

THE RELATION BETWEEN THE GENERA *CYRTINOPSIS* SCUPIN, 1896 AND *KOZLOWSKIELLINA* BOUCOT, 1957

BY

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ABSTRACT

A comparison of some morphological characters of *Cyrtinopsis* and *Kozlowskiellina* shows that the micro-ornamentation of *Cyrtinopsis* is essentially the same as in *Kozlowskiellina* and consists of growth lamellae, capillae and minor growth lines. The cardinal area of *Cyrtinopsis* is composed of a central interarea and a lateral palintrope, exactly the same as in *Kozlowskiellina*. The peculiar pedicle valve interior with the spondylium-like trough of *Cyrtinopsis* is fully comparable to and homologous with the interior of the pedicle valve of *Kozlowskiellina* which is also the case with the cardinalia in the brachial valve in both genera. As a conclusion it seems justified to unite both genera in one subfamily which for priority reasons must be named Cyrtinopsidae.

INTRODUCTION

The genus *Cyrtinopsis* has been assigned by Scupin, 1896, with the type species *Spirifer undosus* Schnur, 1851. In 1957 A. J. Boucot placed the genus *Cyrtinopsis* in a new family, the Cyrtinopsidae (in 1962 changed by Boucot into the correct name Cyrtinopsidae). In the discussion of the family, Boucot states (1957): "The family possesses fine ornamentation distinct from that characterizing all known spiriferacean families".

In the diagnosis of the genus *Cyrtinopsis*, Boucot states (1957): "Delthyridiform Spiriferacea, possessing lamellose ornamentation crossed by radial crenulations; fold and sulcus broad; lateral costae present; shell impunctate. Internally having a high median septum in the pedicle valve to which the dental lamellae are attached in a manner reminiscent of *Cyrtina*. Pseudodeltidium small, apically perforate, occurring in the apex of the deltidium".

Pitrat (1965) changed the family to the subfamily level, the Cyrtinopsinae within the family of the Delthyrididae. He gives the following diagnosis for the subfamily Cyrtinopsinae: "Lateral slope plicate; micro-ornament consisting of very prominent growth lamellae crossed by short radial crenulations; pedicle valve interior with dental plates converging to form spondylium supported by 3-layered septum".

Up to now the following species are known in the genus *Cyrtinopsis*:

Cyrtinopsis pseudoaculeata Scupin, 1896. Eifelian of Eifel region
W. Struve, 1965, p. 22–25.

Cyrtinopsis crenata (Steininger, 1853). Eifelian of Eifel region

W. Struve, 1965, p. 31–34.

Cyrtinopsis exaggerata Struve, 1965. Eifelian of Eifel region

W. Struve, 1965, p. 34–39.

Cyrtinopsis brachyptera (Maillieux, 1914). Middle Eifelian of the Ardennes, Eifel region and Morocco

W. Struve, 1965, p. 13–22.

Cyrtinopsis undosa (Schnur, 1851). Upper Eifelian of Eifel region, Emsian and Eifelian of Ardennes region

W. Struve, 1965, p. 26–31.

Cyrtinopsis naliukini Rzonnickaja, 1952. Upper part of the Lower Devonian and the Middle Devonian of the Kuzneck Basin (Pesterev Seam and Safonov Seams)
M. A. Rzonnickaja, 1952, p. 52–54; Pl. II, Figs. 1–4; text-figs. 1, 1–3.

Cyrtinopsis inflectens (Barrande, 1879). Ludlow or Lower Gedinnian of Bohemia (Vápence Lochkowské)

V. Havlíček, 1959, p. 144–147; Pl. XXIII, Figs. 5–7; text-figs. 65–67.

W. Struve (1965) described some poorly known *Cyrtinopsis*-species and he established within two species several subspecies. In his text-figure 2 an elucidating diagram of the phylogeny of the Eifel species of *Cyrtinopsis* is given.

Little is known about the phylogenetic place of the genus *Cyrtinopsis* among other genera. This publication gives a morphological comparison between *Cyrtinopsis* and the genus *Kozlowskiellina* Boucot, 1957 (see Krans, 1969). Successively I shall describe the micro-ornamentation, the cardinal area, the interior of the pedicle valve and the interior of the brachial valve.

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MORPHOLOGICAL OBSERVATIONS

Description of Cyrtinopsis

The micro-ornamentation. — In the literature the following descriptions of the micro-ornamentation are given:

Boucot, 1957,

p. 38: "lamellose ornamentation crossed by radial crenulations."

p. 39: "fine ornamentation consisting of prominent growth lamellae intersected by minute radial crenulations which simulate costellae, giving the fine ornamentation a reticulate effect." See Pl. 2, Fig. 11.

Vandercammen, 1963,

p. 101: "microsculpture constituée par des lamelles concentriques de croissance relevées et festonnées."

p. 103: "La microsculpture . . . est constituée par des lamelles concentriques de croissance épaisses, régulièrement espacées et dont le bord relevé donne l'aspect typique de chevron. Le bord commissural est festonné et le plat des lamelles concentriques est garni de petites crêtes radiaires séparant les festons." See his text-figure 63, and Pl. X, Fig 2.

Drot, 1964,

p. 69: "Ornementation lamelleuse, recoupée par des crénulations radiaires."

p. 70: "Microornamentation constituée de lamelles d'accroissement proéminentes, onduleuses, recoupées de petites crénulations qui donnent un aspect festonné à leur bord (Pl. 6, Figs. 7, 8). Entre ces crénulations, groupées parfois par deux ou trois, apparaît un minuscule quadrillage constitué de stries paraparallèles aux lamelles d'accroissement et de stries radiaires."

Struve, 1965,

p. 11: "Überaus bezeichnende Skulptur aus dicht gedrängten, lamellosen, am freien Rande girlanden-förmig geschwungenen, mit radialen Leisten besetzten Anwachszonen (gekehlte "Dachziegeln")." See his Tafel 1, Fig. 1; Tafel 2, Figs. 3, 4; Tafel 4, Fig. 3; Tafel 5, Fig. 3.

The components of the micro-ornament of *Cyrtinopsis* are: growth lamellae, radial capillae (see Williams & Rowell, 1965, p. H141, and Krans, 1969, p. 266) and minor growth lines (see Krans, 1969, p. 267, and J. Drot, 1964, p. 69).

A specimen of *Cyrtinopsis undosa* from the Eifelian of the Ardennes (specimen no. 5519, Inst.roy.Sci.nat. Belgique in Brussels, from the Lower Couvinian (Co2c) figured by Vandercammen 1963, Pl. X, Figs. 1-2) makes it clear that the micro-ornament consists of overhanging growth lamellae with radial capillae formed by undulations in the growth lamellae. The outer radial capillae correspond with inner furrows (text-fig. 1).

