TASMANIA
DEPARTMENT OF MINES

GEOLOGICAL SURVEY RECORD
No. 10

TASMANIAN STROPHALOSIIDAE

by

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The Honourable LEONARD HUBERT BESSELL, M.H.A.,
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Abstract

Three new species of Strophalosiidae, one with two distinctive varieties, are described from the Lower Permian (?Sakmarian) Glencoe Formation, Golden Valley Group, N Tasmania. The new taxa are the species *Strophalosia subcircularis* with varieties *tumida* and *brevicardinalis; Costalosia apicallosa;* and *Wyndhamia? irregularis*. The new Tasmanian forms are the oldest known Strophalosiidae in Eastern Australia. The associated fauna suggests a broad correlation with the Allandale Fauna of New South Wales (Runnegar, 1967). Evidence is presented which demonstrates that the strophalosiid growth position differed considerably from that advocated by Maxwell (1954). Certain other strophalosiid species originally described from elsewhere in Eastern Australia (Booker, 1929; Maxwell, 1954) and subsequently recorded from the Tasmanian Permian by various authors, are also described and figured, mostly for the first time. An attempt is made to show that the distribution and sequence of Tasmanian strophalosiid faunas provides a valuable aid both for the internal correlation of the various Tasmanian sections, and for correlation with the Permian of Queensland and New South Wales.

Introduction

Strophalosiids have long been known from the Permian of Tasmania. Indeed, the description of *Wyndhamia [Strophalosia] jukesi* from the Cascades Group of the Hobart area by Etheridge (1880) is the first definitive record of the family in Australia. (Admittedly the sole extant specimen (British Museum (Natural History) B 19298) of *Productus brachythaerus* G. B. Sowerby 1844, non *Terrakea brachythaera* (Morris) 1845, is a strophalosiid (Hill, 1950; Muir-Wood and Cooper, 1960), but was never intended as such in the original description. Similarly, the strophalosiid affinities of *Wyndhamia [Productus] clarkei* (Etheridge) 1872 were not recognised in the original description of the species.)

Johnston (1888) figured but did not describe several strophalosiids. The transverse forms (plate 14, figs. 5, 5a) were doubtfully allocated to *Wyndhamia clarkei* (Etheridge); an elongate form (plate 14, fig. 7) to *Wyndhamia jukesi* (Etheridge); and two exteriors (plate 14, figs. 6, 8) to *Buxtonia [Productus] scabricula* (J. Sowerby), a Cracoean Lower Carboniferous species. Whereas Johnston's figures are insufficient in themselves to permit accurate interpretation, most probably all his material would now be allocated to *Wyndhamia jukesi* (Etheridge) with the exception of the specimen (plate 14, fig. 9), which is certainly not a strophalosiid, but possibly a *Terrakea*.

Subsequent generalised accounts of the Permian stratigraphy of certain areas in Tasmania are given in Nye (1924), Voisey (1938; 1949a; 1949b), Lewis (1946), Prider (1948) and Fairbridge (1949). Strophalosiids were often recorded, but rarely identified specifically, and never described or figured.

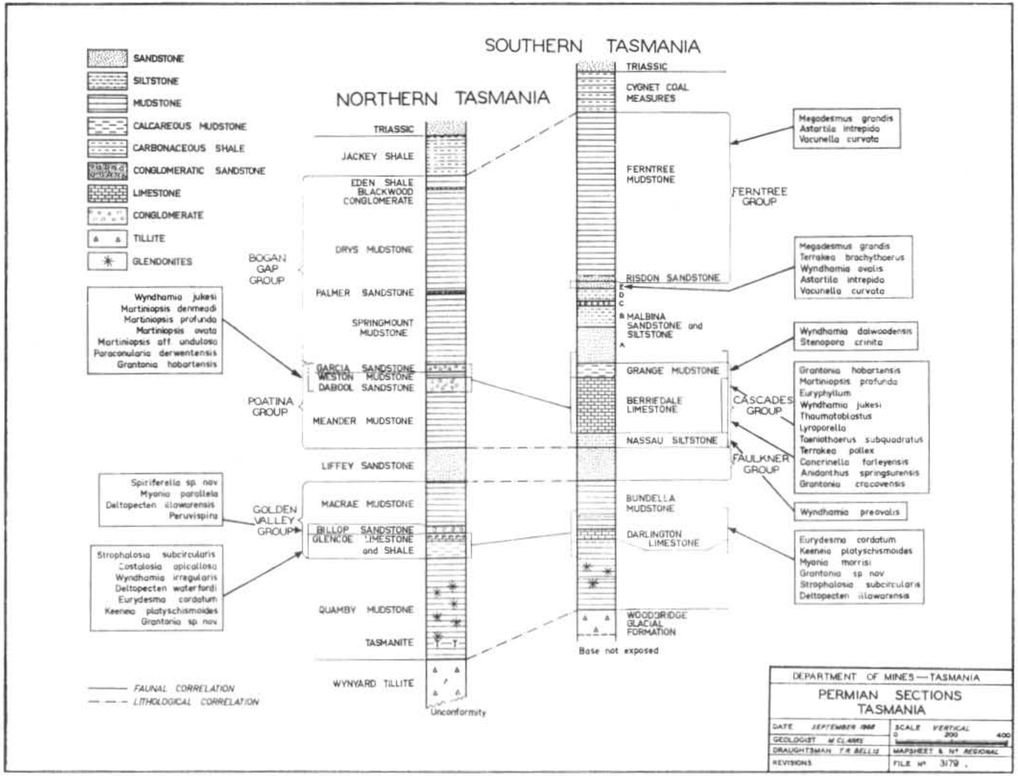
SOUTHERN TASMANIA
NORTHERN TASMANIA
SANDSTONE
SILTSTONE
MUDSTONE
CALCAREOUS MUDSTONE
CARBONACEOUS SHALE
CONGLOMERATIC SANDSTONE
LIMESTONE
CONGLOMERATE
TILLITE
GLENDONITES
TRIASSIC
JACKEY SHALE
EDEN SHALE
BLACKWOOD CONGLOMERATE
DRYS MUDSTONE
PALMER SANDSTONE
SPRINGMOUNT MUDSTONE
GARCIA SANDSTONE
WESTON MUDSTONE
DABOOL SANDSTONE
MEANDER MUDSTONE
LIFFEY SANDSTONE
MACRAE MUDSTONE
BILLOP SANDSTONE
GLENCOE LIMESTONE and SHALE
QUAMBY MUDSTONE
TASMANITE
WYNYARD TILLITE
Unconformity
BOGAN GAP GROUP
POATINA GROUP
GOLDEN VALLEY GROUP
Wyndhamia jukesi
Martiniopsis denmeadi
Martiniopsis profunda
Martiniopsis ovata
Martiniopsis aff. undulosa
Paraconularia derwentensis
Grantonia hobartensis
Spiriferella sp. nov
Myonia parallela
Deltopecten illawarensis
Peruvispira
Strophalosia subcircularis
Costalosia apicallosa
Wyndhamia irregularis
Deltopecten waterfordi
Eurydesma cordatum
Keeneia platyschismoides
Grantonia sp. nov
FAUNAL CORRELATION
LITHOLOGICAL CORRELATION
TRIASSIC
CYGNET COAL MEASURES
FERNTREE MUDSTONE
RISDON SANDSTONE
E
D
C
B
A
MALBINA SANDSTONE and SILTSTONE
GRANGE MUDSTONE
BERRIEDALE LIMESTONE
NASSAU SILTSTONE
BUNDELLA MUDSTONE
DARLINGTON LIMESTONE
WOODBRIDGE GLACIAL FORMATION
Base not exposed
FERNTREE GROUP
CASCADES GROUP
FAULKNER GROUP
Megadesmus grandis
Astartila intrepida
Vacunella curvata
Megadesmus grandis
Terrakea brachythaerus
Wyndhamia ovalis
Astartila intrepida
Vacunella curvata
Wyndhamia dalwoodensis
Stenopora crinita
Grantonia hobartensis
Martiniopsis profunda
Euryphyllum
Wyndhamia jukesi
Thaumatoblastus
Lyroporella
Taeniothaerus subquadratus
Terrakea pollex
Concrinella farleyensis
Anidanthus springsurensis
Grantonia cracovensis
Wyndhamia preovalis
Eurydesma cordatum
Keeneia platyschismoides
Myonia morrisi
Grantonia sp. nov
Strophalosia subcircularis
Deltopecten illawarensis
DEPARTMENT OF MINES — TASMANIA
PERMIAN SECTIONS TASMANIA
DATE SEPTEMBER 1968
GEOLOGIST M CLARKE
DRAUGHTSMAN T R BELLIS
REVISIONS
SCALE VERTICAL
0
200
400
MAPSHEET & Nº REGIONAL
FILE Nº 3179

FIGURE 1.

The first real systematic approach to the stratigraphy of the Permian rocks of Tasmania rests with students of the University of Tasmania under the guidance of M. R. Banks (Banks, 1952; 1955; 1957; 1958; 1962; Banks, Hale and Yaxley, 1955; Banks and Hale, 1957; Banks and Ahmad, 1962; Banks and Read, 1962; Banks and Naqvi, 1967; Ford, 1960; McKellar, 1957; Walker, 1957; Wells, 1957; McDougall, 1959; Woolley, 1959; Anandalwar, 1960; Green, 1961; Sutherland, 1964; Leaman and Naqvi, 1968). During this period it has been possible to prove a generalised Tasmanian sequence characterised at certain horizons by successive strophalosiid faunas similar in many respects to those recorded from Queensland (Maxwell, 1954). Unfortunately this great expansion of our knowledge of Permian stratigraphy has not been accompanied by a complementary advance in systematic palaeontology. As a consequence, the determination of Tasmania faunas has had to await the description of similar forms from elsewhere in Australia. *Wyndhamia jukesi* (Etheridge) thus remains the sole described Tasmanian strophalosiid, whereas several apparently unique forms await description.

During a recent revision of a Lower Permian type section in N Tasmania (Clarke, 1968a), extremely rich, varied and well-preserved strophalosiid faunas were obtained from a horizon considerably below that of *Wyndhamia jukesi* (Etheridge). The main purpose of this report is therefore to describe and illustrate these lowermost N Tasmanian strophalosiid faunas. At the same time the opportunity is taken to illustrate examples of those forms which have been referred to species originally described from other parts of Australia, *viz*: *Wyndhamia dalwoodensis* Booker [=*Strophalosia typica* auctorum], *W. preovalis* (Maxwell), and *W. ovalis* (Maxwell).

Acknowledgements

The author records his thanks to Mr M. R. Banks and Dr P. G. Quilty, University of Tasmania; Dr K. S. W. Campbell, Australian National University; Dr J. Dear, Geological Survey of Queensland; Dr J. M. Dickins, Bureau of Mineral Resources; Dr B. Runnegar, University of New England; and Dr E. Williams, Geological Survey of Tasmania, for much useful discussion and the provision of comparative material from various localities. The author also expresses his thanks to Mr W. Elvey, Tasmanian Government Film Unit, and Mr P. Nankivell, Tasmanian Department of Mines, for their expert assistance with the photographs and illustrations which accompany this report.

Stratigraphy

Strophalosiid faunas occur at various intervals throughout the Tasmania Permian sequence which is summarised in Figure 1. The U. Sakmarian-L. Artinskian species *Wyndhamia jukesi* (Etheridge) in association with *Terrakea pollex* Hill, *Taeniothaerus subquadratus*

(Morris), *Edriosteges* sp. nov., *Cancrinella*, *Anidanthus springsurensis* (Booker), *Grantonia hobartensis* Brown, *Lyroporella*, *Thaumatoblastus* and *Eurydesma sacculum* Dana typifies the main part of the Cascades Group of S Tasmania. The highest parts of the Cascades Group and Malbina A yield *Wyndhamia dalwoodensis* Booker. Malbina E yields the Mantuan species *Wyndhamia ovalis* (Maxwell) together with *Terrakea brachythaera* (Morris) [=*T. solida* (Etheridge and Dun)], *Martiniopsis mantuanensis* (Campbell), *Pterospirifer*? *avicula* (G. B. Sowerby) and *Stenopora crinita* Lonsdale (Banks, 1958 *et seq.* with amendments). Recently the author has collected *Wyndhamia preovalis* (Maxwell) from the Nassau Siltstone near the base of the Cascades Group. Below this level strophalosiids have been recorded but not specifically identified from the Bundella Mudstone, the Darlington Limestone, and the highest parts of a succession which has been correlated with the Quamby Mudstone of N Tasmania (Banks, Hale and Yaxley, 1955; Banks, 1962). The Hobart area therefore affords a continuous and undoubted succession. The Cascades Group and Malbina Formation apparently span that time interval represented by the Sirius Shale Member of the Cattle Creek Formation through to the Mantuan Productus Bed of the Queensland Bowen Basin (Power, 1967). The pre-Cascades Group rocks of the Hobart area are older than the Cattle Creek Formation of the Bowen Basin.

In NE Tasmania the Permian succession is much attentuated. Strophalosiid faunas are thus less varied and comprise only the *Wyndhamia jukesi* and *Wyndhamia dalwoodensis* assemblages from correlates of the Cascades Group.

In N Tasmania there exists a much more fully developed succession ranging from the Wynyard Tillite and its correlates below, to correlates of the Ferntree Mudstone and the Jackey Shale above. In the Golden Valley area, the Stockers Tillite and Quamby Mudstone are virtually devoid of macroscopic fossil material, but further west the occurrence of *Rhacopteris* (Gulline, 1967) and other plants (Gulline and Clarke MS) suggests that the Wynyard Tillite is, in part, of Carboniferous age. The lowest parts of the Golden Valley Group, however, yield the rich strophalosiid faunas described herein, together with other fossils, which suggest approximate equivalence with the Bundella Mudstone of the Hobart area. As pointed out by Clarke (1968a), there are no grounds at present for the exact equation of the Golden Valley Group of N Tasmania with the Darlington Limestone and Bundella Mudstone of S Tasmania. Indeed, much of the pre-Darlington Limestone succession of the Hobart area is more correctly placed within the Golden Valley Group rather than the Quamby Mudstone. Much confusion currently exists in the Tasmanian literature through the failure to distinguish rock stratigraphic units from fossil stratigraphic units.

The Mersey and Faulkner Groups of N and S Tasmania are broad equivalents according to the palynological evidence (Banks, 1962). The succeeding Poatina and Bogan Gap Groups (Bravo and

Pike, 1969) offer little comparison with the post-Faulkner Group succession of the Hobart area. At Poatina, the Poatina Group (' Woodbridge ' Group, McKellar 1957) comprises 190′-200′ mudstone (Meander), 50′ conglomeratic sandstone (Dabool), 20′ bryozoal mudstone (Weston), and 30′ conglomeratic sandstone (Garcia). The Garcia Sandstone is followed by a thick sequence (660′) of monotonous and unfossiliferous mudstone with thin, but distinctive sandstone (Palmer) and conglomerate (Blackwood). This latter sequence, the Bogan Gap Group, has been regarded as a correlate of the Ferntree Mudstone with the Garcia Sandstone, a tentative correlate of the Risdon Sandstone, at its base (McKellar, 1957; Banks, 1962); on faunal grounds this possibility seems remote. The statement that the Weston Mudstone is lithologically very similar to Malbina E (Banks, 1962) indicates a misidentification of the Weston Mudstone. In this vein the record of *Fletcherithyris parkesi* Campbell from the Weston Mudstone at Poatina (Campbell in Runnegar, 1968) must be treated with caution, since the Weston Mudstone, although extremely rich in bryozoa, yields no other fossils. In contrast, the Dabool Sandstone and basal part of the Garcia Sandstone yield abundant and similar shelly faunas. Fossils identified include *Martiniopsis denmeadi* (Campbell), *M. profunda* (Campbell), *M. ovata* (Campbell), *M.* aff. *undulosa* (Campbell), *Paraconularia derwentensis* (Johnston), *Grantonia hobartensis* (Brown, and *Wyndhamia jukesi* (Etheridge). This fauna characterises the main part of the Cascades Group of the Hobart section. It seems unlikely therefore that the base of the Bogan Gap Group (=' Ferntree ' Group auct.) at Poatina is as young as the *Wyndhamia dalwoodensis-Stenopora crinita* fauna of the Grange Mudstone-Malbina A of S Tasmania. By way of contrast a much reduced thickness of sandstone, conglomeratic sandstone and siltstone allocated to the ' Woodbridge ' Formation in the Beaconsfield district, yields *Stenopora crinita, Wyndhamia dalwoodensis* and other fossils (Green, 1959; Clarke, 1969a). Apparently a variety of lithological types of different ages have been allocated severally to an ill-defined ' Woodbridge ' Group or ' Woodbridge ' Formation, which in turn has been regarded as isochronous with the Cascades Group and Malbina Formation of the Hobart area (Banks, 1962).

