. H., and JONES, O. A., 1946.—The geological history of Queensland. A stratigraphical outline. *Dep. Geol. Univ. Qld Pap.* 2 (N.S.) (12), 1-103.

CAREY, S. W., 1947.—Geology of the Launceston district. *Rec. Queen Vict. Mus. Launceston* (for 1946), 2, 31-46.

CHAPMAN, F., 1894.—The Bargate Beds of Surrey and their microscopic contents. *Quart. J. geol. Soc. Lond.,* 50, 677-730.

CHAPMAN, F., 1907.—Notes on fossils from the Collie Coalfield, Western Australia, in the collection of the National Museum, Melbourne. *Geol. Surv. W. Aust. Bull.* 27, 9-18.

CHAPMAN, F., 1933.—Note on our present knowledge of the Permian Foraminifera of Western Australia. *Rep. Aust. Ass. Adv. Sci.* 1932, 21, 453-454.

CHAPMAN, F., and HOWCHIN, W., 1905.—A monograph of the Foraminifera of the Permo-Carboniferous limestone of New South Wales. *Geol. Surv., N.S.W., palaeont. Mem.* 14, 1-22.

CHAPMAN, F., and PARR, W. J., 1934.—A revision of the nomenclature of the Permian Foraminifera of New South Wales. *Proc. Roy. Soc. Vic.,* n.s., 47 (1), 175-189.

CHAPMAN, F., and PARR, W. J., 1937.—On the discovery of Fusulinid Foraminifera in the Upper Palaeozoic of North-West Australia; with a note on a new bivalve. *Vic. Nat.,* 53, 175-179.

CHERDYNZEV, W., 1914.—Zur Foraminiferen Fauna der permischen Ablagerungen des östlichen Teils des europäischen Russlands. *Kazan Univ., Soc. Nat. Trans.* 46 (5), 27.

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.,* (1948-49), 35, 31-84.

CONDIT, D. D., RAGGATT, H. G., and RUDD, E. A., 1936.—Geology of North-west Basin, Western Australia. *Bull. Amer. Ass. Petrol. Geol.,* 20 (8), 1028-1070.

CONDON, M. A., 1954.—Progress report on the stratigraphy and structure of the Carnarvon Basin, Western Australia. *Bur. Min. Resour. Aust. Rep.* 15.

CONKIN, J. E., 1954.—*Hyperammina kentuckeyensis* n. sp. from the Mississippian of Kentucky and discussion of *Hyperammina* and *Hyperamminoides*. *Contr. Cushman Fdn*, 1 (4), 165-169.

CONKIN, J. E., 1956.—"*Nodosinella* Brady, 1876, and associated Upper Paleozoic genera"—a comment. *Micropaleontology*, 2 (2), 193.

COOPER, C. L., 1947.—Upper Kincaid (Mississippian) microfauna from Johnson County, Illinois. *J. Paleont.*, 21 (2), 81-94.

CRESPIN, I., 1939.—Foraminifera in the Permian rocks of Australia. *Rep. Aus. Ass. Adv. Sci.*, 24, 94.

CRESPIN, I., 1943.—Permian Foraminifera from a bore at Coorabin, New South Wales. *Aust. J. Sci.*, 6 (2), 55.

CRESPIN, I., 1944.—Permian Foraminifera from Oonah, Tasmania. *Ibid.*, 8 (2), 59.

CRESPIN, I., 1945.—Some Permian Foraminifera from eastern Australia. *Proc. Roy. Soc. Qld*, 56 (3), 23-30.

CRESPIN, I., 1947.—Foraminifera in the Permian rocks of Australia. *Bur. Min. Resour. Aust. Bull.* 15.

CRESPIN, I., 1950.—Foraminifera in Australian stratigraphy. *XVIIIth int. geol. Cong., Gt. Britain*, 1948, 15, 65-69.

CRESPIN, I., 1955.—Bibliography of Australian Foraminifera. *Micropaleontology*, 1 (2), 172-188.

CRESPIN, I., and BELFORD, D. J., 1957.—New genera and species of Foraminifera from the Lower Permian of Western Australia. *Contr. Cushman Fdn*, 8 (2), 73-76, 80-81.

CRESPIN, I., and PARR, W. J., 1941.—Arenaceous Foraminifera from the Permian rocks of New South Wales. *J. Roy. Soc. N.S.W.*, 74, 300-311.

CROCKFORD, J., 1943.—Bryozoa from the Port Keats Bore, Northern Territory. *Proc. Linn. Soc. N.S.W.*, 68 (3-4), 145-149.

CROCKFORD, J., 1951.—The development of bryozoan faunas in the Upper Palaeozoic of Australia. *Ibid.*, 76 (3-4), 105-122.

CUMMINGS, R. H., 1955.—*Nodosinella* Brady 1876, and associated Upper Palaeozoic genera. *Micropaleontology*, 1 (3), 221-238.

CUMMINGS, R. H., 1956.—Revision of the Upper Palaeozoic textularid foraminifera. *Ibid.*, 2 (3), 201-242.

CUSHMAN, J. A., 1928.—FORAMINIFERA. THEIR CLASSIFICATION AND ECONOMIC USE. 1st Edn. *Contr. Cushman Lab. Spec. Publ.* 1.

CUSHMAN, J. A., 1939.—Paleozoic Foraminifera, their relationships to modern faunas and to their environment. *J. Paleont.*, 9, 284-287.

CUSHMAN, J. A., 1950.—FORAMINIFERA. THEIR CLASSIFICATION AND ECONOMIC USE. 4th Edn. Harvard, University Press.

CUSHMAN, J. A., and WATERS, J. A., 1927.—Pennsylvanian Foraminifera from Michigan. *Contr. Cushman Lab.*, 3 (2), 107-110.

CUSHMAN, J. A., and WATERS, J. A., 1927a.—Arenaceous Paleozoic Foraminifera from Texas. *Ibid.*, 3 (3), 146-153.

CUSHMAN, J. A., and WATERS, J. A., 1928a.—Some Foraminifera from the Pennsylvanian and Permian of Texas. *Ibid.*, 4 (2), 31-55.

CUSHMAN, J. A., and WATERS, J. A., 1928b.—Additional Cisco Foraminifera from Texas. *Ibid.*, 4 (3), 62-67.

CUSHMAN, J. A., and WATERS, J. A., 1928c.—*Hyperamminoides*, a new name for *Hyperamminella* Cushman and Waters. *Ibid.*, 4 (4), 112.

CUSHMAN, J. A., and WATERS, J. A., 1928d.—Upper Paleozoic Foraminifera from Sutton County, Texas. *J. Paleont.*, 2 (4), 358-371.

CUSHMAN, J. A., and WATERS, J. A., 1930.—Foraminifera of the Cisco Group of Texas. *Univ. Tex. Bull.*, 3019, 22-81.

DAVID, T. W. E., ed. BROWNE, W. R., 1950.—THE GEOLOGY OF THE COMMONWEALTH OF AUSTRALIA. 1. London, Edward Arnold.

EHRENBERG, C. G., 1843.—Über die Verbreitung des jetzt wirkenden kleinsten organischen Lebens in Asien, Australien und Afrika, und Bildung auch des Oolithkalkes der Juraformation aus kleinen polythalamischen Tieren. *Ber. preuss. Akad. Wiss., Berlin*, 100-106.

EHRENBERG, C. G., 1854.—MIKROGEOLOGIE. Leipzig, L. Voss. 1-374.

EICHWALD, E. d', 1860.—LETHAEA ROSSICA, ou Paléontologie de la Russie; Première section de l'ancienne période. Stuttgart, E. Schweizerbart. 1, 355.

ELIAS, M. K., 1937.—Depth of Deposition of the Big Blue (Late Paleozoic) sediments in Kansas. *Bull. geol. Soc. Amer.*, 48, 403-432.

ELLIS, B. F., and MESSINA, A. R., 1940 onwards.—Catalogue of Foraminifera. *Amer. Mus. nat. Hist. Spec. Publ.*

ETHERIDGE, R., 1907.—Fossils of the Port Keats Bore, thirty miles north of Fossil Head, Treachery Bay. *Suppl. Parl. Pap. (S. Aust.)*, 55, for 1906.

FAIRBRIDGE, R. W., 1949.—Geology of the country around Waddamana, Central Tasmania. *Pap. Roy. Soc. Tas.* (for 1948), 111-149.

FAIRBRIDGE, R. W., 1952.—The Permian of south western Australia. *XIXième Cong. géol. int. Alger, Symp. Gondwanald*, 136-146.

FAIRBRIDGE, R. W., 1953.—AUSTRALIAN STRATIGRAPHY. Perth, Univ. W. Aust. Text Book Bd.

FLETCHER, H. O., 1939.—Palaeontological evidence of the Hunter Valley in regard to the boundary between the Permian and Carboniferous Systems. *Rep. Aust. Ass. Adv. Sci. (Canberra)*, 24, 91.

GALLOWAY, J. J., 1933.—A MANUAL OF FORAMINIFERA. Bloomington, Indiana.

GLAESSNER, M. F., 1945.—PRINCIPLES OF MICROPALAEONTOLOGY. Melbourne, Univ. Press.

GLAESSNER, M. F., LLEWELLYN, K. M., and STANLEY, G. A. V., 1950.—Fossiliferous rocks of Permian age from the Territory of New Guinea. *Aust. J. Sci.*, 13, 24-25.

GUPPY, D. J., CUTHBERT, J. O., and LINDNER, A. W., 1950.—Geology of the Nerrima Dome, Kimberley Division, Western Australia. *Bur. Min. Resour. Aust. Rep.* 4.

GUPPY, D. J., LINDNER, A. W., RATTIGAN, J. H., and CASEY, J. N., 1952.—The stratigraphy of the Mesozoic and Permian sediments of the Desert Basin Western Australia. *XIXième Cong. géol. int. Alger, Symp. Gondwanald.*

GUPPY, D. J., LINDNER, A. W., RATTIGAN, J. H., and CASEY, J. N., 1958.—The geology of the Fitzroy Basin, Western Australia. *Bur. Min. Resour. Aust. Bull.* 36.

HANLON, F. N., JOPLIN, G. A., and NOAKES, L. C., 1953.—Review of stratigraphical nomenclature. 2. Permian units of the Illawarra district. *Aust. J. Sci.*, 15 (5), 160-164.

HARLTON, B., 1933.—Micropaleontology of the Pennsylvanian Johns Valley Shale of the Ouachita Mountain, Oklahoma, and its relationship to the Mississippian Caney Shale. *J. Paleont.*, 7 (1), 3-29.

HERON-ALLEN, E., and EARLAND, A., 1932.—Some new foraminifera from the South Atlantic, IV. *J. roy. microsc. Soc., Lond.*, 3, 52 (3), 253-264.

HILL, D., 1955.—Contributions to the correlation and fauna of the Permian in Australia and New Zealand. *J. geol. Soc. Aust.*, 2 (for 1954), 83-107.

HILL, D., 1957.—Explanatory Notes on the Springsure 4-mile Geological Sheet. *Bur. Min. Resour. Aust. Note Ser.* 5, 3-19.

HOWCHIN, W., 1894.—A census of the fossil Foraminifera of Australia. *Aust. Ass. Adv. Sci. (Adelaide*, 1893), 1, 25.

HOWCHIN, W., 1894.—On the occurrence of Foraminifera in the Permo-Carboniferous rocks of Tasmania. *Ibid.*, 334.

HOWCHIN, W., 1895.—Carboniferous Foraminifera of Western Australia with descriptions of new species. *Trans. Roy. Soc. S. Aust.*, 19, 194-198.

HUGHES, T. D., 1957.—Limestones in Tasmania. *Geol. Surv. Tas. Min. Resour.* 10.

HUZIMOTO, H., 1936.—Stratigraphical and palaeontological studies of the Titibu System of the Kwanto Mountainland. Part II. Palaeontology. *Tokyo Bunrika Diag., Sci. Rep. Sect.* C.1 (2), 29-125.

IRELAND, H. A., 1956.—Upper Pennsylvanian arenaceous Foraminifera from Kansas. *J. Paleont.*, 30 (4), 831-864.

JOHNSON, W., DELAHUNTY, 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.

JOHNSON, R. M., 1888.—GEOLOGY OF TASMANIA. Tasmania, Govt. Printer.

JONES, T. R., 1882.—Catalogue of the Fossil Foraminifera in the British Museum (Natural History) London.

LEWIS, A. N., 1946.—THE GEOLOGY OF THE HOBART DISTRICT. Hobart, Royal Society of Tasmania.

LOEBLICH, A. R., and TAPPAN, H., 1950.—North American Jurassic Foraminifera: The Type Redwater Shale (Oxfordian) of South Dakota. *J. Paleont.*, 24 (1), 39-60.

LOEBLICH, A. R., and TAPPAN, H., 1955.—A revision of some glanduline Nodosariidae (Foraminifera). *Smith. misc. Coll.*, 126 (3), 2-9.

LUDBROOK, N. H., 1957.—Permian Foraminifera in South Australia. *Aust. J. Sci.*, 19 (4), 161.

MCKELLAR, J. B. A., 1957.—Geology of portion of the Western Tiers. *Rec. Queen Vict. Mus. Launceston*, 7, n.s., 1-13.

MILLER, H. W., and SWINEFORD, A., 1957.—Paleoecology of Nodulose Zone at top of Haskell Limestone (Upper Pennsylvanian) in Kansas. *Bull. Amer. Ass. Petrol. Geol.*, 41 (9), 2012-2036.

MÖLLER, V. VON, 1879.—Die Foraminiferen des russischen Kohlenkalks. *Mem. Acad. Sci. St Petersb.*, ser. 7, 27 (1880), 1-131.

MOREMAN, W. L., 1930.—Arenaceous Foraminifera from Ordovician and Silurian Limestones of Oklahoma. *J. Paleont.*, 4 (1), 42-59.

NOAKES, L. C., OPIK, A. A., and CRESPIN, I., 1952.—Bonaparte Gulf Basin, North Western Australia. A stratigraphic summary with special reference to the Gondwana System. *XIXième Cong. int. géol. Alger, Symp. Gondwanald*, 91-106.

OSBORNE, G. D., 1949.—The stratigraphy of the Lower Marine Series of the Permian System in the Hunter River Valley. *Proc. Linn. Soc. N.S.W.*, 74, 205-223.

PAALZOW, R., 1935.—Die Foraminiferen im Zechstein des östlichen Thüringen. *Jb. preuss. geol. Landesanst.*, 56, 26-45.

PARR, W. J., 1942.—Foraminifera and a tubiculous worm from the Permian of the North-West Division of Western Australia. *J. roy. Soc. W. Aust.*, 27, 97-115.

PHLEGER, F. B., 1954.—Ecology of Foraminifera and associated micro-organisms from Mississippi Sound and Environs. *Bull. Amer. Ass. Petrol. Geol.*, 38 (4), 584-647.

PLUMMER, H. J., 1930.—Calcareous Foraminifera in the Brownwood Shale near Bridgeport, Texas. *Univ. Texas Bull.* 3019, 5-21.

PLUMMER, H. J., 1945.—Foraminifera in the Marble Falls, Smithwick, and lower Strawn Strata around the Llano Uplift in Texas. *Ibid.*, 4401, 209-271.

PRIDER, R. T., 1948.—The geology of the country around Tarraleah, Tasmania. *Pap. Roy. Soc. Tas.* (for 1947), 127-150.

RAGGATT, H. G., 1936.—Geology of the North-west Basin, Western Australia, with particular reference to the stratigraphy of the Permo-Carboniferous. *J. Roy. Soc. N.S.W.*, 70, 100-174.

RAGGATT, H. G., 1939.—Age significance of correlation of Permian of east-central New South Wales with other sequences of the Gondwana region. *Rep. Aust. Ass. Adv. Sci.* (*Canberra*), 24, 91.

RAGGATT, H. G., 1950.—Stratigraphic Nomenclature. *Aust. J. Sci.*, 12, 170.

RAGGATT, H. G., and CRESPIN, I., 1940.—"Possibility of heavy-mineral correlation of some Permian sedimentary rocks, New South Wales", by Dorothy Carroll.—Discussion. *Bull. Amer. Petrol. Geol.*, 24, 1672.

RAGGATT, H. G., and CRESPIN, I., 1941.—Geological notes on Natural Gas and Oil Corporation's Bore at Balmain, City of Sydney, New South Wales. *Aust. J. Sci.*, 4 (3), 102.

RAGGATT, H. G., and FLETCHER, H. O, 1937.—A contribution to the Permian-Upper Carboniferous problems and an analysis of the fauna of the Upper Palaeozoic (Permian) of North-West Basin, Western Australia. *Rec. Aust. Mus.*, 22 (2), 150-184.

REYNOLDS, M. R., 1956.—The identification of the boundary between coal measures and marine beds, Singleton-Muswellbrook district, New South Wales. *Bur. Min. Resour. Aust. Rep.* 28.

RICKWOOD, F. K., 1955.—The Geology of the Western Highlands of New Guinea. *J. geol. Soc. Aust.*, 2, 63-82.

SCHUBERT, R. J., 1908.—Zur Geologie des österreichischen Velebit. *Jb. öst. geol. Bundesanst.*, 59 (2), 345-386.

SCHUBERT, R. J., 1915.—Die Foraminiferen des jüngeren Paläozoikums von Timor. *In* Wanner, *Paläont. Timor*, 2, 49-59.

SCHWAGER, C., 1883.—Carbonische Foraminiferen aus China und Japan. *In* F. von Richthofen, China, 4, 106-159.

SPANDEL, E., 1898.—Die Foraminiferen des deutschen Zechsteins, und ein zweifelhaftes mikroskopisches Fossil ebendaher. *Nürnberg, Verlags-Inst. "General Anzeiger"*, 1-15.

SPANDEL, E., 1901.—Die Foraminiferen des Permo-Carbon von Hooser, Kansas, Nord-Amerika. *Abh. naturf. Ges. Nürnberg*, 175-194.

STAINFORTH, R. M., 1952.—Ecology of arenaceous Foraminifera. *Micropaleontologist*, 6 (1), 42-43.

STEPHENS, T., 1889.—Foraminifera in the Upper Palaeozoic Rocks. *Pap. Roy. Soc. Tas.*, 54.

STURMFELS, E. K., 1950.—Preliminary Report on geology and coal resources of Oaklands-Coorabin Coalfield, New South Wales. *Bur. Min. Resour. Aust. Rep.* 3.

TEICHERT, C., 1941.—Upper Paleozoic of Western Australia: correlation and paleogeography. *Bull. Amer. Ass. Petrol. Geol.*, 25 (3), 371-415.

TEICHERT, C., 1947.—Stratigraphy of Western Australia. *J. Roy. Soc. N.S.W.*, 80, 81 (also 1947—*Bull. Amer. Ass. Petrol. Geol.*, 31, 1-70).

TEICHERT, C., 1950.—Recent Additions to the Stratigraphy of Western Australia. *Bull. Amer. Ass. Petrol. Geol.*, 34 (9), 1787-1794.

TEICHERT, C., 1951.—The marine Permian faunas of Western Australia. *Paläont. Z.*, 24 (1, 2), 76-90.

TEICHERT, C., 1952.—Carboniferous, Permian and Jurassic in the North-West Basin, Western Australia. *XIXième Cong. géol. int. Alger, Symp. Gondwanald*, 115-135.

TEICHERT, C., 1953.—A new ammonoid from the Eastern Australia province. *J. Roy. Soc. N.S.W.* 87, 46-50.

TEICHERT, C., and FLETCHER, H. O., 1943.—A Permian Ammonoid from New South Wales and the correlation of the Upper Marine Series. *Rec. Aust. Mus.*, 21, 156-163.

TEICHERT, C., and GLENISTER, B. F., 1952.—Lower Permian Ammonoids from the Irwin Basin, Western Australia. *J. Paleont.*, 26 (1), 12-23.

THOMAS, G. A., and DICKINS, J. M., 1954.—Correlation and age of the marine Permian formations of Western Australia. *Aust. J. Sci.*, 16 (6), 219-223.

THOMPSON, M. L., 1942.—New genera of Pennsylvanian Fusulinidae. *Amer. J. Sci.*, 240, 403-420.

THOMPSON, M. L., 1949.—The Permian Fusulinids of Timor. *J. Paleont.*, 23 (2), 182-192.

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

TRAVES, D. M., CASEY, J. N., and WELLS, A. T., 1957.—The geology of the South-Western Canning Basin, Western Australia. *Bur. Min. Resour. Aust. Rep.* 29.

VOISEY, A. H., 1938.—The Upper Palaeozoic Rocks of Tasmania. *Proc. Linn. Soc. N.S.W.*, 63 (5-6), 309-333.

VOISEY, A. H., 1949.—The Geology of the country around the Great Lake, Tasmania. *Pap. Roy. Soc. Tas.* (for 1948), 95-103.

WADE, A., 1924.—Petroleum Prospects: Kimberley District of Western Australia and Northern Territory. *Rept. to Commwlth. Aust. Parl.* 5-63.

WADE, A., 1938.—The Geological Succession in the West Kimberley District of Western Australia. *Aust. Ass. Adv. Sci. (Auckland)*, 23, 93.

WALKOM, A. B., 1913.—Stratigraphical geology of the Permo-Carboniferous System in the Maitland-Branxton District. *Proc. Linn. Soc. N.S.W.*, 38 (1), 114-145.

WARTHIN, A. D., 1930.—Micropaleontology of Wetumka, Wewoka and Holdenville Formations. *Okla. geol. Surv. Bull.* 53, 5-94.

WATERS, J. A., 1927.—A group of Foraminifera from the Dornick Hills Formation of the Ardmore Basin. *J. Paleont.*, 1 (2), 129-133.