Some areas on the valves of specimen 5518, Inst. roy.Sci.nat.Belg., (figured by Vandercammen 1963, Pl. X, Figs. 3-5) show a micro-ornamentation with the

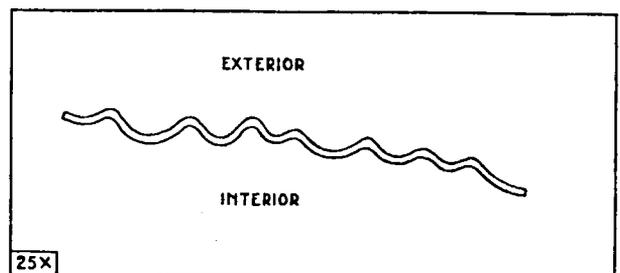


Fig. 1. Anterior view of a growth lamella of *Cyrtinopsis undosa* from the Upper Eifelian of the Ardennes (specimen 5519, Inst.roy.Sci.nat. de Belgique, figured in Vandercammen, 1963, Pl. X, Figs. 1, 2).

Note that the capillae on the exterior of the lamella correspond with furrows in the inner side of the growth lamella.

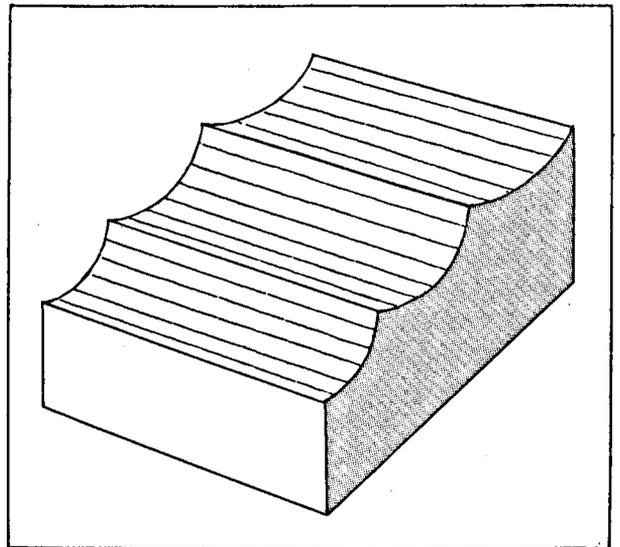


Fig. 2. Schematic representation of the micro-ornamentation of *Cyrtinopsis undosa* from the Upper Eifelian of the Ardennes (specimen 5518, Inst.roy.Sci.nat. de Belgique, figured in Vandercammen, 1963, Pl. X, Figs. 3-5).

The freehanging parts of the growth lamellae have been broken away. Note the minor growth lines on the concave growth lamellae.

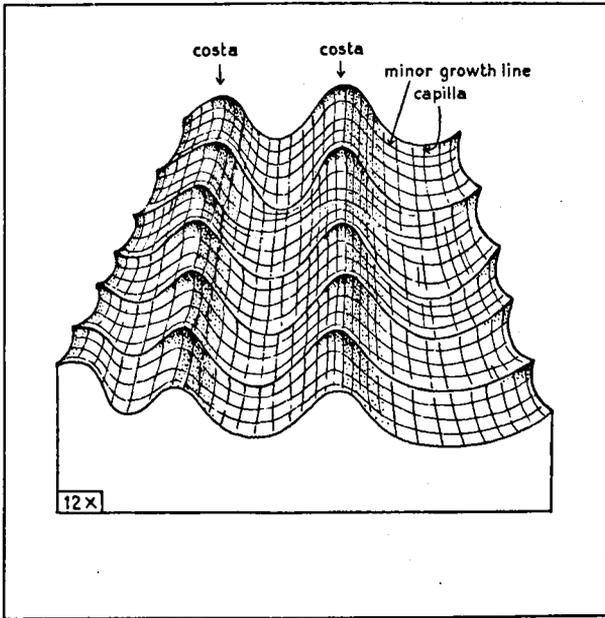


Fig. 3. Schematic representation of the micro-ornamentation of *Cyrtinopsis undosa* from the Upper Eifelian of the Ardennes (specimen 5520, Inst.roy.Sci.nat. de Belgique). Note that on the crests of the costae the curvature of the growth lamellae is more concave than in the intercostal spaces.

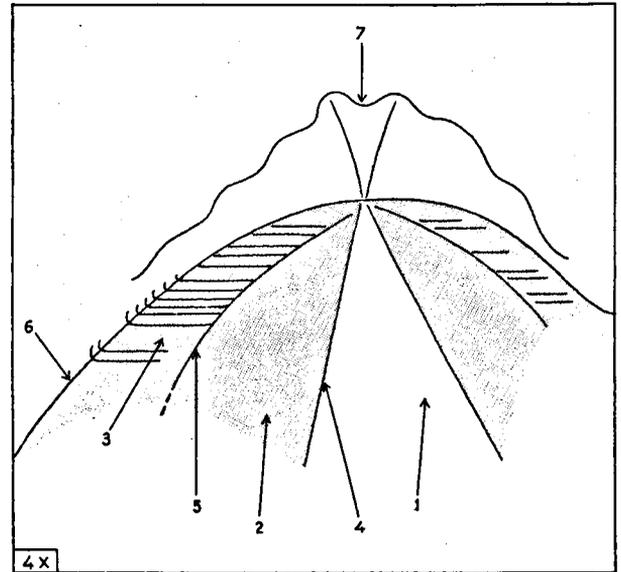
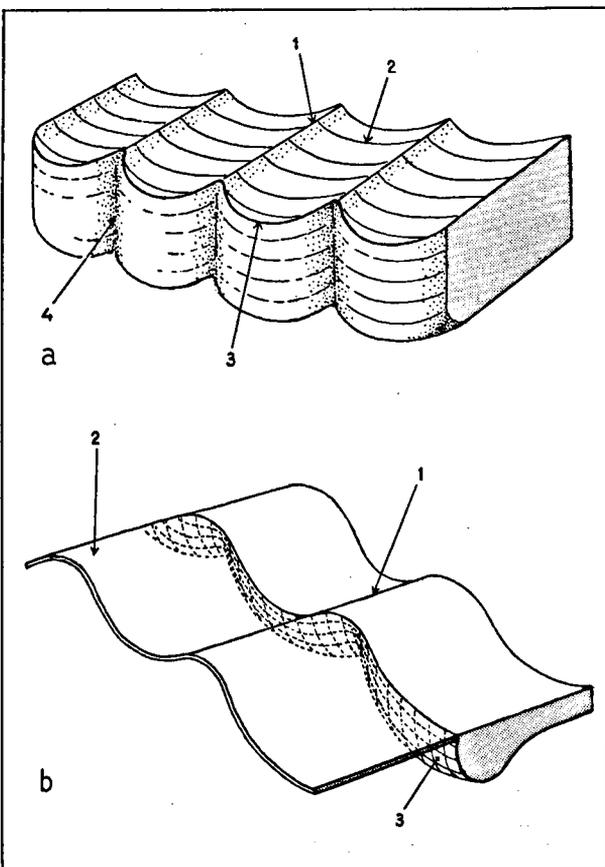


Fig. 5. Cardinal area of the pedicle valve of *Cyrtinopsis undosa* of the Upper Eifelian of the Ardennes (specimen 5518, Inst.roy.Sci.nat. de Belgique, figured in Vandercammen, 1963, Pl. X, Figs. 3-5).

