

ROMAN CHLEBOWSKI & HUBERT SZANIAWSKI

## Chitinozoa from the Ordovician conglomerates at Międzygórz in the Holy Cross Mts

ABSTRACT: The abundant Chitinozoa were found in clayey shale fragments, one of the components of a Lower Ordovician conglomerate, occurring at Międzygórz near Opatów in the Holy Cross Mts. This conglomerate has hitherto been considered as Tremadocian. Here occurring species, *Desmochitina minor* Eisenack, *Lagenochitina* cf. *esthonica* Eisenack and *Rhabdochitina magna* Eisenack, indicate a younger age, probably Arenigian. A new species of the Chitinozoa, viz. *Cyathochitina primitiva* sp. n., has also been established.

### INTRODUCTION

An Ordovician profile with a conglomeratic series in its bottom part is exposed at Międzygórz, a locality situated between Opatów and Sandomierz in the eastern part of the Holy Cross Mts. The entire area of this region is overlaid by a thick cover of loess, from below which fragmentary Paleozoic deposits are exposed in deeply cut ravines (Fig. 1).

The conglomeratic series under study has for many years now been known in literature (Zejszner 1869; Siemiradzki 1903, 1922; Samsonowicz 1916, 1928; Tomczyk 1954; Blaszkę 1957; Turnau-Morawska 1960; Bednarczyk 1964, 1966, 1971). The age of these deposits has recently been determined by W. Bednarczyk (1964, 1966, 1971) as Upper Tremadocian, since they underlie the Arenigian sandstones.

The present writers have dealt with fragments of clayey shales, one of the components of the polymictic conglomerate. These are fragments (0.5—4.0 cm in size) of black or gray-greenish shales, brittle or somewhat plastic and with common muscovite flakes. Many Chitinozoa were separated from these shales, when dissolved in hydrofluoric acid.



Fig. 1

Occurrence of the Ordovician deposits (marked black) in the Holy Cross Mts; simplified from Czarnocki (1953) and Tomczykowa (1968)

#### SYSTEMATIC DESCRIPTION OF CHITINOZOA

(by H. Szaniawski)

The Chitinozoa represent a group of microfossils occurring in the Ordovician, Silurian and Devonian marine deposits. These fossils have been described in paleontological literature only since 1931 (Eisenack 1931) and their systematic position remains unknown. According to Kozłowski (1963), in all likelihood these are cysts, eggs or egg capsules of invertebrates. The possibility of an extensive application of the Chitinozoa in stratigraphy has recently been shown by many authors (e.g. Taugordeau & Jekhovskij 1960; Eisenack 1962b, 1968; Jenkins 1967, 1969, 1970; Laufeld 1967; Umnova 1969; Mannil 1971). For, it turned out that the Chitinozoa were strongly differentiated (more than 500 species are known at present) and subject to rapid evolution. Most of the species have a very extensive geographical distribution and some of them a narrow stratigraphic range. However, their practical use in stratigraphy is at present rather limited because of a relatively few material from continuous profiles sufficiently documented by index fauna. In Poland, apart of Kozłowski's paper (1963) on 'biological problems of the Chitinozoa, they were only the subject of a graduated paper (Maszońska 1971). Except for the latter, they have never been described or used for stratigraphic purposes.

The collection under study consists of over 200 specimens belonging to four species of four genera. All the specimens (cf. Pls 1—2) are more or less flattened but well-preserved. The collection is housed at the Institute of Paleozoology of the Polish Academy of Sciences in Warsaw.

Genus *CYATHOCHITINA* Eisenack, 1955Type species: *Cyathochitina campanulaeformis* (Eisenack, 1931)*Cyathochitina primitiva* sp. n.

(Pl. 1, Figs 1—7, Pl. 2, Figs 11—12)

*Holotype*: a specimen composed of two connected tests (Z. Pal. No. Ch. 1/1), presented in Pl. 1, Fig. 5.

