

María del Carmen R. Díez (*), Fritz H. Cramer (*).—MORPHOLOGY OF *Pseudoclathrochitina carmenchui* (CRAMER 1964), A CHITINOZOAN SPECIES FROM THE LUDLOVIAN OF SPAIN.

Pseudoclathrochitina carmenchui (CRAMER 1964) is a chitinozoan species found in numerous locations in the Cantabrian Mountains, Northern Spain. On stratigraphic considerations the chronological position of this species is placed in the Ludlovian, probably late Ludlovian, and it may range as high as the Lower Gedinnian. Stratigraphic data are not sufficient to precisize this range any further. Miospore assemblages from overlying sediments prove with certainty that the species disappears before the Siegenian. In other words, *P. carmenchui* attains abundance where, in the Cantabrian area, miospores begin to diversify and when the sedimentary area shallows up; its range begins after the disappearance of *Cyathochitina elenitae*, coincides with the acme of *Plectochitina carmina* and *Desmochitina urna* and also with the acme of *Geron guerillerus*. If *P. carmenchui* is facies-dependent, then its distribution pattern coincides with a peak in frequency of large green algae, i. e., a lagoonal to shallowing tidal flat environment.

Morphologically, the species has a superficial similarity to a colonial form called «*Conochitina oelandica silurica*» TAUGOURDEAU 1963, and even more to a «subspecies» of *Linoclitina cingulata* (EISENACK 1937), viz., *L. c. serrata* (TAUGOURDEAU & DE JEKHOWSKY 1960). Transmitted light microscope pictures of these «species» are shown in Plate 1 : 1 - 16; stereoscan pictures in Plates 2 and 3. Especially when these taxa are opaque, fragmented or otherwise damaged, it becomes quite difficult to distinguish between these species with the transmitted light microscope in routine sample analysis. This has its drawbacks for chronostratigraphic precision.

Originally we thought that the single difference between *P. carmenchui* and *L. cingulata serrata* lay in the perforated vs. smooth keel. We have found now that there are a number of fundamental differences in sculpture and construction between these taxa. These differences are so profound that even small fragments of *P. carmenchui* remain well recognizable. Both taxa are discussed and re-illustrated in the systematic portion of this note. To summarize the main differences:

P. carmenchui

1. operculate
2. pseudostome crenulate to straight
3. no aboral callus
4. reticulate sculpture
5. perforate «keel» (continuation of reticulate sculpture)

L. cingulata serrata et al.

1. copulate
2. pseudostome straight
3. stolon/prosome construction
4. smooth (but with occasional «growth» striae)
5. solid keel (formed by attachment of pseudostome to succeeding specimen).

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TAXONOMY

Pseudoclathrochitina carmenchui (CRAMER 1964)

Pl. 1 : 3-6, 10, 11, 15, 16; 2 : 1-7; 3 : 6, 9.

- 1964 *Clathrochitina carmenchui*.—CRAMER: *Leidse Geol. Meded.*, vol. 30, p. 346, Pl. 22 : 8 - 10; 24 : 18*.
- 1966 *Pogonochitina carmenchui*.—TAUGOURDEAU: *Mém. Soc. Géol. France, N. S.*, vol. 45, pt. 1, *Mém.* 104, p. 427.
- 1966 *Pseudoclathrochitina carmenchuae*.—CRAMER: *Bull. Soc. belge Géol.*, vol. 75, p. 94, Pl. 3 : 61, 66.
- 1967 *Clathrochitina carmenchuae*.—CRAMER: *Bol. I. G. M. España*, nr. 77, p. 236,
- 1967 *Pseudoclathrochitina carmenchuae*.—CRAMER: *Not. Com. I. G. M. España*, vol. 94, pp. 45-52.

Pseudoclathrochitina is a monospecific genus at this time.

Original description and emendations.—«Collar transparent, smooth, with a simple boundary. Body chamber conical, somewhat convex, grading within very short distance into a perforated keel. The perforations show a roughly vertical lineation. The wall is not transparent, its surface is smooth; no internal structures observed.» (CRAMER 1964).