- | | |
|---|---------------------|
| 1 = delthyrium | 4 = delthyrial side |
| 2 = ventral interarea | 5 = interareal side |
| 3 = ventral palintrope with growth lamellae | 6 = beak ridge |
| | 7 = sulcus |



← Fig. 4. a. Scheme of the commissure of the pedicle valve of *Cyrtinopsis undosa* (same specimen as the one of text-figure 1). The growth lamella is thickened and underneath each capilla a groove in the thickened part is present. Probably the thick part represents a part of the intramarginal ridge. The grooves in the intramarginal ridge could have a function in respect to the setal follicles as explained in Krans, 1969, text-figure 4. 1 = radial capilla 3 = broken edge of the growth lamella (the overhanging part has been broken away) 2 = minor growth line on the growth lamella 4 = grooves in the supposed intramarginal ridge

b. Scheme of the commissure of *Cyrtinopsis* with a free-hanging growth lamella. 1 = costa 2 = growth lamella 3 = intramarginal ridge

free overhanging growth lamellae broken away and with very clear minor growth lines (text-fig. 2).

A feature similar to that above is to be seen on specimen 5520, Inst.roy.Sci.nat.Belg. (Vandercammen, 1963, Pl. X, Figs. 9, 10). On the crests of the costae the curvature of the growth lamellae is more concave than in the intercostal spaces (text-fig. 3). Minor growth lines are very clearly visible. Small pustules were formed on the intersections of the minor growth lines and the radial capillae.

Specimen 5519, Inst.roy.Sci.nat.Belg., shows another peculiarity. The overhanging growth lamellae are broken and the visible growth lamellae are very thick. Probably Vandercammen (1963) took this example for his text-figure 63. In my opinion the thickness of the growth lamellae is caused by the successive intra-

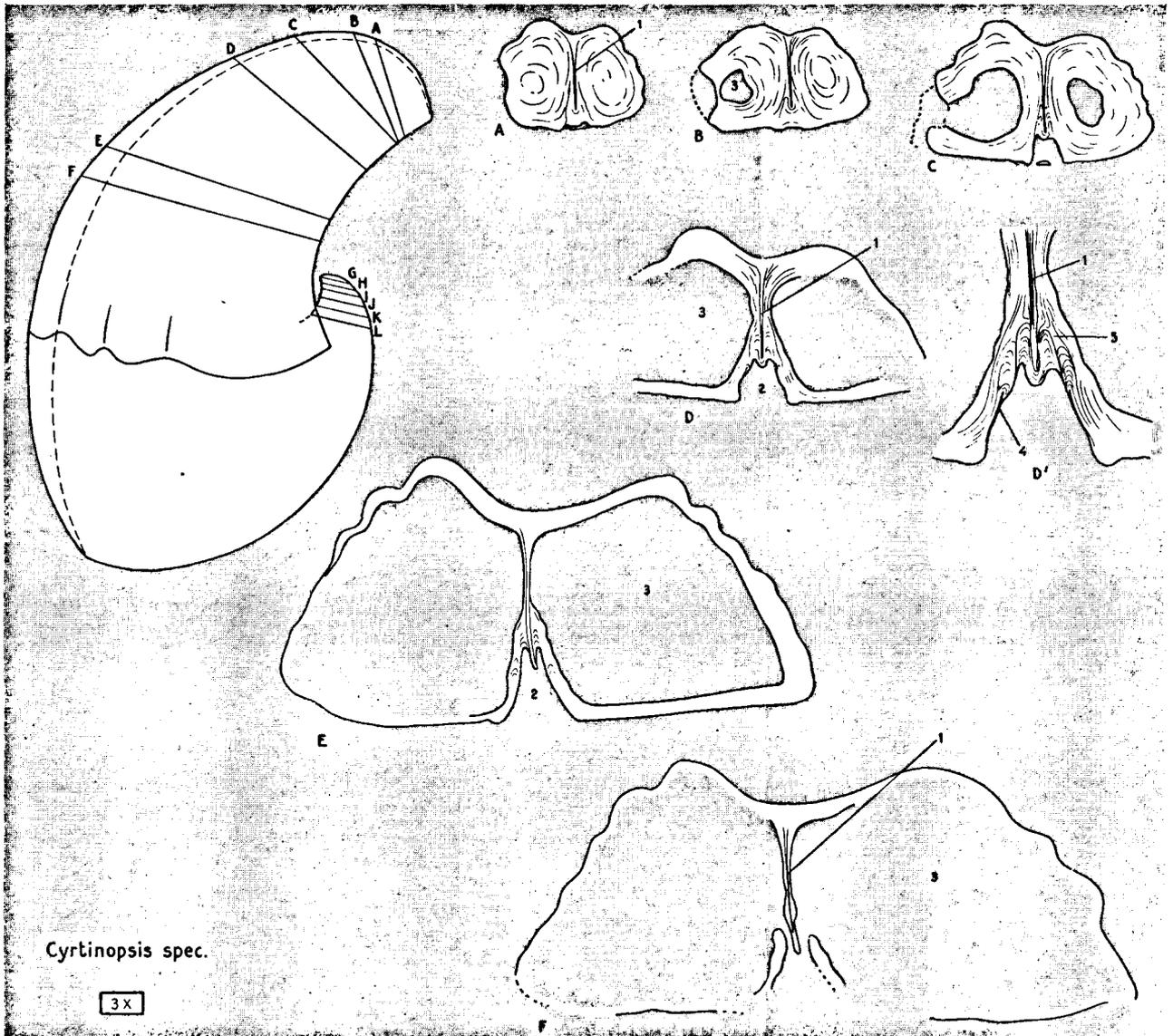


Fig. 6. Transverse sections of the pedicle valve of *Cyrtinopsis* spec. from the Eifelian of Auburg near Gerolstein, Germany. 1 = median septum 4 = dental ridge
2 = spondylium-like trough 5 = secondary connection of dental ridge with the median septum
3 = lateral cavity
Sections A, B, C, D, E and F respectively peelings 69002, 69003, 69004, 69005, 69007 and 69008.

marginal ridges underneath the growth lamellae (text-fig. 4).

Cardinal area. – The ventral cardinal area of *Cyrtinopsis* can be catacline to orthocline, high and plane or very concave. Struve described the differences in the interareas in the different *Cyrtinopsis* species.

