COMMONWEALTH OF AUSTRALIA.

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**DEPARTMENT OF NATIONAL DEVELOPMENT.**

# BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS.

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**RECORDS:**

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1964/96



## CORRELATION OF THE PERMIAN OF THE HUNTER VALLEY, NEW SOUTH WALES AND THE BOWEN BASIN, QUEENSLAND

by

J. M. Dickins

## WITH AN APPENDIX ON THE FORAMINIFERA FROM THE HUNTER VALLEY

by

A. R. Lloyd

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CONTENTS

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## SUMMARY

Marine macrofossils from 24 localities have been examined and their identifications are listed. The collections have been made from all the marine formations of the Permian sequence of the Hunter Valley, to allow faunal comparisons with the Bowen Basin.

Fauna I, the oldest marine fauna in the Bowen Basin, is regarded as being younger than the fauna of the Lochinvar Formation. It is probably slightly younger than that of the Allandale Formation, and equivalent in age to the Rutherford Formation. On this basis all or part of the "Undivided Freshwater Beds" of the Springsure area and all or part of the Lower Bowen Volcanics, excepting the upper beds which contain Fauna I, may be equivalent in age to the Lochinvar and Allandale Formations.

Fauna II, found in the Bowen Basin in the lower part of the Middle Bowen Beds, occurs in the Farley Formation and apparently in the lower part of the Branxton Formation. The "Fenestella Zone" does not appear to be younger than Fauna IIIA. Fauna III, found in the Bowen Basin in the middle part of the Middle Bowen Beds, appears to be represented in the upper part of the Branxton and Fauna IV, from the upper part of the Middle Bowen Beds, in the Muree and Mulbring Formations.

The faunal evidence available suggests closer links between the two basins during Fauna II and IV time than in Fauna III time. A widespread transgressive phase associated with the incoming of Fauna IV, possibly accompanied by a breakdown of previous barriers, may explain the entry of some new species into the Bowen Basin. A consistently cooler climate is suggested for the Sydney Basin.

## INTRODUCTION

The collection of marine macrofossils, on which this report has been based, was made by E.A. Hodgson of the Bureau of Mineral Resources and the author in February 1962. At the same time, E.A. Hodgson made a special collection of samples for palynological examination.

Although large collections of fossils from the Hunter Valley are available, particularly at the Australian Museum, Sydney, the information on the localities of many of the specimens is such that no precise conclusions are possible on their stratigraphical position. The present collection was made from known stratigraphical horizons in order that the faunal sequence could be examined and compared with that in the Bowen Basin, where the author has been working since 1960.

Arrangements for the visit were made with Dr. F.W. Booker, Government Geologist of the Geological Survey of New South Wales and with Mr. A. Ritchie of the Newcastle University College. We were taken to localities in the field by Mr. M.G. McKellar, at that time seconded from the Geological Survey of N.S.W. to the Hunter Valley Foundation, and by Mr. B. Engel and Mr. A. Ritchie of the Newcastle University College. These and Mr. J. H. Rattigan of the Newcastle University College supplied important information and we are most grateful to them for the trouble they have gone to for this study.

With the exception of the spiriferoids, specific identification has been made from the published descriptions. Most of the spiriferoids (including the Ingelarellinae) are so badly in need of review that, in most cases, use of formal names has been avoided. Some comparisons, however, have been made with species recently described by K.S.W. Campbell from Queensland. The species, as a whole, have been especially compared with those occurring in the Bowen Basin, Queensland. The dielasmatids from the collection have not been considered as they have been forwarded to K.S.W. Campbell of the Department of Geology, School of General Studies, Australian National University, who has included them in his recently completed description of the Australian Permian dielasmatids (Campbell, in press).

