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# MORPHOLOGY AND PALEOECOLOGY OF GIVETIAN BRACHIOPODS FROM JURKOWICE-BUDY (HOLY CROSS MOUNTAINS, POLAND)

*Abstract.* — The described assemblage of brachiopods from the Givetian of Jurkowice-Budy (= *Stringocephalus burtini* Beds), Holy Cross Mountains comprises 6 species including one newly erected *Crurithyris jurkowicensis* n.sp. Some observations on the ontogeny and morphology of *Ilmenia hians, Rensselandia gibbosa* and *Stringocephalus burtini* based on numerous young specimens are made. The paleoecology of the whole assemblage is discussed and the periodic disappearance of the benthonic fauna is judged to be due mainly to the oscillatory changes in the sea salinity.

## INTRODUCTION

The calcareous deposits in the Jurkowice-Budy environs were first described by Samsonowicz (1930). The short list of fossils mentioned by him includes the brachiopods: *Cyrtina* sp., *Spirifer inflatus* and *Stringocephalus burtini*. More detailed data on the lithology and fossils of this section were given by further investigators (Pajchlowa & Stasińska, 1965; Kaźmierczak, 1971). Only two fossil groups were, however, studied: stromatoporoids (Kaźmierczak, 1971) and partly tetracorals (Różkowska, 1960). The brachiopods, although quite numerous in the considered deposits, were not, up to now, investigated.

The described here brachiopods were collected between 1969—1972 from the marly limestones of the *Stringocephalus burtini* Beds, outcropping in a quarry at the Budy village, about 2 km S from Jurkowice, 60 km ESE from Kielce, SE part of the Holy Cross Mountains (Text-fig. 1). These beds are stromatoporoid-coral layers, 30 meters thick, in which the presence of *Stringocephalus burtini* Defr. has been stated (Samsonowicz, 1930).

The majority of specimens, obtained by way of washing, come from the weathered part of the limestone exposed in the eastern part of the quarry. The remaining parts of the limestone supply numerous brachiopods but as the rock is very firm and compact they were difficult to obtain.

The whole collection includes several thousands specimens in different growth stage and dimensions, the smallest juveniles attaining 0.7 mm in width. Such an early stage of growth in fossil state was previously not known or described for e.g. *Ilmenia hians, Rensselandia gibbosa* and *Strin-*

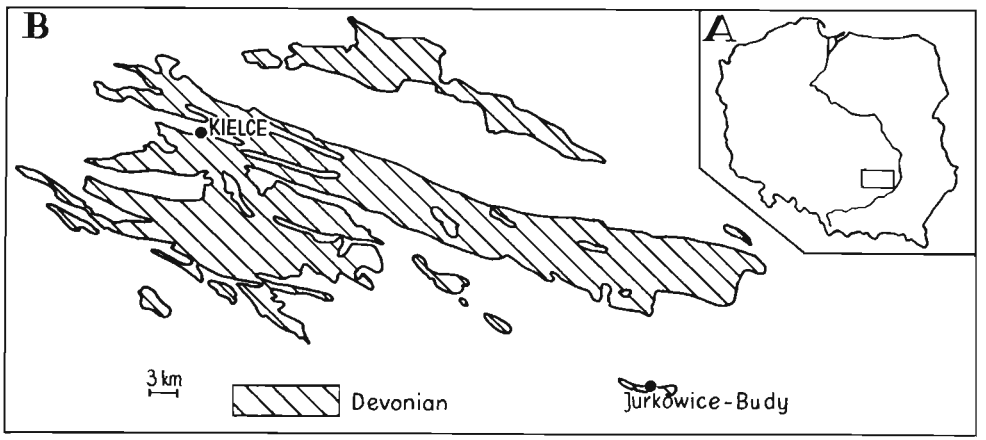


**Fig. 1. General map of Poland (A) and geological sketch map (B) of the Holy Cross Mountains showing the localization of Jurkowice-Budy (after Pajchlowa & Stasińska, 1965; simplified).**

*gocephalus burtini*. The state of preservation of the brachiopods is, in general, good; many shells, however, especially of ambocoelids are often decorticated. Elements of the internal structure are, as a rule, well preserved in both valves.

The studied collection is deposited in the Palaeozoological Institute of the Polish Academy of Sciences in Warszawa, for which the abbreviation Z. Pal. Bp. is used.

*Acknowledgement* — it is a pleasure to record my sincere thanks to Dr. G. Biernat for the critical reading the manuscript and very useful discussions during the work; Dr. J. Kaźmierczak for the discussions of the paleoecological problems; A. Nowiński M. Sc., for the specific identification of tabulates and Mrs. D. Sławik for the ink drawings — all these persons are from the Palaeozoological Institute of the Polish Academy of Sciences, Warszawa.

Also my thanks are due to Mr. A. Piotrowski a student of Palaeontology, Department of Geology, Warsaw University for the help in identification of gastropods and for providing of some fossil brachiopods.

## REMARKS ON THE STRATIGRAPHY

Samsonowicz (1930) emphasized the Givetian age of the stromatoporoid-coral limestones at Jurkowice-Budy (= *Stringocephalus burtini* Beds according to Kaźmierczak, 1971). Kaźmierczak (1971), basing on the stromatoporoid assemblage, included them to the lower part of the Upper Givetian. Their Upper Givetian character is shown also by the tabulates. In these two faunal assemblages, besides the Givetian forms, occur Givetian-Frasnian or even younger ones.

Stromatoporoidea

Givetian species:

*Stromatopora colliculata*
*S. mononensis*

Givetian-Frasnian species:

*Stictostroma lensiforme*
*Ferestromatopora parksi*
*Trupetostroma laceratum*
*Hermatostroma porosum*
*H. perseptatum*
*H. schlüteri*
*H. crassum*
*Actinostroma expansum*

Tabulata

Givetian species:

*Caliapora battersbyi*
*Crassialveolites crassus*
*Alveolites miillieuxi*
*Thamnopora cervicornis*

Givetian-Frasnian species:

*Syringopora fragilis*
*Alveolites parvus*
*Thamnopora boloniensis*

The Upper Givetian age of the discussed beds can be also ascertained by the brachiopods. In addition to the Givetian species such as *Ilmenia hians*, *Rensselandia gibbosa*, *Stringocephalus burtini*, this latter also known from Lowermost Frasnian, occurs e.g. *Ambothyris infima* cited from the Uppermost Givetian-Middle Frasnian in Belgium and Czechoslovakia. In the Devotian of England and Italy its stratigraphic position is not yet precised.

*Stringocephalus burtini* Beds are very similar, in their faunistic character to the upper part of Rodert-Schichten (Korallen-Brachiopoden Kalk) in Eifel, Germany, where, also predominate the rugose corals, stromatoporoids, brachiopods (e.g. *Stringocephalus burtini*, *Rensselandia* sp., ?*Bornhardtina* sp., smooth spiriferoids, athyrids) and trilobites (e.g. members of Dechenellinae) (Hotz, Kräusel & Struve, 1955; Struve, 1961).

## REMARKS ON THE ENVIRONMENT OF BRACHIOPODS

*The abiotic factors.* *Stringocephalus burtini* Beds constitute a more than 30 meter thick complex of green and dark-green marly limestones. In this

exposure biopelmicritic calcarenites with numerous stromatoporoids, corals and brachiopods are intercalated with dark platy calcilutites or gray, nodular marls very poor in fossils (Pajchlowa & Stasińska, 1965; Kaźmierczak, 1971). In the lower part of the *Stringocephalus burtini* Beds, exposed in the western part of quarry, there are thick banks of limestones with massive stromatoporoids, tabulates and tetracorals, some not in their growth position. *Stringocephalus burtini* is here rare, usually preserved as fragments of single valves. In the eastern part of the quarry *Stringocephalus burtini* is more numerous but also, as a rule, preserved in fragments, partly due to hydrodynamic factors or to diagenetic processes. Complete shells, when found, are damaged and greatly deformed. In these limestones, similarly as in the West part of the quarry stromatoporoids and corals predominate, however, being smaller and often preserved in fragments.

In the brachiopod assemblage of that part of the exposure small sized specimens, well preserved, prevail. *S. burtini* is also represented here mo-

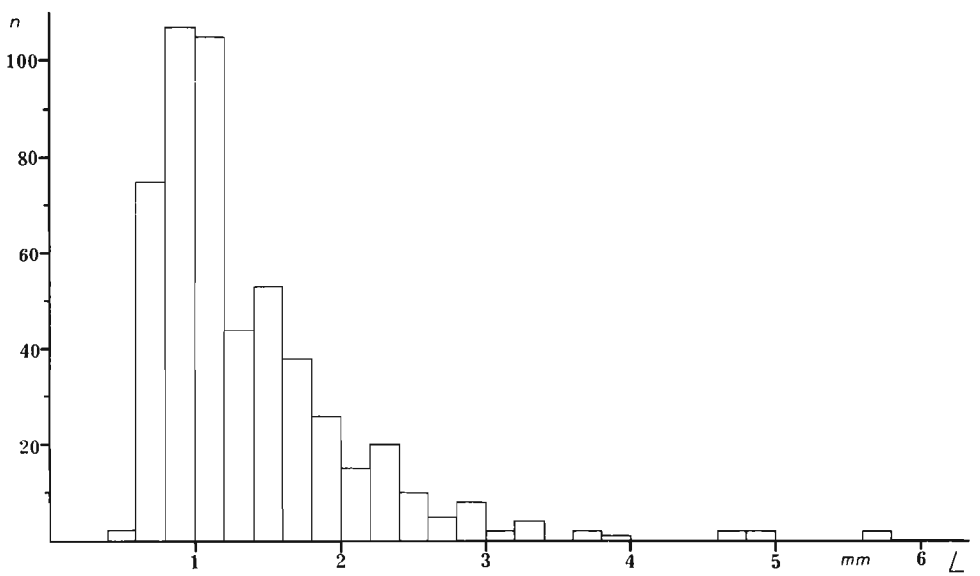


Fig. 2. Diagram of occurrence of different growth stages of *Ilmenia hians* (Buch) in orictocenosis of *Stringocephalus burtini* Beds $L$ — length of the shell, $n$ — number of specimens.

stly by juvenile forms (1—8 mm in length). Larger specimens are rare and sometimes, very fragmentary. In the *Ilmenia hians* orictocenosis small specimens to about 1 mm in length constitute 35% of all complete shells and those to about 2 mm in length 86% (Text-fig. 2). This richness of juvenile specimens appears to be caused by great mortality in the youngest ontogenetic stages as well as by selective hydrodynamic and taphonomic factors which make the whole assemblage poor in larger shells. Even-

tual transport could have played only a small role as the small shells are well preserved without traces of rolling.

*Fauna and flora.* In the *Stringocephalus burtini* Beds more than 50 species, members of the following 13 different groups, are stated:

Stromatoporoidea: *Stictostroma lensiforme, Stromatopora colliculata, S. divergens, S. mononensis, Ferestromatopora parksi, Trupetostroma laceratum, Syringostroma densum, Neosyringostroma logansportense, Hermatostroma porosum, H. perseptatum, H. schlüteri, H. crassum, Actinostroma compactum, A. expansum* (after Kaźmierczak, 1971)

*Amphipora ramosa* (after Samsonowicz, 1930)

Tabulata: *Caliapora battersbyi, Syringopora fragilis, S. volkensis, Crassialveolites crassus, Alveolites parvus, A. miillieuxi, Thamnopora tumephacta, T. boloniensis, Th. cervicornis, Aulopora* sp.

Tetracoralla: *Hexagonaria laxa, H. jurkowicensis, Thamnophyllum* sp., *Acanthophyllum* sp. (after Kaźmierczak, 1971)

Bryozoa: one ramose species of Trepostomata

Brachiopoda: ?*Athyris* sp., *Ambothyris infima, Crurithyris jurkowicensis, Ilmenia hians, Rensselandia gibbosa, Stringocephalus burtini*

Annelida: *Spirorbis* sp.