Material and Preservation

The bulk of the material described herein was collected from a 4-inch thick mudstone exposed on the eastern flank of the Quamby Brook Valley, N Tasmania (fig. 2, loc. 22). This mudstone occurs within the Glencoe Formation (Clarke, 1968a) at a level of about 25 feet below the base of a massive coquina limestone, and about 45 feet below the base of the Billop Sandstone. It apparently corresponds to a level of about 280 feet in the Golden Valley Borehole (Clarke, 1968a). Material was collected from the band for a distance of about 30 feet along the outcrop. Within the band the strophalosiids occur in growth position and in great abundance (see later). *Stenopora tasmaniensis*

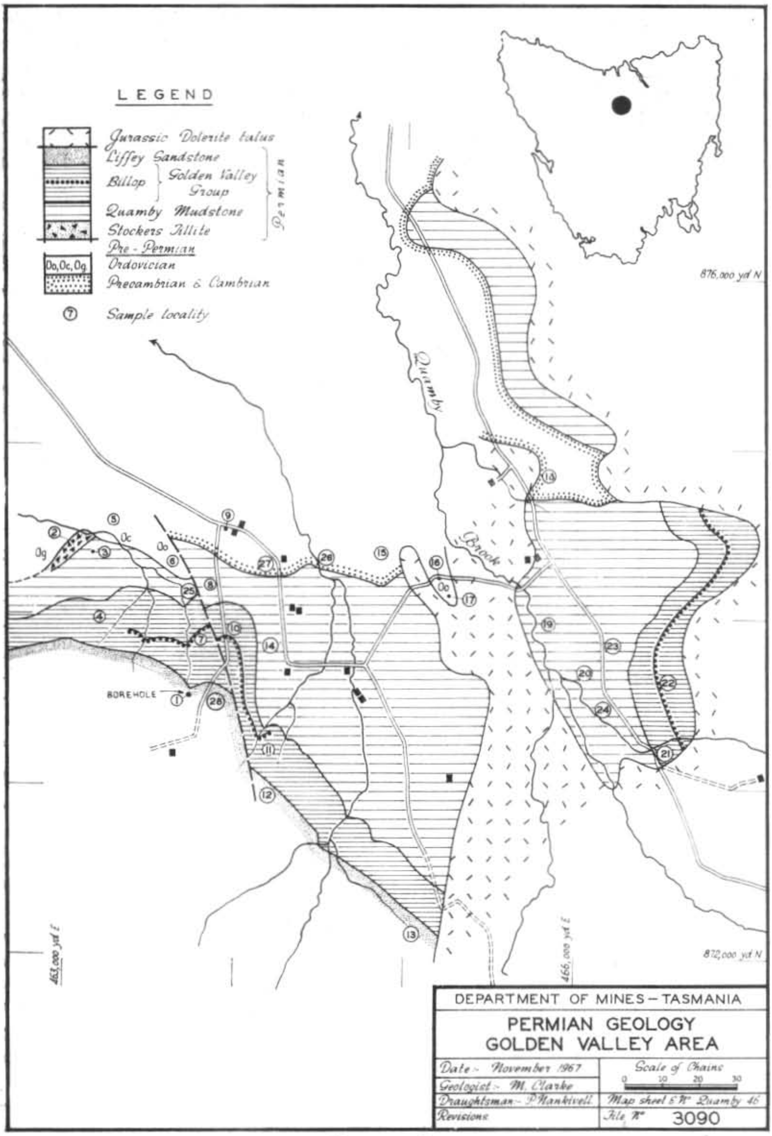
LEGEND
Jurassic Dolerite talus
Liffey Sandstone
Billop
Golden Valley Group
Quamby Mudstone
Stockers Tillite
Permian
Pre-Permian
Oo, Oc, Og
Ordovician
Precambrian & Cambrian
⑦ Sample locality
876,000 yd N
872,000 yd N
463,000 yd E
466,000 yd E
Quamby
Brook
BOREHOLE
Og
Oc
Oo
① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ ⑪ ⑫ ⑬ ⑭ ⑮ ⑯ ⑰ ⑱ ⑲ ⑳ ㉑ ㉒ ㉓ ㉔ ㉕ ㉖ ㉗ ㉘
DEPARTMENT OF MINES – TASMANIA
PERMIAN GEOLOGY
GOLDEN VALLEY AREA
Date:- November 1967
Geologist:- M. Clarke
Draughtsman:- P. Nankivell
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FIGURE 2.

5 cm

Lonsdale is the only other common faunal component, but very rare specimens of *Peruvispira, Keeneia platyschismoides* Etheridge and *Eurydesma hobartensis* (Johnston) also occur. Erratics and pebbles are extremely rare within the band. Above and below this strophalosiid bed, the Glencoe Formation comprises alternations of richly-fossiliferous end erratic-rich, mudstone, siltstone and limestone. In these beds two other indigenous assemblages can be recognised, (1) a stenoporid-fenestellid community and (2) a *Grantonia-Eurydesma-Keeneia* community. But for most part the faunas are clearly reworked and of several generations (Clarke, 1968a). In these reworked assemblages strophalosiids are very subordinate to large numbers of *Eurydesma, Deltopecten, Aviculopecten, Keeneia, Grantonia* and other fossils. The miliolid *Calcitornella* frequently encrusts the shell surfaces of all faunal components.

Other specimens studied include those collected by W. L. Matthews from a unit which is the lithological and faunal equivalent of the Glencoe Formation in an area south of Poatina; and those collected by the author from the Bundella Mudstone of the Kingston area south of Hobart (Moore, 1968; Clarke 1968b). Other figured specimens of *Wyndhamia preovalis* (Maxwell), *W. dalwoodensis* Booker, *W. jukesi* (Etheridge), and *W. ovalis* (Maxwell) were collected from a variety of localities listed later.

The preservation of all specimens is extremely good. Generally, and in particular, those specimens from the Glencoe Formation, the strophalosiids occur in compact mudstone and fine siltstone. Whereas the tenacious nature of the matrix and the lamellose and spinose character of the strophalosiid shell makes clean extraction difficult, all details of the internal and external characters are easily obtained by treating the material with dilute hydrochloric acid. A few shell exteriors were cleaned using potassium hydroxide pellets.

Mode of Life

By virtue of the presence of an umbonal cicatrix, strophalosiids are generally assumed to be fixed Productidinae, at least for some part of their lives (Prendergast, 1943; Maxwell, 1954; Muir-Wood and Cooper, 1960). Muir-Wood and Cooper (1960) did not detail their reasons but stated that 'the Strophalosiidae seem to have been fixed throughout life. In general they are not large shells and may be found attached to a variety of other brachiopods'. Whereas smallness may be a character of such genera as *Devonalosia, Eostrophalosia, Leptalosia* and *Craspedalosia,* it is not particularly valid with respect to most Australian strophalosiids. The bulk of the Australian forms attain 'typical productid' dimensions of associated genera like *Cancrinella, Anidanthus* and *Terrakea.* The views of Maxwell (1954), however, being more detailed and precise, and carrying certain important functional implications, merit more serious disagreement. Maxwell (1954) maintained that 'for at least part of its life *Strophalosia* was maintained in a vertical or oblique position by umbonal cementation' (see fig. 3b). He went further to suggest that 'since gravity becomes an important factor as the valves depart from the vertical, it is essential to consider 'shell attitude' [*sic*] when analysing the functions of various characters'. Objections to Maxwell's postulated growth position are several:—

(1) As a growth position it seems most improbable hydrodynamically; minor currents would cause the shell to topple over unless the umbonal attachment was of a very rigid nature. Whereas rare examples of population variants with large cicatrices are present in most strophalosiid communities, as for example, *Wyndhamia preovalis warwicki* (Maxwell), most strophalosiids show only a minor distortion of the ventral umbo (compare Prendergast, 1943).

(2) Umbonal cementation requires a hard substrate, either in the strict sense, or more broadly in the form of pebbles or shelly material resting on the substrate. However, indigenous strophalosiid faunas invariably characterise soft substrate quiet water mudstone, calcareous mudstone and fine siltstone without pebbles or other shelly debris (Campbell, 1960). Admittedly following the establishment of a shell bank, attachment sites would be readily available, but such a criterion could not apply to the initial establishment of the bed.

(3) Even assuming the doubtful existence of a hard substrate it is difficult to imagine that the umbonal attachment would by necessity be always horizontal. Indeed, many of the N Tasmanian specimens show an umbonal cicatrix in a position whereby 'horizontal orientation' of that cicatrix leads to the absurd conclusion that the strophalosiids lived with their anterior valve margins buried in the substrate. In the case of pebbles or shelly debris providing the attachment site it is possible to provide strophalosiids with orientations which span the compass.

(4) With the growth position advocated by Maxwell 'it is obvious that greater forces are involved in the closing of the valves than in shell opening, since in the former case the movement is against gravity, and in the latter, with gravity' (Maxwell, 1954). However, if the attachment areas of the various muscle systems are broadly proportional to their respective strengths, it seems most probable that the diductor system is relatively stronger. This conclusion would be further strengthened if, as seems possible, the posterior element of the 'adductor' system functioned as an accessory diductor muscle. Certainly it would appear that the posterior element of the 'adductor' system shortened during valve opening rather than lenghtened (fig. 3b). Thus internal musculature does not support the growth position advocated by Maxwell; more probably it suggests that the ventral valve was lowermost, and the dorsal valve uppermost. Additional support for this growth position is furnished by the Quamby Brook strophalosiid bed where numerous specimens with long delicate spines still in place are all orientated with the ventral valve lowermost. Furthermore, many specimens have the two valves slightly ajar, or more rarely, the dorsal valve has sprung open and rests alongside or

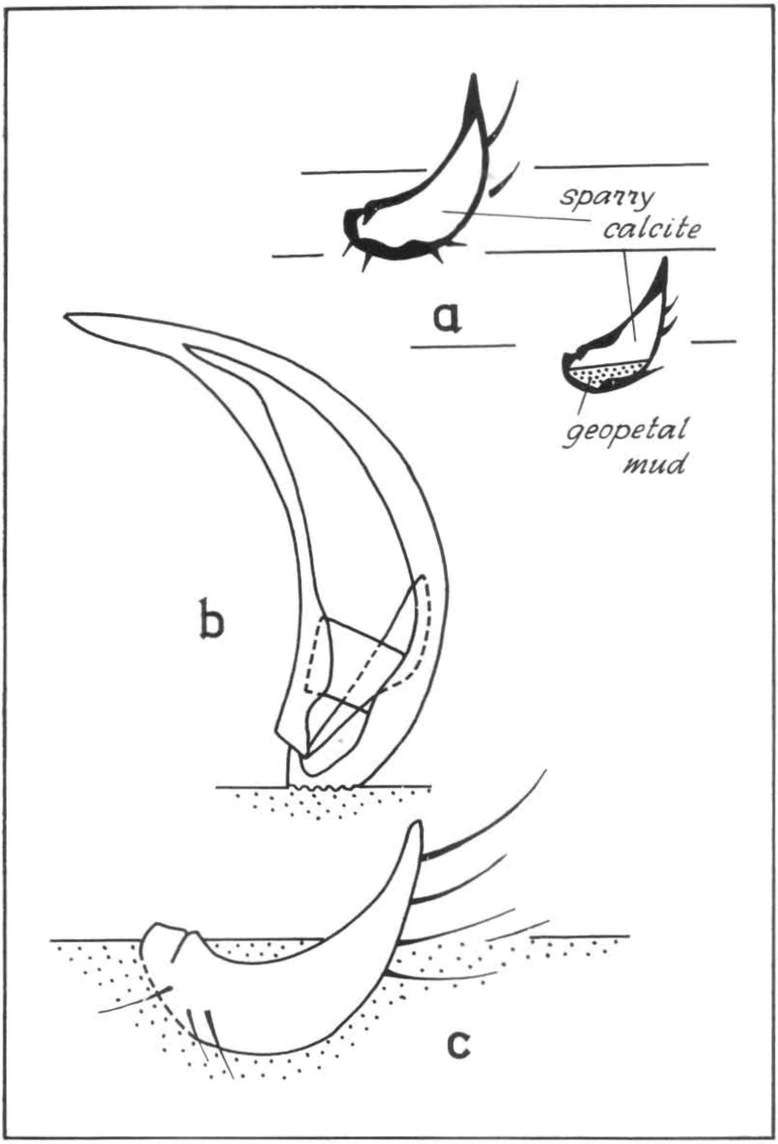
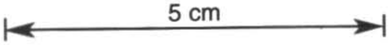


FIGURE 3.

behind the ventral umbo with its internal surface uppermost. All prominent internal features of the dorsal valve such as the cardinal



process and brachial ridges show no clear signs of abrasion, and the association is unlikely to be fortuitous. This suggests either, that on balance the diductor system was more powerful than the adductor system, or, less probably, that the adductor system decayed more rapidly than the diductor system. Further evidence for a growth position with the ventral valve lowermost is provided by two specimens sectioned by chance in the Golden Valley borehole (fig. 3a). Both specimens with spines intact have the same orientation, and in one, geopetal mud rests almost parallel with the bedding.

To summarise it is believed that the majority of Australian strophalosiids after an initial short period of spat attachment, broke from that attachment and lived free on, or partially buried within, a soft substrate (Prendergast, 1943, and fig. 3c). In all probability the strophalosiid growth position differed little from that so clearly demonstrated for *Echinauris* and *Marginifera* (Grant, 1968), and a great many other Productidinae. The necessity for maintaining the antero-lateral margins above the substrate results in geniculation and the continued upgrowth of the trail (Coleman, 1957). It is noticeable that *Costalosia apicallosa* sp. nov., a species with a less convex profile and shorter trail, is characterised by heavy posterior thickening of the ventral valve throughout ontogeny. This thickening may have acted as a posterior counterweight thus assisting in maintaining the anterior margins above the substrate. The development of long, slender and curved spines over the anterior portions of the ventral valve would provide not only anchorage within a soft substrate, but also assist in preventing the downward movement of the anterior shell regions (Grant, 1968).

The Age of the Fauna

The fauna obtained from the Glencoe Formation includes:—

- *Calcitornella stephensi* (Howchin)
- *Costalosia apicallosa* sp. nov.
- *Strophalosia subcircularis* sp. nov. and varieties
- *Wyndhamia*? *irregularis* sp. nov.
- *Grantonia* sp. nov.
- *Martiniopsis* sp. [=*Ambikella, Ingelarella, Tomiopsis* auctorum]
- *Schuchertella* sp. (or *Streptorhynchus* sp.)
- *Keeneia platyschismoides* Etheridge
- ?*Paromphalus ammonitiformis* (Etheridge)
- *Aviculopecten tenuicollis* Dana
- *Deltopecten waterfordi* Dickins
- *Deltopecten illawarensis* (Morris)
- *Eurydesma cordatum* Morris
- *Eurydesma hobartensis* (Johnston)
- *Merismopteria macroptera* (Morris)
- *Stenopora tasmaniensis* Lonsdale
- *Stenopora johnstoni* auctorum
- Fenestellids including *Polypora* sp.

The underlying Quamby Mudstone is virtually devoid of macroscopic fossils but has yielded *Grantonia* sp. nov. The overlying Billop Sandstone yields a fauna similar in many respects to that of the Glencoe Formation but also with *Spiriferella* sp. nov., *Myonia parallela* Dun (previously determined as *M. carinata* (Morris) by the writer (1968a, p. 24), and a large dielasmid, probably *Fletcherithyris*. Strophalosiids and *Eurydesma* are rare, but *Peruvispira* is very abundant.

As stated by Banks (1962), the foraminiferal faunas, bryozoa, lamellibranchs and gastropods all indicate a broad correlation with the Dalwood Group of New South Wales, more especially the Allandale and Rutherford Formations. This age allocation still appears to be the most probable, although little importance is here attached to the encrusting miliolid *Calcitornella*, which certainly ranges high into the Cascades Group (Bravo, personal communication).

Rather unfortunately, strophalosiids are unknown from the Allandale Formation (fide Runnegar). *Strophalosia subcircularis* sp. nov. is an extremely variable form and shows no close affinities with any previously described species. Certain extreme population variants approach the internal ventral morphology of *Wyndhamia preovalis* (Maxwell) from the Cattle Creek Formation and Homevale Beds of Queensland, but spines are never developed on the dorsal valve nor are the internal details of the dorsal valve similar. *Wyndhamia? irregularis* sp. nov. with its elongated and sinuous ventral adductor platform, its irregular, less-impressed diductor scars, and less convex profile shows similarities with *Wyndhamia jukesi* (Etheridge) from the Cascades Group of the Hobart area, and might be reasonably regarded as ancestral to it. *Costalosia apicallosa* sp. nov. is externally nearest to *C. argentea* (Douglas) from an unknown horizon in the Permian of Iran, but lacks dorsal valve spines.

Grantonia sp. nov. has rounded cardinal extremities, fasciculate bundles of 2-3 costae only moderately accentuated by lateral plications, and a very narrow, elongate and notched ventral muscle platform. A fine, thread-like, median septum extends about half-way towards the anterior margin in the posterior regions of the dorsal valve.

Grantonia sp. nov. is close in external characters to *G. hobartensis* Brown from the Berriedale Limestone of S Tasmania particularly with respect to the development of its costal pattern (Armstrong, 1968; the synonymy of *Grantonia* and *Trigonotreta* is not herein accepted). In *G. hobartensis*, however, the cardinal angles are much more acute, the fasciculate bundles are more strongly accentuated by lateral plications, and the ventral muscle platform is short and wide. The ventral muscle platform in *G. cracovensis* Wass from the Cracow area of Queensland is intermediate to those of *Grantonia* sp. nov, and *G. hobartensis*, but in *G. cracovensis* each fasciculate bundle is composed of 5-7 costae. Whereas *Grantonia* sp. nov. and *G. hobartensis* may represent an evolutionary series, *G. cracovensis* does not appear to be a closely related species.

Neospirifer pattersoni Sutherland and Harlow (1967) from the Upper Pennsylvanian of N America is similar to the Glencoe *Grantonia* with respect to its general shell form, ornament, and weak lateral plications. In *N. pattersoni,* however, the ventral muscle field is broader, more anteriorly situated, and its posterior margin rounded. The more posterior position and narrowness of the ventral muscle field in *Grantonia* sp. nov. closely approaches that of *N. cameratus* (Morton) from the Middle Pennsylvanian of N America, but the latter species lacks lateral plications and the costae are stronger and more rounded.

In aggregate the fauna of the Glencoe Formation is clearly older than that of the Cascades Group (U. Sakmarian-L. Artinskian; Fauna II of Dickins, *et al,* 1964; Runnegar, 1967), and therefore on younger than Sakmarian. A broad equation with the Sakmarian Allandale Fauna of New South Wales may therefore be valid. Whereas the neospiriferid components of the fauna do not preclude an uppermost Carboniferous age, the presence of a well-developed *Eurydesma* fauna must at present be taken to indicate a Permian age. Dr R. Helby of the New South Wales Geological Survey is currently conducting a palynological investigation of the Golden Valley borehole and it is hoped that the microfloral evidence may shed further light on this problem.

Systematic Palaeontology

The depository of types and figured specimens is shown by the following abbreviations:—

AMF	Australian Museum, Sydney.
CPC	Commonwealth Palaeontological Collection, Canberra.
TMF	Geological Survey of Tasmania, Hobart.
TM P—Z—	Tasmanian Museum, Hobart.
UQF	University of Queensland, Brisbane.
UTF	University of Tasmania, Hobart.
UWA	University of Western Australia, Perth.

Suborder PRODUCTIDINA Waagen, 1883.
Superfamily STROPHALOSIACEA Schuchert, 1913.
Family STROPHALOSIIDAE Schuchert, 1913.

DIAGNOSIS:

Primitive Strophalosiacea with hinge teeth and sockets; small interareas present in both valves. Small to medium sized ventral umbo usually deformed by a small cicatrix. Ventral valve spinose, rarely costate; dorsal valve lamellose, sometimes spinose, sometimes non-spinose and irregularly dimpled and nodose. Cardinal process bilobed, trilobed or bulbous; brachial ridges long, sharply descendent. Adductor scars usually non-dendritic. L. Devonian-U. Permian.