«(...) the organization and outline of *C. carmenchuae* are similar to those of *Eremochitina (Desmochitina) cingulata* (EISENACK 1937) (...) it frequently possesses an oral mucron. (...) The species is to accomodate taxa with vesicle outline and construction essentially similar to those of *Eremochitina cingulata*, but with a perforate cingulum and oral mucron. The numerous perforations in the cingulum are arranged in a more or less pronounced pattern parallel to the longitudinal vesicle axis. The cingulum does not form a set of grafted processes as found in some specimens of *Cyathochitina clathrata*, nor does it show anastomosing appendices as in *Plectochitina carminae*. Type species of the genus is «*Plectochitina carmenchuae* (CRAMER 1967)».

Dimensions.—Total length 100 to 210 microns; generally 140 to 180 microns; mode 160 microns.

Additional morphographic observations.—Although *P. carmenchui* has as yet not been found in coupled units, its morphology indicates that, as all other chitinozoans, it is a colonial form. Perhars colonial forms are never preserved (as in *Conochitina proboscifera*) because the colonial habitus was present only in a youthful, presumably non-thecate stage of the chitinozoan organism. But at any rate, that single units of *P. carmenchui* may represent portions of a chain-colony, perhaps detached before the acquisition of a theca, is clear from the morphology of this species. The chain-colonies, whether thecate or not, must have followed a pattern, constructed much in the same manner as *L. cingulata*. This is clearly recognized: we find simple, non-colonial operculate forms, Pl. 2 : 2, 4; 3 : 9 and the inoperculate ones, Pl. 1 : 10, 15; 2 : 1, 3, 6; 3 : 6 which, presumably are portions of a disintegrated chain-colony. Neither of the two stages shows a stolon of the types seen in e. g., *Desmochitina urna* (Pl. 3 : 10), *Linochitina cingulata*... *L. erratica* (Pl. 1 : 9, 12-14), *Cyathochitina* sp. (e. g. in EISENACK 1968: Pl. 1 : 10). No callus or stolon is present.

Inoperculate forms may have a crenulate pseudostome boundary; it generally flares out (Pl. 1 : 10; 2 : 1) but may also be terminated along a straight line (Pl. 1 : 4, 5; 2 : 6).

