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Lower Cretaceous Terebratulidae of the Jura region

3. *TEREBRATULA SALEVENSIS* DE LORIOLO AND THE GENERA *PRAELONGITHYRIS* AND *TROPEOTHYRIS*

By FRANK A. MIDDLEMISS¹⁾

ABSTRACT

Terebratula salevensis DE LORIOLO is referred to the genus *Praelongithyris*. It is confined to the Jura region. Forms from other parts of France, Spain and Sardinia which have previously been confused with *P. salevensis* are described as new species *Tropeothyris funtanensis* and *Tropeothyris allavensis*. *Terebratula pilati* BACHMANN is also referred to the genus *Tropeothyris*. Three further new species are described: *Praelongithyris pajaudi*, *Tropeothyris luancensis* and *Tropeothyris islarensis*.

Introduction

Terebratula salevensis was first described by DE LORIOLO from the Neocomian of Mont-Salève, Haute-Savoie (DE LORIOLO 1863). The best description is by PICTET (1872, p. 72), who stresses the inflated appearance of the valves, the generally rounded form of the shell, lacking angles and narrowing anteriorly, and the incurvature of the umbo. DE LORIOLO, on the same page, emphasizes the narrow and thick shape of the shell.

SMIRNOVA (1960, 1972) identified as *T. salevensis* PICTET, 1872, a form occurring in some abundance in the Crimea, in rocks of Lower Barremian age according to her 1960 paper but reassessed as Berriasian in 1972. This form, judging by the published figure and description, has a strong external resemblance to DE LORIOLO's species in the strongly convex valves (especially in the umbonal area), short hinge line, arched lateral commissure, and folding confined to the anterior part of the shell. SMIRNOVA (1972) referred the form to her new genus *Tropeothyris* and, judging by the serial sections given as her Figure 35, the internal structures agree well with those of the type species *T. kugusemi* and the other new species described in the paper, *T. karakaschi* and *T. betchkunensis*, especially in the horizontal, slightly keeled hinge plates bearing the crural bases at approximately a right angle.

During the same 1966–72 period I had found terebratulids with closely comparable external and internal characters in northern Spain, southwestern France (Aude), Ibiza and Sardinia and it seemed obvious to refer these also to *T. salevensis* (MIDDLEMISS 1968, p. 21; 1973, Fig. 6; DIENI, MIDDLEMISS & OWEN 1975, p. 20). Since then I have found undescribed terebratulids in Provence and the Jura region, which have a general resemblance to *T. salevensis* in the rounded aspect of the shell shape, restriction of

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folding to the extreme anterior and incurvature of the umbo, and are also, upon examination of the serial sections, apparently to be referred to *Tropeothyris*. These are probably the forms which COTILLON identified as *T. salevensis* in his study of the Castellane Arc (COTILLON 1971). They are referred to a new species *Tropeothyris allavensis* in the present paper.

The specimens which I called *T. salevensis* from the Hauterivian and Aptian of Les Corbières (MIDDLEMISS 1968) and from the Lower Cretaceous of Ibiza (referred to in DIENI, MIDDLEMISS & OWEN 1975, p.21) soon aroused suspicion as they seemed too long and thin externally, and also because those from Les Corbières which had been sectioned (MIDDLEMISS 1968, Fig. 10) appeared to have hinge plates that were initially too concave and a transverse band too high and ogival to agree well with *Tropeothyris*. The answer to this suspicion was found when I described the Lower Cretaceous terebratulids of southwestern Morocco (MIDDLEMISS 1980) and erected a new species *Kutchithyris kennedyi*, to which I would now assign the Les Corbières specimens and most of those from Ibiza (one of the latter is here referred to *Tropeothyris allavensis*, page 593).

Investigation of the true *T. salevensis* from the Jura region has not previously been undertaken by any author because of the scarcity of available specimens but I have now been able to cut serial sections of five topotype specimens, three from the Geneva Museum collection, one from the Neuchâtel collection and one from the British Museum (Natural History), all from the Hauterivian of Mont-Salève. These specimens agree well in the details of their internal structures, on the basis of which they can be referred to the genus *Praelongithyris*.

To summarize: *Praelongithyris salevensis* (DE LORIO) appears to be a local species confined to the Jura region. Forms which are externally homoeomorphic with it occur within the genus *Tropeothyris* in the Berriasian of the Crimea (*T. salevensis* SMIRNOVA 1972) and the Aptian of Sardinia and northern Spain (*T. funtanensis* sp. nov.). The latter species, especially, is a striking example of external homoeomorphy. Forms sufficiently similar to *P. salevensis* to be liable to confusion with it occur in the Valanginian–Barremian of Provence, the Jura and Ibiza (*Tropeothyris allavensis* sp. nov.) and the Hauterivian–Aptian of Les Corbières (*Kutchithyris kennedyi*).

The assignment of *T. salevensis* to *Praelongithyris* necessitates a reassessment of the geographical distribution of that genus, and this is made more necessary by the discovery of *Praelongithyris* species in South Africa (OWEN 1980), Greenland (OWEN 1976) and North Africa (*P. pajaudi*, here described).

The opportunity is also taken of describing two more new species of *Tropeothyris* (*T. luancensis* and *T. islarensis*) and of assigning *Terebratula pilati* BACHMANN to *Tropeothyris*.

Systematic Palaeontology

Phylum *Brachiopoda* DUMERIL 1806

Class *Articulata* HUXLEY 1869

Order *Terebratulida* WAAGEN 1883

Suborder *Terebratulidina* WAAGEN 1883

Superfamily *Terebratulacea* GRAY 1840Family *Terebratulidae* GRAY 1840Subfamily *Sellithyridinae* MUIR-WOOD 1965Genus *Praelongithyris* MIDDLEMISS 1959

Type species: Praelongithyris praelongiforma MIDDLEMISS 1959

Emended diagnosis. – Umbo suberect to erect; beak ridges rounded. Foramen large, circular, permesothyrid, marginate; labiate in adult to gerontic stage. Angle of truncation 120–130°. In ventral profile elongated. Anterior commissure sulcinate to episulcate in adult stage but rectimarginate condition retained late. Pedicle collar sometimes present. Hinge plates virgate to concave. Crural bases high and clubbed. Crural flanges present. Crural processes may be incurved and thickened at their tips. Transverse band moderate to high-arched. Posterior and anterior dorsal adductor muscle scars separate, posterior closely juxtaposed to posterolateral margins of anterior; posterior elongated, strap-shaped; anterior elongated flask-shaped, with long, narrow posterior portion, expanding anteriorly towards the mid line. Euseptoidum not always present.

Remarks. – I first described *Praelongithyris* from the Aptian of southern England (*P. praelongiforma* MIDDLEMISS, 1959) and in 1976 added an Upper Valanginian–Hauterivian species from northern Germany and northern England [*P. credneri* (WEERTH)]. *P. borealis* from the Valanginian of eastern Greenland was described by OWEN (1976). SMIRNOVA (1972) figured a *Praelongithyris dutempleana* from the Lower Aptian of the Caucasus and Mangyshlak which appears to be truly a member of that genus and not to be confused with *Terebratula dutempleana* D'ORBIGNY, which has now been referred to *Moutonithyris* (MIDDLEMISS 1976, p. 63). GASPARD (1974) described *Praelongithyris rogeri* from the Lower Albian of the Paris Basin. Because of these occurrences I was able (MIDDLEMISS 1979) to regard *Praelongithyris* as a genus of essentially boreal distribution which made its way southwards as far as the Paris Basin in the Albian before becoming extinct. OWEN (1980) referred to *Praelongithyris* the species *Terebratula vanhoepeni* LANG from the Upper Albian of South Africa (and possibly Madagascar and northeastern Iran), which implied still further southward migration by the end of Albian times.

However, in 1980 NEKVASILOVÁ described from the Olivetská Hora Formation (Berriasian–Valanginian) of Štramberk, Moravia, some specimens which she called *Praelongithyris* sp. It is possible to question the generic assignment of this form as the loop is unusually narrow, the crural processes incurved and lacking flanges, and the transverse band very low for this genus (NEKVASILOVÁ 1980, Fig. 6). Nevertheless, the ensemble of internal characters and the external characters shown by the figured specimen combine to suggest that her attribution to *Praelongithyris* is correct. Thus there is evidence of the genus in very early Cretaceous times in an undoubtably Tethyan setting, associated with such Tethyan indicators as *Pygites*, *Lacunosella*, calpionellids and *Beriasella*, as well as the sub-Tethyan brachiopod *Moutonithyris moutoniana* (HOUSÁ 1976).

The hypothesis of a boreal origin of *Praelongithyris* has been further undermined by examination of the specimens reported by REVERT and PAJAUD (1975) from the

Berriasian of Algeria. Examination has confirmed that some of these should be assigned to *Praelongithyris* (*P. pajaudi* sp. nov.).

Indications are at present therefore that the genus was of Tethyan, or perhaps more accurately sub-Tethyan origin and spread into the Jura region and northwards to northern Germany, England and Greenland during Lower Cretaceous time, reaching also southwards to South Africa by the end of the Lower Cretaceous.

Species included. – *P. praelongiforma* MIDDLEMISS, *Terebratula lankesteri* WALKER, *Terebratula credneri* WEERTH, *P. dutempleana* SMIRNOVA 1972 (non *Terebratula dutempleana* D'ORBIGNY), *P. rogeri* GASPARD, *Terebratula vanhoepeni* LANG, *Terebratula salevensis* DE LORIO, *P. pajaudi* nov.

Range of the genus. – Berriasian to Upper Albian.

Praelongithyris salevensis (DE LORIO 1963)

Pl. 1, Fig. 1–3; Text Fig. 1, 2

- V+ 1863 *Terebratula salevensis* DE LORIO, p. 118, Pl. 15, Fig. 11–16.
- V 1866 *Terebratula salevensis* DE LORIO; DE LORIO, p. 86.
- V 1872 *Terebratula salevensis* DE LORIO; PICTET, p. 72, Pl. 202, Fig. 9.
- non 1960 *Terebratula salevensis* DE LORIO; SMIRNOVA, p. 374, Pl. 1, Fig. 4.
- non 1966 *Sellithyris salevensis* (DE LORIO); BOGDANOVA & LOBACHEVA, p. 51, Fig. 17; Pl. 5; Fig. 3–4.
- non V 1968 "*Terebratula*" *salevensis* DE LORIO; MIDDLEMISS, p. 21, Fig. 10; Pl. B Fig. 5–6.
- non 1972 *Tropeothyris salevensis* (PICTET); SMIRNOVA, p. 73, Fig. 35; Pl. 6 Fig. 4.
- non V 1975 *Tropeothyris salevensis* (DE LORIO); DIENI & MIDDLEMISS, p. 20, Fig. 8; Pl. 33 Fig. 1, 7.

Lectotype. – Specimen figured by DE LORIO (1863), Pl. 15, Fig. 11a–d, preserved in the Muséum d'Histoire Naturelle, Geneva. Designated by DIENI & MIDDLEMISS (1975).

Dimensions of lectotype. – L 27.0, W 18.0, T 17.0.

Material. – 12 specimens, all from the Hauterivian of Mont-Salève, Haut-Savoie.

Diagnosis. – *Praelongithyris* of elongate oval to elongate rhomboidal ventral profile (length/width ratio about 1.5), strongly narrowing anteriorly. Thick in lateral profile (thickness in some cases almost equalling width) and of inflated appearance. Maximum convexity in posterior half of pedicle valve; about central in brachial valve. Folds rounded. Umbo suberect to erect. Foramen permesothyrid, attrite, slightly labiate. Symphytium well-exposed and bordered. Lateral commissure strongly arched. Anterior commissure episulcate in adult state. Internal characters as for genus except that loop relatively narrow (about $\frac{1}{3}$ of width of corresponding part of shell) and transverse band moderately arched.

Description. – Folding of the shell may affect as much as the anterior third of the length in adults but is always feeble, even in specimens with quite powerful plication of the anterior commissure. PICTET mentions "un pli médian arrondi, très-peu prononcé" in the pedicle valve and "deux plis très-peu prononcés, souvent à peine visibles" in the brachial valve (1872, p. 72). DE LORIO emphasizes that most specimens are thick and narrow, with width little more than half length in some, and that wide varieties are more uncommon (ibid.).