REMARKS:

A variety of generic names have been applied to Australasian strophalosiids. They include *Strophalosia* W. King, 1846; *Wyndhamia*

Booker, 1929; *Branxtonia* Booker, 1929; *Heteralosia* R. H. King, 1938; *Lialosia* Muir-Wood and Cooper, 1960; *Multispinula* Waterhouse, 1966; and *Echinalosia* Waterhouse, 1967. *Costalosia* Waterhouse and Shah, 1966, can be added to this list.

Branxtonia (type species *B. typica* Booker) is based on an internal mould and is generally considered to be a junior synonym of *Wyndhamia* (type species *W. dalwoodensis* Booker) (Maxwell, 1954; Coleman, 1957; Waterhouse, 1964). Maxwell (1954) further regarded *Wyndhamia* as a junior synonym of *Strophalosia* W. King, 1846. *Heteralosia* was erected by R. H. King (1938) to include those forms with non-spinose dorsal valves in the mistaken belief that *Orthothrix* [*Orthis*] *excavata* Geinitz, 1848, was the type species of *Strophalosia*. *Lialosia* (type species *L. kimberleyensis* (Prendergast)) with an ornament of concentric lamellae, growth lines, faint capillation and spines restricted to a single row at a low angle to the hinge; together with *Costalosia* (type species *C. costata* (Waagen)) which has a costate and spinose ornament, appear to be two well-marked morphologies. Waterhouse (1964) separated *Wyndhamia* from *Strophalosia* by virtue of its wedge-shaped dorsal valve. Most recently, *Multispinula* (type species *M. maxwelli* (Waterhouse)) was erected by Waterhouse (1966) to include those Australian forms with spines on both valves but lacking the wedge-shaped dorsal valve of *Wyndhamia*. *Echinalosia* was proposed (Waterhouse, 1967) as a new name for *Multispinula* Waterhouse which is preoccupied.

Most workers have regarded the presence or absence of spines on the dorsal valve in strophalosiids as a feature of fundamental taxonomic importance. Those forms with spines on both valves have been assigned to the Strophalosiinae Schuchert, 1913, and those with ventral spines only to the Heteralosiinae Muir-Wood and Cooper, 1960. This subdivision would appear to be unquestionable with respect to forms like the Zechstein *Dasyalosia goldfussi* (Münster) and the Pennsylvanian *Heteralosia slocomi* R. H. King.

However, following the application of Muir-Wood, the International Commission on Zoological Nomenclature has designated *Strophalosia gerardi* W. King, 1846, as type species of *Strophalosia* (1962; Opinion 625). As Brunton (1966) points out, the ruling of the I.C.Z.N., 'whilst clearly setting out the complex history of the genus, unfortunately includes errors which detract from its validity'. After examination of the type material of *Strophalosia gerardi* W. King, Brunton (1966) agreed with the previous observations of R. H. King (1938) and Waterhouse (1964) that spines are not present on the dorsal valve of the genoholotype, thereby necessitating the inclusion of *Strophalosia* and *Heteralosia* within the same subfamily. Thus Heteralosiinae Muir-Wood and Cooper is a junior synonym of Strophalosiinae Schuchert. Dasyalosiinae was proposed as a new subfamilial name for those forms with spines on both valves and previously assigned erroneously to the Strophalosiinae (Brunton, 1966).

As noted above this subdivision of the Strophalosiidae appears to be valid with respect to such genera as *Dasyalosia* and *Heteralosia*.

However, Australasian strophalosiid faunas do not support such a clear subdivision. Spinosity of the dorsal valve varies from coarse in some Western Australian forms like '*Strophalosia*' *prideri* Coleman, to fine as in most Queensland species (Maxwell, 1954). The New Zealand forms (Waterhouse, 1964) and certain Tasmania species like '*Strophalosia*' *jukesi* (Etheridge, 1880). Other Tasmanian forms like *Strophalosia subcircularis* sp. nov. lack spines on the dorsal valve. In many assemblages (Maxwell, 1954; Waterhouse, 1964) spinosity of the dorsal valve appears to be intraspecific and of a sporadic nature. The author therefore agrees with Waterhouse (1964) that within the Strophalosiidae spinosity of the dorsal valve is an arbitrary criterion for subfamilial separation. Much the same conclusion can be drawn from Muir-Wood's assignation of *Wyndhamia* (with spines on both valves) to the Strophalosiinae Schuchert emend. Brunton [=Heteralosiinae Muir-Wood and Cooper; Muir-Wood, 1965], rather than the Dasyalosiinae Brunton [=Strophalosiinae Schuchert of Muir-Wood and Cooper, 1960; Muir-Wood, 1965].

Strophalosiid genera pertinent to Australasian faunas may therefor be arranged into three broad groups:—

1. Those forms with strongly spinose dorsal valves—*Dasyalosia, Orthothrix.*
2. Those forms with moderately to weakly spinose dorsal valves—*Costalosia, Wyndhamia, Branxtonia, Multispinula, Echinalosia.*
3. Those forms with non-spinose dorsal valves—*Strophalosia, Heteralosia, Lialosia.*

Group 1:

No figured Australasian form shows a close comparison with *Dasyalosia*, a genus characterised by very strong vermiform spines on both valves. *Strophalosia prideri* Coleman (1957) may be an *Orthothrix*, a Zechstein form. It agrees very closely in most characters with the type species *O. excavata* (Geinitz) notably in the high pointed ventral umbo and interarea, and in the raised button-like anterior adductor platform in the dorsal valve. On the other hand, *S. prideri* is a very much larger species than *O. excavata*, the spines on both valves are less evenly distributed, and the two forms are widely separated geographically.

Group 2:

Costalosia Waterhouse and Shah is unique among strophalosiids in possessing spines developed on costal ridges. As noted by Waterhouse and Shah (1966) the South Asian material can be divided into two groups—

(*a*) the group of *C. costata* (Waagen), the type species with spines on the ventral valve only, and

(*b*) the group of *C. argentea* (Douglas), with spines on both valves.

It is unlikely that a costate ornament would show a synchronous development in two separate strophalosiid lineages, thus supporting the conclusion that spinosity of the dorsal valve is not a character of fundamental taxonomic importance. The Tasmanian *C. apicallosa* sp. nov. belongs to the group of *C. costata* (Waagen).

Branxtonia typica Booker is without doubt an internal mould of *Wyndhamia dalwoodensis* Booker. Thus *Branxtonia* is a junior synonym of *Wyndhamia*. This seems to be the one area of agreement between investigators of Australasian strophalosiid faunas (Maxwell, 1954; Muir-Wood and Cooper, 1960; Waterhouse, 1964; Muir-wood, 1965). *Multispinula* was proposed by Waterhouse (1966) for those forms with spines on both valves, but lacking the wedge-shaped dorsal valve of *Wyndhamia*. *Echinalosia* is a replacement name for *Multispinula* (Waterhouse, 1967). In the author's opinion, *Echinalosia* is a junior synonym of *Wyndhamia*. A wedge-shaped dorsal valve is a natural consequence of strophalosiid morphology where the internal surface of the valve remains almost flat and is geniculated against a short trail, whereas the external surface maintains a fairly even concavity. Possibly the most extreme development of a wedge-shaped dorsal valve occurs in *Lialosia kimberleyensis* (Prendergast) which is certainly not congeneric with *Wyndhamia dalwoodensis* Booker. The majority of Eastern Australian and New Zealand species belong to *Wyndhamia*.

Group 3:

Strophalosia subcircularis sp. nov. and varieties from Tasmania show no trace of spines on the dorsal valve and in this respect are indistinguishable from the type species. Whereas the erection of *Heteralosia* R. H. King (1938) was based on a false premise, there appears to be good evidence for the validity of the genus. The type species, *H. slocomi*, and the majority of Australian forms subsequently referred to *Heteralosia* (Coleman, 1957), consistently differ from *Strophalosia* in their smaller size, more rounded outlines, lesser convexity, details of the cardinal process and the weakness of the brachial ridges. These differences are not readily related to ontogeny (Coleman, 1957) and therefore *Heteralosia* is unlikely to be the youthful growth stage of *Strophalosia*. *Lialosia kimberleyensis* (Prendergast) with a ventral valve ornament of concentric lamellae and growth lines and a single row of fine spines at a low angle to the hinge, and without dorsal valve spines offers no close comparison with any other Australasian strophalosiid.

The following generic allocations are therefore proposed:—

Orthothrix Geinitz, 1847:

?*Strophalosia prideri* Coleman, 1957.

Wyndhamia Booker, 1929:

Wyndhamia dalwoodensis Booker [=*Branxtonia typica* Booker, 1929]; *Strophalosia preovalis* Maxwell, 1954, and var.; *Strophalosia ovalis* Maxwell, 1954; *Productus clarkei* Etheridge, 1872, and var. *minima* Maxwell, 1954; *Wyndhamia enorme* Clarke, 1969b;

Strophalosia jukesi Etheridge, 1880, and var. *concava* Maxwell, 1954; *Strophalosia maxwelli* Waterhouse, 1964; *Strophalosia planata* Waterhouse, 1964; *Wyndhamia? irregularis* sp. nov.; *Strophalosia multispinifera* Prendergast, Coleman, 1957.

Costalosia Waterhouse and Shah, 1966:
Costalosia apicallosa **sp. nov.**

Strophalosia W. King, 1846:
Strophalosia subcircularis sp. nov. and varieties.

Heteralosia **R. H. King, 1938:**
Heteralosia etheridgei Prendergast, 1943; *H. irwinensis* Coleman, 1957; *H. prendergastae* Coleman, 1957; *Etheridgina muirwoodae* Prendergast, 1943.

Lialosia Muir-Wood and Cooper, 1960:
Strophalosia kimberleyensis **Prendergast, 1943;** ***Heteralosia kimberleyensis*** **(Prendergast) of Coleman, 1957.**

Genus STROPHALOSIA W. King, 1846.

Strophalosia King 1844, 1846.
Non *Strophalosia* Etheridge 1880.
Non *Strophalosia* Johnston 1888.
Non *Strophalosia* Prendergast 1943.
Non *Strophalosia* Maxwell 1954.
Non *Strophalosia* Coleman 1957
Strophalosia Muir-Wood and Cooper 1960 emend.
Non *Strophalosia* Waterhouse 1964.
Strophalosia Muir-Wood 1965 emend.
Strophalosia Brunton 1966.

TYPE SPECIES:

Strophalosia gerardi **W. King, 1846, from an unknown Permian horizon in the Himalayas. Holotype: Specimen FC, D 267, Galway University College Collection, Ireland. (Subsequent designation: I.C.Z.N. 1962, Opinion 625.)**

DIAGNOSIS:

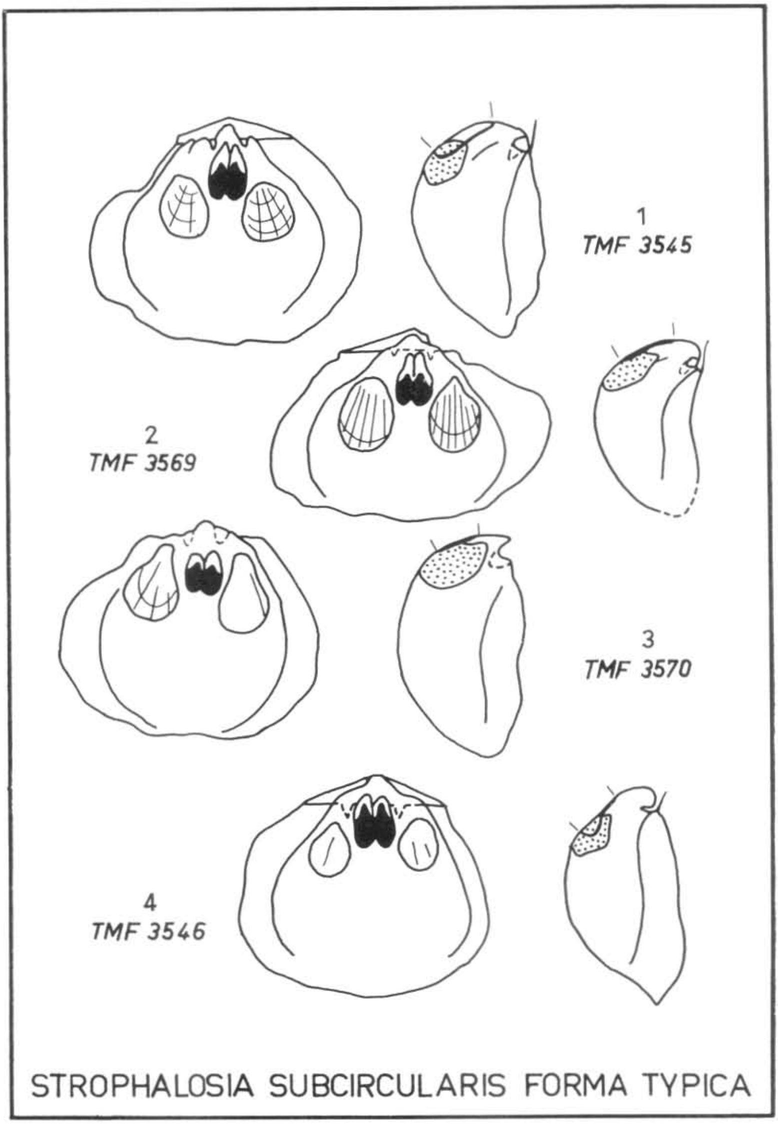
Strophalosiids without spines on the dorsal valve. Distinguished from other related genera with non-spinose dorsal valves by lacking costae (*Costalosia*), possessing spines over the entire ventral valve surface (*Lialosia*), and differing in the internal features of the dorsal valve (*Heteralosia*).

Strophalosia subcircularis sp. nov.

Plate 1, figs. 1-8; plate 2, figs. 1-8; plate 3, figs. 1-8; plate 4, figs. 1-9.
Strophalosia sp. nov. (aff. *S. preovalis* Maxwell group) Clarke, 1968a, p. 23.
Strophalosia aff. *preovalis* Maxwell, Clarke 1968b, p. 142.

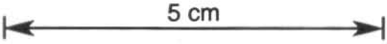
MATERIAL:

Over 1,000 specimens were obtained from a compact mudstone in the Quamby Brook area, N Tasmania (fig. 2, loc. 22). The shells are so crowded together that breakage is unavoidable, but about 250 almost complete specimens were extracted, and then variously treated with dilute hydrochloric acid or caustic potash pellets to reveal the internal and external characters.



STROPHALOSIA SUBCIRCULARIS FORMA TYPICA

FIGURE 4.



HORIZON:

About the middle of the Glencoe Formation, Golden Valley Group, N Tasmania (Clarke, 1968a). Sakmarian, possibly older.

TYPE MATERIAL:

Four syntypes: TMF 3544, a complete specimen showing external morphology; TMF 3547, a dorsal valve interior; and TMF 3545, 3546, two internal moulds of ventral valves.

DIAGNOSIS:

Medium-sized, concavo-convex shells varying in shape but generally subcircular in outline; non-sulcate or weakly sulcate. Hinge width and geniculation variable. Ventral valve spines strong and numerous; dorsal valve non-spinose, but irregularly lamellose, dimpled and finely-nodose. Ventral adductor platform short or of medium length, of moderate height; adductor scars subdivided, unequal in development, oval or pear-shaped. Diductor scars circular or oval, deeply-impressed into the floor of the valve. Teeth supported by callosities of varying development. Dorsal valve with clearly-defined brachial ridges, the anterior portions of which are strongly sigmoidal.

DESCRIPTION—*External*:

The shell is subcircular in outline and is generally a little wider than long. The maximum width occurs at about midlength. Usually the ventral umbo shows no visible attachment scar, but sometimes a minor distortion is present, and rarely a large cicatrix is developed (plate 1, fig. 6). From the umbo the posterior walls sweep forward and outward at an angle of about 120°; small ears are rarely delimited. The cardinal angles are obtuse and rounded; in front the lateral and anterior margins are well rounded.

The hinge varies from 0.4 to 0.7 of the maximum width and is usually close to one half. The dorsal interarea is low in height and slopes backwards at about 40° to the plane of the dorsal visceral disc. The ventral interarea is twice as high and is almost parallel with the plane of the valves. Both interareas are ornamented by faint vertical and stronger horizontal striae, which pass into the concentric lamellae over the rest of the shell. Details of the narrowly triangular delthyrium and the single convex pseudodeltidium in the ventral valve, and the narrow convex chilidium enclosed within a triangular lophidium in the dorsal valve are normal for the Strophalosiidae (see Waterhouse, 1964, p. 33).

Apart from the nepionic part of the valve which is flat or slightly convex, the external surface of the dorsal valve is evenly concave. The profile curves gradually into the trail. Usually the trail is about one third as long as the visceral disc. The internal surface of the valve is almost flat over the visceral disc but shows a sharp anterior geniculation. The difference between the internal and external profiles of the dorsal valve leads to a wedge-shaped cross-section. The

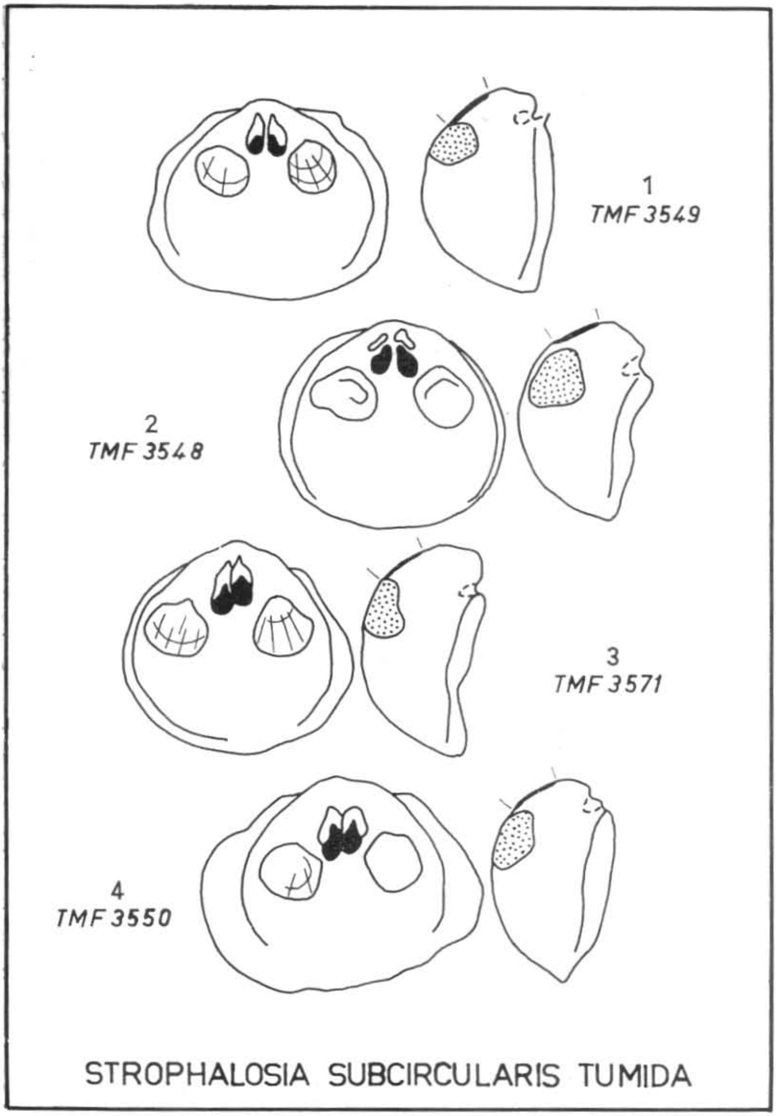
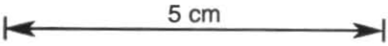

1
TMF 3549
2
TMF 3548
3
TMF 3571
4
TMF 3550
STROPHALOSIA SUBCIRCULARIS TUMIDA

Figure 5.


