https://doi.org/10.24199/j.mmv.1981.42.02 30 September 1981

A NEW SPECIES OF *TORNQUISTIA* (BRACHIOPODA: CHONETIDINA) FROM THE ARTINSKIAN (PERMIAN) OF WESTERN AUSTRALIA

By N. W. Archbold

Department of Geology, University of Melbourne, Parkville, Victoria, 3052.

Abstract

The new species *Tornquista gregoryi*, from the late Baigendzinian (late Artinskian) Wandagee Formation of the Carnarvon Basin, Western Australia, is described. Internal structures of the species are elucidated by use of the peel technique. The content and evolution of the family Anopliidae is briefly reviewed and revised.

Introduction

The classification and distribution of the chonetacean family Anopliidae and representatives of the family from the Permian sequence of the Carnarvon Basin, Western Australia, have previously been investigated by the author (Archbold 1980). After that study had gone to press, Dr. P. Jell of the National Museum of Victoria passed on to me a collection of chonetid brachiopods, from the Permian sequences of Western Australia, that is housed in the National Museum collections. The specimens described below were collected by Dr C. Teichert in the years 1939 and 1941. The new species *Tornquistia gregoryi* was investigated with the aid of peels, a technique seldom applied to the Chonetidina as a group, and the value of this technique for the elucidation of hidden interior structures is shown herein.

Additions and amendments to the inferred phylogeny of the Anopliidae previously presented by the author (Archbold 1980, p. 182), made necessary by the works of Jing and Hu (1978) and Havlicek and Racheboeuf (1979) are given below.

Collections: All specimens are housed in the National Museum of Victoria (NMV), Melbourne, Victoria.

Stratigraphy and Age: Tornquistia gregoryi sp. nov. is known only from the Wandagee Formation of the Carnarvon Basin. The Permian stratigraphy of the Carnarvon Basin has been documented by Condon (1967) and reviewed by Playford et al. (1975); it is not proposed to review the sequence further here.

The age of the Wandagee Formation is considered to be Late Baigendzinian (Late Artinskian Stage) as indicated by Glenister and Furnish (1961), and revised by Dickins (1976) and Waterhouse (1976).

Localities for *Tornquistia gregoryi* sp. nov. are given with the systematic description.

Terminology: The terminology applied herein to the Anopliidae is that used previously by the author (Archbold 1980).

Techniques: Small chonetacean specimens are frequently preserved with their valves conjoined and hence elucidation of the dorsal internal structure is impossible unless thin sections or peels are prepared. The peel technique has been seldom applied to the Chonetidina. Campbell (1953) and Muir-Wood (1962, pp. 112-113) used peels to assist in the determination of internal structures and the present author (op. cit. 1980) provided serial sections, in the form of peels, to confirm the internal structures of species of *Demonedys* and *Tornquistia*. The peels of *Tornquistia gregoryi* sp. nov. described herein were prepared by grinding and etching in the normal manner. Specimens were embedded in clear polyester resin and the block was ground at set intervals; a distance of 0.1 mm apart appears most suitable for the determination of cardinal structures. Etching of the ground surfaces was for three seconds using 10% HCl. Peels were made of the etched surfaces on sheet "celluloid" moistened with a solution of "celluloid" dissolved in acetone. The peels were projected on to photographic paper and outlines traced accurately. The orientation of calcite fibres is semi-diagrammatic.

SYSTEMATIC PALAEONTOLOGY

Suborder Chonetidina Muir-Wood 1955
Family Anopliidae Muir-Wood 1962

Subfamily Anopliinae Muir-Wood 1962
Genus **Tornquistia** Paeckelmann 1930

Type Species: Leptaena (*Chonetes*) *polita* McCoy 1852.

Diagnosis: Small, smooth anopliids with lateral septa and strongly developed accessory septa in the dorsal valve. Alveolus distinct. Cardinal process small, bilobed or weakly quadrilobate internally. Ventral valve strongly convex.

Discussion: The geographical and age ranges of the genus have previously been reveiwed by the author (op. cit. 1980) who demonstrated that numerous Permian species belonging to smooth genera of the Rugosochonetidae had incorrectly been assigned to *Tornquistia* (or *Paeckelmannia*). *Tornquistia* is readily distinguished from *Demonedys* Grant (1976) by the absence of a prominent ventral fold. *Anoplia* Hall and Clarke (1892), a genus superficially similar to *Tornquistia,* possesses a raised, internally bilobate cardinal process and long, curved, crenulated socket ridges. *Yagonia* Roberts (in Roberts et al. 1976) also possesses an elongate, bilobed cardinal process in addition to many pairs of spinose radial ridges between the short lateral septa and the pronounced accessory septa. *Yagonia* is also distinguished from *Tornquistia* by its remarkably large size.

