

On the taxonomy of the Recent species of the genus *Chrysallida* Carpenter from Europe, the Canary Islands and the Azores
(Gastropoda, Pyramidellidae)

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Detailed descriptions, distributional data as well as drawings of shells of the Recent species of the genus *Chrysallida* from Europe, the Canary Islands and the Azores are presented. *Chrysallida interspatiosa* nov. spec. is described from the Azores. *Chrysallida interita* is proposed as a nomen novum for *Acteon pygmaea* Grateloup, 1838 nec Lea, 1833.

Key words: Gastropoda, Opisthobranchia, Pyramidellidae, *Chrysallida*, East Atlantic, Europe, Canary Islands, Azores.

INTRODUCTION

Although nowadays a number of studies on the characterization of the Recent species of the genus *Chrysallida* Carpenter, 1857, from Europe, the Canary Islands and the Azores is available, their identification remains far from easy in many cases. Unfortunately, the studies of Nordsieck (1972), the first modern reviser of this genus, are problematic, since according to recent understanding that author interchanged several generic names and a number of synonyms. Fretter, Graham & Andrews (1986) gave detailed descriptions and excellent drawings, but deal with only ten (Atlantic) species. The elaborate identification key, with marginal notes, and a number of good photographs, by Van Aartsen (1977) is very useful. However, within the framework of this key, the often considerable intraspecific variability is not sufficiently taken into account.

The present paper aims at providing more detailed information on the Recent *Chrysallida* species from Europe, the Canary Islands and the Azores. In addition, a new species is described from the Azores. In the descriptions special attention is given to the dimensions and their ratios, the position and shape of the protoconch, a differential diagnosis and the provenance of the material investigated, which comprised all *Chrysallida* samples from the collections of J.C.A. Eikenboom (Hellevoetsluis) - EH; J. van der Linden (The Hague) - LH; H.P.M.G. Menkhorst (Krimpen aan de IJssel) - MK; W. van Putten (Oostvoorne) - PO; the Nationaal Natuurhistorisch Museum (Leiden) - NNM (formerly RMNH and RGM) and the Zeemuseum (Scheveningen) - ZMS; as well as a number of samples from the collections of H.J. Hoenselaar (Alkmaar) - HA, and the Zoölogisch Museum Amsterdam - ZMA.

In the descriptions of the species, localities are listed geographically, starting with the most northern Atlantic ones, following the western European coast line down to Gibraltar, subsequently the northern, eastern and southern Mediterranean coast, followed by localities on the Canary Islands and the Azores.

In a few cases, where the authors did not have (enough) material at their disposal, brief descriptions based on literature data are given. In all other cases, detailed drawings of the species dealt with are presented as well.

DIMENSIONS AND RATIOS

Although the present study showed that it is not possible to identify the various *Chrysallida* species on the basis of their dimensions only and the ratios thereof, these parameters are of importance in a number of specific cases.

Two factors have to be considered: - (1) the differences between the species; - (2) the intraspecific variability, which includes the variability in shape (e.g., very limited in *C. emaciata* and rather considerable in *C. spiralis*) as well as the different ratios of various parts of seemingly full-grown specimens of different length (e.g., *C. fenestrata*, length 2.4 and 3.8 mm). Thus, dimensions and their ratios should always be quoted as ranges.

In the present study, seemingly full-grown, undamaged specimens from as many localities as possible were used for the following measurements:

L - The length of the shell, measured as indicated in fig. 1.

LW - The length of the last whorl as a percentage of the total length of the shell, measured, like L, along the axis of the shell in order to eliminate the effect of the angle of the suture to the shell axis. Within one species, LW % is strongly influenced by the length of the shell, e.g. *C. emaciata* with L 1.5 mm/LW 55%, L 1.9 mm/LW 52%, L 2.3 mm/LW 44%. This parameter is, e.g., very important for the separation of *C. sarsi* and *C. juliae*.

A - The height of the aperture as a percentage of the total length of the shell, measured as indicated in fig. 1. Within one species, A decreases, just like LW, with increasing length of the shells.

L/B - The ratio between the length of the shell and its largest breadth, measured as indicated in fig. 1. The more slender the shell, the higher is the ratio L/B. This parameter is of importance when comparing shells from different species with the same length.

B/b - The ratio between the largest breadth of the shell (B) and that of the antepenultimate whorl (b), measured as indicated in fig. 1. B/b is a yardstick for the conical character of the shell: a lower number indicates a cylindrical shape (e.g., *C. doliolum*: B/b 1.1), a high number a conical shape (e.g., *C. decussata*: B/b up to 2.8).

THE PROTOCONCHS OF CHRYSALLIDA SPECIES AS COMPARED TO THOSE IN THE GENUS TURBONILLA

As discussed extensively by Van Aartsen (1977, 1981, 1987), the protoconchs of Pyramidellidae are coiled around the axis of the shell. Within this family, species show some variation of this type of protoconch, but the intraspecific variability is only limited.

At some variance with Van Aartsen's original classification, we distinguish in this paper the following types of protoconchs:

— type A: angle of protoconch with shell axis from 90° to a good 120° , whereby: A-I is the planorboid version, with all protoconch whorls in one plane at an angle of about 120° (fig. 2) with the axis of the shell; A-II is the helicoid version, with a clearly protruding nucleus and an angle of about 90° with the shell axis.

— type B: angle of protoconch with the axis of the shell from 130° to some 160° (figs. 3,6 and 4,7).

— type C: angle almost 180° : the protoconch has almost disappeared into the first teleoconch whorl (intorted) (fig. 5).

All *Turbonilla* have an A-I or A-II protoconch. We do not agree with Van Aartsen's (1977: 50) statement that all *Chrysallida* have a type C (intorted) protoconch; in our opinion this is only the case for some species (e.g., *C. spiralis*), whereas in most species the protoconch whorls are visible as a loop, hanging obliquely over the first teleoconch whorls: type B (figs. 4,7). There are even species (e.g., *C. fenestrata*) where the angle between the protoconch and teleoconch axes is still smaller, tending to type A-I (planorboid) (figs. 3,6). Part of the first half whorl of the protoconch is then visible. Even in the last mentioned cases separation of *Turbonilla* and *Chrysallida* is well possible: in a *Turbonilla* with a planorboid protoconch (figs. 2,6) its first part (c. 1.5 whorl) has for at most 25% disappeared into the first teleoconch whorl; in a *Chrysallida* with such a protoconch this amounts to about 50% (fig. 6).

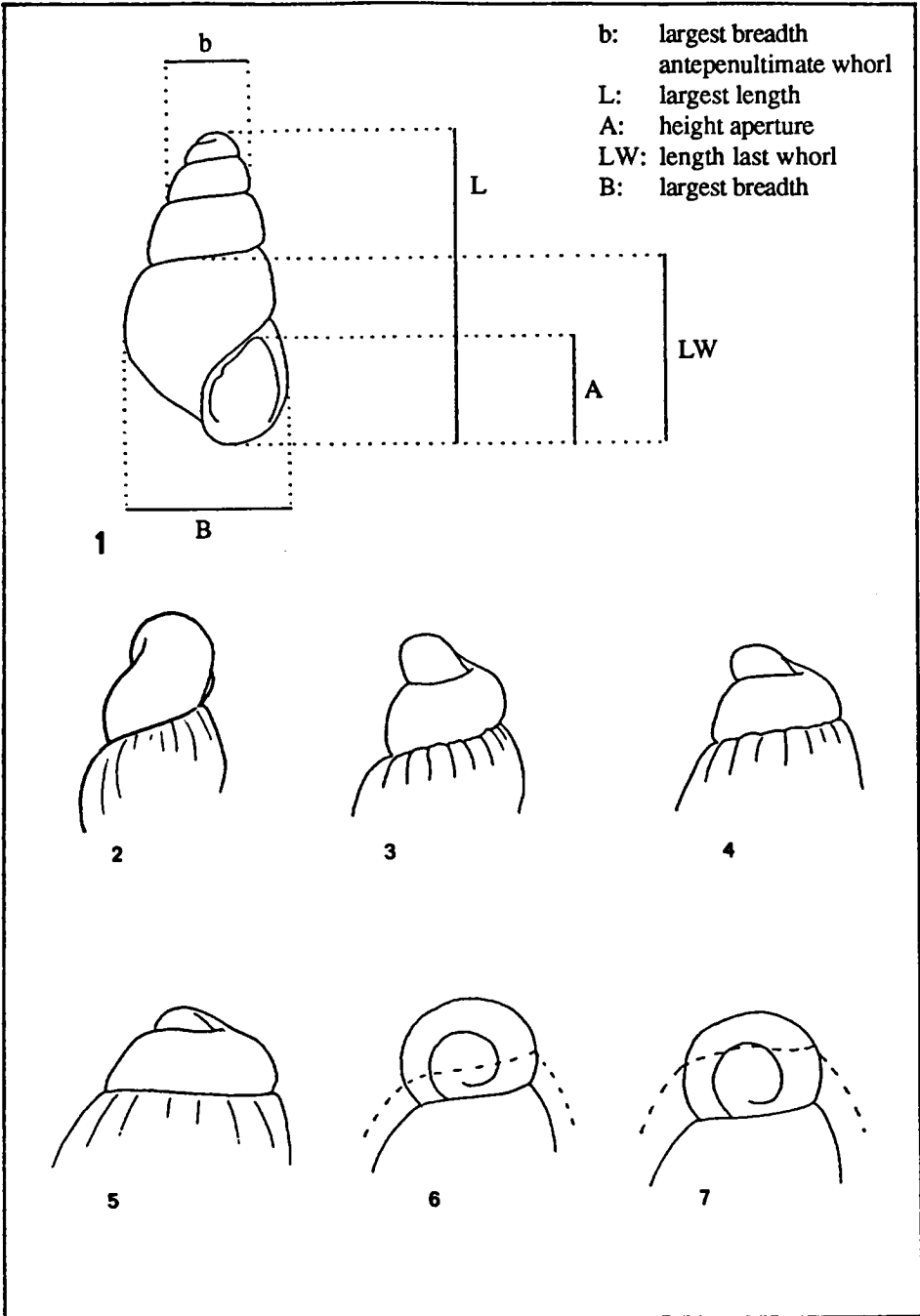
In the following descriptions of the various species, characterization of the "top" of the shell (pointed, blunt) refers to the combination of the protoconch and the first teleoconch whorls. The latter are often broad, but may be narrow like in most *Turbonilla* (e.g., *C. terebellum*, *C. decussata* and, particularly, *C. fenestrata*).