Trilobita: *Dechenella (Dechenella)* sp.

Ostracoda: few smooth and few ornamented species: *Aparchites sp., Cavellina* sp., *Amphissites* sp., *Neodrepanella* sp.

Conchostraca: *Rhabdostichus* sp.

Bivalvia: *Conocardium* sp.

Gastropoda: *Macrochilina arcuata, Macrochilina* sp., *Murchisonia* cf. *angulata, M. bilineata, M. intermedia, M.* sp., *Loxonema* sp., *Buechelia* sp., *Naticopsis* sp. (two species), *Yunnania* sp.

Echinodermata: unidentified fragments of calyxes and stems.

Charophyta: ?*Trochiliscus* sp.

The most numerous in species and specimens are stromatoporoids, tabulates, tetracorals, gastropods and brachiopods. The stromatoporoids are dominated by the spherical, irregularly bulbous or rarely columnar coenostea (Kaźmierczak, 1971). The ramose forms of *Amphipora* occur but sporadically. The tabulates are represented both by bulbous forms and ramose. Similarly, within the tetracorals, besides the massive colonial species, occur also solitary ones.

The gastropods are dominated by the species of *Murchisonia* and these together with some of the brachiopods — *Ilmenia hians, Stringocephalus burtini* are the most characteristic of the macrofauna of the discussed section. In the gastropod orictocenosis occur mostly small specimens representing the youngest growth stages of *Murchisonia* species or shells of adult individuals, representatives of *Naticopsis, Buechelia, Yunnania.*

This richly differentiated fauna of filtering organisms, using detritus as nourishment, is evidence of the nutritious properties of the water, in which the *Stringocephalus burtini* Beds were deposited.

The general state of preservation of the fossils and the whole faunistic-floristic assemblage suggest the following characteristics of the basin:
1. a very limited depth; stromatoporoids, tabulates, colonial tetracorals and partly the ostracods being evidence of a shallow water zone. Presence of charophytes, probably transported, is suggestive of neighbour of a zone of coastal water;

2. a moderate turbulence; presence of some massive colonial stromatoporoids and tetracorals, not in their growth position, and above all, of fragmentary brachiopod shells and of organic detritus are very suggestive of a sedimentary process oscillating in water of a moderate turbulence;

3. oscillatory facial changes; in the *Stringocephalus burtini* Beds layers yielding rich and highly diversified fauna are interbedded with marly limestones very poor or devoid of fossils, those occurring being: ostracods, trilobites, conchostraceans and charophytes. According to Kaźmierczak (1971) the periodic disappearance of the benthonic faunal assemblage was caused by some deterioration in the aeration of the sea bottom. However, the character of this impoverished benthonic faunals suggests probable changes in the water salinity. The recent conchostraceans occur in fresh and brackish water and only single species as e.g. *Rabdostichus pulex* (Clarke) have been found as fossils in the sea deposits (Novožilov, 1960). In the Givetian deposits of Tuva (USSR), conchostraceans were recorded together with dessications cracks and ripple marks characteristic of lagoonal sediments (Novožilov, 1960). Within the palaeozoic ostracods, both sea and fresh water species are known as well as those of e.g. *Cavellina* (occurring also at Jurkowice-Budy) which are accustomed to great salinity oscillations, and do tolerate even great oscillations (Benson, 1961).

All the above suggests that the occasional disappearance of the benthonic fauna was closely connected with the freshening of the water. The changes in salinity could have been slight which could account for the presence of swimming trilobites as also of charophytes, these latter probably transported from the neighbouring of freshened shallows. These changes could not be tolerated by the tabulates, tetracorals and brachiopods — only by such eurybiontic forms as ostracods and conchostraceans.

In addition, the above conclusions are supported by the palaeogeographical data. Moreoever Pajchlowa (1959) stated that the lithoral zone of the Givetian basin presumably extended a few kilometers to the E of Jurkowice — Budy. Miłaczewski (oral communication) supposes that the land could be situated further to the NE. The new boreholes data show that a part of the Givetian basin situated E of Jurkowice — Budy was highly differentiated both in salinity and bottom morphology. The basin

was varying from moderately deep to extremely shallow: occurence of wide shallowness or islands is inferred.

*Autecology of brachiopods.* In the considered section the brachiopods species are characterized by a different number of specimens (Text-fig. 3). The most numerous about 95%, is *Ilmenia hians* (Buch). Very scarce are:

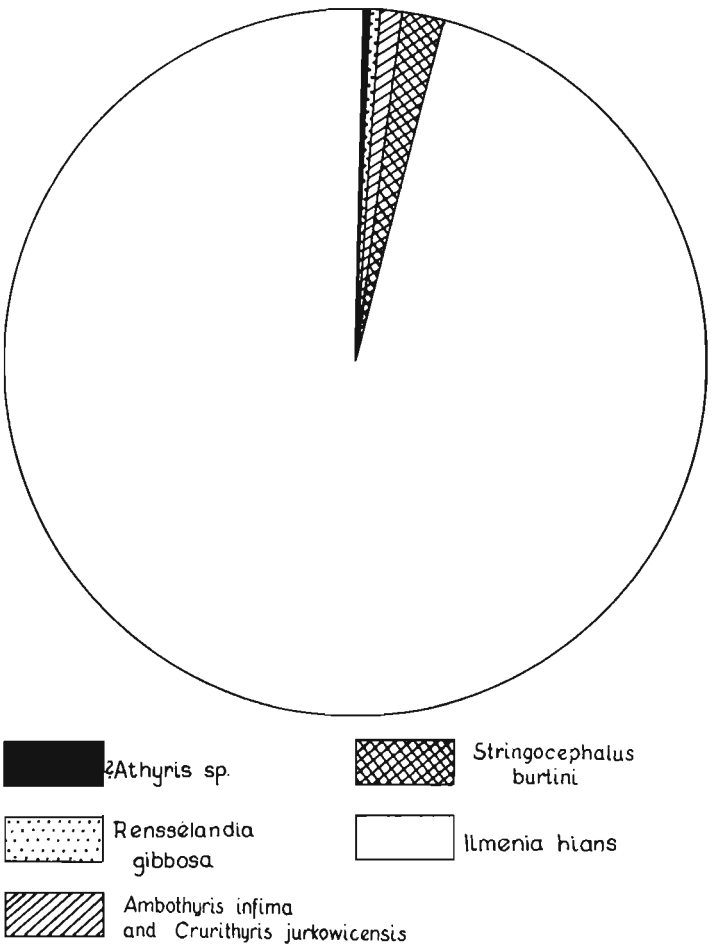


Fig. 3. Diagram illustrating a quantitative composition of all brachiopod species in orictocenosis of *S. burtini* Beds.

*?Athyris* sp., *Ambothyris infima* (Whidborne), *Crurithyris jurkowicensis* n.sp. and *Rensselandia gibbosa* Cloud together comprising about 2%.

All brachiopods species represent the anchoring (sensu Ivanova, 1962, p. 17) type with the exception of *Rensselandia gibbosa* and *Stringocephalus burtini* which are free laying in the gerontic stage. *Stringocephalus burtini* occurs in sediments deposited in conditions of moderate turbulation of water and is not preserved in its growth position. In the section of Dziewki

(Cracow-Silesia region) *S. burtini* also occurs in limestone deposited in water of very low hydrodynamic activity (Baliński, 1970).

The free lying shells have their brachial valve directed downwards, a probable consequence of its position in the early growth stages (Text-fig. 4). The gerontic individuals of *S. burtini* which lose the pedicle as the callus within the pedicle foramen develops, could possibly have their pedicle valve turned upwards due to such mechanical factors — as e.g. currents, or even very great activity of the animal.

Changing of the shell position is very probable also for strophomenids, however, for them the position of a convex valve directed upwards is not fortuitous (Rudwick, 1970, p. 90). The two recorded types of shell orienta-

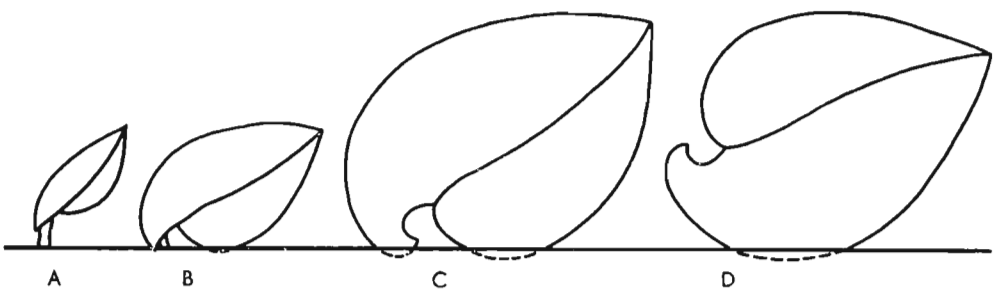


Fig. 4. Successive growth position in *S. burtini* Defr.

tion for *S. burtini* have one feature in common, i.e. a very strongly inclined downwards ventral umbo resulting in the anterior part of the shell being directed upwards due to the center of gravity being moved posteriorly and helped by the great biconvexity of shell. Orientation of the free lying shells of *S. burtini* and probably of all other stringocephalids is, in general, the same as for the other biconvex free lying brachiopods (Makridin, 1964, p. 22, Text-fig. 4; Ivanova, 1962, p. 44—46; Rudwick, 1970, p. 69; Richards, 1972, p. 100, Text-fig. 9).

## DESCRIPTIONS

### Family **Athyridae** M'Coy, 1844

#### ?*Athyris* sp.

(Pl. VII, Figs 1—2)

*Material.* — Thirty recrystallized, complete shells and few single pedicle valves with preserved internal details.

*Description.* — Shell small, biconvex, roundly outlined, length slightly exceeding the width; antero-lateral margins regularly arched, ventral umbo small, pedicle foramen round, deltidial plates small. Shell surface smooth.

Dimensions in mm:

| Z. Pal. Cat. No. Bp. XXII | Length | Width | Thickness |
|---|---|---|---|
| 99 | 5.7 | 5.0 | 3.0 |
| 101a | 4.7 | 4.0 | 2.9 |
| 101b | 2.9 | 2.5 | 1.6 |
| 101c | 2.6 | 2.7 | 1.3 |
| 100 | 2.2 | 2.2 | 1.1 |
| 102 | 1.0 | 0.9 | 0.47 |

*Interior.* Pedicle valve with dental plates long and thin; brachial valve with cardinal plate, other elements not observed.

*Remarks.* — Specimens of ?*Athyris* sp. are very rare in the orictocenosis of *Stringocephalus burtini* Beds, constituting less than 1% of all brachiopods (Text-fig. 4). The majority (90%) measure less than 3 mm in length, and appear to represent the young growth stage. Adult specimens are, in all probability, very rare or not preserved.

*Occurrence.* — Middle Devonian (Givetian) Jurkowice-Budy, Holy Cross Mountains, Poland.

## Family **Ambocoeliidae** George

### Genus *Ambothyris* George, 1931

*Remarks.*— In 1931 George erected two new genera *Ambothyris* and *Crurithyris,* basing diagnosis of the first genus on the external morphology. Later, some authors (e.g. Veevers, 1959) mentioned great individual variability of the shell morphology and even of internal structure within the ambocoelids pointing out the desirability of a revision of *Ambothyris.* Such diagnostic morphological features as e.g. length of hinge line, degree of umbo incurving, degree of flattening of ventral area do not seem to be of generic value. These features change considerably within species of different genera, thus, in *Ladija saltica* Veevers from the Devonian of Australia the length of hinge line changes from brachythyrid to submegathyrid (Veevers, 1959, p. 127), in *Ilmenia hians* (Buch) from Jurkowice-Budy from almost megistothyrid (*sensu* George, 1931) to submegathyrid (Pl. VIII, Figs 4—5).