Tornquistia gregoryi sp. nov.
(Plate 3, figs. 1-28; text figs. 1-2.)

Holotype: NMV P60709, a ventral valve, from Teichert's field locality WC(16-24) 1, described as "Wandagee Series, zones 16-24, northeast side of syncline, north of Minilya River, west of Coolkilya Pool." Now in Wandagee Formation.

Material: Four conjoined shells and 21 isolated ventral valves. One specimen was sectioned to reveal the internal structures.

Measurements: All specimens were measured and yielded the following ranges of measurements in mm. Graphical scatter plots are provided (fig. 1).

Maximum Width	Mid-width	Thickness	Length
11.4-6.7	10.8-6.3	3.8-2.1	8.8-2.1

Localities: After a reconnaissance visit in 1938, an area on Wandagee Station on the Minilya River in the Carnarvon Basin, was selected by Dr C. Teichert and others, then of the University of Western Australia, for detailed mapping. The mapping was begun in 1939 and continued in 1940 and 1941. The specimens described herein were collected during those years and came from the stratigraphic interval named by Teichert the Wandagee Series, *Calceolispongia* stage. That stratigraphic interval is now known as the Wandagee Formation. Specimens collected during those surveys are accurately located stratigraphically although geographically they are not so reliably located for, as Teichert (1949 p. 37) noted, "the type section of the Wandagee Series occurs in featureless, plain country which is singularly lacking in any kind of geographic features which could be named".

The localities of the specimens are recorded as follows.

Specimens NMV P60700-NMV P60712 are from Teichert's field locality WC (16-24)1, recorded as "Wandagee Series, zones 16-24, northeast side of syncline, north of Minilya River, west of Coolkilya Pool". Specimens NMV P60713-NMV P60724 are from Teichert's field locality WC (21-25)5, recorded as "Coley's locality E9 and station 29J of the 1939 survey; Wandagee Series, *Calceolispongia* stage, zones 16-24". Mr H. Coley, of Wandagee Station, was an indefatigable fossil collector, who became familiar with the stratigraphic occurrences of species of *Calceolispongia.*

Etymology: The species is named in honour of Augustus Charles Gregory, pioneer explorer of the Swan River Colony and one of the first to investigate the Permian rocks of Western Australia.

Description: Medium size for genus; convexity low in juveniles, higher in adults. Mesial portion of ventral valve inflated, at times with a weak ventral fold posteriorly developed, other specimens with a higher convex ventral valve. Greatest width usually at hinge line; occasional specimens develop a rounded quadrate outline with mid-width equal to or slightly greater than hinge width. Interareas low. Dorsal valve gently concave. Exterior of shell smooth with weakly