SOME REMARKS

In the descriptions of the species the number of ribs per whorl is seldom mentioned. In view of the great variability within one species, counting the number of ribs appeared to be senseless. However, in species with many ribs, close together, like in *C. suturalis* and *C. juliae*, this is mentioned. The same is done with species with only a few ribs per whorl, and thus broad interspaces.

Chrysallida with one spiral ridge on the penultimate and preceding whorls and two spirals on the last whorl, only have two spiral ridges on that last whorl if the ribs do not end abruptly on the periphery but, sometimes fading, continue until the base of the shell. However, in case the ribs end near the top of the aperture, the lowest spiral ridge forms more a termination of the ribs, rather than a real spiral. The species showing this spiral pattern have in fact two spiral ridges on all preceding whorls. Owing to the fact that the lowest part of these whorls is covered by the upper part of the next whorl, only one spiral remains visible. In some specimens the lowest spiral ridge is still visible in the suture. The same phenomenon, of course, occurs in *Chrysallida* with more spiral ridges.

In fresh, more or less transparent, shells a 'spiral ridge' is visible at the top of the whorl, just below the suture. This however, is not a real spiral, such as in *Chrysallida* spec. C, but the translucent bottom of the preceding whorl.



Chrysallida doliolum s.s. (Philippi, 1844)
(figs. 13, 14)

Rissoa doliolum Philippi, 1844, Enumeratio Molluscorum Siciliae 2: 132, pl. 23 fig. 19.

General description (after 336 shells from 31 localities).—The shape of the shell varies from pupoid and slightly conical ($B/b = 1.5$) to slender ($L/B = 3.0$) and nearly cylindrical ($B/b = 1.1$). The protoconch is of type B, tending to A (“planorboid”, or “A1”). Frequently, part of the first half whorl is visible, its suture is brown. There are four, exceptionally five, flat to barely convex teleoconch whorls. The suture is narrow, wavy because of the somewhat bulging upper parts of the ribs and lies somewhat obliquely to the shell axis. The ribs are broad, and close-set, the interstices narrow. These may continue to the base of the last whorl or decrease and disappear around the upper part of the aperture. They are straight (seldom sinuous) and vertical or somewhat leaning to the right. Generally, both directions occur in one shell, whereby the highest and the lowest whorls show vertical ribs, and those in between are markedly opisthocline. There are no spirals. The aperture is relatively small, egg-shaped and narrowing towards its upper side. There is a small tooth-pleat, no umbilicus and no umbilical chink. *C. doliolum* is the only coloured European *Chrysallida*. The basic colour is yellow-white to yellow. There are orange-brown lines or bands on the whorls. Furthermore, there is a broad band at the upper side of the initial whorls, just under the suture, and sometimes a second, narrow spiral line just at their bottom, close to, or even within, the suture. The lowest whorl has three spiral bands: the upper one (the broadest) just under the suture, the middle one just above the aperture, and the lowest one alongside the aperture, starting just above the tooth fold.

Length 1.8-2.5 mm, LW 48-58%, A 26-31%, L/B 2.2-3.0, B/b 1.1-1.5 (based on 21 shells).

Differential diagnosis. — Because of the colour bands, confusion with other *Chrysallida* species is impossible.

Material examined (locality and number of specimens). — Spain: Cadiz, Gétarès/4 (LH, MK); Murcia, Cartagena/31 (PO).

France: Pyrénées-Orientales, Banyuls-sur-Mer/15 (MK); Bouches-du-Rhône, Cap Couronne/5 (LH), Sausset-les-Pins/10 (MK); Var, Ile de Levant/6 (PO), Le Bruscat/3 (LH); Alpes-Maritimes, Antibes/112 (LH, ZMS).

Italy: Imperia, Alassio/17 (MK); Grosseto, Isola Argenterola/1 (EH); Sicily, Romagnola/1 (NNM).

Malta: Rdum il-Qammieh/2 (LH).

Figs. 1-7. Methods of measurement and types of apex of *Chrysallida*. 1, Measurements A, B, b, L, and LW. 2, Side-view of the pointed top of *Turbonilla*; the protoconch is planorboid or A1. 3, Side-view of the pointed top of *Chrysallida*; the protoconch is of type B, strongly tending to A. It is more sunken into the first teleoconch whorl than type A (cf. figs. 2, 6). 4, Blunt top (also broad first teleoconch whorl) of *Chrysallida* with a more coiled protoconch, type B. 5, The protoconch is almost completely intorted; in combination with a broad first teleoconch whorl, it gives the shell a very blunt appearance. 6, Planorboid of A1 protoconch of *Turbonilla* in front-view (cf. fig. 2); the interrupted line indicates the position of the first teleoconch whorl of *Chrysallida* with a protoconch tending to type A (cf. fig. 3). 7, The interrupted line represents the first teleoconch whorl of *Chrysallida* with a still more sunken protoconch, type B (cf. fig. 4).

Yugoslavia: Croatia, Vrsar/1 (PO), Šibenik/6 (MK), Sparadiči/3 (EH), Slano/3 (EH), Baniči/45 (EH).

Israel: Haifa/5 (LH, MK).

Canary Islands: Fuerteventura, depth 40 m/2 (NNM); Gran Canaria, Maspalomas/1 (LH); Hierro/2 (NNM); Lanzarote, depth 36-110 m/6 (NNM); Palma, depth 50-420 m/16 (NNM); Tenerife, Playa de las Americas/7 (PO).

Madeira: Porto Santo/3 (NNM).

Azores: Faial, depth 140 m/4 (NNM); Flores, depth 30-104 m/4 (NNM); Formigas/1 (NNM); Santa Maria, depth 60-65 m/13 (NNM); São Jorge/1 (NNM); São Miguel, depth 10-220 m/6 (NNM).

Distribution. — The entire Mediterranean area, Canary Is., Madeira and Azores. Also known from Cape Verde Is., dredged from 25-800 m (NNM). According to Nordsieck (1972) also Lusitania (Portugal).

Chrysallida doliolum s.l.

With two colour bands on the last whorl, only a forma?
(fig. 15)

General description (after 15 shells from 9 localities). — The forma (?) deviates from *C. doliolum* s.s. in two main points. It is considerably larger, i.e. over 3.0 mm long (2.0 mm being normal). The colour bands are different. On the last whorl there are two bands, the upper one half-way the suture and the upper side of the aperture, the lower one next to the upper part of the aperture (somewhat lower than the middle band in *C. doliolum* s.s.). On the other whorls there is only one band, in the centre of the whorl. Less striking is the somewhat (also relatively) greater length of all whorls, so that a specimen of 3.5 mm still has the same number of whorls (five) as a large (2.5 mm.) specimen of *C. doliolum* s.s. No other additional differences are observed.

Length 2.5-3.5 mm, LW 46-57%, A 24-30%, L/B 2.4-2.9, B/b 1.1-1.4 (based on 10 shells).

Discussion. — The question whether these shells belong to another species, e.g. *C. bicincta* (Tiberi, 1868) (see Parenzan, 1970), *C. cylindrica* (B.D. & D., 1883), or *C. buquoyi* (Locard, 1886), still has to be answered (see also Nordsieck, 1972).

Material examined (locality and number of specimens). — France: Pyrénées-Orientales, Banyuls-sur-Mer/2 (MK); Alpes-Maritimes, Antibes/1 (LH).

Yugoslavia: Croatia, Slano/1 (EH), Baniči/2 (EH).

Malta: Rdum il-Qammieh/3 (LH).

Cyprus: Paphos/1 (LH).

Israel: Haifa/3 (LH).

Egypt: Mersa Matruh/1 (NNM).

Canary Islands: Lanzarote, depth 150 m/1 (NNM).

C. jeffreysiana (Monterosato, 1884)
(figs. 16, 17)

Trabecula jeffreysiana Monterosato, 1884, Nomenclatura generica e specifica di alcune conchiglie Mediterranee: 86.

Syn.: *Chrysallida undata* (Watson, 1898).

General description (after 31 shells from 12 localities). — The shell is conical with rather convex whorls and a blunt top. The protoconch is of type B, tending to A

(planorboid or A1). Sometimes a part of the first half whorl of the protoconch is visible. There are four or five convex teleoconch whorls, strongly constricted at the upper and the underside. Consequently, the suture is rather wide and, particularly, deep; its direction is markedly oblique. The ribs are straight to slightly curved and are vertical or somewhat inclined to the left or to the right. They generally do not continue to the base, but become obscured half-way the aperture. The shape and the number of the ribs in *Chrysallida* is generally variable and particularly so in *C. jeffreysiana*. The number on the last whorl varies from 15 to 28. Also the breadth is extremely variable: from very narrow, rather high and sharp, to broad and high or even (but rarely) flat. Thus, the interstices vary from very narrow to very broad. There are no spirals. The aperture is oval, there is no tooth and hardly an umbilical chink. As a matter of interest, many specimens show, on several whorls, the ribs thickened to varices.

Length 2.2-3.2 mm, LW 50-58%, A 25-32%, L/B 2.2-2.8, B/b 1.4-1.7 (based on 15 shells).