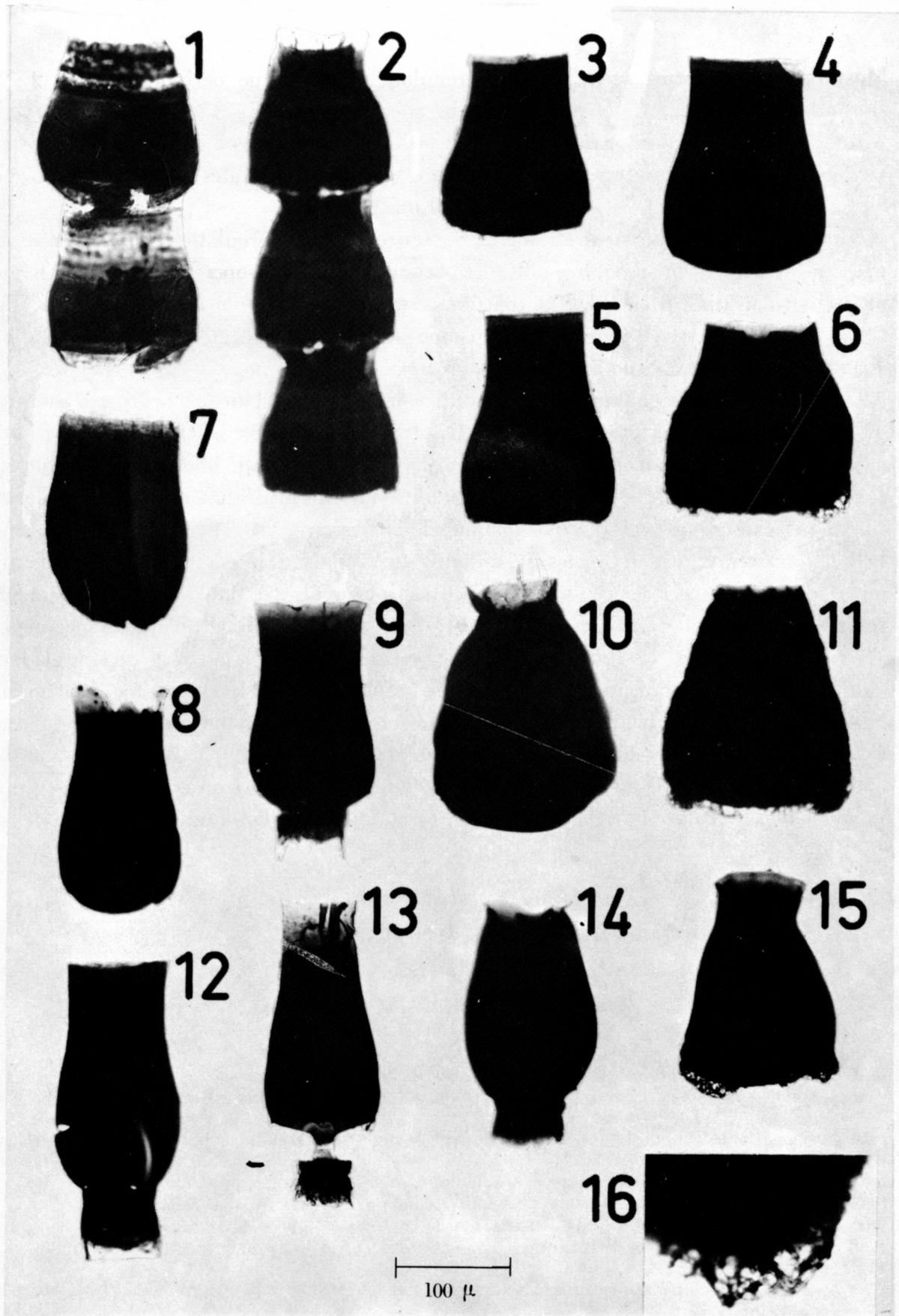


PLATE 1. Transmittd light pictures of *Linochitina cingulata* c. s. (1, 2, 7 - 9, 12 - 14) and of *Pseudoclathrochitina carmenchui* (3 - 6, 10, 11, 15, 16). Notice the strong similarity in outline between certain specimens of the two species (e. g., 1 and 2 vs. 3, 4 and 5). Striae are visible on fig. 1; the sculptured skirt is shown enlarged in fig. 16. Generally, in fair to marginally preserved and hence opaque specimens neither of these two characteristics is visible in the transmitted light microscope in either normal or infrared light.

The magnification of all figures except fig. 16, is indicated by the 100 micron bar; for fig. 16 the bar is 20 microns long.

Most operculate forms seem to have crenulate pseudostome periphery. Plate 2 : 2, show the operculum; the operculum in the specimen of Plate 3 : 9 is clearly present within the upper portion of the neck. (Notice that this form has a straight pseudostome termination). No operculum is present in the specimens of Plates 1 : 3, 4; 2 : 6, and 3 : 6. These specimens have straight pseudostome edges.

The infrared pictures show the presence of an operculate or non-operculate prosome structures in some, but not all, specimens. The (non-operculate) prosomes are of the normal kind, *i. e.*, the type that is present in *L. cingulata serrata*. It is not distinguishable from the sequence of prosome structures illustrated so beautifully by TAUGOURDEAU & MAGLOIRE (1967) in *L. erraticata... L. cingulata*.

The species is characterized by a «perforated keel». This, according to the previous descriptions, perforate keel is in reality a continuation of the irregularly reticulate sculpture that covers most of the body wall except for the body chamber bottom. It seems that the sculpture is formed by an additional wall layer that covers the ectoderm, like a net extending over the body chamber edge as a skirt. The skirt is fragile and breaks off easily, which makes it difficult to recognize in shattered or thermally metamorphosed specimens. The reticulate sculpture of the flanks of the specimens remains recognizable in tiny fragments, even on completely opaqued specimens.