5 cm

degree of accentuation of the wedge-shaped profile appears to be partly a function of ontogeny, and also a consequence of natural variation in the assemblage.

Both valves are ornamented with close concentric growth lamellae, of which 3-4 occur in 1 mm. These lamellae are most strongly developed around the antero-lateral margins of the valves. The dorsal valve is finely-nodose and irregularly dimpled, but spines are never developed. The entire ventral surface, however, is covered by tubular spines. They are arranged in a crude quincuncial pattern. On the posterior shell regions they are small and thin, but they increase in diameter and length towards the anterior margin where their length exceeds 20 mm.

Internal; Ventral Valve:

The teeth lie moderately close together and are supported by callosities of varying proportions. The variation in the development of the dental callosities from small and plate-like to large and bulbous appears to be random; there is no simple relationship between the development of the dental callosities and ontogeny.

The adductor platform is situated close to the posterior wall, is of a low to moderate height, and is very well-defined. It is of moderate length, generally longer than wide. The posterior extremities of the scars are pointed, but the anterior ends are more or less evenly rounded. A low median groove, or less commonly, a myophragm divides the muscle platform into two halves. Each muscle scar is subdivided; the anterior element is pear-shaped and approximately twice as large as the posterior element which is acutely crescentic, rather more impressed into the muscle platform and partially encloses the anterior element.

The diductor impressions are circular or elongate-oval in shape and are moderately impressed into the floor of the valve. Their outlines are therefore well defined. The position of the diductor scars relative to the adductor platform varies from one of negligible overlap to one of almost complete overlap. The characteristic position is roughly the mean of these two extremes. The surfaces of the diductor scars are variously ornamented with longitudinal striations and concentric bands representing the migration of the anterior margin of the muscle attachment with successive growth increments.

Large pits lie immediately in front of the adductor platform and the remainder of the valve interior is minutely dimpled and pitted.

Dorsal Valve:

The cardinal process rises sharply and is separated from the median septum at its base by a shallow depression. The process itself is moderately large and bulbous. In posterior aspect a large median lobe is present with a median slit, and on each side is a small lateral lobe. Internally the median lobe is bilobed, divided by a low median depression. Lateral muscle apophyses can be distinguished in well-preserved specimens.

Socket ridges are of moderate development. From the process they pass in front of the dental sockets and then curve round to lie parallel to the hinge.

In front the median septum is about two-thirds the length of the valve. It is constricted and low between the adductor platform, but increases in height anteriorly.

The adductor platform is strongly subdivided. The anterior elements are larger, pear-shaped and in the plane of the valve or inclined towards the median septum. The posterior elements are more acutely pear-shaped, slope backwards and are impressed into the floor of the valve.

Brachial ridges arise at the angles of the posterior adductor scars then pass round and forwards roughly parallel with the margin of the disc. Near the anterior margin of the disc they swing abruptly backwards and terminate in strongly sigmoidal curves near the anterior end of the median septum.

DIMENSIONS (*in mm*)

SYNTYPES:

Ventral valve	Width	Length	Height	Area		Adductors		Diductors
	W	L	H	L	H	L	W	L
3544	34.2	33.5	17.0	21.8	2.9	—	—	—
3545	31.0	28.0	15.2	16.0	2.1	7.6	5.0	7.2
3546	30.0	27.0	15.0	16.2	2.3	5.3	5.2	6.4

Dorsal valve	Width	Length	Hinge	Median septum
	W	L	HL	MS
3547	29.0	24.8	15.2	11.2

Strophalosia subcircularis var. *tumida* nov.

Plate 5, figs. 1-4.

TYPE MATERIAL:

Three syntypes, all internal ventral moulds, TMF 3548-3550. From same bed as *Strophalosia subcircularis* forma typica.

DIAGNOSIS:

Strophalosia subcircularis with a more rounded internal ventral outline, more globose profile and tumid umbonal regions. The ventral diductor scars are more quadrangular in outline and less evenly impressed into the floor of the valve. The adductor scars are highly differentiated, sometimes completely separated.

DIMENSIONS (*in mm*)

SYNTYPES:

Ventral valve	Width	Length	Height	Area		Adductors		Diductors
	W	L	H	L	H	L	W	L
3548	29.0	29.0	16.0	—	—	5.6	6.0	7.2
3549	30.4	27.2	14.1	—	—	6.2	6.1	6.2
3550	32.8	27.8	15.2	—	—	5.8	6.6	7.4

Strophalosia subcircularis var. *brevicardinalis* nov.

Plate 6, figs. 1-2, 4.

TYPE MATERIAL:

Three syntypes: TMF 3551-3552, two internal moulds of ventral valves; TMF 3553, a dorsal valve. All from the same bed as *Strophalosia subcircularis* forma typica.

DIAGNOSIS:

Strophalosia subcircularis with an elongated outline, less convex profile, narrowed umbonal regions and a short hinge line. The muscle scars are cramped within the narrowed umbonal regions and the adductor scars are narrow and raised on a platform of moderate height.

DIMENSIONS (*in mm*)

SYNTYPES:

Ventral valve	Width	Length	Height	Area		Adductors		Diductors
	W	L	H	L	H	L	W	L
3551	31.5	31.5	13.2	14.2	4.0	8.2	3.4	6.4
3552	30.0	34.0	12.2	—	—	8.0	3.4	8.0

Dorsal valve	Width	Length	Hinge
	W	L	HL
3553	26.0	22.0	9.5

REMARKS:

Strophalosia subcircularis sp. nov. and varieties comprise an extremely variable group. The spinosity of the ventral valve for the majority of specimens shows little variation but specimens with a finer spinosity (plate 3, figs. 1, 3-4), a less dense spinosity (plate 3, fig. 2), or a coarse spinosity (plate 3, figs. 5-8), also occur. These variations in the ventral spinosity are not apparently related to the varieties *brevicardinalis* and *tumida* as defined by the internal morphology. The dorsal valve is finely nodose and dimpled but spines are never developed.

The separation of the varieties *tumida* and *brevicardinalis* is necessarily subjective in a continuously variable community. The variety *tumida* with its globose contour, tumid umbonal region, lesser impressed and more quadrate diductor scars and well-differentiated adductor scars is numerically rare which suggests that its recognition is only possible in extreme population variants. The variety *brevicardinalis* which comprises about ten per cent of the community, also grades continuously into the main population with respect to most characters (figs. 9-10) but is set apart by virtue of its narrow hinge lines and narrow adductor platform (fig. 8). A few specimens otherwise similar to *brevicardinalis* but lacking a short hinge line have been retained within *subcircularis* forma typica. Gerontic individuals of the *subcircularis* species group show a pronounced development of posterior callus in the ventral valve (plate 4, fig. 7). In

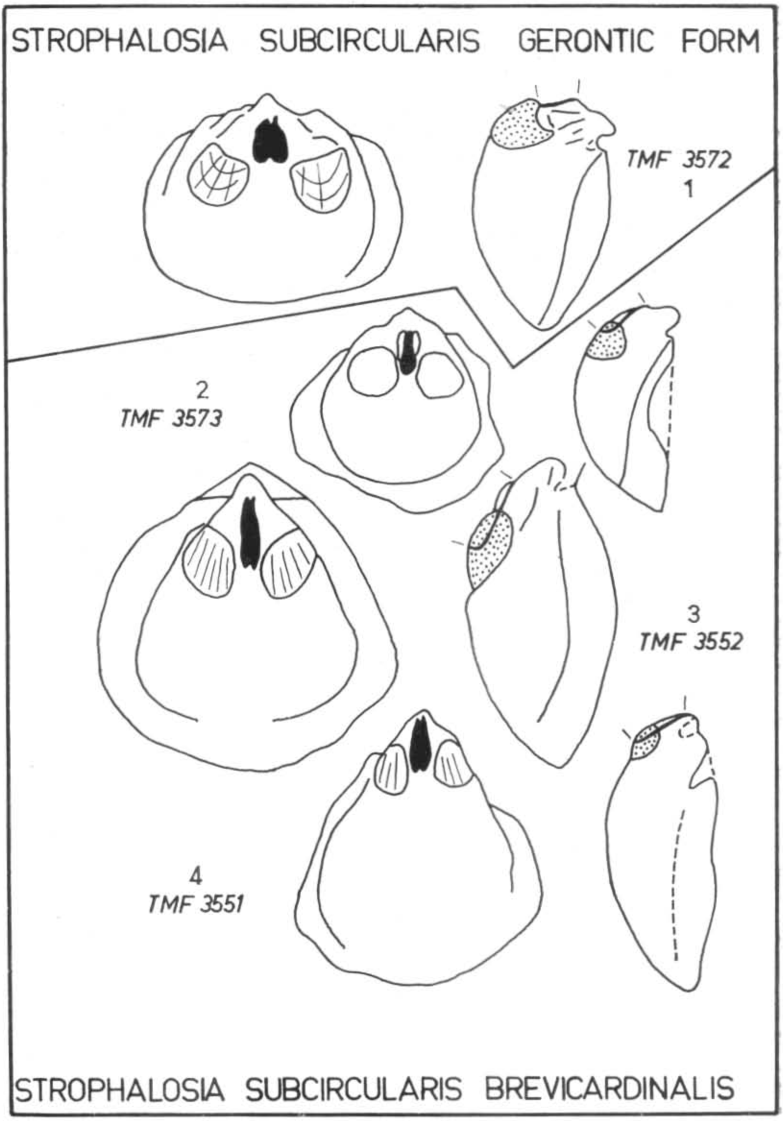

STROPHALOSIA SUBCIRCULARIS GERONTIC FORM
TMF 3572
1
2
TMF 3573
3
TMF 3552
4
TMF 3551
STROPHALOSIA SUBCIRCULARIS BREVICARDINALIS

FIGURE 6.

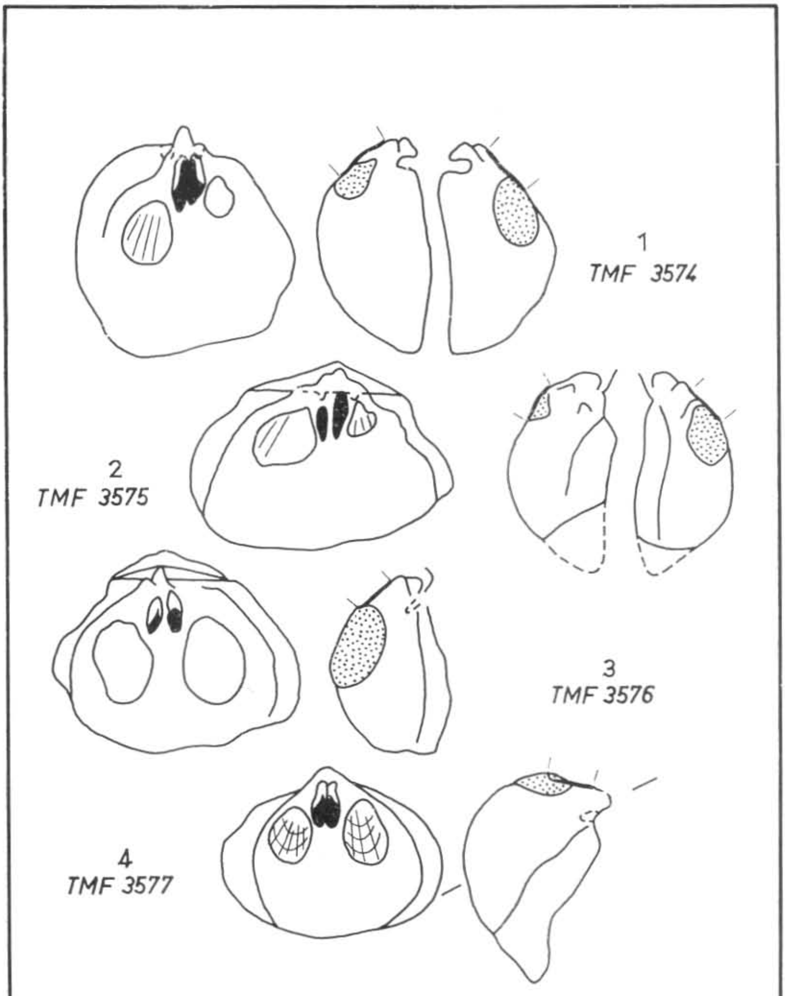
5 cm

contrast to the posterior callus developed in *Costalosia apicallosa* sp. nov., the posterior portions of the ventral diductor scars in *subcircularis* although truncated by callus, are not appreciably shortened by it. Rather the callus is developed posterior to the muscle attachment and this coupled with a more incurved umbo causes the posterior wall to be steep and high.

Strophalosia subcircularis sp. nov., and variants show no close comparison with other Eastern Australian and New Zealand strophalosiids. *Wyndhamia* spp. from Queensland show no obvious subdivision of the ventral adductor scars except in rare cases (*e.g.*, CPC 9504), and have dorsal valve spines (Maxwell, 1954). *Wyndhamia* spp. from New Zealand (Waterhouse, 1964) also possess dorsal valve spines but resemble the Tasmanian species in the subdivision of the ventral adductors. However, whereas one impression lies almost anterior to the other in the New Zealand forms, in *subcircularis* the anterior scar deeply embays the posterior scar which is acutely crescentic. *Strophalosia subcircularis* sp. nov. is externally close to *Strophalosia gerardi* W. King sensu stricto, but the internal details of the type species are very poorly known (Brunton, 1966). *Strophalosia subcircularis* sp. nov. syntype TMF 3545 is almost identical with an incomplete internal mould of '*Strophalosia jukesi*' Prendergast non Etheridge from Western Australia (Prendergast, 1943, plate 5, figs. 19-20; spec. UWA 20264). Coleman (1957) assigned this specimen to *Orthothrix*? *prideri.* Assuming that UWA 20264 possesses the internal characters typical of *Orthothrix*? *prideri* (Coleman), *subcircularis* and *prideri* are internal but not external homeomorphs.

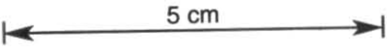
OCCURRENCE:

In addition to the type locality *Strophalosia subcircularis* sp. nov. occurs in abundance in the Bundella Mudstone of the Kingston area S of Hobart (Moore, 1968; Clarke, 1968b). It is also abundant in the lithological and faunal equivalent of the Glencoe Formation in a creek bed about 3 miles W of Millers Bluff and about 12 miles SSE of Poatina (lat. 41° 55′ 3″S; longit. 147° 5′ 36″E). Specimens from the upper parts of the Glencoe Formation at Poatina (=upper Quamby Mudstone+Brumby Marl, McKellar, 1957) probably belong to this species but well-preserved interiors have not been available. Poorly preserved specimens of *Strophalosia* cf. *subcircularis* also occur rarely in the basal parts of the Golden Valley Group at Scolyers Hill near Oonah (Gee et al., 1968). In contrast, Strophalosiidae from 'Golden Valley Group' shelly siltstone and mudstone of the Kansas Creek Beds (Jennings and Burns, 1958; Ford, 1960) at Western Bluff, at Point Hibbs (Banks and Ahmad, 1962), and immediately above the Tasmanite Oil Shale at Mersey Great Bend, Latrobe, differ very markedly from *Strophalosia subcircularis* sp. nov. This may be the result of geographical variation but more probably indicates that the establishment of conditions suitable for the proliferation of shelly faunas in calcareous siltstone and mudstone of 'Golden Valley Group' facies varied in time from place to place.



STROPHALOSIA SUBCIRCULARIS PATHOLOGICAL VARIANTS

FIGURE 7.