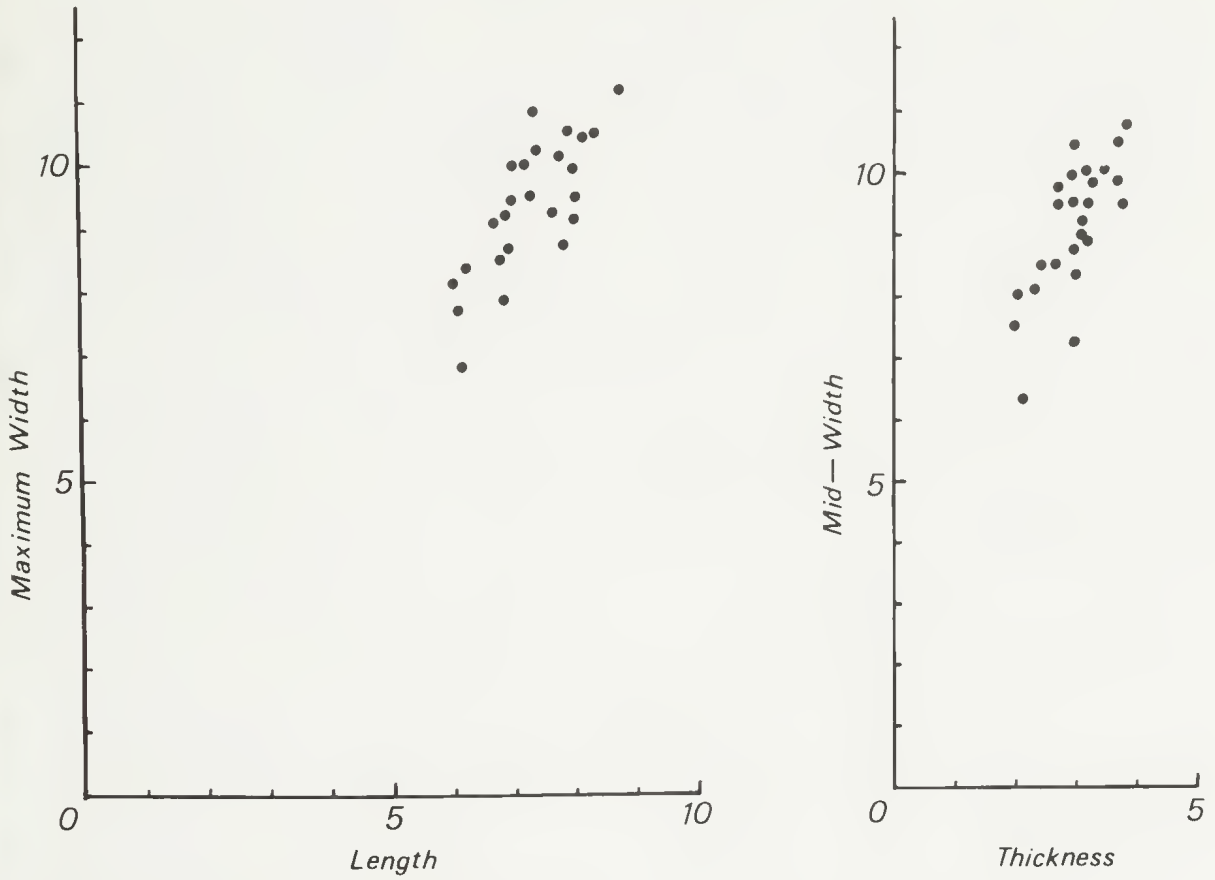


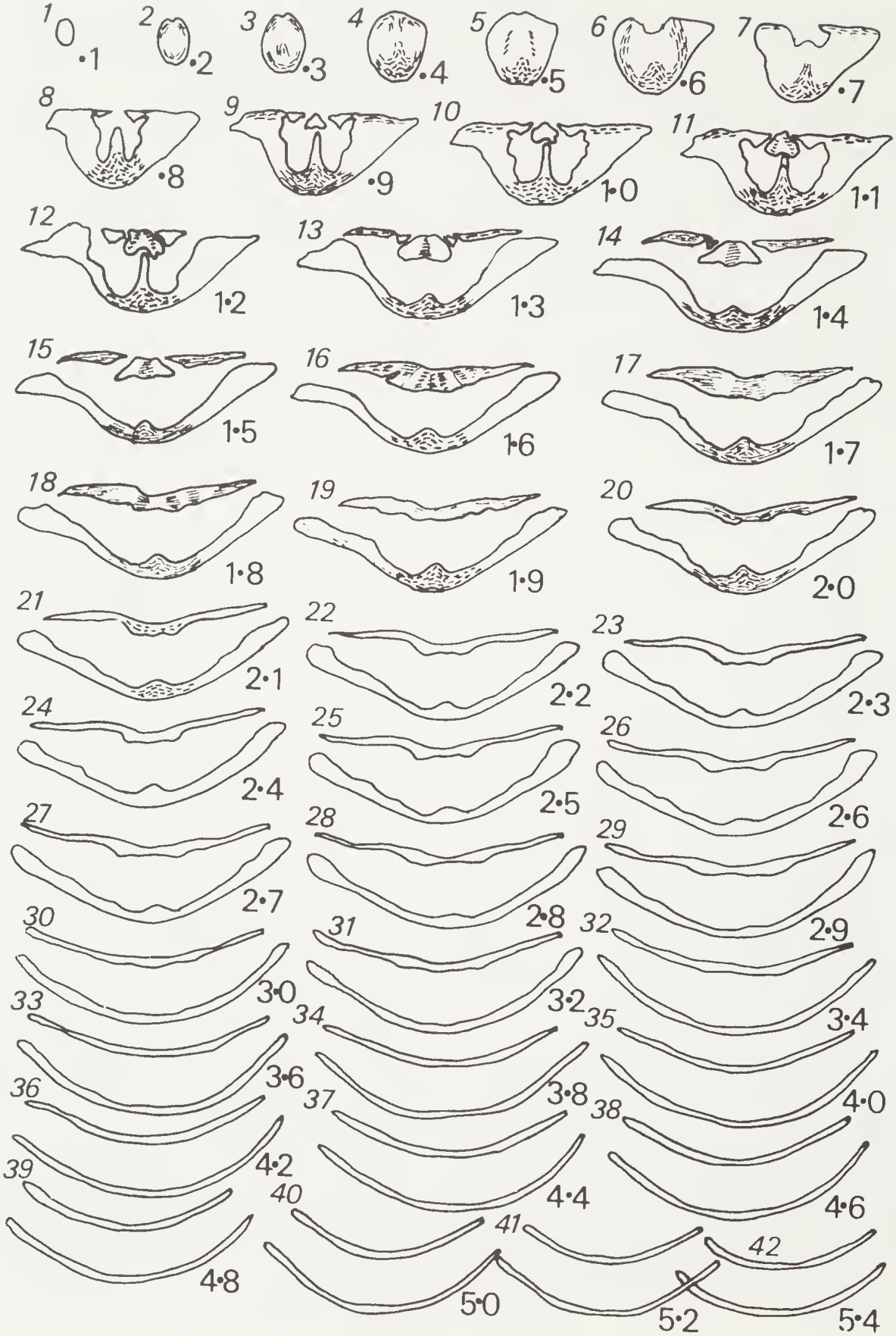
Fig. 1 — Scatter Plots (in mm) of measurements of *Tornquistia gregoryi* sp. nov.

developed growth lines. Cardinal spines poorly known, apparently short and well spaced.