M a t e r i a l e x a m i n e d.—The species is very abundant in the Upper Ludlovian of the Cantabrian Mountains; the material used in the scanning electron microscope work comes from the village of Felechas, North of the road from Boñar to Sabero and Cistierna in the Province of León, at [42° 50' 55" N; 1° 32' 15" W] on the southern flank of the Cantabrian Mountains. The sampled horizon is the topmost thick green shale intercalation of the San Pedro Formation and is late Ludlovian in age.

Linochitina cingulata (EISENACK 1937)
serrata (TAUGOURDEAU & DE JEKHOWSKY 1960) and
Linochitina cingulata (EISENACK 1937) *p. p.*

Plate 1 : 1, 2, 7-9, 12-14; 3 : 1-5, 7, 8.

- 1937 *Desmochitina cingulata*.—EISENACK: *Palaeont. Z.* 19, p. 220, Pl. 15 : 6, 7.
- 1960 *Desmochitina cingulata serrata*.—TAUGOURDEAU & DE JEKHOWSKY: *Rev. Inst. français Pétr.*, vol. 15, p. 1226, Pl. 6 : 76 - 81.
- 1960 *Desmochitina cf. cingulata*.—TAUGOURDEAU & DE JEKHOWSKY: *Rev. Inst. français Pétr.*, vol. 15, p. 1226.
- 1964 *Desmochitina* sp.—TAUGOURDEAU & MAGLOIRE: *Grana Palyn.*, vol. 6, p. 37, Pl. 4: 28, 32.
- 1964 *Desmochitina cingulata*.—CRAMER: *Leidse Geol. Meded.*, vol. 30, p. 348, Pl. 22: 17.
- 1966 *Eremochitina cingulata*.—CRAMER: *Bull. Soc. belge Géol.*, vol. 75, p. 93, Pl. 3: 71, 72.
- 1968 *Linochitina cingulata*.—EISENACK: *Palaeontographica A*, vol. 131, pp. 170-171, Pl. 24 : 12, 16; 29 : 29-32; 31 : 18.
- 1968 *Desmochitina cingulata serrata*.—JARDINÉ & YAPAUDJIAN: *Rev. Inst. français Pétr.*, vol. 23, p. 468, Pl. 6: 17.
- 1969 *Desmochitina cingulata*.—MACLOIRE: *Int. Symp. Devonian Syst., Calgary 1967*, vol. 2, pp. 481 - 482, Pl. 2: 23; 4: 27; 5: 18.
- 1973 *Linochitina cingulata*.—CRAMER: *J. Paleont.*, vol. 47, p. 282, Pl. 2: 25, 26.

Linochitina erraticata (EISENACK 1931), *L. cingulata*, and *L. c. serrata* form, especially at the higher Silurian paleolatitudes, a continuously variable morphologi-