Discussion. — In the literature one finds little agreement in author and year of *C. jeffreysiana*: Seguenza in Monterosato, Seguenza in Kobelt, or Monterosato, and the years 1872, 1875 and 1886 all occur. Monterosato mentions the species for the first time in 1872 as *Odostomia jeffreysiana*, but still considers it a variety of *O. clathrata* Jeffreys and adds: "Seguenza ms." No description is given and therefore it has to be considered a nomen nudum. The second mention of Monterosato is dated 1875, this time not any more as a variety, but as a species: *O. (Pyrgulina) jeffreysiana* Seguenza ms. Some localities from which the species is recorded are given, but again no description of the shell and as such the name has again to be considered a nomen nudum. Eventually, in 1884, Monterosato introduces the new genus *Trabecula*, with a clear description of the characters. Under that he mentions as type-species and only representative of the genus *T. jeffreysiana* Seguenza ms. The first valid description of this species therefore is that of Monterosato in 1884.

Differential diagnosis. — Because of the complete lack of spiral ridges and a tooth, the convexity of the whorls and the constricted, inclined suture, confusion with other *Chrysallida* is almost excluded. Only *C. clathrata* can be considered in this respect; this species, however, is smaller, more slender, shows clear spirals and often less pronounced ribs.

Material examined (locality and number of specimens). — Spain: Cadiz, Gétarès/1 (MK).

Italy: Sicily, Trapani/1 (MK), Mondello/1 (NNM), Marzameni/1 (NNM).

Greece: Athens, Lagonisi/1 (LH).

Cyprus: Paphos/1 (LH).

Canary Islands: Fuerteventura, Corraleja/6 (LH), Gran Taraja/3 (LH), Playa del Moro/4 (LH); Gran Canaria, Maspalomas/2 (LH); Lanzarote, Arrecife/3 (LH), outer harbour-Arrecife/7 (LH).

Distribution. — The entire Mediterranean area, Canary Islands. According to Nordsieck (1972) also "Westindien, Pazifik-Kalifornien".

Chrysallida spiralis (Montagu, 1803)
(figs. 18, 19)

Turbo spiralis Montagu, 1803, Testacea Britannica 2: 323

Syn.: *Voluta pellucida* Dillwyn, 1817.

Chrysallida lacourti Nordsieck, 1972.

General description (after 282 shells from 25 localities). — Although the shape of the shell is rather variable (cf. Discussion) it is generally strongly conical with a blunt top and a broad base. The protoconch is of type C. There are, depending on the also very variable length, three to (length of 3 mm or more) five flat teleoconch whorls; however, the last one, rather high, is convex. The suture is wide and deep, its direction almost horizontal. The ribs are broad and flat, close together, therefore the interstices are narrow. The ribs are very variable: often straight, sometimes a little flexuous, vertical, normally leaning to the left but sometimes to the right, sometimes different directions are observed in one shell. The initial whorls have one broad, flat spiral ridge on the base, just above the suture. This spiral, which is sometimes difficult to observe, borders the ribs above it. Also on the last whorl the most apical spiral borders the ribs. On this whorl there are about six spirals. In most cases, two of these (also broad and flat) spiral ridges are located above the upper edge of the aperture, the others, less developed, next to the aperture. All these spirals are closer together, their interstices are very narrow. Fresh specimens show in these interspaces fine, small riblets in a strongly prosocline position. The aperture is rather large, egg-shaped. The position of the tooth is variable too and it is sometimes only visible after turning the shell to the left. The umbilicus is equally variable: from large, spherical to a chink or even absent.

Length 1.5-3.4 mm, LW 56-72%, A 32-42%, L/B 1.7-2.3, B/b 1.6-2.4 (based on 18 shells).

Discussion. — *C. spiralis* shows remarkable differences in the ratio, even in specimens of the same length and recorded from the same locality, e.g. LW 58% and 69% or B/b 1.6 and 2.2 (both for shells of 1.9 mm; the lowest values for a slender, not so conical specimen, the highest ones for a broad, strongly conical shell). This is even more remarkable since the lowest values (58, 1.6) in this species are only measured mostly in shells that are substantially longer (3.0 mm). This great variability will among others have been Nordsieck's motivation to create his new species *C. lacourti* in 1972. The authors agree with Van Aartsen (1977) that this last-mentioned species cannot be distinguished from *C. spiralis*. A study of the holotype (NNM, see below) has learnt that neither the dimensions, nor the ratio, nor the number of ribs differ from the normal (variable) habitus of *C. spiralis*. For further remarks about *C. lacourti* see also Rolan Mosquera (1983). According to Van Aartsen & Giannuzzi-Savelli (1991) *Turbo spiralis* Montagu, 1803, is preoccupied by *Turbo spiralis* Poiret, 1801; the name *Chrysallida pellucida* (Dillwyn, 1817) is the one to be used for the species. For practical reasons the authors prefer to use the well-known and commonly used name, particularly in view of the obscure and almost totally ignored homonym *Turbo spiralis* Poiret, 1801.

Differential diagnosis. — Confusion is possible with three other *Chrysallida* showing spirals on the base of the shells, next to the aperture. *C. alleryi*, a species the authors are unacquainted with, only known from literature. The shape of the shell is more slender (L/B 2.5), the spirals on the base often barely visible. *C. emaciata*, which is on average much smaller, much more slender, has convex whorls and, next to the aperture, fine spiral striae instead of broad, flat spiral ridges. *C. brusinai*, which is also smaller (length to 2 mm), less conical (particularly the smallest *C. spiralis* specimens are often strongly conical), the suture is deeper and sharper, the apex is less blunt, the ribs higher, their interstices larger and, above all, the interstices of the spiral ridges on the base have about the same breadth as the spirals themselves.

Material examined (locality and number of specimens). — Norway: Trondheim-fjord, Grande Viken/90 (EH, LH, MK); Hardaland, SSW. of Kausland/2 (NNM), Bergen/2 (NNM).

Great Britain: Scilly Isles/2 (NNM); Wales, Fairborne/1 (NNM); North Yorkshire, Scarborough/2 (NNM); Dorset, Kimmeridge/9 (NNM); Channel Islands, Herm/1 (MK).

Ireland:?, Barley Cove/2 (MK).

North Sea: Tea Kettle Hole/1 (NNM).

The Netherlands: Noord-Holland, IJmuiden/1 (NNM) (the other 7 samples are probably fossil shells).

France: Ille-et-Vilaine, bay of St. Malo/48 (NNM); Côtes-du-Nord, St. Jacut/34 (LH, ZMS); Finistère, Kersequenou/8 (LH), Ile Tudy/2 (LH); Morbihan, Gâvres/7 (LH), Penthièvre/26 (LH, ZMS); Vendée, Jard-sur-Mer/21 (LH); Gironde, Bassin d'Arcachon/1 (NNM).

Spain: Santander, Laredo/7 (EH, LH, PO); Pontevedra, Ria de Arosa/4 (NNM).

Italy: Sicily, Romagnolo/7 (NNM) (identification uncertain, see sub Distribution).

Canary Islands: Lanzarote, depth 120m/1 (NNM).

C. lacourti.

France: Vendée, Fromentine/1 (NNM, holotype: 56009); Gironde, Bassin d'Arcachon/1 (NNM).

Distribution. — From Norway, south along the European coasts to NW. Spain and Portugal, Canary Islands. Some shells from the Mediterranean do resemble *C. spiralis* more than they do *C. brusinai*. The bad condition of the material, however, prevents reliable identification.

The majority of the shells recorded from the Dutch beaches are fossil (cf. also De Boer & De Bruyne, 1991).

Parenzan (1970) and Fretter, Graham & Andrews (1986) mention also records from the (Western) Mediterranean.

Chrysallida brusinai (Cossmann, 1921)
(fig. 20)

Parthenina Brusinai Cossmann, 1921, Essais de paléoconchologie comparée 12: 258, fig. 10.

Syn.: *Chrysallida turbonilloides* (Brusina, 1869).

Chrysallida incerta (Milaschewitch, 1916).

General description (after 312 shells from 24 localities). — A small but solid shell, conical with a blunt top. The protoconch is of type B, tending to C (intorted). There are three or four flat teleoconch whorls, the last one rather high. The suture is broad and deep, about vertical or somewhat oblique. The ribs are straight or very slightly curved, about vertical or somewhat leaning to the right or to the left. They are sharply outlined and about as broad as the interstices. On the initial whorls there is always one spiral ridge on the base of the whorls, bordering the ribs on their abapical side. Below that, the whorl constricts considerably. Sometimes a second, narrower, spiral can be seen within the suture. The last whorl has, just above the aperture, one spiral ridge, on which the ribs finish and below which the whorl also strongly constricts. Next to the aperture there are still four (sometimes five) spiral ridges. The interspaces are as broad as, or slightly narrower than, the spirals. Well-preserved and fresh shells show, in these interstices, very fine riblets as a continuation of the real ribs, but in

a strongly prosocline direction (the same riblets can be seen within the sutures between the whorls). The aperture is egg-shaped; the tooth well visible. The umbilical chink is insignificant to absent.

Length 1.5-2.1 mm, LW 56-66%, A 31-39%, L/B 1.9-2.5, B/b 1.4-2.0 (based on 25 shells).

Discussion. — In the two samples from San Carlos (Taragona, Spain) a few shells of a different type were present: the last whorl is more convex, the ribs are much more opisthocline and are slightly flexuous. On the last and penultimate whorls there is, just above the normally single spiral ridge, one more and much narrower spiral, which is placed between the ribs. Furthermore there are six, instead of four or five, spirals next to the aperture. The protoconch is more tending towards type B.

Differential diagnosis. — See under *C. spiralis*. The difference with *C. emaciata* is clear. *C. emaciata* is much more slender, the shell is thinner, more fragile, the whorls convex, and at the base fine, close-set striae can be observed, instead of the pronounced spiral ridges in *C. brusinai*.