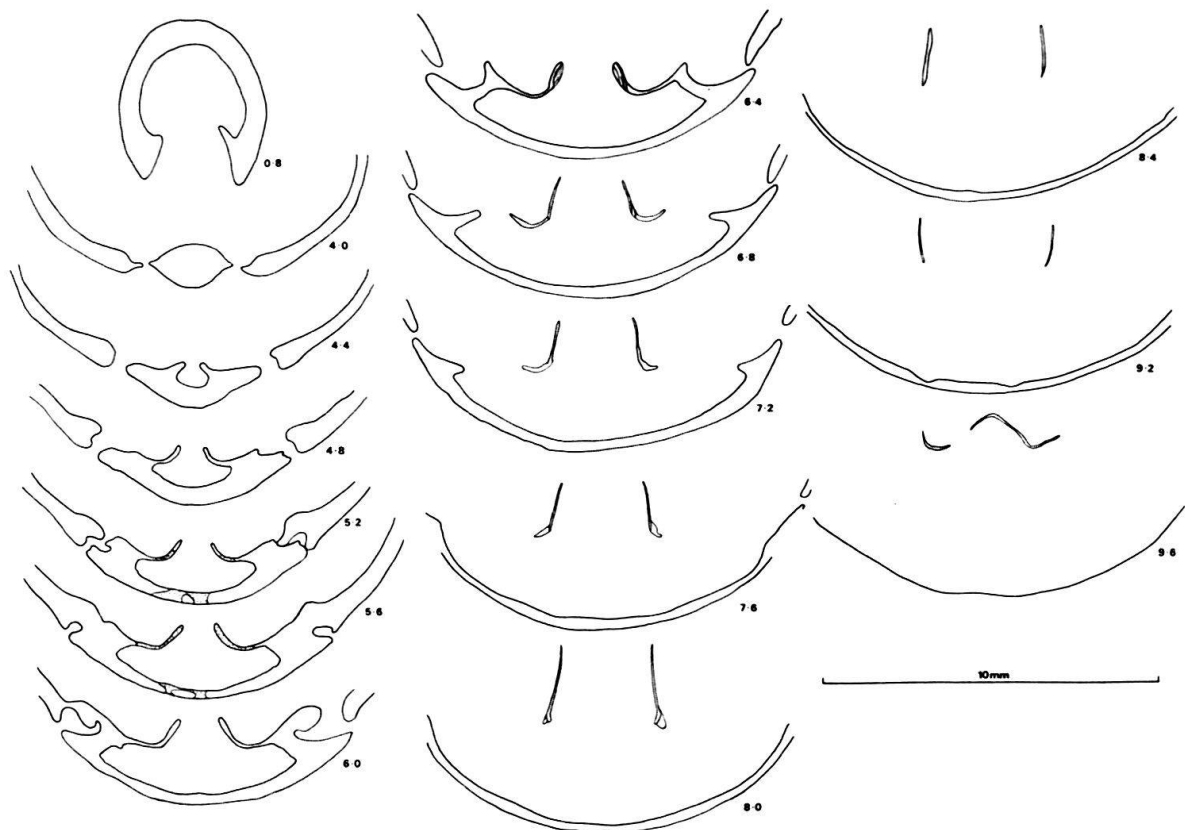


Fig. 1. Serial sections through *Praelongithyris salevensis* DE LORIOL. The concave shape of the early-formed hinge plates can be seen at 4.4 and 4.8. They become less concave anteriorly, as at 6.4, which also shows the high, clubbed crural bases. Sections 8.4 and 9.2 show the relatively narrow loop and 9.6 the moderately-arched transverse band. Stipple represents silicified tissue. BM BB 84705²), Hauterivian, Mont-Salève.

As usual in this genus, biplication is developed late. Juveniles are elongate oval, egg-shaped, rectimarginate. Gentle uniplication appears at a length of about 15 mm and appears to pass directly into an episulcate stage, but specimens up to 20 mm in length may remain uniplicate. DE LORIOL says the anterior commissure may be almost rectimarginate even in adults.

Remarks. – Not enough specimens are available to enable variation to be thoroughly analyzed but relatively rare variants occur which are clearly wider than thick and these tend to have poorly developed plication of the commissure.

P. salevensis differs from other species of the genus chiefly in the altogether more rounded appearance of the shell and the pinching in laterally of the anterior region (although this does occur in some varieties of *P. credneri*) coupled with a long elongated posterior part of the shell, so that the ventral profile lacks the scuttle-shaped appearance of *P. praelongiforma*. *P. salevensis* most resembles some varieties of *P. credneri* and is presumably closely related to that species.

²) Abbreviations: BM = British Museum (Natural History), IGPSB = Istituto di Geologia, Padova, Sardinian brachiopod Coll.

Distribution. – Hauterivian of the southern and central Jura, mainly at Mont Salève, but also at Sillens, Ain (F. Viéban Coll, Grenoble). Hauterivian of Vorarlberg. PICTET records it from the Hauterivian of Le Landeron and in the Basel Collection are a few specimens not only from Le Landeron but also from Gleresse, Cressier (marnes à nodules calcaires) and Twann.

BOGDANOVA and LOBACHEVA (1966, p.51) describe as *Sellithyris salevensis* (DE LORIO) a form from the Hauterivian–Barremian of the Kopet Daga. This, from their serial sections, is not a *Tropeothyris* and could be a *Praelongithyris* but the sections are insufficiently detailed to be certain. The specimens which they figure (P. 5, Fig. 3 and 4) appear to be juvenile and not very well preserved. It is unlikely that they are identifiable with *P. salevensis* in view of the great geographical separation.

GOČANIN (1938) records the presence of what he calls *T. salevensis* DE LORIO in the collections of the Geological Institute at Belgrade (without figures), but does not know either the provenance or the age and admits that they are poorly preserved.

Evidence of occurrence of this species above the Hauterivian is uncertain. DE LORIO recorded one specimen from the Upper Urgonian of Essert (near Salève). A few specimens in the Basel Collection which appear to be juvenile *P. salevensis* are from the urgonian of Morteau (Doubs) but could be Hauterivian in age (REMANE 1982) (from their matrix they could, in fact, be from the Pierre Jaune). Two specimens in the Lausanne Museum from the Aptian of La Presta (Neuchâtel) are labelled as this species but are poorly preserved and are more probably to be referred to *Boubeithyris prestensis*.

It may be concluded that the species is probably confined to the Hauterivian and possibly Barremian of the southern and central Jura and Vorarlberg.



Praelongithyris pajaudi sp. nov.

Pl. 1, Fig. 4; Tex Fig. 3

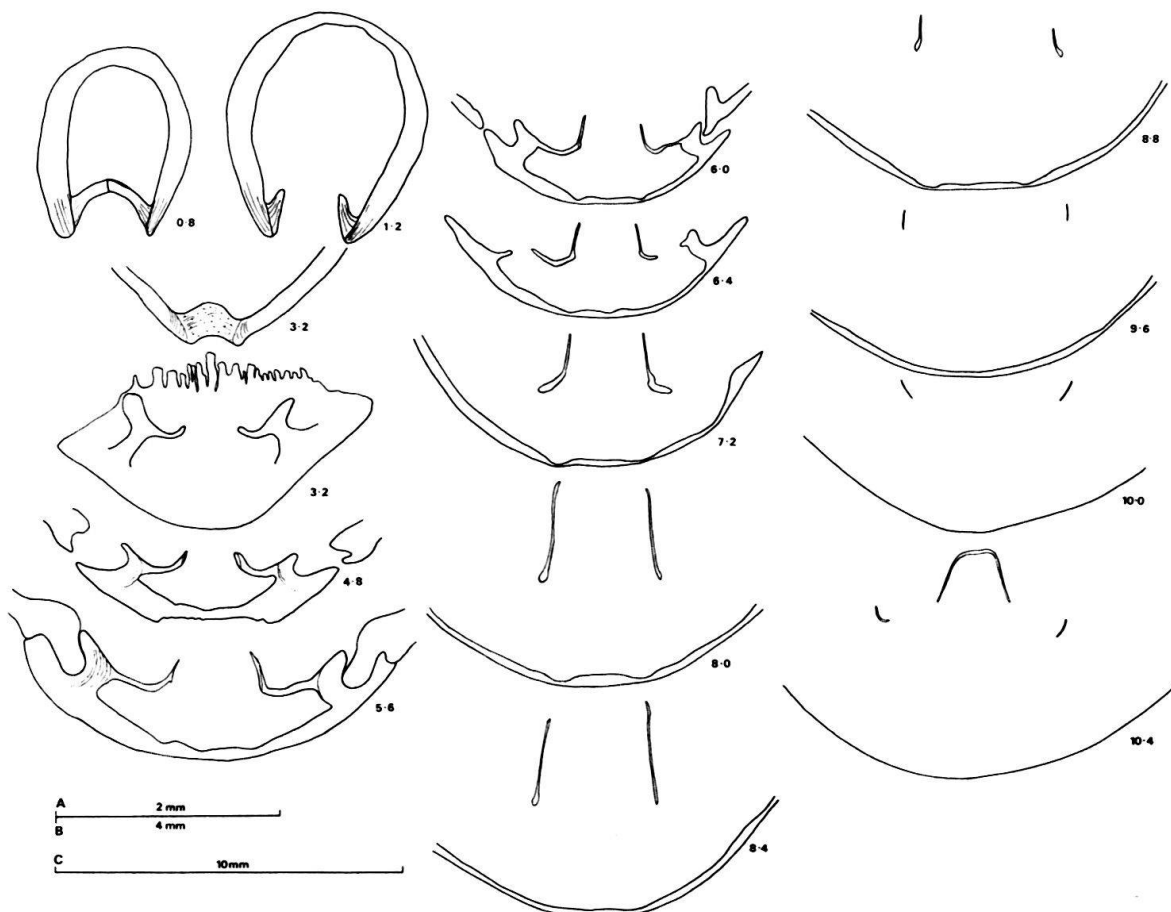
V 1975 *Praelongithyris* sp.; REVERT & PAJAUD, p. 44 (non p. 40; non Pl. 2, Fig. 3).*Name.* – In honour of Monsieur DANIEL PAJAUD.*Holotype.* – PM 1, Berriasian, Ouled Mimoun (formerly Lamoricière), Algeria. Pajaud Coll., Université Pierre et Marie Curie, Paris.*Dimensions of holotype.* – L 30.5, W 22.0, T 15.75.*Paratypes.* – PM 2, 3, 4, 5. Locality as holotype. Pajaud Coll. GN 2. Locality as holotype, Grenoble University Coll.*Dimensions of paratypes.* – PM 2: L 26.5, W 20.25, T 17.25, PM 3: L 25.5, W 19.0, T 15.5, PM 4: L 21.25, W 17.5, T 11.75, PM 5: L 18.0, W 15.75, T 10.0, GN 2: L 26.0, W 20.0, T 13.25.*Material.* – 5 specimens (types) from the Pajaud Collection. 1 specimen (paratype) from the Grenoble University Collection (which contains about fifty specimens from the type locality).

Fig. 3. Serial sections through *Praelongithyris pajaudi* sp. nov. The pedicle collar is seen at 0.8, symphytium at 3.2 and cardinal process at 4.0. Sections 4.8– 6.0 show well the gently concave hinge plates and well-developed crural bases. 10.4 shows the rather highly-arched transverse band. Stipple represents punctate tissue. GN 2, Grenoble University Coll., probably Berriasian, Ouled Mimoun, Algeria. A = scale for section 4.0. B = scale for sections 4.8 and 5.6. C = scale for the remaining sections.

Diagnosis. – *Praelongithyris* of elongate pentagonal ventral profile, laterally restricted anteriorly; P/A ratio about 1.4. Pedicle valve strongly and evenly convex; brachial valve with maximum convexity in posterior half. Umbo suberect to erect. Anterior commissure sulciphate. Pedicle collar well developed. Hinge plates gently concave, with crural bases developed early. Transverse band high-arched.

Description. – Juveniles are relatively short and pentagonal in shape and the length/width ratio appears to increase allometrically with growth. Thickness also appears to increase allometrically, as in most terebratulids, but less regularly than length. The foramen becomes labiate in individuals of about 20 mm or more in length. Growth line evidence (for what it is worth) suggests that the commissure remains rectimarginate until a shell length of about 15 mm is attained and then passes directly into the sulciphate stage.

Remarks. – *P. pajaudi* differs from other species of the genus in its higher ratio of width to length (average L/W 1.26) combined with somewhat deeper concavity of the lateral sulci at the anterior end of the brachial valve. These characters, together with the strongly arched convexity of the pedicle valve and the tendency to flattening of the brachial valve at the anterior end, give it a marked external resemblance to *Loriolithyris valdensis* (DE LORIO) but it does not become episulcate in the adult stage like the latter species. *P. vanhoepeni* has a comparable length width/ratio but a lower P/A ratio and a much more regularly oval dorsal profile.

Distribution. – Berriasian of Ouled Mimoun (formerly Lamoricière), Algeria, where it was noted as early as 1850 by VILLE under the name of *Terebratula praelonga* (quoted by POMEL 1889).

Subfamily *Rectithyridinae* MUIR-WOOD 1965

Genus *Tropeothyris* SMIRNOVA 1972

Type species: Tropeothyris kugusemi SMIRNOVA 1972

Original diagnosis. – (Translated from SMIRNOVA 1972): Large, oval or subpentagonal shells with round folds, varying in size. Umbo high, massive, strongly recurved; shoulders well defined. Symphytium large, well exposed. Pedicle collar usually present. Cardinal process small, transversely elongate with undulating surface. Hinge plate concave, arched in cross section with strongly developed keels and tapering inner ends. Crural processes slightly recurved, lacking crural flanges. Loop wide, short with steeply curved transverse plate. Anterior dorsal adductor impressions petaliform with inner edges parallel to euseptoidum, their outer edges slightly concave.