On a specimen of *Cyrtinopsis undosa* (no. 5518, Inst.roy.Sci.nat.Belg., figured by Vandercammen, 1963, Pl. X, Figs. 3–5) it becomes clear that the lateral parts of the cardinal area are provided with overhanging growth lamellae (text-fig. 5) and that these lateral parts do not lie in the same plane as the interarea proper.

As we have stated earlier (1969, p. 268–269) an interarea is a posterior sector of shell with a growing edge at the hinge line where the two mantle lobes are fused. A palintrope is a posterior sector of shell with a growing edge not coinciding with the hinge line. The growing edge is in fact part of the normal commissure but is situated between the cardinal extremities.

Overhanging growth lamellae are formed by mantle retraction along the commissure. It is evident that also the cardinal area of the specimen just mentioned is in fact composed of an interarea (central part provided with the delthyrium) and of a palintrope (the two lateral parts with growth lamellae). This feature is also to be seen in *Cyrtinopsis undosa* of the Eifelian

of Gerolstein as is shown by Boucot, 1957, Tafel 2, Figs. 14, 15 and in *Cyrtinopsis* cf. *brachyptera* of the Eifelian of the Eifel region, Boucot, 1957, Tafel 2, Fig. 18.

J. Drot, 1964, illustrates the cardinal area of *Cyrtinopsis undosa maiderensis* Drot, 1964, where also here the peculiar form of the cardinal area appears. This subspecies comes from the Upper Eifelian of Morocco (Pl. 6, Fig. 2a of J. Drot, 1964). W. Struve, 1965, figures *Cyrtinopsis exaggerata maillieuxi* Struve, 1964, from the Eifelian of the "Gerolsteiner Mulde", Tafel 2, Figs. 2b, 2c, which shows the same type of cardinal area. The same is true for *Cyrtinopsis pseudoaculeata* Scupin, 1896, on Struve's Tafel 3, Fig. 2b.

The distinctness of this character of the cardinal area depends greatly on the conservation of the specimens and this is the reason why it cannot always be demonstrated.

Interior of the pedicle valve. — Text-figure 6 shows a series of sections made on a specimen of *Cyrtinopsis* sp. of the Eifelian of Auburg near Gerolstein (this specimen was kindly given to me by Dr. W. Struve). No dental plates are present (dental plates are platelike structures lying underneath the edges of the delthyrium and reaching the floor of the valve). In *Cyrtinopsis* we are dealing with dental ridges which are fused to a long and high median septum by convergence towards the floor of the valve forming a spondylium-like trough (Pl. I, Fig. 1; Pl. II, Fig. 1; Pl. III).

The fusion of the dental ridges with the median septum does not take place at the crest of the septum but somewhat lower so that in the trough the median septum still protrudes (text-fig. 7). From section 69005 it becomes also clear that outgrowths of the dental ridges towards the septum form the proper connection between the dental ridges and the median septum. In the dental ridges a very thin layer of clear prismatic calcite has been found on the delthyrial flanks of the ridges which could be possibly a myotest layer indicating the attachment of a pair of pedicle muscles. These attachment areas on the flanks of the trough indicate the extension of the two dental ridges. The form of the trough is determined by the attachment of the accessory diductors. The anterior extension of the trough is determined by the passing by from the pedicle sac towards the floor of the valve of the pedicle adjustors just anterior of the trough. Because of the fact that not all muscles have been attached in the trough, the latter can not be named spondylium, since this should be a trough serving for the attachment of all muscles. Therefore we call it a spondylium-like trough.

Interior of the brachial valve. — Crural plates are present in the sections of *Cyrtinopsis* spec. from the Eifelian of Auburg near Gerolstein (specimen provided by Dr. W. Struve) (text-fig. 8; Pl. I, Fig. 2; Pl. II, Fig. 2). The crural plates are very thick and do not really protrude as plates. The lateral cavities are very shallow. The crural bases are small and the outer hinge

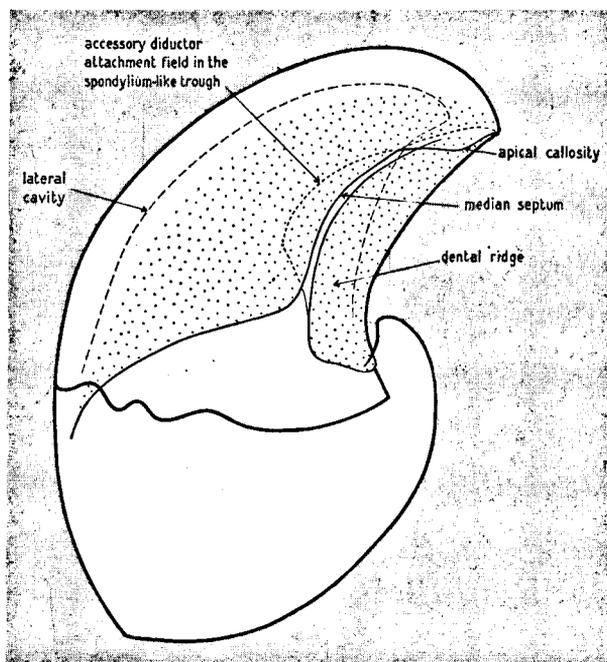


Fig. 7. Median projection of the ventral apical complex of *Cyrtinopsis* spec.

plates well distinguishable. The lamellae of the cardinal process are formed on a concave platform. In the plane of symmetry a deeper groove between the lamellae is present so that the cardinal process shows a weak bilobal aspect.

Comparison with *Kozlowskiellina*

Micro-ornamentation. — The components of the micro-ornamentation of both *Cyrtinopsis* and *Kozlowskiellina* are the same: growth lamellae, radial capillae corresponding with inner furrows, and minor growth lines (compare text-figure 1 with Krans, 1969, text-figure 1). Furthermore the aspect of the micro-ornament in case that the overhanging parts of the growth lamellae of *Cyrtinopsis* are broken away is just the same as in *Kozlowskiellina*, especially so in *Kozlowskiellina velata* (Krans, 1969, Pl. III, Figs. 5, 6). The growth lamellae in *Cyrtinopsis undata* show a greater concavity on the crests of the costae than in intercostal spaces. This aspect is also to be seen in *Kozlowskiellina* (see Krans, 1969, text-figure 3).

Both *Cyrtinopsis* and *Kozlowskiellina* show evidence for the presence of intramarginal ridges (see Krans, 1969, text-figure 2 and Pl. V, Fig. 4).

The similarities in the micro-ornamentation are very remarkable as this type of micro-ornamentation is unique in the spiriferids.