The internal structure of *Crurithyris* and *Ambothyris* appears to be almost identical (Text-fig. 5). The tendency of crural plates to join, observ-

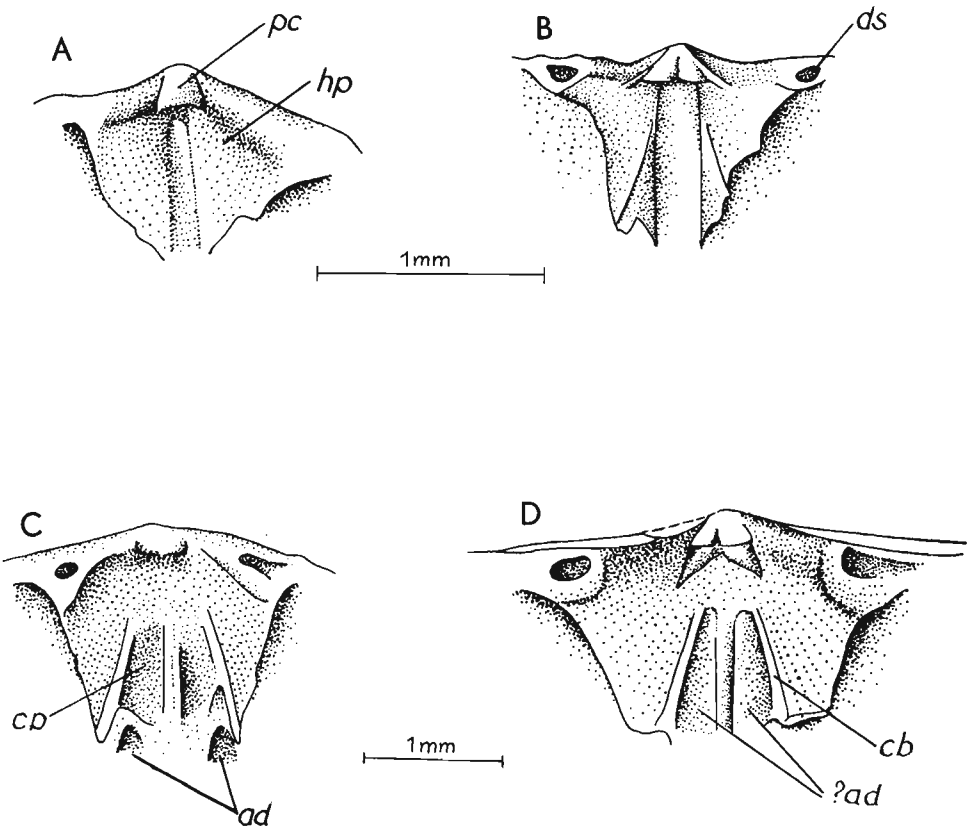


Fig. 5. Appearance of dorsal cardinalia in: A-B *Crurithyris jurkowicensis* n.sp., C-D *Ambothyris infima* (Whidborne): *ad* adductor scars, *cb* crural base, *cp* crural plate, *ds* dental socket, *hp* hinge plate, *pc* cardinal process.

ed in *Ambothyris infima* (George, 1931, p. 41), is not a rule. In some specimens of this species from Jurkowice-Budy the crural plates are distinctly separated by longitudinal furrows (probably for muscle attachement) as in *Crurithyris*. George (1931) pointed out some other differences in e.g. ornamentation of *Crurithyris* and *Ambothyris*: presence of spines in the former and absence in the latter. However, the presence or absence of the tiny surface spines depends much upon the state of preservation of fossil specimens. Havliček (1959, p. 178) suggested their presence in *Ambothyris infima*, these in specimens from Jurkowice-Budy are fairly distinct (Pl. VIII, Fig. 8).

To conclude, the discussed genera are judged to be synonims. However, this question can only be resolved by revision of the type specimens of two genotypes — *Ambothyris infima* (Whidborne) and *Crurithyris urei* (Fleming)

## *Ambothyris infima* (Whidborne, 1893)

(Pl. VII, Figs 3-6; Pl. VIII, Fig. 8; Text-fig. 5C-*D*)

?1897. *Spirifer Urii* Fleming; F. Smyčka, Devonoští..., p. 13—14, Pl. 2, Figs 13a-c.
1931. *Ambothyris infima* (Whidborne); T. N. George, On *Ambocoelia* Hall..., p. 43—44, Pl. 3, Figs 1—2.
1956. *Ambothyris infima* (Whidborne); A. Vandercammen, Revision..., p. 6—11, Pl. 1, Figs 1—9.
?1959. *Ambothyris infima* (Whidborne); V. Havliček, Spiriferidae..., p. 178, Pl. 27, Fig. 6.

*Material.* — Thirty complete and more than ten incomplete shells, about twenty single valves with, in many cases, preserved internal details.

Dimensions in mm:

| Z. Pal. Cat. No. Bp. XXII | Length | Width | Thickness | Index of thickness |
|---|---|---|---|---|
| 104 | 5.5 | 5.3 | 3.6 | 0.65 |
| 106 | 4.2 | 5.2 | 3.2 | 0.76 |
| 105 | 3.4 | 4.2 | 2.5 | 0.76 |
| 109 | 2.5 | 2.8 | 1.6 | 0.64 |
| 113 | 1.7 | 2.3 | 1.4 | 0.82 |

*Description.* — Shell small, ventribiconvex, subpentagonal in outline, width slightly exceeding shell length, antero-lateral margins rounded, anterior margin sulcate. Pedicle valve deep, ventral area high, apsacline, brachial valve shallowly flattened.

*Ornamentation.* Many shells have a more weathered or less primary layer. On the preserved patches of the shell radially disposed microspicules of two sizes are observed (Pl. VIII, Fig. 8). Decorticated specimens are radially striated similarly to the other species of the genus.

*Interior.* Pedicle valve: dental plates lacking; apical plates sometimes preserved. Brachial valve: cardinal process small, widened; crural plates with a tendency to be joined.

*Remarks.* — The specimens in question in shell dimensions and outline are very much like *Ambothyris infima* figured by George (1931, Pl. 3, Figs. 1—2) especially to one of the syntypes (George, 1931, Pl. 3, Fig. 2) mainly in the well developed ventral area and in the pentagonal outlined pedicle valve. They are also near *Ambothyris infima* from Čelechovice (Czechoslovakia) figured by Havliček (1959, p. 178—179, Pl. 27, Fig. 6) differing somewhat in having a less massive and incurved ventral umbo and lower ventral area. *Spirifer Urii* figured by Smyčka (1897, Pl. 2, Fig. 13) from Čelechovice possesses, similarly as the here studied specimens, a much higher ventral area than is shown by Havliček (1959, Pl. 27, Fig. 6).

The illustrations given by Smyčka are not sufficiently clear for a more detailed comparison.

*Occurrence.* — *A. infima* is known from the Uppermost Givetian of Lummaton (Devonshire, England) and ? Čelechovice (Czechoslovakia), Uppermost Givetian and Middle Frasnian of Belgium, Middle Devonian of Carnic Alps (Italy), and Givetian of Jurkowice-Budy, Holy Cross Mountains (Poland).

## *Crurithyris jurkowicensis* sp. nov.

(Pl. VII, Fig.7; Pl. VIII, Figs 1-3, 7; Text-fig. 5*A-B*)

*Holotype*: Z. Pal. Cat. No. Bp. XXII/121; Pl. VIII, Fig. 3.

*Type horizon: Stringocephalus burtini* Beds, Middle Devonian, Givetian.

*Type locality*: A quarry, E of Jurkowice-Budy, E Holy Cross Mountains, Kielce region.

*Derivation of the name: jurkowicensis* — found at the locality Jurkowice.

*Diagnosis.* — Small, almost spherical, subpentagonal to suboval in outline, length equal to the width, ventral sulcus shallow, brachial valve flattened medially, ventral umbo moderate, beak massive and incurved.

*Material.* — Fifteen complete but recrystallized and twenty very damaged shells and more than thirty single valves with preserved structural elements, exterior mostly decorticated.

Dimensions in mm:

| Z. Pal. Cat. No. Bp. XXII | Length | Width | Thickness | Index of thickness |
|---|---|---|---|---|
| 125a | 3.5 | 3.4 | 2.6 | 0.74 |
| 121 | 3.3 | 3.3 | 2.7 | 0.77 |
| 125b | 3.4 | 3.3 | 2.8 | 0.82 |
| 123 | 2.7 | 2.7 | 2.0 | 0.74 |
| 122 | 2.6 | 2.6 | 2.0 | 0.77 |

*Description.* — Shell small, strongly biconvex, nearly spherical, suboval to subpentagonal in outline, width equal to the length. Cardinal margin constituting two-thirds of the shell width, antero-lateral margins rounded, anterior margin slightly sulcate.

*Ornamentation.* Most of the specimens are almost decorticated. The preserved patches of external shell layer show a microornamentation of spinose elevations (Pl. VIII, Fig. 7) and on the internal shell layer numerous, 4—5 in one mm, fine radial striae.

*Interior.* Pedicle valve: without dental plates, apical plate sometimes present. Brachial valve: cardinal process small, trigonal in outline, wide, crural plates subparallel.

*Remarks.* — *Crurithyris jurkowicensis* n.sp. is very much like *Crurithyris urei* (Flemming) and *Ambothyris halii* Branson. However, *Crurithyris urei* is less convex (index of thickness only 0.56—0.64), shell wider (the ratio of length to shell width differing somewhat). *Ambothyris halii* from Iowa figured by Stainbrook (1943, Pl. 70, Figs 49—55) is less biconvex, ventral beak smaller and thinner with a slightly different shell outline. *C. jurkowicensis* n.sp. shows a similarity to *C. inflata* (Schnur) from the Skały beds, Holy Cross Mountains, figured by Biernat (1966, Pl. 29, Figs 1—8). This latter is, however, wider with a more distinct pentagonal shell outline, in addition, the median furrows are shallower and recorded more often in the brachial valve. *Spirifer inflatus* var. *sinuata* Leidhold (Leidhold, 1928, p. 69, Pl. 6, Fig. 3) possesses more distinct and deeper median furrows and has a slightly different shell outline in comparison to *C. jurkowicensis.*

*Occurrence.* — Middle Devonian (Givetian); Jurkowice-Budy, Holy Cross Mountains, Poland.

## Genus *Ilmenia* Nalivkin, 1941

### *Ilmenia hians* (von Buch, 1836)

(Pl. VIII, Figs 4—6; Pl. IX, Figs 1—11; Text-figs. 2, 6—8)

1871. *Orthis hians;* F. A. Quenstedt, Die Brachiopoden, Pl. 43, Figs 61—62 (non *Spirifer* cf. *hians*, Pl. 54, Fig. 24; non *Spirifer hians*, Pl. 54, Figs 25—33).
1853. *Orthis Lewisii* Dav.; J. Schnur, Zusammenstellung..., p. 217, Pl. 38, Fig. 3.
1900. *Spirifer hians* v. Buch; H. Scupin, Die Spiriferen..., p. 53—54, Text-fig. 5.
1908. *Spirifer hians* v. Buch; K. Torley, Die Fauna..., p. 17, Pl. 5, Figs 4—5.
1922. *Spirifer hians* v. B. sp.; W. Paeckelmann, Der mitteldevonische..., p. 62—64, Pl. 1, Fig. 3.
1957. *Rhynchospirifer hians* (Buch); B. Paulus, *Rhynchospirifer* n. gen. ..., p. 59—60, Pl. 1, Fig. 3, 8.
1957. *Rhynchospirifer ahbachensis* Paulus; Ibidem, p. 58—59, Pl. 3, Fig. 17.
1965. *Martinia inflata* (Schnur); U. Jux & F. Strauch, Die "Hians"-Schille..., p. 58—72, Pl. 2, Figs 1—5.