WATERS, J. A., 1928.—A group of Foraminifera from the Canyon Division of the Pennsylvanian Formation of Texas. *Ibid.*, 1 (4), 271-275.

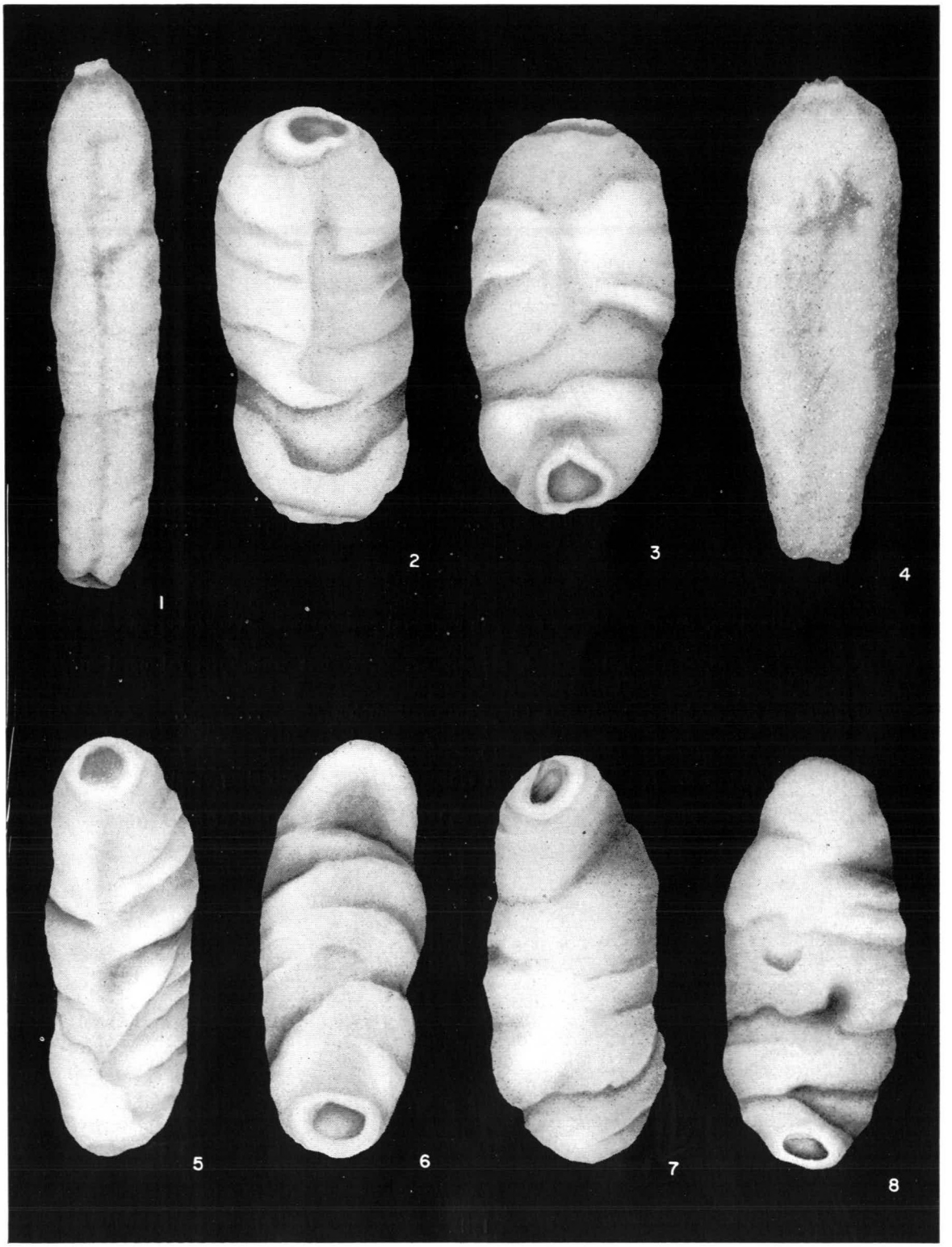
WEBB, E. A., 1956.—Exploratory oil wells penetrating Permian in central Queensland. *Bull. Amer. Ass. Petrol. Geol.*, 40 (10), 2329-2353.

WELLS, A. T., 1957.—Geology of the Deloraine-Golden Valley area. *Rec. Queen Vict. Mus. Launceston*, 8, n.s., 1-13.

PLATE 1.

FIGURES 1-8—*Hippocrepinella biaperta* sp. nov. .. .. Page 37

1. Paratype C. Gently curved test showing apertural openings at each end of test. x 43.
2, 3. Holotype. Two views of test showing apertural openings surrounded by thickened lip and typical distorted test. x 54.
4. Paratype D. Tapering test with greatest width in upper third. x 44.
5, 6. Paratype A. Two views to show apertural openings. x 55.
7, 8. Paratype B. Two views to show apertural openings. x 57.



Australian Permian Foraminifera.

PLATE 2.

FIGURES 1-3—*Pelosina ampulla* sp. nov. .. .. Page 42

1. Holotype. Showing flask-shaped, inflated, finely siliceous, smooth test. x 37.
2. Paratype A. Showing protruding apertural neck. x 34.
3. Paratype B. Large compressed test with apertural neck. x 36.

FIGURES 4-5—*Psammosphaera pusilla* Parr .. .. Page 38

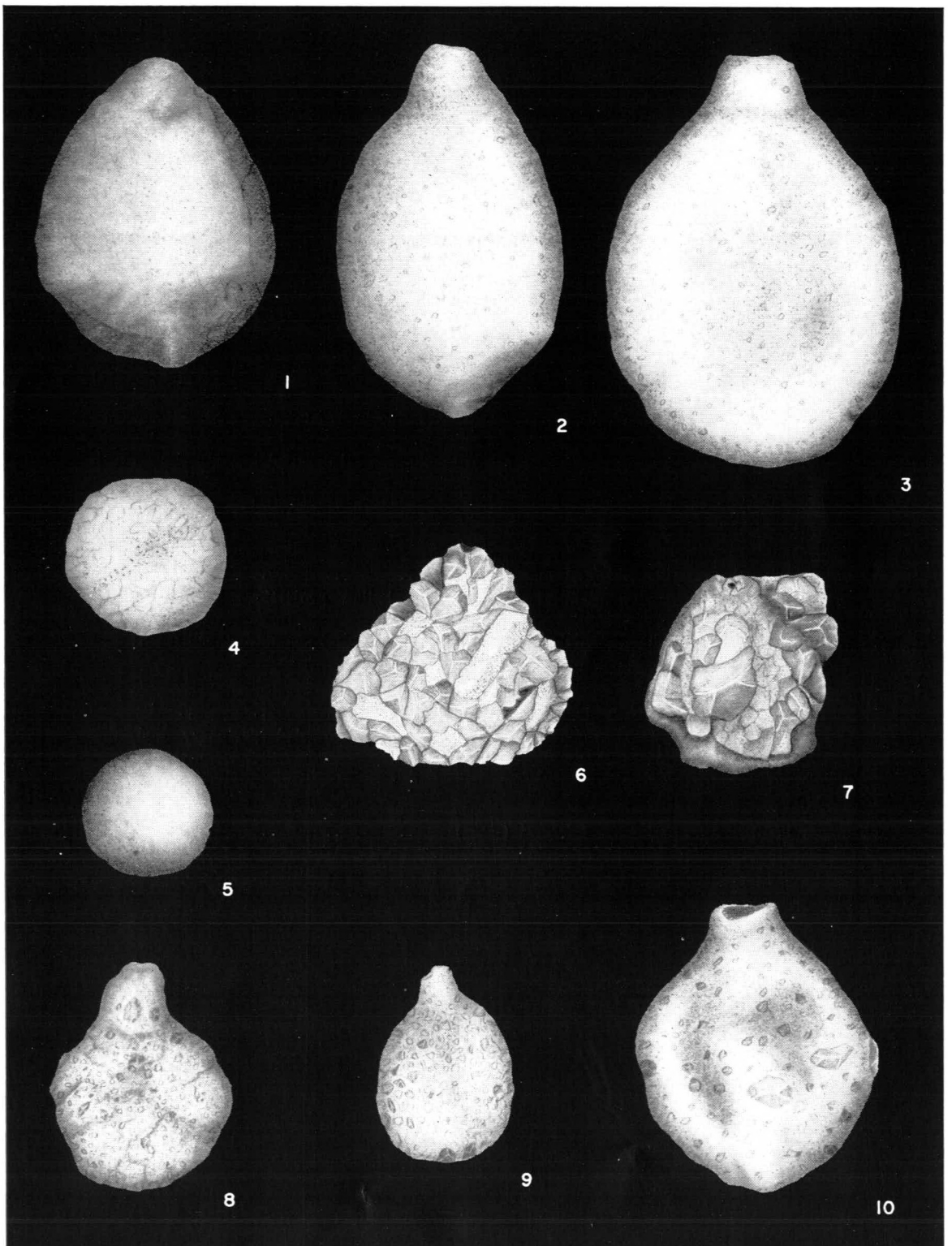
4. Hypotype B. Small, slightly compressed test. x 80.
5. Hypotype A. Typical small globular test. x 60.

FIGURES 6-7—*Proteonina arenosa* sp. nov. .. .. Page 38

6. Holotype. Showing globular test with apertural protuberance and coarse arenaceous test. x 33.
7. Paratype. Irregularly shaped, coarsely arenaceous test with apertural opening surrounded by quartz grains. x 29.

FIGURES 8-10—*Pelosina hemisphaerica* Chapman and Howchin .. .. Page 42

8. Hypotype A. Test composed of moderately coarse, irregularly shaped quartz grains and with protruding neck. x 30.
9. Hypotype B. Test more regular in shape with narrow protruding apertural neck. x 35.
10. Hypotype C. Test irregularly compressed but apertural neck still prominent. x 38.



Australian Permian Foraminifera.

PLATE 3.

FIGURES 1-5—*Sacculinella australae* gen. et sp. nov. .. .. Page 43

1. Holotype. Showing sack-like shape of single ovate chamber and large apertural opening surrounded by thickened lip. x 44.
2. Paratype A. Test slightly compressed with fine horizontal bands of carbonaceous material running across test. x 44.
3. Paratype C. Test moderately large with thickened lip rolled back to show rough surface of inside wall. x 46.
4. Paratype D. Test large, compressed, showing large apertural opening surrounded by thickened lip. x 46.
5. Paratype B. Test showing rounded apertural lip. x 44.

FIGURES 6-8—*Thurammina phialaeformis* sp. nov. .. .. Page 39

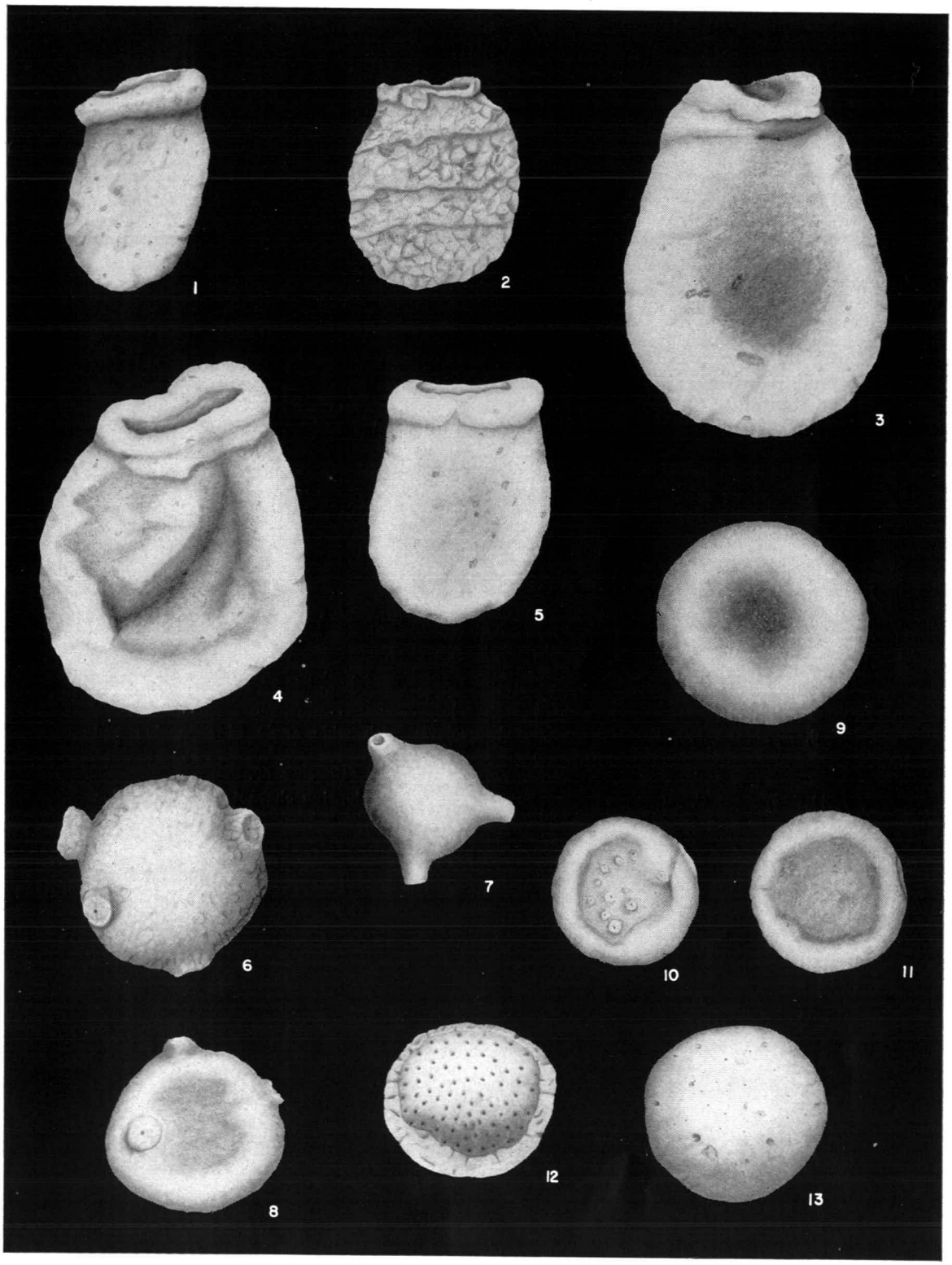
6. Holotype. Showing globular test and nipple-like projections with apertural openings scattered over test. x 27.
7. Paratype A. Showing globular test with long projections and apertures at end of each one. x 20.
8. Paratype B. Test compressed but projections present. x 23.

FIGURES 9-11—*Thuramminoides sphaeroidalis* Plummer .. .. .. Page 40

9. Hypotype A. Test moderately compressed with rounded periphery and fine arenaceous test. x 25.
10. Hypotype B. Test compressed and showing minute apertural openings. x 24.
11. Hypotype C. Test deflated in central portion. x 10.

FIGURES 12-13—*Thuramminoides teicherti* (Parr) .. .. Page 41

12. Hypotype A. Interior of broken test showing wall structure. x 13.
13. Hypotype B. Complete globular test showing minute apertural openings. x 15.



Australian Permian Foraminifera.

PLATE 4.

FIGURES 1-5—*Hyperammina callytharraensis* sp. nov. .. .. Page 45

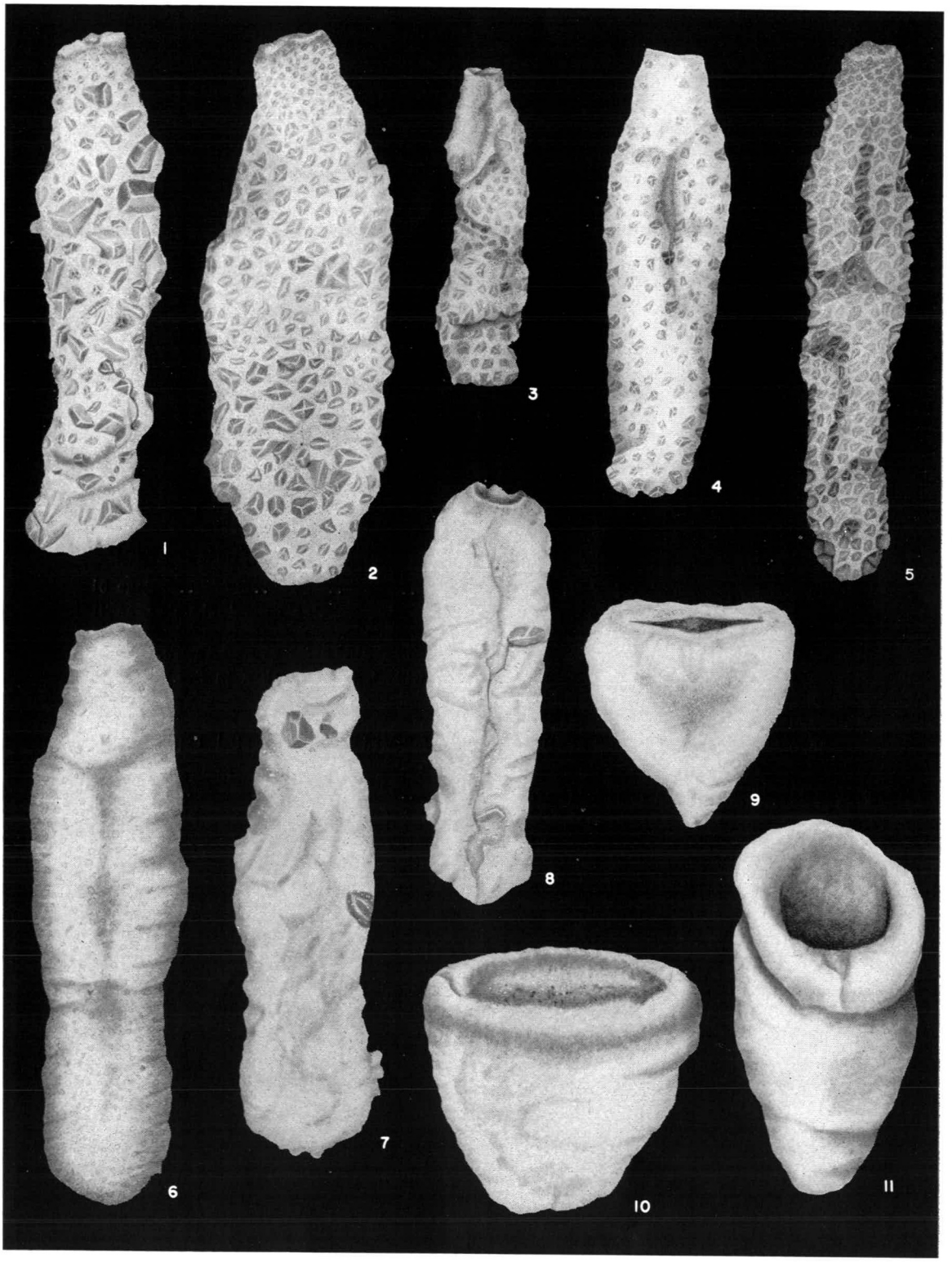
1. Holotype. Complete test showing broad proloculus and constricted area around aperture. x 38.
2. Paratype A. Test slightly flattened but constricted aperture prominent. x 51.
3. Paratype C. Initial end broken but characteristic apertural constriction present. x 25.
4. Paratype B. Test almost complete. x 36.
5. Paratype D. Typical specimen but slightly longer than holotype. x 25.

FIGURES 6-8—*Hyperammina fusta* sp. nov. .. .. Page 51

6. Holotype. Complete test with club-shaped proloculus and long neck tapering towards aperture. x 63.
7. Paratype A. Complete typical specimen. x 65.
8. Paratype B. Complete specimen with shorter apertural neck. x 57.

FIGURES 9-11—*Hyperammina expansa* (Plummer) .. .. Page 49

9. Hypotype A. Slightly compressed specimen with wide angle of expansion and elongate apertural opening. x 59.
10. Hypotype B. Specimen showing rounded initial portion. x 59.
11. Hypotype C. Specimen somewhat attenuated but showing characteristic expansion of second chamber with large apertural opening. x 68.



Australian Permian Foraminifera.

PLATE 5.