Cardinal area. — The cardinal area of *Cyrtinopsis* consists of a central interarea and a lateral palintrope. This peculiarity of the cardinal area, which is like the micro-ornament of *Cyrtinopsis* rather unique, is also to be found in all the species of *Kozlowskiellina* (see Krans, 1969, text-figure 5 and Pl. III, Figs. 7, 8).

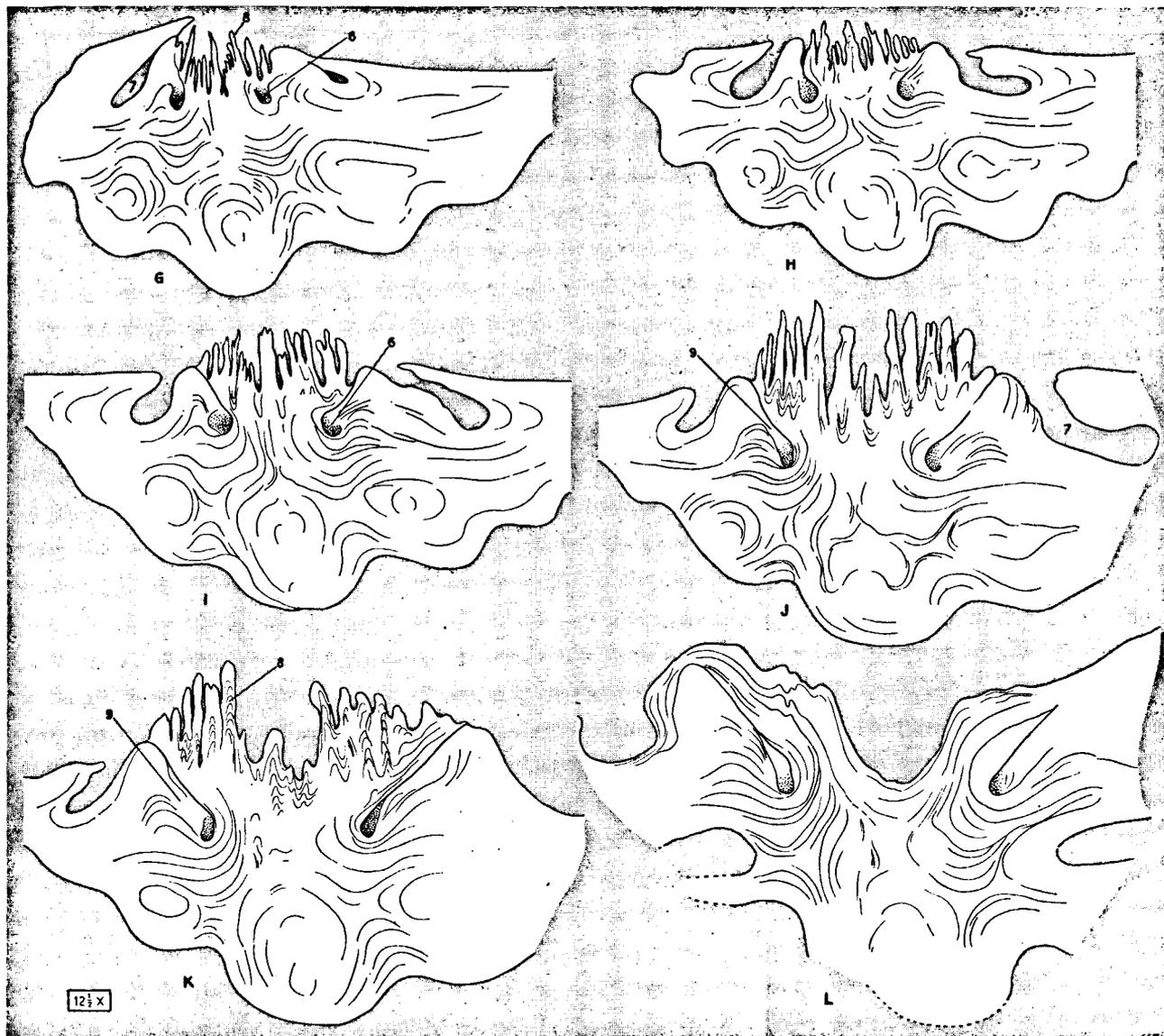


Fig. 8. Transverse sections of the brachial valve of *Cyrtinopsis* spec. from the Eifelian of Auburg near Gerolstein, Germany (same specimen as text-figure 6, position of sections are indicated in text-figure 6).

6 = crural base

8 = lamellae of the cardinal process

7 = dental socket

9 = outer hinge plate

Sections G, H, I, J, K and L respectively peelings 69010, 69011, 69012, 69013, 69014 and 69015.

Interior of the pedicle valve. – The formation of a spondylium-like trough is only present in the genera *Cyrtinopsis* and *Kozlowskiellina*. In *Kozlowskiellina* the evolutionary changes can be traced, indicating that a reduction of the dental plates took place, giving rise to the formation of the dental ridges. By convergence of the dental ridges towards the median septum a spondylium-like trough is formed, which is present in several *Kozlowskiellina* species, as also in *Cyrtinopsis*. The morphology and growth of the trough in *Cyrtinopsis* are exactly the same as in *Kozlowskiellina*.

The supposed evolutionary changes of this trough are figured in text-figure 9.

Interior of the brachial valve. – The internal characters of *Cyrtinopsis*, so far as we were able to examine the specimen, are: thick crural plates, a concave platform for the lamellae of the cardinal process which shows itself a weak bilobed aspect. Rather well developed outer hinge plates.

In some species in the genus *Kozlowskiellina* we find a similar interior of the brachial valve, especially so in *Kozlowskiellina perlamellosa* (see Krans, 1969, text-fig. 22).

