Two Hollinid Ostracodes from the Silurian Mulde Marl of Gotland

By

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ABSTRACT.—Two ostracode species belonging to the family *Hollinidae* are described from the Middle Silurian Mulde marl of Gotland, Sweden. A new genus *Triemilomatella* is proposed, with the new species *T. prisca* as the type species. The other species described is provisionally assigned to the genus *Parabolbina*, but since only tecnomorphs have been found this species cannot be properly defined. The dimorphism in *Triemilomatella* is shown to be of locular type. The new subfamily *Ctenoloculininae* is proposed for the hollinids with locular dimorphism.

Introduction

In 1953 HENNINGSMOEN (pp. 240–241, Pl. 1, Figs. 5–8) discussed dimorphic characters, and figured both dimorphs of a hollinid ostracode species from the Silurian Mulde marl of Gotland determined by him as *Parabolbina auricularis* (JONES). A closer study of new material of this species revealed new dimorphic features. A comparison of the Mulde specimens with photographs of the holotype of *Bollia auricularis* JONES (1887, Pl. XIII, Figs. 10a–c), kindly supplied by the authorities of the British Museum (Natural History) proved the Mulde specimens to be specifically different from the English species. Further studies showed that these species belong to a new genus for which here the name *Triemilomatella* n. gen. is proposed. During the general examination of the Mulde ostracode fauna (MARTINSSON 1955 and 1956) another previously undescribed hollinid ostracode was found which apparently belongs to *Parabolbina*. As only tecnomorphic carapaces have been found this species cannot be properly defined at present, and is described here as *Parabolbina* sp.

The terminology of the ostracode carapace employed in the present paper corresponds largely to that applied by KESLING (1951b) as emended and completed in a forthcoming paper by JAANUSSON (1956). The dimorphic adventral structure for which the term carinate (= carinal) has been used (HESSLAND 1949, HENNINGSMOEN 1953) is called the *histial structure*, chiefly because the term "carinal" has previously been applied to a quite different type of adventral extensions of the carapace of the podocope ostracodes. As suggested by JAANUSSON (1956) the adventral dimorphic extensions of hollinids are not of velar origin, as supposed by KESLING (1952) and HENNINGSMOEN (1953), but represent most probably a histial structure, homologous with that of the Ordovician sigmoopsids. The terms female and male type (HENNINGSMOEN 1953)

are replaced by the terms *heteromorphs* and *tecnomorphs*, respectively. As tecnomorphs are designated specimens belonging to preadult instars as well as adult specimens which are essentially similar to the preadult instars, and which do not exhibit the dimorphic characters of the heteromorphs. The introduction of this term has been necessitated by the frequent impossibility without access to an extensive material for measurements to distinguish between the adult valves of the "male type" and the preadult instars of both sexes. The area of the domicilium in front of S 2 is termed the *preadductorial area* and that behind S 2 the *postadductorial area*. The area between the histial structure and the free margin is called the *subhistial field*. A dorsum is termed *epicline* when it projects beyond the hinge line, and *hypocline* when it does not conceal the hinge line in strictly lateral view. The abbreviations (tr.) (= transversal) and (long.) (= longitudinal) are used in the descriptions to indicate the direction of the length or width of the part of the valve referred to.

All material described in the present paper belongs to the Museum of the Palaeontological Institute, Uppsala University, and has been collected by C. WIMAN, V. JAANUSSON, and A. MARTINSSON. The authors are indebted to Mr. R. BAKER, British Museum (Nat. Hist.), for having placed photographs of the holotype of *Bollia auricularis* JONES at their disposal.

Fam. *Hollinidae* SWARTZ, 1936

Subfam. *Ctenoloculininae* nov.

DIAGNOSIS.—Unisulcate to quadrilobate *Hollinidae* with locular dimorphism. Subhistial field of the heteromorphs provided with two or more loculi.

GENERA. — *Ctenoloculina* BASSLER, 1941
Parabolbina SWARTZ, 1936
Tetrasacculus STEWART, 1936
Bisacculus STEWART & HENDRIX, 1945
Subligaculum KESLING & MCMILLAN, 1951
Abditoloculina KESLING, 1952
Triemilomatella n. gen.

DISCUSSION.—The conception of the family *Hollinidae* in the present paper coincides on the whole with that of HENNINGSMOEN (1953). Following KESLING (1951a) *Sulcicuneus* KESLING, 1951, is, however, considered to belong to the family *Primitiopsidae* (cf. MARTINSSON 1955).