FIGURES 1-5—*Hyperammina elegans* (Cushman and Waters) .. .. .. Page 47

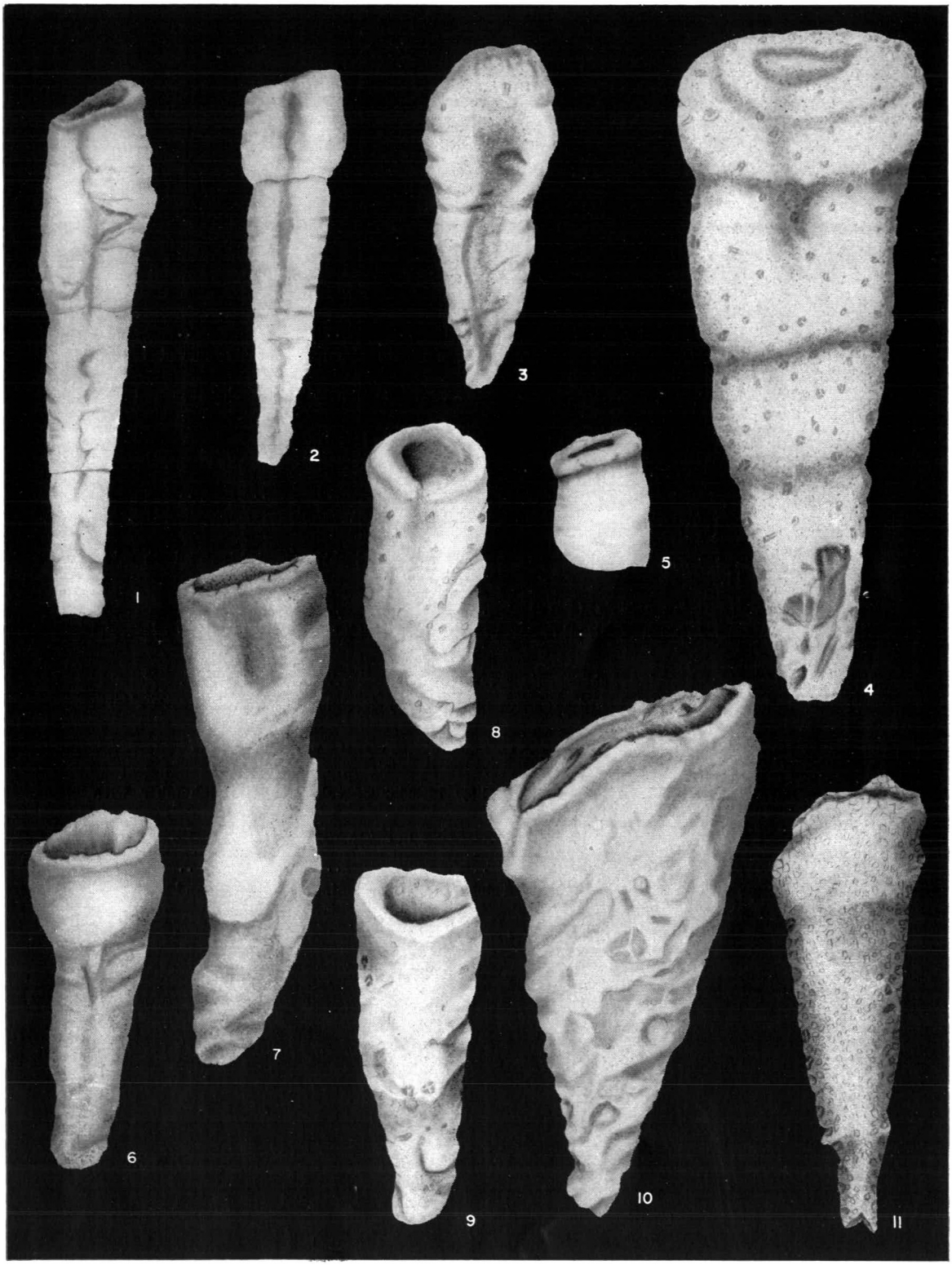
1. Hypotype A. Typical gently tapering smooth test. x 10.
2. Hypotype B. Fragment of typical specimen. x 10.
3. Hypotype C. Complete small test, probably megalospheric. x 27.
4. Hypotype D. Almost complete specimen showing apertural opening in centre of last-formed chamber. x 35.
5. Hypotype E. Specimen showing thickened lip of probable microspheric test. x 16.

FIGURES 6-10—*Hyperammina hadzeli* sp. nov. .. .. Page 51

6. Holotype. Showing the characteristic expanding tubular second chamber as it approaches the wide apertural opening. x 32.
7. Paratype A. Test slightly crushed but with typical characters well shown. x 27.
8. Paratype B. The tubular second chamber widening earlier than in figs. 6 and 7. Rounded apertural opening well shown. x 33.
9. Paratype C. Characters as in fig. 8. x 38.
10. Paratype D. Showing small proloculus followed by exaggerated expansion of second chamber. Test compressed. x 56.

FIGURE 11—*Hyperammina acicula* (Parr) .. .. Page 44

11. Hypotype B. Specimen showing "hour-glass" tapering. x 25.



Australian Permian Foraminifera.

PLATE 6.

FIGURES 1-4—*Hyperammina fletcheri* sp. nov. .. .. Page 50

1. Holotype. Complete specimen showing elongate sinuous, slightly curved test of almost uniform width. x 28.
2. Paratype B. Broken specimen showing rounded tubular second chamber and thin wall of test. x 32.
3. Paratype A. Showing narrow sinuous thin-walled test. x 36.
4. Paratype C. Compressed specimen showing characteristic thin-walled test. x 34.

FIGURES 5-6—*Hyperammina coleyi* Parr .. .. Page 46

5. Hypotype A. Showing bulbous proloculus, straight tubular second chamber, and coarse arenaceous test. x 13.
6. Hypotype B. Showing bulbous proloculus and slightly curved second chamber. x 11.

FIGURE 7—*Hyperammina acicula* (Parr) .. .. Page 44

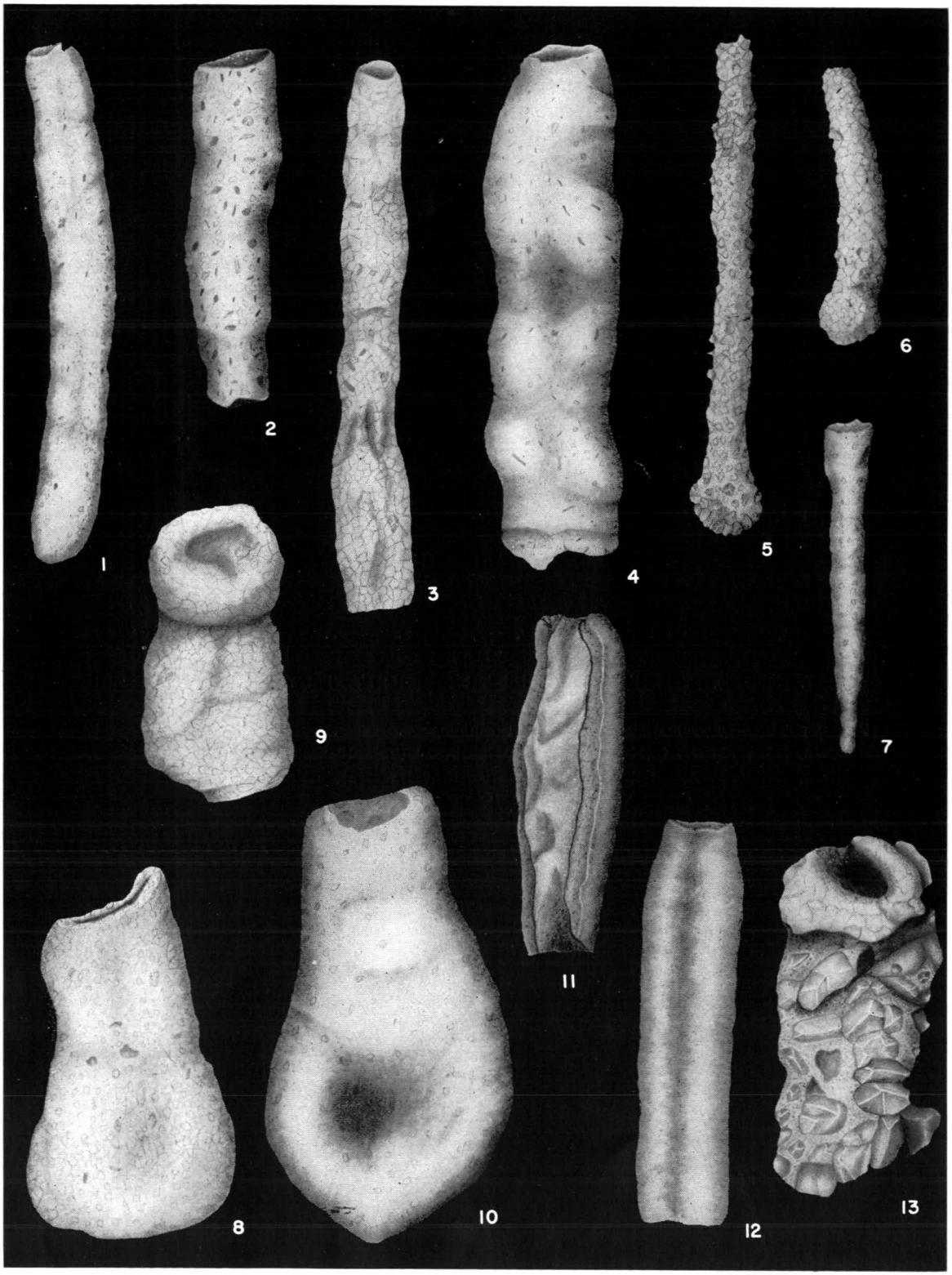
7. Hypotype A, with small globular proloculus and "hour-glass" tapering of second chamber. x 9.

FIGURES 8-12—*Hyperammina hebdenensis* sp. nov. .. .. Page 52

8. Holotype. Showing broad proloculus followed by second chamber of almost uniform width. x 40.
9. Paratype A. Showing thick lip surrounding apertural opening. x 33.
10. Paratype B. Showing broad proloculus with initial spine. x 34.
11. Paratype D. Specimen broken to show interior of tubular second chamber with moderately thin wall. x 14.
12. Paratype C. Fragment of specimen showing uniform width of test. x 13.

FIGURE 13—*Hyperamminita rudis* (Parr) .. .. Page 54

Hypotype B. Specimen showing thick lip surrounding aperture and coarsely arenaceous test. x 32.



Australian Permian Foraminifera.

PLATE 7.

FIGURES 1, 2—*Hyperamminita rudis* (Parr) .. .. Page 54

1. Hypotype A. Showing typical coarsely arenaceous test. x 40.
2. Hypotype C. Smaller test with wide apertural opening. x 26.

FIGURES 3-5—*Hyperammina coleyi* Parr .. .. Page 45

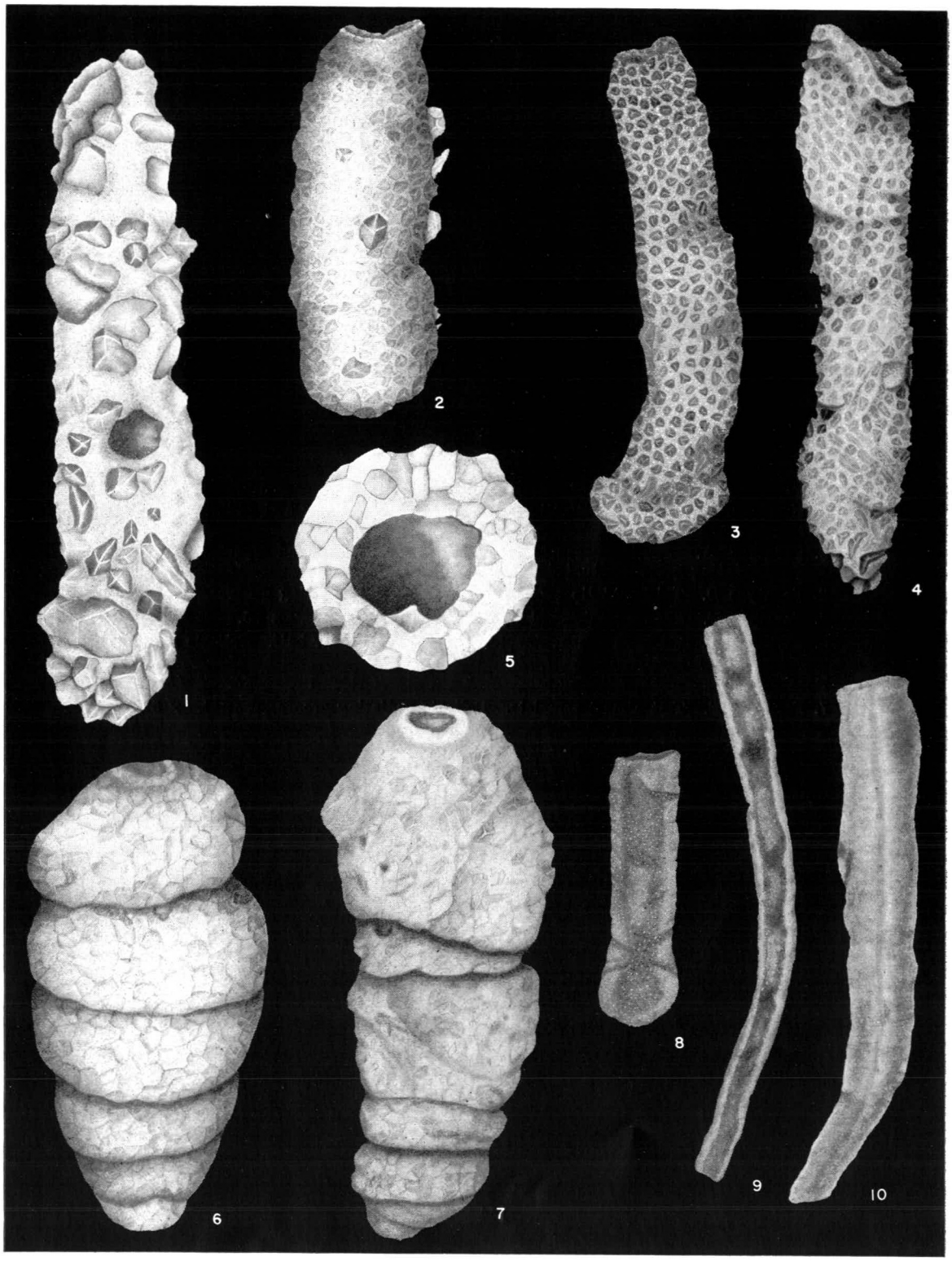
3. Hypotype C. Test with bulbous proloculus and second chamber of uniform width. x 24.
4. Hypotype D. Arrow-headed proloculus followed by chamber of uniform width. x 31.
5. Hypotype E. Horizontal section of specimen to show thickness of wall. x 50.

FIGURES 6, 7—*Lugtonia thomasi* sp. nov. .. .. Page 65

6. Paratype. Showing inflated chambers and deeply depressed sutures. x 37.
7. Holotype. Test slightly distorted but complete showing six chambers of unequal size, depressed sutures and large circular aperture. x 39.

FIGURES 8-10—*Hyperammina elegantissima* Plummer .. .. Page 48

8. Hypotype C. Initial portion, showing broad proloculus. x 60.
9. Hypotype A. Delicately tapering polished fragment. x 30.
10. Hypotype B. Slightly broader test. x 56.



Australian Permian Foraminifera.

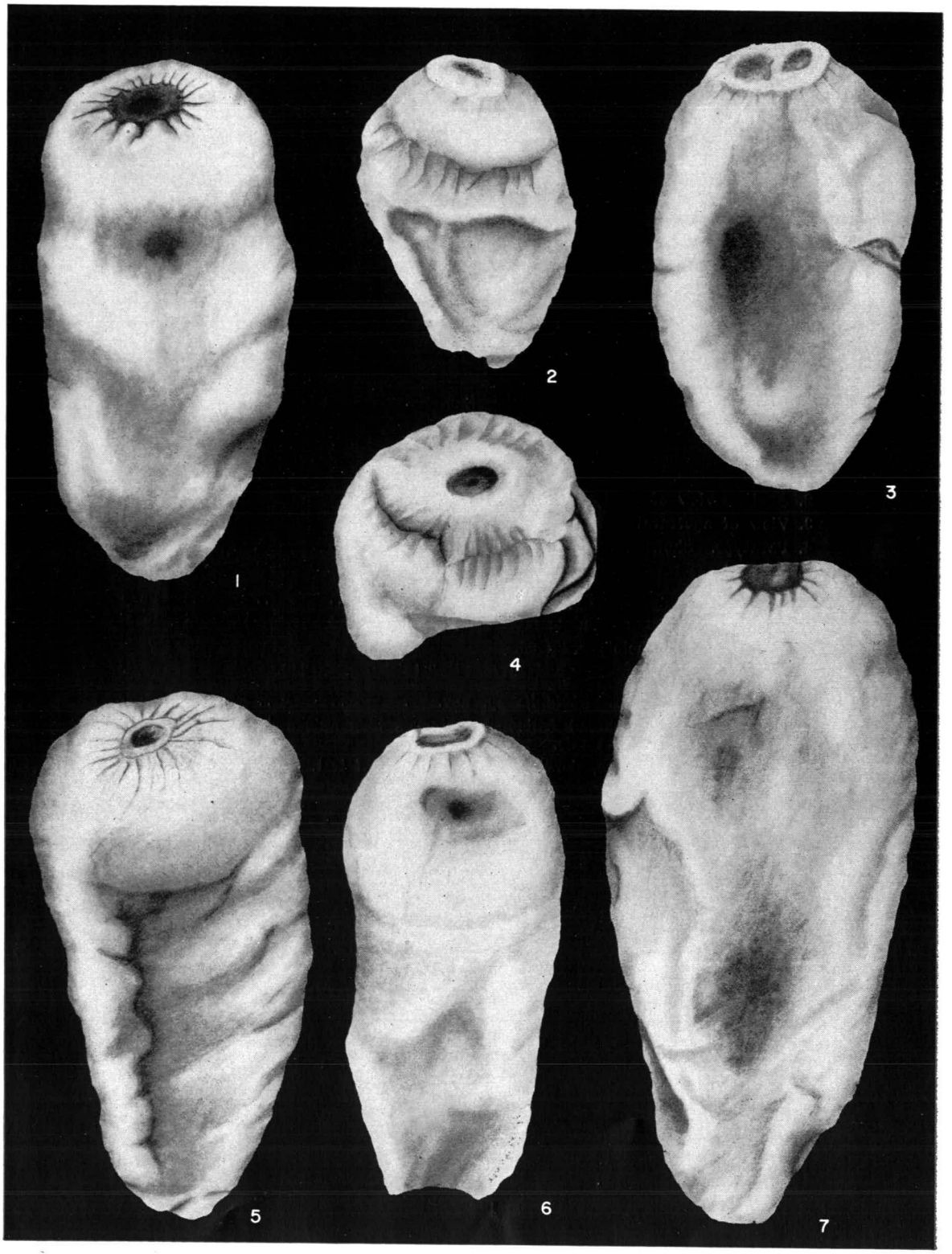
PLATE 8.

FIGURES 1-7—*Pseudohyperammina radiostoma* gen. and sp. nov. .. .. Page 55

1. Holotype. Showing thickened lip around apertural opening and radiating elongate grooves surrounding the lip. x 68.
2. Paratype A. Specimen crushed but thickened lip around apertural opening. Radiating grooves situated on shoulder of test. x 61.
3. Paratype D. Thickened lip prominent with delicate radiating grooves. x 58.
4. Paratype F. Showing thickened lip and radiating grooves. x 85.
5. Paratype C. Specimen almost complete. Crushed in lower half. Delicate radiating grooves present. x 59.

Paratype B. Delicate radiating grooves on margin of thick lip. x 64.

7. Paratype E. Test almost complete. Delicate radiating grooves present. x 58.



Australian Permian Foraminifera.

PLATE 9.

FIGURES 1-5—*Giraliarella angulata* gen. et. sp. nov. .. .. Page 56

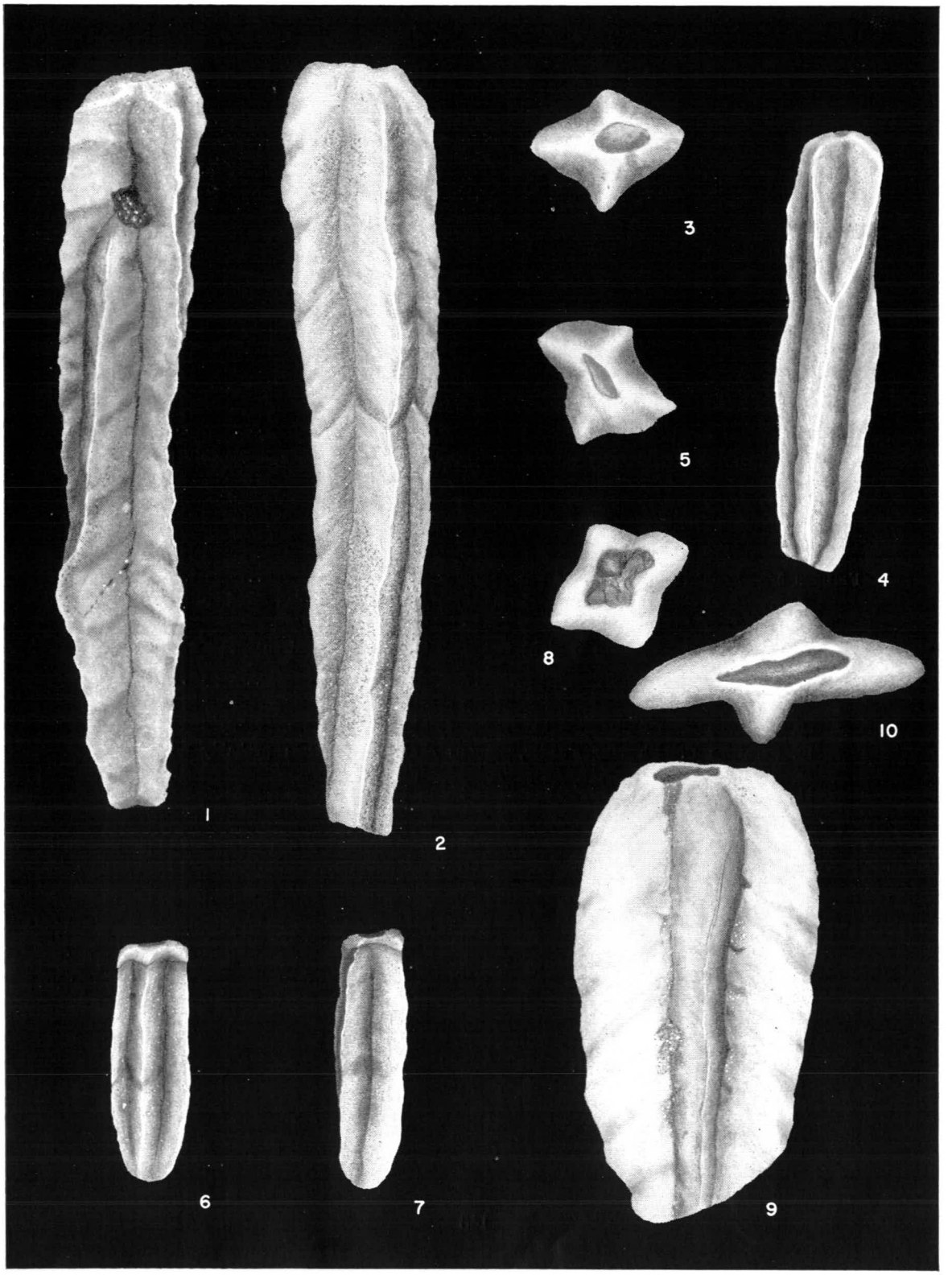
1. Holotype. Showing sharp elongate ridges and deep furrows; one ridge later bifurcates. x 76.
2. Another view of holotype. x 76.
3. View of apertural opening in holotype. x 125.
4. Paratype. Showing one ridge bifurcating in upper third. x 90.
5. View of apertural opening in paratype. x 166.