Emended diagnosis. – Rectithyridinae of elongate oval to pentagonal ventral profile. Generally rounded in appearance and tending to be inflated in lateral view. Umbo suberect to incurved. Folds gentle and rounded. Pedicle collar usually present. Cardinal process small but with well developed muscle-attachment area. Hinge plates horizontal, may be keeled, moderately differentiated from inner socket ridges, becoming more concave or resupinate anteriorly. Crural bases may be clubbed, set at almost a right angle to the hinge plates. Crural processes high, slightly incurved, lacking flanges. Transverse band medium to moderately high-arched. Euseptoidum sometimes present

but very small. Muscle impressions as in original diagnosis (no new information has been obtained).

Remarks. – SMIRNOVA (1975) assigned to *Tropeothyris* seven species from the Upper Tithonian of the Polish Carpathians but comparison of the serial sections and plates there given with those of the type species makes it difficult to understand why they should belong to that genus, as BOULLIER (1976 p.368) has remarked. One of them, *Terebratula immanis* ZEUSCHNER, was previously referred to *Juralina* by W. BARCZYK (1969).

If the earliest undoubted occurrence of the genus is in the Berriasian of the Crimea, it had spread westward to Provence by the Valanginian, continuing in the Crimea and Mangyshlak until the Lower Barremian, in Sardinia, northern Spain and the central Alpine area until the Aptian (or possibly Albian), and in Northwest Europe until the Lower Cenomanian (OWEN 1982).

Species included. – *T.kugusemi* SMIRNOVA, *T.karakaschi* SMIRNOVA, *T.salevensis* SMIRNOVA (non *T.salevensis* DE LORIO, 1863; non *T.salevensis* PICTET, 1872). *T.betchkunensis* SMIRNOVA, *T.funtanensis* nov. *T.allavensis* nov., *T.luancensis* nov., *T.islarensis* nov., *Terebratula pilati* BACHMANN.

Range of the genus. – Berriasian to Lower Cenomanian.

Tropeothyris funtanensis sp. nov.

Pl. 1, Fig. 6–7, and Pl. 2, Fig. 1; Text Fig. 4

V 1975 *Tropeothyris salevensis* (DE LORIO); DIENI & MIDDLEMISS, p. 184, Fig. 8; pl. 33 fig. 1, 7.

Name: From the type locality.

Holotype. – IGPSB 22a, from the basal Aptian of Badde Funtana Morta, near Orosei, Sardinia; in the collections of the Institute of Geology, University of Padua. This is the only available whole specimen but is damaged.

Dimensions of holotype. – L 26.25, W 19.0, T 15.25.

Paratypes. IGPSB 22 (posterior end damaged), IGPSB 24 (plaster cast, but complete) – same locality as holotype and preserved in the same collection. BB 84706 (plaster cast), upper part of the Castro Limestone (KENDALL 1967, p.93, Fig. 717), Lower Aptian, Sámano, Prov. Santander, Spain (British Museum, Nat. Hist. Coll.).

Dimensions of paratypes. – IGPSB 22: L not measurable, W 17.0, T 13.0, IGPSB 24: L 25.0, W 17.25, T 17.0, BB 84706: L 33.75, W 23.25, T 22.0.

Material. 4 specimens from the basal Aptian of the type locality; 1 specimen from the Lower Aptian of northern Spain.

Diagnosis. – *Tropeothyris* of elongate oval ventral profile, maximum width slightly anterior of midline. Both valves very convex; pedicle valve with maximum convexity close to umbo. Umbo erect. Symphytium very short and wide. Foramen mesothyrid, slightly labiate. Beak ridges very rounded. Lateral commissure oblique. Anterior commissure sulcinate to episulcate, plicae and sinuses rounded. Shell folded only at ante-

rior end in adult stage; plication and folding developed at a late stage of growth. Hinge plates horizontal, keeled. Otherwise internal structures as for genus.

Remarks. – This is the species of *Tropeothyris* which most closely resembles *Prae-longithyris salevensis* externally, more so even than SMIRNOVA'S *T. salevensis* of 1972, which appears to be somewhat dorsoventrally compressed at the anterior end and to have an umbo incurved rather than suberect to erect. It differs from *P. salevensis* externally in that the umbo is more erect and the anterior end markedly less pinched in laterally than in the latter species (PICTET writes of the «amincissement du côté frontal» in *P. salevensis*). Internally the differences are, of course, generic in value.

The scarcity of specimens precludes discussion of ontogeny or of variation except that adults appear to be characterized by increasing thickness and generally inflated appearance.

Distribution. – Lower Aptian of Sardinia and northern Spain. Specimens in Madame Arnaud's collection at Grenoble, from the Aptian of the Vercors, which have been identified as *T. salevensis*, could possibly be *T. funtanensis*.



Fig. 4. Serial sections through *Tropeothyris funtanensis* sp. nov. Selective silicification of primary skeletal structures within the cardinal process had occurred in this specimen, as indicated at 4.0. The fundamentally horizontal hinge plates, with well-developed crural bases, are seen at 4.4–6.0. Maximum height of the crural processes is shown at 8.0, the moderately-arched transverse band at 9.6. IGPSB 23, basal Aptian, Badde Funtana Morte, Orosei, Sardinia. (From DIENI, MIDDLEMISS & OWEN 1975.)

Tropeothyris allavensis sp. nov.

Pl. 2, Fig. 2–4; Text Fig. 5, 6

Name. – From the type locality.

Holotype. – BB 84708, Grande Lumachelle horizon, uppermost Valanginian, Les Allaves, Basses Alpes (British Museum, Nat. Hist. Coll.).

Dimensions of holotype. – L 42.0, W 29.5, T 19.0.

Paratypes. BM BB 84707, locality as holotype. BN 3a, Hauterivian, Censeau, Jura, Besançon University Coll. (plaster cast). BM BB 84709, Pujol Gras, Ibiza, age uncertain (probably Barremian), Rangheard Coll., Besançon (plaster cast). BM BB 84710, Valanginian, Benidoleig Quarry, prov. Alicante, Spain, Fourcade Coll. (plaster cast). BM BB 84711, Neocomian or Barremian, La Solana, Jalon, prov. Alicante, Spain, Fourcade Coll. (plaster cast).

Dimensions of paratypes. – BB 84707: L 30.5, W 22.25, T 14.5, BN 3a: L 29.5, W 23.0, T 15.25, BB 84709: L 34.0, W 24.5, T 17.75, BB 84710: L 43.0, W 32.75, T 18.5, BB 84711: L 36.5, W 26.25, T 19.25.

Material. – Holotype and paratypes only.

Diagnosis. – *Tropeothyris* of elongate oval ventral profile, maximum width distinctly anterior of midline (P/A ratio about 1.5). Moderately depressed (thickness about, or less than, $\frac{1}{2}$ length and about $\frac{2}{3}$ width). Pedicle valve regularly convex; brachial valve slightly flattened anteriorly. Umbo suberect to erect. Foramen permesothyrid, labiate. Symphytium short but visible, bordered. Anterior commissure sulcipleate, with plicae and sinuses very gentle even in the adult stage. Shell smooth and

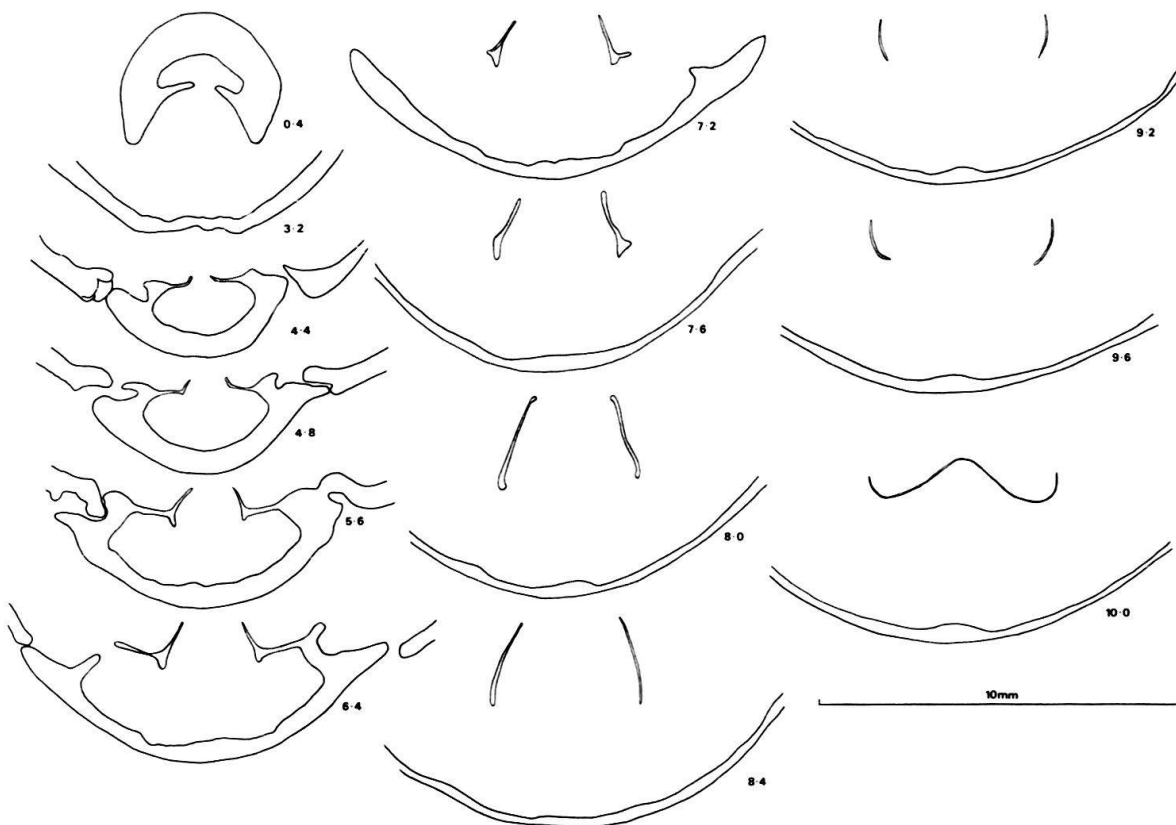


Fig. 5. Serial sections through *Tropeothyris allavensis* sp. nov. The pedicle collar is seen at 0.4 and the symphytium at 3.2. The horizontal, keeled hinge plates are well shown in sections 4.4–5.6. The rectangular relationship of fixed crural bases to hinge plates is best seen at 6.4, the flangeless crural processes at 8.0 and the moderately arched transverse band at 10.0. All detail was obscured by silicification up to 5.6 inclusive. BM BB 84707, author's Coll., Grande Lumachelle horizon, uppermost Valanginian, Les Allaves. Basses Alpes.

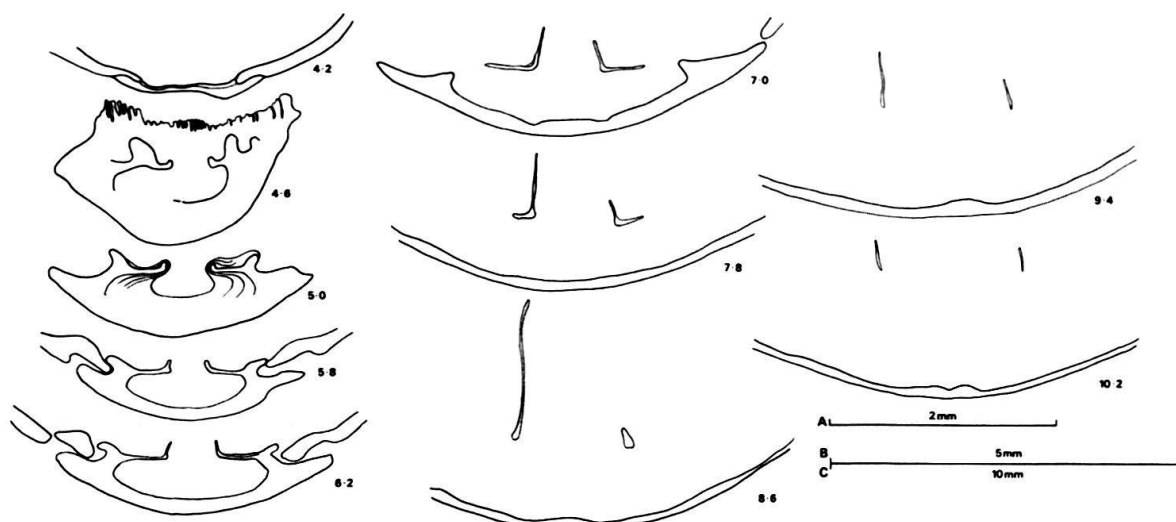


Fig. 6. Serial sections through *Tropeothyris allavensis* sp. nov. Section 4.6 shows the cardinal process enclosing the initially horizontal hinge plates, with precociously developed crural bases. The transverse band was not preserved. BN 3a, Besançon University Coll., Hauterivian, Censeau, Jura. A = scale for section 4.6. B = scale for section 5.0. C = scale for the remaining sections.

rounded with extremely gentle folding affecting the anterior third of the brachial valve only. Internal structures as for genus.

Remarks. – *T. allavensis* differs from other species of the genus in its much more depressed shape and more gentle plication of the anterior commissure. *Kutchithyris kennedyi* is easily confused with *T. allavensis* on external appearance but is markedly thicker in the corresponding adult stage, has sharper plications and a more incurved umbo and may develop an episulcate anterior commissure.