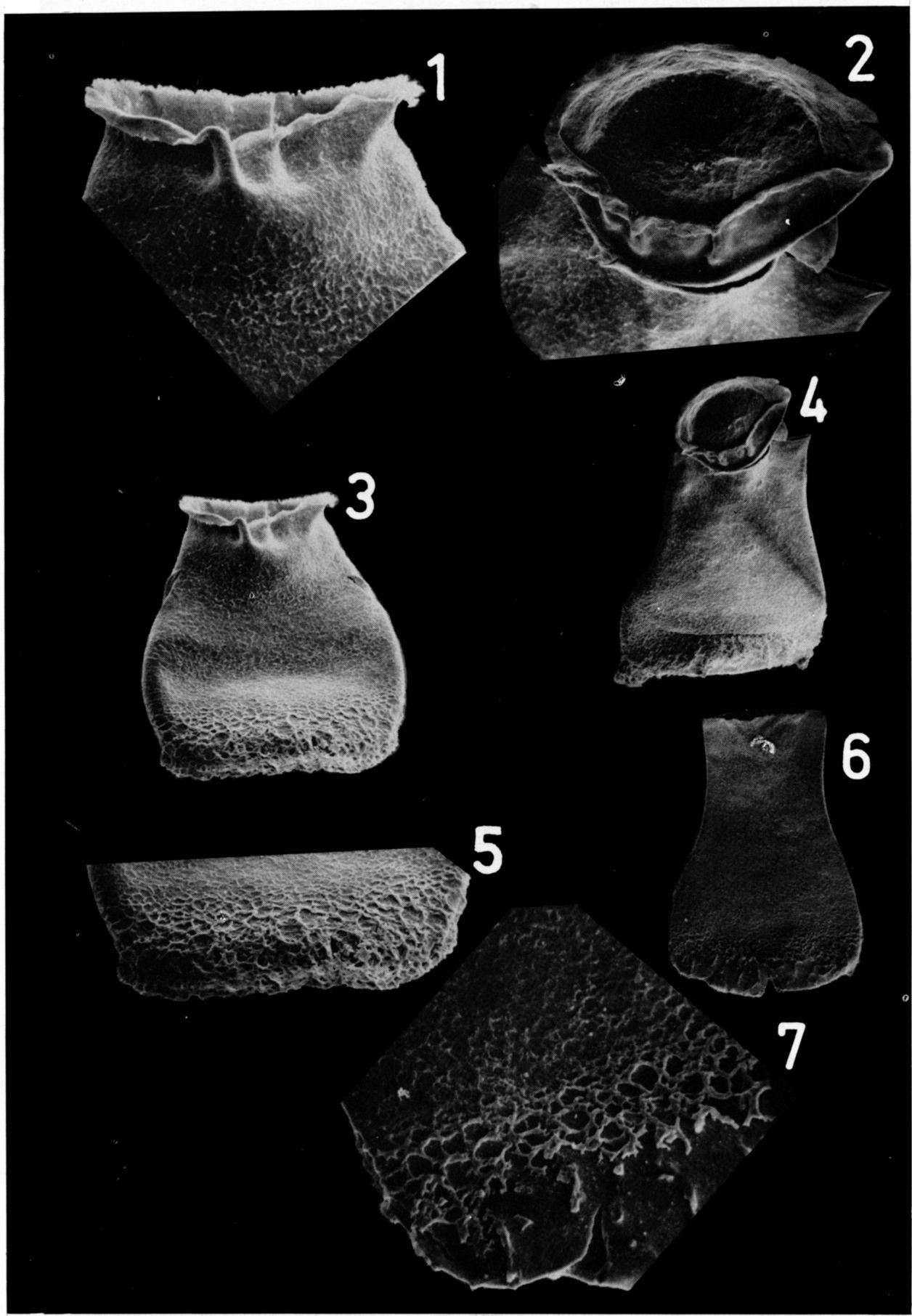


PLATE 2. Stereoscan pictures of *Pseudoclathrochitina carmenchui*. Notice variation in outline of vesicle (3 vs. 6), of periphery (1 vs. 6), sculpture cover and of sculpture morphology.

cally transitional series. It is the short and plump forms (*i. e.*, those answering to the diagnoses of *L. cingulata* and *L. c. serrata*) which, when confused with *P. carmenchui*, will cause wrong age assignments.

The original descriptions and emendations of *L. cingulata* and *L. c. erratica* are:

«Die Einzelblasen dieser Art sind etwa Krugförmig gestaltet. Die distale Hälfte hat ungefähr die Form einer Dreiviertel-Kugel, sie geht altmäßig ohne Kragenbildung in den kurzen, zylindrischen Halsteil über, dessen Mündung recht weit ist. Die Copula ist sehr klein und dünn so daß sie in der Kolonie nicht zu sehen ist. Die Blasen stecken mit ihrem distalen Pol in der weiten Mündung der vorhergehenden Blase. Die Copula wird so verdeckt und kann nur bei Einzelblasen oder der untersten Blase einer Kolonie beobachtet werden. Eine Fußscheibe fehlt.