FIGURES 6-8—*Giraliarella travesi* sp. nov. .. .. Page 57

6. Holotype. Showing angulate test and thick lip around apertural opening. x 95.
7. Another view of holotype. x 95.
8. View of apertural opening and surrounding thick lip. x 250.

FIGURES 9, 10—*Giraliarella rhomboidalis* sp. nov. .. .. Page 58

9. Holotype. Showing broad frilled character on long axis and rounded surface in upper part of short axis. x 71.
10. View of apertural face, showing rhomboid shape of test. x 122.



Australian Permian Foraminifera.

PLATE 10.

FIGURES 1-4—*Reophax asper* Cushman and Waters .. .. Page 59

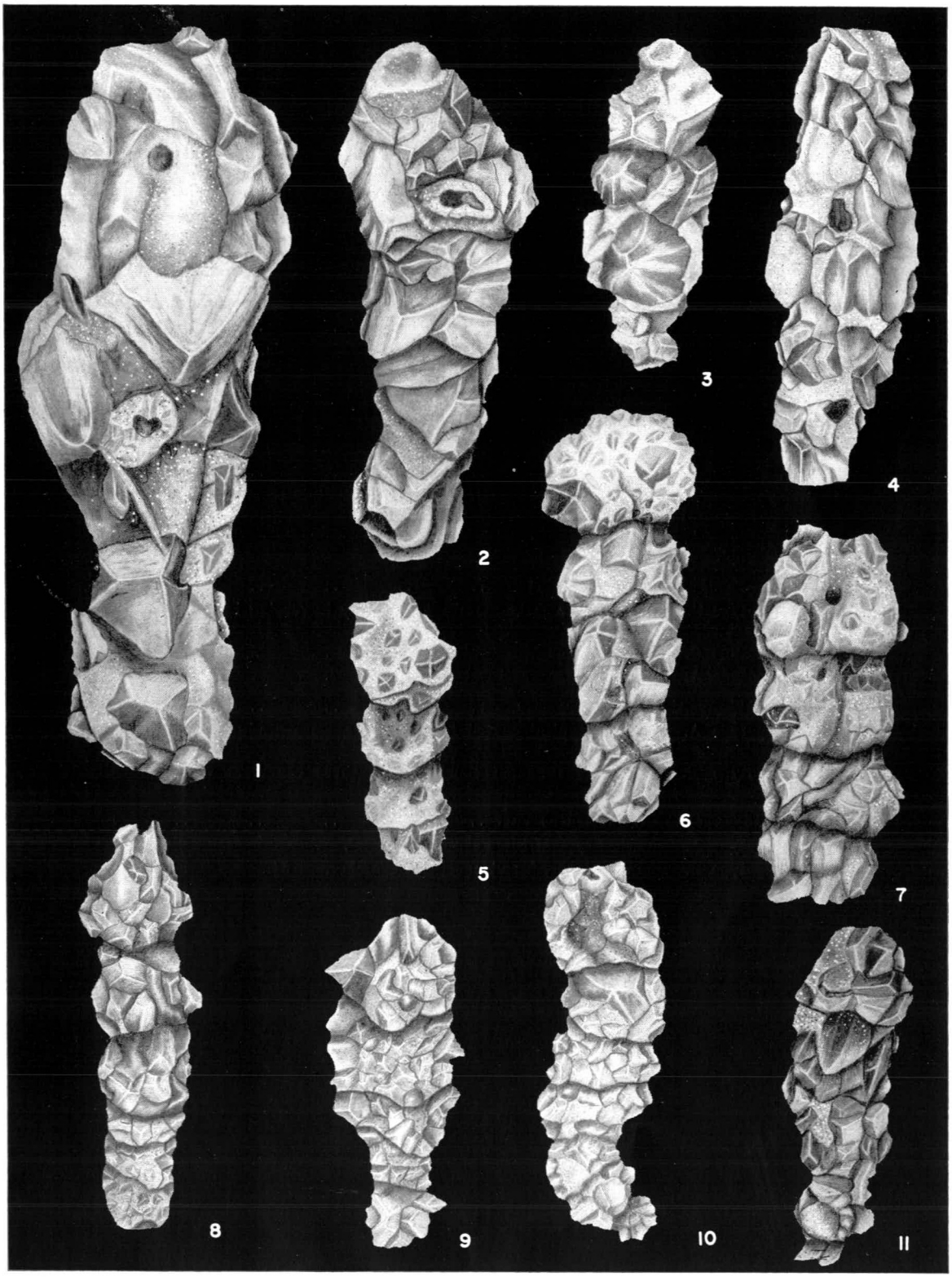
1. Hypotype A. Showing elongate test, indistinct chambers and coarsely arenaceous test. x 75.
2. Hypotype B. Typical specimen. x 44.
3. Hypotype C. Small test but features typical. x 78.
4. Hypotype D. Typical specimen. x 83.

FIGURES 5-7—*Reophax minutissimus* Plummer .. .. Page 63

5. Hypotype B. Small compressed rough test, with strongly depressed sutures. x 82.
6. Hypotype A. Showing strongly depressed sutures. x 75.
7. Hypotype C. Showing straight test with typical depressed sutures. x 70.

FIGURES 8-11—*Reophax belfordi* sp. nov. .. .. Page 60

8. Holotype. Small test consisting of five chambers gradually increasing in size. x 74.
9. Paratype A. Small test with irregularly shaped chambers. x 78.
10. Paratype C. Showing slender, sinuous character of test; probably microspheric form. x 77.
11. Paratype B. Showing sinuous character of test. x 69.



Australian Permian Foraminifera.

PLATE 11.

FIGURES 1-4—*Reophax ellipsiformis* sp. nov. .. .. Page 61

1. Holotype. Showing typical ellipsoidal shape and straight axis. x 30.
2. Paratype C. Showing typical features. x 50.
3. Paratype B. Test slightly crushed. x 50.
4. Paratype A. Test slightly crushed in central portion. Apertural neck prominent. x 63.

FIGURES 5, 6—*Reophax emaciatus* Plummer .. .. Page 62

5. Hypotype B. Showing typical flattened test, blunt initial end and constricted apertural end. x 52.
6. Hypotype A. Test compressed, with group of coarse quartz grains at initial end. x 36.

FIGURES 7-9—*Reophax fittsi* (Warthin) .. .. Page 63

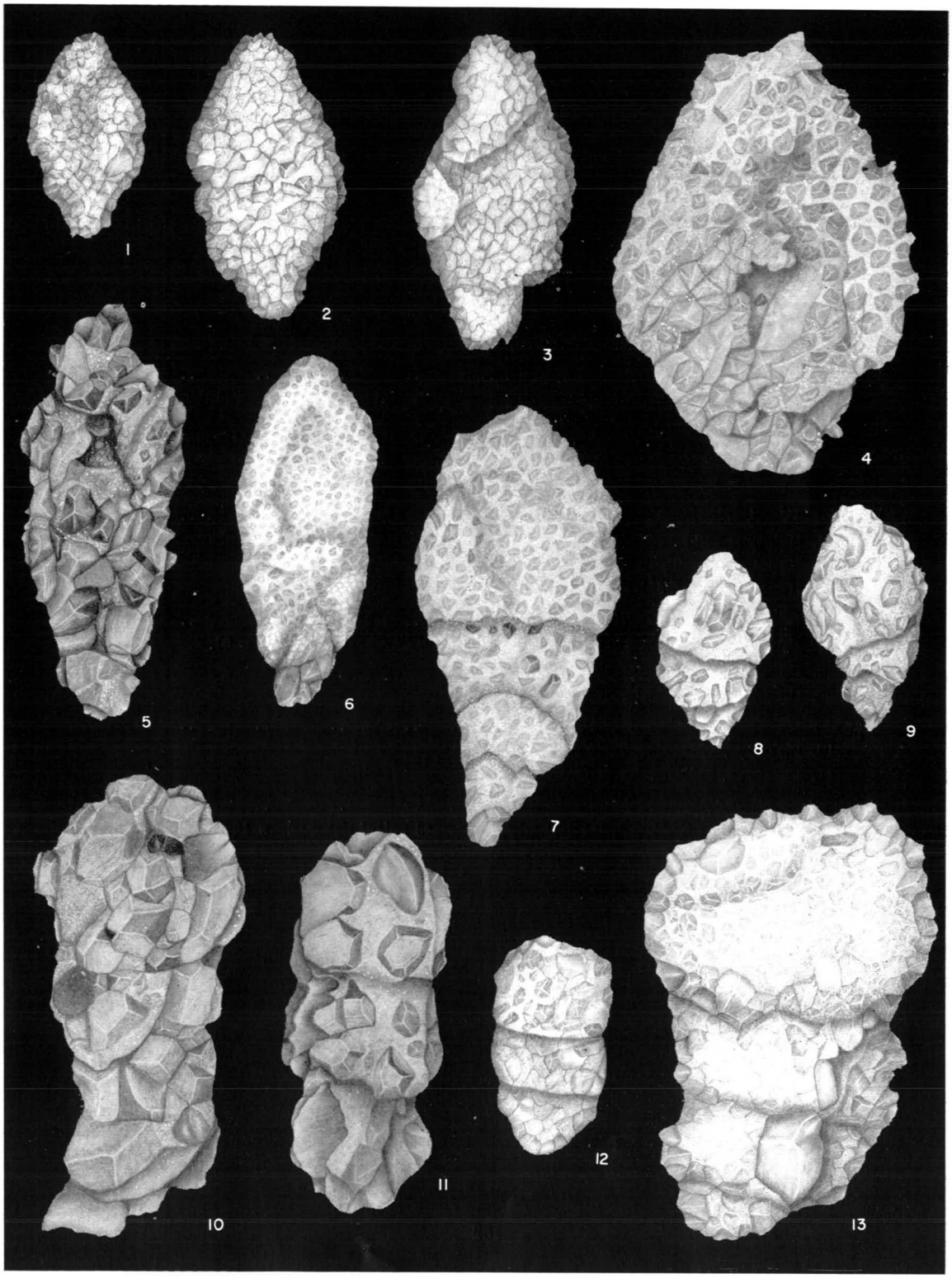
7. Hypotype C. Showing four early chambers gradually increasing in size, with large last chamber, tapering sharply to apertural opening. x 34.
8. Hypotype B. Showing large apertural chamber. x 27.
9. Hypotype A. Showing large apertural chamber. x 27.

FIGURES 10, 11—*Reophax subasper* Parr .. .. Page 64

10. Hypotype A. Showing typical curved test with chambers gradually increasing in size. x 57.
11. Hypotype B. Immature specimen consisting of three chambers very gradually increasing in size. x 54.

FIGURES 12, 13—*Reophax tricameratus* Parr .. .. Page 65

12. Hypotype A. Showing typical three chambers. x 23.
13. Hypotype B. Showing large, broad apertural chamber. x 54.



Australian Permian Foraminifera.

PLATE 12.

FIGURES 1-3—*Ammodiscus erugatus* sp. nov. .. .. Page 65

1. Holotype. Microspheric. Showing minute initial chamber followed by six planispiral whorls. x 49.
2. Paratype A. Megalospheric. Showing gradual increase in width of undivided second chamber with broad final whorl. x 62.
3. Paratype B. Small test somewhat worn and rougher than in figs. 1 and 2. x 40.

FIGURES 4-6—*Ammodiscus multicinctus* Crespin and Parr .. .. .. Page 67

4. Holotype refigured. Showing short constrictions giving lobate periphery. x 44.
5. Hypotype A. Typical test with characteristic constrictions. x 51.
6. Hypotype B. Typical small test. x 89.

FIGURES 7-9—*Ammodiscus nitidus* Parr .. .. Page 68

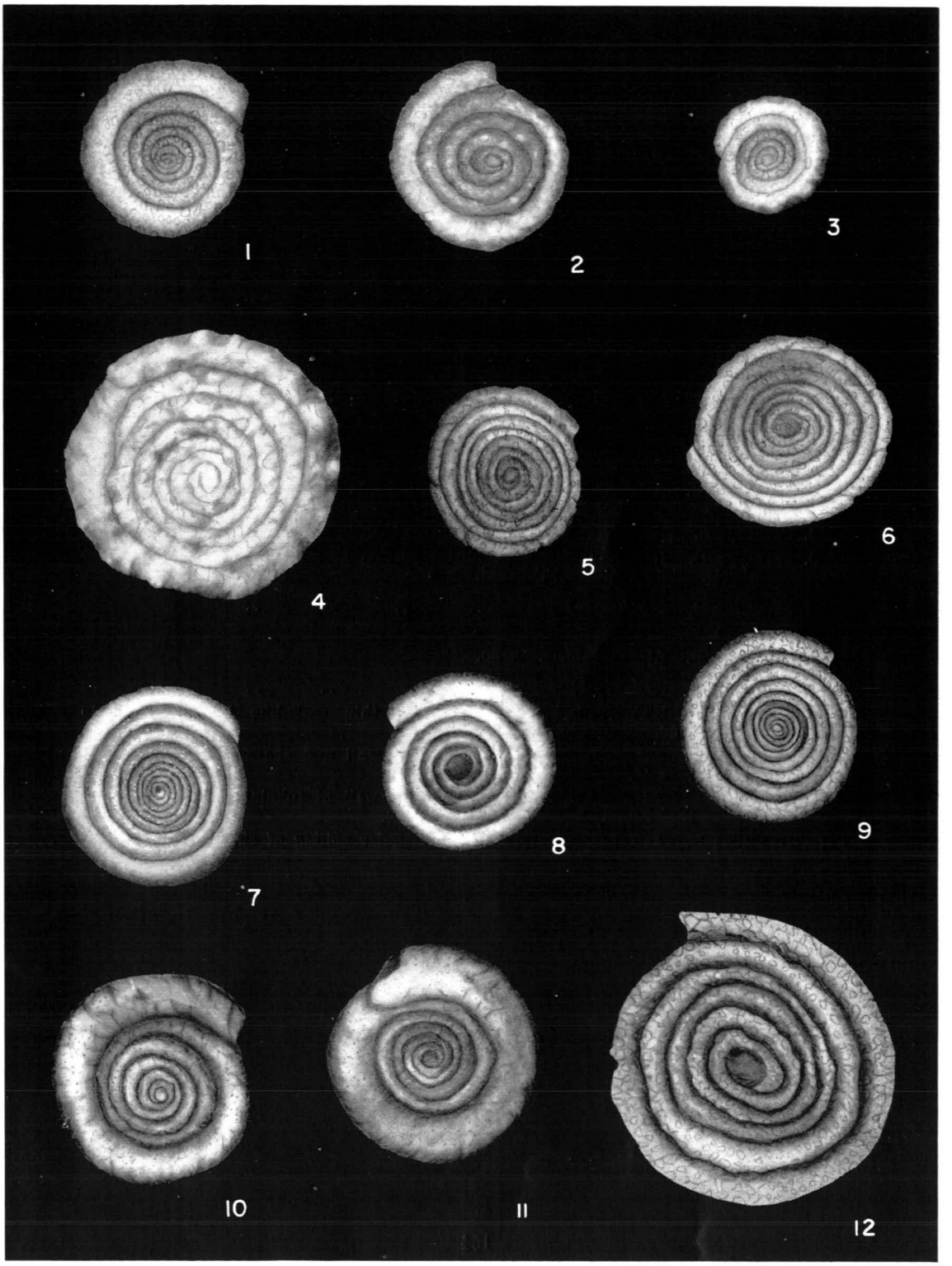
7. Hypotype A. Microspheric form with very fine arenaceous test. x 61.
8. Hypotype B. Megalospheric form. x 61.
9. Hypotype C. Microspheric form. x 52.

FIGURES 10, 11—*Ammodiscus oonahensis* sp. nov. .. .. Page 69

10. Holotype. Megalospheric form. x 24.
11. Paratype. Microspheric form. x 18.

FIGURE 12—*Ammodiscus wandageeensis* Parr .. .. Page 69

12. Hypotype. Showing large test with depressed spiral sutures. x 10.



Australian Permian Foraminifera.

PLATE 13.

FIGURES 1-5—*Glomospirella nyei* sp. nov. .. .. Page 70

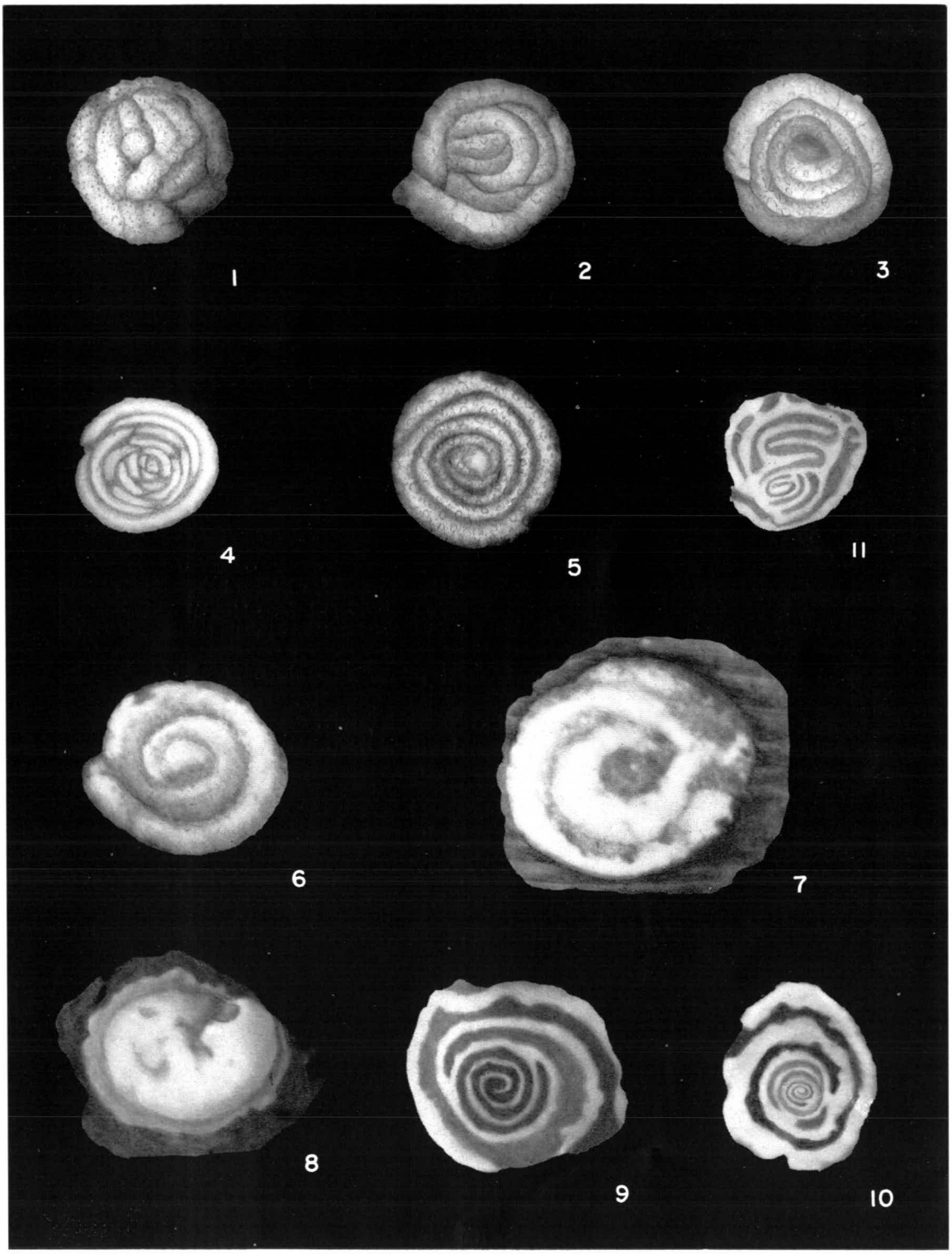
1. Holotype. Showing irregular direction of coiling of tubular chamber, becoming planispiral in last whorl. x 67.
2. Paratype A. Similar to holotype. x 100.
3. Paratype B. Coiling becoming planispiral in later portion with the tubular chamber increasing in width. x 135.
4. Paratype C. Tubular second chamber thinner than in previous specimens. x 100.
5. Paratype D. Irregular coiling in initial portion becoming planispiral for three whorls. Spiral suture thickened. x 47.

FIGURES 6-7—*Glomospira adhaerens* Parr .. .. Page 70

6. Hypotype A. Unattached form with characteristic coiling. x 66.
7. Hypotype B. Attached form. x 80.

FIGURES 8-11—*Calcitornella heathi* Cushman and Waters .. .. .. Page 83

8. Hypotype A. Unattached surface showing thin scale-like test attached to shell. x 66.
9. Hypotype C. Attached surface showing shell wall and characteristic coiling of chamber. x 46.
10. Hypotype D. Attached surface, showing thin wall of tubular chamber in early portion then rapidly becoming thicker. x 30.
11. Hypotype B. Attached surface showing irregular coiling of chamber. x 30.