RELATION BETWEEN CYRTINOPSIS AND KOZLOWSKIELLINA

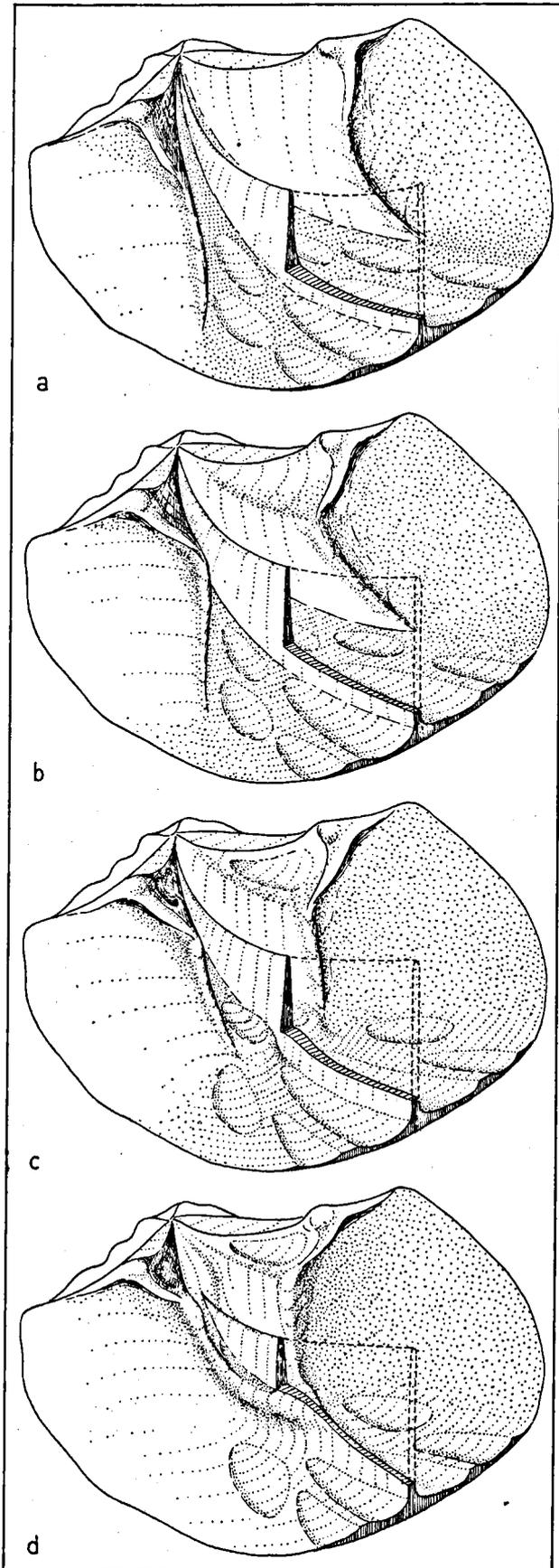
Morphological considerations

All characters of *Cyrtinopsis* (i.e. micro-ornamentation, cardinal area, interior of pedicle valve and interior of brachial valve) indicate a close relationship with the genus *Kozlowskiellina*.

Concerning the micro-ornamentation. — Placing the micro-ornamentation of *Cyrtinopsis* in the scope of the evolution of the species in *Kozlowskiellina*, we see that the micro-ornament of *Cyrtinopsis* is not a very early stage in the evolution but comes near to the morphology of *Kozlowskiellina velata*, *K. perlamellosa* and *K. raricosta*. *K. velata* is known from the Helderberg of Oklahoma whereas *K. raricosta* appears in the Siegenian of Nevada. Judged from the micro-ornament it consequently could be possible that *Cyrtinopsis* branched off from the *Kozlowskiellina* tree somewhere before the appearance of *K. velata*, *K. perlamellosa* and *K. raricosta*.

Concerning the cardinal area. — The cardinal area of *Cyrtinopsis* is of the same type as the one of *Kozlowskiellina*. Because of the fact that all *Kozlowskiellina* species possess a lateral palintrope and a central interarea, no evolutionary indication is possible on this ground.

As is stated by Amsden the Silurian *kozlowskiellinins* possess a rather high catacline to orthocline cardinal area whereas the Devonian species have a much lower cardinal area except *K. cyrtinoides*. On this ground it would be possible that *Cyrtinopsis* branched off from the *Kozlowskiellina* branch somewhere before the appearance of the *kozlowskiellinins* like *K. velata*, *K. hesione*, *K. perlamellosa*.



← Fig. 9. Supposed evolution of the spondylium-like trough in the subfamily of the Cyrtinopsidinae.
 a = primitive condition in the pedicle valve with two distinct dental plates reaching the floor of the valve.
 b = on the dental plates attachment of a pair of pedicle muscles causes the reduction of the dental plates to dental ridges with a convergence of the ridges towards the median plane.
 c = raising of the accessory diductors field on both sides of the median septum.
 d = formation of a spondylium-like trough by further raising of the accessory diductor field. This condition is to be found in several *Kozlowskiellina*-species and in *Cyrtinopsis*.

Concerning the interior of the pedicle valve. – The absence of dental plates and converging dental ridges of *Cyrtinopsis* indicate that *Cyrtinopsis* probably arose from the kozlowskiellinins after the appearance of *K. vaningeni*. The ventral interior of *Cyrtinopsis* is much alike *K. cyrtinoides* and *K. raricosta*. Therefore we may conclude that *Cyrtinopsis* arose after the appearance of *K. vaningeni*.

The presence of a clear median septum indicates that *Cyrtinopsis* arose from the *vanningeni*-branch rather than from the *strawi*-branch (cf. Krans, 1969, text-figure 24).

Concerning the interior of the brachial valve. – The interior of the brachial valve and especially the cardinal process of *Cyrtinopsis* is much alike *K. perlamellosa*. On this basis it would be logical that *Cyrtinopsis* appeared somewhere between *K. velata* and *K. perlamellosa*.

However, the stratigraphic range of *Cyrtinopsis* does not fit in this concept. Therefore it is very probable that this highly functional structure developed independently of the kozlowskiellinins, so that concerning the cardinal process we assume a parallel evolution in *Cyrtinopsis* in relation to the branch of *K. velata* to *K. perlamellosa*.

Concluding we may say that *Cyrtinopsis* is closely related to *Kozlowskiellina* and that it arose from the *Kozlowskiellina* tree somewhere between *K. vaningeni*, *K. deltidialis* and *K. velata*.

Paleogeographic considerations

The Silurian shows generally a rather cosmopolitan brachiopod fauna (see Boucot, Johnson and Talent, 1967) so that from this point of view the geographical distribution of the kozlowskiellinins does not have much evolutionary consequences. By the end of the Silurian *Kozlowskiellina cyrtinoides* appears in Tennessee with a very well developed "spondylial trough" whereas in Bohemia *Cyrtinopsis inflectens* occurs. But in the Early Devonian two brachiopod faunal provinces became marked (see Boucot, Johnson and Talent, 1967), the Appalachian and the Old World provinces. This provinciality becomes more prominent in the late Gedinnian and further in the Devonian. From this it is easily understandable that also the history of the *Kozlowskiellina-Cyrtinopsis* group shows a differentiation. In the Appalachian province we see a further development in the *Kozlowskiellina*-species, in the Old World in the Bohemian and later in the Renish Bohemian province the development of the *Cyrtinopsis* group took place.

An evolutionary diagram is shown in text-figure 10.