As pointed out by KESLING (1952, Fig. 1, pp. 770–771) the loculate and non-loculate Devonian hollinid genera form separate, apparently monophyletic groups. The discovery of a Middle Silurian loculate hollinid genus described in the present paper extends the distribution of the group with locular dimorphism further backwards in time. In order to distinguish in the classification

of this family between the two main phylogenetic lineages of hollinids, the new subfamily *Ctenoloculininae* is proposed in the present paper for the hollinids with a locular dimorphism. There is, however, at present no doubt that *Hollininae* and *Ctenoloculininae* are so closely related as to warrant their inclusion in the same family. The general pattern of lobation as well as the formation of the heteromorphic histial flange are almost identical in both subfamilies.

The loculi in *Triemilomatella* are shallow, and separated by very low and rounded partitions. Since *T. prisca* is the earliest loculate hollinid species hitherto known the poor development of the loculi may represent primitive conditions. This would suggest a somewhat independent formation of the histial flange and of the interlocular transversal septa, but more material of Silurian loculate hollinids should be studied in order to decide this question.

Gen. *Triemilomatella* n. gen.

TYPE SPECIES.—*Triemilomatella prisca* n. sp.

DERIVATION OF THE NAME.—From Greek τριήμι = one and a half, and the diminutive of λωματος = provided with a limb, alluding to the "one and a half" arrangement of the histial flange in the tecnomorphs.

DIAGNOSIS.—Unisulcate, with a relatively broad, moderately long (tr.) sulcus extending to half the height of the valve or slightly longer. Tecnomorphs with a bilobal histial structure consisting of a short posterior and a long anterior flange. Anterior ends of both flanges merge into the general surface of the domicilium, posterior ends abrupt, pointed. Heteromorphs with a long, continuous, flange-like histium possessing the same general width as the tecnomorphic histium, posterior end usually extended into a spine. In both dimorphs the histium reaches nearly to the transversal mid-line of the postadductorial area. Subhistial field in heteromorphs of the type species with 6(–7) loculus-like shallow depressions.

SPECIES.—*Bollia auricularis* JONES, 1887 and *Triemilomatella prisca* n. sp.

DISCUSSION.—The species here referred to *Triemilomatella* were included by HENNINGSMOEN (1953, p. 241) in *Parabolbina*. The tecnomorphs of the latter genus possess, however, two pairs of prominent spurs and no flange, and the heteromorphic histial flange, though similar in general shape and extension to that of *Triemilomatella*, has a strongly undulate lateral surface. The radially directed furrows upon this surface evidently correspond to the partitions between the loculi on the subhistial field. These differences between *Parabolina* and *Triemilomatella* are considered by the present writers to be of generic importance. In the bilobal shape of the tecnomorphic histial structure *Subligaculum* displays a certain similarity to *Triemilomatella*. Contrary to the latter genus it is, however, the anterior and not the posterior part of the histial structure which is longer in *Subligaculum*, the former being shaped as a mode-

rately long (long.) flange, whereas the posterior part consists of a prominent spur like that of *Parabolbina* (cf. KESLING & MCMILLAN 1951, Pl. 2, Figs. 3–4). In *Subligaculum* the lateral surface of the heteromorphic histial flange is also strongly undulate, and the subhistial field is provided with a row of rather deep loculi. Moreover, the lobation of the latter genus differs from that of *Triemilomatella*. In spite of these differences *Triemilomatella* is most probably related to the two genera discussed above.

OCCURRENCE.—Middle Silurian (Wenlockian). Northern Europe (Gotland, England).

Triemilomatella prisca n. sp.

Pl. I, Figs. 1–6.

1901 *Bollia auricularis* JONES — JONES in CHAPMAN, p. 150.
1934 *Ctenobolbina auricularis* (JONES) — BASSLER & KELLETT, p. 67, p. 240 (partim).
1953 *Parabolbina auricularis* (JONES) — HENNINGSMOEN, p. 240, Pl. 1, Figs. 5–8.

HOLOTYPE.—Heteromorphic carapace, Museum of the Palaeontological Inst., Uppsala, no. G 129, figured on Pl. I, Fig. 1.

TYPE LOCALITY.—Gotland, parish of Fröjel, Mulde brickyard.

TYPE STRATUM.—Mulde marl, probably uppermost Wenlockian (cf. HEDE 1942, p. 19).