Australian Permian Foraminifera.

PLATE 14.

FIGURES 1-3—*Ammobaculites wandageensis* sp. nov. .. .. Page 74

1. Holotype. Four chambers in coiled portion, followed by four uniserial chambers. x 93.
2. Paratype A. Uncrushed but incomplete specimen. x 116.
3. Paratype B. Test complete but only three chambers in uniserial portion. x 100.

FIGURES 4-9—*Ammobaculites eccentrica* sp. nov. .. .. Page 73

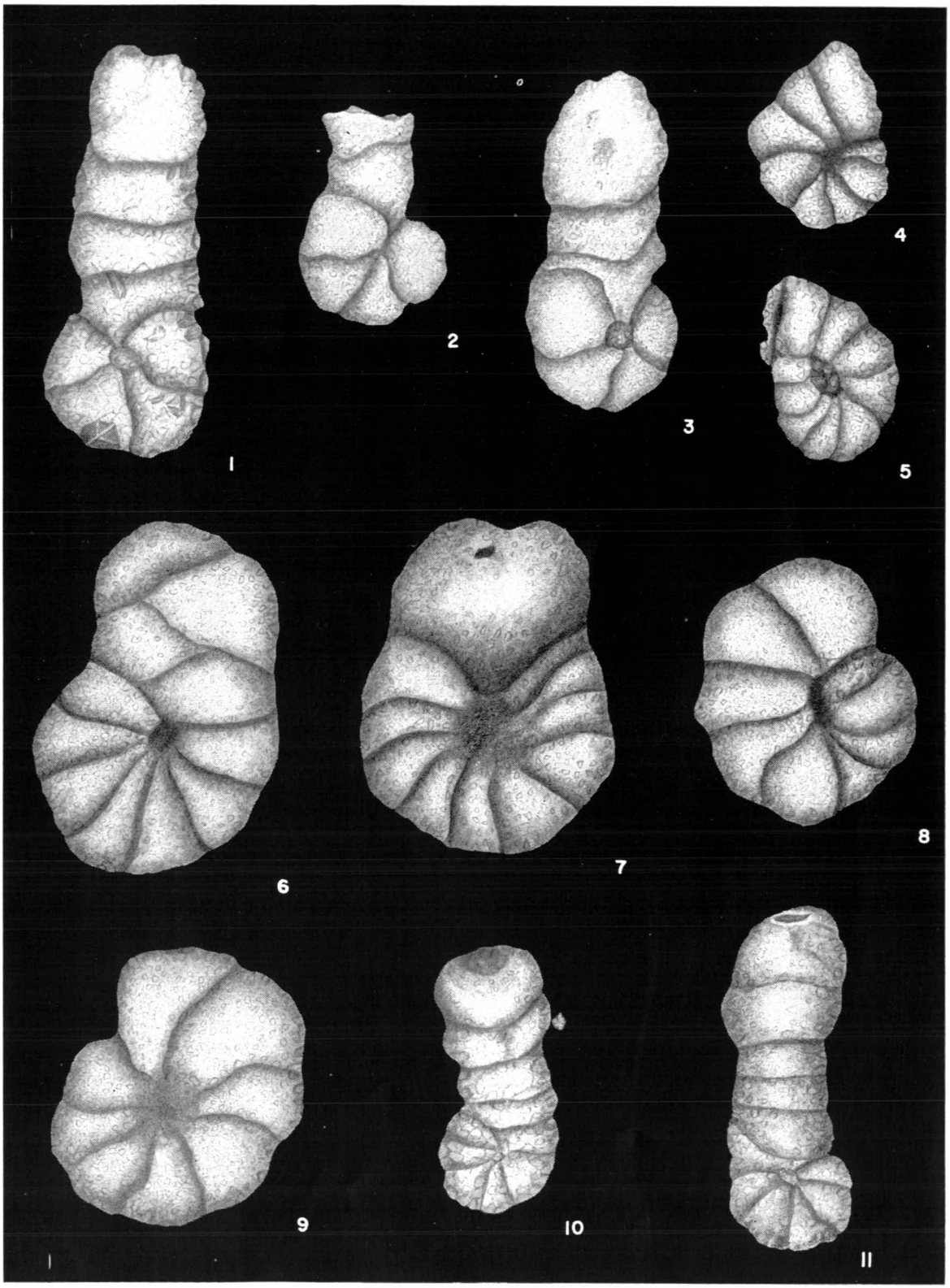
4, 5. Holotype. Two views showing uniserial character of last-formed chamber. x 100.

6, 7. Paratype B. Two views. Fig. 6 shows tendency to become biserial on one side. Fig. 7 shows last-formed chamber on the other side becoming uniserial with apertural opening in centre of upper part of chamber. x 290.

8, 9. Paratype A. Two views. Showing asymmetrical character of last formed chamber. x 300.

FIGURES 10, 11. *Ammobaculites woolnoughi* Crespin and Parr .. .. .. Page 75

10. Hypotype A. Test slightly compressed with characteristic six chambers in coiled portion. x 33.
11. Hypotype B. Specimen showing rounded character of test. x 31.



Australian Permian Foraminifera.

PLATE 15.

FIGURES 1-7. *Textularia bookeri* sp. nov. .. .. Page 77

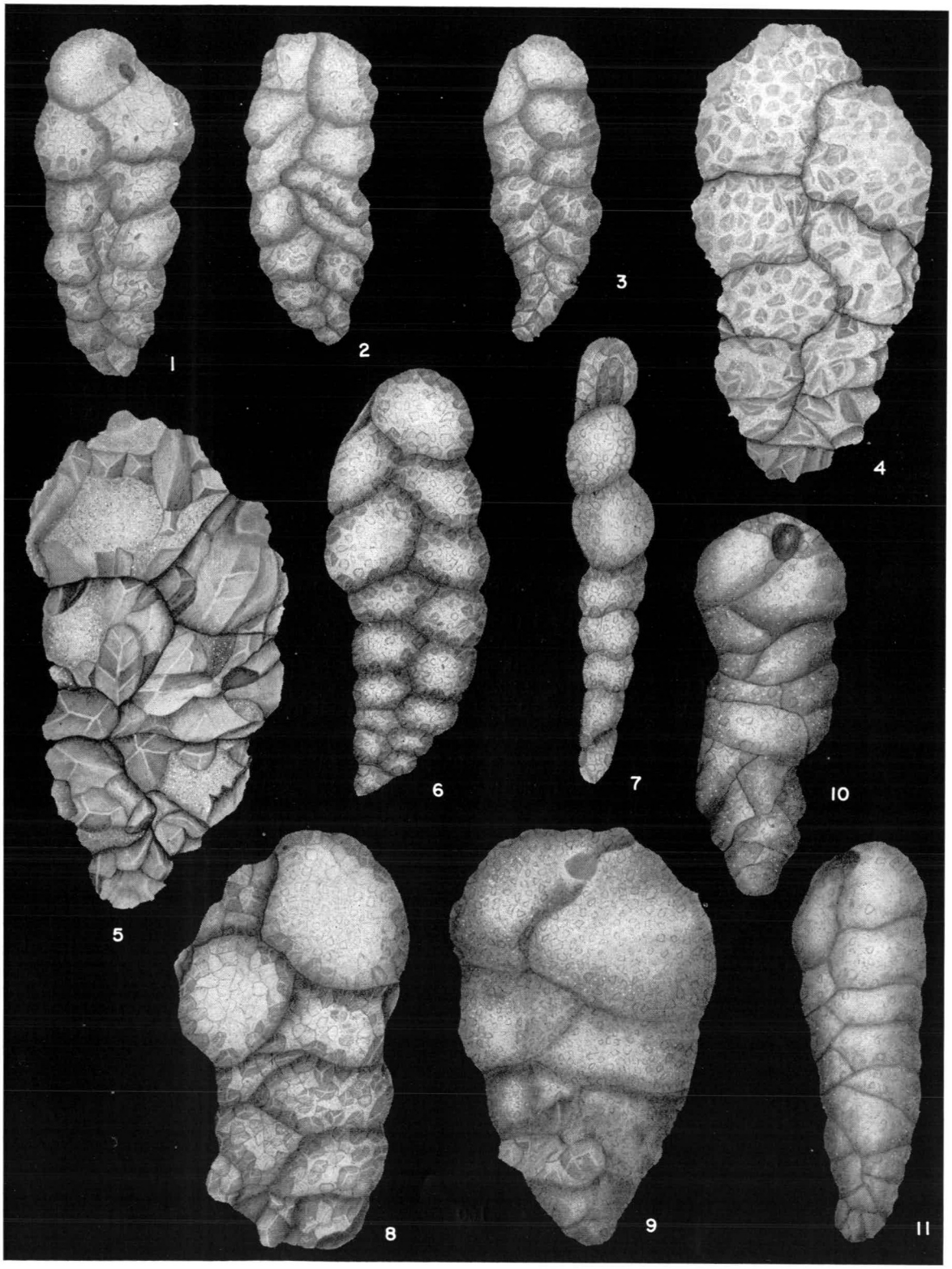
1. Holotype. Gently curved and tapering test. x 41.
2. Paratype B. Test slightly compressed but showing gently curved test. x 38.
3. Paratype C. Microspheric form. x 33.
4. Paratype A. Test broader and shorter than holotype and more coarsely arenaceous. x 83.
5. Paratype E. Similar to Paratype A. x 82.
6, 7. Paratype D. Microspheric form. Fig. 7, side view showing compressed sinuous test. x 39.

FIGURES 8, 9. *Textularia improcera* sp. nov. .. .. Page 78

8. Holotype. Short stout test. x 86.
9. Paratype. Short stout but slightly distorted test. x 75.

FIGURES 10, 11. *Digitina recurvata* Crespin and Parr .. .. Page 79

10. Hypotype B. Showing irregularly arranged early chambers later becoming biserial. x 40.
11. Hypotype A. Rounded test with irregularly arranged chambers in early portion, later becoming biserial. x 37.



Australian Permian Foraminifera.

PLATE 16.

FIGURES 1-6—*Hemigordius harltoni* Cushman and Waters .. .. .. Page 79

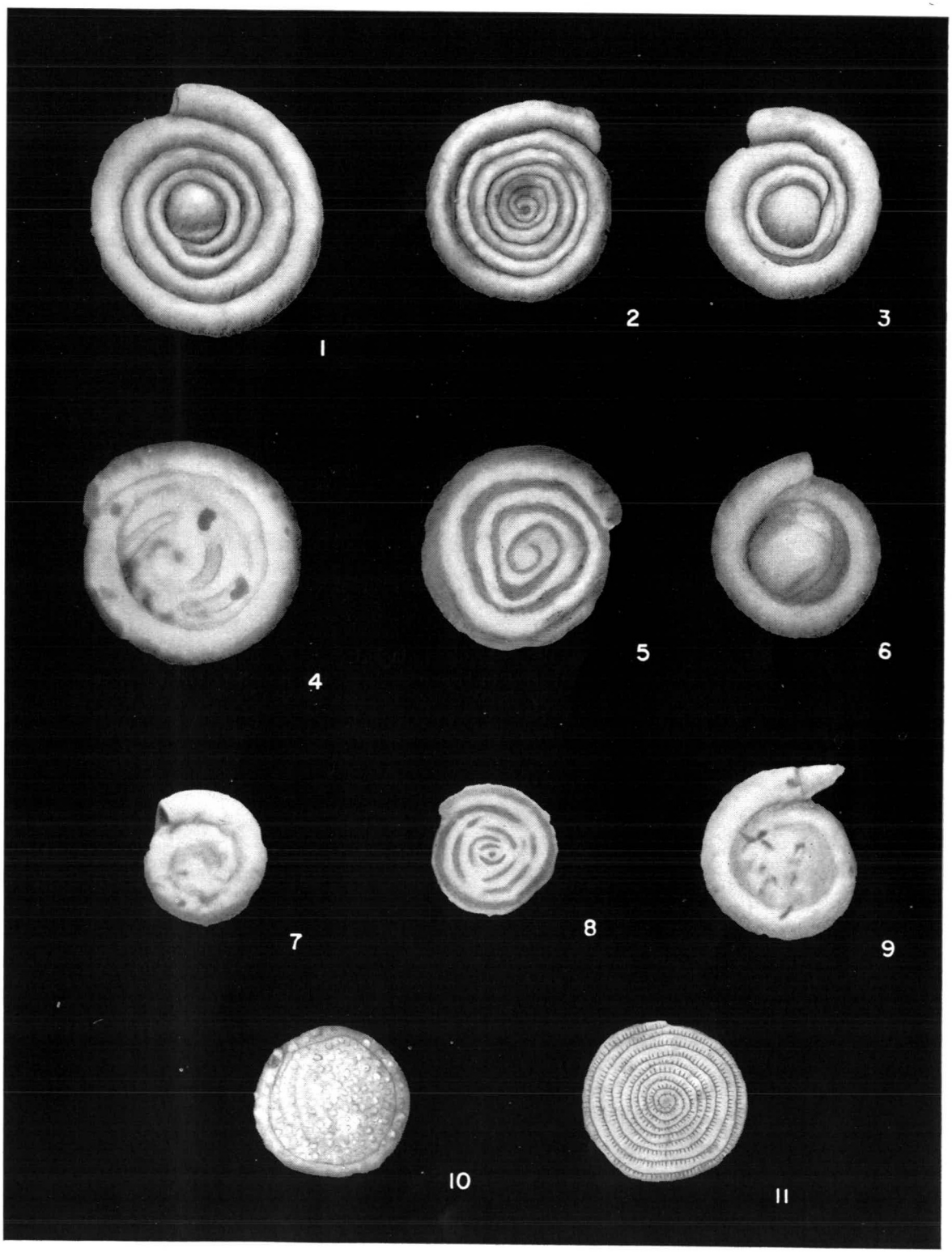
1. Hypotype A. Megalospheric. Proloculus covered with secondary growth material. x 55.
2. Hypotype B. Microspheric. Showing minute proloculus followed by undivided tubular second chamber. x 58.
3. Hypotype C. Megalospheric. x 65.
4. Hypotype D. Showing irregular coiling of tubular second chamber. x 90.
5. Hypotype E. Secondary growth material partially removed to show irregular coiling. x 100.
6. Hypotype F. Test covered with thin coating of secondary growth material. x 86.

FIGURES 7-9—*Hemigordius schlumbergi* (Howchin) .. .. Page 81

7. Hypotype A. Test characteristically covered with secondary growth material. x 21.
8. Hypotype B. Secondary growth material removed to show irregular coiling of second tubular chamber. x 20.
9. Hypotype C. Showing unusual projection of apertural opening. x 34.

FIGURES 10-11—*Spirillina papillo-dentata* sp. nov. .. .. Page 119

10. Holotype. Ventral surface covered with rounded papillae. x 47.
11. Holotype. Dorsal surface showing coiled spiral ornamented with fine radial grooves. x 50.



Australian Permian Foraminifera.

PLATE 17.

FIGURES 1-3—*Calcitornella elongata* Cushman and Waters .. .. .. Page 82

1, 2. Hypotype A. Two views of tubular chamber encrusting productid spine. Tube coiled rather closely in early portion later becoming loosely coiled along direction of spine. Test covered with secondary growth material, surface of which is often roughened. x 46.

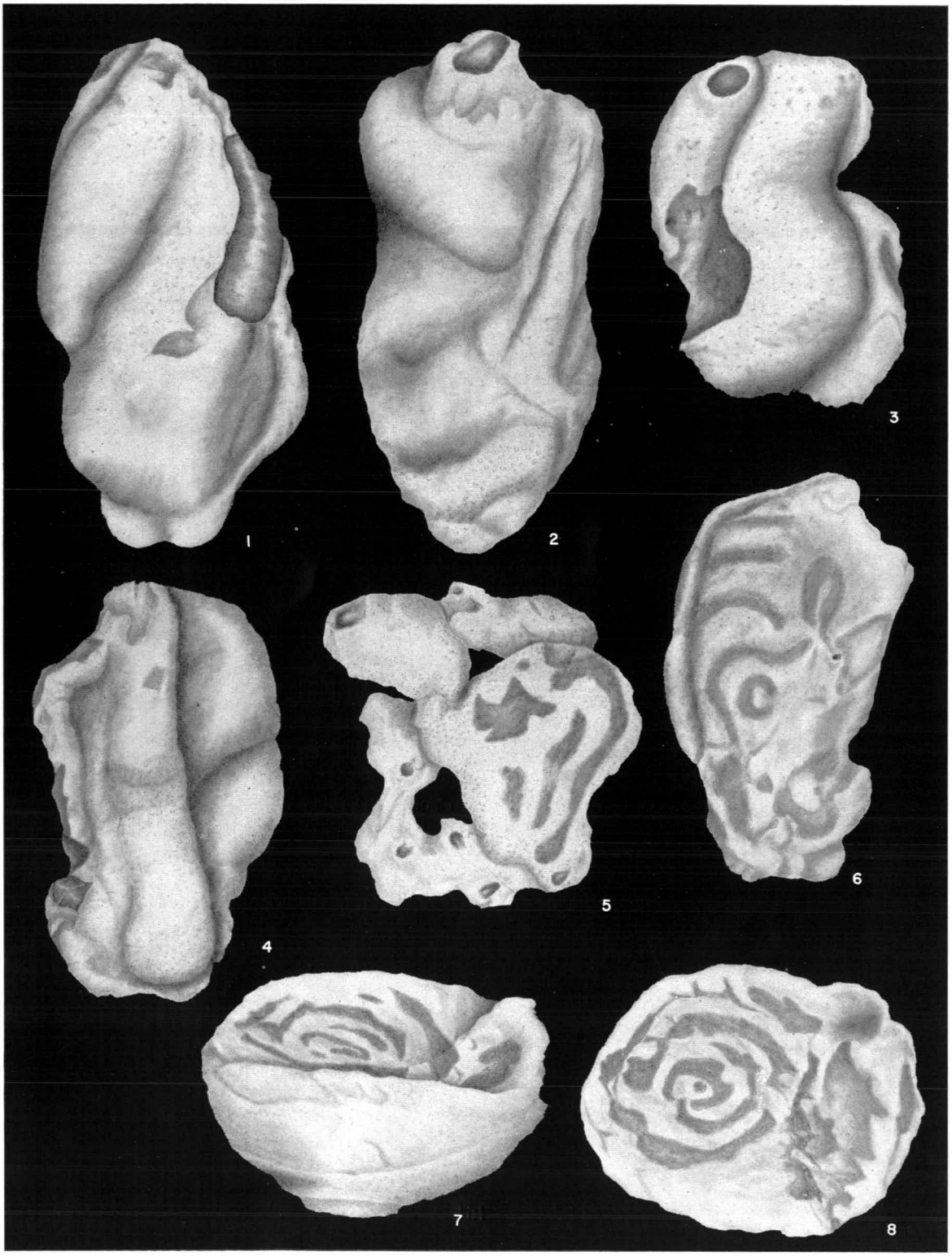
3. Hypotype B. Unattached surface showing rounded aperture at end of tubular chamber. x 46.

FIGURES 4-8—*Calcitornella stephensi* (Howchin) .. .. Page 84

4, 6. Hypotype A. Views of attached and unattached surfaces. x 61.

5. Hypotype C. Specimen attached to bryozoa. Secondary growth material removed showing coiling of tubular chamber with aperture at end of tube. x 50.

7, 8. Hypotype B. Views of attached and unattached surfaces of specimen. x 61.



Australian Permian Foraminifera.

PLATE 18.

FIGURES 1-4—*Trepeilopsis australiensis* sp. nov. .. .. Page 86

1. Holotype. Tubular chamber in helical spiral around productid spine, coiling partially obscured by secondary growth material. x 65.
2. Paratype A. Secondary growth material almost removed to show helical spiral coiling of tubular chamber which gradually increases in width; after reaching top of spine, reverses direction, swinging back over test from top to bottom. x 63.
3. Paratype B. Coiling as shown in Fig. 2, but the closeness and number of the coils suggest microspheric form. x 31.
4. Paratype C. Young specimen in which tubular chamber has not swung back over test. Aperture shown as circular opening. x 67.