Material examined (locality and number of specimens). — Portugal: Algarve, Praia da Alvor/7 (MK), Praia da Rocha/9 (LH).

Spain: Cadiz, Gétarès/8 (LH, MK); Taragona, San Carlos/14 (LH, MK); Gerona, Rosas/1 (MK), Cadaqués/1 (NNM).

France: Pyrenées-Orientales, Banyuls-sur-Mer/3 (MK); Bouches-du-Rhône, Lauron/9 (LH), Cap Couronne/6 (LH), Sausset-les-Pins/25 (LH, MK, NNM); Alpes-Maritimes, Antibes/5 (LH).

Italy: Sicily, Balestrate/1 (NNM), Romagnolo/1 (NNM), Sciacca/28 (NNM).

Yugoslavia: Slovenia, Savudrija/15 (LH); Croatia, Vrsar/97 (EH, PO), Zadar/42 (PO), Šibenik/1 (MK), Split/1 (NNM), Baniči/11 (EH), Slano/10 (EH).

Greece: Kefallinia, Lassi/11 (MK), Athens, Lagonisi/2 (LH).

Turkey: (SE. Turkey), Mersin/4 (LH, MK).

Distribution. — The entire Mediterranean area, south coast of Portugal. Also known from Mauretania (NNM).

Chrysallida alleryi (Kobelt, 1903)

Parthenina (*Pyrgulina*) *alleryi* Kobelt, 1903, Iconographie der schalentragenden europäischen Meeresconchylien 3: 134, pl. 73 figs. 9-10.

General description. — The shell is slender ($L/B > 2.5$) and conical with a blunt top. There are many very narrow ribs, close to each other, so that the interstices are only lines. On the base of the shell, next to the aperture, there are some barely visible spiral ridges. Length 2.0-2.5 mm. Original description:

“Schale länglich kegelförmig, fast pupaförmig, ziemlich durchsichtig, wenig glänzend, weisslich; Gewinde fast regelmässig kegelförmig, mit stumpfem Apex und fast geraden Seiten; 6 ziemlich rasch zunehmende, fast flache, durch eine leicht berandete Naht geschiedene Windungen, dicht mit zahlreichen haarförmigen, schrägen, leicht gebogenen Längsrippchen skulptirt; die letzte kaum grösser, nicht aufgeblasen; die Längsrippen verschwinden an der Peripherie und werden durch schwache, ganz undeutliche Spirallinien ersetzt. Mündung klein, breit eiförmig, oben etwas zugespitzt; Aussenrand einfach, scharf, an der Insertion leicht ausgeschnitten; Spindel nur leicht verdickt, zahnlos.

Aufenthalt im Mittelmeer; meine Exemplare von Viarreggio, von R. del Prete im Magen von Seesternen gesammelt.''

Discussion. — The data in the general description above, are obtained from the literature only (Van Aartsen, 1977; Nordsieck, 1972). The latter author also mentioned a small tooth in the aperture.

Distribution. — From the Mediterranean north to the Channel (Nordsieck, 1972).

Chrysallida emaciata (Brusina, 1866)

(fig. 21)

Turbonilla emaciata Brusina, 1866, Contribuzione della fauna dei Molluschi Dalmati: 69.

General description (after 640 shells from 29 localities). — The shape of the shell is slender, cylindrical, with short convex whorls and a blunt top. The protoconch is of type B. There are four or five (rarely six) short and convex whorls. The suture is deep and rather wide, inclined. The ribs are narrow and curved, somewhat flexuous on the last whorl. They are vertical or slightly prosocline and continue as far as the last spiral on the base. Dependent on the number of ribs, the interstices may be broader or narrower than the ribs. On the initial whorls there is one spiral ridge at about 1/3 of the height from the abapical suture. Occasionally a second spiral is present in the suture. The last whorl has two spirals, the lower one on the same level as the upper side of the aperture, the other at some distance above it. Apart from these spiral ridges, fresh shells also show a spiral microstructure between the ribs over the whole surface. On the ribless part of the base there are about ten very thin, wavy spirals, close together and much narrower than the real spiral ridges, although coarser than the microsculpture. The aperture is rather broadly oval. There is a tooth, generally only visible on turning the shell somewhat to the left.

Length 1.4-2.4 mm, LW 43-55%, A 23-32%, L/B 2.3-3.1, B/b 1.4-1.5 (based on 56 shells).

Discussion. — First, this shell was named *Turbonilla pygmaea* by Brusina (1864); however, this name was preoccupied by *Acteon pygmaea* De Grateloup, 1838, also a species of *Chrysallida*. Subsequently it was renamed by Brusina in 1866 as *T. emaciata*.

Van Aartsen (1977) quotes the length of *C. emaciata* as 1.5-2.0 mm. The authors however, found several tens of specimens of 2.1-2.4 mm. This is of importance in determining the various ratios. Thus, shells in the range given by Van Aartsen contain 25% of specimens with a L/B ratio lower than 2.6, which, consequently, would come under a completely different group in Van Aartsen's identification key. His criterion of LW < 50 is even only met by 10% of the specimens investigated of the given dimensions. That percentage, however, becomes 100% for shells with a length of 2.1-2.4 mm, which also all show an L/B ratio of 2.6 or more. It thus appears that the standards used by Van Aartsen only apply to shells larger than quoted by himself and that his identification key does not apply to specimens of *C. emaciata* smaller than 2.1 mm.

Differential diagnosis. — The species most resembling *C. emaciata* is not a *Chrysallida*, even not a member of the Pyramidellidae: *Graphis albida* (Kanmacher, 1798). Apart from the apparent difference in the protoconch (not coiled), *Graphis albida* is even more slender, has more whorls and many thin spirals (thinner than the main spirals of *C. emaciata*) over the total height of all whorls. There is no tooth. No *Turbonilla* resembles *C. emaciata*, because of the differences in the protoconch, in the convexity of the whorls and by the general absence of a tooth. All *Chrysallida* showing

spiral ridges on the base of the shell, are much more conical and much coarser, with flat whorls. *C. sigmoidea* is much heavier and larger, has more wavy ribs and only thin spirals, close together (no main spirals). There is no tooth. Of all *Chrysallida* *C. suturalis* resembles *C. emaciata* most, but the former has flat whorls and, at least on the initial whorls, almost straight and vertical ribs. There are no spiral ridges on the base.

Material examined (locality and number of specimens). — Portugal: Algarve, Praia da Alvor/56 (MK), Praia da Rocha/26 (LH).

Spain: Cadiz, Cadiz/1 (NNM), Tarifa/1 (LH), Gétarès/85 (LH, MK, NNM); Murcia, Cartagena/4 (PO); Gerona, Rosas/2 (MK); Mallorca, Palma/6 (LH).

France: Pyrénées-Orientales, Banyuls-sur-Mer/7 (MK); Bouches-du-Rhône, Lauron/17 (LH), Cap Couronne/3 (LH), Ste. Croix/80 (LH), Sausset-les-Pins/41 (LH, MK, NNM); Var, Ile de Levant/2 (PO), Le Bruscat/45 (LH); Alpes-Maritimes, Antibes/29 (LH), Villefranche-sur-Mer/2 (NNM).

Italy: Livorno, Antignano/2 (LH); Sicily, Mondello/16 (LH), San Lorenzo/4 (MK), Trapani/9 (PO).

Yugoslavia: Slovenia, Savudrija/6 (LH); Croatia, Vrsar/49 (EH, PO), Zadar/56 (PO), Banići/34 (EH), Slano/13 (EH).

Greece: Kefallinia, Lassi/4 (MK); Athens, Lagonisi/13 (LH); Crete, Stavros/17 (MK).

Distribution. — The entire Mediterranean area and the south coast of Portugal.

Chrysallida suturalis (Philippi, 1844)

(fig. 22)

Rissoa suturalis Philippi, 1844, Enumeratio Molluscorum Siciliae 2: 129.

Rissoa striata Philippi, 1836 (non Adams, 1795), ibidem 1:154, pl. 10. fig. 8.

General description (after 84 shells from 17 localities). — The shell is slender, cylindrical, with a blunt top. The protoconch is of type B. There are four to five (rarely six) flat teleoconch whorls, suddenly bent inwards very near to the upper and lower suture. The suture is narrow and deep, noticeably oblique. Generally the ribs are narrow and sharp. Since there are many, close together, the interstices are narrow as well. Only occasionally the ribs are somewhat more distant (fewer ribs) and thus the spaces in between are broader. The ribs are vertical and straight to slightly flexuous. They continue to the base, or decrease around the periphery of the last whorl. The initial whorls have one spiral ridge on their base, sometimes two, in which case the lower one lies practically within the suture and is difficult to observe. The last whorl has two spiral ridges, the lower one on the level of the upper edge of the aperture, the other just above it. All spirals are very thin and often not easy to distinguish. Furthermore, there is a microstructure of spiral striae between the ribs on all whorls. The aperture is narrow oval, the small tooth is visible on turning the shell to the left. There is an insignificant umbilical chink.

Length 1.7-2.6 mm, LW 43-53%, A 24-34%, L/B 2.8-3.3, B/b 1.3-1.4 (based on 18 shells).

Discussion. — Sizes and ratios given in the literature only rarely agree, even the quoted length of shells can differ considerably; thus, Van Aartsen mentions L 1.5-2.0 mm, LW < 50% and L/B \pm 2.6. About half the number of the shells in the material investigated, has a length of between 2.0 and 2.6 mm, and only in this length interval LW is \leq 50%. Shells in the length interval given by Van Aartsen all have an LW

higher than 50%, at 1.5 mm even 57%. Fretter, Graham & Andrews (1986) report LW 51-57%, which is largely outside the area in the present investigation (LW 43-53%) and not at all in accordance with the LW < 50% of Van Aartsen. The ratio L/B 2.4-2.6 given by Fretter et al. is even completely different; that of the present authors is 2.8-3.3 and Van Aartsen records \pm 2.6.