DERIVATION OF THE NAME.—Lat. *priscus*, early occurring, primitive, alluding to the fact that this species is one of the oldest loculate hollinids hitherto described.

DIAGNOSIS.—Length of the heteromorphic valves 550–730 μ, postadductorial area comparatively short, anterior cardinal angle about 105–110°. The pre- and postadductorial areas rather strongly convex, greatest convexity as a rule at about the transversal mid-line of the postadductorial area. Domicilium ornamented by closely spaced small tubercles of about uniform size, frequently arranged into rows.

MATERIAL.—275 separate valves, 100 carapaces.

DESCRIPTION.—Anterior half of the valve slightly higher than the posterior half, anterior end more broadly rounded. Posterior cardinal angle slightly smaller than the anterior cardinal angle which is about 105–110°. Both the pre- and post-adductorial areas rather strongly convex, greatest convexity as a rule at about the transversal mid-line of the postadductorial area.

Hinge-line long, dorsum rather high, convex and slightly epicline posteriorly, low and hypocline anteriorly. The cardinal corners of the left valve prominent, thickened and slightly protruding beyond the hinge-line (cf. Pl. I, Figs. 1 d, 3 d); those of the right valve flattened. The left valve overlaps the right one along the free margin, the overlap being conspicuous posteriorly and anteriorly, but very slight to almost absent ventrally. Both valves possess a narrow, low marginal ridge consisting of coalesced tubercles (4–5 per 10 μ) close to the free edge.

The hingement of the left valve consists of a simple, thin, usually poorly defined edge in the middle of the dorsal contact surface along the whole dorsal margin. Close to the anterior cardinal corner the edge becomes almost obsolete. The right valve with a narrow groove in the middle of the dorsal contact surface; its posterior end as a rule slightly expanding.

Sulcus moderately wide (long.), deep, transversally directed, slightly longer (tr.) than half the height of the valve. Its posterior margin more or less straight, anterior margin distinctly concave. The ventral end of the sulcus expands slightly, and continues anteroventrally in a shallow, poorly defined depression which disappears at about half the distance between the ventral end of the sulcus and the histium.

Tecnomorphic valves with bilobed histial structure, consisting of a long posterior and a short anterior flange. The posterior flange extends posteriorly roughly to the transversal mid-line of the postadductorial area or slightly behind it; its posterior margin is abrupt, the posterior end produced into a spine of varying length. Anteriorly the posterior flange extends to about the transversal mid-line of the pre-adductorial area or slightly in front of it, merging there into the general surface of the domicilium. The width (tr.) of the posterior flange increases in posterior direction. The anterior flange is short and situated anteroventrally. Its greatest width is usually slightly less than that of the posterior flange, its posterior margin being abrupt, straight to concave, the posterior end slightly protruding in posterior direction. The anterodorsal part of the anterior flange is conspicuously curved towards the free edge (cf. Pl. I, Fig. 3a), its anterior end merging into the general surface of the domicilium ventrally of the horizontal mid-line of the preadductorial area.

Heteromorphic valves provided with a long (long.) continuous histial flange. Its general width is equal to, and its posterior extension identical with that of the posterior tecnomorphic flange, and the posterior end is commonly extended into a stout spine, broken off on most specimens studied. Anteroventrally the contact area between the flange and the domicilium is situated higher up laterally than the corresponding part of the tecnomorphic valves; the anterior end reaches also considerably higher up dorsally than that of the tecnomorphs (cf. Pl. I, Figs. 1a, 2a), merging into the general surface of the domicilium somewhat dorsally of the horizontal mid-line of the preadductorial area, and as a rule also slightly dorsally of the horizontal mid-line through the middle of the sulcus.

In both dimorphs the lateral surface of the histial flange is smooth and slightly concave, situated in ventral view well below the top of the domicilium, and separated from the lateral surface of the domicilium by a usually rather distinct change in convexity. The flange is conspicuously thickened along its distal margin.

Tecnomorphic valves with a slightly concave subhistial field without any trace of loculi. In heteromorphic valves the subhistial field is faintly undu-

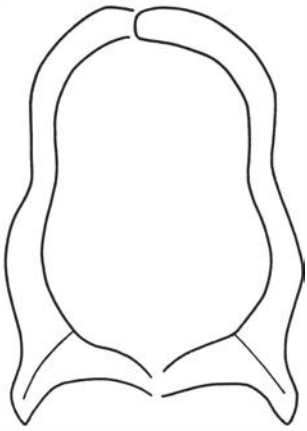

Fig. 1. Transversal section (roughly at the level of S2) of a tecnomorphic carapace of *Triemilomatella prisca* n. sp. After a thin section, × 100. On account of recrystallization the contact area of the valves is not clearly discernible.

late and provided with 6(–7) wide and faint depressions usually visible only in strongly inclined illumination. They are invariably present on all heteromorphs examined. These depressions evidently represent orimentary loculi.