Ventral interior with well developed teeth, delthyrium wide; ventral median septum high posteriorly, articulating with slot between halves of bilobed cardinal process, lower anteriorly, extending for about one half valve length. Valve floor, excluding muscle region, with scattered pustules.

Dorsal interior with strongly bilobed cardinal process. No median septum. Accessory septa well developed, extending anteriorly as gently diverging, distinct ridges for two-thirds valve length. Lateral septa short, low. Anterior of valve strongly pustulose except for region between the accessory septa.

Observations on the peels of Tornquistia gregoryi: Forty-two peels were prepared from the parallel serial grinding of a complete shell of *T. gregoryi*; the first thirty peels being at 0.1 mm distance apart, the subsequent peels at 0.2 mm apart. The full set is shown in Fig. 2. The ventral median septum is obvious by peel no. 8 and in peels 10 to 12 can be seen to be articulating with the bifid cardinal process. Peel 12 indicates the pronounced bifid nature of the interior of the cardinal process. An additional weakly developed lateral groove adjacent to the strong median groove on the internal face of the cardinal process in peel 12 may indicate a tendency for the cardinal process to be weakly quadrilobate. Weakly developed low lateral septa are indicated in peels 17-19 and the accessory septa arise gently in peel 17 and persist anteriorly until peel 32, hence being almost 2 mm long. The ventral median septum persists until peel 29 and hence is about half the length of the valve. The anterior sections of the two valves reveal the thin nature of the shell anteriorly.


1 0·1
2 0·2
3 0·3
4 0·4
5 0·5
6 0·6
7 0·7
8 0·8
9 0·9
10 1·0
11 1·1
12 1·2
13 1·3
14 1·4
15 1·5
16 1·6
17 1·7
18 1·8
19 1·9
20 2·0
21 2·1
22 2·2
23 2·3
24 2·4
25 2·5
26 2·6
27 2·7
28 2·8
29 2·9
30 3·0
31 3·2
32 3·4
33 3·6
34 3·8
35 4·0
36 4·2
37 4·4
38 4·6
39 4·8
40 5·0
41 5·2
42 5·4

Discussion: This distinctive species, characterized by the incipient development of a ventral fold posteriorly in many specimens and the high, arched convexity of mature individuals is readily distinguished from other species of the genus. *Tornquistia magna* Archbold (1980 p. 186 pl. 25, figs. 5-13) also is characterised by the possession of a highly convex ventral valve with a strongly inflated mesial portion of the valve; however, no trace of an incipient ventral fold occurs in *T. magna* unlike *T. gregoryi*. *T. gregoryi* is probably a direct descendant of *T. magna*. Other Western Australian species of *Tornquistia* are normally not as strongly convex as *T. gregoryi*. True *Tornquistia* is relatively rare in Permian strata (cf. discussions in Archbold 1980 p. 184) and of foreign species only *T. gibbera* Afanas'yeva (1977) from the Late Carboniferous or Early Permian (Asselian) Paren Horizon of the Kolyma-Omolon region, USSR, need be compared with *T. gregoryi*. The Siberian species is distinctly convex; however, no trace of an incipient median fold is present and the dorsal internal septa are weakly developed in comparison with the strongly developed accessory septa of *T. gregoryi*.

The presence of an incipient, posteriorly developed, ventral fold in *T. gregoryi* recalls the genus *Demonedys* Grant (1976). However, that genus is characterised by species small in size and with a pronounced ventral fold and hence should not be confused with *Tornquistia* (cf. Grant 1976, Archbold 1980). The ventral median septum of *Demonedys* is short and high unlike the relatively long septum of *Tornquistia*. Nevertheless the discovery of a species of *Tornquistia* with an incipient ventral fold supports the view of Archbold (1980. p. 183) that *Demonedys* developed from a *Tornquistia* stock.

Archbold (1980, p. 188) referred several poorly preserved specimens from the Wandagee Formation to *Demonedys*. Re-examination of these specimens indicates that they could just as readily be immature specimens of *T. gregoryi* hence it is now assumed that *Demonedys granti* is restricted to the Cundlego Formation of the Carnarvon Basin until proven otherwise.