FIGURE 5—*Ammovertella inclusa* (Cushman and Waters) .. .. .. Page 72

5. Hypotype. Showing irregular coiling of finely arenaceous tubular chamber. x 44.

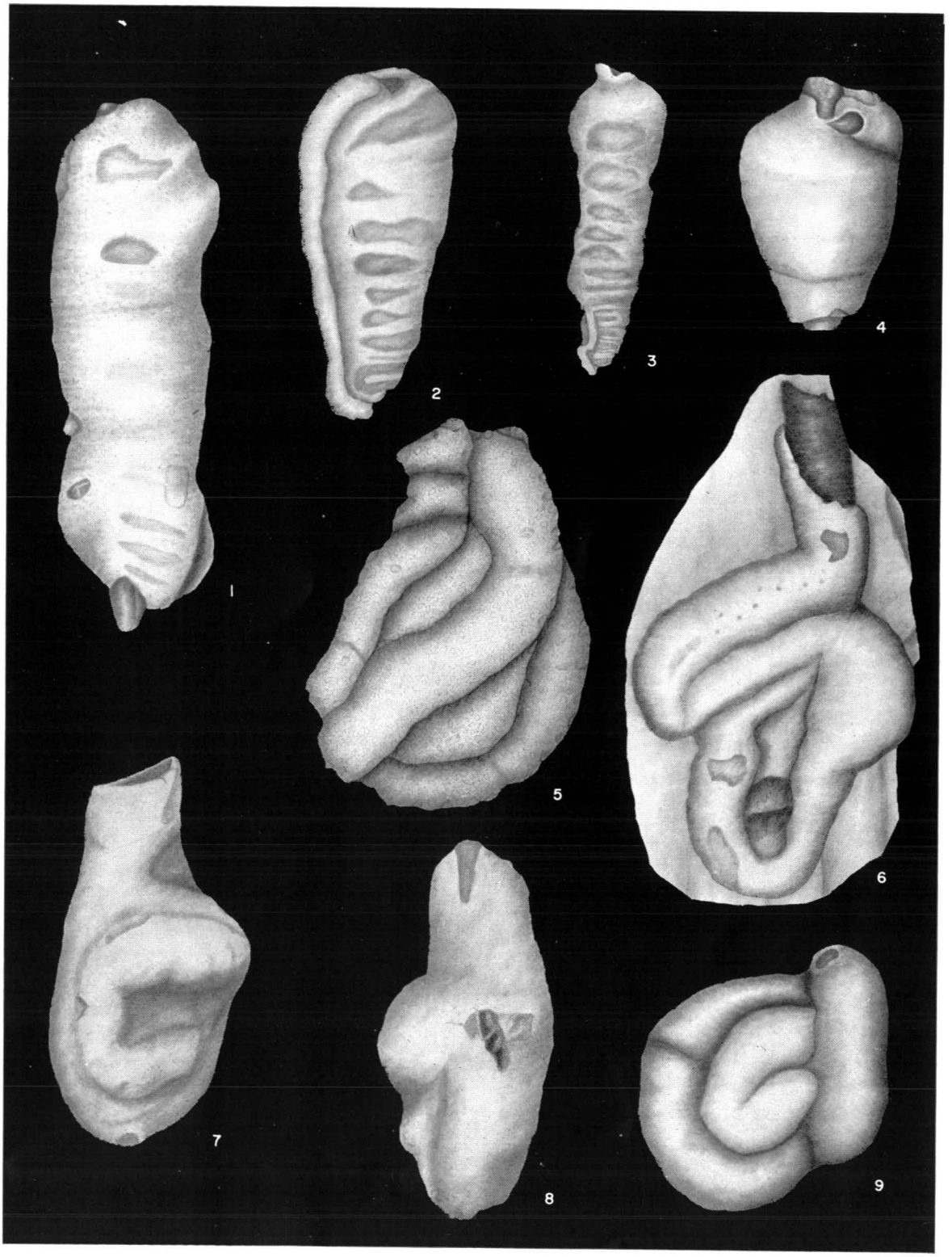
FIGURE 6—*Calcivertella palata* sp. nov. .. .. Page 85

6. Holotype. Unattached view, showing minute proloculus followed by tubular second chamber loosely coiled back and forth then becoming straight. x 111.

FIGURES 7-9—*Orthovertella protea* Cushman and Waters .. .. .. Page 82

7, 8. Hypotype B. Two views of test showing method of coiling of tubular chamber. x 65.

9. Hypotype A. Coiling tubular second chamber, showing rounded aperture at end of tube. x 66.



Australian Permian Foraminifera.

PLATE 19.

FIGURES 1-3—*Stacheia dickinsi* sp. nov. .. .. Page 95

1. Holotype. Showing irregular coiling of finely arenaceous tubular second chamber around productid spine. x 41.
2. Paratype B. Test covered with secondary growth material but irregular coiling of tubular second chamber visible. x 73.
3. Paratype A. Test covered with secondary growth material but irregular coiling visible. x 44.

FIGURES 4-6—*Placopsilina wooramelensis* sp. nov. .. .. Page 94

4. Holotype. Unattached surface, showing initial coil followed by irregular shaped chambers. x 78.
5. View of attached surface of holotype. x 78.
6. Paratype. Specimen attached to fragment of shell. x 87.

FIGURES 7-8—*Tolypammina undulata* Parr .. .. Page 72

7. Hypotype A. Showing irregular coiling of tubular second chamber. x 31.
8. Hypotype B. Similar to Hypotype A. x 54.

FIGURES 9-10—*Plummerinella kimberleyensis* sp. nov. .. .. Page 85

9. Holotype. View of attached surface showing proloculus and complex coiling of tubular second chamber. Small projections do not extend across whorl. x 66.
10. Paratype. Showing thick shell wall in adult stage. x 58.

FIGURE 11—*Calcitornella heathi* Cushman and Waters .. .. .. Page 83

11. Showing irregular coiling of tubular second chamber. x 60.

Australian Permian Foraminifera.

PLATE 20.

FIGURES 1-5—*Streblospira meandrina* Crespin and Belford .. .. .. Page 89

1. Holotype. Specimen in glycerine. Side view showing involute test of form. x circa 53.
2. Holotype. Side view with shell material covering involute central portion. x circa 53.
3. Peripheral view of holotype, showing zigzag arrangement of chambers and compression of test. x circa 53.
4. Horizontal section showing large proloculus and gradual increase in size of second chamber. x circa 90.
5. Vertical section showing large proloculus and change in plane of coiling. x circa 85.

FIGURES 6-9—*Streblospira kimberleyensis* Crespin and Belford .. .. .. Page 89

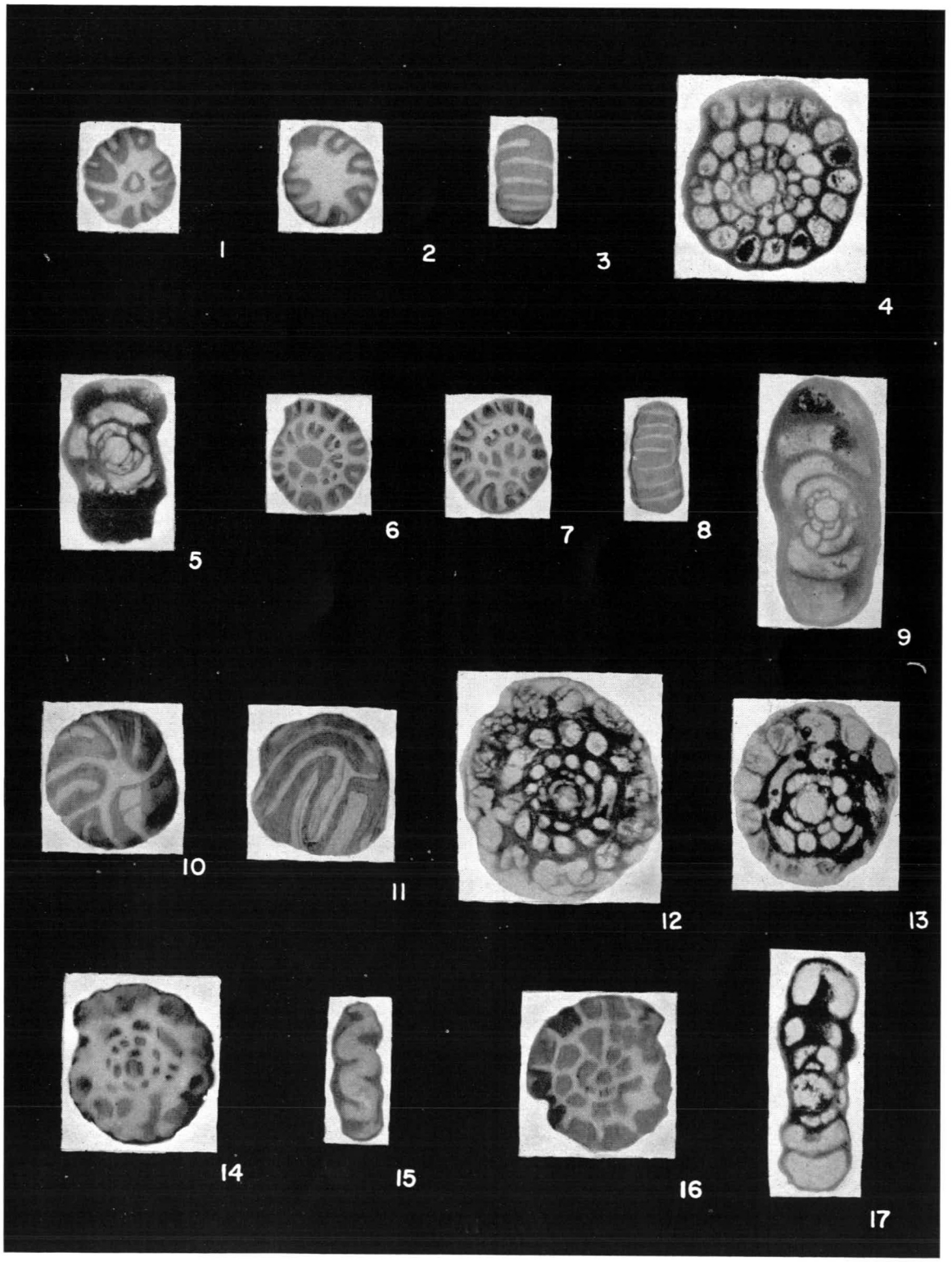
6. Holotype. Specimen in glycerine. Side view showing slightly involute test. x circa 50.
7. Holotype. Specimen in glycerine. Side view showing slightly involute test. x circa 50.
8. Peripheral view of holotype, showing compressed test and zigzag arrangement of second chamber. x circa 50.
9. Vertical section showing large proloculus, slightly involute form of test and coiled second chamber. x circa 88.

FIGURES 10-13—*Streblospira australae* Crespin and Belford .. .. .. Page 88

10. Holotype. Side view. Specimen in glycerine showing method of coiling and zigzag tubular second chamber. x circa 70.
11. Peripheral view of holotype, showing zigzag spiral and change in direction of coiling. x circa 70.
12. Section of a form which seems to have retained uniform coiling for a greater number of whorls than in other specimens. x 107.
13. Section showing globular proloculus and early whorls. x 107.

FIGURES 14-17—*Flectospira prima* Crespin and Belford .. .. .. Page 88

14. Holotype. Side view of dry specimen. x 77.
15. Edge view of holotype showing short zigzag bends of tubular second chamber. x 77.
16. Paratype B. in glycerine. Side view. x 77.
17. Vertical section showing globular proloculus, planispiral coiling, slightly overlapping whorls and part of chamber wall with tubular openings at one edge. x 100.



Australian Permian Foraminifera.

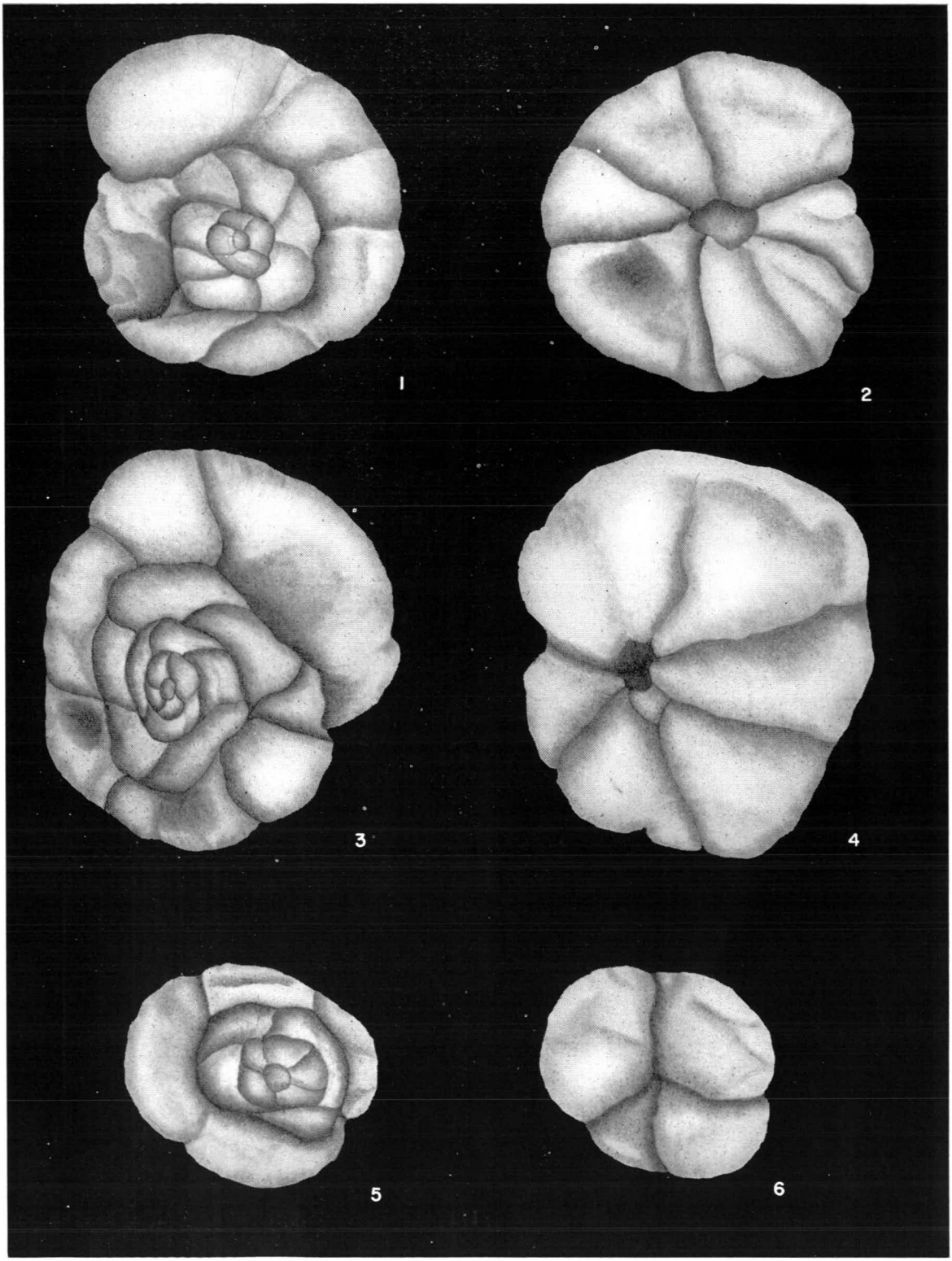
PLATE 21.

FIGURES 1-4—*Trochammina laevis* sp. nov. .. .. Page 90

1. Holotype. Dorsal surface showing closely coiled chambers in initial portion followed by chambers increasing rapidly in size. x 64.
2. Holotype. Ventral surface showing six large chambers and umbilical area. x 64.
3. Paratype. Dorsal surface with final chambers very rapidly increasing in size. x 63.
4. Paratype. Ventral surface showing six large chambers and umbilical area. x 63.

FIGURES 5-6—*Trochammina subobtusa* Parr .. .. Page 92

5. Hypotype. Dorsal surface showing inflated initial chambers and few chambers in final whorl. x 97.
6. Ventral surface of hypotype showing four inflated chambers. x 97.



Australian Permian Foraminifera.

PLATE 22.

FIGURES 1-4—*Trochammina pulvilla* Crespin and Parr .. .. .. Page 91

1. Hypotype A. Dorsal surface showing numerous chambers gradually increasing in size. x 91.
2. Ventral surface of Hypotype A, with seven chambers and small umbilical depression. x 83.

Hypotype B. Showing minute chambers in initial portion. x 80.

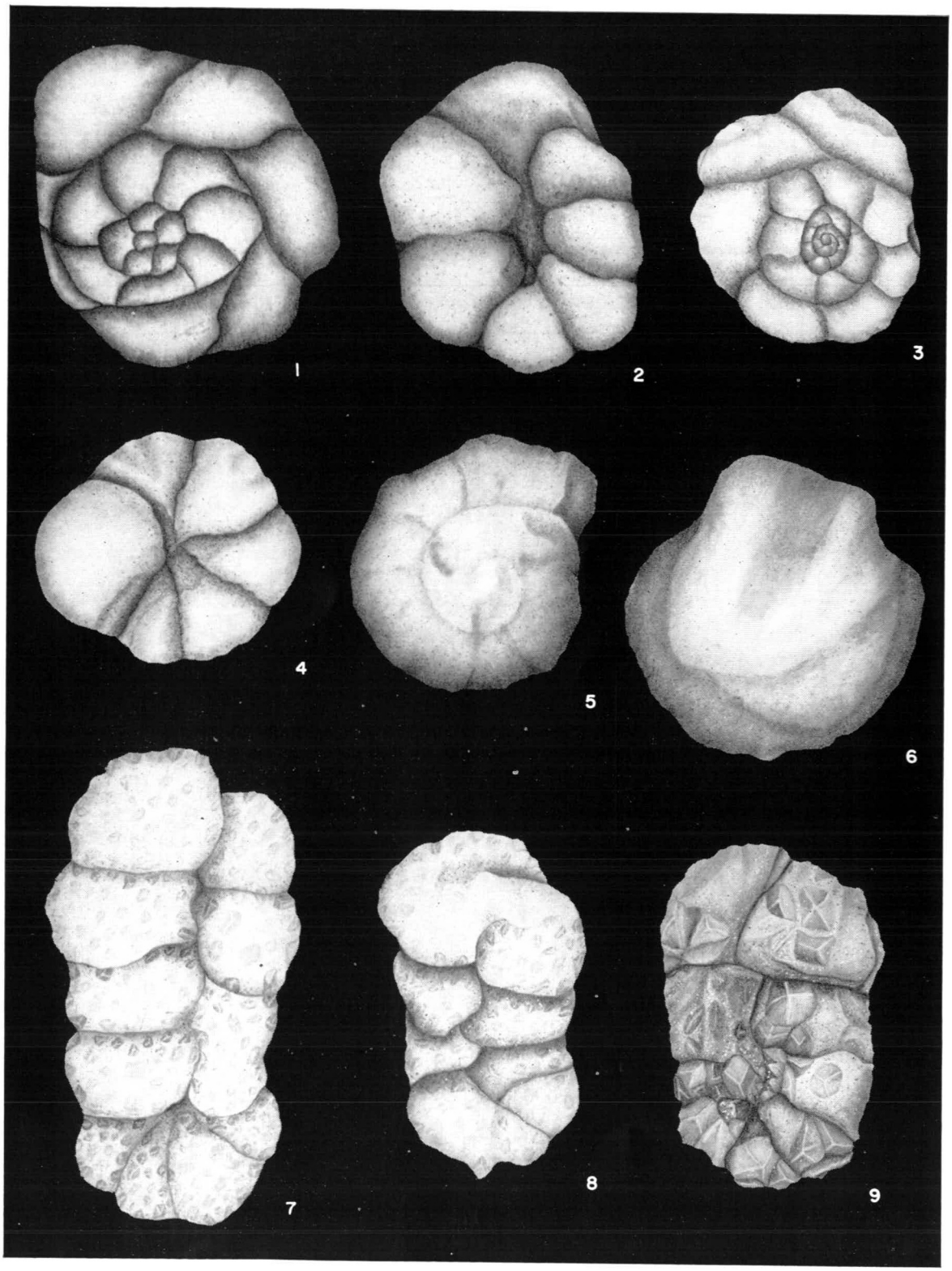
4. Ventral surface of Hypotype B with six chambers and inconspicuous umbilical depression. x 80.

FIGURES 5-6—*Trochammina pokolbinensis* new name .. .. Page 91

5. Hypotype. Dorsal surface showing three whorls and indications of several chambers. x 71.
6. Distorted ventral surface of Hypotype. x 71.

FIGURES 7-9—*Spiroplectammina carnarvonensis* sp. nov. .. .. .. Page 76

7. Holotype. Four chambers in coiled portion, chambers then becoming biserially arranged. x 95.
8. Paratype A. Test slightly distorted. x 114.
9. Paratype B. Test more coarsely arenaceous than previous specimens. x 81.



Australian Permian Foraminifera.

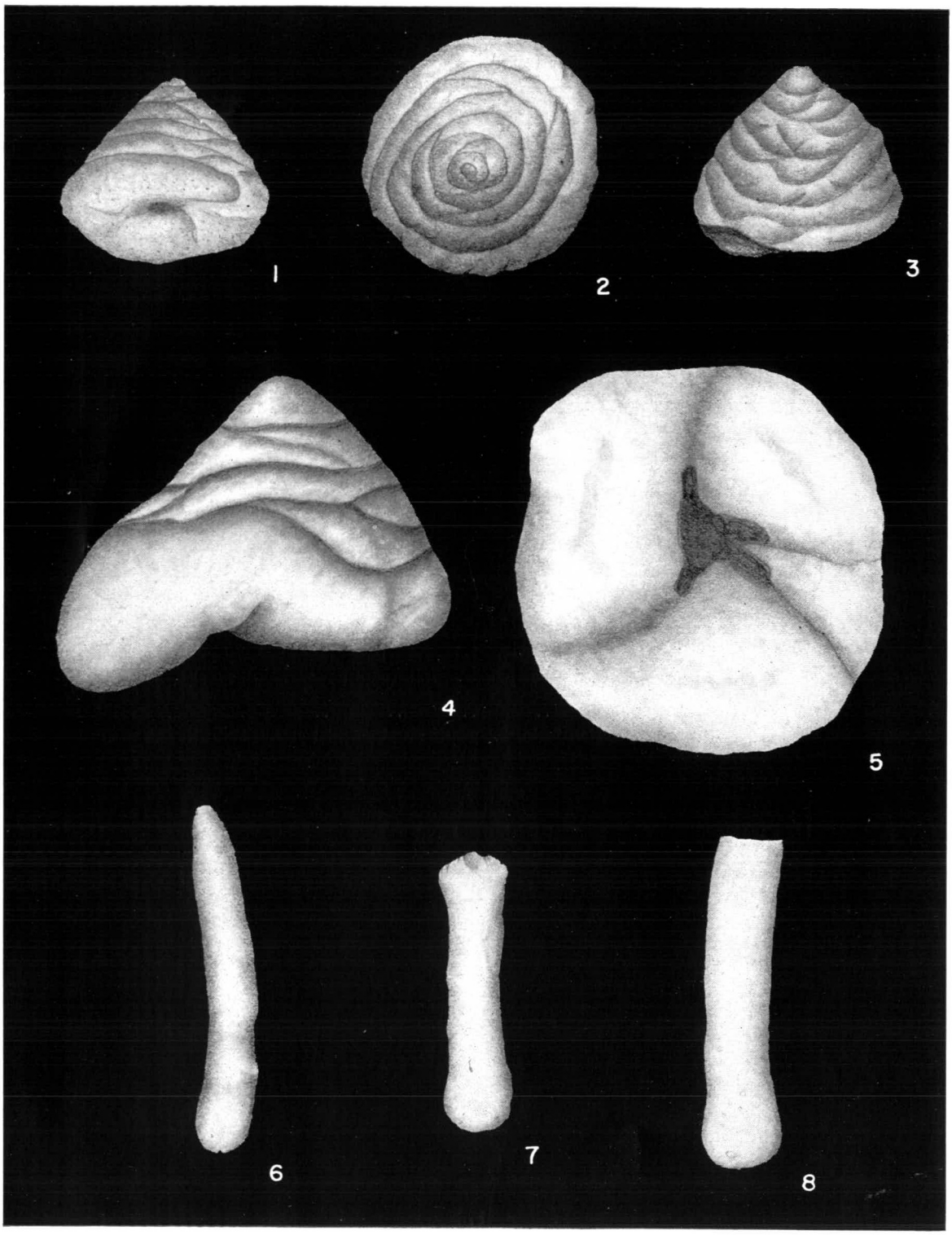
PLATE 23.