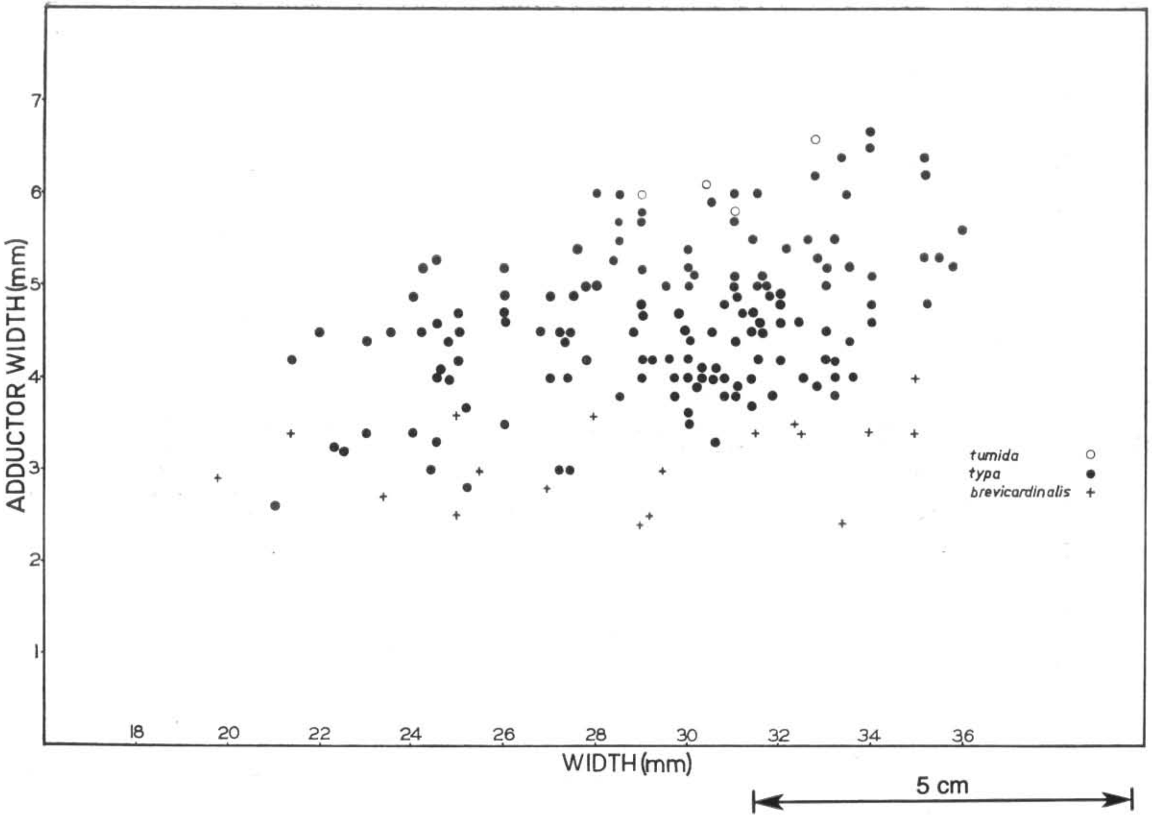

ADDUCTOR WIDTH (mm)
1
2
3
4
5
6
7
18
20
22
24
26
28
30
32
34
36
WIDTH (mm)
tumida ○
typa ●
brevicardinalis +
5 cm

FIGURE 8.

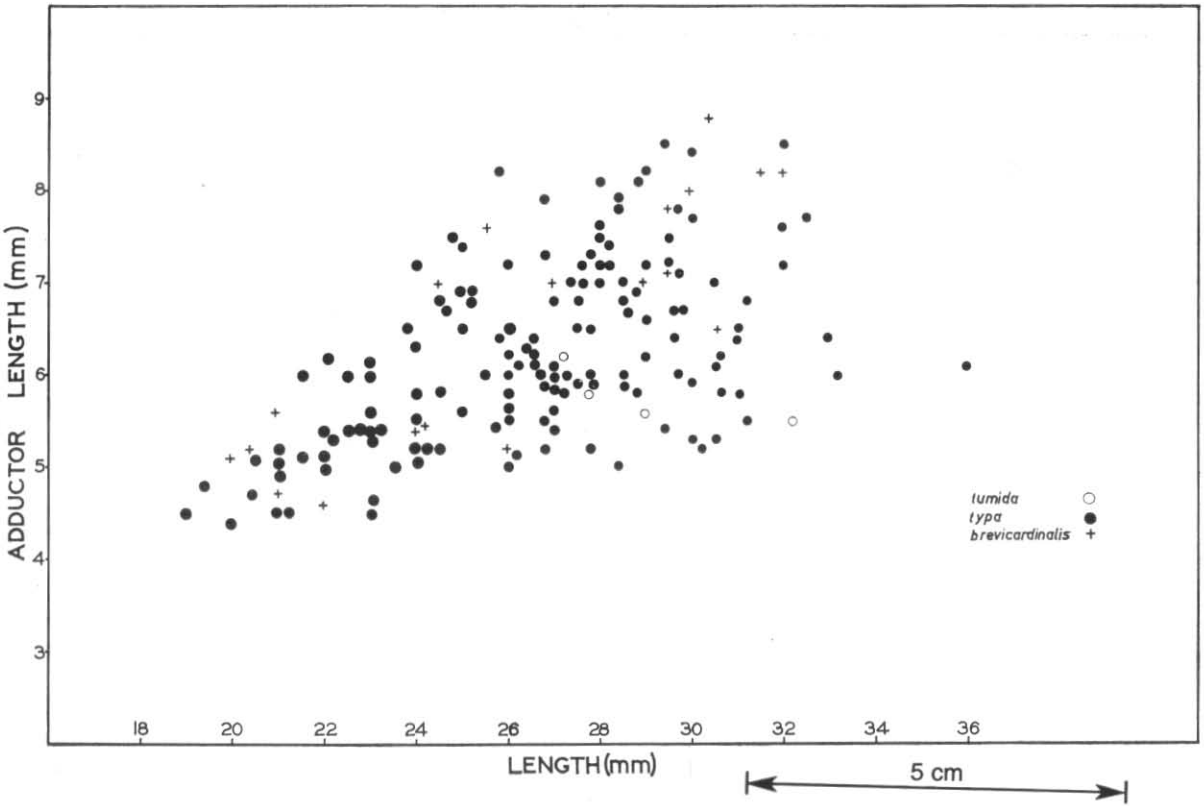

ADDUCTOR LENGTH (mm)
9
8
7
6
5
4
3
18
20
22
24
26
28
30
32
34
36
LENGTH (mm)
tumida ○
typa ●
brevicardinalis +
5 cm

FIGURE 9.

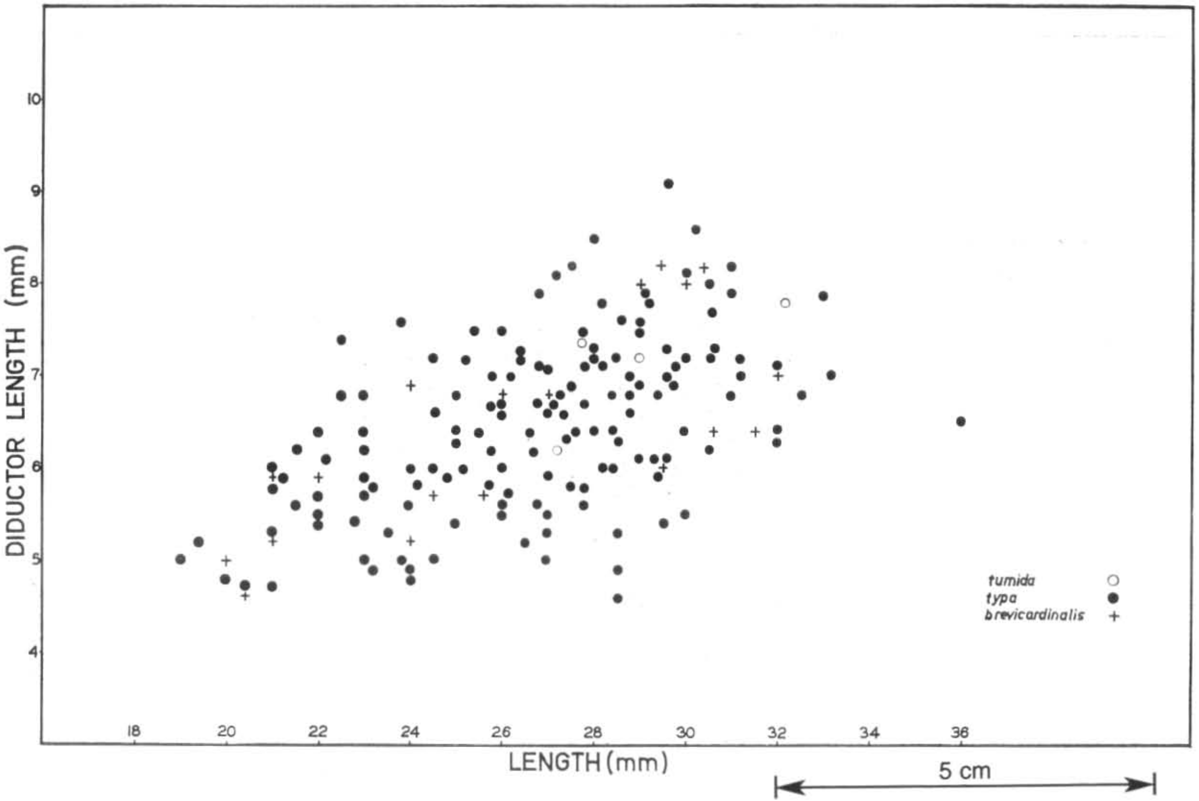

DIDUCTOR LENGTH (mm)
10
9
8
7
6
5
4
18
20
22
24
26
28
30
32
34
36
LENGTH (mm)
tumida ○
typa ●
brevicardinalis +
5 cm

FIGURE 10.

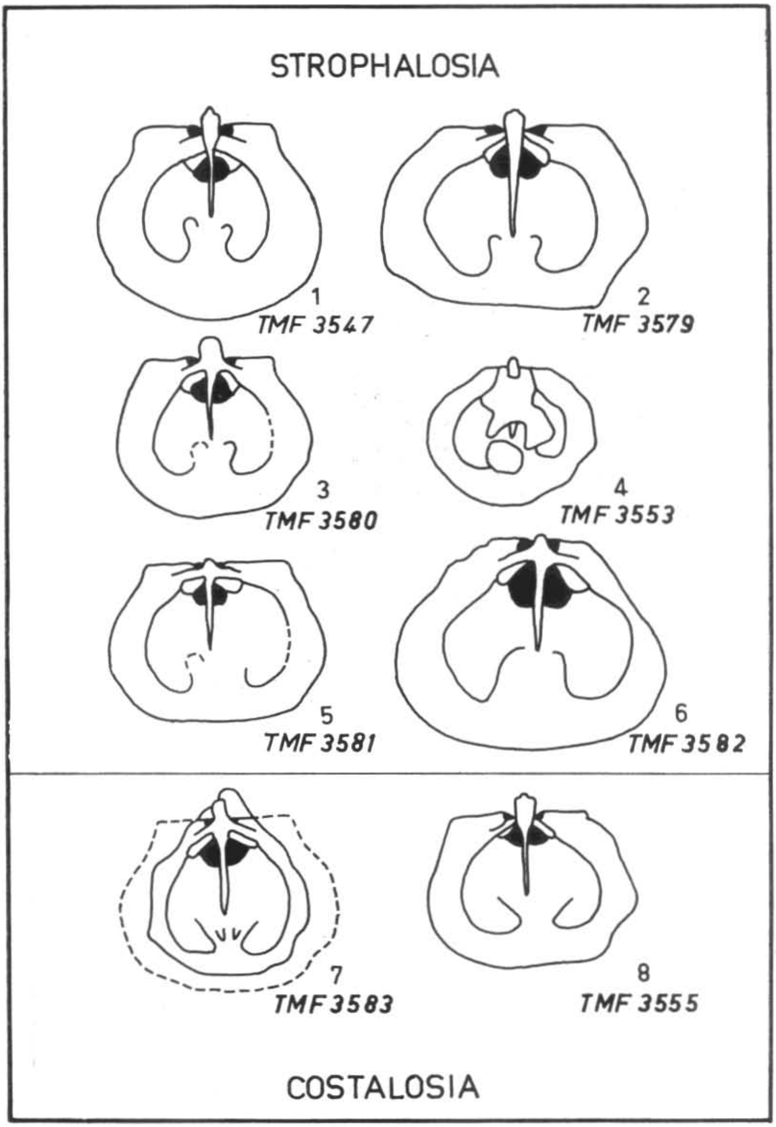
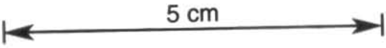
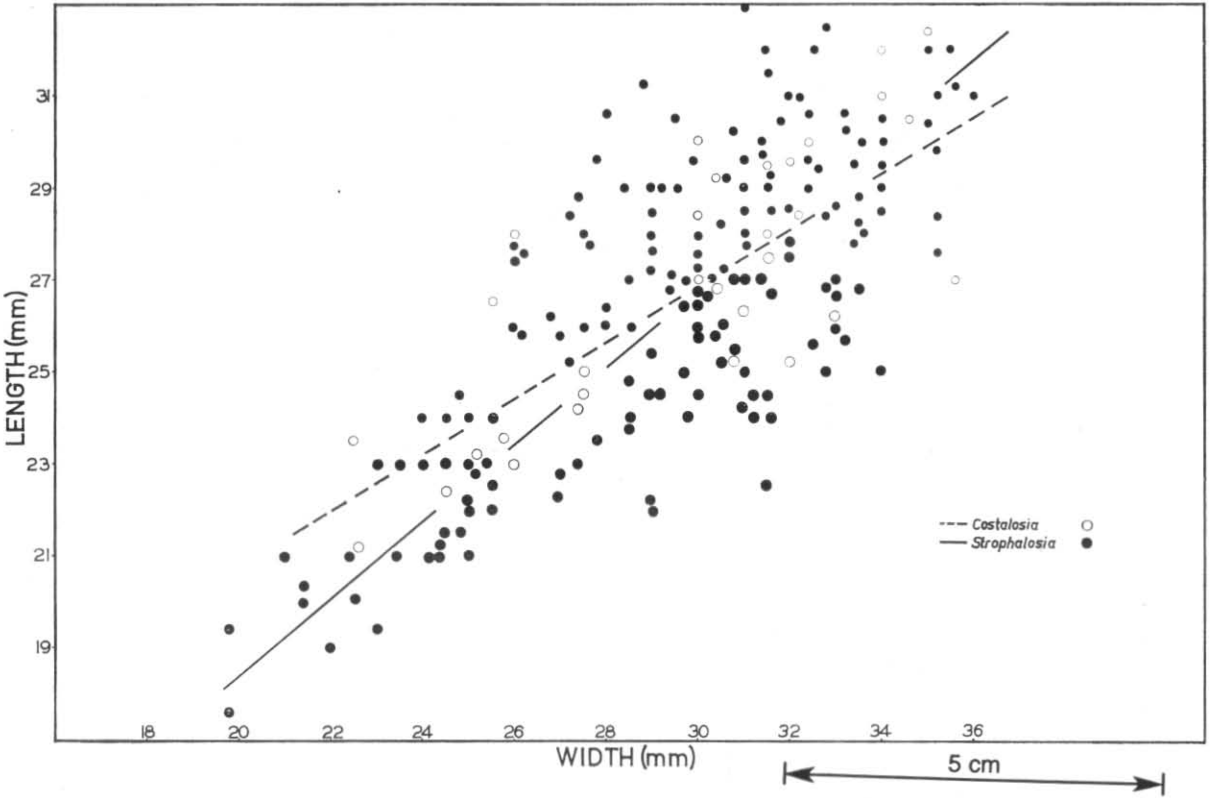

STROPHALOSIA
1
TMF 3547
2
TMF 3579
3
TMF 3580
4
TMF 3553
5
TMF 3581
6
TMF 3582
7
TMF 3583
8
TMF 3555
COSTALOSIA

FIGURE 11.


5 cm



LENGTH (mm)
31
29
27
25
23
21
19
WIDTH (mm)
18
20
22
24
26
28
30
32
34
36
--- Costalosia ○
— Strophalosia ●
5 cm

FIGURE 12.

Genus COSTALOSIA Waterhouse and Shah, 1966.

Costalosia Waterhouse and Shah, 1966.

TYPE SPECIES:

Costalosia costata (Waagen) from the Lower Productus Limestone, Salt Range, West Pakistan (original designation, Waterhouse and Shah, 1966). Lectotype: specimen F 3644, Geological Survey of India, Calcutta.

DIAGNOSIS:

Costate strophalosiids with or without dorsal valve spines.

Costalosia apicallosa sp. nov.

Plate 6, figs. 9-11; plate 7, figs. 1-8.

Costalosia sp. nov. aff. *C. argentea* (Douglas), Clarke 1968a, p. 23.

MATERIAL:

Over 40 specimens from the Glencoe Formation, Quamby Brook (fig. 2, loc. 22). Mostly complete ventral valves, but 33 specimens have since been leached to reveal the internal characters.

HORIZON:

About the middle of the Glencoe Formation, Golden Valley Group, N Tasmania. Sakmarian, possibly older.

TYPE MATERIAL:

Four syntypes, TMF 3554 a ventral exterior partly leached to show the internal muscle platforms, TMF 3555 a dorsal valve, and TMF 3556-3557 two internal ventral moulds.

DIAGNOSIS:

Medium-sized *Costalosia* externally similar to *Costalosia argentea* (Douglas) but larger and without dorsal valve spines. Ventral diductor scars short and crescentic.

DESCRIPTION; *External*:

The shell is concavo-convex, non-sinuate; the dorsal valve geniculate and with a short trail. In outline the valves are subcircular, but generally wider than long. The hinge line is about two thirds the maximum width which occurs at about midlength. The ventral umbo is slightly incurved and sometimes deformed by a small cicatrix. The ventral interarea lies almost parallel with the plane of the shell, but the dorsal interarea is less high and slopes backwards at about 30°. Details of the interareas are normal for the Strophalosiidae. Concentric growth lamellae and stronger wrinkles are common more particularly on the anterolateral portions of the dorsal valve. Spines are abundant on the ventral valve, but absent on the dorsal valve. The ventral spines show a crude quincuncial arrangement near the ventral umbo, but over the anterior two thirds they are developed on low, broad and rounded, intercalated costae as in *Costalosia argentea* (Douglas). The dorsal valve is wedge-shaped in cross-section due to the differences in the internal and external contours.