Fig. 2 – *Tornquistia gregoryi* sp. nov. Transverse serial sections of specimen NMV P60706, x5. The larger numbers refer to the position of the section, in mm, from the posterior extremity of the shell. Orientation of calcite fibres is shown semi-diagrammatically. Pseudo-punctae (taleolae) not shown.

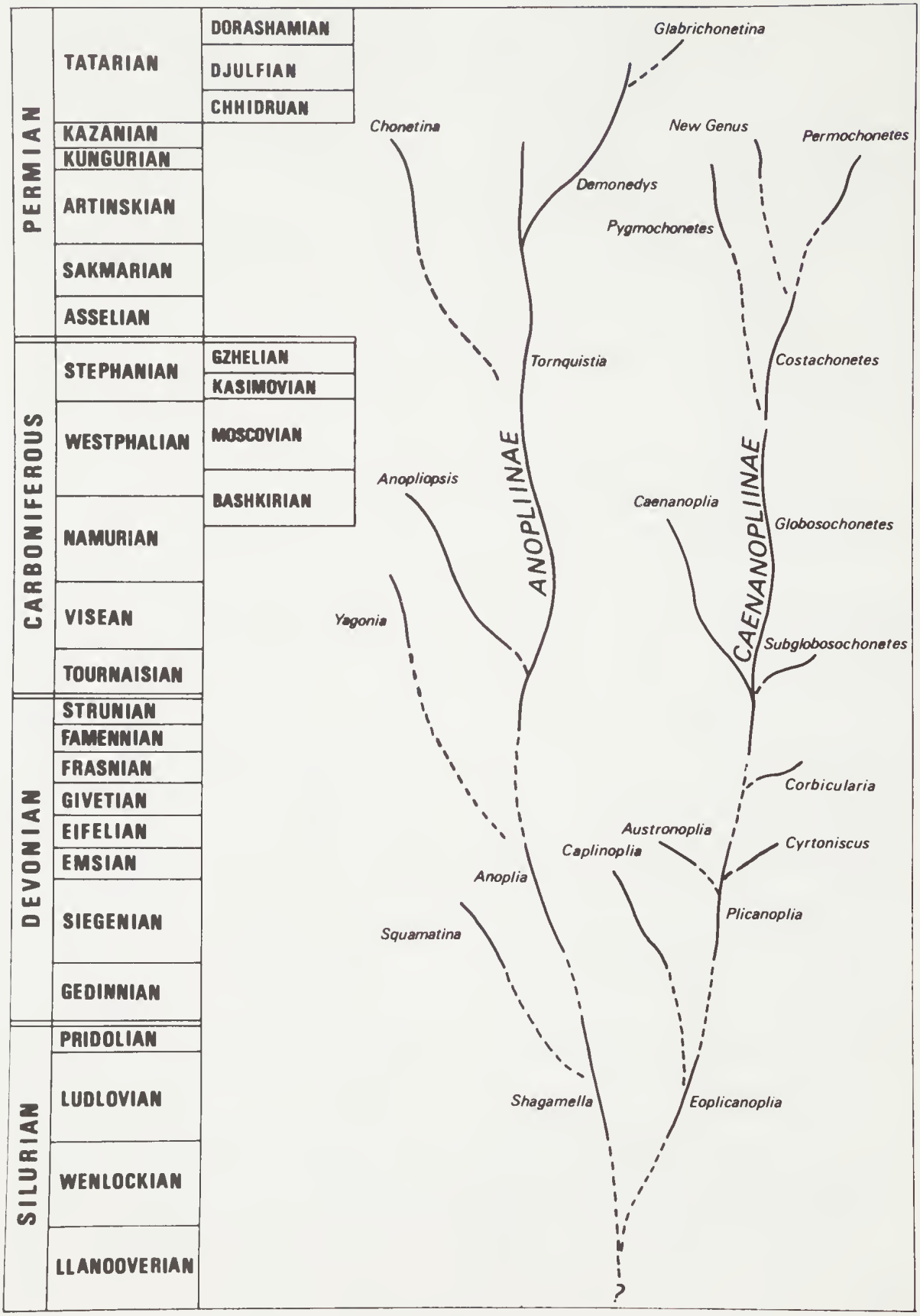
PHYLOGENY OF THE ANOPLIIDAE

A detailed account of the inferred phylogeny of the Anopliidae has been given by the author (Archbold 1980) but the works of Jing and Hu (1978) and Havlicek and Racheboeuf (1979) necessitate amendments to that account.

Caplinoplia Havlicek and Racheboeuf from the Siegenian and Emsian of Czechoslovakia is a caenanopliinid with strong, long, curved lateral and accessory septa and a short, anteriorly placed median septum, in the dorsal valve. It is probably a descendent of *Eoplicanoplia* Boucot and Harper (1968), a Ludlovian genus with lateral septa and a variably developed dorsal median septum, rather than being an off shoot from *Plicanoplia* Boucot and Harper (1968), a Siegenian genus with lateral and accessory septa but no median septum, in the dorsal valve.