«Charakteristisch für die Art ist ein scharfer Ringgrat, der den distalen Pol umgibt. Bei der völlig undurchsichtigen Farbung des Fossils ist er nur bei Auflicht sichtbar; sonst gibt er sich nur an den Seiten als kleine, spitze Hervorrägungen zu erkennen.

«Die größte Kolonie hat fünf Blasen. Damit ist bewiesen, daß die Ketten länger sein können, als bisher bei *Desmochitina*-Arten beobachtet wurde, and daß die Vierzahl nur zufällig ist.

«Länge der Einzelblasen ca. 0,1 mm; Länge der abgebildeten Kolonie 0,5 mm; L : B = ca. 1,4 (bei Einzelblasen); Mündungsweite ca. 75 %.» (EISENACK 1937).

EISENACK 1968: pp. 170, 171: «Vgl. 1937, S. 220 mit dem Zusatz daß Bauch und Hals sehr allmählig ineinander übergehen können. (...) Die Ringleiste bei *L. cingulata* ist nicht homolog dem bis zu Flügelsaum ausartenden Pol-Rand bei Cyathochitina-Arten; die Polfläche liegt nicht vertieft innerhalb der Ringleiste. Diese kann gelegentlich sehr reduziert sein, so daß die Unterscheidung von *L. erratica* schwierig ist.»

Linochitina cingulata serrata.—«Colonies formées de deux à dix loges, tronconiques à la base, cylindriques dans la moitié supérieure. Le fond plus ou moins bombé est bordé d'une fine carène denticulée. La communication entre les loges est assurée par de larges cupola dont la partie inférieure est mince et veinée. Les loges montrent de fines striés (très rarement visibles) dans la partie supérieure.

Dimensions de l'holotype: longueur: 100 μ ; largeur: 70 μ (pour une loge).» (TAUGOURDEAU & DE JEKHOWSKY 1960: p. 1.226).

These definitions cover the morphology of the group adequately; Plate 1 : 1 illustrates a striate form; Plate 1 : 2 and Plate 3 : 3 - 5 show average forms from high Silurian paleolatitudes.

CONCLUSIONS

P. carmenchui is an acopulate species from Northern Spain that is restricted to the Ludlovian, probably to the late Ludlovian; *L. cingulata/L. cingulata serrata* which are copulate, range in the same area from the late Llandoveryan to the early Gedinnian, but literature accounts place its range bottom still lower in the Silurian. Certain individual morphological characters, such as: operculum, crenulate pseudostome