*Type horizon*: Lower Ordovician.

*Type locality*: Międzygórz in the Holy Cross Mts.

*Derivation of the name*: Latin *primitivus* — original, as it is the earliest species of *Cyathochitina* known so far and marked by a very simple form.

*Diagnosis*. — Test relatively wide, cylindroconical. The length of chamber equalling about two-thirds of the total length of test and the width of chamber equalling its length. Base flat, its edge in the form of a narrow rim. Neck only slightly differentiated from the chamber, very wide and flaring. The diameter of aperture somewhat smaller than that of base.

*Material*. — About 150 single tests and three composed of two tests each.

*Description*. — The specimens occur in the form of single tests and chains. Particular tests vary in length from 218 to 359  $\mu$ . Chamber conical to cylindrical, its length equalling 0.6 to 0.7 of the total length of test. Its maximum diameter, measured at the base, equals 0.8 to 1.2 of its length. Chamber very wide over the entire length. Flanks of most specimens tapering very slightly. Base flat, with concentric lines barely discernible. An attachment scar (a result of joining the chain) in the form of a longitudinal furrow is visible in most specimens. Basal edge provided with a narrow, but relatively thick rim. Neck, slightly differentiated from the chamber, is short, very wide and flaring, its width equalling 0.85 to 0.76 of maximum diameter at its narrowest point and 0.77 to 0.93 of maximum diameter at aperture. An impression left by the basal surface of another test next in chain (Pl. 1, Fig. 4b) is preserved in some specimens near aperture. Test wall smooth, lustrous.

*Comparison and remarks*. — The new species differs from all typical representatives of *Cyathochitina* in a more cylindrical chamber, slightly differentiated, very wide neck and the lack of carina proper. Most likely, those are primitive characters of the genus. Somewhat similar characters are displayed by *Cyathochitina regnelli* Eisenack which is also one of the stratigraphically oldest (Lower Llanvirnian) species of the genus. The new species differs from it in a more cylindrical chamber and considerably larger test.

Genus *DESMOCHITINA* Eisenack, 1931Type species: *Desmochitina nodosa* Eisenack, 1931*Desmochitina minor* Eisenack, 1931

(Pl. 2, Figs 5—9)

1931. *Desmochitina? minor* n. sp.; Eisenack, p. 93, Pl. 3, Figs 9—11.  
 1968. *Desmochitina minor* forma *typica* Eisenack; Eisenack p. 396, Pl. 2, Fig. 29.  
 1963. *Desmochitina minor* Eisenack; Kozłowski, p. 426, Figs 1—4.  
 1968. *Desmochitina minor* forma *typica* Eisenack; Eisenack, p. 180, Pl. 24, Fig. 21.  
 1969. *Desmochitina minor* Eisenack; Jenkins, p. 20, Pl. 6, Figs 1—18 (here remained an early synonymy).  
 1968. *Desmochitina minor typica* Eisenack; Umnova, Pl. 2, Figs 1—2.  
 1969. *Desmochitina minor grandicolla* Eisenack; Umnova, Pl. 2, Figs 3—4.  
 1970. *Desmochitina minor* Eisenack; Jenkins, p. 275, Pl. 50, Figs 10, 12—17.

*Material.* — Fifty-five single tests and four chains consisting of two to three tests each. One of the specimens (Pl. 2, Fig. 10), considerably larger (220  $\mu$ ) and more elongate, has been identified as *Desmochitina* aff. *minor* Eisenack.