Pygmochonetes Jing and Hu (1978) a caenanopliinid from the Artinskian-Kungurian of China possesses similar internal structures to *Costachonetes* Waterhouse (1975) but *Costachonetes* invariably possesses a variably developed ventral sulcus, at least posteriorly (Archbold 1980 pp. 183, 189; Prokof'ev 1975 p. 17, pl. 1, figs 8-14). *Pygmochonetes*, characterised by a strongly inflated ventral valve with a highly arched median section, apparently includes *Chonetella dubia* Loczy (1897, p. 67, text fig. 16) from the Late Carboniferous of China, a species indicated by Archbold (1980, p. 181) to possibly belong to a new genus. *Pygmochonetes* and *Costachonetes* may have evolved independently from *Globosochonetes* as indicated by Archbold (1980, p. 183) or *Pygnochonetes* may have evolved from early *Costachonetes*.

I now include *Yagonia* Roberts (in Roberts et al. 1976) within the Anopliinae. *Yagonia* was possibly derived from *Anoplia*, as indicated on text fig. 3, but this remains one of the


PERMIAN
TATARIAN
DORASHAMIAN
DJULFIAN
CHHIDRUAN
KAZANIAN
KUNGURIAN
ARTINSKIAN
SAKMARIAN
ASSELIAN
CARBONIFEROUS
STEPHANIAN
GZHELIAN
KASIMOVIAN
WESTPHALIAN
MOSCOVIAN
BASHKIRIAN
NAMURIAN
VISEAN
TOURNAISIAN
DEVONIAN
STRUNIAN
FAMENNIAN
FRASNIAN
GIVETIAN
EIFELIAN
EMSIAN
SIEGENIAN
GEDINNIAN
SILURIAN
PRIDOLIAN
LUDLOVIAN
WENLOCKIAN
LLANOOVERIAN
Glabrichonetina
Chonetina
New Genus
Permochonetes
Demonedys
Pygmochonetes
Tornquistia
Costachonetes
ANOPLIINAE
CAENANOPLIINAE
Anopliopsis
Caenanoplia
Globosochonetes
Yagonia
Subglobosochonetes
Corbicularia
Austronoplia
Caplinoplia
Cyrtoniscus
Anoplia
Plicanoplia
Squamatina
Shagamella
Eoplicanoplia
?

more hypothetical relationships within the Anopliinae.

Finally, *Squamatina* Havlicek and Racheboeuf (1979, p. 109), a genus of typical anopliinid size and shape from the Siegenian of Czechoslovakia may be an atypical descendent of *Shagamella* Boucot and Harper (1968). Havlicek and Racheboeuf (1979, p. 109) noted the external similarity of *Squamatina* to *Anoplia* and that the internal structures of *Squamatina* were atypical of the Anopliidae, with which I agree, nevertheless, *Shagamella*, the earliest known member of the Anopliinae, possesses poorly developed *or no* accessory septa and hence is similar to its chonetid ancestory. *Squamatina* can be interpreted as a member of the Anopliidae also possessing interior characters of the Chonetidae, the ancestors of the Anopliidae.

Other genera and relationships shown in text fig. 3 are discussed in Archbold (1980) with the exception that *Chonetes* (*Chonetina*) *westphalicus* Böger & Fiebig (1963, pp. 147-148) from the Westphalian of Germany is now placed in *Tornquistia* following Winkler Prins (1970, p. 3) and Brand (1970, p. 100). This, in turn, leaves the origin of *Chonetina* open to question.

Acknowledgements

I thank Dr P. Jell, National Museum of Victoria, for the loan of specimens in his care. Dr G. A. Thomas, University of Melbourne, critically read the manuscript. Mrs G. Waterman typed the manuscript. The assistance of the staff of the Baillieu Library is acknowledged.

References

Afanas'yeva, G. A., 1977. Suborder Chonetidina. In, Sarycheva, T. G., (Ed.), Pozdnepaleozoiskie Prodiktidy Sibiri i Arktiki. *Trudy Paleont. Inst. Akad. Nauk SSSR*, 161-5-41.

Archbold, N. W., 1980. Studies on Western Australian Permian Brachiopods. I. The Family Anopliidae (Chonetidina). *Proc. Roy. Soc. Vict.*, 91(2): 181-192.

Fig. 3 — Inferred phylogeny of the Family Anopliidae Muir-Wood (modified from Archbold 1980, p. 182).

Böger, H. and Fiebig, H., 1963. Die Articulaten Brachiopoden des West Deutschen Oberkarbons. *Palaeontographica Abt. A.* 122: 111-165.