Lateral surface of the domicilium except the sulcus ornamented by closely set, distinct, small tubercles or granules of about uniform size. On some parts of the domicilium the tubercles appear to be arranged in distinct rows, on some specimens, however, such rows are not distinguishable. The tecnomorphic subhistial field is ornamented with tubercles of the same appearance, whereas the heteromorphic, loculiferous subhistial field is smooth. The ornamentation especially on the protruding parts of the domicilium seems to be easily worn off, giving to some specimens a smooth appearance.

Discussion.—Curiously enough no preadult instars have been found of this species in spite of the rather large material examined. Some tecnomorphic specimens with relatively weakly developed histial flanges were assumed to belong to the preadult instars, but their size dispersion falls within the limits of that of the heteromorphs. No explanation to this phenomenon can be given at present.

The size dispersion from a sample signed 1955:1 (Martinsson 1956) is shown in Fig. 2. The dimensions refer to single left valves or left valves of entire carapaces. The total length and the height over the sulcus, with histium included, have been recorded. The maximal size dispersion for the two dimorphs is:

Heteromorphs, length 550–730 μ,
height 495–610 μ,
tecnomorphs, length 615–730 μ,
height 475–555 μ.

From the diagram it is evident that the average tecnomorphs are somewhat lower and inconsiderably longer than the heteromorphs. 135 specimens were measured.

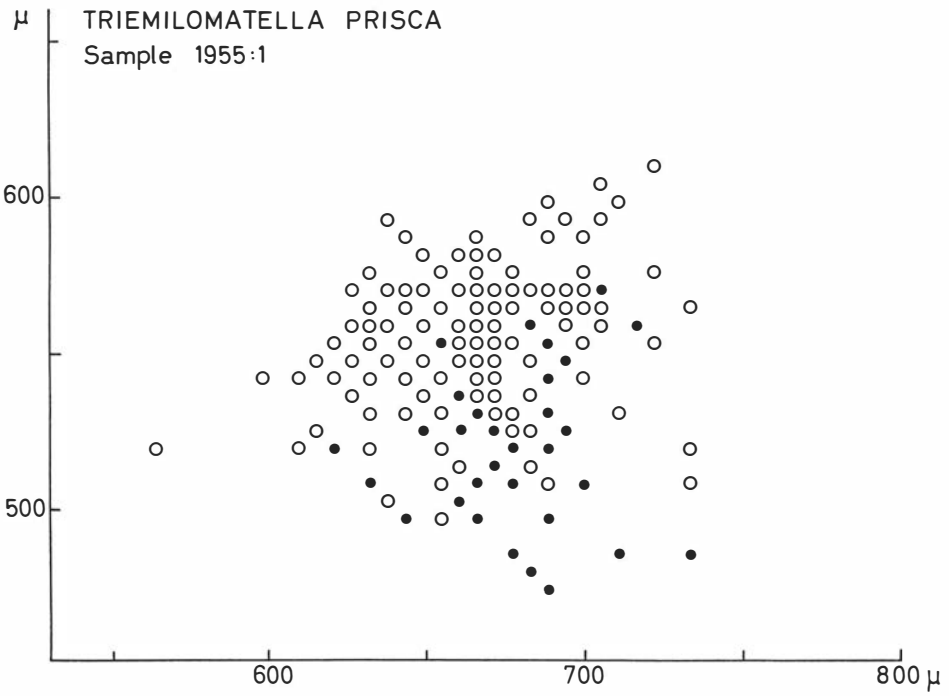

Fig. 2. Size dispersion of *Triemilomatella prisca*. Heteromorphs set down as circlets, tecnomorphs as dots. Height along the ordinate, length along the abscissa. All carapaces and valves in the sample belong to adult specimens. The tecnomorphs tend to be somewhat longer and lower than the heteromorphs.