*Remarks.* — Eight informal intraspecific taxons were distinguished within the species *Desmochitina minor* by Eisenack (1958, 1962a). The Ordovician specimens from Międzygórz are most closely related to *Desmochitina minor* forma *typica* Eisenack, 1958, considered by other authors (Laufeld 1967; Jenkins 1969, 1970; and the present writer) as a separate species. The specimens from Międzygórz, considerably larger than so far known representatives of this species, differ only in size. The dimensions of five specimens from glauconite limestones ( $B_2$ ) from Estonia, as given by Eisenack (1958), are as follows: length from 84 to 116  $\mu$  and maximum diameter from 57 to 59  $\mu$ . The largest specimens, described by Jenkins (1970) from the Upper Ordovician of Oklahoma are 120  $\mu$  long and 86  $\mu$  wide. On the basis of collections from various Ordovician horizons of Poland, Kozłowski (1963) maintains that typical specimens are 135  $\mu$  in length and 120  $\mu$  in maximum diameter. The specimens from Międzygórz are 125 to 180  $\mu$  long and 115 to 135  $\mu$  in maximum diameter. According to Eisenack (1968), the size of *D. minor* forma *typica* is variable, larger forms being usually met with in the Lower rather than Upper Ordovician. Since the morphological details and size proportions of particular elements of the Międzygórz specimens almost do not differ at all from those of either the neotype of *D. minor* (cf. Eisenack 1958, 1962a), or most of so far described representatives of this species (*sensu stricto*), the present writer believes that the differences in size here discussed cannot provide a basis for excluding the specimens available from the species under study. In regard to dimensions, the specimens from Międzygórz are conformable with those from glauconite limestones ( $B_2$ ) of Estonia, described by Eisenack (1958) as *Desmochitina minor* forma *grandicolla* Eisenack, from which they differ, however, in a considerably narrower aperture and shorter colarette.

*Occurrence.* — This species, very common in the Ordovician, is usually abundantly represented and has an extensive stratigraphic range. According to Eisenack (1968), in the Baltic province it occurs from the Upper Arenigian glauconite limestones ( $B_2$ ) to the Upper Ashgillian. According to Umnova (1969), in the Moscow Syncline it appears only in the uppermost part of the Kunda stage, that is, in the Lower Llanvirnian ( $B_3$ ). However, the occurrence of this species in the Upper Arenigian was also found in Belgium (Martin 1969).

#### Genus *LAGENOCHITINA* Eisenack, 1931

Type species: *Lagenochitina baltica* Eisenack, 1931

*Lagenochitina* cf. *esthonica* Eisenack, 1955

(Pl. 2, Fig. 4)

*Material.* — Two incomplete specimens.

*Remarks.* — The two specimens may be only tentatively identified, since they lack the distal part of neck, which, in the species *Lagenochitina esthonica*, has a very characteristic colarette. In regard to shape, the Międzygórz specimens are most similar to some of those from the Lower Llanvirnian of England (Jenkins 1967, Pl. 74, Fig. 4), while in size they are conformable with those of the Upper Arenigian ( $B_2$ ) of Estonia, which, according to Eisenack (1955) are 400 to 660  $\mu$  long. The incomplete specimen from Międzygórz, shown in Pl. 2, Fig. 4, is 400  $\mu$  long. Specimens from the Lower Llanvirnian of Sweden and England are considerably larger, their length fluctuating between 650 and 1,360  $\mu$  (Eisenack 1955, 1968; Jenkins 1967). The Międzygórz specimens, somewhat similar to *Lagenochitina baltica* Eisenack, 1931, differ however in a stronger elongation and considerably larger dimensions.

*Occurrence.* — The stratigraphic range of the species is relatively narrow. It was described by Eisenack (1955, 1968) from glauconite limestones of the Upper Arenigian ( $B_2$ ) of Estonia and from the Lower Llanvirnian of Sweden. Its occurrence was also found by Mannil (1971) in the Upper Arenigian ( $B_2$ ) and Lower Llanvirnian of Northern Estonia and in the Lower Llanvirnian of the Moscow Synclise. Jenkins (1967) described this species from the Lower (?) Llanvirnian of England.