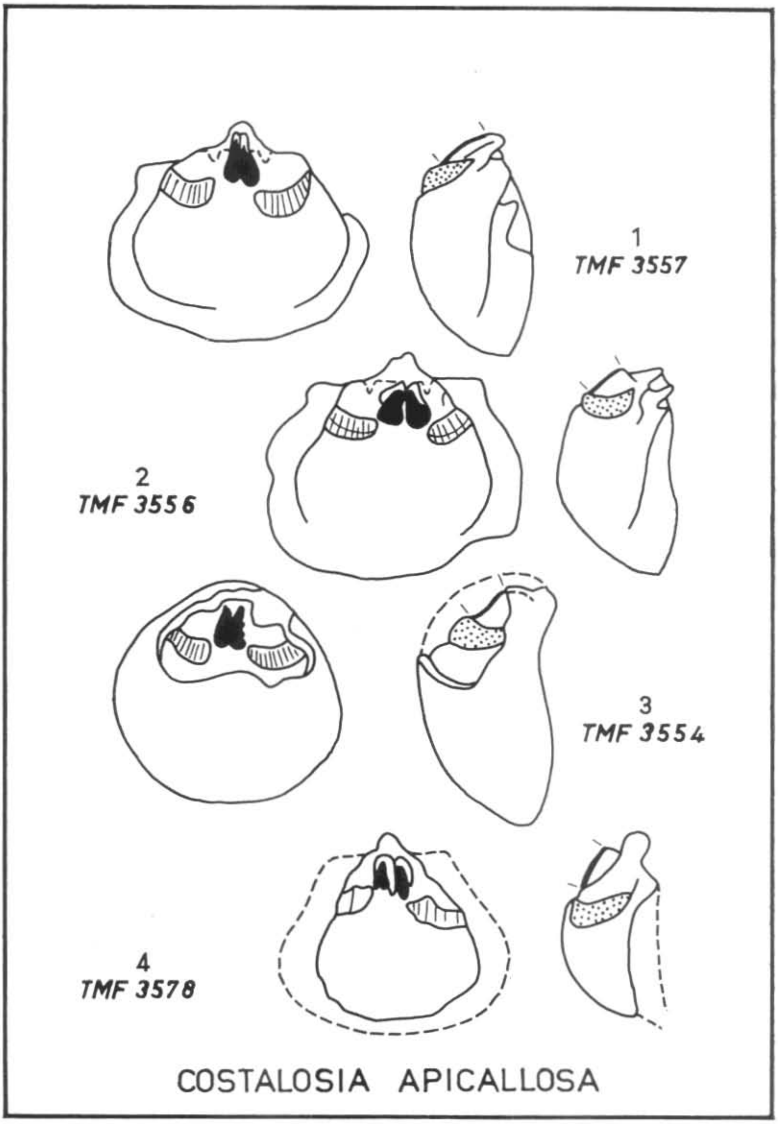
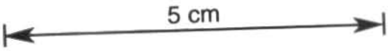
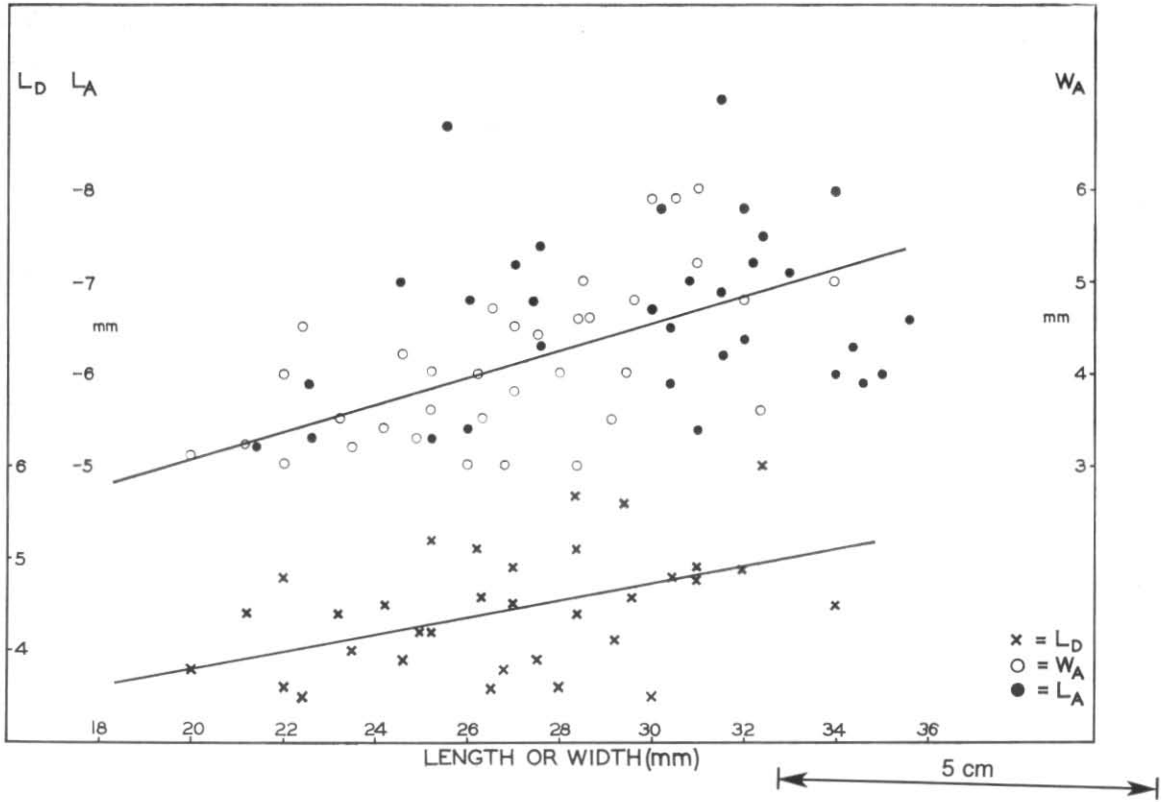

1
TMF 3557
2
TMF 3556
3
TMF 3554
4
TMF 3578
COSTALOSIA APICALLOSA

FIGURE 13


5 cm



L_D
L_A
W_A
-8
-7
mm
-6
6
-5
5
4
6
5
mm
4
3
× = L_D
○ = W_A
● = L_A
18
20
22
24
26
28
30
32
34
36
LENGTH OR WIDTH (mm)
5 cm

FIGURE 14.

Internal:

In the ventral valve the teeth lie close together and are supported by small plate-like callosites. The adductor platform is placed close to the posterior wall, is in the plane of the valve, or raised on a low platform. The muscle scars are well-defined, of moderate length and generally longer than wide. Each muscle scar is usually subdivided; the anterior element is pear-shaped and several times larger than the posterior element which is rather more impressed into the platform.

The diductor scars occupy depressed areas, are clearly defined and longitudinally striated. They are crescentic in shape with the posterior margin of the muscle attachment much shortened by apical callus.

The dorsal valve displays characters typical of the Strophalosiidae. Two characters may be unique to *Costalosia*. Firstly the adductor attachment is deeply sunk into the floor of the valve and slopes backwards at about 30° with respect to the plane of the visceral disc; the scars are subdivided into anterior and posterior elements; the anterior element is pear-shaped whereas the posterior element is narrow and elongate and more deeply sunk into the floor of the valve. Secondly the brachial ridges, which originate at the extremities of the posterior adductor scars, do not show the strong anterior sigmoidal curvature typical of most strophalosiids.

DIMENSIONS (*in mm*)

SYNTYPES:

Ventral valve	Width	Length	Height	Area		Adductors		Diductors
	W	L	H	L	H	L	W	L
3554	30.8	28.5	18	—	—	6.6	3.8	4.1
3556	31.5	28.0	13.1	18.6	—	6.0	7.0	3.6
3557	30.4	26.8	14.0	—	—	5.0	4.5	3.8

Dorsal valve	Width	Length	Hinge	Median septum
	W	L	HL	MS
3555	27.0	20.2	16.8	13.0

REMARKS:

Costalosia apicallosa sp. nov. is externally close to *Costalosia argentea* (Douglas) from an unknown horizon in the Permian of Iran. It differs, however, in its larger size and lack of dorsal valve spines. The internal details of *Costalosia* spp. from South Asia are poorly known (Waterhouse and Shah, 1966). The Tasmanian species with its crescentic, much shortened ventral diductor scars, its deeply impressed and backwards sloping dorsal adductor platform, and its non-sigmoidal brachial ridges, possesses characters not displayed by other strophalosiids. If these characters are typical of the genus as a whole, *Costalosia* is a distinctive form both with respect to its internal and external characters.

It should be noted here that in *Costalosia apicallosa* sp. nov. the brachial ridges originate at the angles of the posterior adductor scars. A similar consideration is true for all strophalosiids that I have examined. Prendergast (1943) recorded a similar finding for *Lialosia*

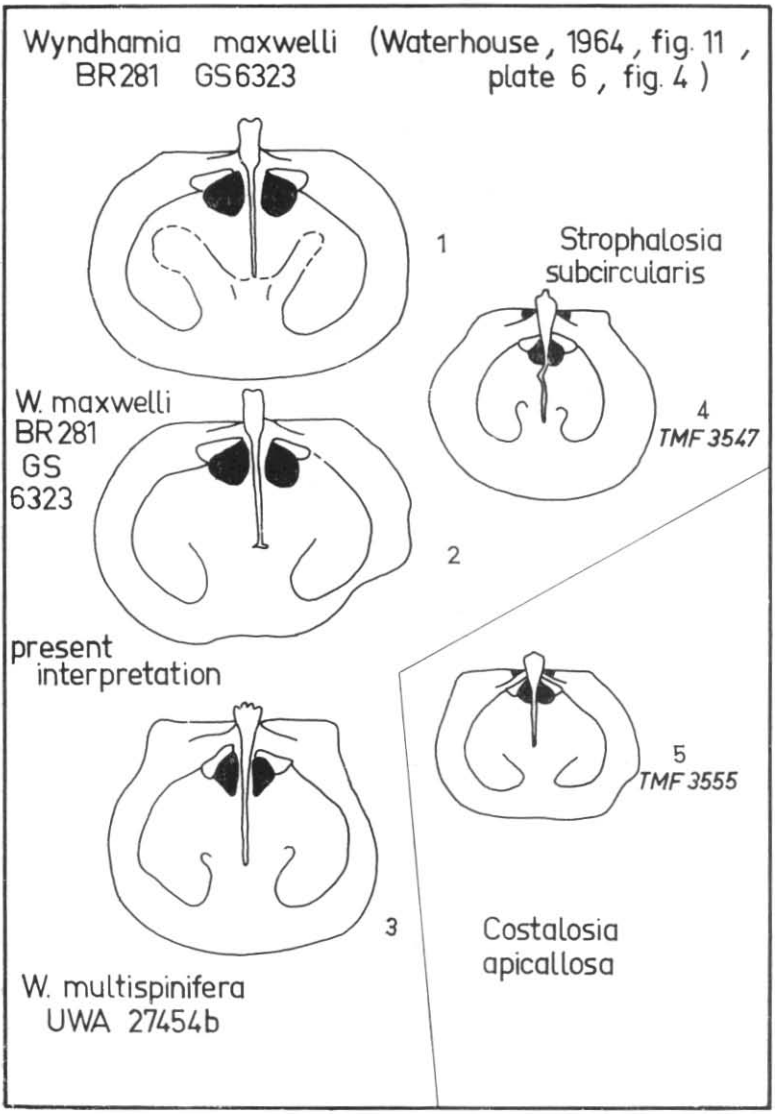


FIGURE 15.

5 cm

kimberleyensis. It is therefore surprising to note the unanimity of observation between Maxwell (1954), Coleman (1957), and Waterhouse (1964) that the brachial ridges in strophalosiids arise at the junctions between the anterior and posterior adductor scars. Their illustrations do not support such a conclusion.

OCCURRENCE:

Costalosia apicallosa sp. nov. is only known to me from the type locality.

Genus WYNDHAMIA Booker, 1929.

Wyndhamia Booker, 1929.
Branxtonia Booker, 1929.
Strophalosia Prendergast, 1943 **partim.**
Strophalosia Maxwell, 1954.
Strophalosia Coleman, 1957 partim.
Wyndhamia Muir-Wood and Cooper, 1960; Muir-Wood, 1965.
Branxtonia Muir-Wood and Cooper, 1960.
Strophalosia Waterhouse, 1964.
Wyndhamia Waterhouse, 1964; 1969.
Multispinula Waterhouse, 1966.
Echinalosia Waterhouse, 1967, 1969.
Not necessarily *Strophalosia* auctorum.

TYPE SPECIES:

Wyndhamia dalwoodensis Booker, 1929 (original designation).

TYPE MATERIAL:

A definite type specimen for *Wyndhamia dalwoodensis* was not chosen by Booker. Therefore any one of Booker's seven figured specimens (plate 1, figs. 1-5; plate 3, figs. 5, 7) could be chosen as lectotype. I refrain from selecting a lectotype for several reasons. Maxwell (1954) selected the specimen figured as *Branxtonia typica* Booker (plate 3, figs. 1-3; AMF 41763) as genoholotype of *Branxtonia*. Since Maxwell (1954) regarded both *Wyndhamia* and *Branxtonia* as junior synonyms of *Strophalosia* W. King, a designation of type specimen for *Wyndhamia dalwoodensis* was unnecessary. However, *Wyndhamia* and *Branxtonia* are not junior synonyms of *Strophalosia* following the selection of *Strophalosia gerardi* W. King as type species of *Strophalosia* (I.C.Z.N. 1962, Opinion 625). Whereas I agree entirely with Maxwell (1954), Waterhouse (1964), and other workers that all the Branxton material figured by Booker is conspecific, the genoholotype of *Branxtonia typica* will not serve as genolectotype for *Wyndhamia*. One of several procedures could be adopted:—

(*a*) Any one of the three internal ventral valve moulds figured by Booker (plate 1, fig. 1-2; plate 3, fig. 5) could be chosen as lectotype. Although all three specimens are imperfectly preserved this is the simplest procedure to adopt. *Branxtonia* would thus be a junior synonym of *Wyndhamia*.

(*b*) Either of the two internal dorsal valve moulds figured by Booker (plate 1, figs. 3-4) could be selected as lectotype. Since neither of these specimens is distinguishable in itself from the type material of '*Strophalosia*' *jukesi* Etheridge 1880, *Wyndhamia dalwoodensis* then becomes a junior synonym of '*Strophalosia*' *jukesi*, and the genus *Wyndhamia* invalid. The genus *Branxtonia* with the designated genoholotype *B. typica* would thus be valid.

(*c*) Either of the two external dorsal valve moulds figured by Booker (plate 1, fig. 5; plate 3, fig. 7) could be chosen as lectotype. In this case *Wyndhamia* would become impossible to define. *Branxtonia* would again remain as a valid genus.

Of these three possible alternatives I prefer the first since it is the simplest and is also implicit in the work of Maxwell (1954) and Waterhouse (1964). A possible drawback is the use of *Wyndhamia dalwoodensis* for the much more preferable *Branxtonia* [*Strophalosia*] *typica* auctorum. For this reason the second alternative has merit. The third possibly has a similar result but is considered unreasonable in principle.

Multispinula was erected to define those strophalosiids with spines on both valves but without the wedge-shaped dorsal valve of *Wyndhamia* (Waterhouse, 1966). *Echinalosia* was proposed as a replacement name for *Multispinula* Waterhouse, which is preoccupied (Waterhouse, 1967; 1969). In the author's opinion *Echinalosia* is a junior synonym of *Wynhamia*. A wedge-shaped dorsal valve is a natural consequence of strophalosiid morphology whereby the internal and external contours of the dorsal valve are markedly different. The degree of 'wedging' seems to vary considerably within any given community.

Wyndhamia dalwoodensis Booker.

Plate 8, figs. 4-5.

Wyndhamia dalwoodensis Booker, 1929.
Wyndhamia valida Booker, 1929.
Branxtonia typica Booker 1929.
Strophalosia typica Maxwell, 1954.
Wyndhamia dalwoodensis Waterhouse, 1964.

TYPE MATERIAL (see above):

From 2,250 feet below the Muree Beds, Branxton Subgroup at Port. 147, Parish Branxton, County Northumberland, N.S.W.

DIAGNOSIS:

Shell large, ventral valve moderately convex and characteristically strongly sinuate. Dorsal valve wedge-shaped in cross-section and with coarse endospines developed along the antero-lateral internal margins of the visceral disc and trail. Ventral adductor platform long and low; diductor scars large, circular to oval, but ill-defined.

Wyndhamia jukesi (Etheridge).

Plate 8, figs. 1-3, 7.

Strophalosia jukesi Etheridge, 1880.
Strophalosia jukesi Johnston, 1888.
Strophalosia clarkei Johnston, 1888, excluding plate 14, fig. 9.
Non *Strophalosia jukesi* Prendergast, 1943.
Strophalosia jukesi Maxwell, 1954 partim, *i.e.* excluding *S. jukesi* Prendergast, 1943.
Strophalosia gerardi var. *tasmaniensis* Prendergast, MS.

HOLOTYPE:

BMNH BB 9807, probably from the Berriedale Limestone exposed in Rathbone's Quarry, Granton, Tasmania (see Maxwell, 1954).

DIAGNOSIS:

Similar to *Wyndhamia dalwoodensis* but non sinuate.

REMARKS:

Wyndhamia dalwoodensis and *W. jukesi* are two closely related species, the sole consistent difference being the ventral sinuation of *dalwoodensis*. *Strophalosia gerardi* King, var. *tasmaniensis* Prendergast MS (*Pap. Proc. R. Soc. Tasm.* MS. see Prendergast, 1943) is not a valid species. However, in the Tasmanian Museum collections there is a tray containing three specimens and a loose label with the inscription 'holotype, *Strophalosia gerardi* var. *tasmaniensis* n. var. Rathbone's Limestone Quarry, Mt Nassau, Granton, 1 mile south of Dromedary Railway Station'. According to the museum catalogue, specimen P20Z104 is the holotype. Unfortunately all three specimens are labelled similarly. In the absence of figures it is impossible to decide which of the three specimens Prendergast intended as holotype. I here select the best of the three specimens (figured herein plate 8, fig. 3) as lectotype. The two other specimens will be relabelled P20Z105 and P20Z106 as per museum catalogue. In my opinion *Strophalosia gerardi* var. *tasmaniensis* is indistinguishable from the typical Rathbone's Quarry *W. jukesi.* Prendergast (1943) evidently had a different conception of the characters of *W. jukesi* (Prendergast, 1943; plate 5, figs. 19-20). Maxwell (1954) whilst listing *W. jukesi* (Prendergast) in his list of synonymy for *W. jukesi* (Etheridge), commented elsewhere (1954, p. 546) that the same specimen was nearer to *Wyndhamia dalwoodensis* [=*Strophalosia typica*] than to *W. jukesi.* In fact the specimen is not obviously related to either *W. dalwoodensis* or *W. jukesi;* the ventral musculature is distinctive and endospines are not present on the internal entero-lateral regions of the brachial valve. Coleman (1957) assigned the specimen to *Orthothrix*? [*Strophalosia*] *prideri.* As noted previously if '*Strophalosia jukesi*' Prendergast non Etheridge is typical of *Orthothrix*? *prideri* then *Strophalosia subcircularis* sp. nov. and *O.*? *prideri* are internal homeomorphs. *Strophalosia gerardi* King var. *tasmaniensis* Prendergast MS (=*W. jukesi* (Etheridge)) is not closely related to *S. gerardi* W. King sensu stricto; it is much more equidimensional in outline and possesses spines on both valves. I point out these facts relating to the invalid *Strophalosia gerardi* var. *tasmaniensis* Prendergast MS in order to prevent the possible future publication of the name as a nomen nudium in a catalogue of fossils in the Tasmanian Museum.