The following sex ratios have been recorded from two samples:

Sample	Measured as	Tecnomorphs	Heteromorphs	Sex ratio %
1955: 1	carap. and left valves	32	103	24 : 76
1955: 1	carapaces only	4	4	50 : 50
1890: CW	carap. and left valves	37	55	40 : 60
1800: CW	carapaces only	28	26	52 : 48

It is difficult to decide whether the ratios calculated on carapaces should be preferred to those calculated on valves, but it may be of some significance that on the whole the heteromorphs dominate, which may indicate their being females. For further discussion concerning the size dispersion and sex ratio, cf. MARTINSSON (1956).

T. auricularis differs from *T. prisca inter alia* by the following characters: (1) the postadductorial area is relatively longer and narrower; (2) the dorsal part of the domicilium is less convex; (3) the greatest convexity of the valve lies considerably in front of the transversal mid-line of the postadductorial

area; (4) the anterior cardinal angle is 136° on the photographs of *T. auricularis* against about 105–110° in *T. prisca*; (5) the marginal ridges appear to be stronger. As pointed out by HENNINGSMOEN (1953, p. 240) the type specimen of *T. auricularis* is apparently a tecnomorphic carapace. It is provided with only one histial flange corresponding to the posterior histial flange of tecnomorphs of *T. prisca*, but without an examination of the actual specimen it cannot be ascertained whether the anterior flange is broken off or not developed. The surface of the domicilium appears to be smooth on the photograph of this specimen. Whether this is so in reality cannot be ascertained as the fine granulation does not always appear on photographs taken without ammonium chloride coating. The possibility of surface corrosion must also be taken into account if the specimen actually appears to be smooth.

OCCURRENCE.—Found so far only at the type locality.

Gen. *Parabolbina* SWARTZ, 1936

Parabolbina sp.

Pl. I, Figs. 7–8.

MATERIAL.—5 tecnomorphic carapaces.

DESCRIPTION.—Anterior half of the valve slightly, but distinctly higher than the posterior half, anterior end broadly rounded. Posterior cardinal angle about 100–105°.

Hinge-line long, dorsum high, very slightly hypocline posteriorly, low, poorly defined, and strongly hypocline anteriorly. Cardinal corners flattened, that of the left valve faintly thickened and slightly protruding. The left valve overlaps the right valve inconspicuously along the free margin. Left valve with a faint, denticulate marginal ridge; the right valve seems to be provided with a fainter, smooth ridge close to the free margin, its shape could, however, not be clearly observed. Hingement unknown since only closed carapaces were found.

Sulcus moderately broad, slightly longer (tr.) than half the height of the valve, transversally directed, deep, with a more or less straight posterior and concave anterior margin. Ventral end of the sulcus rather well defined, slightly expanded, continuing in two very shallow depressions, one longer, better defined, and posteroventrally directed, the other shorter and anteroventrally directed. Before reaching half the distance between the ventral end of the sulcus and the free margin of the valve the depressions merge into the general surface of the domicilium.

Carapace with two pairs of flattened, blade-like, quandrangular spurs, one of them smaller and situated anteroventrally, the other longer (tr.) and broader (long.), situated slightly in front of the transversal mid-line of the sulcus, and at a considerably greater distance from the free edge than the anterior spur.

The whole domicilial surface ornamented with closely spaced, distinct granules of about the same size and arrangement as in *Triemilomatella prisca*.

DIMENSIONS.—Length of the valves 550–730 μ, height of the valves (spurs included) 495–610 μ.

DISCUSSION.—The present five tecnomorphs appear to belong to a new *Parabolbina* species, but before the heteromorphic valves have been found the species cannot be properly defined. It seems to differ from the tecnomorphs of other *Parabolbina* species *inter alia* by its relatively broad, flattened spurs.

OCCURRENCE.—Gotland, parish of Fröjel, Mulde brickyard. Mulde marl, probably uppermost Wenlockian.

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Explanation of Plate I

In the plate every single specimen is designated by one number. The different views of a specimen are lettered as follows: *a* = anterior view; *d* = dorsal view; *i* = internal view; *l* = lateral view; *o* = oblique latero-ventral view; *v* = ventral view.

The photographic work was carried out by Mr. N. HJORTH. All specimens were whitened with ammonium chloride before photographing. Magnification of Figs. 1–4 and 7–8 × 45, of Figs. 5 and 6 × 52,5.