*Material.* — More than two thousands of complete shells, about seven hundreds single valves with preserved internal structure. Exterior well preserved, decorticated shells not rare. Interior rarely recrystallized.

*Description.* — Shell small to medium size, ventribiconvex, subrounded in outline, width slightly exceeding shell length. Antero-lateral margins regularly arched. Median furrows lacking or very weak. Pedicle valve

Dimensions in mm:

| Z. Pal. Cat. No. Bp. XXII | Length pedicle v. | brachial v. | Width | Thickness |
|---|---|---|---|---|
| 141 | 13.0 | 10.0 | 11.0 | 8.0 |
| 140 | 12.6 | 12.0 | 14.5 | 10.5 |
| 218 | 10.0 | 9.0 | 12.0 | 0.8 |
| 184 | 8.0 | 7.5 | 10.0 | 6.3 |
| 194a | 6.7 | 5.0 | 7.0 | 4.5 |
| 194b | 6.0 | 4.6 | 6.2 | 4.0 |
| 203 | 4.8 | 3.7 | 4.1 | 2.4 |

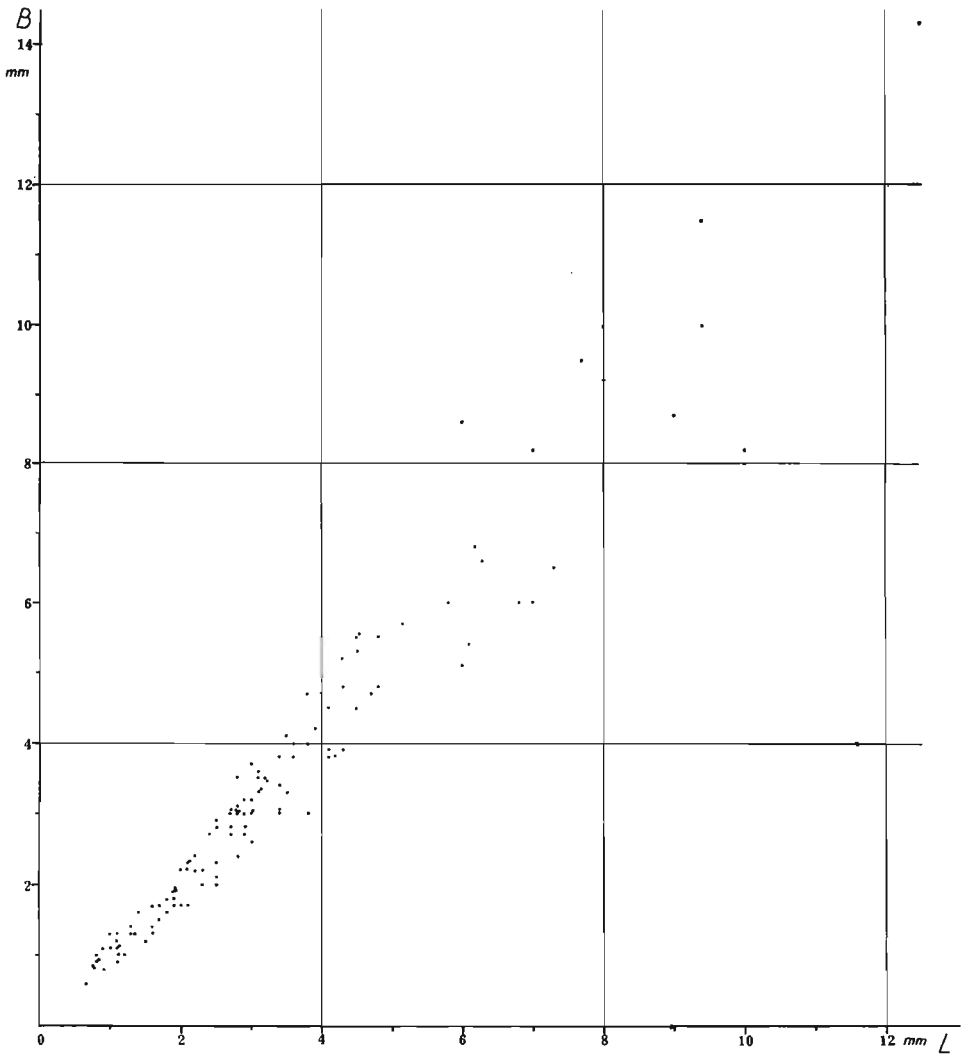


Fig. 6. Diagram illustrating length (L) to width (B) shell ratio in *Ilmenia hians* (Buch).

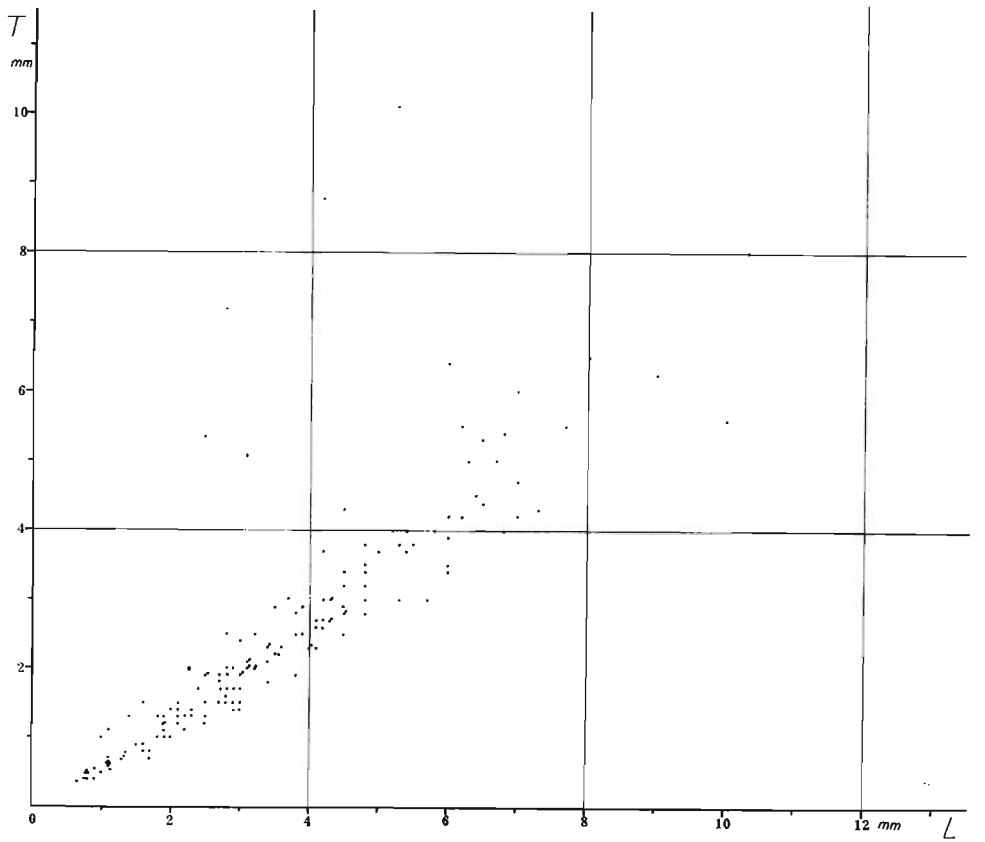


Fig. 7. Diagram showing length (L) to thickness (T) shell ratio in *Ilmenia hians* (Buch).

deep, ventral area high, apsacline to almost catacline. Brachial valve shallow, dorsal area comparatively high, anacline.

*Ornamentation.* Shell surface (if well preserved) is covered by very thin radial striae, 5—9 in 1 mm (Pl. VIII, Fig. 6) and concentric lines, distinct in the gerontic stage.

*Interior.* Pedicle valve: dental plates massive and short. Muscle scars sometimes well discernible often with a dividing median thickening. Brachial valve: cruralium usually resting on a low median septum. Cardinal process distinct, claviform (Pl. IX, Figs 10—11).

*Ontogeny.* — The smallest specimens in the collection attain 0.7 mm — 0.8 mm in length (Text-figs 6—7); both valves of the shell are of almost the same length and depth (Pl. IX, Figs 1—2); longitudinal oval to pear-like in outline, no surface ornamentation or extremely delicate on the anterior part of shell, composed of fine radial and concentric lines (Pl. IX, Figs 1—3). With growth the shell becomes more roundly to subroundly outlined, surface ornamentation more distinct, ventral area enlarging (Pl.

VIII, Figs 4—5; Pl. IX, Figs 4—5, Text-fig. 8); in the largest specimens of this growth stage height of the area often exceeding half the valve length. Dental plates lacking in specimens 1 mm in length being short in adult specimens (Pl. IX, Figs 6, 9). Cardinal process, crural plates and crura are developed in specimens 1 mm long (Pl. IX, Figs 7, 8).

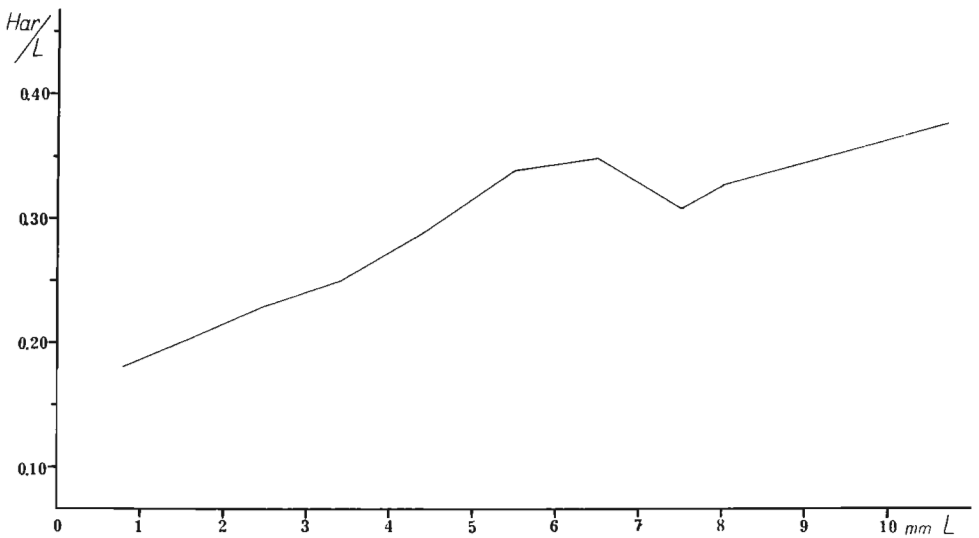


Fig. 8. Diagram illustrating length (L) to height index of ventral area (Har/L) in *Ilmenia hians* (Buch).

*Intraspecific variability.* The collection contains single specimens greatly differing from the typical ones. The differencs concern, among others, the quite different proportions of shell- shells elongate or wide (Pl. VIII, Figs 4—5) and the presence of median furrows (Pl. VIII, Fig. 5). Also very changeable are the internal elements such as: dental plates which can be very reduced, expressed as thickenings of the internal delthyrial edges or massive and short plates. In the brachial valves length of cruralium oscillates in the limits of 13—25%. In the abnormal (pathologic?) forms the cruralium can be asymmetrical or not developed in which case only the crural plates are present.

*Remarks.* — *Ilmenia hians* (Buch) in the discussed collection is dominated by small shells. The largest complete shell attains 13 mm in length. It is very likely that in the natural environment larger specimens also occurred, but, unfortunately, are not preserved as complete shells in fossil state. In Schwelmer Kalkes (Germany) the above species is also dominated by small sized specimens, the largest attaining 17 mm in length (Paeckelmann, 1922, p. 62).