The authors did not find shells with more than two spiral ridges on the last whorl, as stated by Fretter et al. (1986).

Differential diagnosis. — See under *C. emaciata* for this species. Some specimens of *C. clathrata* do resemble *C. suturalis* somewhat more. The general shape of the first species is coarser (L/B lower), there are fewer and heavier ribs, the suture is more open and on every whorl there is one more, much coarser, spiral ridge. The other *Chrysallida* with two spirals on the last whorl and one on the others are generally coarser in shape, much more conical, most are longer and have a more pronounced tooth; the latter is strikingly different from that of *C. nanodea* (see below). In this context, it is remarkable that, from some locations of the Canary Islands, there are specimens of *C. obtusa* with a reduced tooth and three spirals on the last whorl somewhat resembling *C. suturalis*.

Material examined (locality and number of specimens). — Spain: Murcia, Cartagena/3 (PO).

France: Pyrénées-Orientales, Banyuls-sur-Mer/1 (MK); Bouches-du-Rhône, Lauron/3 (LH), Ste. Croix/7 (LH); Var, Le Brusca/4 (LH).

Italy: Savona, Laigneglia/2 (MK); Pisa, Marina di Pisa/1 (NNM); Sicily, Mondello/2 (LH), Trapani/2 (MK), San Lorenzo/4 (MK).

Yugoslavia: Slovenia, Savudrija/1 (LH); Croatia, Vrsar/3 (EH), Rovinj/4 (MK), Starigrad Paklenica/26 (PO), Krka/6 (MK).

Malta: Rdum il-Qammieh/13 (LH).

Turkey: (SE. Turkey), Mersin/2 (MK).

Distribution. — The authors have seen this species only from the entire Mediterranean area. *C. suturalis* is also recorded from the Atlantic coast of Europe, north to the British Isles (Rolan Mosquera, 1983; Fretter, Graham & Andrews, 1986). Looking at their SEM photography, it is clear that this shell is not *C. suturalis*, but a specimen of the variable *C. obtusa*, cf. L/B 2.3, *C. suturalis* 2.8-3.3 and B/b 1.6, *C. suturalis* 1.3-1.4; also the rib pattern is very different. Thus the record of Fretter et al. is doubtful (cf. Discussion).

Chrysallida terebellum (Philippi, 1844)

(figs. 8, 9, 23, 24)

Chemnitzia terebellum Philippi, 1844, Enumeratio Molluscorum Siciliae 2: 138, pl. 24 fig. 12.

Syn.: *Chrysallida moulinsiana* (P. Fischer, 1865).

General description (after 1140 shells from 35 localities). — The shell is slender conical (large specimens) to compact conical (short specimens), with a rather pointed top. The protoconch is of type B, its angle with the axis of the shell is more variable than in most other *Chrysallida*, and the protoconch type may tend to A. There are five to eight very flat teleoconch whorls. Their breadth strongly diminishes in upward direction, so that B/b is high (1.7-2.0) for short shells with few whorls, and low (1.2-1.4) for longer shells, of which the last three whorls are rather cylindrical. Thus, the longer specimens also still give a conical impression. The suture is narrow, not very deep and lies somewhat obliquely to the shell axis. The ribs are broader than the interstices or

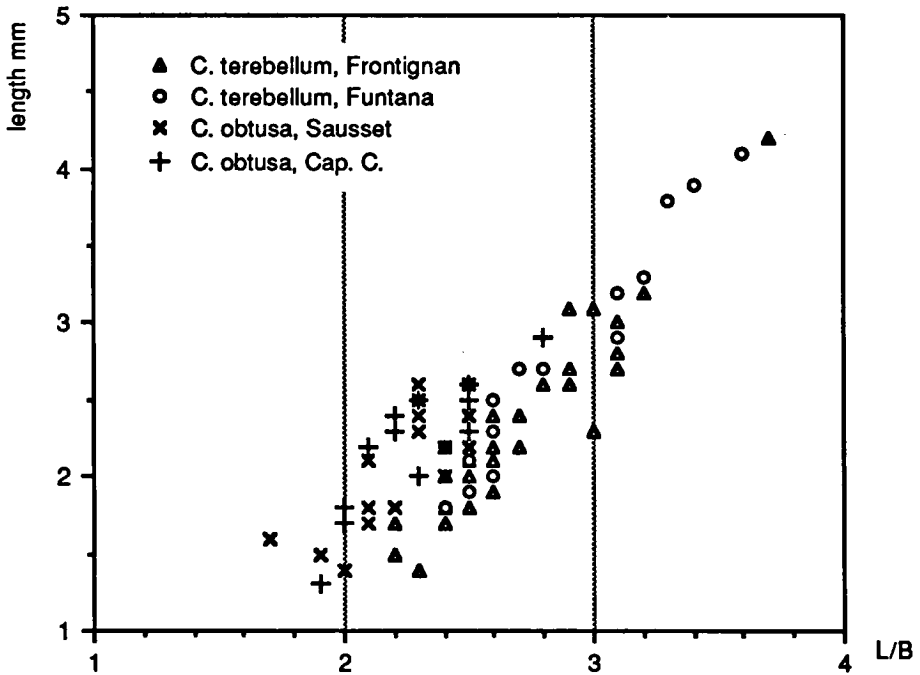
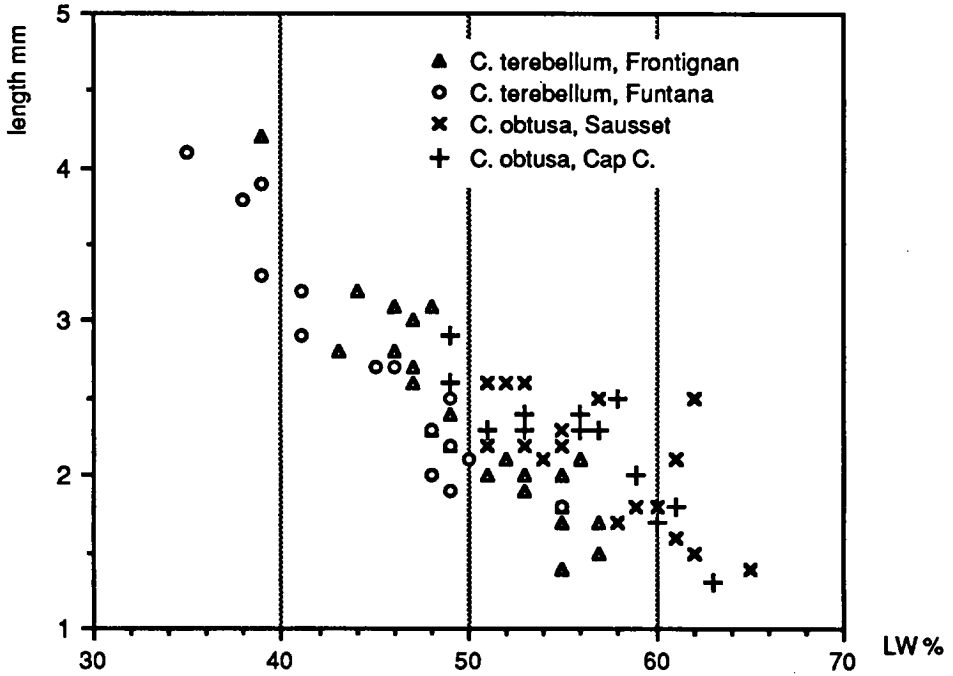
equally broad. On the initial whorls the ribs are straight; on the last two they may be slightly flexuous. All ribs are inclined to the right. The initial whorls have one spiral ridge, just above the suture. Occasionally, a second one can be observed, always practically within the suture. The last whorl has two spiral ridges, in front view just above the aperture; the lower one less pronounced, as a termination of the ribs. Only in the rare cases where the ribs do not abruptly terminate above the aperture, but gradually decrease and continue somewhat further, the lower spiral ridge is as strongly marked as the higher one. The aperture is mostly narrow-oval; there is a pronounced tooth. Almost all shells have an umbilical groove.

Length 1.7-4.5 mm, LW 34-57%, A 21-33%, L/B 2.2-3.6, B/b 1.2-2.0 (based on 93 shells).

Discussion. — Van Aartsen's (1977) criteria for the identification of *C. terebellum*, LW < 50% and L/B 2.6 (in fact ≥ 2.6), are generally sufficient to identify Atlantic specimens of this species, which are often somewhat larger than Mediterranean ones. A length of almost 7 mm (Van Aartsen, 1977: 56) is exceptional; in the present study, comprising 261 specimens of Atlantic origin, no shells longer than 4.5 mm were found. As stated earlier in this paper, ratios may strongly depend on the length of the shells. The LW increases to values considerably higher than 50% for smaller specimens (fig. 8) and L/B becomes lower than 2.6 (fig. 9). Thus, with regard to Atlantic *C. terebellum*, Van Aartsen's criteria do not apply to specimens smaller than 2.7 mm; they do almost always apply to those with a length of 2.7-3.0 mm and always when the length is more than 3 mm. This is not a major problem in the identification of adult Atlantic specimens, since in our samples these have a length of at least 2.7 mm. However, the situation is different for Mediterranean specimens of *C. terebellum*. Their length varies between 1.7 and 4.4 mm and their average length is much lower than that of the Atlantic ones. Only shells longer than 2.5 mm have an L/B ≥ 2.6 ; those longer than 2.2 mm an LW < 50%. Thus, Van Aartsen's identification criteria apply here only to specimens of minimally 2.6 mm in length (figs. 8, 9). However, *C. terebellum* specimens from the Mediterranean are generally smaller than 2.6 mm (more than half of the 879 shells investigated) and some samples contained no specimens longer than 2.5 mm. Fretter, Graham & Andrews (1986) mention a maximum length of 2.5 mm and as many as seven teleoconch whorls for Atlantic specimens. This must be a mistake, since with that length there are always only five whorls.