Boucot, A. J. and Harper, C. W., 1968. Silurian to Lower Devonian Chonetacea. *J. Paleont.* 42(1): 143-176.

Brand, P. J., 1970. Scottish Carboniferous chonetids. *Bull. geol. Surv. Gt. Br.*, 31: 89-137.

Campbell, K. S. W., 1953. The Fauna of the Permo-Carboniferous Ingelara Beds of Queensland. *Pap. Dep. Geol. Univ. Qd.*, 4(3): 1-30.

Condon, M. A., 1967. The Geology of the Carnarvon Basin, W.A. Part 2. Permian Stratigraphy. *Bull. Bur. Miner. Resour. Geol. Geophys. Aust.*, 77: 1-191.

Dickins, J. M., 1976. Correlation Chart for the Permian System of Australia. Ibid. 156B: 1-26.

Glenister, B. F. and Furnish, W. M., 1961. The Permian ammonoids of Australia. *J. Paleont.*, 35: 673-736.

Grant, R. E., 1976. Permian brachiopods from southern Thailand. *J. Paleont.*, 50 (supp. *Paleont. Soc. Mem.* 9): 1-269.

Hall, J. and Clarke, J. M. 1892. An Introduction to the study of the genera of Palaeozoic Brachiopoda. *Paleont. New York*, 8(1): 1-367.

Havlicek, V. and Racheboeuf. P. R., 1979. Chonetacea (Brachiopodes) du Silurien et du Devonien de Boheme (Tchecoslovaquie). *Annal. de Paleont. (Invert.)*, 65(2): 69-138.

Jing, Y. and Hu, S., 1978. Brachiopods of the Kuhfeng Formation in South Anhui and Nanking Hills. *Acta Palaeont. Sinica*, 17(2): 101-127.

Loczy, L., 1897. A fosszilis emlös—és puhatestü allatmaradvanyok leirasa es a palaeontologiai—stratigraphiai eredmenyek. In, Szechenyi, B. (Grof)., *Keletazsiai Utjanak, Tudományos Eredménye 1877-1880.* Köt. 3: I-VII, 1-192. Budapest. Kilián Frigyes Egyetemi.

McCoy, F., 1852. Contributions to British Palaeontology. On some new Brachiopoda from the Carboniferous Limestone. *Ann. Mag. nat. Hist. Ser.* 2. 10: 421-429.

Muir-Wood, H. M., 1962. *On the morphology and classification of the brachiopod suborder Chonetoidea.* British Museum (Natural History). pp. 1-132.

Paeckelmann, W., 1930. Die Brachiopoden des deutschen Unterkarbons. I Teil: Die Orthiden, Strophomeniden und Choneten des Mittleren und Oberen Unterkarbons. *Abh. Preuss. Geol. Landesanst. N.F.* 122: 143-326.

Playford, P. E., Cope, R. M., Cockbain, A. E., Low, G. H., and Lowry, D. C., 1975. Phanerozoic. In, Geology of Western Australia. *West. Australia Geol. Surv. Mem.*, 2: 233-432.

Prokof'ev, V. A., 1975. Brakhiopody verkhnego Karbona Samarskoi Luki. *Trudy Vses. nauchno—issled. Geol.—razved. neft. Inst. (VNIGNI)*, 162: 1-144.

Roberts, J., Hunt, J. W., and Thompson, D. M. 1976. Late Carboniferous marine invertebrate zones of eastern Australia. *Alcheringa* 1: 197-225.

Teichert, C., 1949. Permian crinoid *Calceolispongia. Mem. geol. Soc. Amer.*, 34: 1-132.

WATERHOUSE, J. B., 1975. New Permian and Triassic brachiopod taxa. *Pap. Dep. Geol. Univ. Qd.* 7(1): 1-23.

WATERHOUSE, J. B., 1976. World correlations for Permian marine faunas. *Pap. Dep. Geol. Univ. Qd.* 7(2): 1-232.