*Ilmenia hians* is externally very like *Rhynchospirifer ahbachensis* Paulus — the type specimen of this species attaining 19 mm in length. It seems very probable that these two forms are conspecific.

*Occurrence.* — Middle Devonian (Givetian): Germany, Belgium. In Poland the species is, up to now, known from one locality — Jurkowice-Budy, Holy Cross Mountains.

## Family **Stringocephalidae** King

### Genus *Rensselandia* Hall, 1867

### *Rensselandia gibbosa* Cloud, 1942

(Pl. X, Figs 1—5; Pl. XI, Figs 1—2, 7—9; Pl. XII, Fig. 1; Text-figs 9—11)

1942. *Rensselandia gibbosa* sp. nov.; P. E. Cloud, Terebratuloid..., p. 99. Pl. 14, Figs 5—9.

*Material.* — Forty small shells (to 7 mm in length), one adult, almost complete, more than 20 single valves of different size, internal elements well preserved.

Dimensions (in mm): length = 61, length of brachial valve = 51, width = 59, thickness = 41.

*Description.* — Shell large, a little longer than wide, suboval in outline. Pedicle valve much deeper than the opposite valve, beak low, strongly incurved, pedicle foramen mesothyrid, hinge line subterebratulid.

*Interior.* Pedicle valve with short dental plates and without median septum, deltidial plates small, discrete. Brachial valve with flattened, trigonal hinge plates not supported by the crural ones (Pl. XI, Figs 1, 8—9); low median myophragm present; traces of diductors distinct on the posterior part of hinge plates and between them on the valve floor (Pl. XI, Fig. 9). Loop, proserved only in one young, 7 mm long specimen, possesses in its anterior part in the symmetry plane a high, long and vertical plate (Pl. XI, Fig. 7) touching the ventral valve floor.

*Ontogeny.* — The smallest specimens of *R. gibbosa* attain 0.7 mm in length and are very similar to the young shells of *Stringocephalus burtini*. The differences concern, among others, the morphology of delthyrium. In *S. burtini* the apical part of the delthyrium is covered by a pedicle plate and in *R. gibbosa* the delthyrium is open, the deltidial plates appearing in specimens 7 mm long and are very small (Pl. XII, Fig. 1). These mentioned differences help very much to recognize the representatives of both species. The smallest specimens of *R. gibbosa* are very variable in the shape and

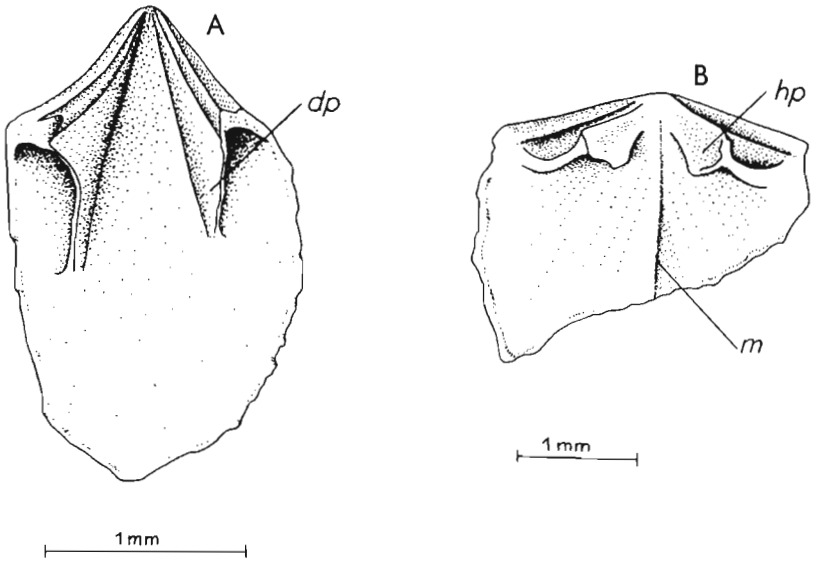


Fig. 9. Ventral (A) and dorsal (B) interior of *Rensselandia gibbosa* Cloud; *dp* dental plate, *hp* hinge plate, *m* myophragm.

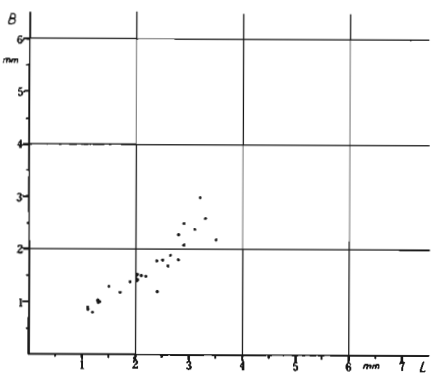


Fig. 10. Diagram illustrating length (L) to width (B) shell ratio in young growth stage of *Rensselandia gibbosa* Cloud.

proportions of shell and in size of ventral beak. The shells can be wide, rounded to very elongate or lens-like in outline (Pl. X, Figs. 1—4; Pl. XI, Fig. 2, Text-fig. 10). The height of the ventral beak is changeable. In specimens 7 mm long (Text-fig. 11) comprising 12—35% of the whole shell surface, in adults (61 mm long), 16%.

In the smallest pedicle valves the dental plates are long and thin (Text-fig. 9*A*) being in adults much shorter. The smallest brachial valves, similarly as in adults, show well developed hinge plates not supported by the crural plates (Text-fig. 9*B*).

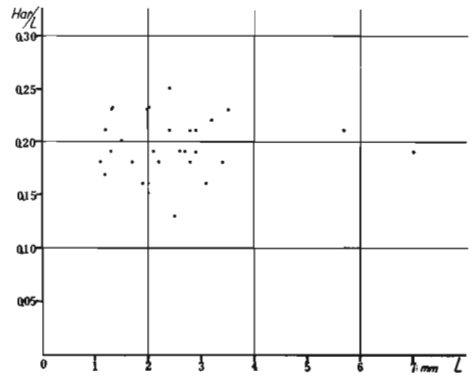


Fig. 11. Diagram illustrating length (L) to height index of ventral area (Har/L) in young growth stage of *Rensselandia gibbosa* Cloud.

*Remarks.* — The studied specimens are almost identical to those of *Rensselandia gibbosa* from the Givetian of Paffrath (Germany). One complete specimen found in Jurkowice-Budy (Pl. X, Fig. 5) is very similar in general appearance to the paratypes (Cloud, 1942, Pl. 14, Figs 7—8).

*Occurrence.* — Middle Devonian (Givetian); Paffrath (Germany) and Jurkowice-Budy (Holy Cross Mountains, Poland).

## Genus *Stringocephalus* Defrance, 1825

## *Stringocephalus burtini* Defrance, 1825

(Pl. XI, Figs 3—6; Pl. XII, Figs 2—4; Text-figs 12—15)

1825. *Terebratula burtini* Defr.; J. M. L. Defrance, *In*: H. M. D. Blainville, Manuel de malacologie..., p. 511; atlas (1827), Pl. 53, Fig. 1—1c.

1971. *Stringocephalus burtini* Defr.; A. Baliński, *Stringocephalus burtini...*, p. 463—467, Pl. 1, Figs 1—5; Pl. 2, Figs 1—3; Text-figs 2—4 (*here synonymy from 1827 to 1963*).

*Material.* — More than 70 complete shells to 13 mm of length, 5 complete or almost complete shells above 13 mm in length, 200 of different

Dimensions in mm:

| Z. Pal. Cat. No. Bp. XXII | Length | Width | Thickness | Umbonal angle pedicle v. | brachial v. |
|---|---|---|---|---|---|
| 6 | 90 | 95 | 60 | 82° | 157° |
| 8 | 23 | 23 | 11 | 67° | 174° |
| 29 | 7 | 6.3 | 3 | 62° | 165° |

size fragments of shell or valves. Small specimens well preserved, the larger ones mostly damaged. Interior without preserved loop.

*Description.* — Shell strongly ventri-biconvex, hearth-like in outline, as wide as long, to 10 cm in length; hinge line evenly arched, antero-lateral margins rounded, anterior margin rectimarginate.

Pedicle valve very convex, beak large, incurved, pedicle foramen small, oval to round, hypothyrid. Brachial valve convex (40% of the whole shell convexity), elipsoidal in outline.

*Interior.* Pedicle valve: ventral median septum about 80% of the valve length, low and thickened posteriorly, high and thin anteriorly. In the brachial valve median septum shorter than in the opposite valve, high posteriorly; cardinal process long and massive, posteriorly arched, distally divided; hinge plates large, much convex (arched) ventrally. Crura thin, delicate and arched dorsally.

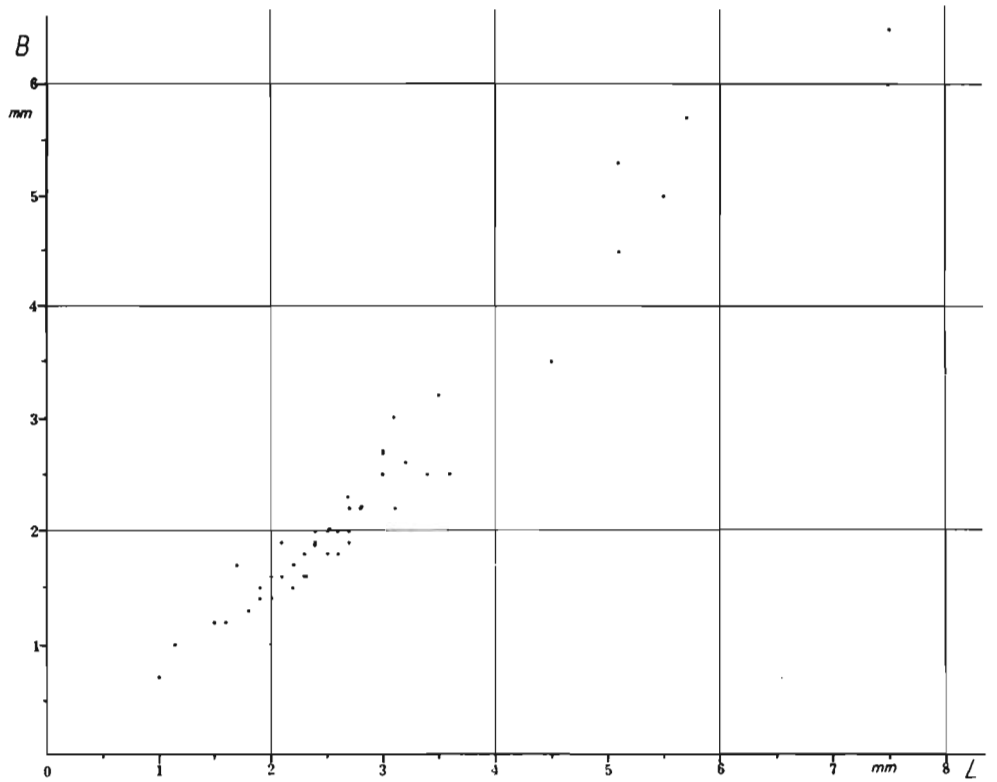


Fig. 12. Diagram illustrating length (L) to width (B) shell ratio in young growth stage of *Stringocephalus burtini* Defr.