The fossils appear to range in age from lowermost Permian to lower Upper Permian (using a twofold division of the Permian). The evidence for this is reviewed elsewhere (Dickins, MS.).

| | STAGES OF URAL AREA | STAGES IN WESTERN PART OF AUSTRALIA | | PERTH BASIN (Irwin River Area) | CARNARVON BASIN (North end of Kennedy Range) | | CANNING BASIN (Fitzroy River Area) | BOWEN BASIN (Blenheim Area) | | BOWEN BASIN (Springsure Area) | SYDNEY BASIN (Hunter Valley) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| UPPER PERMIAN | TATARIAN | F | | | | | Liveringa Fm.<br>Upper marine beds incl. Hardman Member | Upper Bowen Coal Measures | | Bandanna Fm. (upper part) | Newcastle Coal Measures<br>Tomago Coal Measures |
| | KAZANIAN | E | | | Kennedy Gp. | Binthalya Fm.*<br>Mungadan Sst. | Liveringa Fm.<br>middle part | Beds | Unit C (upper part of Middle Bowen Beds ) | Bandanna Fm. (lower part)<br>Mantuan *Productus* Bed<br>Formation to be named | Mulbring Fm.<br>Muree Fm. |
| | KUNGURIAN<br>? | D | 2 | | Byro Gp. | Coolkilya Gw.<br>Baker Fm. | Liveringa Fm. (lower marine part) Lightjack and Balgo Members | Bowen | Unit B (=middle part of Middle Bowen Beds =Collinsville Coal Measures) | Catherine Sst.<br>Ingelara Fm.<br>Aldebaran Sst. | Upper part of Branxton Fm.<br>" *Fenestella* Zone"<br>Lower part of Branxton Fm. |
| LOWER PERMIAN | ARTINSKIAN<br>? | | 1 | Wagina Sst.*<br>Mingenew Fm. | | Nalbia Gw<br>Wandagee Fm.<br>Cundlego Fm.<br>Bulgadoo Sh.<br>Mallens Gw.<br>Coyrie Fm. | Noonkanbah Fm. | | | | |
| | | C | | Carynginia Fm.<br>Irwin River Coal Measures<br>High Cliff Sst. | Wooramel Gp. | | Poole Sst (upper part) | Middle | Unit A (lower part of Middle Bowen Beds ) | Sirius Fm.<br>Staircase Sst.<br>Stanleigh Fm. | Greta Coal Measures<br>Farley Fm. |
| | SAKMARIAN | B | | Fossil Cliff Fm. | Callytharra Fm. | | Nura Nura Member of Poole Sst. | Lower Bowen Volcanics | | Sediments with *Glossopteris* and lacking marine fossils (incl. Orion Fm.) | Rutherford Fm. |
| | | A | | Holmwood Shale*<br>Nangetty Glacial Fm. | Lyons Gp. (with Carrandibby Fm. at top ) | | Grant Fm. | | | | Allandale Fm.<br>Lochinvar Fm. |

Bureau of Mineral Resources Geology & Geophysics

**Either position doubtful or only partly referable to the subdivision*

To accompany Record № 1964/96

M(S)27

## CORRELATIONS

Recently four main faunal assemblages referred to as Faunas I, II, III and IV, in ascending order of stratigraphical position, have been recognised in the marine rocks of the Bowen Basin. Fauna III has been further subdivided into Faunas IIIA, IIIB and IIIC (Dickins, 1962 and in press; and Dickins, Malone and Jensen, in press). Fauna I is from the top part of the Lower Bowen Volcanics and Faunas II, III and IV from the lower, middle and upper parts, respectively, of the Middle Bowen Beds (Units A, B and C of Dickins, Malone and Jensen).

Each of these faunas is in turn compared with the faunas from the Hunter Valley. Previously published data, where this seems relevant, as well as that derived from the present collection, are used in the comparison.

Correlations shown in the accompanying chart, taken from Dickins (MS.), are based on conclusions made in this report.

Fauna I

Fauna I is similar to Fauna II (for faunal references see references given above). It is distinguished by containing "Megadesmus" cf. antiquatus, "Pachymyonia" cf. etheridgei, a species of Aviculopecten with unspecialized ribbing and a distinct species of Notospirifer. The evidence for correlating Fauna II with the Farley Formation and for regarding it as younger than the Allandale Formation is considered in the next section. The same arguments apply also to Fauna I, except for the four distinctive species. Of these, however, only "Megadesmus" cf. antiquatus would suggest correlation with the Allandale, above which it has so far not been recorded in New South Wales. "P". etheridgei has been recorded from both the Allandale and Farley Formations, and in part seems synonymous with Myonia farleyensis. Specimens similar to Aviculopecten sp. are found in the Farley and Notospirifer sp. is not known from New South Wales. Unfortunately the faunas from the Rutherford Formation are poorly known, but taking into consideration the conclusions from the next section, the evidence seems to indicate that Fauna I is slightly younger than the fauna from the Allandale Formation. If no break occurs above the Allandale, Fauna I may be equivalent in age to the Rutherford Formation. This is slightly higher than the correlation suggested for the base of the marine sequence in

the Springsure area of the Bowen Basin by Fletcher (1945, p.296).