T. allavensis is clearly a rare species. The only previous author who has mentioned it is COTILLON (1971), whose record of *T. cf. salevensis* from the Upper Valanginian of the Castellane arc almost certainly refers to this species.

Distribution. – Upper Valanginian of Provence, Hauterivian of the central Jura, Barremian(?) of Ibiza, Valanginian to Barremian(?) of southeastern Spain.

Tropeothyris luancensis sp. nov.

Pl. 2, Fig. 5, and Pl. 3, Fig. 1–3; Text Fig. 7, 8

V 1973 «*Terebratula*» sp. aff. *salevensis*; MIDDLEMISS, Fig. 6.

Name. – From the type locality.

Holotype. – BB 84712, topmost Lower Aptian or basal Upper Aptian, San Pedro de Antromero, Luanco, Prov. Oviedo, Spain (British Museum, Nat. Hist. Coll.).

Dimensions of holotype. – L 16.75, W 14.25, T 10.25.

Paratypes. – BB 84713, locality as holotype, Wienands Coll., British Museum (Nat. Hist.). BB 84714, age uncertain (probably Barremian or Aptian), Sierra del Cid, Prov. Alicante, Spain; Azema Coll., British Museum (Nat. Hist.) (plaster cast). BB 84715,

probably Upper Aptian, Murcia, Spain; Fourcade Coll., British Museum (Nat. Hist.). BM BB 846716, age uncertain (probably Aptian), Cala de Charraca, Ibiza; Rangheard Coll., Besançon. BB 84717, Hauterivian, map reference 880.550/137.765, Ollières, near St-Maximin-la-Ste-Baume, Var; Esterle Coll., British Museum (Nat. Hist.). BB 84718, probably Hauterivian, western part of plateau of Cap Romarin, Aude; Jaffrezo Coll., British Museum (Nat. Hist.).

Dimensions of paratypes. – BB 84713: L 19.5, W 16.25, T 13.5, BB 84714: L 25.0, W 22.75, T 16.5, BB 84715: L 19.25, W 16.0, T 12.75, BB 84716: L 14.25, W 11.75, T 8.75, BB 84717: L 20.5, W 18.0, T 14.0, BB 84718: L 18.25, W 15.5, T 12.75.

Material. – About 280 specimens from the type locality; 1 specimen (paratype) from Prov. Alicante; 1 specimen (paratype) from Ibiza; 3 specimens from near Ollières, Var; 4 specimens from Cap Romarin, Var.

Diagnosis. – *Tropeothyris* of broad oval ventral profile, length only a little greater than width (average L/W ratio of the type specimens 1.17); thickness about $\frac{2}{3}$ of length. Maximum width about the midline. Both valves uniformly convex. Umbo erect to incurved. Foramen mesothyrid. Symphytium short, bordered; hidden in adult stage. Anterior commissure sulcinate to episulcate, with sharp plicae and rounded sinuses. Shell folded only at extreme anterior end in adults. Cardinal process well developed, bifid. Internal structures otherwise as for genus.

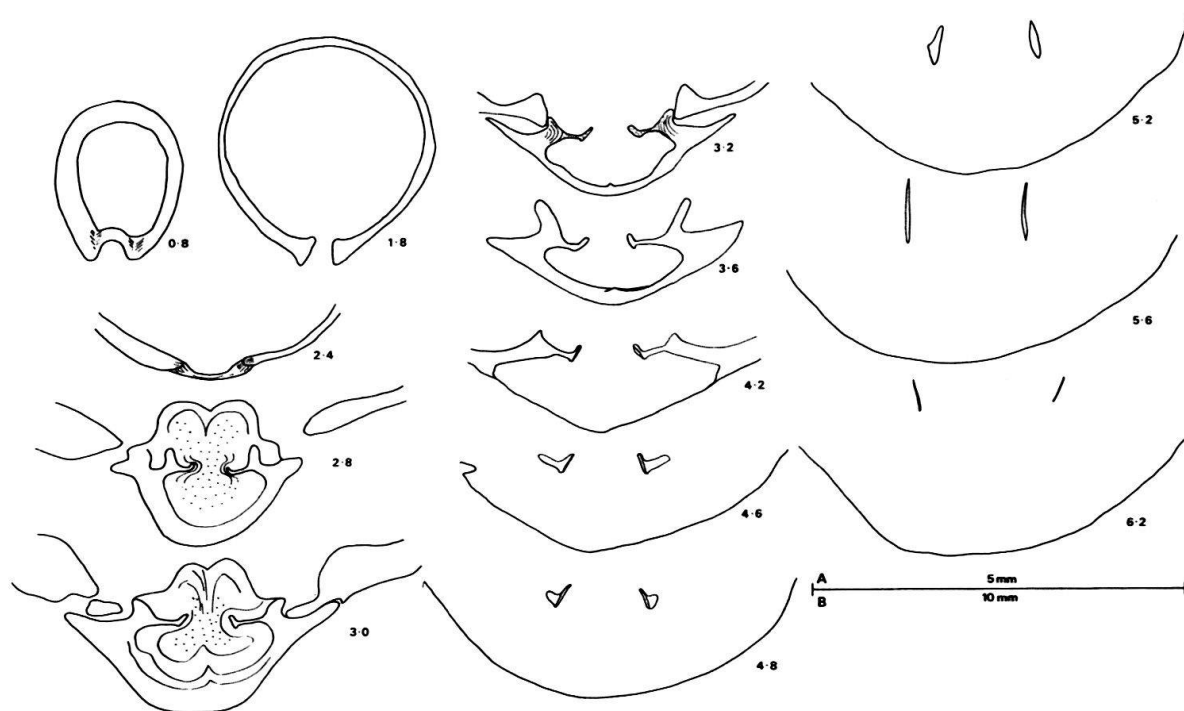
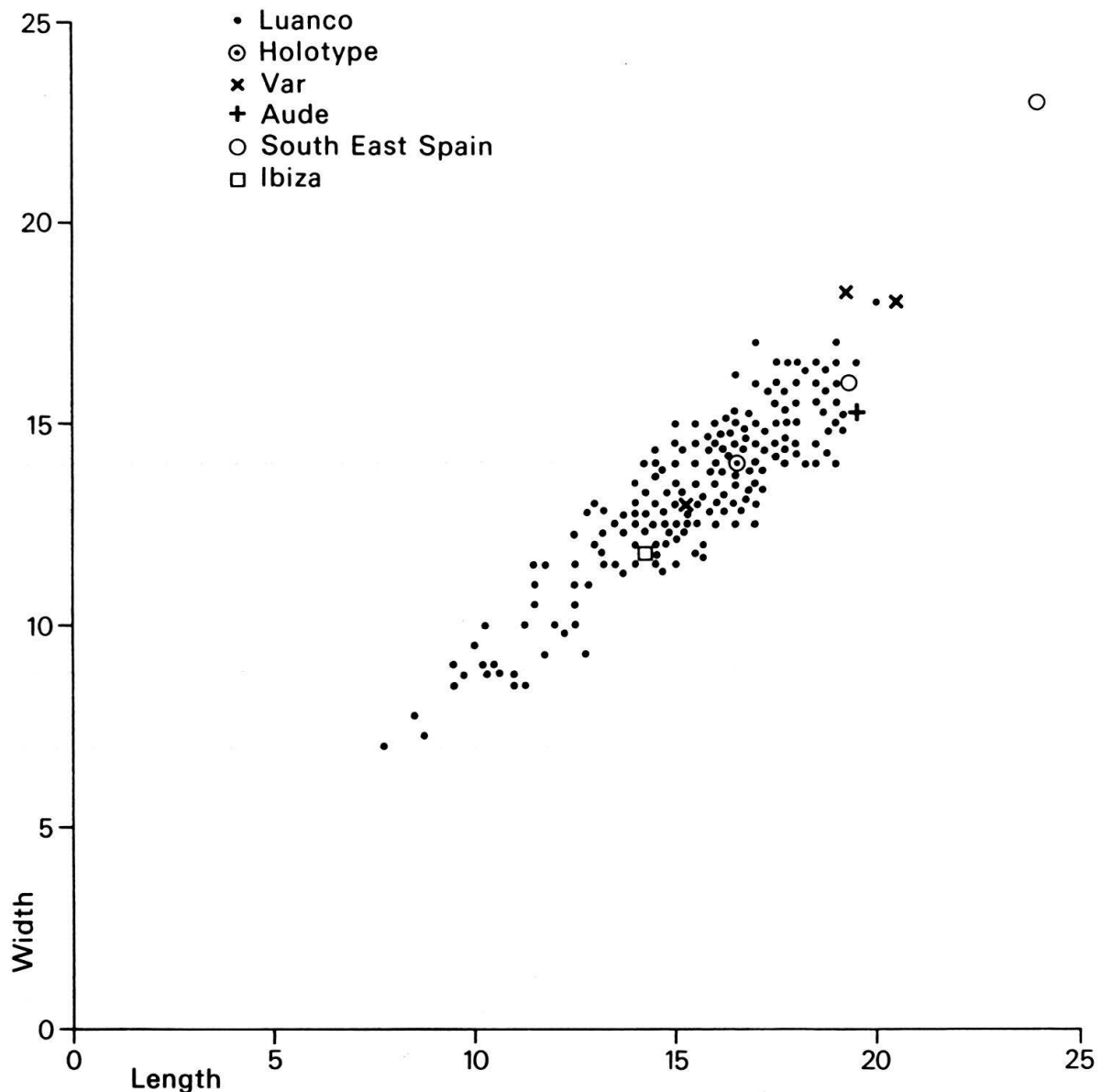


Fig. 7. Serial sections through *Tropeothyris luancensis* sp. nov. The pedicle collar is seen at 0.8 and the symphytium at 2.4. At 2.8 and 3.0 the well-developed bifid cardinal process is well seen, enclosing the initially horizontal hinge plates. The transverse band was not preserved. BM BB 84713, Wienands Coll., topmost Lower Aptian or basal Upper Aptian, San Pedro de Antromero, Luanco, prov. Oviedo, Spain. A = scale for sections 2.8 and 3.0. B = scale for the remaining sections.

Description. – Unlike most species of the genus, this species develops a sulcinate anterior commissure at an early stage of growth, at a length of about 12 mm, when it appears to pass directly from a rectimarginate to a sulcinate stage. The anterior commissure passes into the episulcate stage when the shell is about 19 mm in length. The sharpness of the plicae of the anterior commissure, combined with gentle rounded sinuses, is a notable feature of the species. The clearly defined anterior commissure, combined with lack of folding of the shell, gives the species a characteristically neat appearance. I thought at one time of calling it *Pulchrithyris* (a preoccupied name) because of this. Folding of the shell is not seen at all in individuals less than about 14 mm in length, and then only at the extreme anterior end. General shape remains constant during ontogeny and the length/width ratio increases isometrically (Text Fig. 8a) but, as in so many terebratulid species, the length/thickness ratio shows an allometric increase (Text Fig. 8b), and these ratios are the most variable characters of the species.



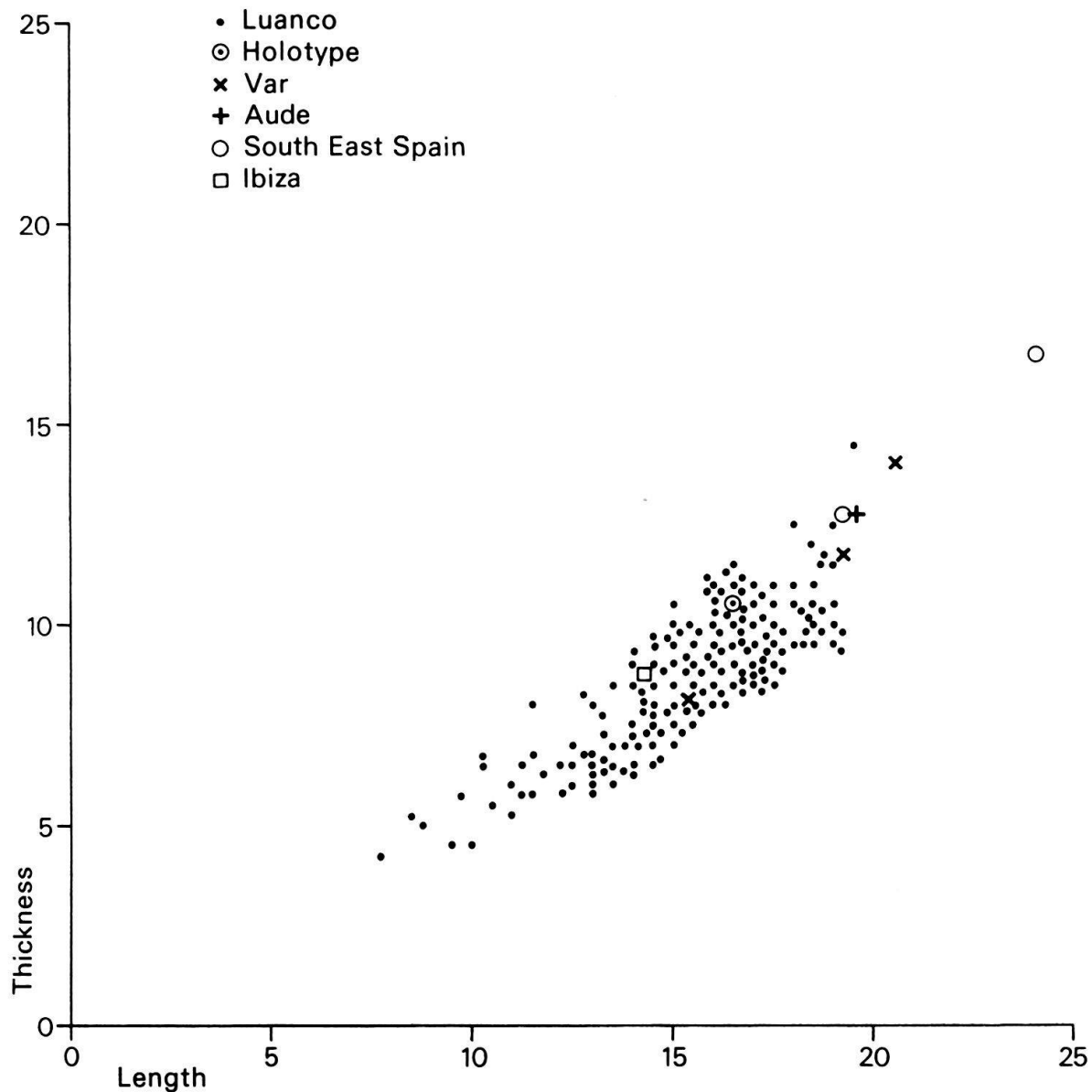


Fig. 8. Scatter diagrams of a) length and width, b) length and thickness in *Tropeothyris luancensis*.