FIGURES 1-5—*Tetrataxis conica* Ehrenberg .. .. Page 93

1. Hypotype A. Specimen showing general angle of test and umbilical opening on ventral surface. x 77.
2. Dorsal surface of Hypotype A, showing alternating arrangement of chambers. x 77.
3. Side view of Hypotype A. x 77.
4. Hypotype B. Side view of specimen with strongly rounded periphery. x 83.
5. Ventral surface of Hypotype B showing characteristic petaloid shape of umbilical area. x 83.

FIGURES 6-8—*Earlandia condoni* sp. nov. .. .. Page 58

6. Holotype. Showing globular proloculus, and long tubular second chamber tapering slightly towards aperture. x 51.
7. Paratype A. Globular proloculus and compressed apertural opening. x 54.
8. Paratype B. Test incomplete but with typical globular proloculus. x 58.



Australian Permian Foraminifera.

PLATE 24.

FIGURES 1-3—*Lenticulina* (*Astacolus*) *initialis* sp. nov. .. .. .. Page 96

1. Holotype. Showing involute initial portion with adult chamber becoming evolute. x 63.
2. Paratype A. Showing more elongate chambers and long apertural face. x 55.
3. Paratype B. Test completely evolute. x 69.

FIGURES 4-5—*Dentalina grayi* Crespin .. . . Page 97

4. Holotype refigured. x 56.
5. Hypotype. x 61.

FIGURES 6-7—*Dentalina habra* sp. nov. .. .. Page 98

6. Paratype. Showing attenuated chambers of test. x 68.
7. Holotype. Showing attenuated chambers and sharp spine at initial end. x 46.

FIGURE 8—*Lingulina antiqua* (Chapman and Howchin) .. .. .. Page 108

8. Hypotype. Test slightly crushed but showing typical large apertural chamber. x 51.

FIGURE 9—*Lingulina* sp. .. .. Page 109

9. Specimen showing coiling in initial portion and parallel sides of rectilinear portion. x 68.

FIGURES 10-11—*Dentalina nerrimaensis* sp. nov. .. .. Page 98

10. Holotype. Showing finely striated test. x 66.
11. Paratype. Showing pointed initial end and broken apertural chamber. x 47.

Australian Permian Foraminifera.

PLATE 25.

FIGURES 1-3—*Nodosaria fisheri* sp. nov. .. .. Page 102

1. Holotype. Megalospheric form, showing hispid surface and fine striae covering sutural lines. x 87.
2. Paratype A. Microspheric form with initial portion broken. x 75.
3. Paratype B. Megalospheric form, with fewer chambers than holotype. x 97.

FIGURES 4-8—*Nodosaria irwinensis* Howchin .. .. Page 103

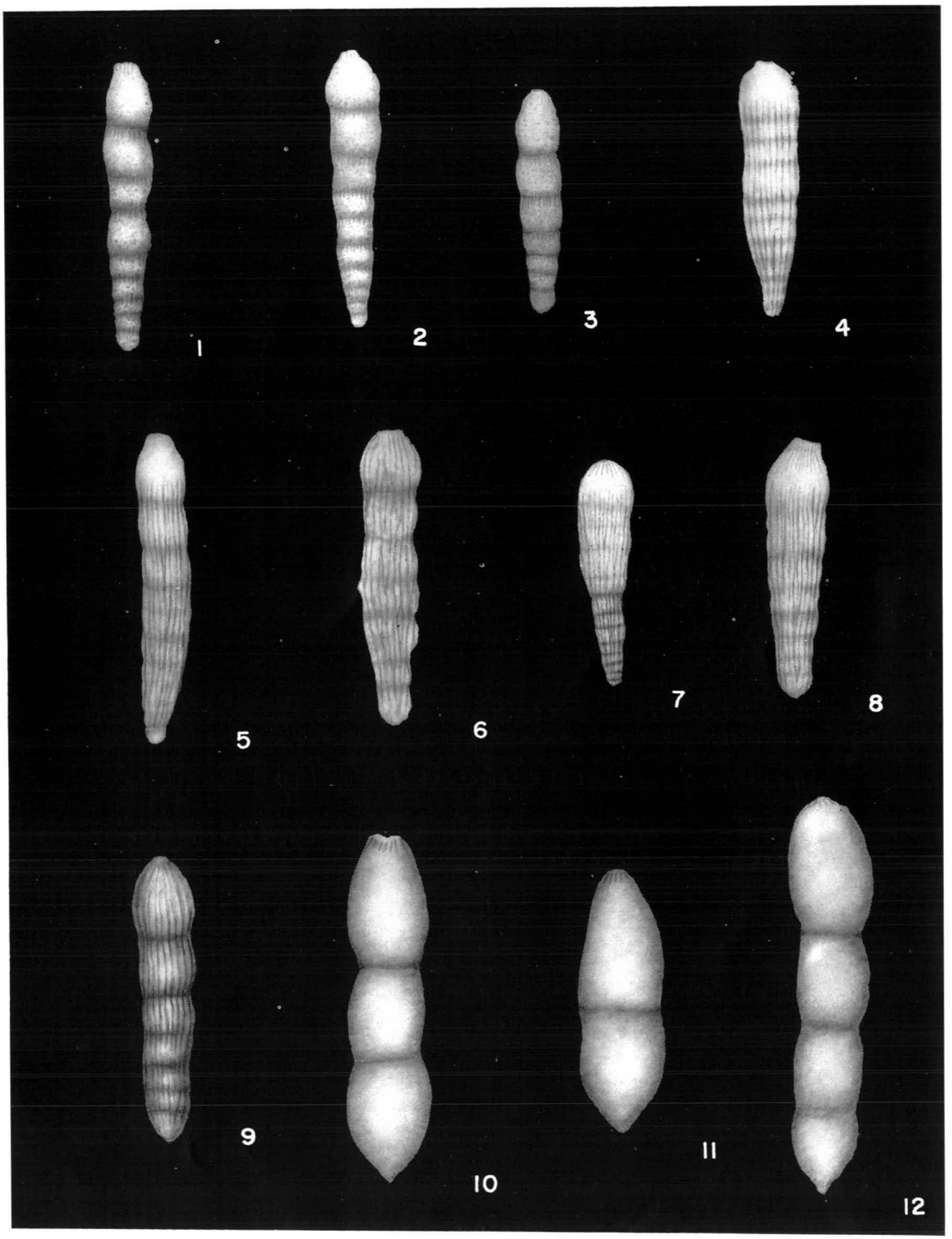
4. Hypotype A (topotype). x 42.
5. Hypotype B (topotype). Showing smooth globular initial chamber. x 62.
6. Hypotype C. Showing large striate globular initial chamber. x 58.
7. Hypotype D. Microspheric form with early chambers missing. x 50.
8. Hypotype E. Showing asymmetrical position of aperture. x 43.

FIGURE 9—*Nodosaria striatella* (Paalzow) .. .. Page 106

9. Hypotype. Showing irregular shape of some chambers. x 45.

FIGURES 10-12—*Nodosaria spiculata* sp. nov. .. .. Page 105

10. Holotype. Showing spine at initial end followed by the typical three chambers. x 106.
11. Paratype B. Showing typical pointed initial end with only two chambers comprising test. x 78.
12. Paratype A. Showing typical sharp spine and with four chambers comprising test. x 175.



Australian Permian Foraminifera.

PLATE 26.

FIGURES 1-4—*Nodosaria tereta* sp. nov. .. .. Page 99

1. Holotype. Megalospheric. Showing small globular proloculus and non-radiate aperture. x 62.
2. Paratype A. Megalospheric form with elongate apertural chamber. x 92.
3. Paratype B. Microspheric form; initial end broken. x 66.
4. Paratype C. Microspheric form; initial end broken but twelve chambers present. x 36.

FIGURES 5-6—*Nodosaria conico-densestriata* Paalzow .. .. .. Page 100

5. Hypotype A. Showing typical rounded ribs which just extend over the last suture. x 32.
6. Hypotype B. x 46.

FIGURES 7-8—*Nodosaria crassula* sp. nov. .. .. Page 101

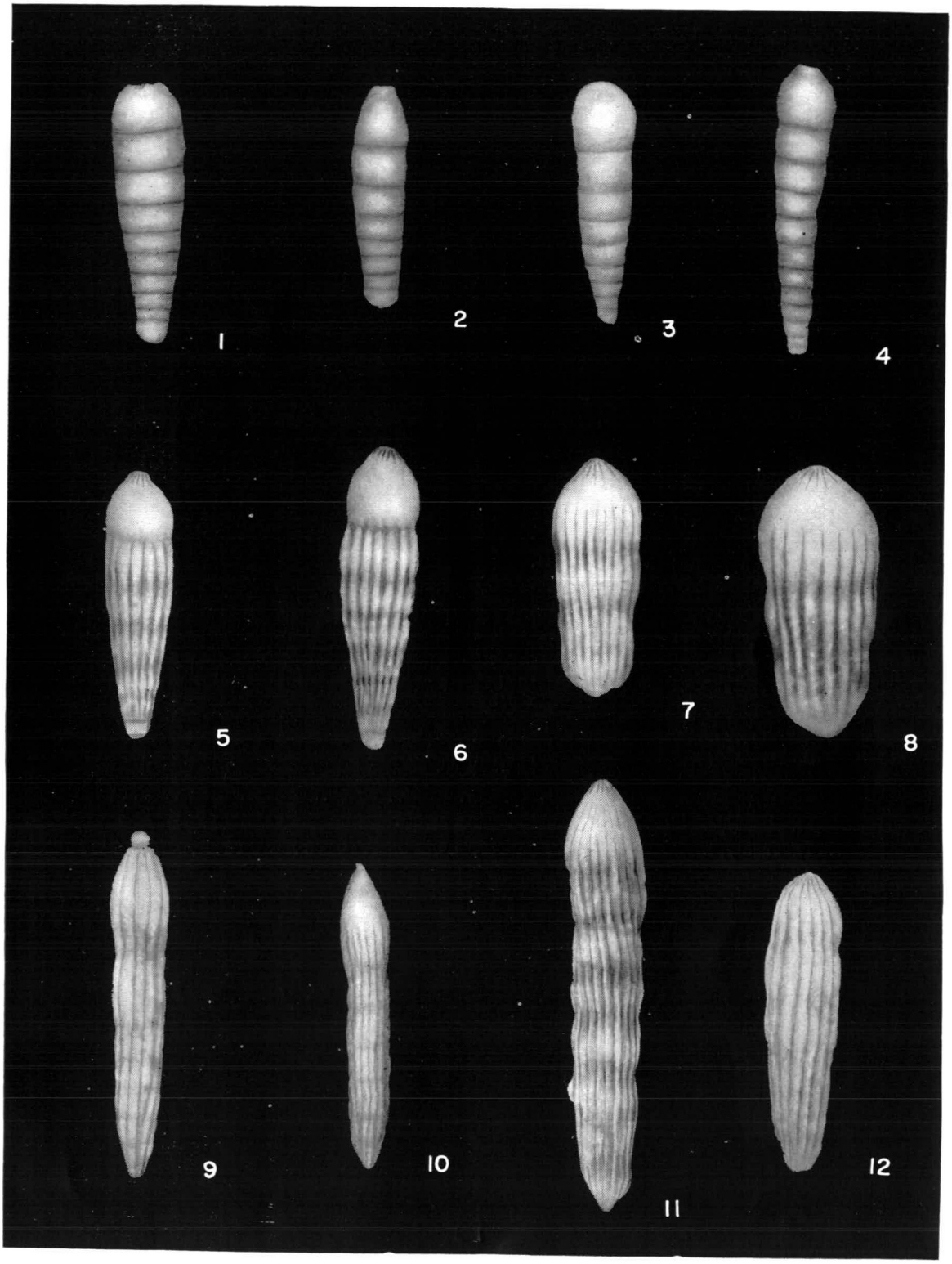
7. Holotype. Showing short, stout test and rounded ribs. x 33.
8. Paratype. x 39.

FIGURES 9-10—*Nodosaria decoris* sp. nov. .. .. Page 101

9. Holotype. Showing long slender striate test with thickened central band on protruding aperture. x 54.
10. Paratype. Striae absent on the upper half of the apertural chamber. x 62.

FIGURES 11-12—*Nodosaria springsurensis* Crespin .. .. Page 106

11. Hypotype. Sutures slightly more depressed than in holotype, Fig. 12. x 44.
12. Holotype, refigured. x 30.



Australian Permian Foraminifera.

PLATE 27.

FIGURES 1-5—*Nodosaria raggatti* sp. nov. .. .. Page 104

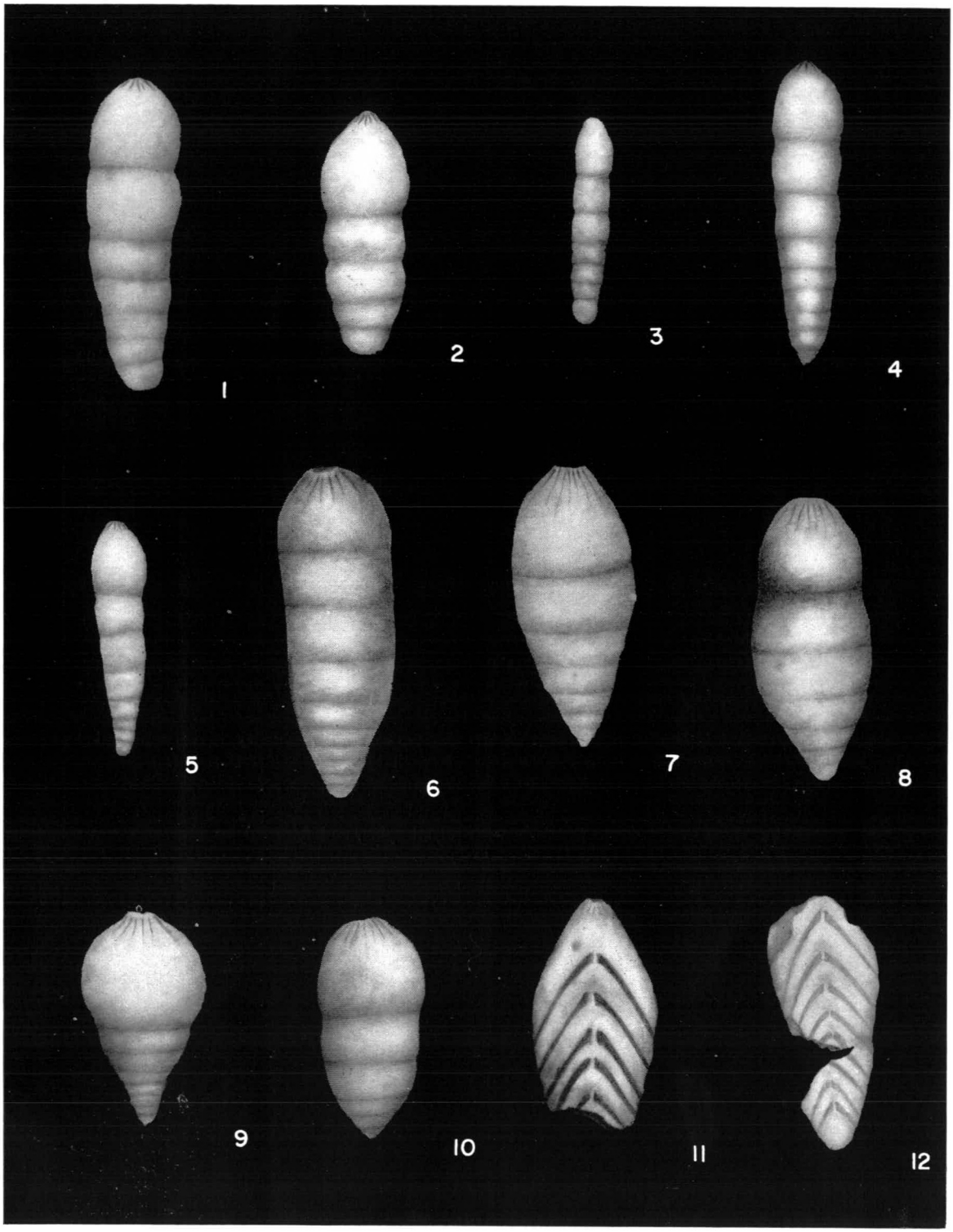
1. Holotype. Showing globular proloculus, distinct sutures, gradual increase in size of chambers and radiate aperture. x 62.
2. Paratype A. Small stout test. x 73.
3. Paratype B. Small slender test with prominent globular proloculus. x 55.
4. Paratype C. Microspheric form with pointed initial chamber and last three chambers increasing rapidly in size. x 62.
5. Paratype D. Megalospheric form, showing small proloculus and slightly attenuated apertural chamber. x 41.

FIGURES 6-10—*Rectoglandulina serocoldensis* (Crespin) .. .. . Page 107

6. Paratype refigured. Showing six small chambers in lower third, followed by four chambers rapidly increasing in size. x 44.
7. Holotype refigured. Megalospheric form with seven chambers. x 45.
8. Hypotype A. Showing constricted suture at base of apertural chamber with greatest width in middle third. x 51.
9. Hypotype B. Microspheric form showing exaggerated inflation of apertural chamber and abrupt tapering in earlier portion. x 44.
10. Hypotype C. Megalospheric form. x 48.

FIGURES 11-12—*Frondicularia sutilis* sp. nov. .. .. Page 114

11. Holotype. Showing thick and strongly arched sutures and radiate aperture. x 48.
12. Paratype. Showing bulbous proloculus and thick, strongly arched sutures. x 41.



Australian Permian Foraminifera.

PLATE 28.

FIGURES 1-4—*Frondicularia aulax* sp. nov. .. .. Page 109

1. Holotype. Megalospheric form with globular proloculus, arched sutures, and deep longitudinal median groove. xx 33.
2. Paratype A. Megalospheric form with median groove strongly developed. x 50.
3. Paratype B. Megalospheric form. Well developed test with globular proloculus. x 37.
4. Paratype C. Microspheric form with small initial spine, followed by five minute chambers and eleven others gradually increasing in size. Median groove present in younger portion of test. x 33.

FIGURES 5-8—*Frondicularia hillae* sp. nov. .. .. Page 110

5. Holotype. Megalospheric form showing irregular striations and protruding aperture. x 60.
6. Paratype B. Microspheric form with long, irregularly striated test. Aperture broken. x 80.
7. Paratype A. Small megalospheric form. x 20.
8. Paratype C. Transparent frill of calcareous material surrounds early portion of test. x 86.

FIGURES 9-12—*Frondicularia impolita* sp. nov. .. .. Page 111

9. Holotype. Megalospheric form showing rough to hispid surface. x 112.
10. Paratype B. Test longer and narrower than holotype. x 70.
11. Paratype A. Test smaller than holotype and strongly hispid in early portion. x 96.
12. Paratype C. Microspheric form with initial spine, and followed by numerous small chambers in early portion. x 71.

Australian Permian Foraminifera.

PLATE 29.