Because Fauna I is found in the top part of the Lower Bowen Volcanics and Fauna I or II in the bottom part of the Stanleigh Formation (the lowest marine formation in the Springsure area), all or most of the main part of the Lower Bowen Volcanics and the "Undivided Freshwater Beds", underlying the Stanleigh Formation, are probably equivalent to the Lochinvar and Allandale Formations. The Lochinvar and Allandale Formations contain volcanics not dissimilar to those of the Lower Bowen. Both the Lower Bowen Volcanics and "Undivided Freshwater Beds", (shown in the chart as "Sediments with Glossopteris and lacking marine fossils") contain Glossopteris, are transitional with and do not appear to be substantially older than the beds above.

Fauna II

Fauna II has many resemblances to the fauna found in the Farley Formation in New South Wales. It also resembles that from the lower part of the Branxton Formation, below the "Fenestella Zone". The few species in common with the Allandale Formation appear to range higher both in New South Wales and Queensland.

Species in the present collection from the Farley Formation which are conspecific or closely related to species in Fauna II are:

Strophalosia cf. jukesi
Ingelarella cf. plana or ovata*

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* These specimens seem to have some of the features of I.plana and some of I.ovata. They have a sulcus similar to that in I.ovata but brachial adminicula which vary from those found in I.ovata to those found in I.plana. They are very similar to specimens in Fauna II from the St. Lawrence Sheet area and from the Stanleigh Formation of the Bowen Basin (Dickins, 1964).

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Astartila? gryphoides
Megadesmus nobilissimus
Chaenomya sp.
Eurydesma hobartense
Aviculopecten cf. subquinquelineatus
Peruvispira cf. elegans

Of the species identified, the Allandale Formation contains only Ingelarella cf. profunda, Eurydesma hobartense and

Aviculopecten cf. tenuicollis which are closely related to species in Fauna II. Of these, however, the stratigraphical position of I.cf. profunda is not clear and similar forms are found higher in the sequence (see HV 1a); E. hobartense is found in the Farley and A. tenuicollis is long ranging. The Allandale, in addition, contains different species of Ingelarella, Megadesmus, Eurydesma, Deltopecten and Peruvispira.

That Fauna II is younger than the Allandale is suggested also by the correlation of this fauna, possibly with that of the Callytharra Formation and Nura Nura Member of Western Australia, or, more probably with the Wooramel Group - the Allandale fauna, in turn, seems closely related to that of the Lyons Group. The basis for these correlations was suggested in Dickins (1961) and further evidence is considered in Dickins (MS.).

The fauna of the lower part of the Branxton Formation below the "Fenestella Zone" can be related to Fauna II because it contains Deltopecten, Terrakea sp, Strophalosia valida (closely related to S. brittoni), and a Notospirifer similar to N. extensus. Recent work in the Bowen Basin has shown that N. extensus is probably characteristic for Fauna II but may range into Fauna IIIA. The uppermost correlation of the lower part of the Branxton Formation is limited by the "Fenestella Zone" which appears to be not younger than Fauna IIIA.

In these circumstances, the appearance of two species of Ingelarella in the lower part of the Branxton, similar to I. magna and I. isbelli of Fauna IV of the Bowen Basin, might appear puzzling. Detailed examination has shown, however, that the magna-like form has a consistently sharper umbo than I.magna and that, in both, the adminicula are shorter and at a more primitive stage of development than in I.magna and I.isbelli and are similar to those found in I. plana. The data, therefore, from these two Ingelarellas are compatible with the other faunal evidence.

The ammonoid, Neocrimites meridionalis Teichert & Fletcher 1943, recorded apparently from the lower part of the Branxton Formation (see Glenister and Furnish, 1961), does not have a great deal of bearing on the correlation of the New South Wales and Queensland sequences, although its occurrence is compatible with the conclusions made.