Genus *RHABDOCHITINA* Eisenack, 1931

Type species: *Rhabdochitina magna* Eisenack, 1931

*Rhabdochitina magna* Eisenack, 1931

(Pl. 3, Figs 1—3)

1931. *Rhabdochitina magna* n. sp.; Eisenack, p. 90, Pl. 3, Figs 16—18, Text-figs 3—5.  
 1961. *Rhabdochitina truncata* n. sp.; Taugordeau, p. 152, Pl. 5, Figs 78—79.  
 1965. *Rhabdochitina magna* Eisenack; Eisenack, p. 127, Pl. 10, Fig. 10.  
 1967. *Rhabdochitina magna* Eisenack; Jenkins, p. 466, Pl. 74, Figs 6, 9—10, 12.  
 1968. *Rhabdochitina magna* Eisenack; Eisenack, p. 187, Pl. 32; Fig. 1.  
 1969. *Rhabdochitina magna* Eisenack; Umnova, Pl. 1, Figs 1—2.  
 1969. *Rhabdochitina gallica* Taugordeau; Umnova, Pl. 1, Figs 3—4.

*Material.* — Five specimens, including only one complete.

*Remarks.* — The Ordovician specimens from Międzygórz differ from typical representatives of *R. magna* from the Baltic province (Eisenack 1931, 1962a, 1965) in a stronger contraction of the basal part and comparatively larger width. Eisenack (1962a) maintains that the length of the specimens from Baltic limestones varies from 874 to 1,350  $\mu$  and width from 80 to 113  $\mu$ , while the only complete specimen from Międzygórz is 1,126  $\mu$  long and 146  $\mu$  wide. A yet larger width in relation to length is displayed by specimens described by Jenkins (1967) from the Llandellian of England whose length fluctuates between 750 and 909  $\mu$  and width between 110 and 142  $\mu$ . In regard to the contraction at the base, the Międzygórz specimens are similar to forms described by Taugordeau (1961) under the name *R. truncata*. According to the last-named author, these forms differ from *R. magna* in a considerably larger elongation. In fact, the dimensions of the specimens described by Taugordeau (1961) and their length-to-width ratio are, however, within the range of variability of *R. magna*, given by Eisenack (1962a). The species *R. magna* is now understood very broadly and it is most likely to be divided in the future into several subspecies or even separate species.

*Occurrence.* — According to Eisenack (1968), in the Baltic province, typical forms of this species occur in the Upper Ordovician ( $F_1$  and  $F_2$ ) only, but other, similar forms may be found as early as beginning with the Upper Arenigian glauconite limestone ( $B_2$ ). The occurrence of *R. magna* in the Upper Arenigian and Llanvirnian of the Moscow Synclise was found by Umnova (1969). The form, identified by this author as *R. gallica* Taugordeau (cf. synonymy) and which, in the present writers' opinion, also belongs to *R. magna*, occurs in that region as early as the Lower Arenigian. This species was also described by Jenkins from the Llanvirnian and Llandellian of England.

STRATIGRAPHIC CONCLUSIONS

The assemblage of the Chitinozoa, occurring in the shales of conglomeratic series at Międzygórz, is composed of relatively large, smooth-walled forms devoid of ornamentation and all kinds appendages. Such

forms are typical of the Lower Ordovician. On the basis of so far known stratigraphic ranges of here occurring species, the age of the clayey shales should be estimated most likely as Upper Arenigian or Lower Llanvirnian. The situation of the conglomerates with fragments of shales in the profile overlaid by *Orthis* sandstones of Upper Arenigian age (cf. Bednarczyk 1971) would, therefore, be indicative of the Arenigian age of both the clayey shales and conglomerates formed by the reworking of these shales. These conclusions, which are in conformity with those drawn by J. Znosko and R. Chlebowski (1974), should, however, be still treated very cautiously, since the Chitinozoa have not so far been studied in detail and the stratigraphic ranges of here occurring species may turn out to be more extensive. Although the genera *Desmochitina* Eisenack, *Cyathochitina* Eisenack and *Rhabdochitina* Eisenack are very common in the Ordovician deposits and their occurrence has so far been never recorded below the Upper Arenigian, the fact should, however, be taken into account that the occurrence of the Chitinozoa in the Lower Arenigian and Tremadocian has so far been rather insufficiently recognized because of a very common great clasticity of these deposits in Europe.