Taxonomical considerations

Taxonomically this relationship has a consequence. The genus *Cyrtinopsis* is placed by Struve, 1965, in the family of Cyrtinopsidae Wedekind, 1925. Pitrat, 1965, using the imperfect name Cyrtinopsidae, placed this

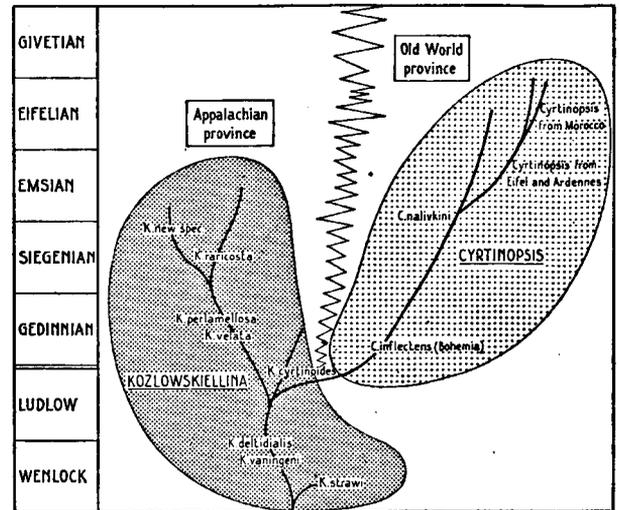


Fig. 10. Phylogeny of *Kozlowskiellina* and *Cyrtinopsis*. During the Silurian a cosmopolitan brachiopod fauna was extant. In the Early Devonian two brachiopod faunal provinces developed: the Appalachian province and the Old World province. This caused the diversity in the group giving rise to two distinct groups: the *Kozlowskiellina* group in the Appalachian province and the *Cyrtinopsis* group in the Old World province.

group on the subfamily level Cyrtinopsinae. Derived from the valid name Cyrtinopsidae the subfamily should be named Cyrtinopsidinae. In this subfamily only the genus *Cyrtinopsis* is known. However, it has been shown in this paper, that there is a close phylogenetic relation between *Cyrtinopsis* and *Kozlowskiellina*. Therefore it would be more logical to place the genus *Kozlowskiellina* within the same subfamily as the genus *Cyrtinopsis*. As the subfamily name Cyrtinopsidinae has priority over the subfamily name Kozlowskiellininae the genera *Cyrtinopsis* and *Kozlowskiellina* must be placed in the subfamily Cyrtinopsidinae.

The definition of this subfamily may be stated as follows: Delthyridae with lateral slopes plicate. Microornamentation consisting of growth lamellae provided with capillae and minor growth lines. Pedicle valve interior with a median elevation in the floor, in most forms a real, high median septum; in the primitive forms real dental plates, in more advanced forms reduction of the dental plates to dental ridges; in some forms the dental ridges converge and form with the mostly high median septum a spondylium-like structure.

Brachial valve interior with in the primitive forms two small lamellated diductor fields situated on the inner socket walls, in the more advanced forms a more developed cardinal process with a more or less bilobed appearance; outer hinge plates mostly rather well developed; short and thick crural plates with mostly shallow lateral cavities.

It is clear that one valid definition of the subfamily which delimits it from other subfamilies is rather difficult to give since the genera within this subfamily and their species are far too differentiated. The state-

ment about the definition of a genus in Krans (1969, p. 265) is also true on the subfamily level, namely that the definition of a subfamily which is in fact a group

of historically related genera should be a historic account of all included species.

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PLATE I

Cyrtinopsis spec. from the Eifelian of Auburg near Gerolstein, Germany.

Fig. 1. Acetate peel of a section of the pedicle valve (peeling 69003, = section B of text-figure 6).

Note the median septum and the plugged spondylium-like trough. 20 ×.

Fig. 2. Acetate peel of a section of the brachial valve (peeling 69010 = section G of text-figure 8).

Note the two crural bases (black) and the crural plates. 20 ×.

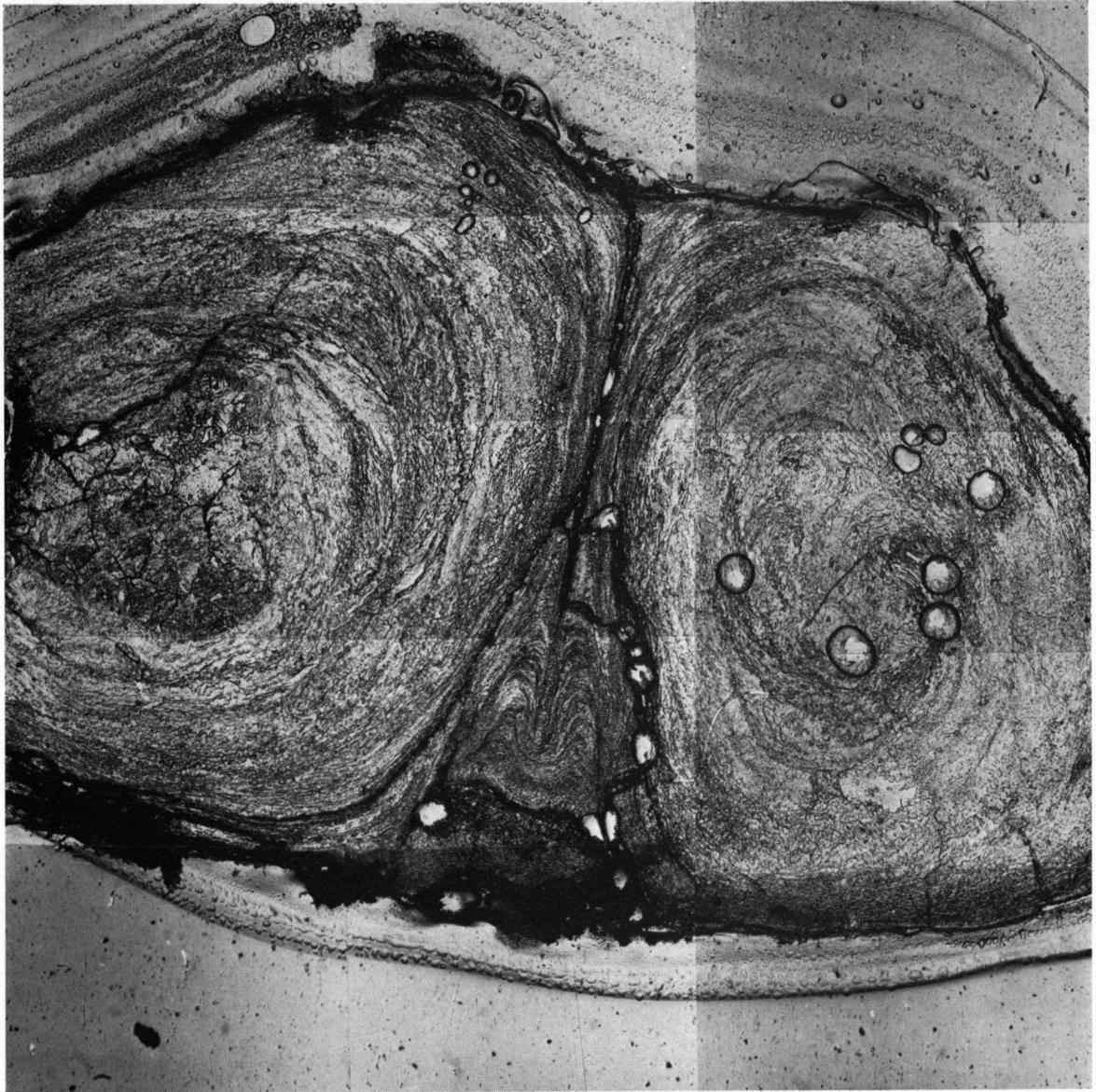


PLATE II

Cyrtinopsis spec. from the Eifelian of Auburg near Gerolstein, Germany.