Fauna III

Fauna III, which in the Bowen Basin is found in the middle part of the Middle Bowen Beds, is poorly represented in

the collection made from the Hunter Valley, and indeed seems poorly developed in other areas of Permian outcrop in New South Wales. Only a relatively few species are recorded from the "Fenestella Zone" although the Zone is rich in numbers of specimens. Strophalosia cf. jukesi or preovalis and Ingelarella related to I.plica and I.plana suggest an age not younger than Fauna II, whereas Notospirifer sp. and Myonia sp. suggest equivalence to Fauna III. It seems unlikely that the "Fenestella Zone" can by younger than Fauna IIIA.

The fauna of the upper part of the Branxton Formation is represented only by a few species from a single locality. It is probably equivalent to Fauna III.

Fauna IV

Fauna IV, which in the Bowen Basin is found in the upper part of the Middle Bowen Beds, is well developed in the Muree and Mulbring Formations. Because of lack of information from the uppermost part of the Branxton Formation it is not known whether it first appears somewhat lower down in the sequence.

Its presence in the Muree Formation is indicated especially by forms closely related to or conspecific with Terrakea solida, Strophalosia ovalis, Neospirifer sp. B. In the Mulbring it is indicated by Myonia carinata and Chaenomya sp. It seems likely that the upper boundary of the Mulbring Formation and the Middle Bowen Beds are not very different in age. The occurrence of Keeneia-like forms throughout the sequence in the Hunter Valley into the highest part of the Mulbring, is of interest as this genus is not known in the Bowen Basin above the basal part of the beds with Fauna II.

## PALAEOGEOGRAPHICAL IMPLICATIONS

Marine faunas equivalent in age to those of the Lochinvar and Allandale Formations seem to be absent from the Bowen Basin and, therefore, whereas Permian marine sedimentation commenced in the Hunter Valley in early Sakmarian time, it did not begin in the Bowen before late Sakmarian.

The close relationship of Faunas II and IV with faunas in New South Wales indicates similar climatic and sedimentary environments and probably direct links, at these times, between the two basins. Faunas equivalent to Fauna III are poorly developed in New South Wales and the two basins were possibly isolated either by climatic or geographical factors. During this time, however, some links were apparently maintained

between Queensland and Western Australia (see Dickins MS.). In these circumstances Fauna II species may have lingered on longer in New South Wales than in Queensland and the "Fenestella Zone" may be younger than IIIA. The alternative explanation accepted in the previous section, that the "Fenestella Zone" is not younger than IIIA, is regarded as more probable.

The close relationship of Fauna IV with that of the Muree and Mulbring Formations may indicate the breaking down of a barrier between the two basins and may explain the absence from the Bowen Basin of forms apparently ancestral to I. magna and I. isbelli, which occur in the lower part of the Branxton Formation. The incoming of Fauna IV in the Bowen Basin, and probably also in the Sydney Basin, corresponds with a widespread transgressive phase.

The occurrence of the Keeneia-group of forms as high as the Mulbring Formation and the consistently greater differences between the New South Wales and Western Australian faunas may indicate persistent cooler conditions in New South Wales.

On the basis of conclusions presented in this paper the pelecypod genus Deltopecten disappeared from Western Australia, Queensland and New South Wales at about the same time.

## IDENTIFICATIONS

Dalwood Group (Lower Marine)

Lochinvar Formation

HV6. 0.3 miles north of Lochinvar Station in small cut on west side of road from station to convent on New England Highway - "Gastropod horizon", recorded as 1280' above base of formation.

Gastropods

*Peruvispira allandalensis* Fletcher 1958

Allandale Formation

HV7. Railway cutting between Lochinvar and Allandale Stations, under overhead bridge. Singleton 4-mile Sheet. 444E, 955 N.

Brachiopods

*Ingelarella* sp. A (wide with shallow sulcus and low fold).

Pelecypods

*Phestia* sp.
*Merismopteria* sp.
*Eurydesma cordatum* Morris 1845
*Eurydesma hobartense* (Johnston) 1887
*Aviculopecten* sp. (moderate rib complexity)
*Schizodus* sp. A. (umbo rather rounded, slightly carinate)
*Schizodus* sp. B. (umbo rather sharp and more carinate than sp. A.)
Small *Stutchburia* or "*Megadesmus*" *cuneatus* Sowerby 1838

Gastropods

*Planikeeneia* cf. *minor* Fletcher 1958

HV9a. Railway cutting between Lochinvar and Allandale Stations, 400 yards east of Allandale Station.