*Institute of Geochemistry, Mineralogy and Petrography  
of the Warsaw University  
and  
Institute of Paleozoology  
of the Polish Academy of Sciences  
02-089 Warszawa, Al. Zwirki i Wigury 93  
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R. CHLEBOWSKI i H. SZANIAWSKI

CHITINOZOA ZE ZLEPIENCA MIĘDZYGÓRSKIEGO Z ORDOWIKU  
GÓR ŚWIĘTOKRZYSKICH

(Streszczenie)

W okruchach łupków ilastych będących jednym ze składników polimiktycznego zlepieńca dolnego ordowiku z Międzygórza koło Opatowa (fig. 1) stwierdzono obecność licznych Chitinozoa (por. pl. 1—2). Występujące tutaj gatunki: *Desmochitina minor* Eisenack, *Lagenochitina cf. esthonica* Eisenack i *Rhabdochitina magna* Eisenack, wskazują na ordowicki (po-tremadocki) wiek tych łupków. Ponieważ okruchy łupków są składnikami zlepieńca, wiek samego zlepieńca musi być młodszy niż dotychczas przyjmowano (tremadok wg Bednarczyka 1971). Najprawdopodobniej zlepieńiec międzygórski reprezentuje arenig, i to nie najniższe jego ogniwa (por. Znosko & Chlebowska 1974). Wśród badanych Chitinozoa opisano jeden gatunek nowy, *Cyathochitina primitiva* sp. n.

*Institut Geochemii, Mineralogii i Petrografii  
Uniwersytetu Warszawskiego*

oraz

*Zakład Paleozoologii Polskiej Akademii Nauk  
02-089 Warszawa, Al. Żwirki i Wigury 93  
Warszawa, w październiku 1973*