Differential diagnosis. — Because of its slender shape, flat whorls, rib pattern and pointed top, of which the protoconch occasionally tends towards type A, *C. terebellum* is often confused with *Turbonilla*. However, even when the spirals are not clearly visible, the presence of a tooth in *C. terebellum* is decisive. The species may be confused with large specimens of *C. obtusa* which are more slender than usual and have ribs leaning to the right. However, at the same length the ratios LW, A and B/b are almost invariably higher for *C. obtusa* than for *C. terebellum* (figs. 8, 9). On average, *C. obtusa* is smaller, has often more convex whorls, is less slender, has a flatter top, and both the aperture and the whorls (particularly the last one) are higher. Furthermore, in

Figs. 8-9. 8 (top) Shells of *Chrysallida terebellum* smaller than 2.2 mm have an LW of more than 50%; those of *C. obtusa* mostly have an LW of 50% or more. 9 (bottom) The L/B ratio of *C. terebellum* decreases to values below 2.6 for shells of 2.2 mm and smaller; almost all *C. obtusa* have an L/B of less than 2.6.



most specimens of *C. obtusa* the ribs are vertical or leaning to the left. Shells of *C. indistincta* are much more cylindrical, with a much flatter top, and rather flat whorls that are somewhat constricted in the middle. Furthermore, *C. indistincta* has no tooth and many more spirals. *C. suturalis* is smaller, more slender and more cylindrical, and has a flat top. The ribs are narrow and close together in almost vertical position. It has a deep-set tooth-like columellar pleat, not a clear tooth. The differences with *C. limitum* and *C. nanodea* are dealt with in the paragraphs on these species.

Material examined (locality and number of specimens). —

France (Atlantic): Ille-et-Vilaine, Le Vivier-sur-Mer/10 (LH), Cancale/5 (NNM), St. Lunaire/8 (ZMS); Côtes-du-Nord, St. Jacut/78 (LH, NNM, ZMS), Trébeurden/9 (LH); Gironde, Bassin d'Arcachon/45 (NNM).

Spain (Atlantic): Santander, Laredo/14 (EH, LH, PO); Pontevedra, Ria de Arosa/20 (NNM).

Portugal: Algarve, Praia da Alvor/5 (MK), Praia da Rocha/67 (LH).

Spain (Mediterranean): Cadiz, Gétarès/9 (LH, MK), Puerto de Santa Maria/4 (NNM); Murcia, Mar Menor/9 (PO); Taragona, San Carlos/77 (EH, LH, MK); Mallorca, Puerto Andraitz/1 (LH).

France (Mediterranean): Hérault, Frontignan/247 (HA), Mèze/9 (LH); Bouches-du-Rhône, Le Grau-du-Roi/3 (LH), Lauron/8 (LH), Ste. Croix/11 (LH); Var, Le Brusca/5 (LH); Alpes-Maritimes, Antibes/2 (LH).

Italy: Giulia, Grado/16 (EH).

Malta: (fished)/4 (LH).

Yugoslavia: Slovenia, Savudrija/9 (LH); Croatia, Funtana/257 (HA), Vrsar/138 (EH, PO), Sparadiči/21 (EH), Baniči/1 (EH), Slano/7 (EH); Montenegro, Kotor/1 (NNM).

Greece: Athens, Lagonisi/5 (LH).

Cyprus: Paphos/27 (LH).

Rumania: Eforie Sud/7 (LH).

Egypt: Mersa Matruh/1 (NNM).

Distribution. — The entire Mediterranean area and European west coast to the north of Brittany.

Chrysallida nanodea (Monterosato, 1878)
(figs. 27-29)

Odostomia (*Pyrgulina*) *nanodea* Monterosato, 1878, J. Conchyl. Paris 26: 317.

Syn. (?): *Chrysallida delpretei* (Sullioti, 1889).

General description (after 232 shells from 14 localities). — The shell is slender, sometimes more compact, cylindrical. Only the largest specimens are somewhat conical. The top is rather blunt. The protoconch is of type B, occasionally tending to C. There are five to seven flat to slightly convex teleoconch whorls. The suture is inclined, narrow and rather deep, or more wide and shallow. The ribs are clearly marked and not very broad. Dependent on the number of ribs (very variable), the interstices are as broad as, or broader than, the ribs, but smaller interspaces do occur as well. The ribs are vertical, or more or less inclined to the right, straight or, at least on the last whorl, sinuous. They end abruptly at the periphery of the last whorl, but often they continue, decreasing and disappearing or not, towards the base of the shell. The initial whorls have one spiral just above the abapical suture. In a single case we observed

a second spiral on the penultimate whorl, which is practically incorporated into the suture. The last whorl has two spiral ridges, both just above the aperture, close to each other, the lowest one rather as a conclusion of the ribs than a real spiral. If, nevertheless, the ribs do continue in any form, then there are two normal spiral ridges. The aperture is narrow egg-shaped with a significant tooth. There is at best an umbilical chink.

Length 2.0-3.7 mm, LW 41-58%, A 24-33%, L/B 2.5-3.2, B/b 1.2-1.5 (based on 18 shells).

Discussion. — According to Nordsieck (1972) and Van Aartsen (1977), there are two different species: *C. nanodea* and *C. delpretei* (Sullioti, 1889), somewhat related to each other and with only slightly different appearance. The suture in *C. nanodea* is deep, in *C. delpretei* rather shallow; the ribs in *C. nanodea* are nearly straight and vertical and in *C. delpretei* curved or flexuous and a little inclined to the right (compare figs. 27, 28). On the contrary, the authors have seen many specimens which could not be incorporated in either one of the species named before, because they have the characters of both, or partly of the one and partly of the other. Therefore the authors decided that both taxa are only one species with *C. nanodea* the oldest name. But, reading the paper of Sullioti (1889) himself (and not the opinion of Kobelt about this question), they meet with some difficulties. Sullioti writes explicitly: "... per la mancanza degli ornamenti spirali," i.e. ... by the absence of spiral ridges. By virtue of that character it is at least improbable that *Turbonilla delpretei* is a *Chrysalida* at all (also mentioned by Van Aartsen, 1977). Therefore it is hardly acceptable that *C. delpretei* is even a synonym of *C. nanodea*.

Differential diagnosis. — Although *C. nanodea* shows some resemblance with *C. terebellum* there are remarkable differences. *C. terebellum* has flat whorls and its broader and straight ribs are inclined more to the right. *C. terebellum* is more conical in its initial whorls and has a more pointed top, its protoconch is less coiled. For the differences with *Turbonilla*, cf. *C. terebellum*.

Although *C. indistincta* is generally smaller, individual specimens may strongly resemble in shape and rib-pattern the shells of *C. nanodea* with flexuous ribs. The much larger number of spirals on the whorls and the absence of a tooth in *C. indistincta* are decisive. *C. sigmoidea* could be confused with larger specimens of *C. nanodea*, but *C. sigmoidea* has no tooth, a very flat and blunt apex, and spiral striae (no real spirals) over the total height of all whorls.

Although, as Van Aartsen mentions, *C. nanodea* can grow to a larger size than *C. suturalis*, one often sees specimens of about the same length. Nevertheless, *C. suturalis* has (much) finer ribs, close together, the initial whorls are somewhat longer and particularly the tooth (rather a pleat) is only visible on turning the shell, whereas *C. nanodea* has a clearly visible tooth.

Material examined (locality and number of specimens). — Spain (Atlantic): Santander, Laredo/13 (EH, PO).

Portugal: Algarve, Praia da Rocha/7 (LH).

Spain (Mediterranean): Murcia, Mar Menor/1 (PO); Taragona, San Carlos/116 (HA, LH, MK).

France: Hérault, Etang de Thau/23 (PO); Bouches-du-Rhône, Sausset-les-Pins/11 (MK, ZMS), Lauron/1 (LH).

Yugoslavia: Croatia, Rovinj/4 (MK), Vrsar/8 (PO), Starigrad Paklenica/9 (PO), Slano/22 (EH).

Greece: Crete, Stavros/2 (MK).

Cyprus: Limassol/7 (LH), Paphos/8 (LH).

Distribution. — From NW. Spain south to the Mediterranean.

Chrysalida intermixta (Monterosato, 1884)

(fig. 33)

Pyrgulina intermixta Monterosato, 1884, Nomenclatura generica e specifica di alcune conchiglie Mediterranee: 87.

Syn.: *Chrysalida monozona* (Brusina, 1869).

General description (after 412 shells from 31 localities). — The shell is compact conical, only the largest specimens are somewhat slender conical. The top is rather pointed. The protoconch is of type B, tending to A. Its overhanging loop is only slightly tilted, so that in some cases a very small part of the first whorl is visible. The suture is almost vertical, deep and rather wide. The four or five teleoconch whorls are constricted at their upper and lower side. The main part of the whorls is flat or a little convex. The ribs are generally narrow, high and sharp, and are distant from each other, so that the interstices are considerably broader (up to twice) than the ribs. However, broader ribs with equally broad interspaces also occur. Mostly the ribs incline to the left, sometimes they are almost vertical, but they never incline to the right. They are slightly curved or straight. The ribs terminate abruptly just above the aperture (seldom decreasing or even continuing to the base). The spiral pattern is variable too. In most cases there is on the initial whorls one, often vague, spiral close to the abapical suture and two on the last whorl, the lower one generally as a border of the interspaces, rather than as a real spiral. However, even fresh specimens often do not show a single spiral. Fresh and clean shells always show clear spiral striae between the ribs of all the whorls, at a magnification of 10 x as 'sparkling' between the ribs, just like in other species with spiral striae. The aperture is oval-rhomboid with a clear tooth. An (insignificant) umbilical chink or sometimes a modest umbilicus is present.