Brachiopods

*Ingelarella* sp. A

Pelecypods

"*Megadesmus*" *antiquatus* Sowerby 1838 (the more elongated form is referred to as "*M*" *antiquatus*. It may be a synonym of "*M*" *cuneatus*).

HV10. Harpur's Hill, cutting on south side of New England Highway near crest of hill, apparently same horizon as HV9a. Singleton 4-mile Sheet 443E, 957N.

Brachiopods

*Ingelarella* sp A

*Neospirifer* sp. ind.

Pelecypods

Possible small "*Megadesmus*" *cuneatus*

*Megadesmus globosus* Sowerby 1838

*Merismopteria* sp.

*Eurydesma hobartense*

*Stutchburia* sp. ind.

*Schizodus* sp. B.

*Minilya* sp. nov.

Gastropods

*Keeneia ocula* (Sowerby) 1838

Conulariid

HV21. Polkolbin Area. ¼ mile south-east of road junction at foot of Mt. View (Bellbird-Mt. View and Cessnock-Mt. View road junction near abandoned farm house).

Brachiopods

*Ingelarella* cf. *profunda* Campbell 1961

*Neospirifer* sp.

Pelecypods

*Eurydesma hobartense*

*Aviculopecten* cf. *tenuicollis* (Dana) 1847

Conulariid

Fenestellid and stenoporid bryozoans

Top of Allandale Formation or Base of Rutherford

HV9b. Railway cutting between Lochinvar and Allandale Stations, 300 yards east of Allandale Station.

Brachiopods

*Ingelarella* sp. A

*Neospirifer* sp. A

*Pseudosyrinx* sp.

Pelecypods

*Myonia* cf. *farleyensis* Dun 1932

*Deltopecten* sp. ind.

*Streblopteria* cf. *parkesi* Fletcher 1929

Fenestellid and stenoporid bryozoans

Rutherford Formation.

HV24. Near Jackson's Hill. On obscure track to south of road. About 3½ miles east-north-east of Cessnock. Singleton 4 mile 431E, 942.5N.

Pelecypods

Stutchburia cf. randsi (Etheridge Jnr.) 1892
Aviculopecten sp. ind.

Fenestellid bryozoans.

Farley Formation

HV12. Ravensfield (Brown's) Quarry, south-west of Farley.

Ravensfield Sandstone.

Brachiopods

Ingelarella sp.
Pseudosyrinx sp.

Pelecypods

Megadesmus nobilissimus (de Koninck) 1877
Astartila? gryphoides (de Koninck) 1877
Astartila? sp. (could be an Astartella)
Pyramus? sp.
Chaenomya sp. (similar to species from Fauna II of Bowen Basin but may be a different species)
Palaeosolen? sp.
Merismopteria sp.
Eurydesma cf. hobartense (other specimens in the B.M.R. Museum from the Ravensfield quarry confirm the occurrence of E. hobartense).
Aviculopecten cf. subquinquelineatus (McCoy) 1847
Stutchburia farleyensis Etheridge Jnr. 1900 (not very different to S. compressa. Some specimens may have radiating ornament).
Schizodus sp. C. (rather rounded carina, umbo pointed towards front).

Gastropods

Warthia sp.
Mourlonia sp.
Peruvispira cf. elegans Fletcher 1958
(differs from P. allandalensis and is similar to species from Fauna II of the Bowen Basin. It shows, however, some differences from P. elegans).
Macrochilina sp.

Conulariid

HV13. Farley Road. About 120 yards north of railway bridge crossing road immediately east of station. Stratigraphically in the middle part of the formation.

Brachiopods

Lissochonetes sp.

Ingelarella cf. plana or ovata Campbell (very similar to specimens from "Eurydesma Limestone", Dilly, Bowen Basin).

Pelecypods

Astartila? gryphoides

Myonia farleyensis

Merismopteria sp.

Atomodesma sp.

Stutchburia farleyensis

Schizodus sp. C

Gastropods

Keeneia sp. ind.

HV22. About ½ mile along track running south from old Mt. View School. Fossils are from 2nd ridge along the track.

Brachiopods

Strophalosia cf. jukesi Etheridge Jnr. 1880

Ingelarella cf. plana or ovata

Pelecypods

Phestia sp. (similar to species at HV16 from lower Branxton)

Myonia farleyensis

Stutchburia farleyensis

Gastropods

Peruvispira cf. elegans

Maitland Group (Upper Marine)

Branxton Formation

(a) Lower Part.