## PLATE 1

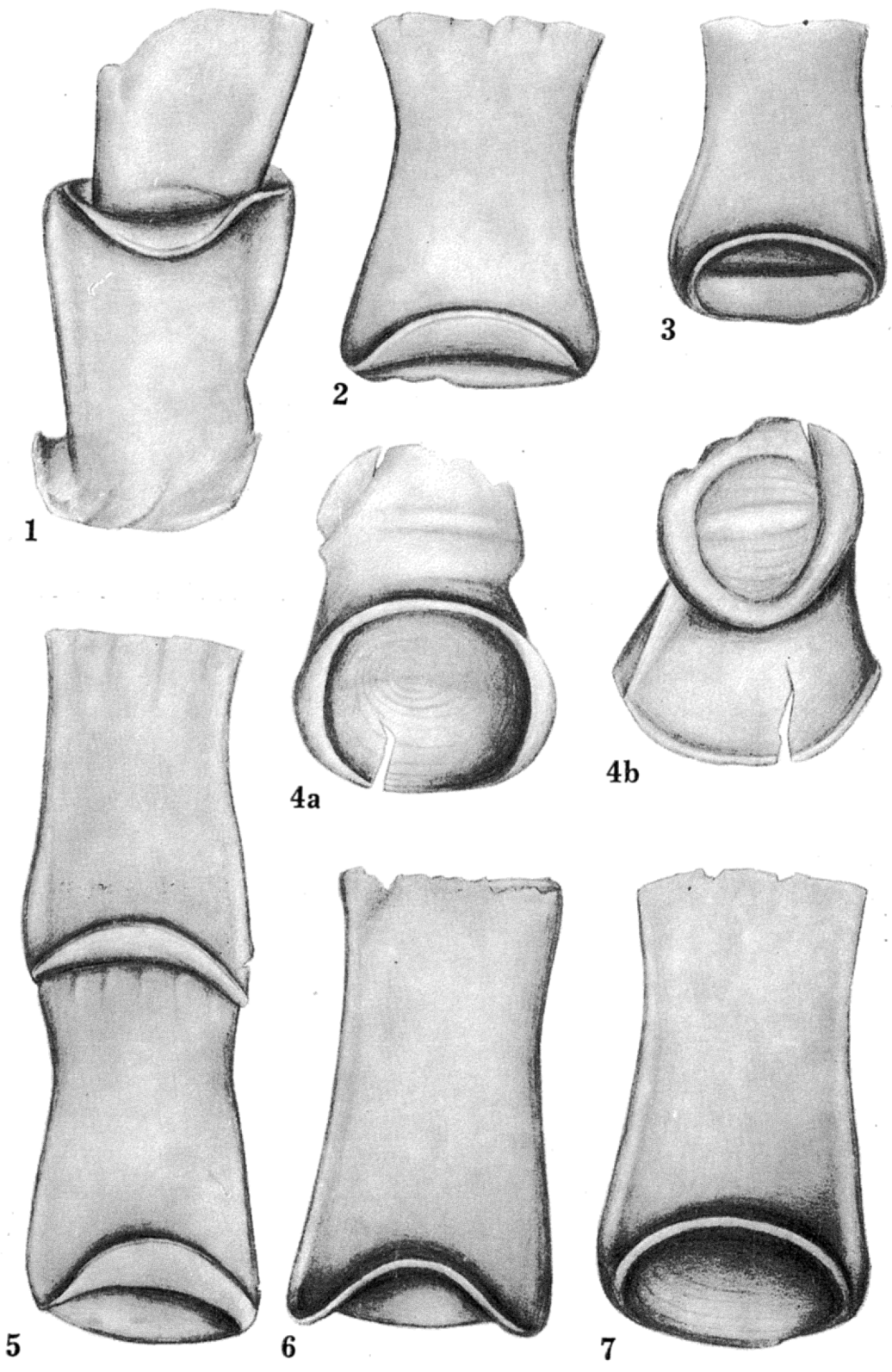
*Cyathochitina primitiva* sp. n.

1 — chain composed of two incomplete tests, 2 — single test with a comparatively narrow neck, 3 — small test with a longitudinal furrow on the base, 4 — deformed test (4a latero-basal view, 4b latero-apertural view, showing an impress of the base of next test in the chain), 5 — holotype: chain composed of two joined tests, 6 — long, cylindrical test, 7 — big test with visible base (Z. Pal. No. Ch. 1/1-7)