*Ontogeny.* Boucot, Johnson & Struve (1966) studied in detail the ontogeny of *Stringocephalus nevadensis* Frost & Langenheim from Specter Range, South Nevada. The specimens were silicified, the smallest one attained a width of 3 mm for brachial and 5 mm for pedicle valves. The smallest specimens in the present collection attain 0.7—1 mm in width and 1—2 mm in length (Text-fig. 12). Recent observations give some new data on the growth process:

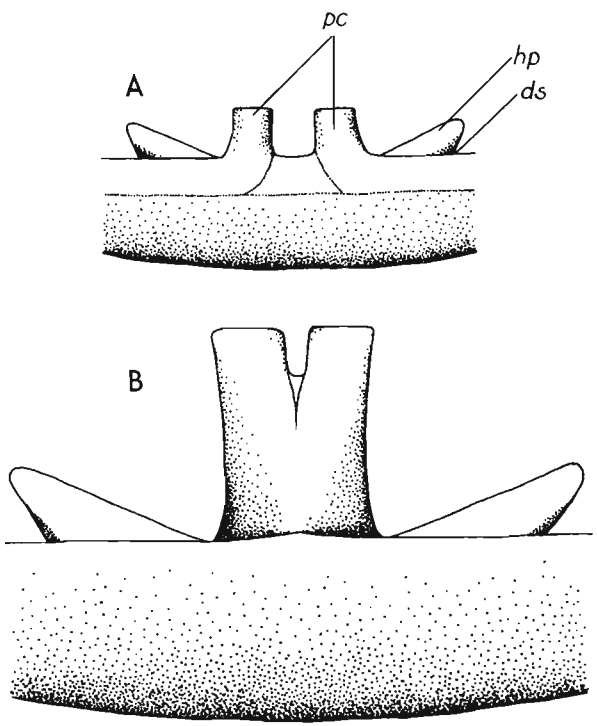


**Fig. 13.** Scheme illustrating development of the cardinal process in *Stringocephalus burtini* Defr.; *A* a stage of a double cardinal process, *B* a stage of a single and bifurcated cardinal process; *hp* hinge plate, *ds* dental socket, *pc* cardinal process.

1. In specimens to 2.5 mm in width (an exception — one 3.4 mm) — the cardinal process is developed as two distinctly separated processes growing independently (Pl. XI, Fig. 3*c*; Pl. XII, Figs 2, 3*b*, Text-fig. 13). With growth of shell these processes progressively thicken, the distance between them becoming smaller and in consequence, one, single structure appears. Many specimens, to about 7 mm in width, of the present collection (Pl. XI, Fig. 4) as also *S. nevadensis* (Boucot, Johnson & Struve, 1966, p. 1350, Pl. 168, Figs 3—10) show a cardinal process in the stage of a double struc-

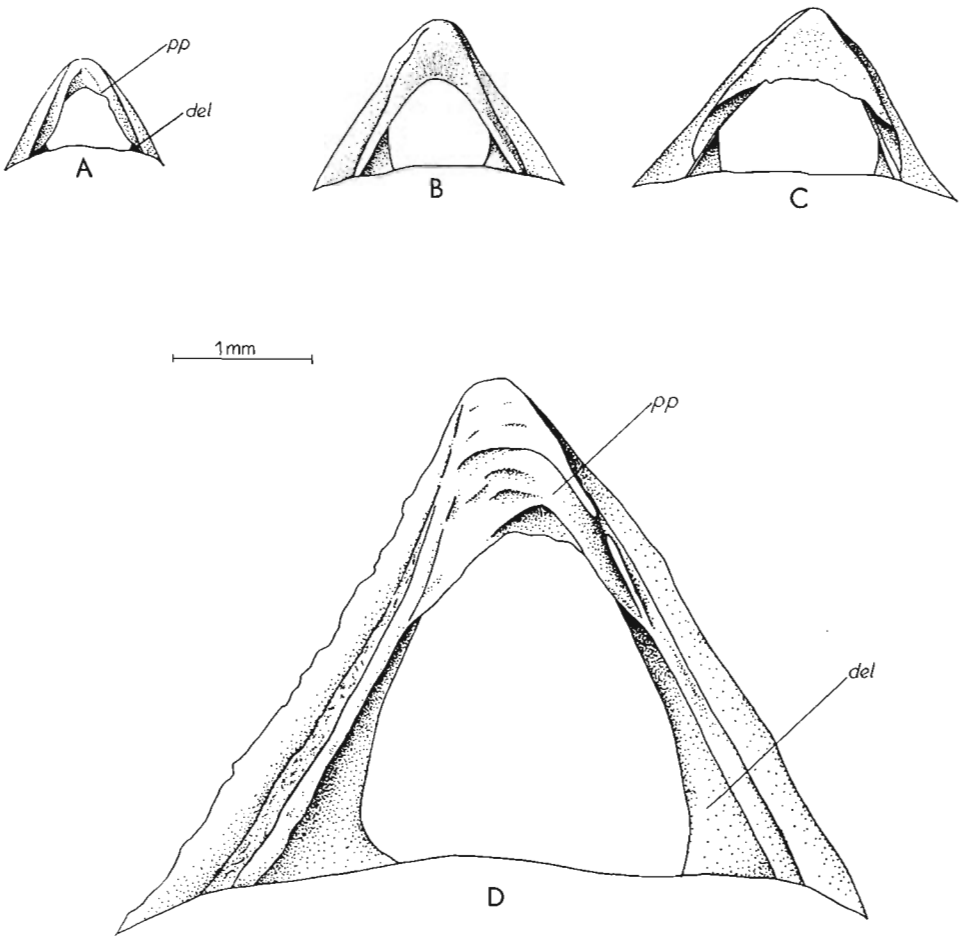


Fig. 14. Growth changes of delthyrium in younger growth stages of *Stringocephalus burtini* Defr.; *del* deltidial plate, *pp* pedicle plate.

ture. An analogy in the growth process of the cardinal process is observed in *Conomimus truncatus* (Johnson, Boucot & Gronberg, 1968, p. 409).

2. Specimens 0.7 mm — 6.0 mm in width have a well developed pedicle plate, the deltidial ones being, in this stage, extremely small (Pl. XI, Figs 3—4; Pl. XII, Fig. 3, Text-fig. 12). Pedicle plate may occupy about one-third of the delthyrium height and is, sometimes, very convex (Text-fig. 14*C*). This stage is characterized by a large ventral beak which attains 52% of the shell length (Pl. XII, Fig. 3). The beak of the largest specimens constitutes only about 25% or even 16% of the whole shell length (Text-fig. 15).

*Remarks.* — In the details of external morphology and internal structure the discussed specimens are very close to those of *Stringocephalus burtini* from Germany and from Poland, Cracov-Silesian region.

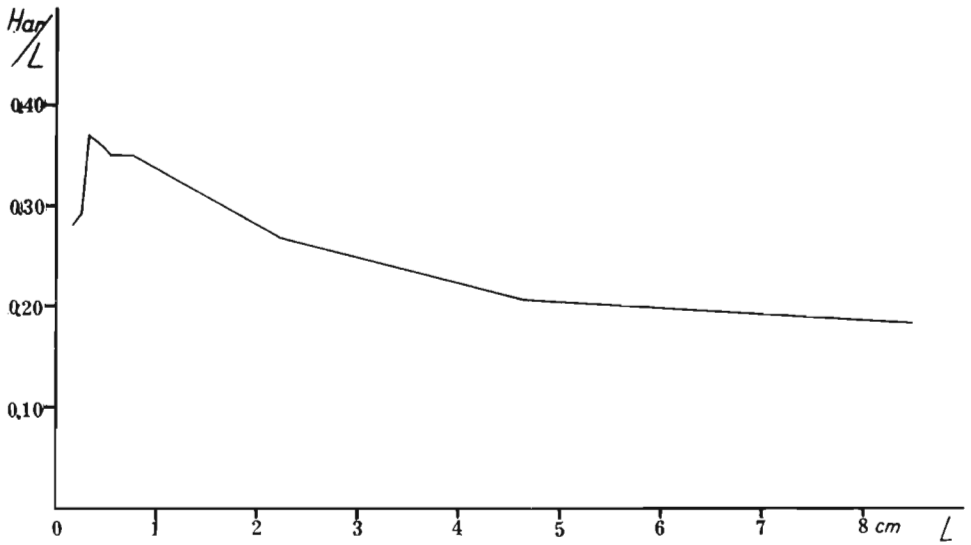


Fig. 15. Diagram illustrating length (L) to height index of ventral beak (Har/L) in *Stringocephalus burtini* Defr.

*Occurrence.* — The species is known from Givetian (and probably in Belgium and Germany occasionally in the Lowermost Frasnian) of Europe, Asia, North America, North Africa. In Poland it is known, up to now, from the Givetian of Brudzowice-Dziewki environs (Cracov-Silesian region) and Jurkowice-Budy (SE part of the Holy Cross Mountains).

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*Warszawa, Żwirki i Wigury 93*
*February, 1973*

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ANDRZEJ BALIŃSKI

## MORFOLOGIA I PALEOEKOLOGIA ŻYWECKICH RAMIENIONOGÓW Z JURKOWIC — BUD (GÓRY ŚWIĘTOKRZYSKIE)

### Streszczenie

Stromatoporoidowo-koralowcowe wapienie z Jurkowic-Bud odkryte przez Samsonowicza (1930) (= warstwy ze *Stringocephalus burtini* według Kaźmierczaka, 1971) zawierają bogaty zespół skamieniałości obejmujący ponad 50 gatunków z 13 różnych grup systematycznych. Najliczniej w gatunki i osobniki reprezentowane są stromatoporoidy, tabulaty, tetrakorale, ślimaki i ramienionogi. Obok warstw z bogatą i różnorodną fauną morską występują przeławicenia marglistych wapieni o silnie zubożałym zespole. W wapieniach tych występują małżoraczki, trylobity, Conchostraca i Charophyta. Analiza tego zespołu gatunków wskazuje, że zmiany środowiskowe objawiające się zanikaniem ramienionogów i innej fauny bentonicznej były wywołane prawdopodobnie zmianami w zasoleniu (wysładzanie). Zmian tych nie wytrzymy-

wały typowo morskie tabulaty, tetrakorale i ramienionogi, lecz tylko eurybiotyczne małżoraczki i Conchostraca oraz typowo morskie, lecz pływające trylobity. Również obecność Charophyta, które mogły być napławione z pobliskich, wysłodzonych płycizn potwierdza do pewnego stopnia te przypuszczenia.

Zespół ramienionogów z warstw ze *Stringocephalus burtini* obejmuje sześć gatunków, w tym jeden nowy *Crurithyris jurkowicensis* n.sp. Najliczniej (ok. 95% zespołu) reprezentowany jest gatunek *Ilmenia hians* (Buch), najrzadsze są gatunki *?Athyris* sp., *Ambothyris infima* (Whidborne), *Crurithyris jurkowicensis* n.sp. i *Rensselandia gibbosa* Cloud (w sumie tylko ok. 2%).

Wśród ramienionogów zdecydowaną przewagę stanowią okazy małe o dobrym stanie zachowanie. Nawet przedstawiciele Stringocephalidae reprezentowani są głównie przez formy młodociane (1—8 mm długości). Większe okazy są o wiele rzadsze i ponadto silnie pokruszone. Liczny i na ogół bardzo dobrze zachowany materiał pozwolił na przeprowadzenie ciekawych badań nad ontogenezę pewnych gatunków. Przeprowadzone obserwacje nad budową wewnętrzną przedstawiciela rodzaju *Ambothyris* nasunęły przypuszczenie, że rodzaj ten jest synonimem rodzaju *Crurithyris*.

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АНДЖЕЙ БАЛИНЬСКИ

## МОРФОЛОГИЯ И ПАЛЕОЭКОЛОГИЯ ЖИВЕТСКИХ БРАХИОПОДОВ ИЗ МЕСТНОСТИ ЮРКОВИЦЕ-БУДЫ (СВЕНТОКШИСКИЕ ГОРЫ, ПОЛЬША)

### Резюме

Строматопороидно-коралловые известняки, выявленные Самсоновичем (1930) в местности Юрковице-Буды (= слои со Stringocephalus burtini, по Казьмерчаку, 1971), содержат богатое сообщество окаменелостей, насчитывающее свыше 50 видов из 13 разных систематических групп. Наиболее обильным количеством видов и особей отличаются строматопороиды, табуляты, тетракораллы и брюхоногие и брахиоподы. Наряду со слоями, изобилующими разнообразной морской фауной, залегают прослои мергелистых известняков с весьма скудной фауной. В этих известняках встречаются остракоды, трилобиты, Conchostraca и Cha-

rophyta. Изучение этого сообщества приводит к выводу, что изменения среды обитания, вызвавшие исчезновение брахиоподов и другой бентонной фауны, состояли в опреснении водоема. Вероятно, колебания солености были убийственные для типично морских табулят, тетракораллов и брахиоподов и переносились единственно эврибиотическими остракодами и Conchostraca, а также типичными морскими, но плавающими трилобитами. Присутствие Charophyta, нанесенных, вероятно, из близлежащих опресненных мелководий, также в некоторой степени подтверждает высказанное предположение.