Incurvature of the umbo also increases concurrently with the allometric increase in thickness.

Remarks. – This species differs from other species of the genus in its higher ratio of width to length (compare, for example, the slopes of the scatters in Text Fig. 8a and 12a). Throughout ontogeny it has a stubby, tumid appearance, increased by the lack of folding of the shell. This lack of folding differentiates the species on external appearance from all species of *Sellithyris*, which its proportions of length, width and thickness would otherwise recall.

The type locality at San Petro de Antromero, Luanco, has been described by, among others, KARREBERG (1934), SCHROEDER and WIENANDS (1966) and DE POZO (1972). SCHROEDER and WIENANDS give the most clearly documented account, in which terebratulids are recorded as occurring in their groups *g* to *j*, of which *g* is certainly,

and *h* and *i* probably, Lower Aptian, *j* Upper Aptian. The main concentration of *T. luancensis* occurs in a marly horizon somewhat difficult to place in SCHROEDER and WIENANDS' succession but probably corresponding to part of either *h* or *i*. A marly horizon about 0.7 m in thickness, consisting of a solid mass of orbitolines, is underlain by about 3 m of marls in which very large numbers of well-preserved terebratulids are mixed with the abundant orbitolines. The great majority of the terebratulids are specimens of *T. luancensis*, well-preserved and of differing growth stages, indicating that the site of life was very local and that the fossils represent a redistributed life assemblage. Associated in the same bed are comparatively rare specimens of two terebratellidine species. It is noteworthy that *Sellithyris sella*, common in some other north Spanish Aptian localities (Puerto de Alizas and Sardiñero), is apparently absent here, probably excluded by the local success of *T. luancensis*.

Distribution. – Hauterivian of Var and Aude, Barremian(?) to Upper Aptian(?) of southeastern Spain, Aptian of Ibiza and of northern Spain.

Tropeothyris islarensis sp. nov.

Pl. 3, Fig. 4–5, and Pl. 4, Fig. 1–3; Text Fig. 9, 10

Name. – From the village of Islares, between Castro Urdiales and Laredo, prov. Santander, Spain.

Holotype. – BM BB 84719, topmost Aptian or basal Albian, Islares, near Castro Urdiales, Spain; sponge beds beneath the highest exposed group of limestones (author's Coll.).

Dimensions of holotype. – L 39.5, W 27.5, T 23.5.

Paratypes. – BM BB 84720, horizon and locality as holotype. DF 1, DF 2, DF 3, Clansayesian, Futie, near Bellegarde, Ain (Delamette Coll.).

BM BB 84721, BM BB 84722, BM BB 84723, Aptian or Albian, Sierra de Ramon, Ibiza (Rangheard Coll.).

BM BB 84724, Gargasian, between Benichembla and Castell de Castell, prov. Alicante, Spain (Fourcade Coll.).

BM BB 84725, Upper Aptian or basal Albian, Pic de Seigneur, Tuchan, Aude (Debuyser Coll.).

Dimensions of paratypes. – BB 84720: L 34.5, W 25.5, T 19.0, DF 1: L 41.0, W 27.0, T 23.25, DF 2: L 37.25, W 25.0, T 21.75, DF 3: L 56.25, W 37.25, T 31.0, BB 84721: L 42.0, W 31.0, T 24.25, BB 84722: L –, W 28.0, T 21.0, BB 84723: L 37.5, W 28.0, T 19.0, BB 84724: L 42.25, W 33.5, T 25.0, BB 84725: L 41.5, W 30.25, T 21.0.

Material. – 16 specimens from the Clansayesian of Futie, Ain (Delamette Coll.). 16 specimens from the topmost Aptian or basal Albian near Castro Urdiales, Spain (author's Coll.). 5 specimens from the Aptian or Albian of Ibiza (Rangheard Coll.). 1 specimen (paratype) from the Upper Aptian of Alicante (Fourcade Coll.). 19 specimens from the (?)Upper Aptian or basal Albian of Pic de Seigneur, Aude (Debuyser Coll.). 4 specimens from the Upper Aptian of Les Corbières, Aude, associated with *Mesorbitolina texana texana*, teste R. Schroeder (Charrière Coll.).

Diagnosis. – *Tropeothyris* of elongate oval ventral profile, maximum width slightly anterior of midline (P/A ratio about 1.23). Moderately inflated, thickness more than $\frac{1}{2}$ length (average of type specimens 0.56) and more than $\frac{3}{4}$ width (average 0.78). Valves regularly convex in lateral view. Umbo suberect to erect; slightly produced in gerontic stage. Foramen mesothyrid, slightly telate or attrite; labiate in gerontic stage. Symphytium short; clearly visible and bordered in gerontic stage. Anterior commissure sulcipleate to gently episulcate; plicae narrow and sharp, median sinus broad and rounded. Shell little folded except in the gerontic stage. Internal structures as for genus.

Description. – The beak angle is the most variable character in this species, from which it follows that the degree of exposure of the symphytium is also variable. In particular there is a tendency for specimens from Spain and Ibiza to have a higher beak angle (almost incurved) than those occurring further northeast, in France.

The youngest specimens seen are 25 mm in length and are relatively thin (thickness about 0.4 of length) and gently uniplicate. Sulcification is developed by a length of

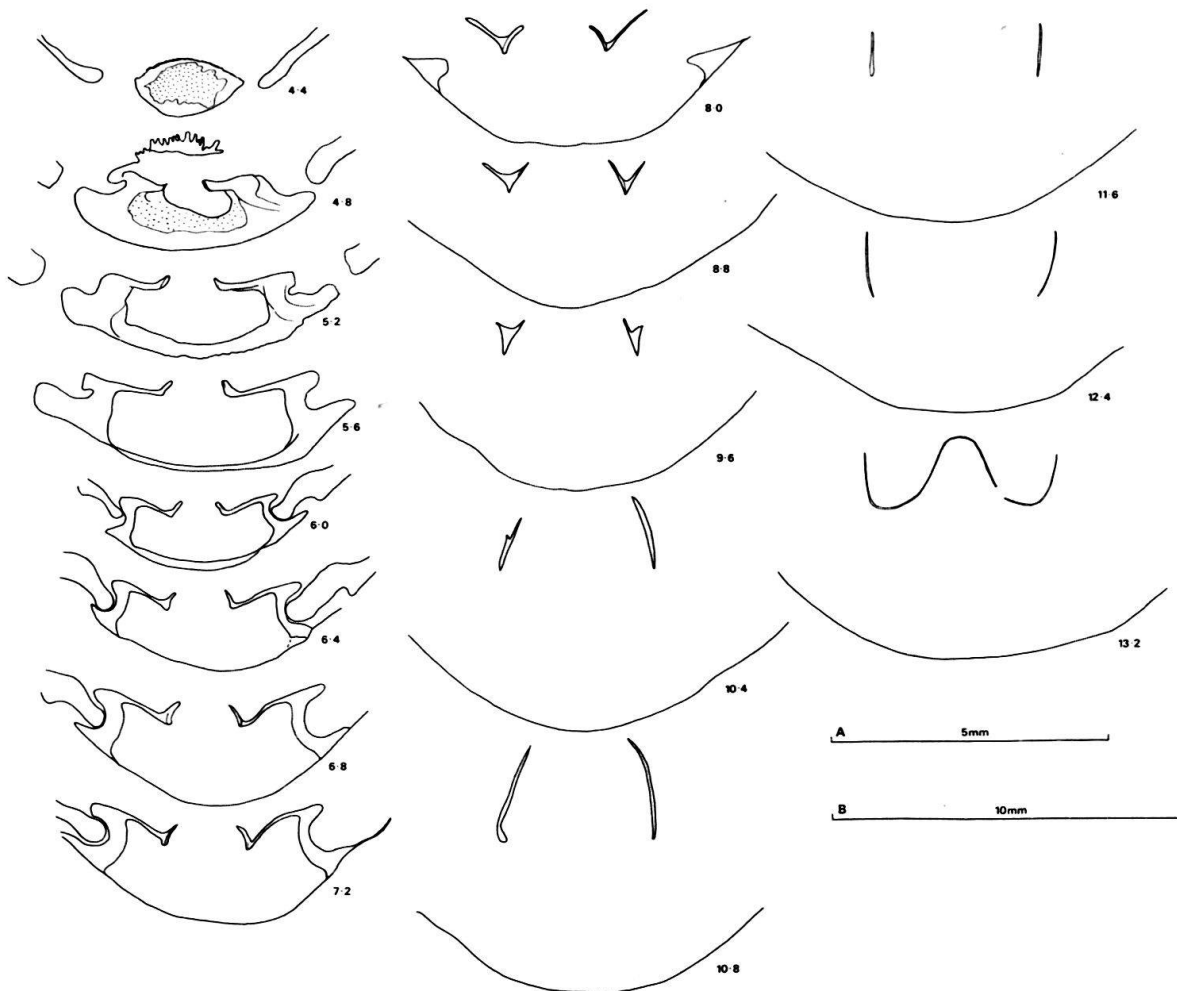


Fig. 9. Serial sections through *Tropeothyris islarensis* sp. nov. The cardinal process is seen at 4.4–4.8 and the initially horizontal hinge plates, with precociously developed crural bases, at 4.8. The hinge plates start to become resupinate at 6.0. The incurved, flangeless crural processes are at their maximum height at 10.8 and the moderately-arched transverse band appears at 13.2. Stipple indicates punctate tissue. DF 1, Delamette Coll., Geneva University, Clansayesian, Futie, Ain. A = scale for sections 4.8–5.6. B = scale for the remaining sections.

about 28 mm. Although episulcation of the anterior commissure is occasionally developed, the great majority of adult and even very large gerontic specimens are sulciplicate. In gerontic specimens more than about 45 mm in length the ventral umbo becomes slightly produced and the foramen labiate. This results in the unusual phenomenon of the symphytium becoming more visible in older specimens (in most terebratulids the beak angle tends to increase with age, causing the symphytium to become less visible).

Remarks. – In relative thickness and tumidity this species is in some ways intermediate between *T. allavensis* and *T. funtanensis*. It differs most obviously from *T. allavensis* in being relatively thicker, having a less exposed symphytium at corresponding growth stages (except the gerontic) and in showing a more distinct difference between the narrow plicae and the broad rounded median sinus of the anterior commissure. *T. islarensis* differs from *T. funtanensis* in being somewhat less relatively thick, lacking especially the presence of maximum convexity close to the umbo seen in the latter species, and in being rarely episulcate in the adult stage. Episulcate specimens of *T. islarensis* can much resemble *T. funtanensis* (Pl. 4, Fig. 2) but differ in being more regularly convex and in possessing the characteristic *islarensis* anterior commissure (see above). *T. islarensis* ceases to resemble *T. funtanensis* in the gerontic stage as it develops deep folding of the anterior part of the shell and a relatively produced ventral umbo.