HV16. In Redhouse Creek about ½ mile east of junction of Dalwood Road with New England Highway, at junction with small tributary. Singleton 4-mile Sheet 438E, 963N.

Brachiopods

Terrakea sp. (not thickened at umbo, similar or conspecific with species in Faunas II and IIIA of Bowen)

Strophalosia (Wyndhamia) valida Booker, 1929 (these specimens are close or possibly even conspecific with S. brittoni Maxwell 1954 from Fauna II, which they resemble in the flattish, thickened brachial valve and the shape of the pedicle valve and its elongated adductor muscle scars).

Ingelarella sp. B (similar to I.isbelli but dorsal adminicula short and of I.plana type)

Ingelarella sp. C (somewhat similar to I. magna but umbo sharper and adminicula of less advanced type).

Notospirifer sp. (similar to N.hillae or N.extensus and same as at HV1b).

Neospirifer sp. A

Trigonotreta sp. (same as in sandstone at Jervis Bay. Differs from alate form in Fauna IV by lesser complexity of ribbing in sulcus).

Pelecypods

Phestia sp. (may be new, same as in sandstone at Jervis Bay).

Deltopecten sp.

HV23. Dalwood Road. From Redhouse Creek about 1 mile east of junction with New England Highway. Close in stratigraphical position to HV16.

Brachiopods

Ingelarella sp. B

Notospirifer sp. (same as at HV16)

Neospirifer sp.A

Trigonotreta sp. (same as at HV16)

Gastropods

Keeneia cf. occasa Fletcher 1958

(b) "Fenestella Zone"

HV1a. Railway cutting between 1,100 and 1,600 yards west of Branxton Station, 117 feet above base of zone (from section measured by M.G. McKellar).

Brachiopods

Ingelarella spp. (forms comparable to I.profunda, I.plana and I.plica seem present).

Notospirifer sp. (similar to species at HV16 and HV23 - short adminicula in brachial valve).

Pelecypods

*Merismopteria* sp.

Fenestellid bryozoans

HV1b. As for HV1a, 137-140 feet above base of zone (from section measured by M.G. McKellar).

Brachiopods

*Terrakea* sp.

*Strophalosia* cf. *jukesi* Etheridge Jnr. 1880 or *preovalis* Maxwell 1954 (seems identical with Queensland species).

*Ingelarella* cf. *plica* or *angulata* Campbell (one specimen has furrow in sulcus as in *I.plica*, others lack it as in *I.angulata*, adminicula relatively short).

*Ingelarella* cf. *plana* Campbell 1960 (flattish sulcus)

*Notospirifer* sp. (as in HV1a)

*Neospirifer* sp. A

*Trigonotreta* sp. (sulcus relatively simple).

*Cancellospirifer*? sp.

Pelecypods

*Astartila* sp. (seems to be an undescribed species)

*Myonia* sp. (not *M.carinata* - similar to *Myonia* in Fauna III and possibly Fauna II of Bowen Basin).

Gastropods

*Keeneia* sp. ind.

Solitary corals

Fenestellid bryozoans

HV2. Railway bridge at Branxton: Cessnock-Branxton road. Singleton 1 mile Sheet 360E, 617N. Exact stratigraphical position not clear but close to "*Fenestella* Zone".

Brachiopods

*Strophalosia* cf. *preovalis*

*Neospirifer* sp. A.

*Pseudospyrinx* sp.

Bryozoan encrusting pebble 1 inch across.

(c) Upper Part.

HV20. Bow Wow Creek, in section measured by M.G. McKellar from 151°24'50"E, 32°53'40"S (5.2 miles southeast Cessnock Post Office) to 151°26'15"E, 32°55'30"S, between "*Fenestella* Zone" and Muree Formation (or Member), 753 feet above top of "*Fenestella* Zone".

Brachiopods

*Strophalosia* cf. *jukesi* (spines fine - definitely not *S.clarkei* but could be species in Ingelara and is very similar to that in the "*Fenestella* Zone" and at Nowra Hill).

Pelecypods

*Atomodesma* (*Aphanaia*)? sp. (as in Fauna IV of Bowen Basin)
*Streblopteria* sp.