Lower Ordovician, Międzygórz conglomerate at Międzygórz, Holy Cross Mts

All specimens are completely flattened; taken c. X 200





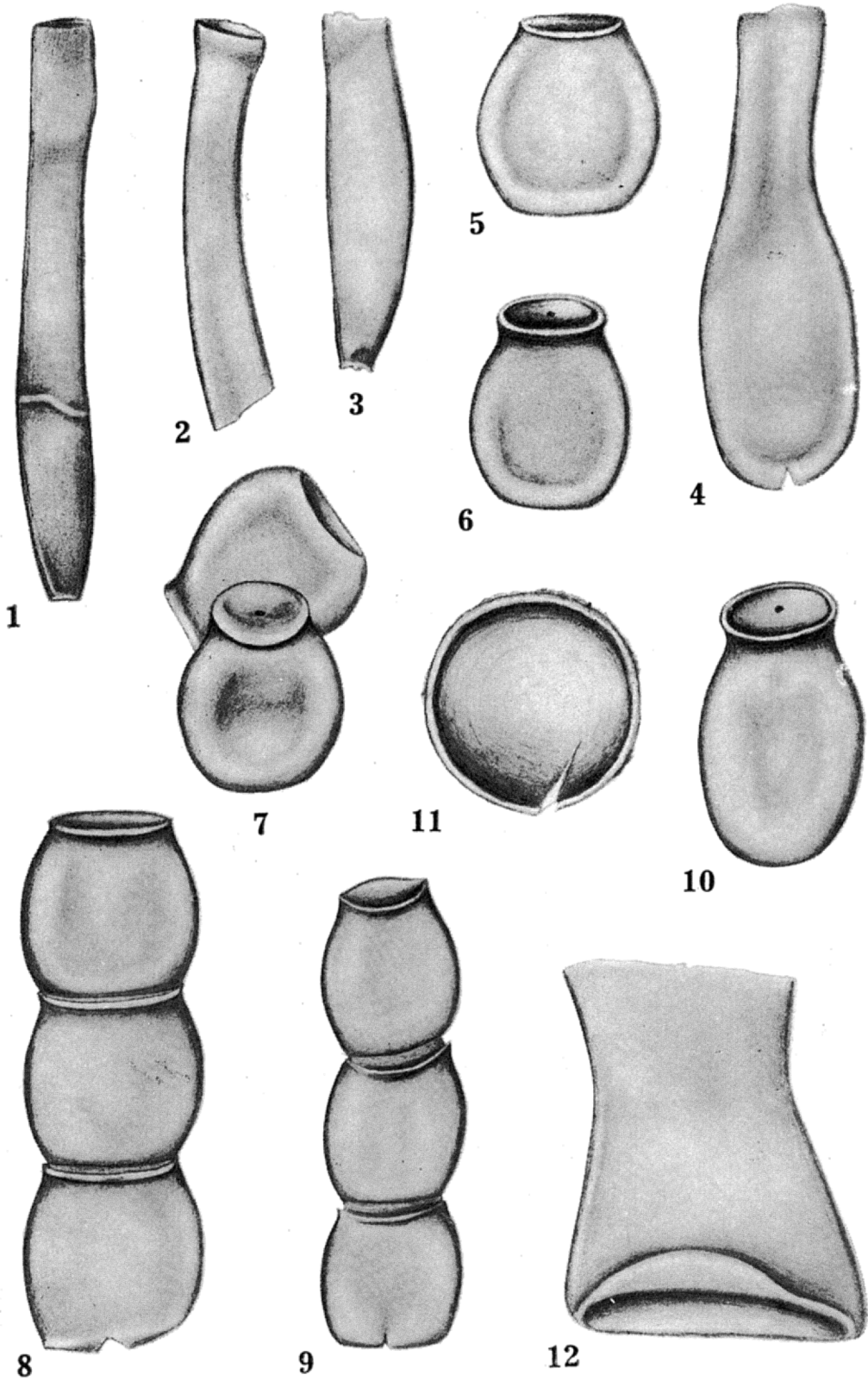


PLATE 2

- 1-3 — *Rhabdochitina magna* Eisenack; 1 — complete, slightly deformed specimen, 2 — upper part of test with a well developed colarette, 3 — basal part of test (Z. Pal. No. Ch. I/215-218).
- 4 — *Lagenochitina* cf. *esthonica* Eisenack; specimen with distal part of neck broken off (Z. Pal. No. Ch. I/210).
- 5-9 — *Desmochitina minor* Eisenack; 5 — single, comparatively wide test, 6 — single test with visible operculum, 7 — assemblage composed of two irregularly joined tests, 8 — chain composed of three tests, 9 — chain composed of three small tests (Z. Pal. No. Ch. I/150-154).
- 10 — *Desmochitina* aff. *minor* Eisenack; a comparatively long test with operculum (Z. Pal. No. Ch. I/200).
- 11-12 — *Cyathochitina primitiva* sp. n.; 11 — base with a well visible basal edge and concentric lines, 12 — comparatively wide test (Z. Pal. No. Ch. I/8-9).

Lower Ordovician, Międzygórz conglomerate at Międzygórz, Holy Cross Mts

All specimens are more or less flattened; Figs 1-3 taken c.  $\times$  80, Figs 4-12 taken c.  $\times$  200