The course of the anterior commissure in *T. islarensis* much resembles that seen in the Albian species *Moutonithyris dutempleana* and some species of *Ornatothyris*, and Spanish examples of *T. islarensis*, especially, with their relatively incurved umbos, have in the past been confused with *M. dutempleana*. From *Ornatothyris* spp. the present species can be distinguished at once by lacking the characteristic exaggerated growth

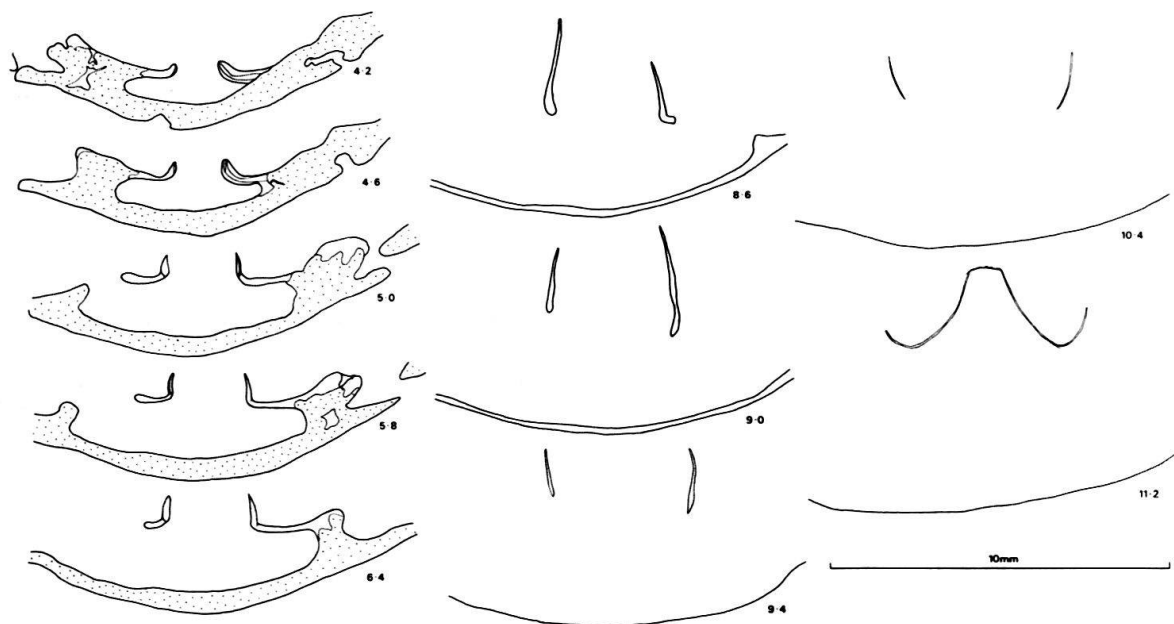


Fig. 10. Serial sections through *Tropeothyris islarensis* sp. nov. The initially horizontal hinge plates, with precociously developed crural bases, are seen at 4.2, the maximum height of the crural processes at 9.0 and the moderately-arched transverse band at 11.2. Stipple indicates silicified tissue. BM BB 84720, author's coll., topmost Aptian or basal Albian, Islares, prov. Santander, Spain.

lines of that genus. Distinction from *M. dutempleana* on the basis of external characters is more difficult. *M. dutempleana* is more pentagonal in dorsal profile and has a much higher P/A ratio (2 or more); labiation of the foramen and involvement of the shell in folding both develop at an earlier growth stage. Internally the differences are generic in value, although the two genera are certainly rather closely related. Essentially, in *Moutonithyris* the hinge plates are horizontal and cuneate, with the hinge plate joined at about the centre of the fixed crural base, whereas in *Tropeothyris* the hinge plates become concave or resupinate and the fixed crural bases are joined to the ventral sides of the median free edges of the hinge plates at approximately a right angle to the hinge plates. Also the transverse band of the loop is lower-arched in *Moutonithyris*.

Distribution. – Uppermost Aptian (and possible basal Albian) of the southern Jura, Aude, northern Spain, southeastern Spain and Ibiza.

Tropeothyris pilati (BACHMANN 1867)

Pl. 3, Fig. 6 and Pl. 5, Fig. 1–3; text Fig. 11, 12

+ 1867 *Terebratula pilati* BACHMANN in KAUFFMANN, p. 142, Pl. 7 Fig. 10–12.

Holotype (here chosen). – The specimen figured by BACHMANN (1867) as Plate 7, Figure 10. It is uncertain where the specimen is at present. Kauffmann material is housed in the Naturhistorisches Museum, Bern, and the Natur-Museum, Lucerne. At the latter is one specimen which closely resembles the holotype (Schublade Ba3).

Material. 10 specimens from the Geschmättlischichten (Valanginian or Hauterivian) of Pilatus, Unterwalden, Switzerland (Wyssling Coll.); 2 specimens labelled Hauterivian from Sisikon the Vierwaldstättersee, Uri, Switzerland (Basel Coll.); 32 specimens from the Geschmättlischichten of Vorarlberg (Wyssling Coll.). There are also specimens in the British Museum (Nat. Hist.) (B 21908).

Diagnosis. – *Tropeothyris* of elongate oval ventral profile (width approximately $\frac{3}{4}$ of length); P/A ratio about 1.25–1.5; attaining large size as adult (up to at least 46 mm in length). Pedicle valve uniformly convex; brachial valve has maximum convexity near umbo, with anterior third somewhat concave in lateral profile in adults. Umbo erect to incurved. Foramen permesothyrid, labiate. Beak ridges moderately sharp. Symphytium short, hidden in adult stage. Lateral commissure strongly arched in adult stage. Anterior commissure uniplicate to strongly sulcinate. Internal structures as for genus except that transverse band moderately low.

Description. – The length/width ratio develops isometrically, the length/thickness ratio allometrically, with a small allometric constant (Fig. 12). Juvenile forms are elongate oval, relatively thin, uniformly convex, rectimarginate. The juvenile rectimarginate stage becomes gently uniplicate when the shell is about 20 mm in length and develops sulcination at about 25 mm, although individuals of up to 30 mm may retain a uniplicate anterior commissure. The characteristic very strong arching of the lateral commissure is developed only in adults from a length of about 35 mm. Folding of the shell is not present in specimens less than about 25 mm in length and affects the brachial valve earlier than the pedicle valve, so that in fully grown specimens folding affects approximately the anterior half of the brachial valve and the anterior third of the pedicle valve.

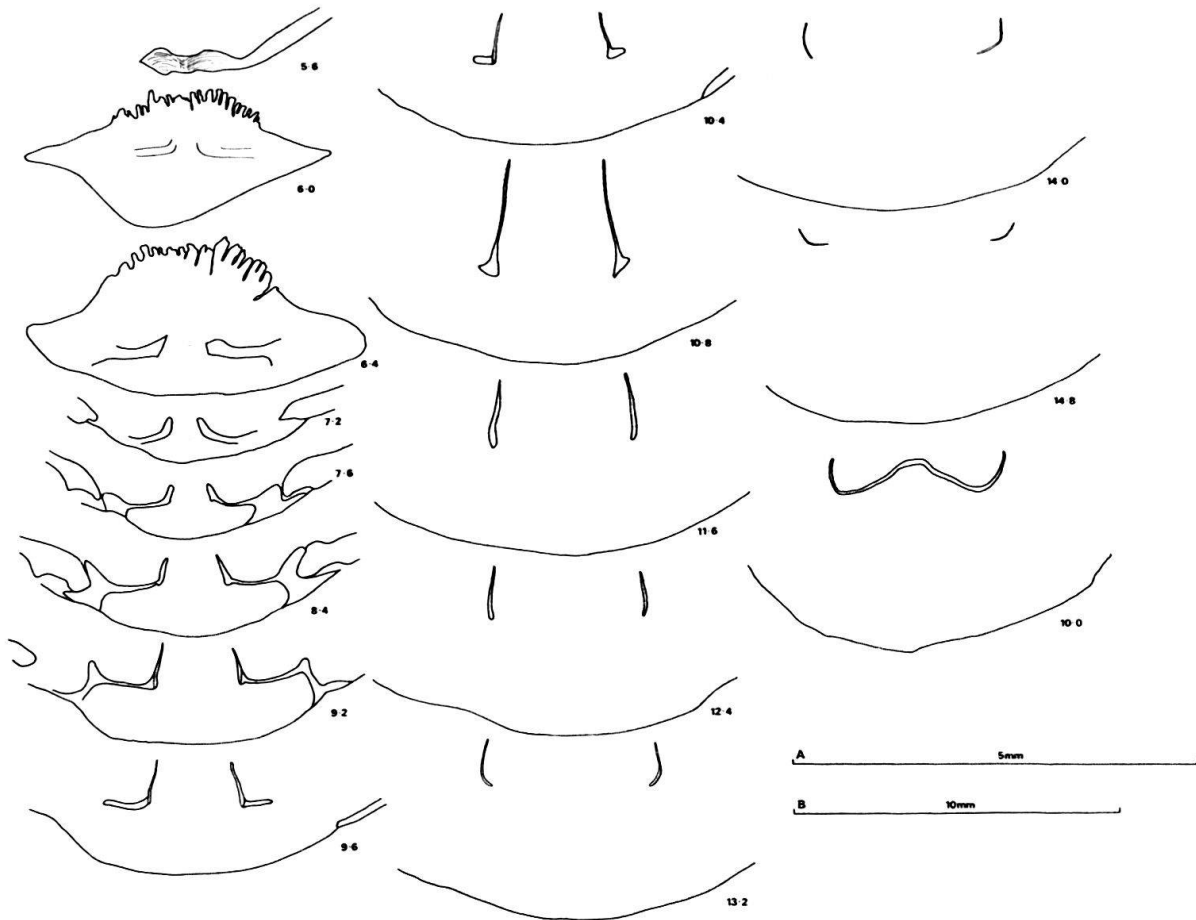


Fig. 11. Serial sections through *Tropeothyris pilati* BACHMANN. The symphytium is seen at 5.6 and the cardinal process, enclosing the initially horizontal hinge plates, at 6.0–6.4. The hinge plates become slightly concave anteriorly and at 9.2 the high crural bases, attached at a right angle to the hinge plates, can be seen. The crural processes are at maximum height at 10.8 and the moderately low-arched transverse band appears at 10.0. The external shell was not preserved in the earlier sections. 73.30, Wyssling Coll. (Zürich), Geschmättlischichten, Vorarlberg, except for section 10.0, which is from P1, Wyssling Coll., Geschmättlischichten, Pilatus, Switzerland (a smaller specimen). A = scale for sections 6.0 and 6.4. B = scale for the remaining sections.

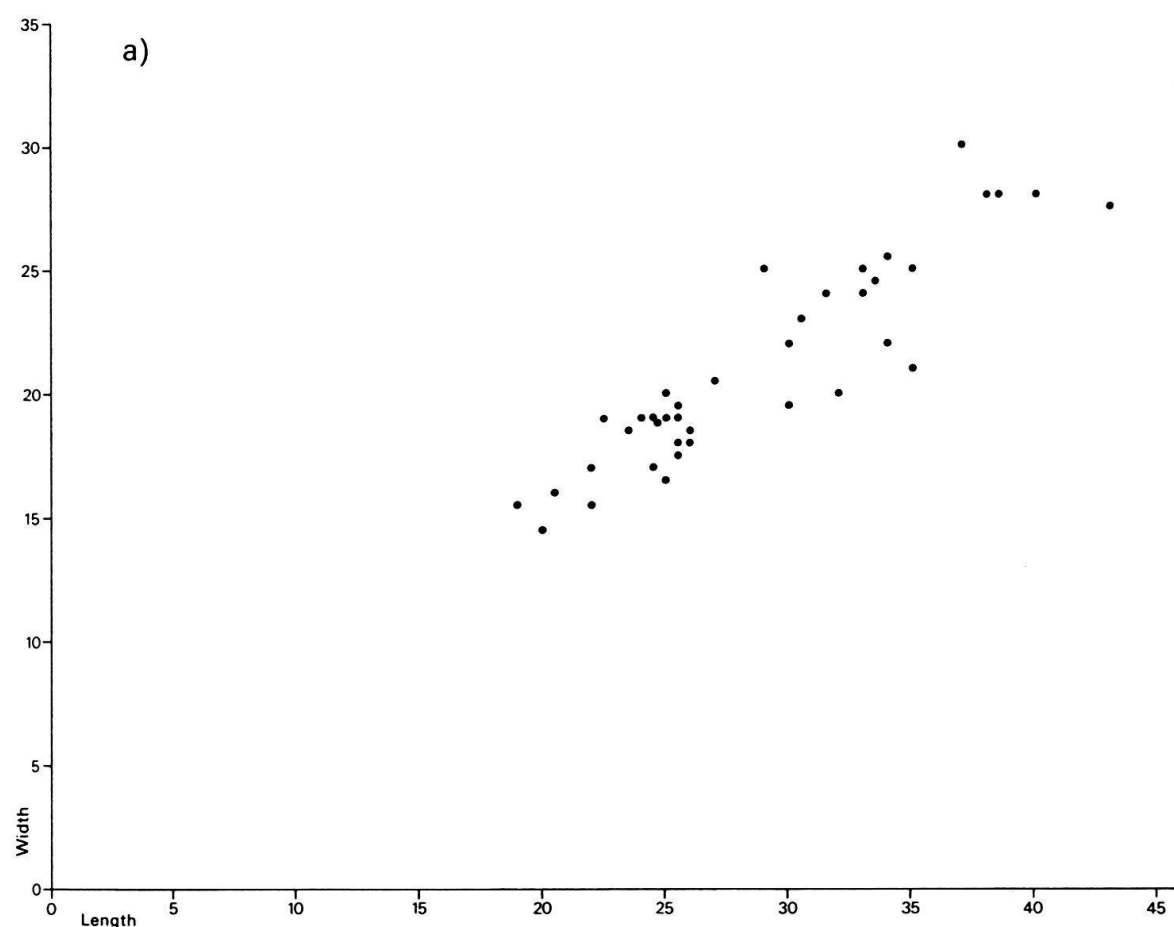
Remarks. – *T. pilati* is distinguished from other species of the genus by the very strong sulcification (but not episulcation) of its anterior commissure, and the high-arched lateral commissure in adults. Folding of the shell is, in fully grown specimens, stronger than in any other species of *Tropeothyris*.