Corals

*Thamnopora* sp.

Crinoid stems

Fenestellid bryozoans

Glendonites

Muree Formation

HV5. Quarry immediately north of Convent School. Newcastle 4-mile Sheet, 456E, 955N.

Brachiopods

*Terrakea* sp. (small and not thickened at umbo).
*Strophalosia clarkei* (Etheridge Snr) 1872 (approaches *S. ovalis*)
*Ingelarella angulata* Campbell 1959
*Notospirifer* cf. *minutus* Campbell 1960
*Trigonotreta* sp. (fairly simple rib pattern in sulcus)

Pelecypods

*Chaenomya* sp. (close to *Chaenomya* from Fauna IV of Bowen Basin)
*Pyramus*? cf. *undatus* (Dana) 1847

HV14a. Newcastle-Singleton railway line, cutting 2 miles west of Branxton Station, east end.

Brachiopods

*Strophalosia clarkei*
*Ingelarella* sp.
*Neospirifer* sp. A.
*Neospirifer* cf. sp. B.
*Trigonotreta* spp. (one fairly alate with one rib in sulcus, others with considerable subdivision in sulcus).

HV14b. As for HV14a, in cutting 100 yards to west.

Brachiopods

Strophalosia clarkei

S. ovalis Maxwell 1954

Pebbles from this locality include acidic volcanics.

HV14c. As for HV14a and b, west end of cutting about 50 yards west of HV14b.

Brachiopods

Strophalosia ovalis

Ingelarella sp.?

Neospirifer sp. A.

Trigonotreta sp.?

Cancellospirifer? sp.

Many pebbles of acidic volcanic material and fragments of yellow and greenish clay.

HV18b. Base of "Bolwarra Conglomerate" in Bow Wow Creek. In same section as HV20 - from base of Muree Formation (or Member).

Brachiopods

Ingelarella sp. (very flat sulcus)

Ingelarella oviformis (McCoy) 1847 ?

Neospirifer sp. A.

Neospirifer sp. B.

Trigonotreta sp. (alate form with complex rib pattern in sulcus and on fold.

Cancellospirifer? sp.

HV18c. As for 18b but scree in creek derived from base of "Bolwarra Conglomerate".

Brachiopods

Ingelarella sp. (lacks sulcus and very thickened at umbo)

Ingelarella oviformis (McCoy) 1847 ? (some specimens have groove in sulcus, but others lack groove).

HV19. Bow Wow Creek, below top cliff-forming unit of Muree. In same section as HV20, HV18b and HV18c, 139 feet above base of Muree (from section measured by M.G. McKellar).

Brachiopods

Terrakea sp. (externally similar to T.solida but could be identified as T. brachythaera)

Strophalosia ovalis
Strophalosia cf. clarkei
Ingelarella sp. (of all specimens in collection is the one most like I.magna)
Neospirifer sp. B

Mulbring Formation

HV4. Singleton Railway Bridge, north or left bank immediately west of bridge. Singleton 1-mile Sheet, 161E, 740N.

Brachiopods

Terrakea cf. brachythaera
Ingelarella sp. (large, of I.magna type, but umbo sharper and sulcus different)

Pelecypods

Myonia carinata
Chaenomya sp. (similar to or identical with species in Fauna IV. Among described species possibly similar to C. etheridgei of de Koninck (1877), C.audax of Dana, (1849) and C.curvatum of Morris (1845).
Stutchburia? sp. ind.

Gastropods

Warthia sp.
Planikeeneia occasa Fletcher 1958?

Large Crinoid Cups

Large Stenoporid Bryozoans

Glendonites

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# APPENDIX

## FORAMINIFERA FROM THE PERMIAN FORMATIONS FROM THE HUNTER RIVER VALLEY, N.S.W.

by

A.R. Lloyd

The following results were obtained from the examination for Foraminifera of outcrop material submitted by J.M. Dickins and E.A. Hodgson from the Permian Formations of the Hunter River Valley, N.S.W. The species were rare in occurrence unless otherwise stated. The samples are listed in stratigraphical order based on the information supplied by J.M. Dickins. Other fossils found are also listed.

Sample HV6, from small cut on west side of road, 0.3 miles north of Lochinvar Station. Lochinvar Formation.
Foraminifera:

*Bathysiphon* sp.