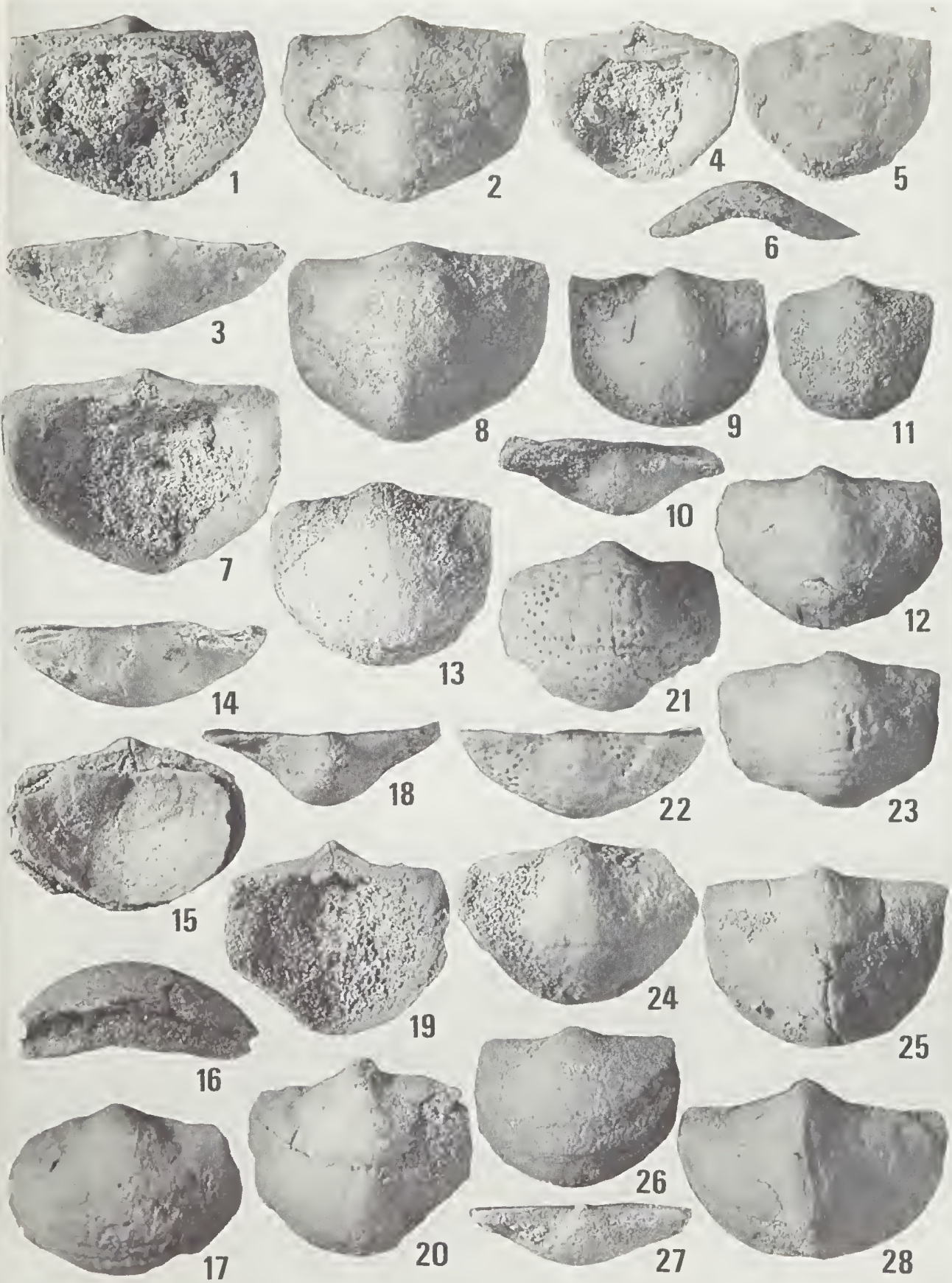
WINKLER-PRINS, C. F., 1970. The brachiopod faunas of the Aegir Marine Band and of the British, Belgian and Dutch marine bands of the same age. *Rapport. Geol. Bureau Heerlen*, 1153: 1-8.

Explanation of Plate

PLATE 3

Tornquistia gregoryi sp. nov. All figures x4.5.

Figs. 1-3. NMV P60715. Dorsal, ventral and posterior views of shell.
Figs. 4-6. NMV P60712. Dorsal, ventral and anterior views of shell.
Figs. 7-8. NMV P60713. Dorsal and ventral views of ventral valve.
Figs. 9-10. NMV P60718. Ventral and posterior views of ventral valve.
Figs. 11. NMV P60724. Ventral view of ventral valve.
Figs. 12. NMV P60707. Ventral view of ventral valve.
Figs. 13. NMV P60716. Ventral view of ventral valve.
Figs. 14-17. NMV P60706. Posterior dorsal, anterior and ventral views of shell.
Figs. 18-20. NMV P60709. Holotype. Posterior, dorsal and ventral views of ventral valve.
Figs. 21-22. NMV P60717. Ventral and posterior views of ventral valve.
Figs. 23. NMV P60708. Ventral view of ventral valve.
Figs. 24. NMV P60705. Ventral view of ventral valve.
Figs. 25. NMV P60702. Ventral view of ventral valve.
Figs. 26-27. NMV P60710. Ventral and posterior views of ventral valve.
Figs. 28. NMV P60700. Ventral valve in ventral view.


1
2
4
5
6
3
8
9
11
10
7
12
13
21
14
18
22
23
15
19
24
25
16
26
17
20
27
28