Сообщество брахиоподов из слоев со *Stringocephalus burtini* включает шесть видов, в том числе один новый вид — *Crurithyris jurkowicensis* n. sp. В самом большом количестве (около 95% всего сообщества) представлен вид *Ilmenia hians* (Buch), наиболее же редки виды *?Athyris* sp., *Ambothyris infima* (Whidborne), *Crurithyris jurkowicensis* n. sp. и *Rensselandia gibbosa* Cloud (совместно всего лишь около 2%).

Среди брахиоподов решительно преобладают мелкие экземпляры, характеризующиеся хорошей сохранностью. Даже представители Stringocephalidae представлены, главным образом, формами юношеской стадии (1—8 мм длины). Более крупные экземпляры встречаются реже и сильно раздробленном состоянии. Богатый и, как правило, хорошо сохраненный материал дал возможность провести интересные исследования по онтогенезису некоторых видов. Изучение внутреннего строения представителя рода *Ambothyris* привело к заключению, что этот род является синонимом рода *Crurithyris*.

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## EXPLANATION OF PLATES

Specimens presented on all plates from *Stringocephalus burtini* Beds, Jurkowice-Budy

### Plate VII

Figs 1—2. *?Athyris* sp.; Two specimens (Z. Pal. Bp. XXII/100, 90) in different individual age: *a* — ventral, *b* — side, *c* — umbonal views; *1*×8, *2*×6.5.

Figs 3—6. *Ambothyris infima* (Whidborne); *3*—*5*, three specimens of different size (Z. Pal. Bp. XXII/109, 105, 104): *a* — dorsal, *b* — side, *c* — umbonal views. *6* dorsal interior (Z. Pal. Bp. XXII/111) slightly damaged; *3*, *4*×8, *5*×6.5, *6*×10.

Fig. 7. *Crurithyris jurkowicensis* n.sp. Brachial valve very damaged (Z. Pal. Bp. XXII/124) showing preserved crural plates and cardinal process, ×11.

## Plate VIII

Figs 1—3, 7. *Crurithyris jurkowicensis* n.sp. *1—2*, two paratypes (Z. Pal. Bp. XXII/123, 122) in *a* — dorsal, *b* — side, *c* — umbonal views; *3* holotype (Z. Pal. Bp. XXII/121) in *a* — dorsal, *b* — side, *c* — umbonal, *d* — ventral, *e* — anterior views, ×9; *7* fragment of external shell surface with preserved spines (Z. Pal. Bp. XXII/136); ×33.

Figs 4—6. *Ilmenia hians* (Buch); *4—5* two adult shells (Z. Pal. Bp. XXII/142, 141) of different outline; a — dorsal, *b* — side, *c* — umbonal views; 4×3.5, 5×2.5. *6* fragment of valve with preserved surface ornamentation (Z. Pal. Bp. XXII/154), ×22.

Fig. 8. *Ambothyris infima* (Whidborne), fragment of valve surface (Z. Pal. Bp. XXII/110) with preserved spines, ×28.

## Plate IX

Figs 1—11. *Ilmenia hians* (Buch). *1—5*, a range of specimens in different individual age (Z. Pal. Bp. XXII/145—148, 140): *a* — dorsal, *b* — side, *c* — umbonal views; *6*, *9* two very small pedicle valves (Z. Pal. Bp. XXII/150, 152) with preserved internal details; *7—8* two very small brachial valves (Z. Pal. Bp. XXII/149, 150) with well preserved interior; *10—11* two large brachial valves with well preserved interior (Z. Pal. Bp. XXII/143, 144), some differences in the appearance of e.g. cardinal plates and muscle scars marked; *1—3*, *6—9*×23, *4*×15, *5*×2.5, *10—11*×5.

## Plate X

Figs 1—5. *Rensselandia gibbosa* Cloud; Five specimens in different individual age. *1—4*, four juvenile shells (Z. Pal. Bp. XXII/76, 78—79, 81) showing a great range of individual variability; *5*, adult shell slightly damaged (Z. Pal. Bp. XXII/97): *a* — dorsal, *b* — side, *c* — umbonal views; *1—2*, *4*×8, *3*×22, *5*×1.

## Plate XI

Figs 1—2, 7—9. *Rensselandia gibbosa* Cloud; *1*, *8—9* three brachial valves, of different size, slightly damaged, showing some internal details (Z. Pal. Bp. XXII/82, 95—96); *2* a complete small shell very oval in outline (Z. Pal. Bp. XXII/80); *7* small, damaged brachial valve with preserved loop bearing a vertical plate (Z. Pal. Bp. XXII/77): *a* — umbonal (slightly oblique), *b* — ventral views; *1*, *9*×2, *2*×8, *7*×7, *8*×10.

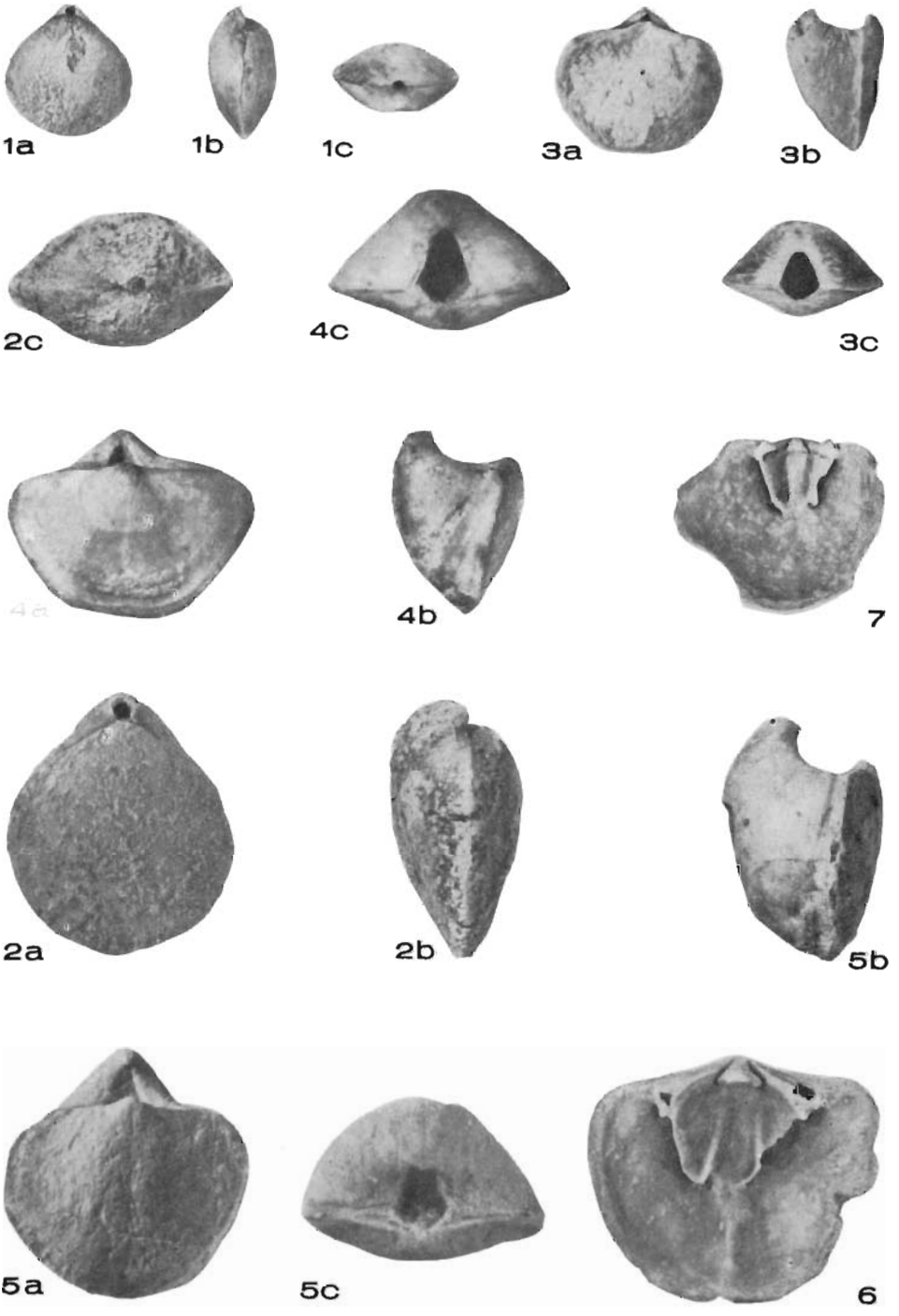
Figs 3—6. *Stringocephalus burtini* Defr.; *3—4*, two small well preserved shells (Z. Pal. Bp. XXII/29—30): *a* — dorsal, *b* — side, *c* — umbonal views; *5—6*, two large, slightly differing in their exterior and damaged shells (Z. Pal. Bp. XXII/2—3): *a* — dorsal, *b* — side views. *3*×*13*, *4*×*6*, *5—6*×2.5 diminished.

## Plate XII

Fig. 1. *Rensselandia gibbosa* Cloud; umbonal view of a small shell, small deltidial plates well marked (Z. Pal. Bp. XXII/77), ×6.

Figs 2—4. *Stringocephalus burtini* Defr.; *2* umbonal view of a small brachial valve showing hinge plates and double cardinal process (Z. Pal. Bp. XXII/37); *3* small shell well preserved with a high ventral area and a double cardinal process (Z. Pal. Bp. XXII/34): *a* — dorsal, *b* — umbonal views; *4* large but damaged and slightly deformed shell (Z. Pal. Bp. XXII/1), *a* — dorsal, *b* — side, *c* — umbonal views; *2*—*3*×13, *4*×1.