Fig. 1. Acetate peel of a section of the spondylium-like trough (peeling 69005 = section D of text-figure 6).

Note the extension of the right dental ridge with a part of the probable myotest. 20 ×.

Fig. 2. Acetate peel of a section of the brachial valve (peeling 69015 = section L of text-figure 8).

Note the crural bases, the outer hinge plates and the smooth, concave platform of the cardinal process and the formation of some low lamellae on the outgrowths of the outer hinge plates. 20 ×.

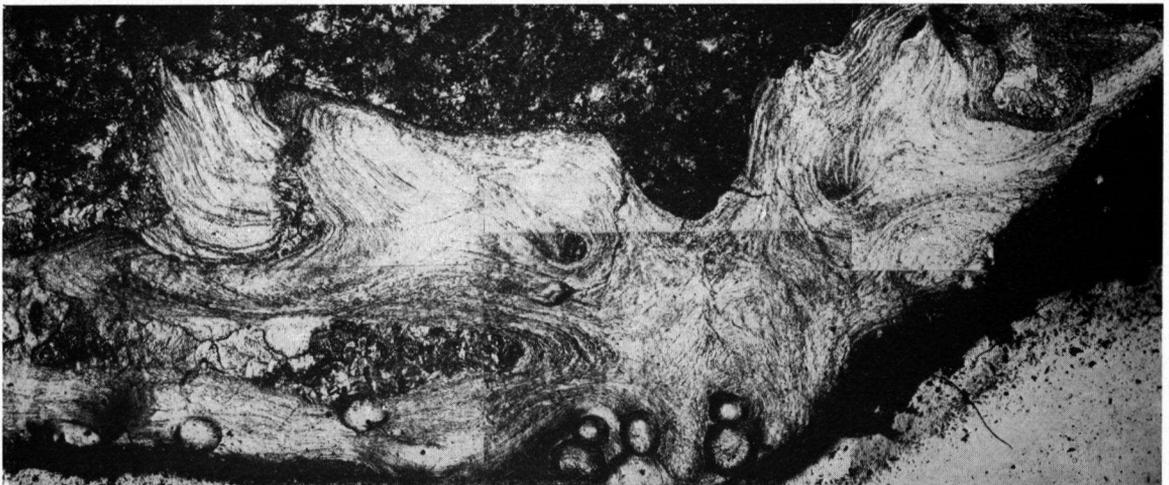
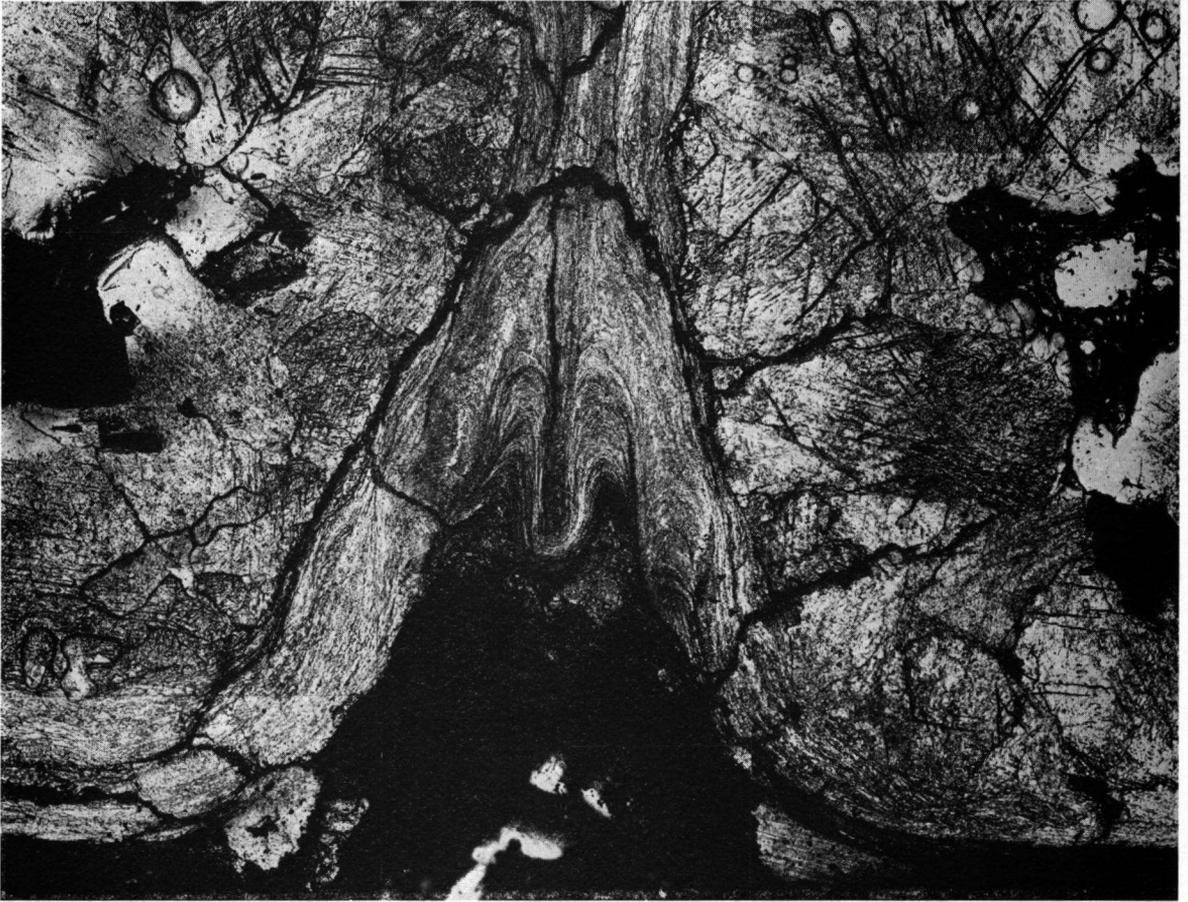


PLATE III

Cyrtinopsis spec. from the Eifelian of Auburg near Gerolstein, Germany.

Acetate peel of the pedicle valve (peeling 69007 = section E of text-figure 6).

Note the thick myotest on both sides of the base of the median septum in the floor of the valve, the pronounced median septum, the extension of the two dental ridges and the connection of the dental ridges with the median septum, forming the spondylium-like trough. 20 ×.