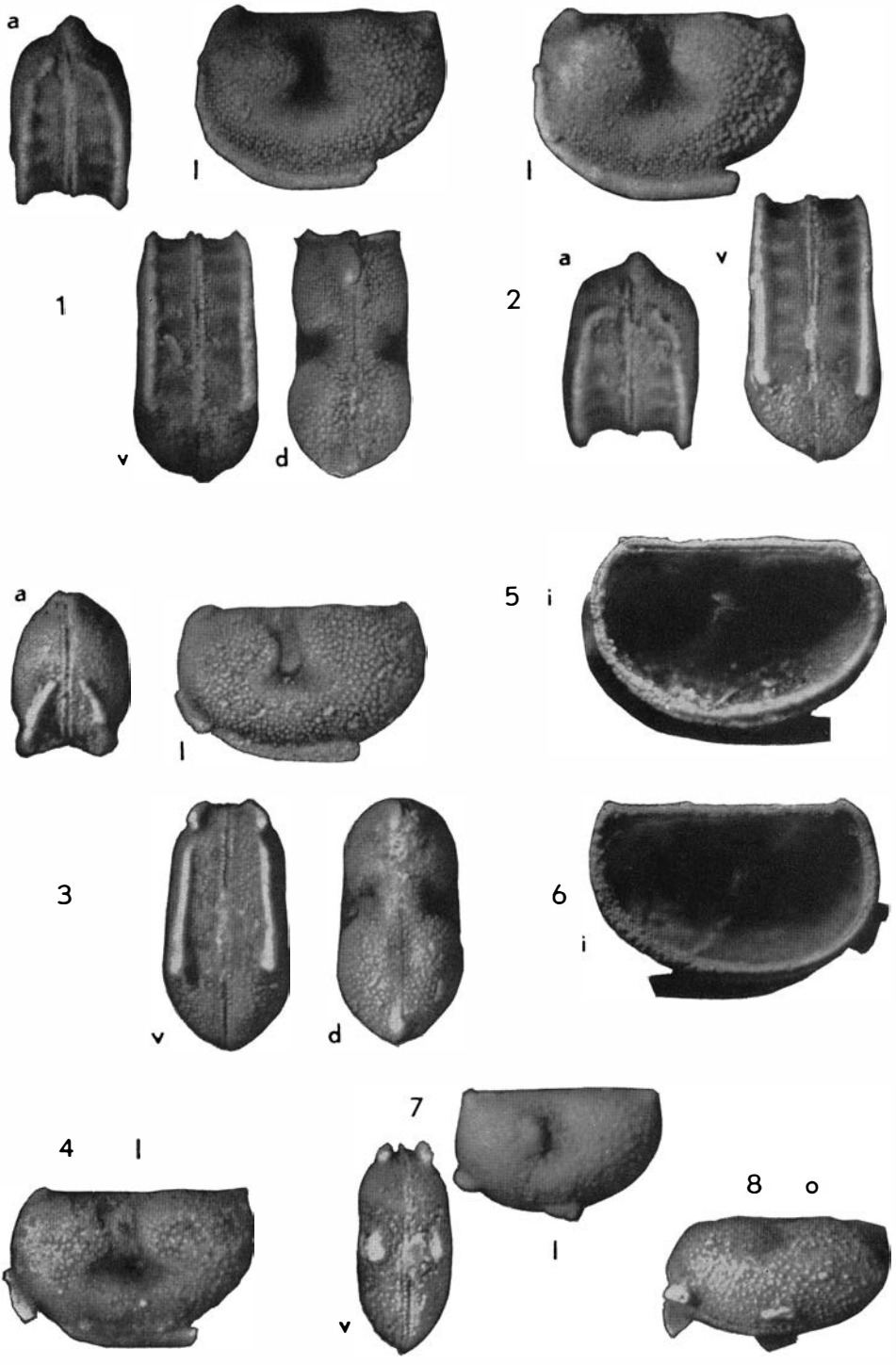
The numbers in brackets are the catalogue numbers in the Museum of the Palaeontological Institute, Uppsala.

Triemilomatella prisca n. gen., n. sp.

Fig. 1. Holotype. Heteromorphic carapace, posterior spine of the histium broken off (No. G 129).
Fig. 2. Heteromorphic carapace (No. G 130).
Fig. 3. Tecnomorphic carapace (No. G 131).
Fig. 4. Tecnomorphic carapace (No. G 132).
Fig. 5. Right heteromorphic valve (No. G 133).
Fig. 6. Left tecnomorphic valve (No. G 134).

Parabolbina sp.

Fig. 7. Tecnomorphic carapace (No. G 135).
Fig. 8. Tecnomorphic carapace (No. G 136).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