Sample HV8, from erosion channels on stockroute, 200 yards east of Allandale Station. Basal Rutherford or uppermost Allandale Formation.
Foraminifera:

*Ammobaculites* sp.
*Haplophragmoides* sp.
*Bathysiphon* sp.

Sample HV13, Farley Road, 120 yards north of bridge crossing road near Farley Station. Farley Formation.

Foraminifera:

*Ammobaculities woolnoughi* Crespin and Parr 1940 (abundant)

Sample HV1b, 1,100 to 1,600 yards west of Branxton Station. "*Fenestella* Zone".

Foraminifera:

*Bathysiphon* sp.

Sample HV20, Bow Wow Creek, 5.2 miles southeast of Cessnock Post Office. Between "Fenestella Zone" and Muree Formation (or Member).

Brachiopoda:
Productid fragments

Bryozoa

Foraminifera:
Ammodiscus multicinctus Crespin and Parr 1940
Bathysiphon sp.
Textularia sp.
Ammobaculites sp.

Sample HV17, Mt. Vincent-Ellalong Road, about 3½ miles from Mt. Vincnet. Mulbring Formation.
Foraminifera:

Ammodiscus multicinctus Crespin and Parr 1940 (abundant)

Bathysiphon sp.

Sample HV3, Junction of Minimbah Stockroute and New England Highway (Singleton 1-mile Sheet, 138E, 644N). Mulbring Formation.

Foraminifera:
Ammodiscus multicinctus Crespin and Parr 1940 (common)

A. sp. ?A. erugatus Crespin 1958
Bathysiphon sp.
Textularia sp. ?T. bookeri Crespin 1958

Sample HV4, Singleton Railway bridge, north bank of Hunter River, immediately west of bridge. Dochra Mudstone of Raggatt (Singleton 1-mile Sheet 161E, 740N). Mulbring Formation.

Ostracods.

Foraminifera:

Textularia bookeri Crespin 1958 (abundant)
T. sp. aff. T. improcera Crespin 1958
Ammobaculites woolnoughi Crespin and Parr (common)

Ammodiscus multicinctus Crespin and Parr 1940
Bathysiphon sp.
Frondicularia sp. cf. F. limpida Crespin 1958
Rectoglandulina sp. ?R. serocoldensis (Crespin) 1945

The samples were insufficient in number to permit any conclusions on the vertical and horizontal distribution of the foraminifers. The important result of the investigation was the discovery of calcareous foraminifers, Frondicularia sp.cf. F.limpida Crespin 1958, and Rectoglandulina sp. ?R.serocoldensis (Crespin) 1945 (originally placed in the genus Nodosaria), from the Mulbring Formation. Crespin, in Raggat and Crespin (1940) and in Appendix 4 in Reynolds (1956), considered that calcareous foraminifers, and in particular the genera Frondicularia, Nodosaria and Geinitzina did not extend above the Branxton. This discovery of calcareous foraminifers in the Mulbring adds support to the statement of Reynolds (1956, p.16), that "they are not limited to any stratigraphical horizon but rather restricted by some factor such as ecological conditions". It also indicates that the presence of calcareous foraminifers is not a valid criteria for correlating with the Branxton Formation.

Sun Oil Bore

The bore was drilled immediately west of Ravensfield Quarry, inside of entrance gate on the north side of the road. On information supplied by J.H. Rattigan, the drilling began just below the Ravensfield Sandstone at base of the Farley Formation. The base of the Rutherford Formation was reached at about 1248 feet. Beneath this, alternating basalt and lappilli tuff with a small amount of sandstone and mudstone were encountered, which indicate the Allandale or Lochinvar Formation. The following results were obtained but the fauna was too poor to permit any correlation.

| | |
|---|---|
| 1005-1107 feet. | Nodosaria sp. ?N.raggatti Crespin 1958 |
| 1107 feet; 1185 feet; 1195 feet; 1245 feet; | Barren |
| 1255-1300 feet | Ammobaculites sp.; ?Haplophragmoides sp. |
| 1430 feet | Ammodiscus sp. ? A.erugatus Crespin 1958 |
| 1435-1440 feet | Barren. |
| 1450 feet | Fragmentary Foraminifera |
| 1583 feet; 1697-1710 feet; 1897 feet; 1960 feet; | Barren |

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