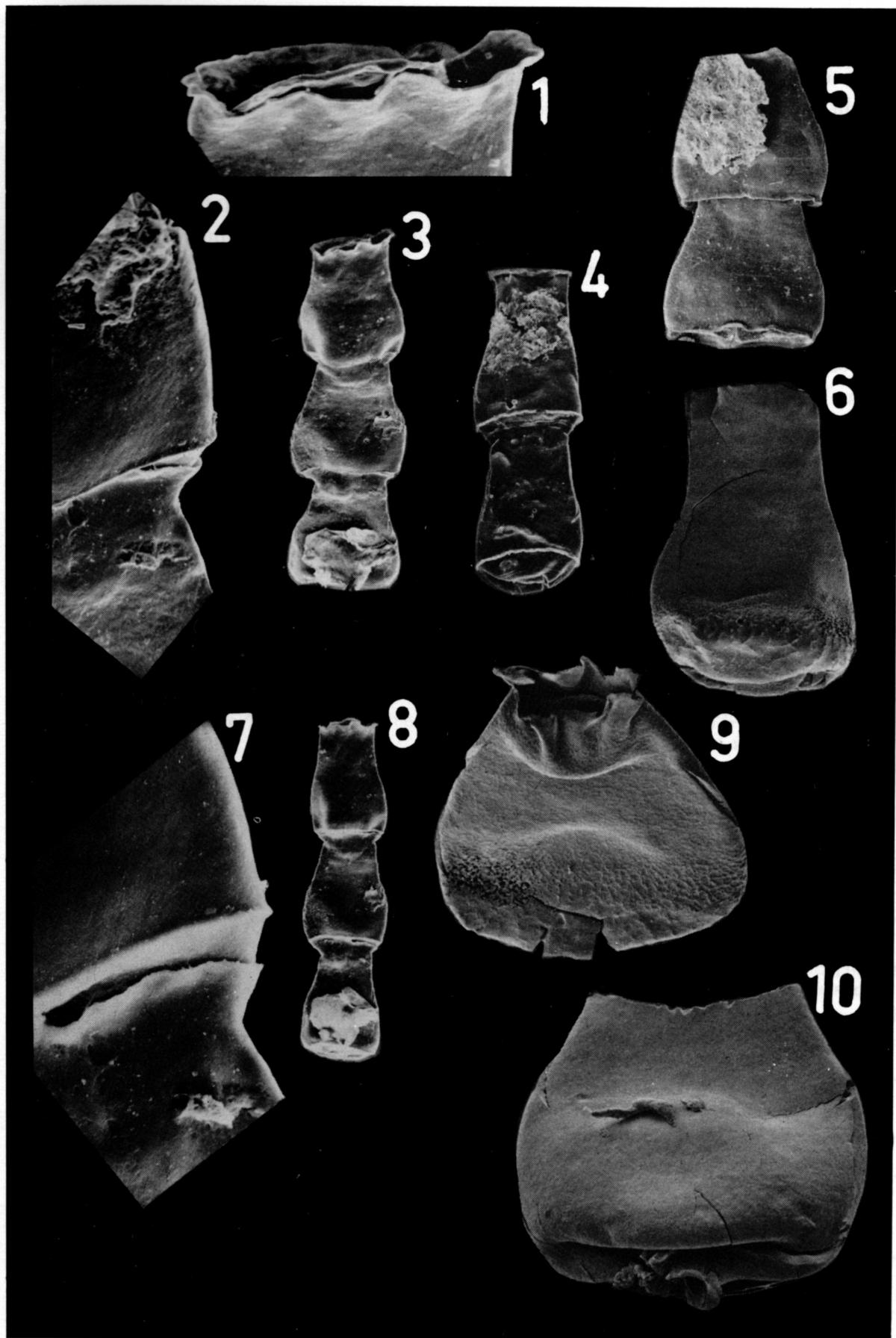


PLATE 3. Stereoscan pictures of *Linochitina cingulata* c. s. (1-5, 7, 8) *Pseudoclathrochitina carmenchui* (6, 9) and *Desmochitina urna* (10). Striae on *L. cingulata* visible on figure 3 and 5; variability in morphology and sculpture of *P. carmenchui* shown by figures 6 and 9. Figure 9 shows deformational effect of in-place operculum in compressed specimen, giving it a superficial similarity (in transmitted light) to *D. urna* (fig. 10).

periphery, absence of aboral callus or stolon are present only in *P. carmenchui*, but not in the other taxon. That taxon has a complex prosome/stolon/copula structure, a straight pseudostome periphery and a true keel whereas *P. carmenchui* has what is called a «perforate keel».

Scanning electron microscope work shows that the «perforated keel» of *P. carmenchui* is in reality a skirt-like extension of the kind of reticulate sculpture formed by the periderm, a thin wall layer on top of the ectoderm, on the flanks of the specimens (the sculptured periderm is absent at the body chamber bottom). *L. cingulata* et al. is smooth; no sculptured periderm is present. The sculptured periderm on *P. carmenchui* is sufficiently characteristic and coarse enough to remain visible on fragments, and even on specimens that have undergone rather strong incipient thermal metamorphism. We have not found any sculpture similar to that of *P. carmenchui* on other chitinozoan taxa (*Kalochitina* et al. which may have a slight constructional resemblance, have a completely different sculpture of the periderm). Hence, *P. carmenchui* will prove to be a very useful zone fossil for the tidal flat environment of the *Neovervachium carminae* biofacies.

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