In Tasmania *W. jukesi* characterises the main parts of the Cascades Group whereas *W. dalwoodensis* occurs in the Grange Mudstone and Malbina A. Further detailed collecting is required to establish the validity of this distribution but in the meantime it supports the contention that the main part of the Cascades Group is slightly older than the Branxton Subgroup of the Hunter Valley area, New South Wales (Runnegar, 1968).

Wyndhamia? irregularis sp. nov.

Plate 4, figs. 5-8.

Strophalosia sp. nov. (aff. *S. jukesi* (Etheridge)) Clarke, 1968a, p. 23.

TYPE MATERIAL:

Four syntypes TMF 3565-3568, all incomplete internal ventral valve moulds from about the middle of the Glencoe Formation, N Tasmania (fig. 2, loc. 22). Sakmarian, possibly older.

DIAGNOSIS:

Shell of medium size, of medium to low convexity and non sinuate. Ventral adductor platform of low to moderate height, long and irregular in outline; scars subdivided. Ventral diductor scars large and irregular in shape, clearly defined but weakly impressed into the floor of the valve. Dental callosities small and platelike. Dorsal valve unknown.

DIMENSIONS (*in mm*)

SYNTYPES:

Ventral valve	Width	Length	Height	Area		Adductors		Diductors
	W	L	H	L	H	L	W	L
3565	28.7	26.5	c12.0	—	—	8.9	4.9	8.2
3566	28.0	25.0	c13.0	15.7	1.5	9.0	5.0	8.6
3567	34.4	28.7	12.5	19.4	2.6	8.5	4.7	9.1
3568	30.2	29.0	16.2	—	—	8.1	5.0	8.0

REMARKS:

Although this form is a very rare element within the population obtained from the Quamby Brook strophalosiid bed, its distinctive characters leave no doubt in my mind that it represents a separate species. In its general form, low convexity, long irregular ventral adductor platform and large irregular and coarsely striated diductor scars this species shows certain similarities with *Wyndhamia jukesi* (Etheridge), and might be reasonably regarded as ancestral to it. For this reason the species is doubtfully referred to *Wyndhamia* rather than to *Strophalosia,* but in the absence of a knowledge of the dorsal valve, notably as to the presence or absence of external spines and/or the presence or absence of endospines, this assignation must remain in doubt.

OCCURRENCE:

The syntypes are the only specimens known to me.

Wyndhamia ovalis (Maxwell)

Plate 8, fig. 6

Strophalosia ovalis Maxwell, 1954.

HOLOTYPE:

UQF 15630; from the Mantuan Productus Bed, 1½ miles NW of Consuelo Homestead, Springsure district, Queensland.

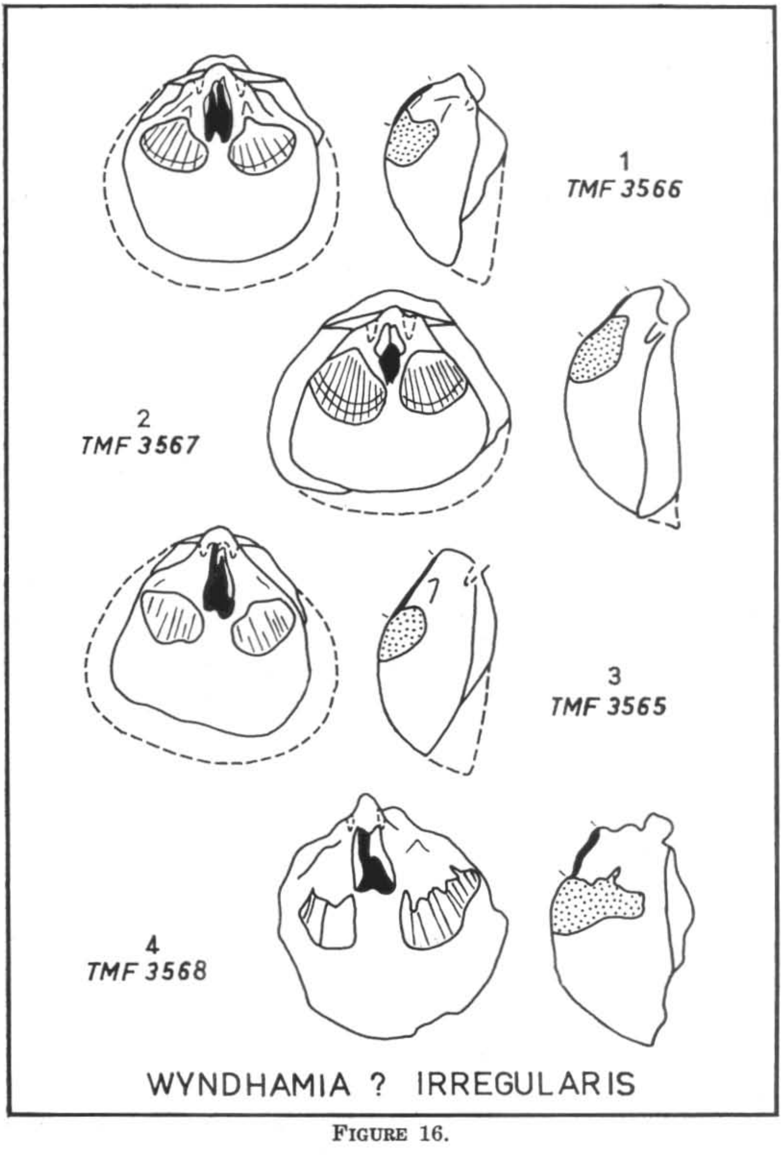
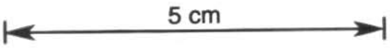

1
TMF 3566
2
TMF 3567
3
TMF 3565
4
TMF 3568
WYNDHAMIA ? IRREGULARIS

FIGURE 16.


5 cm

DIAGNOSIS:

Shell large, coarsely spinose and subcircular in outline. Ventral umbonal wall thickened; ventral adductor platform high, short to medium in length.

REMARKS:

This form with its very high ventral adductor platform and umbonal callus behind the diductor scars is probably the most distinctive of all the species of *Wyndhamia*. In Tasmania, *W. ovalis* is only known to me from Malbina E of the Hobart area where it occurs in association with *Terrakea brachythaera* (Morris), *Martiniopsis mantuanensis* (Campbell) and other forms. The assemblage suggests a firm correlation with the Mantuan Productus Bed in Queensland (Banks, 1962; Banks and Read, 1962).

Wyndhamia preovalis (Maxwell)

Plate 6, figs. 7-8

Strophalosia preovalis Maxwell, 1954.

HOLOTYPE:

UQF 15622; from Cattle Creek, 2 miles upstream from its junction with Consuelo Creek, Springsure district, central Queensland (Cattle Creek Formation, Power (1967)).

DIAGNOSIS:

Shell small to medium sized and subcircular in outline. Ventral adductor platform short and low. Diductor scars circular and clearly defined. Interior of dorsal valve without endospines; brachial ridges obscure.

Wyndhamia enorme Clarke

Strophalosia brittoni Maxwell, 1954 partim, *i.e.* all specimens excluding the holotype.
Wyndhamia enorme Clarke, 1969b.

HOLOTYPE:

UQF 16258; from the Mt Britton-Homevale beds, 4 miles SW of Eungella station, Bowen district, Queensland.

DIAGNOSIS:

Shell large, weakly sinuate. Ventral adductor platform long and of moderate height; diductor scars well-defined, large and circular or oval in outline. Dental callosities large and bulbous. Dorsal valve unknown.

Genus PSEUDOSTROPHALOSIA Clarke, 1969.

Pseudostrophalosia Clarke, 1969b.

TYPE SPECIES:

Pseudostrophalosia brittoni (Maxwell) (original designation Clarke, 1969b).

DIAGNOSIS:

Large, specialised strophalosiids otherwise similar to *Wyndhamia*, but with dendritic posterior ventral adductor scars.

REMARKS:

The relationship of *Pseudostrophalosia* to other closely related forms is discussed in more detail elsewhere (Clarke, 1969b).

Pseudostrophalosia brittoni (Maxwell)

Strophalosia brittoni Maxwell, 1954 (holotype only).
Pseudostrophalosia brittoni Clarke, 1969b.

HOLOTYPE:

UQF 15657; from the Mt Britton-Homevale beds, 4 miles SW of Eungella station, Bowen district, Queensland.

DIAGNOSIS: As for genus.

REMARKS:

In Tasmania *Wyndhamia preovalis* occurs abundantly in the Nassau Siltstone at the base of the Cascades Group on Mt Nassau. *Wyndhamia enorme* and *Pseudostrophalosia brittoni* occur sparingly in the main parts of the Cascades Group where *Wyndhamia jukesi* is the dominant species. A single somewhat distorted specimen of *Wyndhamia enorme* (TMF 3564) from Rathbone's Quarry is very close to the holotype with respect to its ventral musculature but displays a dorsal valve with coarse endospines as in *W. jukesi*. It therefore seems that, in Tasmania at least, *W. enorme* is an extreme population variant of *W. jukesi*. Unfortunately the internal details of the dorsal valve of the Queensland type material are unknown. It seems possible therefore that *W. jukesi* and *W. enorme* may represent variants within a single species group. In Queensland *W. enorme* predominates, whereas in Tasmania *W. jukesi* is the common form. Admitting this hypothesis the correlation of the Cattle Creek Formation in Queensland (*W. enorme, W. preovalis* and *P. brittoni*) with the base and main part of the Cascades Group in Tasmania is further enhanced.

Summary and Conclusions

Strophalosiid faunas occur at frequent intervals throughout the Permian of Tasmania. In view of their abundance, wide distribution and variety, they possess considerable importance as stratigraphical index fossils. In broad outline there appear to be three basic faunas. The lowest fauna from the Golden Valley Group of N Tasmania and the Bundella Mudstone of the Hobart area, comprising new species of *Strophalosia, Costalosia* and *?Wyndhamia* (described herein), is markedly different and older than any previously described strophalosiid assemblage from Eastern Australia or New Zealand. The associated molluscan and bryozoan faunas, however, suggest a broad correlation with the Allandale Formation of the Hunter Valley area, New South Wales (Banks, 1962; Runnegar, 1968). The second fauna comprises the *W. preovalis-W. jukesi-W. dalwoodensis* association from the Cascades Group and Malbina A and their correlates. The apparent sequence of *W. preovalis,* followed by *W. jukesi, W. enorme* and *P. brittoni,* then ultimately *W. dalwoodensis* within this fauna in S Tasmania, allows a firm correlation with the Cattle Creek Formation in Queensland (Maxwell, 1954) and the Branxton Subgroup in New South Wales (Runnegar, 1968). The occurrence of *W. dalwoodensis* in the highest parts of the Cascades Group and Malbina A may indicate that those parts are slightly younger than the Cattle Creek Formation. By similar reasoning the occurrence of *W. preovalis* and *W. jukesi* in the lower and main part of the Cascades Group may indicate that those parts are slightly older than the Branxton Subgroup. The third and youngest fauna comprises *W. ovalis* from Malbina E of the Hobart area. This species together with the associated fauna indicates a firm correlation with Mantuan Productus Bed of Queensland.

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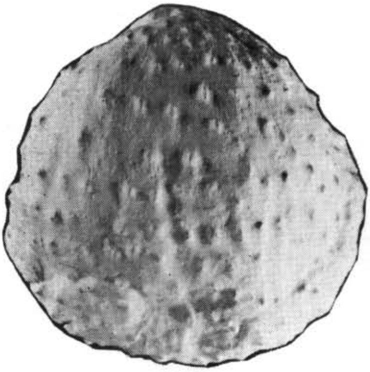
Plates 1-8

PLATE 1

FIGURES 1-8: *Strophalosia subcircularis* sp. nov. (1 x 1.20; 2-7 x 1.33; 8 x 1.55).
Ventral aspects of ventral valve exteriors TMF 3589, 3590, 3591, 3592, 3593, 3594, 3595 and 3596 respectively.
5, with some spines still attached.
6, a specimen with an unusually large cicatrix.

LOCALITY: All specimens are from the Glencoe Formation, Quamby Brook Valley, loc. 22.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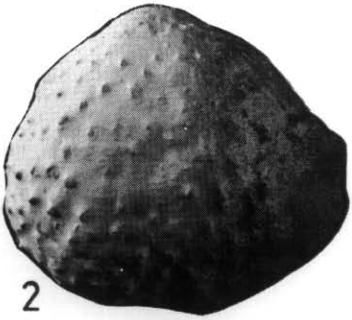
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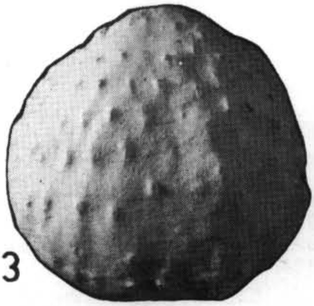
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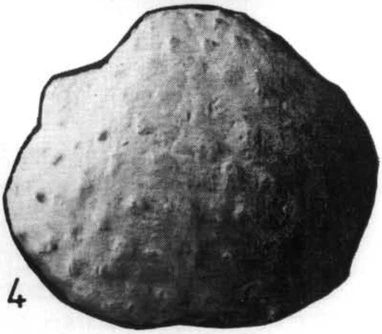
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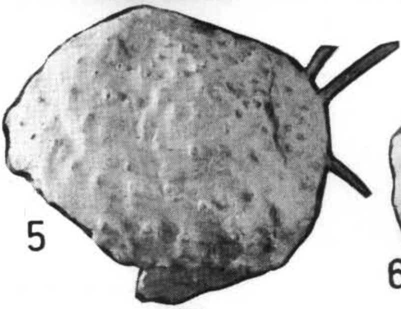
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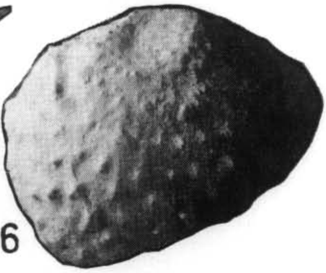
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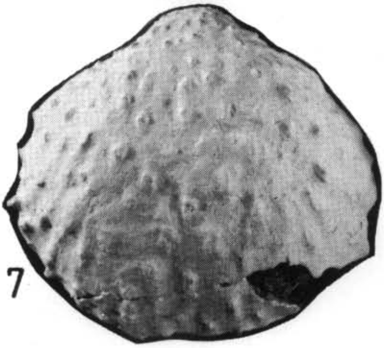
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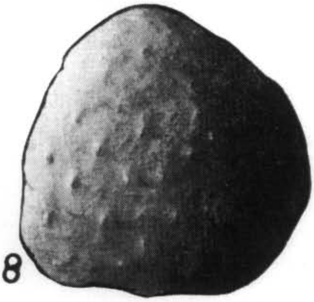
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PLATE 2

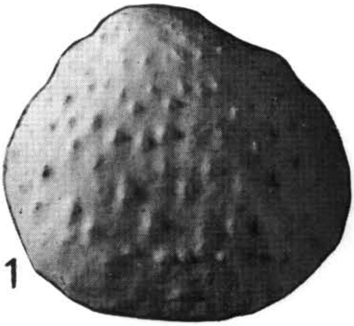
FIGURES 1-8: *Strophalosia subcircularis* sp. nov. (1-2, 4-5, 7 x 1.33; 3, 6, 8 x 1.40).

1-2, 4, 6-8, ventral aspects of ventral valve exteriors TMF 3597, 3598, 3599, 35100, 35101 and 35102 respectively.

3, dorsal valve exterior and ventral interarea TMF 35103.

5, dorsal valve interior TMF 35104.

LOCALITY: All specimens are from the Glencoe Formation, Quamby Brook Valley, loc. 22.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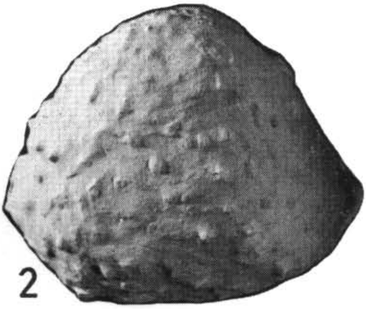
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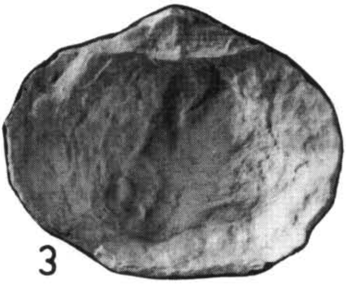
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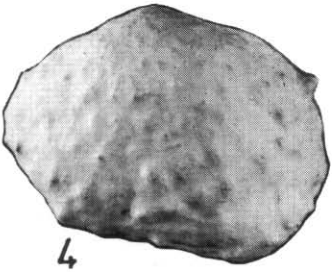
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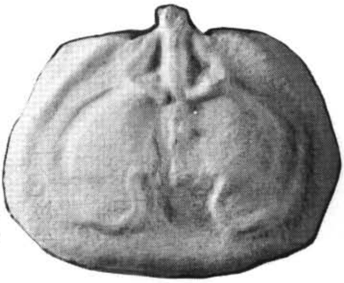
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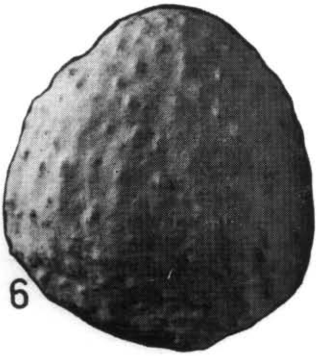
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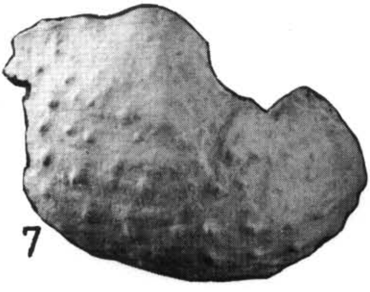
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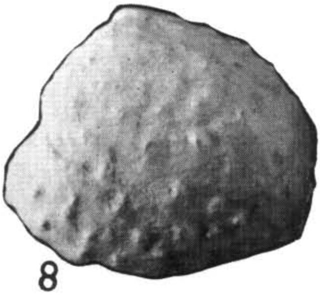
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PLATE 3

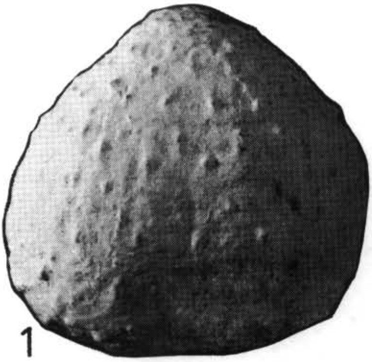
FIGURES 1-8: *Strophalosia subcircularis* sp. nov. (1, 3-4, 6-7 x 1.33; 2, 8 x 1.25; 5 x 1.45).