Length 1.6-3.1 mm, LW 49-61%, A 26-37%, L/B 2.0-2.5, B/b 1.5-1.9 (based on 29 shells).

Discussion. — Van Aartsen's (1977) criteria for *C. intermixta* $L/B \pm 2.6$ (in fact < 2.6) and $LW > 50\%$ apply in almost all cases (only one of the specimens measured $L/W 49\%$). As stated above, the interspaces are not always 1.5 to 2 times as broad as the ribs, particularly not for shells found in Gétarès, Cadiz, Spain.

Although identification of *C. intermixta* is not so easy because of its variability, every sample appears to contain enough specimens with optimal characters to enable identification of the others.

Differential diagnosis. — Because of the shape, the position of the ribs, the relatively pointed top, the clear spiral striae between the ribs and the occasional absence of the main spirals, confusion with (juvenile) *Turbonilla scalaris* (Philippi, 1836) could occur. Apart from the much less collapsed protoconch, this species is much heavier and more scalariform, and it has no tooth.

C. emaciata is much more slender, more cylindrical, has more convex whorls and has the spiral striae on the base. *C. terebellum* is more slender, more conical and its ribs incline to the right.

Separation from *C. obtusa* is sometimes difficult, particularly for specimens from Gétarès. The ribs of *C. obtusa* occasionally are inclined to the left, and the ribs of *C.*

intermixta sometimes may be as broad as the spaces in between. As a rule the two species can be separated as follows. *C. obtusa* has a less open suture, the whorls are less constricted. The ribs are almost always rather broad, closer together, so that the interstices are narrow. The protoconch is more blunt: type B tending to C instead of to A. The spiral striae between the ribs are absent or at most very vague.

The ribs of *C. jeffreysiana* and *C. clathrata* are also occasionally prosocline. *C. jeffreysiana* is larger, has more convex whorls, no spirals, no spiral striae and no tooth. *C. clathrata* is much more slender, more 'elegant', and generally the ribs continue to the base. On the initial whorls there are two and on the last whorl three spirals, instead of one and two respectively.

Material examined (locality and number of specimens). — Spain (Atlantic): Santander, Laredo/9 (EH, LH, PO).

Portugal: Algarve, Praia da Alvor/5 (MK), Praia da Rocha/3 (LH).

Spain (Mediterranean): Cadiz, Gétarès/212 (LH, MK); Murcia, Cartagena/2 (PO); Taragona, San Carlos/1 (MK); Gerona, Rosas/4 (MK).

France: Bouches-du-Rhône, Lauron/8 (LH), Cap Couronne/2 (LH), Ste. Croix/7 (LH), Sausset-les-Pins/5 (MK, NNM); Var, Le Brusç/8 (LH), Ile du Levant/5 (PO); Alpes-Maritimes, Antibes/36 (LH).

Italy: Sicily, Mondello/9 (LH), San Lorenzo/3 (MK), Trapani/42 (NNM, PO).

Malta: Rdum il-Qammieh/3 (LH).

Yugoslavia: Slovenia, Savudrija/6 (LH); Croatia, Vrsar/5 (PO), Rovinj/10 (PO), Starigrad Paklenica/3 (PO), Biograd/2 (EH), Šibenik/3 (MK), Split/1 (NNM), Baniči/3 (EH), Slano/1 (EH).

Greece: Kefallinia, Lassi/2 (MK); Athens, Lagonisi/5 (LH).

Cyprus: Limassol/3 (LH).

Turkey: (SE. Turkey), Mersin/4 (LH).

Distribution. — The Atlantic coast of Europe from NW. Spain south to Gibraltar and the entire Mediterranean area. Nordsieck (1972) also records the species from NW. Spain north to Great Britain(?).

Chrysellida interspatiosa spec. nov.

(figs. 10, 25, 26)

Type material. — Holotype: NNM 56612, Azores, S. of São Miguel, 37°39'N, 25°32'W, depth 480 m. Paratypes: all other material mentioned below.

General description (after 29 shells from 4 localities). — The shell is conical, with a blunt top. The protoconch is almost of type C. There are three to four flat teleoconch whorls. The suture is moderately wide and deep, somewhat oblique. The ribs are vertical; occasionally rather vague. They are clearly sinuous, especially at the uppermost part, and decreasing towards the base of the last whorl or, sometimes, terminating abruptly just above the aperture. The interstices are very wide, generally at least twice as broad as the ribs. The initial whorls have one spiral between the ribs, just above the abapical suture. The last whorl has two spirals at its lower part, just above the aperture. They are often difficult to distinguish. The aperture is oval; the insignificant tooth-pleat is only visible after turning the shell to the left. Since the small umbilical chink may be more or less hidden behind the edge of the aperture, it is rarely visible. Fresh and clean shells show, between the ribs and at the end of the last whorl, a structure of clear, close-set, sinuous growth-lines in the same direction of the ribs.

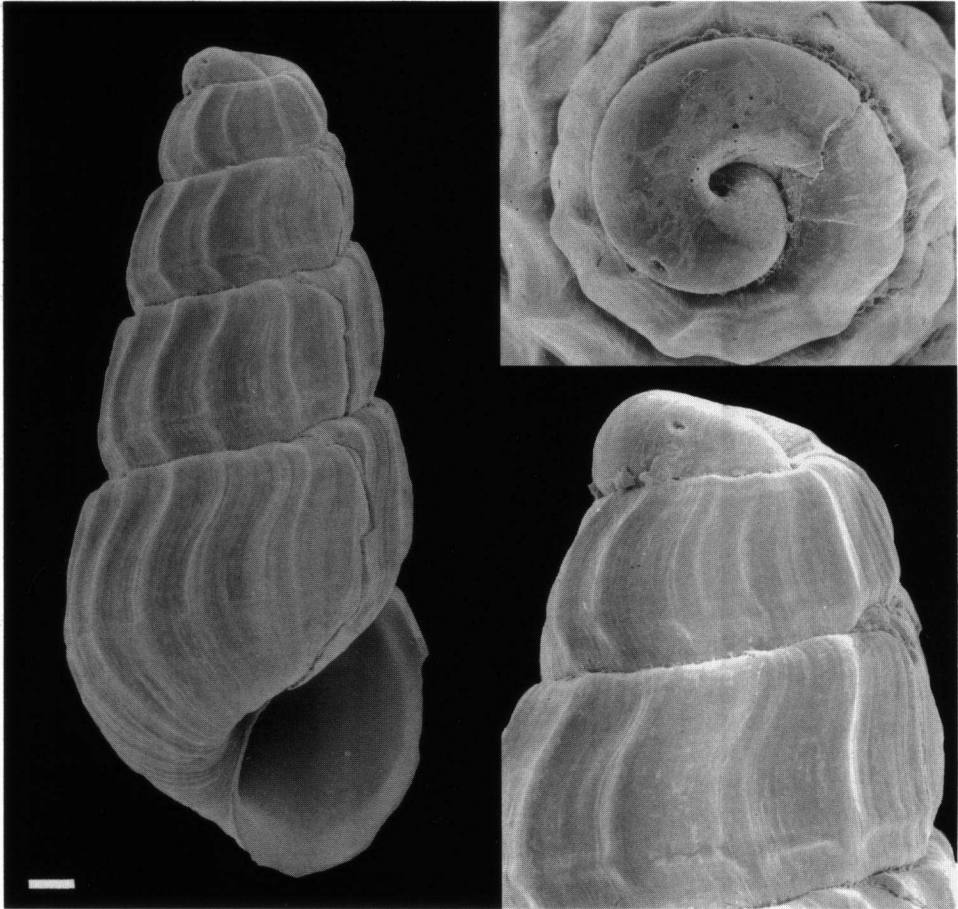


Fig. 10. *Chrysallida interspatiosa* n. sp., paratype (NNM 56614), Cancap 5.020, Azores, E. of Formigas, depth 240-245 m. Scales 0.1 mm. S.E.M. photographs by J. Goud (NNM).

Length 1.5-2.4 mm, LW 53-66%, A 30-37%, L/B 2.0-2.4, B/b 1.5-1.8 (based on 11 shells).

Derivatio nominis. — *Inter* (Lat.) between, *spatiosus* (Lat.), among other things wide, broad, referring to the large interspaces between the ribs.

Discussion. — There is no European *Chrysallida* with the same combination of characters typical of *C. interspatiosa*. *C. intermixta* also has broad interspaces between the ribs, but these are not sinuous and the protoconch is of type B and not intorted; there is a microsculpture of spiral striae between all ribs, instead of 'microcostae'. The first two features also hold for *C. obtusa*. All *Chrysallida* with sinuous ribs are very different.

Material examined (locality and number of specimens). — Azores: S. of São Miguel (type locality), 37°39'N, 25°32'W, depth 480 m, Cancap 5.012/13, 26-V-1981 (NNM 56613); S. of São Miguel, 37°41'N, 25°25'W, depth 225 m, Cancap 5.074/4, 31-V-1981 (NNM 56615); E. of Formigas, 37°16'N, 24°44'W, depth 240-245 m, Cancap 5.020/2, 27-V-1981 (NNM 56614); E. of Faial, 38°30'N, 28°38'W, depth 300 m, Cancap 5.126/10, 5-VI-1981 (NNM 56616).

Distribution. — As yet only known from the Azores, from 225-480 m deep.

Chrysallida obtusa (Brown, 1827)

(figs. 8, 9, 30-32)

Jamnia obtusa Brown, 1827, Illustrations of the Recent conchology of Great Britain and Ireland: pl. 50, fig 38.

Syn.: *Chrysallida interstincta* (Montagu, 1803).