All photographs made by the author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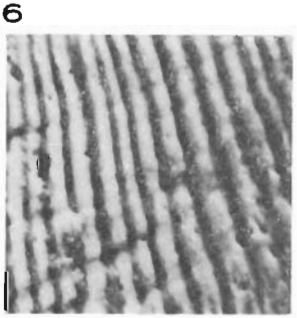

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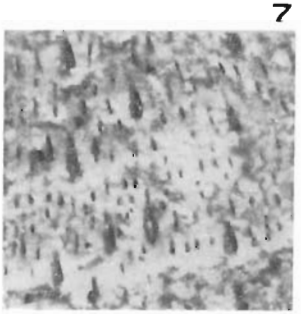

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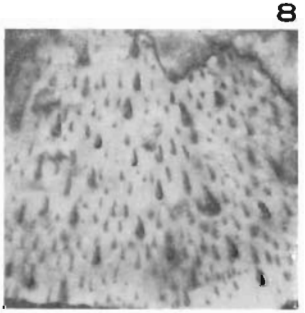

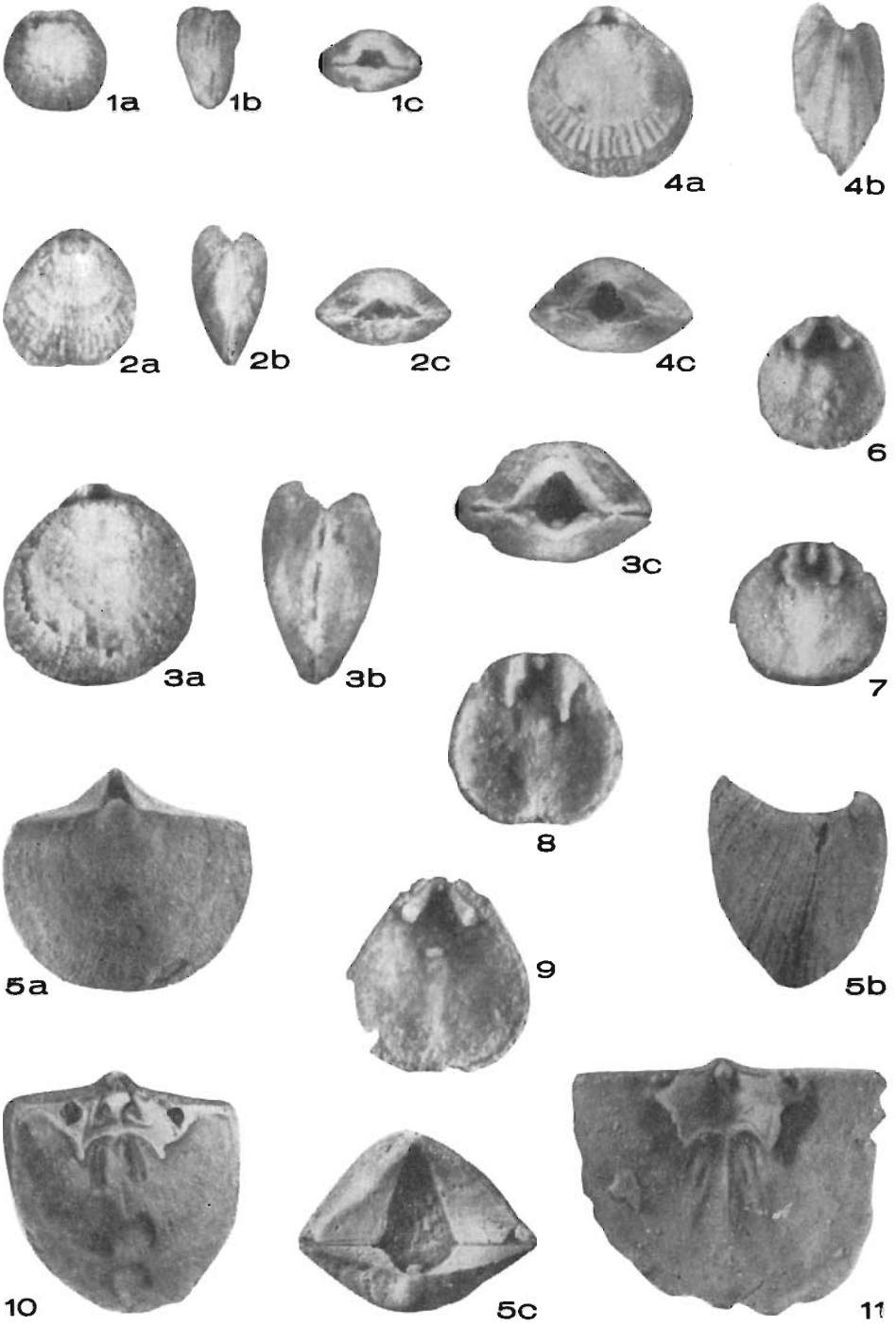
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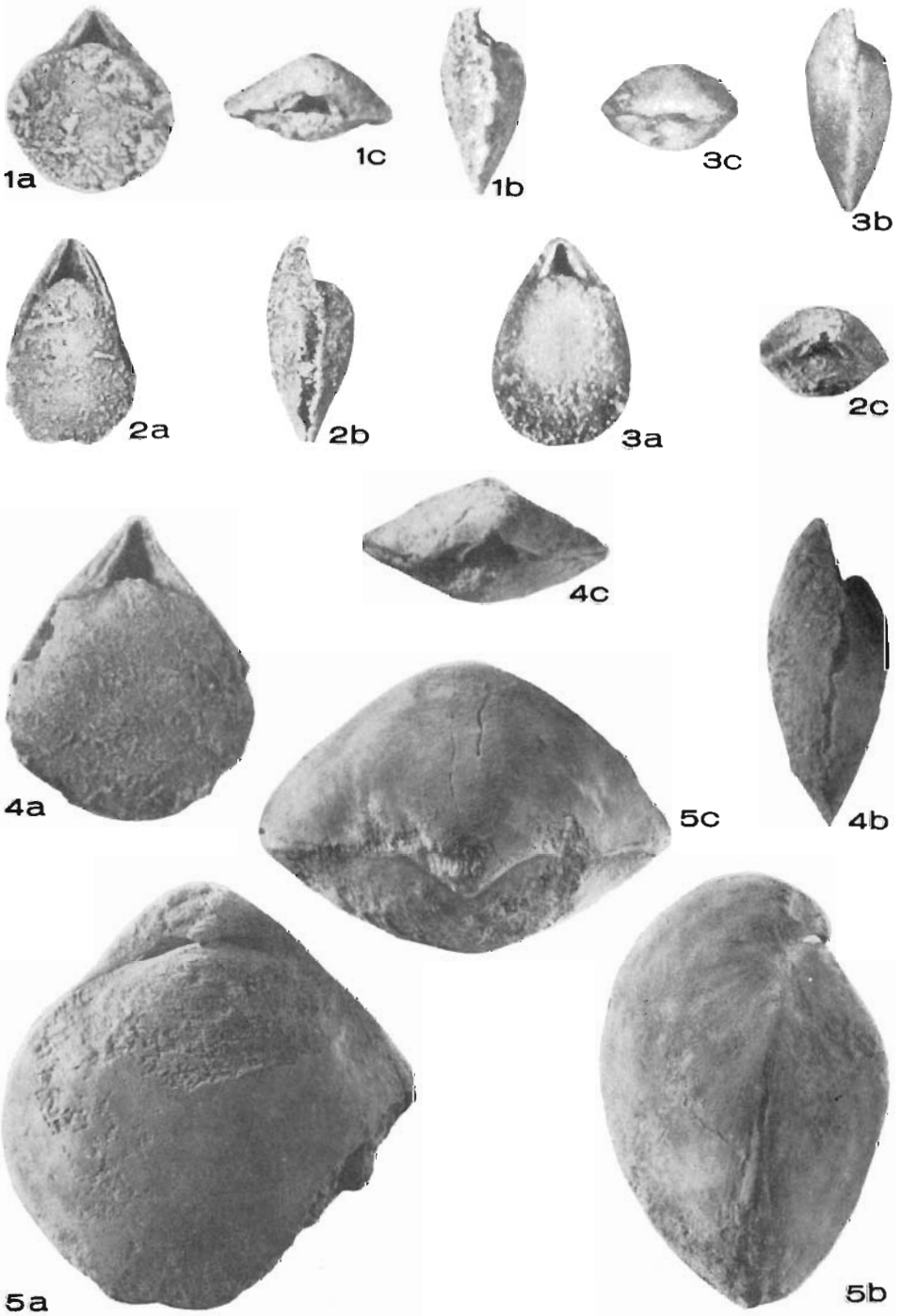
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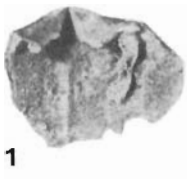
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2

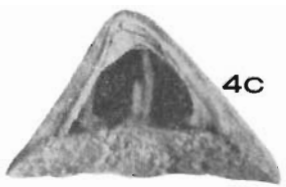

3c


7a


3a


3b


7b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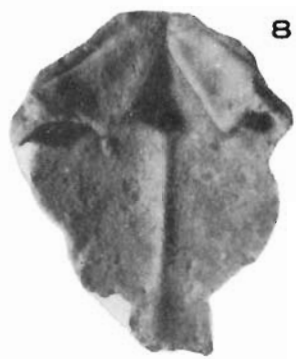
4a


4b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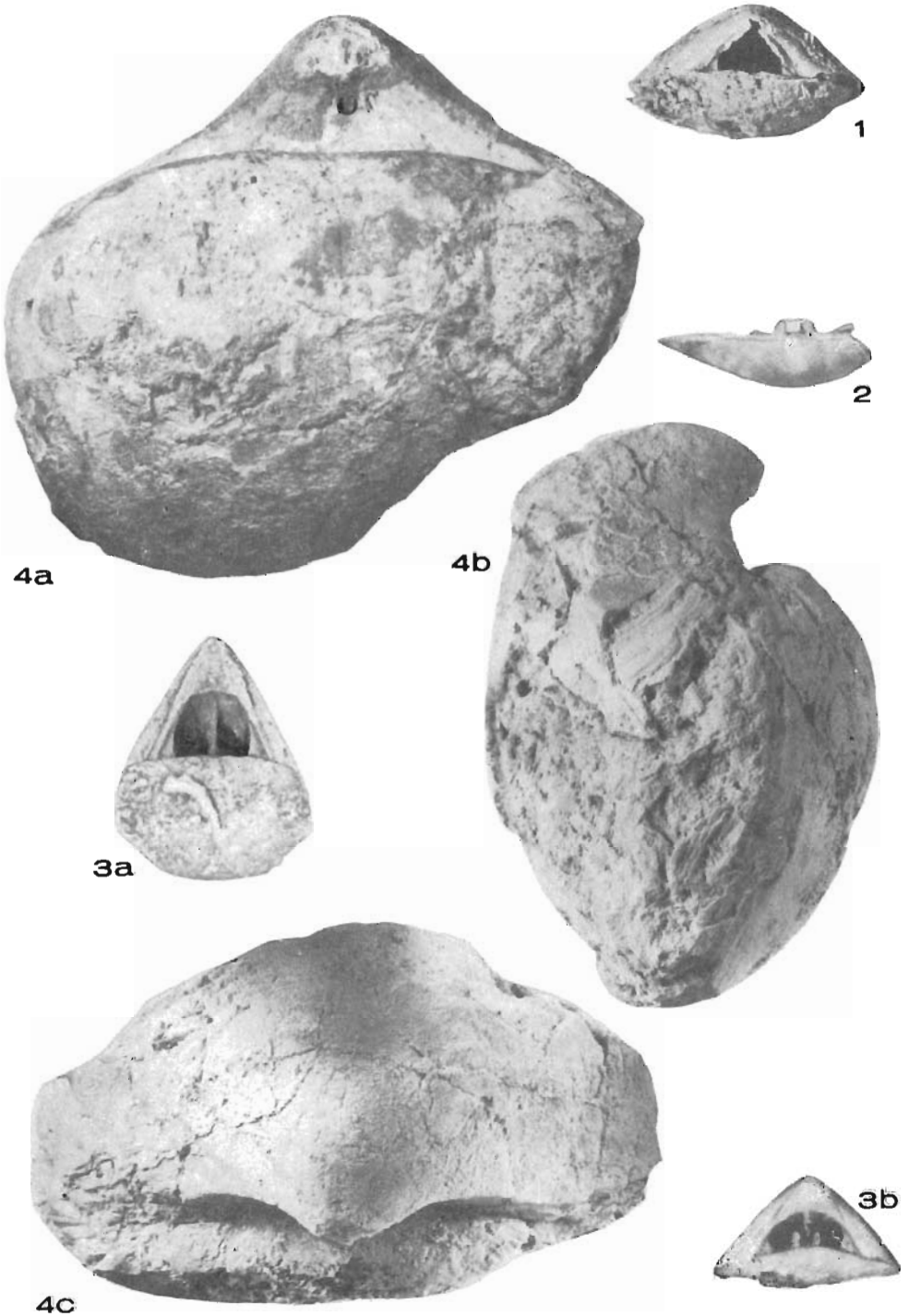
5a


5b


6a


6b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