FIGURES 1-2—*Frondicularia limpida* sp. nov. .. .. Page 112

1. Holotype. Initial end broken. x 58.
2. Paratype. Suture slightly depressed. x 67.

FIGURES 3-7—*Frondicularia parri* Crespin .. .. Page 113

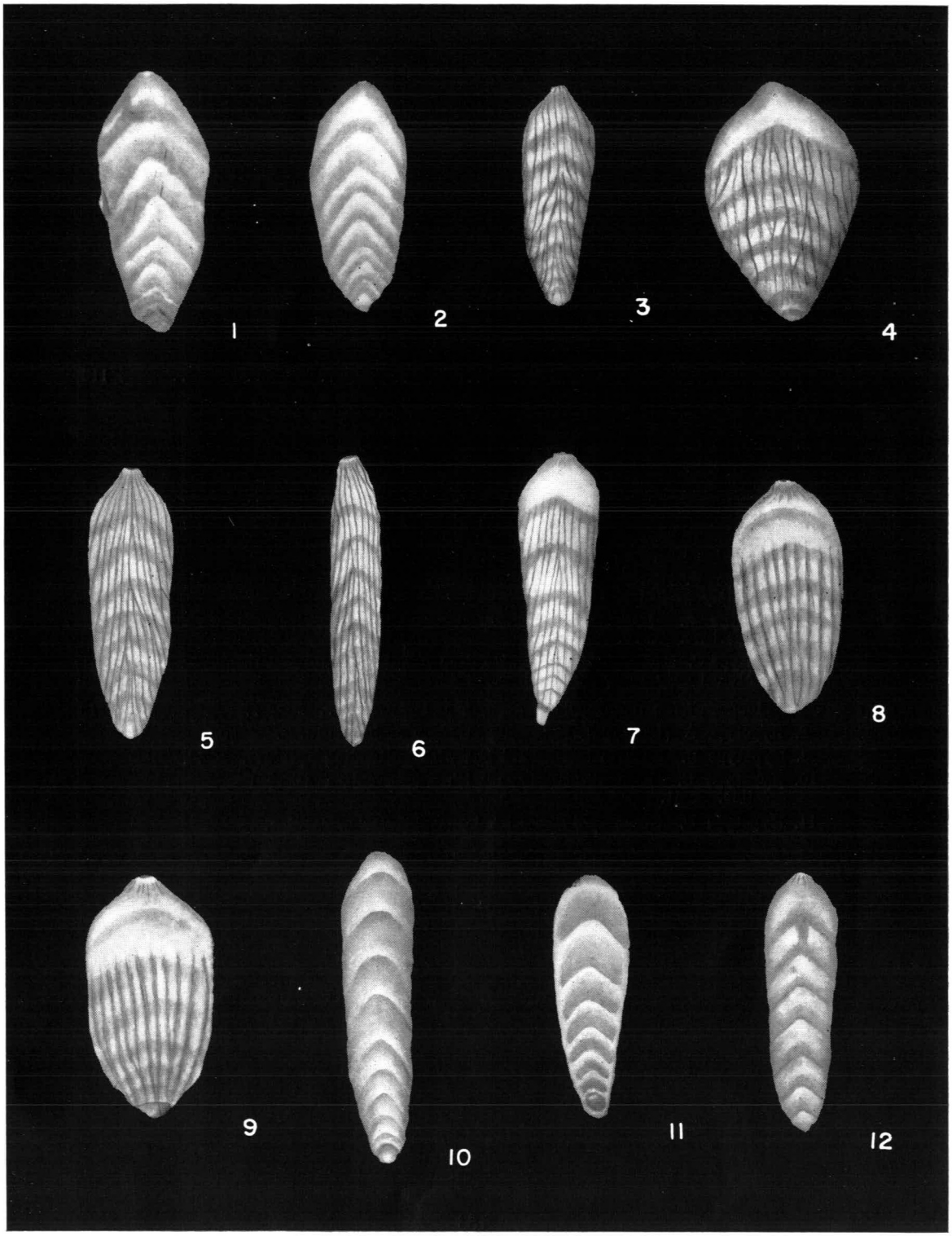
3. Holotype refigured. x 45.
4. Hypotype A. Unusually thick and broad specimen. x 87.
5. Hypotype B. Striae more numerous than in holotype. x 56.
6. Hypotype C. Attenuated specimen with typical striae. x 41.
7. Hypotype D. Microspheric form with initial spine and with striae not extending over surface of apertural chamber. x 56.

FIGURES 8-9—*Frondicularia semicostula* sp. nov. .. .. Page 113

8. Holotype. Showing broad rounded ribs which do not extend over last-formed chambers. x 58.
9. Paratype. Broad spine at initial end. x 80.

FIGURES 10-12—*Frondicularia woodwardi* Howchin .. .. Page 115

10. Hypotype A (topotype). Showing globular proloculus and typical arched sutures. x 42.
11. Hypotype B. Shorter specimen with typical proloculus and sutures. x 69.
12. Hypotype C. Typical specimen. x 49.



Australian Permian Foraminifera.

PLATE 30.

FIGURES 1-3—*Geinitzina caseyi* sp. nov. .. .. Page 113

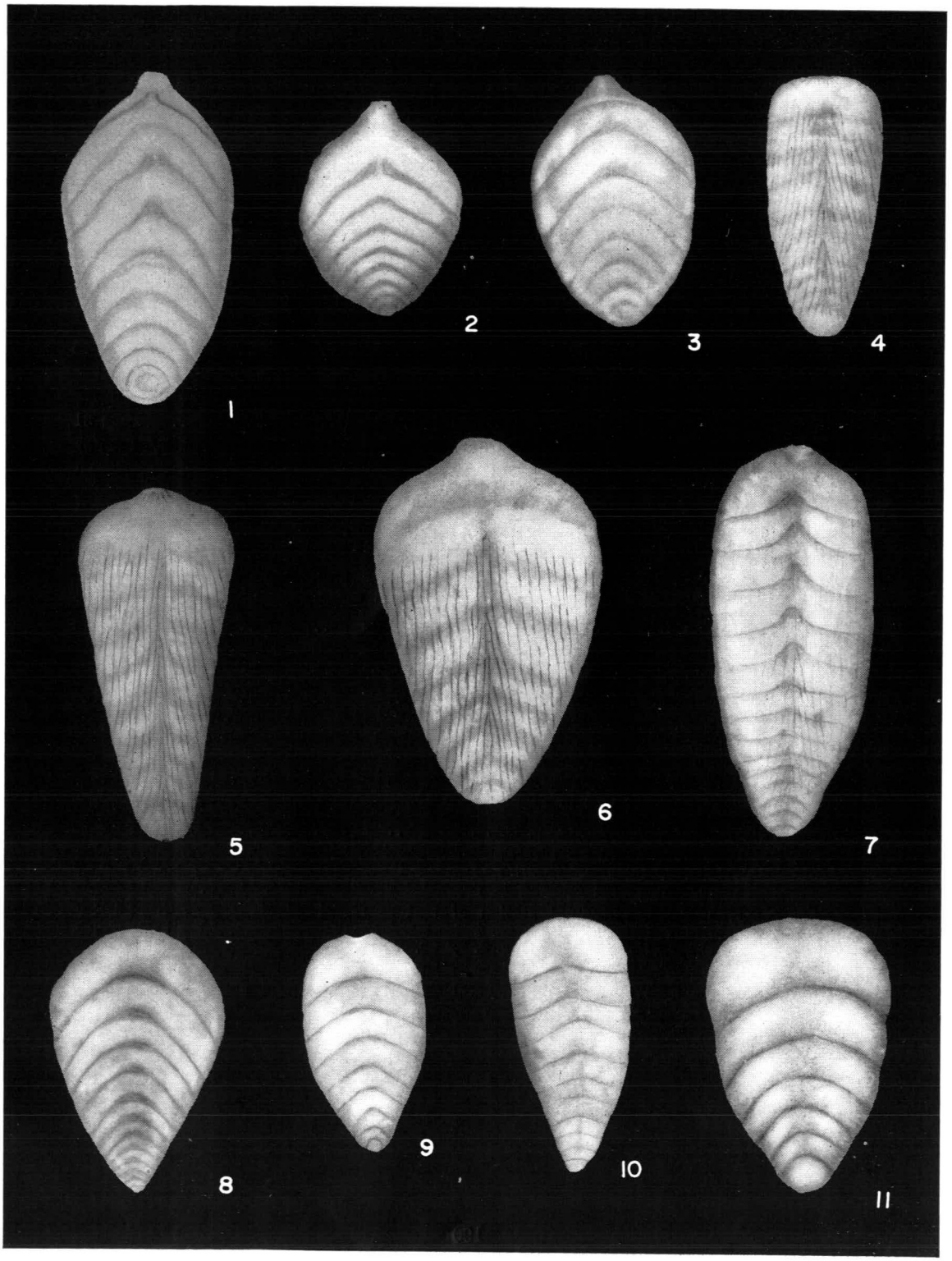
1. Holotype. Showing globular proloculus and gently arched sutures which become thickened along median line with growth of test. x 80.
2. Paratype A. Small stout specimen showing gently arched sutures. x 87.
3. Paratype B. Minute proloculus with sutures gently arched. x 100.

FIGURES 4-7—*Geinitzina striatosulcata* sp. nov. .. .. Page 116

4. Holotype. Megalospheric form with globular proloculus, sutures becoming almost straight with growth of test, characteristic striae and sulcus along longitudinal median line. x 42.
5. Paratype B. Microspheric form with initial end broken, sutures becoming very gently arched and with deep sulcus along median line. x 44.
6. Paratype A. Megalospheric form, stouter than holotype and with protruding aperture. x 70.
7. Paratype C. Microspheric form with deep sulcus along median line and with sutures arched only along median line. x 42.

FIGURES 8-11—*Geinitzina triangularis* Chapman and Howchin .. .. .. Page 118

8. Hypotype A (topotype). Showing strongly arched sutures. x 60.
9. Hypotype B. Sutures less arched but with protruding aperture. x 46.
10. Hypotype C. Elongate specimen with slight sulcus along longitudinal median line. x 51.
11. Hypotype D. Stout specimen with large globular proloculus. x 56.



Australian Permian Foraminifera.

PLATE 31.

FIGURES 1-2—*Thuramminoides sphaeroidalis* Plummer .. .. .. Page 40

1. Hypotype D. Horizontal section showing thick, very finely arenaceous shell-wall surrounding central cavity. x 33.

2. Hypotype E. Horizontal section showing thick, finely arenaceous shell-wall suggesting labryinthic structure. Small apertural openings on wall of cavity. x 80.

FIGURE 3—*Tetrataxis conica* Ehrenberg .. .. Page 93

3. Hypotype C. Vertical section showing arrangement of chambers and variation in thickness of wall structure. x 80.

FIGURES 4-5—*Hemigordius schlumbergi* (Howchin) .. .. Page 81

4. Hypotype D. Horizontal section showing large proloculus followed by tubular section chamber which is irregularly coiled at first then becoming planispiral. Shell-wall thick. x 60.

5. Hypotype E. Vertical section showing sigmoidal arrangement of chambers and thick shell-wall. x 60.

FIGURE 6—*Hemigordius harltoni* Cushman and Waters .. .. .. Page 79

6. Hypotype D. Horizontal section showing large proloculus followed by tubular second chamber increasing rather rapidly in width. Shell-wall thin. x 80.

FIGURE 7—*Geinitzina triangularis* Chapman and Howchin .. .. .. Page 118

Hypotype E. Longitudinal section showing thick shell-wall. Indications of apertural openings in arched portion of sutures. x 80.

FIGURES 8, 11—*Nodosaria irwinensis* Howchin .. .. Page 103

8. Hypotype F. Megalospheric. Longitudinal section showing small globular proloculus, thick wall structure and apertural opening centrally situated along median line. x 60.

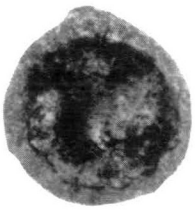
11. Hypotype G. Microspheric. Longitudinal section. Initial chambers missing. Other characters as in Figure 8. x 60.

FIGURES 9, 10, 12—*Nodosaria tereta* sp. nov. .. .. Page 99

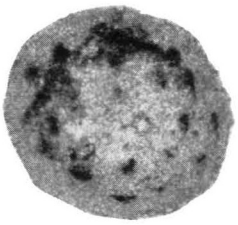
9. Paratype D. Longitudinal section of youthful megalospheric test with globular proloculus, thick shell-wall and thick inner layer surrounding heart-shaped suture. Apertural opening in depressed area of suture. x 60.

10. Paratype E. Longitudinal section of mature megalospheric test with globular proloculus followed by seven irregularly shaped chambers. Wall structure and shape of suture as in Fig. 9. x 60.

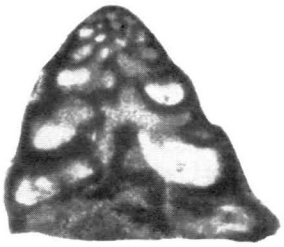
12. Paratype F. Longitudinal section of microspheric test showing at least seventeen chambers. Wall structure, general shape of sutures and position of aperture as in figures 9, 10. x 33.



1



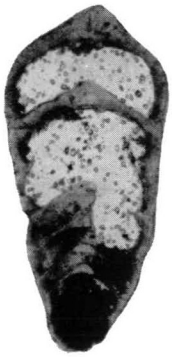
2



3

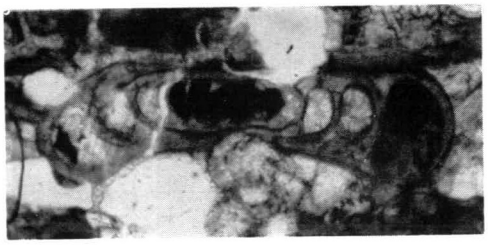
4

6



7

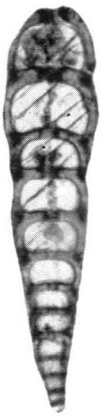
8



5

9

10



11

12

Australian Permian Foraminifera.

PLATE 32.

FIGURE 1—Thin section of limestone from Middalya Station. Showing horizontal sections of *Streblospira australae* Crespin and Belford at top left and *Calcitornello stephensi* (Howchin) at lower right. x 80.

FIGURES 2, 4, 9—*Calcitornella stephensi* (Howchin) .. .. Page 84

Hypotypes E, F, G. Sections showing irregular method of coiling of tubular second chamber. Proloculus is present in figures 4 and 9.

Figs. 2 and 9. x 33.

Fig. 4. x 60.

FIGURES 3, 5-8—*Trepeilopsis australiensis* sp. nov. .. .. Page 86

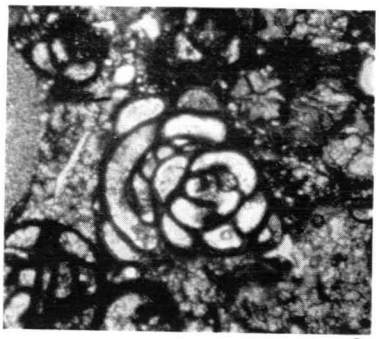
3, 8. Paratypes F and G. Vertical sections showing helical coiling of tubular chamber attached to productid spine. x 80.

5. Paratype D. Section showing helical coiling of tubular chamber around spine, then swinging back over length of coiled portion of test. x 60.

6. Paratype E. Vertical section near margin of test showing spine projecting at either end of test and the regular coiling of chamber at right angles to spine. Thickening along median line indicates position of spine of attachment. x 60.

7. Paratype H. Vertical section showing irregular coiling of tubular chamber. x 33.

1



2

3

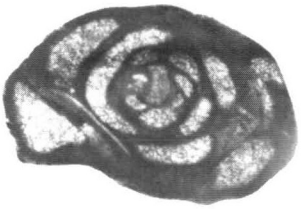
4

5

6

7

8



9

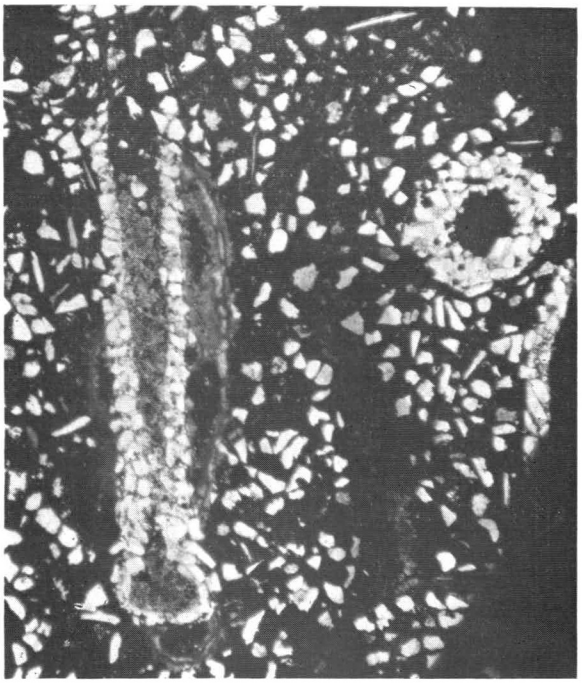
Australian Permian Foraminifera.

PLATE 33.

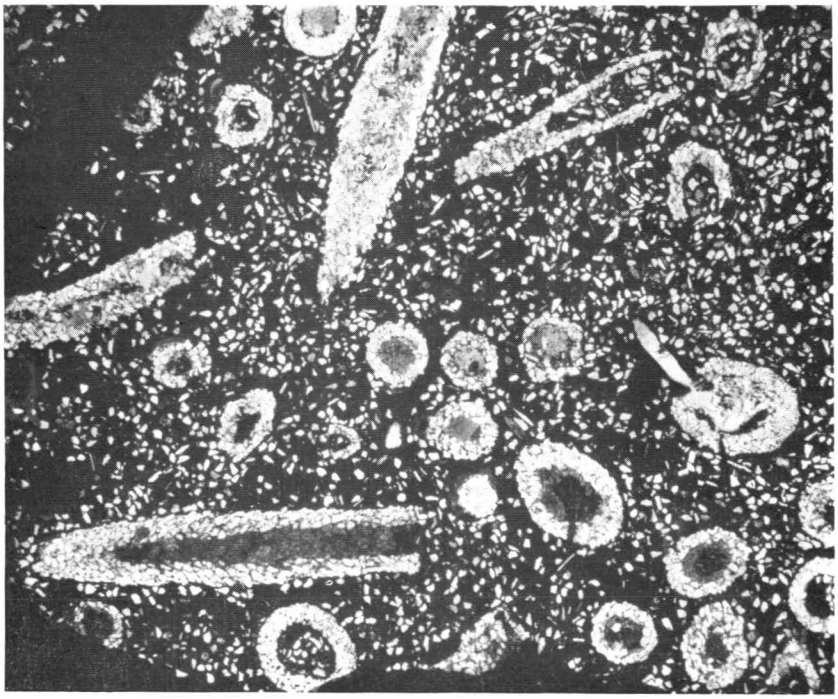
FIGURES 1-2—*Hyperammina coleyi* Parr .. .. Page 46

Thin sections of basal portion of Quinnanie Shale, Wandagee area, Western Australia.

1. Hypotype F. Longitudinal section of specimen showing coarse arenaceous test, typical bulbous proloculus and very gradual increase in width of chamber. Horizontal section of a test showing thick, coarsely arenaceous wall. x 29.
2. Hypotype G. Section showing sections of tests in different directions. x 12.



1



2

Australian Permian Foraminifera.

Page 196 is blank.

INDEX.

Compiled by P. J. JONES.

Reference to systematic descriptions is in bold face; to illustrations, in italics.

422/58.—10

422/58.—11

POSTSCRIPT.

PERMIAN FORAMINIFERA FROM THE IRWIN RIVER AREA, WESTERN AUSTRALIA.

J. M. Dickins recently submitted to the writer for micro-palaeontological examination a collection of rocks made by him towards the end of 1957 from outcrops in the Irwin River area. The samples came from stratigraphical sections not previously examined. The result was that foraminifera were discovered for the first time in the Carynginia Formation and in the Holmwood Shale, and an assemblage of arenaceous species was found in the Fossil Cliff Formation.

Arenaceous genera only were present in the samples. They included described species, species which are described in this Bulletin and three new species. A carbonaceous siltstone from the Carynginia Formation contained an assemblage dominated by the genus *Hyperammina,* together with a probable new species of *Hippocrepinella,* a primitive genus common in the Quamby Mudstone of Tasmania. Such an assemblage has not been recorded previously from any formation in the Permian rocks of Western Australia. Another sample from the Carynginia Formation contained an assemblage with close affinities with that of the Wooramel Group of south-eastern Carnarvon Basin, especially with the Madeline Formation. The new species *Proteonina arenosa* Crespin had not previously been found outside the Madeline Formation.

Two new species, *Glomospirella nyei* Crespin and *Hyperammina callytharraensis* Crespin, are characteristic of samples from the Holmwood Shale; the latter species is very common in the Callytharra Formation of the Carnarvon Basin.

The localities of the samples together with the foraminiferal content are given below.

Carynginia Formation.

Section in bed of North Irwin River, 5 feet above base of formation—

Hyperammina cf. *elegans* (Cushman and Waters)
Hyperammina sp. nov.
Hyperammina expansa (Plummer)
Hyperammina fusta Crespin
Hippocrepinella sp. nov.

10 feet below top of Red Hill, Woolaga Creek—

Ammodiscus nitidus Parr.
Hyperammina cf. *callytharraensis* Crespin
Proteonina arenosa Crespin
Spiroplectammina carnarvonensis Crespin
Thuramminoides sphaeroidalis Plummer

Fossil Cliff Formation.

About halfway between highly ferrugineous band and bottom limestone at High Cliff—

Ammodiscus nitidus Parr
Ammobaculites woolnoughi Crespin and Parr
Hyperammina cf. *elegans* (Cushman and Waters)
Reophax sp. nov.

Proteonina arenosa Crespin
Thuramminoides sphaeroidalis Plummer
Trochammina subobtusa Parr

2 feet below base of High Cliff Sandstone at High Cliff—
Ammodiscus nitidus Parr
Hyperammina callytharraensis Crespin
Hyperammina hadzeli Crespin
Proteonina arenosa Crespin

HOLMWOOD SHALE.

Pt. 112, Pintharuka, R 3/441, S.E. point of Hill—
Glomospirella nyei Crespin
Hyperammina callytharraensis Crespin (common)
Pelosina ampulla Crespin
Psammosphaera pusilla Parr
Trochammina subobtusa Parr

Woolaga Beds. PB. 12—
Glomospirella nyei Crespin
Hyperammina sp.
Pelosina ampulla Crespin
Thurammina phialaeformis Crespin
Thuramminoides sphaeroidalis Plummer
Trochammina subobtusa Parr

High Cliff, top part below prominent calcareous horizon—
Ammodiscus nitidus Parr
Glomospirella nyei Crespin
Hyperammina callytharraensis Crespin
Thuramminoides sphaeroidalis Plummer
Trochammina subobtusa Parr

Upper part of Holmwood Shale in Beckett's Gully, west of Irwin River—
Glomospirella nyei Crespin (common)
Hyperammina hadzeli Crespin

By Authority: A. J. ARTHUR, Commonwealth Government Printer, Canberra.