It is distinguished from species of other genera by the generic characters of its internal structure but has an external resemblance to some of these. BACHMANN, in his original description, compares it with *Terebratula praelonga* (= *Praelongithyris praelongiforma*), *Terebratula biplicata* (= *Moutonithyris dutempleana*) and *Terebratula subsella* (= *Kutchithyris subsella*) and these, with the addition of *Musculina* spp., are the species with which it is most likely to be confused. It differs from all species of *Praelongithyris* chiefly in having a more incurved umbo, sharper beak ridges and in having folding which affects a greater proportion of the anterior part of the shell in adults, and from *P. praelongiforma* in particular in being more laterally constricted anteriorly and in having a smaller P/A ratio. From *M. dutempleana* it differs in having

a smaller P/A ratio, a higher-arched lateral commissure and a narrow central sinus of the anterior commissure and by not developing an episulcate commissure even in the fully adult stage. It differs from species of *Musculina* in attaining much greater size, having a much smaller P/A ratio, umbo more incurved and symphytium more hidden, and in developing both plication of the commissure and folding of the shell at a much larger growth stage.

T. pilati in the adult stage does have a very close external resemblance to *K. subsella*, especially, as BACHMANN remarked, to the forms ascribed to that species which occur in the Kimmeridgian of Le Havre. The main external differences are: a) the umbo of *K. subsella* reaches the erect rather than the incurved stage, the symphytium is less hidden and the foramen less labiate; b) the lateral sinuses of the commissure are wider and more laterally extended in *K. subsella*, giving it a «winged» selliform appearance; c) in early growth stages *T. pilati* is relatively long and narrow, contrasting with the sub-circular early growth stages of *K. subsella*.

Distribution. – BACHMANN (1867, p. 142) remarks that this species had long been known to geologists around the Vierwaldstättersee as either *T. praelonga* or *T. biplicata*. It is very common in the Geschmättlschichten (Valanginian–Hauterivian) of Unterwalden and Uri and the corresponding horizon in Vorarlberg, and occurs rarely in the Altmannschichten (Lower Barremian) of Vorarlberg. It is confined to the central Switzerland–Vorarlberg area.



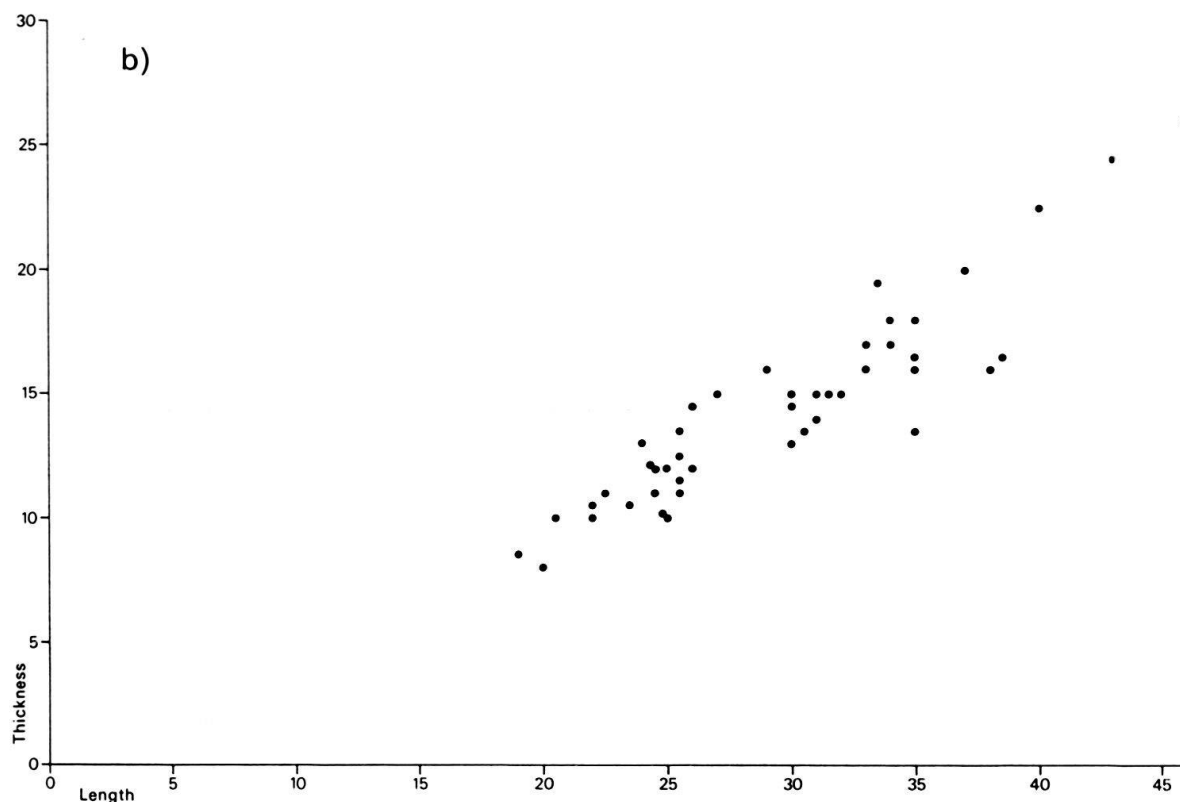


Fig. 12. Scatter diagrams of a) length and width, b) length and thickness in *Tropeothyris pilati*.

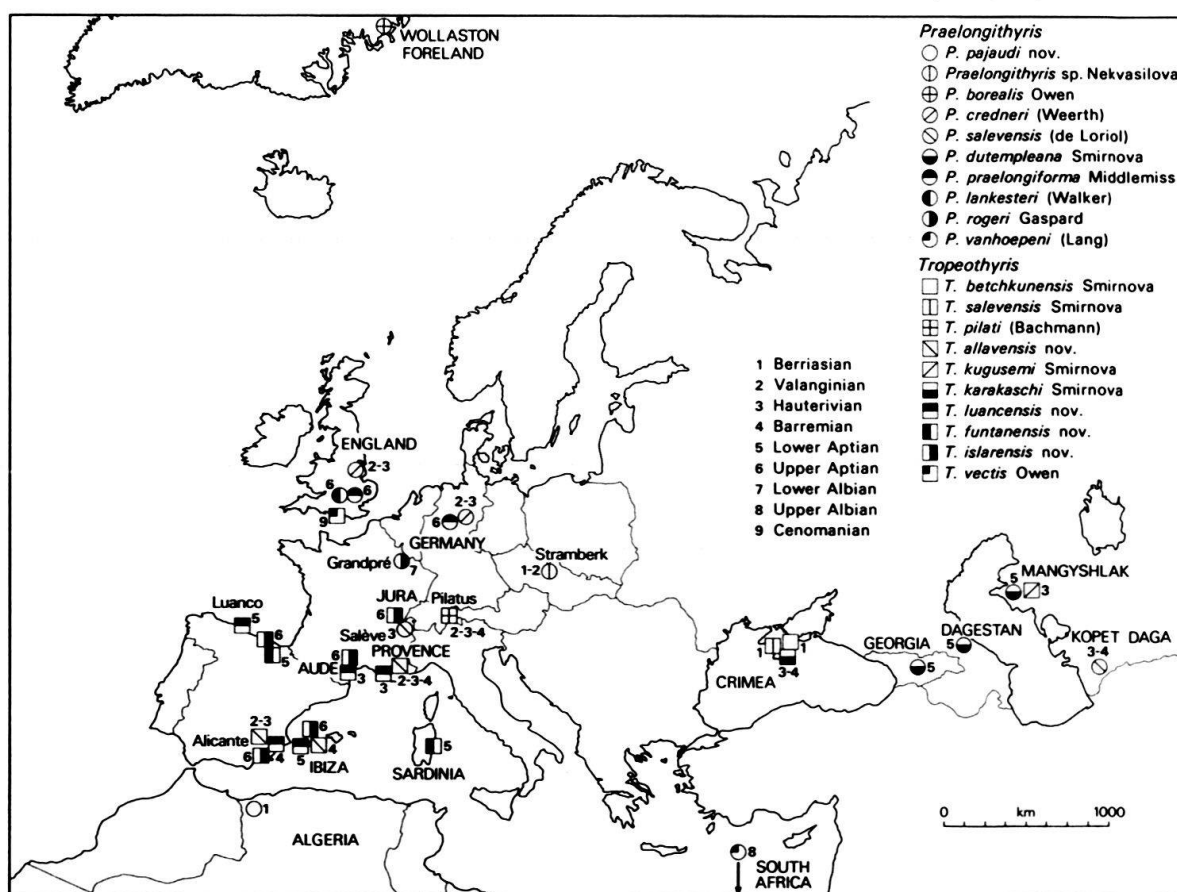


Fig. 13. Geographical distribution of the species of *Praelongithyris* and *Tropeothyris*.

Undescribed species of *Tropeothyris* also occur in the Geschmättlschichten and Altmannschichten, and also as high as the Upper Aptian, in Vorarlberg (Föllmi and Wyssling Collections, Zürich).

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Plate 1

Fig. 1–3

Praelongithyris salevensis (DE LORIO).

1a–d = plaster cast of sectioned specimen (see Text Fig. 2), Jaccard Collection (Neuchâtel), 49/9G/1, Hauterivian, Mont-Salève, Haut Savoie. 2a–d = Jaccard Collection (Neuchâtel), 49/9G/2, Hauterivian, Mont-Salève. 3a–d = plaster cast of sectioned specimen (see Text Fig. 1), BM BB 84705 (formerly B 6278/1), Middle Neocomian, Mont-Salève.

Fig. 4–5

Praelongithyris pajaudi sp. nov.

4a–d = Holotype, Pajaud Collection (Paris), PM 1, Berriasian, Ouled Mimoun (formerly Lamoricière), Algeria. 5a–d = plaster cast of sectioned specimen (see Text Fig. 3), Grenoble University Collection GN 2, probably Berriasian, Ouled Mimoun, Algeria.

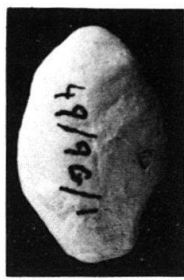
Fig. 6–7

Tropeothyris funtanensis sp. nov.

6a–d = Holotype, Padua University Collection IGPSB 22a, basal Aptian, Badde Funtana Morta, Orosei, Sardinia. 7a–d = plaster cast, Padua University Collection IGPSB 24, horizon and locality as holotype.



1a



1b



1c



1d



6a



2a



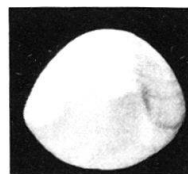
2b



2c



2d



3d



6b



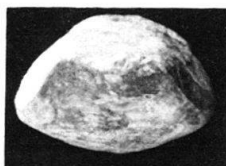
3a



3b



3c



4d



6c



4a



4b



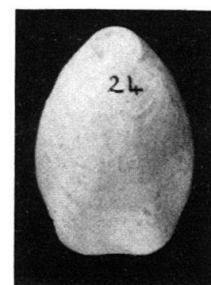
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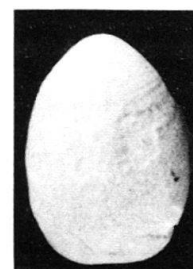
5d



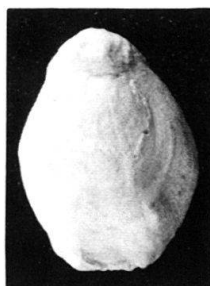
6d



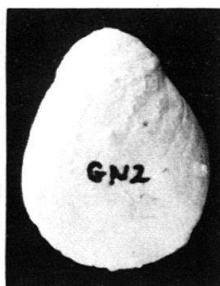
7a



7c



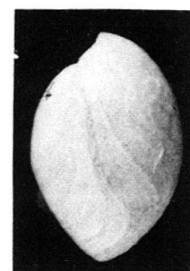
5a



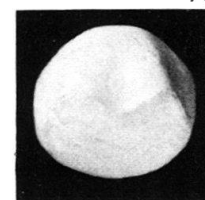
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5c



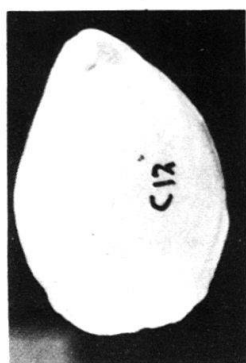
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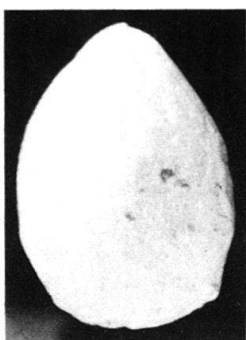
7d

Plate 2

- Fig. 1 *Tropeothyris funtanensis* sp. nov.
1a–d = plaster cast, BM BB 84706 (formerly C 12), Castro Limestone, Lower Aptian, Sámano, Santander, Spain.
- Fig. 2–4 *Tropeothyris allavensis* sp. nov.
2a–d = Holotype, BM BB 84708 (formerly GN 9/5), Grande Lumachelle, Upper Valanginian, Les Allaves, Basses Alpes. 3a–d = plaster cast of sectioned specimen (see Text Fig. 5), BM BB 84707 (formerly GN 9/1), horizon and locality as holotype. 4a–d = plaster cast of sectioned specimen (see Text Fig. 6), Besançon University collection BN 3a, Hauterivian, Censeau, Jura.
- Fig. 5 *Tropeothyris luancensis* sp. nov.
5a–d = Holotype, BM BB 84712 (formerly PA 1), Lower Aptian or basal Upper Aptian, San Pedro de Antromero, Luanco, Oviedo, Spain.