1-4, ventral aspect of ventral valve exteriors TMF 3544 (syntype), 35105, 35106 and 35107 respectively showing fine or less dense spinosites.

5-8, ventral aspect of ventral valve exteriors TMF 35109, 35110, 35111 and 35112 respectively showing coarse spinosities (TMF 35110 is partly decorticated).

LOCALITY: All specimens are from the Glencoe Formation, Quamby Brook Valley, loc. 22.

5 cm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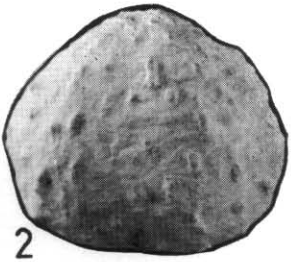
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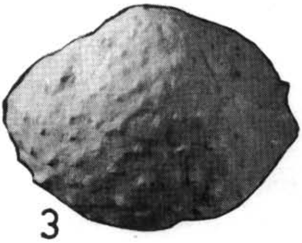
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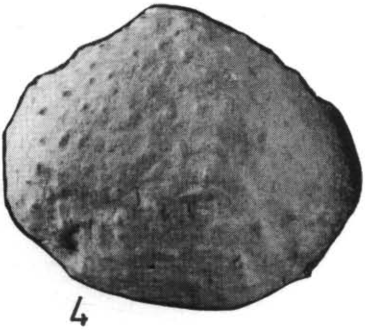
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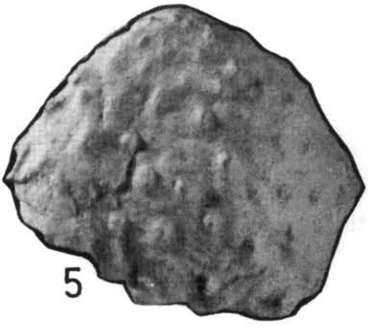
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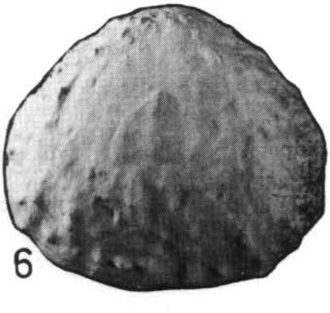
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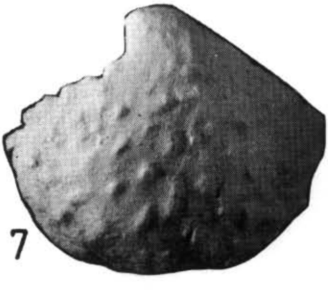
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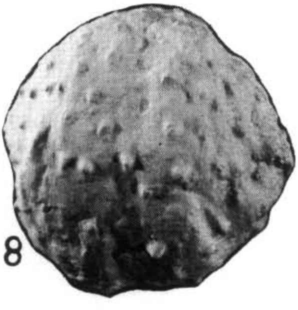
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PLATE 4

FIGURES 1-9: *Strophalosia subcircularis* sp. nov. (1 x 1.40; 2 x 1.33; 3-5 x 1.30; 6-9 x 1.25).

1-2, ventral and posterior views of ventral valve internal mould, syntype TMF 3545.

3-4, ventral aspect of ventral valve internal moulds TMF 3569 and 3570.

5, ventral aspect of ventral valve internal mould, syntype TMF 3546.

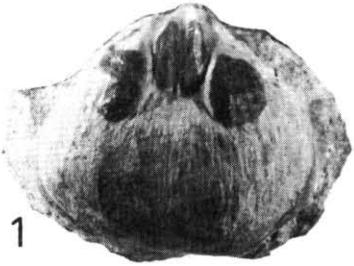
6, dorsal valve interior, syntype TMF 3547.

7, ventral aspect of ventral valve internal mould TMF 3572, a gerontic individual showing pronounced posterior thickening of the umbonal walls.

8-9, ventral aspect of ventral valve internal moulds TMF 3574 and 3576. Pathological deformities; 8 with markedly unequal diductor scars, and 9 with small adductor platform and abnormally large diductor scars.

LOCALITY: All specimens are from the Glencoe Formation, Quamby Brook Valley, loc. 22.

5 cm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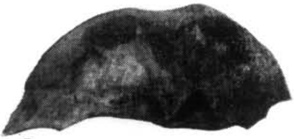
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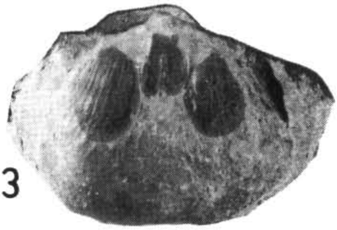
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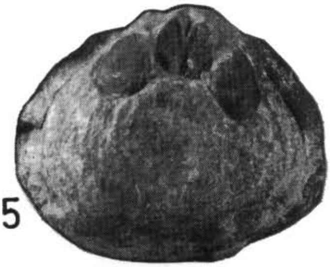
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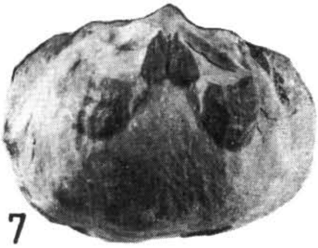
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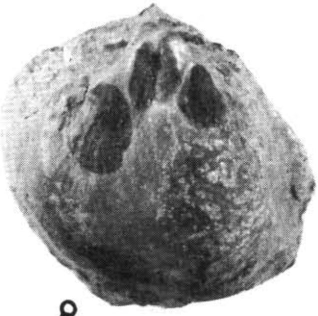
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PLATE 5

Figures 1-4; *Strophalosia subcircularis* sp. nov., var. *tumida* nov. (1, 3 x 1.25; 2, 4 x 1.33).

1-2, 4. syntypes TMF 3548, 3549, 3550, ventral aspect of ventral valve internal moulds.

3, TMF 3571, ventral aspect of ventral valve internal mould.

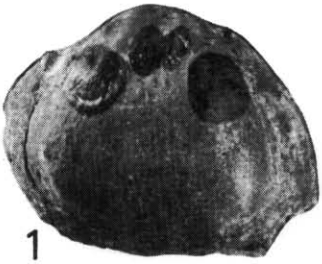
Figures 5-8: *Wyndhamia*? *irregularis* sp. nov. (5-7 x 1.40; 8 x 1.33).

5-7, syntypes TMF 3565, 3566, 3567, ventral aspect of ventral valve internal moulds.

8, syntype TMF 3568, a gerontic individual, ventral aspect of ventral valve internal mould.

Locality: All specimens are from the Glencoe Formation, Quamby Brook Valley, loc. 22.

5 cm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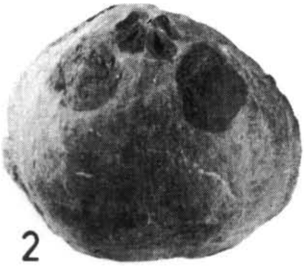
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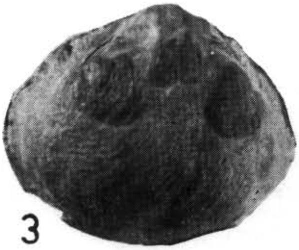
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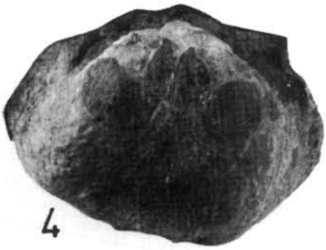
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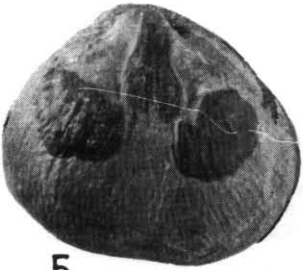
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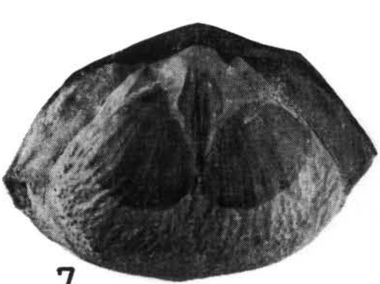
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PLATE 6

Figures 1-2, 4: *Strophalosia subcircularis* sp. nov., var. *brevicardinalis* nov. (1 x 1.20; 2, 4 x 1.15).

1, 4, syntypes TMF 3551, 3552, ventral aspects of ventral valve internal moulds.

2, TMF 3573, ventral aspect of ventral valve internal mould.

Figures 3, 5-6: *Strophalosia subcircularis* sp. nov. (3 x 1.25; 5-6 x 1.20).

3, TMF 35120, internal aspect of dorsal valve.

5-6, ventral and lateral aspect of ventral internal mould TMF 3577, an individual with an unusually long trail.

Figures 7-8: *Wyndhamia preovalis* (Maxwell) (7 x 1.20; 8 x 1.25).

7, topotype CPC 9503, ventral aspect of ventral valve internal mould.

8, TMF 35119, ventral aspect of ventral valve internal mould.

Figures 9-11: *Costalosia apicallosa* sp. nov. (x 1.25).

TMF 35116, 35117, 35118, anterior and ventral aspect of incomplete ventral valves showing external ornament.

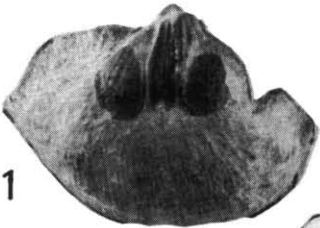
Localities:

1-6, 9-11, Glencoe Formation, Quamby Brook Valley, loc. 22.

7, Homevale Ridge, just east of Homestead, Queensland (see: *Bull. Bur. Miner. Resour. Geol. Geophys. Aust.* No. 64. p. 57 (1964)).

8, Nassau Siltstone, Geiss Creek, near Granton.

5 cm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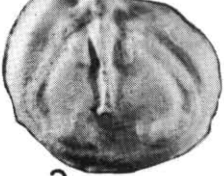
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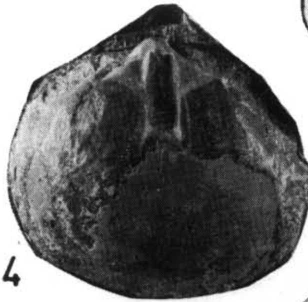
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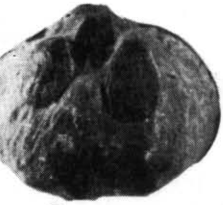
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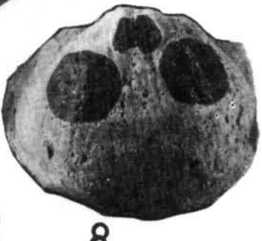
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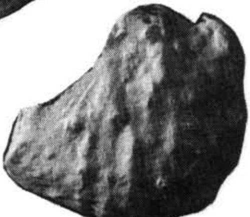
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10


11

PLATE 7

Figures 1-8. *Costalosia apicallosa* sp. nov. (1-2 x 1.40; 4-7 x 1.33; 3 x 1.25; 8 x 1.20).

1-2, syntype TMF 3554, ventral and anterior views of ventral valve exterior showing external ornament and partly etched to show muscle platforms.

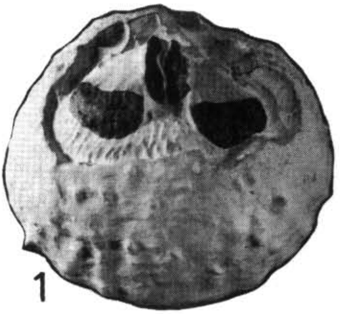
3-4, syntypes TMF 3557, 3558, ventral aspect of ventral valve internal moulds.

5, 7, TMF 35113, 35114, ventral aspect of ventral valve internal moulds.

6, syntype TMF 3555 dorsal valve interior.

8, TMF 35115, ventral view of ventral valve exterior.

Locality: All specimens are from the Glencoe Formation, Quamby Brook Valley, loc. 22.



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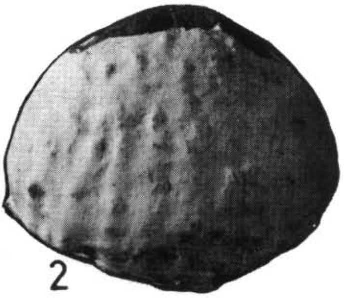

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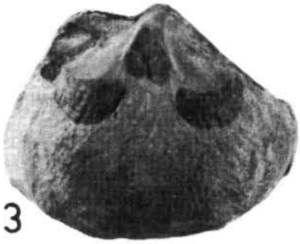

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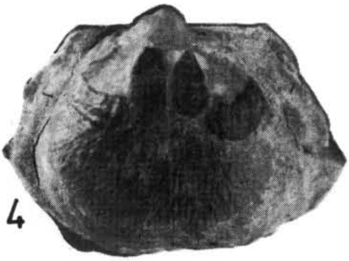

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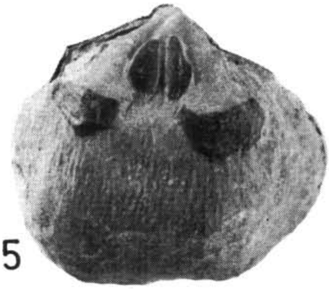

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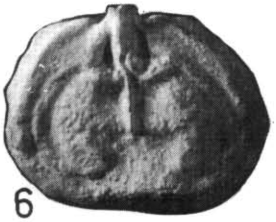

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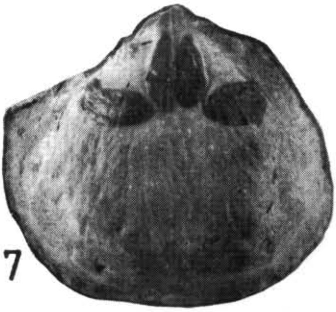

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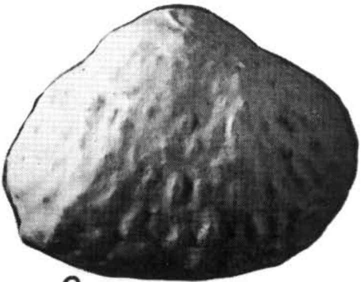

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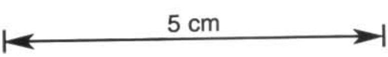


PLATE 8

FIGURES 1-3, 7: *Wyndhamia jukesi* (Etheridge) (1, 3 x 1.40; 2 x 1.35; 7 x 1.33).

1, TMF 3584, ventral aspect of ventral valve exterior.

2, TMF 3585, silicified internal mould of dorsal valve.

3, TM P20Z104 lectotype *Strophalosia gerardi* W. King var. *tasmaniensis* Prendergast MS, ventral aspect of ventral valve exterior.

7, TMF 3586, dorsal valve interior.

FIGURES 4, 5: *Wyndhamia dalwoodensis* Booker. (x 1.25).

4, UTF 28044, ventral aspect of ventral valve internal mould.

5, TMF 3587, dorsal valve interior.

FIGURE 6: *Wyndhamia ovalis* (Maxwell). (x 1.25).

TMF 3588, ventral aspect of ventral valve internal mould.

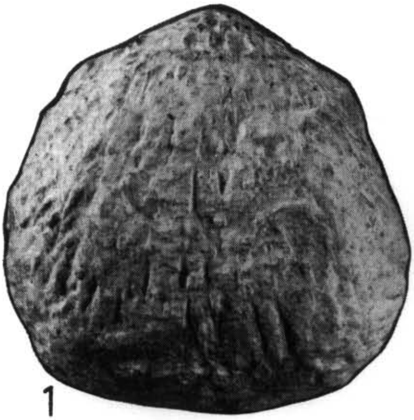
LOCALITIES:

1, 3, 5, 7, Berriedale Limestone, Rathbone's Quarry, Granton.

2, Main Limestone (=Peter Limestone, Banks, 1955; 1962), Friendly Beaches, Coles Bay.

4, sandstone (=Malbina A correlate), Arcadian Siding, Maydena area.

6, Malbina E, Mt Nassau, near Granton.



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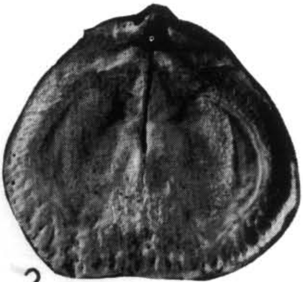

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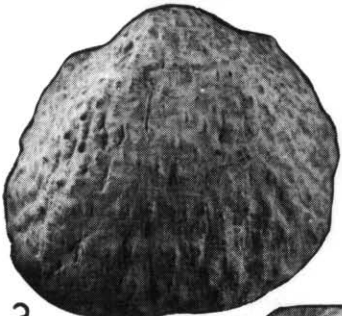

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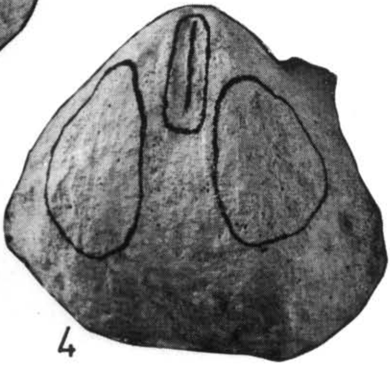

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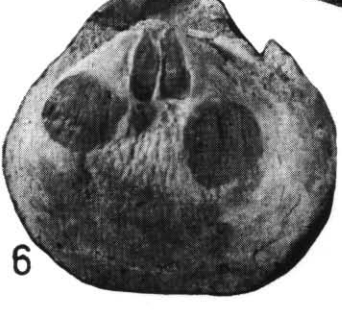

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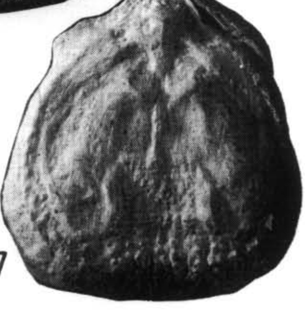

7

5 cm