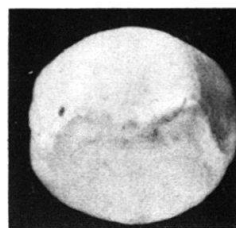
1a



1b



1c



1d



5a



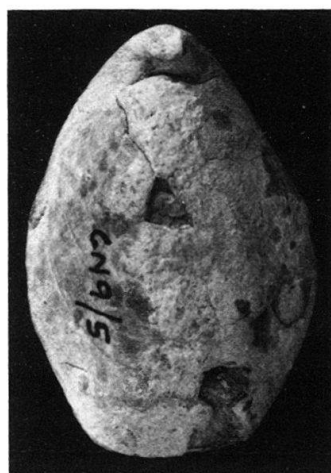
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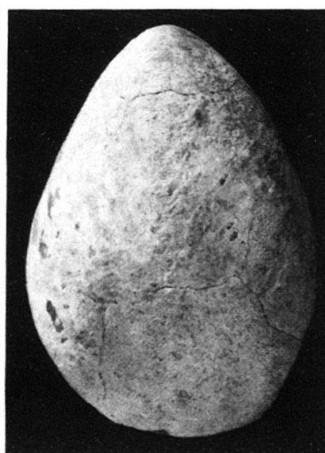
5c



5d



2a



2b



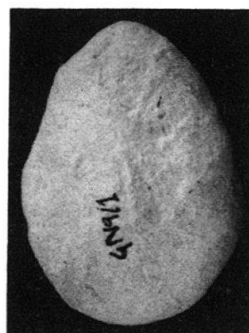
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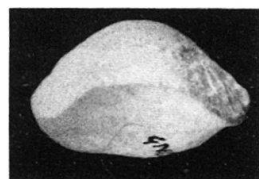
2d



3a



3b



3d



3c



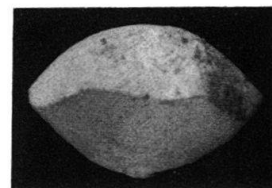
4a



4b



4c



4d

Plate 3

- Fig. 1-3 *Tropeothyris luancensis* sp. nov.
1a-d = plaster cast of sectioned specimen (see Text Fig. 7), BM BB 84713 (formerly C8/2), Wienands Collection, horizon and locality as holotype. 2a-d = BM BB 84717 (formerly Est a/1), Esterle Collection, Hauterivian, Ollières, Var. 3a-d = plaster cast, BM BB 84714 (formerly F 2981), Azéma Collection, Sierra del Cid, Alicante, Spain.
- Fig. 4-5 *Tropeothyris islarensis* sp. nov.
4a-d = Holotype, BM BB 84719 (formerly C1/2), Upper Aptian or basal Albian, Islares, Castro Urdiales, Spain. 5a-d = plaster cast of sectioned specimen (see Text Fig. 10), BM BB 84720 (formerly C1/1), horizon and locality as holotype.
- Fig. 6 *Tropeothyris pilati* (BACHMANN).
6a-d = juvenile uniplicate specimen, Wyssling Collection (Zürich) P3, Geschmättlischichten, Pilatus, Unterwalden.

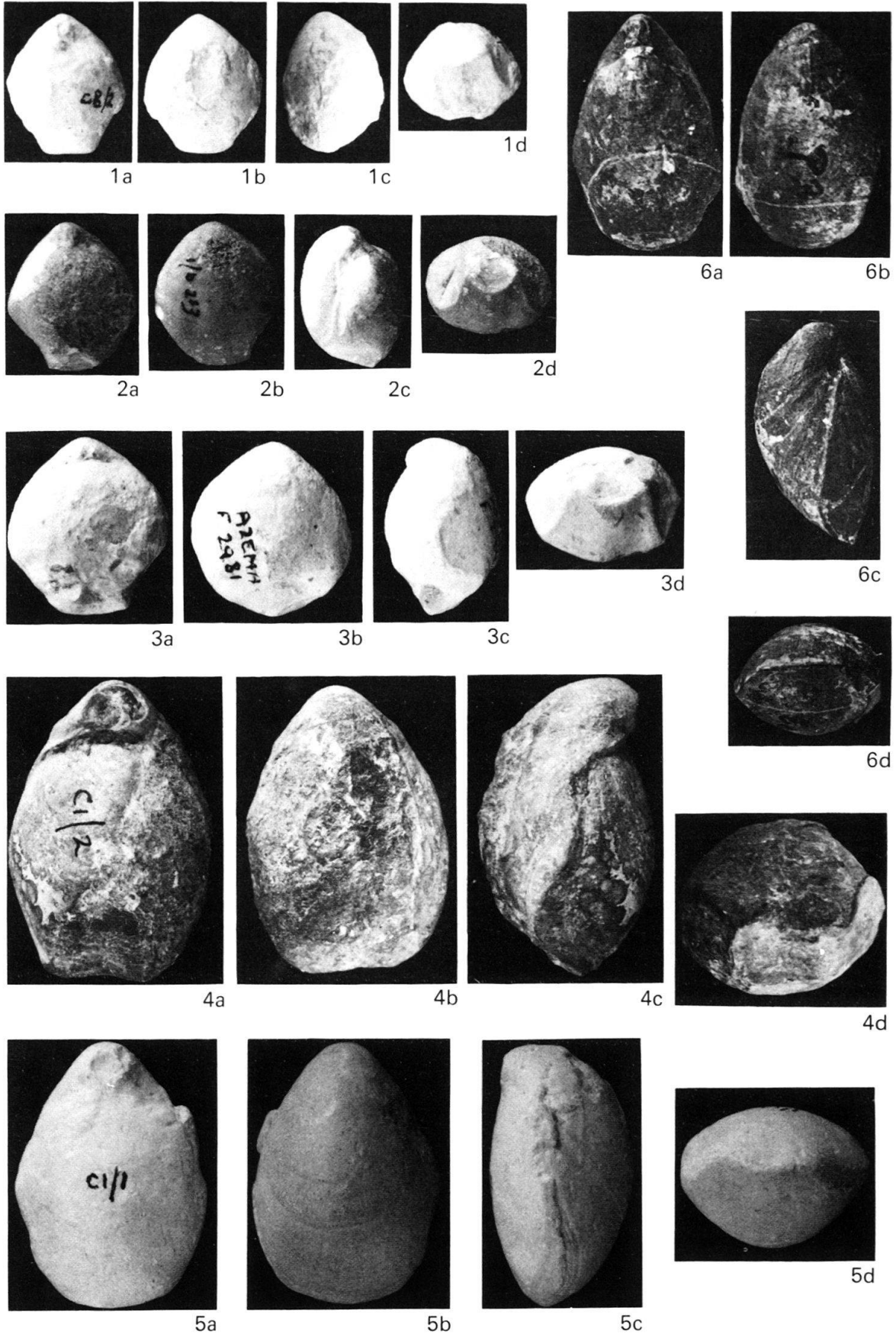
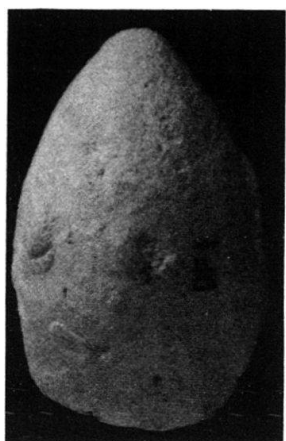


Plate 4**Fig. 1-3***Tropeothyris islarensis* sp. nov.

1a-d = plaster cast of sectioned specimen (see Text Fig. 9), Delamette Collection (Geneva) DF 1, Upper Aptian (Clansayésian), Futie, Ain. 2a-d = Delamette Collection DF 2, horizon and locality as 1. 3a-d = large gerontic specimen, Delamette Collection DF 3, horizon and locality as 1.



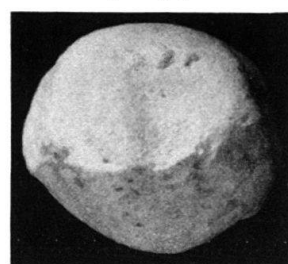
1a



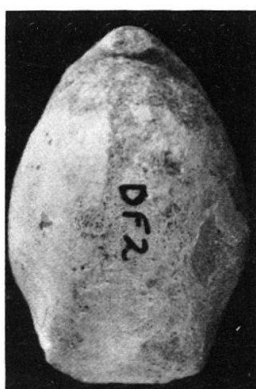
1b



1c



1d



2a



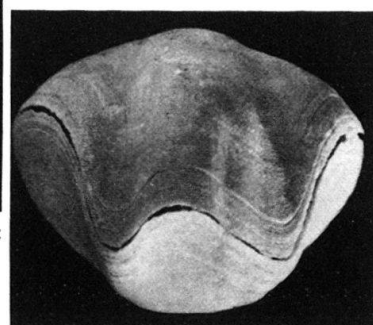
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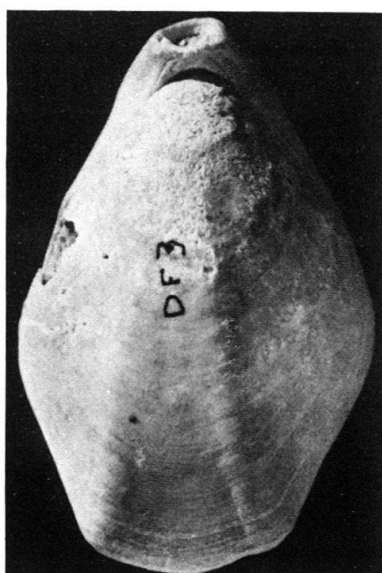
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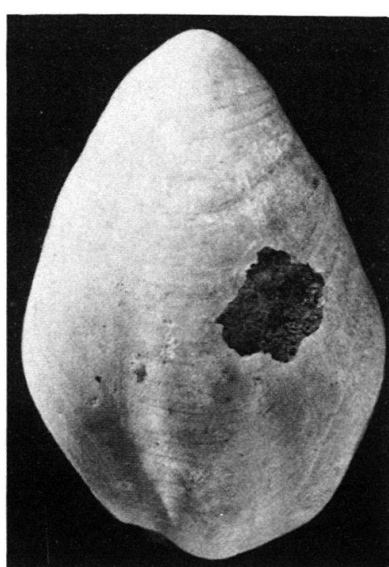
2d



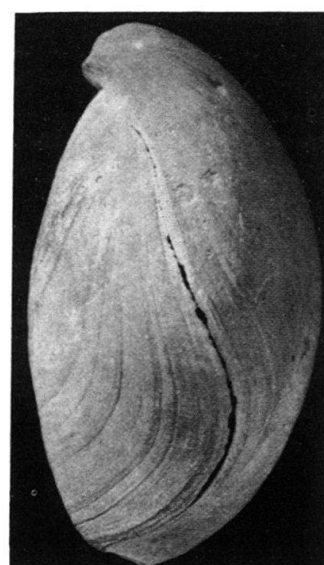
3d



3a



3b



3c

Plate 5

Fig. 1-3

Tropeothyris pilati (BACHMANN).

1a-d = typical adult specimen, Basel Museum Collection L 2176/2, Hauterivian, Sisikon, Uri. 2a-d = plaster cast of sectioned specimen (see Text Fig. 11), Wyssling Collection (Zürich) P1, Geschmättlischichten, Pilatus, Unterwalden. 3a-d = plaster cast of sectioned specimen (see Text Fig. 11), Wyssling Collection (Zürich) 73.30, Geschmättlischichten, Vorarlberg.



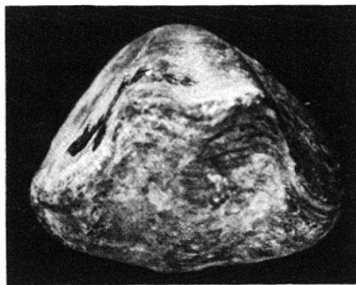
1a



1b



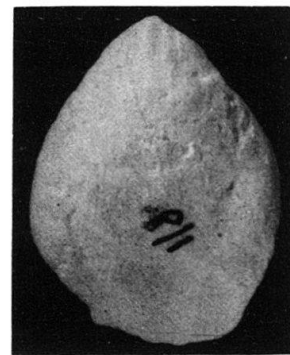
1c



1d



2a



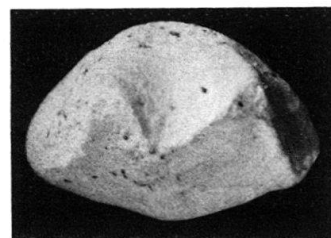
2b



2c



2d



3d



3a



3b



3c