General description (after 1810 shells from 38 localities). — The shape of the shell is very variable, from compact conical (B/b 2.1) to slender, nearly cylindrical (L/B 2.9 and B/b 1.3) with a blunt top. The protoconch is of the type B. There are four or five flat to slightly convex teleoconch whorls, the last one relatively high. The suture is generally narrow and deep (although specimens with a wider suture also occur), sometimes (nearly) horizontal, sometimes oblique. The ribs are broader than or equal to the interspaces, straight and vertical, occasionally somewhat inclined to the right or the left. They end abruptly at the last spiral, just above the aperture. In a small percentage of the shells (very rarely from Atlantic origin) the ribs continue, decreasing or not, to the base (fig. 32). In some shells the ribs may be close together (fig. 31) or may be slightly curved or flexuous as well (fig. 32). The spiral pattern is not so variable; the initial whorls have one spiral, just above the abapical suture, the last whorl has two spirals on the periphery, the lower one is a real spiral when the ribs continue to the base, but mostly, when the ribs end abruptly, it is more a border of interstices and ribs (compare figs. 30 and 32). The aperture is oval-spherical to narrow egg-shaped or rhomboid. The tooth is generally directly visible, often only after turning the shell to the left. There may be an umbilicus, an umbilical chink or no umbilicus at all.

Length 1.7-3.2 mm, LW 29-67%, A 26-41%, L/B 1.8-2.9, B/b 1.3-2.1 (based on 82 shells).

Discussion. — *C. obtusa* is the most variable *Chrysallida*, particularly the specimens from the Mediterranean. Some specimens from the Canary Islands (Lanzarote) have two spirals on the penultimate whorl and three on the last one, the supplemental spiral at some distance apical from the normal spirals. Other shells, also from the Canary Islands, have a reduced tooth deep within the aperture.

Identification of *C. obtusa* is still possible on taking the differences with other species (cf. below) into account.

Differential diagnosis. — Since the spiral pattern is not variable (only some shells from the Canary Islands resemble somewhat *C. clathrata*, cf. there), *C. obtusa* can only be confused with *Chrysallida* also having one spiral on the initial whorls and two on the last one. These are generally the species of which the shape resembles *C. obtusa* most, except for *C. emaciata*, since the short and convex whorls, and spiral striae on the base of the shell, never occur in *C. obtusa*.

C. suturalis is always very slender and cylindrical (L/B 2.8-3.3, B/b 1.3-1.4), *C.*

obtusa rarely so (L/B 1.8-2.9, B/b 1.3-2.1). *C. obtusa* never has so many narrow ribs, close to each other and continuing to the base, all together like *C. suturalis*.

Small specimens of *C. terebellum* are sometimes difficult to separate from *C. obtusa* (cf. there).

C. nanodea is generally much longer and more slender than *C. obtusa* and has more ribs per whorl, so that the interstices are much smaller. Specimens from Yugoslavia (Slano, fig. 29) of about the same length may resemble *C. obtusa*. The latter species is, however, clearly more conical and has a higher last whorl.

Only the specimens of *C. obtusa* with prosocline ribs with large spaces in between like those from Gétarès, Cadiz, Spain) resemble *C. intermixta*. This species has more convex whorls, a deeper constricted suture, a somewhat less coiled protoconch and the 'sparkling' (spiral striae) between the ribs.

For differences with *C. penchynati*, cf. there.

Material examined (locality and number of specimens). — Norway: Trondheim Fjord, Grande Viken/253 (MK), Trondheim Fjord/1 (NNM); Bergen/4 (NNM); Hordaland, Kausland/2 (NNM).

Great Britain: Channel Islands, Guernsey/2 (NNM).

France (Atlantic): Côtes-du-Nord, Trébeurden/2 (LH); Finistère, Ile Tudy/4 (LH); Vendée, Jard-sur-Mer/8 (LH).

Spain (Atlantic): Santander, Laredo/1 (EH); Oviedo, Gijón/1 (NNM); Pontevedra, Ria de Arosa/37 (NNM).

Portugal: Algarve, Praia da Rocha/1 (LH).

Spain (Mediterranean): Cadiz, Gétarès/337 (LH, MK); Taragona, San Carlos/120 (LH, MK).

France (Mediterranean): — Pyrenées-Orientales, Banyuls-sur-Mer/16 (MK); Bouches-du-Rhône, Lauron/4 (LH), Cap Couronne/285 (HA, LH), Ste. Croix/13 (LH), Sausset-les-Pins/153 (LH, MK); Var, Le Brusç/3 (LH); Alpes-Maritimes, Antibes/16 (LH).

Italy: Savona, Laigneglia/20 (MK); Grosseto, Isola Argenterola/1 (EH); Forli, Rimini/10 (LH); Taranto, Gandoli/7 (NNM).

Yugoslavia: Slovenia, Savudrija/5 (LH); Croatia, Vrsar/84 (PO), Rovinj/124 (MK, PO), Starigrad Paklenica/186 (PO), Baniči/30 (EH), Slano/22 (EH).

Greece: Kefalinnia, Lassi/4 (MK).

Cyprus: Paphos/2 (LH).

Turkey: (SE. Turkey), Mersin/5 (LH).

Canary Islands: Gran Canaria, Maspalomas/1 (LH); Fuerteventura, depth 90 m/4 (NNM); Lanzarote, depth 34-120 m/45 (NNM); Palma, depth 100 m/4 (NNM).

Madeira archipelago: SE. of Madeira, depth 108 m/1 (NNM).

Distribution. — The Atlantic coast of Europe from Norway south to Gibraltar and the entire Mediterranean area, Madeira and Canary Islands.

Chrysallida penchynati (B., D. & D., 1883)
(fig. 34)

Odostomia penchynati Bucquoy, Dautzenberg & Dollfus, 1883, Les mollusques marins du Roussillon 4: Gastropodes: 171, pl. 20 fig. 11.

General description (after 367 shells from 9 localities). — The shell is small, somewhat pupoid, slightly cylindrical with a blunt top. The protoconch is of type B. There

are three or four rather flat whorls, the upper part of each whorl is strongly curved inwards near the suture, giving the shell a more or less shouldered appearance. The suture is deep and open, inclined. The ribs are narrow and sharp, vertical and occasionally straight, more often slightly curved, continuing until the base, sometimes fading, seldom abruptly ending on the periphery of the last whorl. The interstices are as broad as, or broader than, the ribs. The initial whorls have one spiral, just above the abapical suture. The penultimate whorl sometimes has a second spiral, hidden in the suture. The last whorl has two spirals, the lower one starting at the upper edge of the aperture. There is also a microstructure of spiral striae over the surface of all whorls, giving it a 'sparkling' appearance. The aperture is narrow egg-shaped; the small tooth-pleat is only visible after turning the shell to the left. There is a very small umbilical chink.

Length 1.5-2.0 mm, LW 51-62%, A 29-34%, L/B 2.2-2.7, B/b 1.4-1.7 (based on 17 shells).

Discussion. — Only after considerable hesitation the authors have decided to deal with *C. penchynati* as a valid species, instead of a forma of *C. obtusa*. Its characters are, however, very constant and, particularly where they occur together, clearly different from those of any form of the very variable *C. obtusa*. It is no problem at all to separate both species in a mixed sample (in fact all samples mentioned below).

Differential diagnosis. — Almost all characters of *C. penchynati* may occur in *C. obtusa*, but they never occur all in one shell. All specimens of *C. penchynati* have narrow, sharp and vertical ribs; the ribs of *C. obtusa* are generally broader, flatter; they are vertical but also inclined to the right or the left, only a small percentage is continuing to the base. In *C. penchynati* the ribs are mostly continuing. *C. obtusa* is somewhat coarser, blunter and gives a more conical impression. The whorls are only rarely shouldered; if so, there is at least one other character of the little variable *C. penchynati* absent. There is one constant difference: *C. obtusa* has a tooth, often directly visible, *C. penchynati* always a modest tooth-pleat, only visible after turning the shell. Ultimately this difference was decisive in considering *C. penchynati* a separate species.

Confusion with *C. suturalis* may be even more easy than with an average *C. obtusa*, but *C. suturalis* can grow somewhat longer, is much more slender (L/B 2.8-3.3 versus 2.2-2.7) and more cylindrical (B/b 1.3-1.4 versus 1.4-1.7), as a result of which the whorls seem to be higher, which they are not (LW 43-53% versus 51-62% in *C. penchynati* — compare figs. 22 and 34). Also, *C. suturalis* does not have shouldered whorls.

C. clathrata has noticeably fewer and broader ribs and on every whorl one spiral more. Its tooth-pleat is hardly visible, even when turning the shell. All whorls, particularly the initial ones, are longer and its suture is more inclined.

Material examined (locality and number of specimens). — Spain: Gerona, Cadaqués/5 (NNM).

France: Pyrenées-Orientales, Banyuls-sur-Mer/1 (MK); Bouches-du-Rhône, Ste Croix/3 (LH), Sausset-les-Pins/3 (MK), Cap Couronne/2 (LH); Var, Le Brusç/10 (LH), Ile de Levant/9 (PO); Alpes-Maritimes, Antibes/332 (LH, ZMS).

Italy: Savona, Laigneglia/2 (MK).

Distribution. — So far only known from the northwestern part of the Mediterranean Sea.

Chrysallida farolita Nordsieck, 1972

Chrysallida farolita Nordsieck, 1972, Die europäischen Meeresschnecken: 96, pl. P1 fig. 22.

General description (from literature only). — The shell is slender conical. The protoconch is of type B. There are about five flat teleoconch whorls; the suture is rather deep and inclined. The ribs are straight and flat, broader than the interstices, decreasing and disappearing around the periphery of the last whorl. They are strongly inclined to the left. The initial whorls have one spiral, just above the abapical suture, the last whorl two; all spirals are insignificant. Aperture more or less ovate. There is a clear tooth and an umbilical chink.

Length \pm 3 mm. LW 40-50%, A \pm 30%, L/B \pm 2.7.

Discussion. — One of the authors (LH) has 3 shells (Spain: Taragona, San Carlos. France: Bouches-du-Rhône, Lauron; Alpes-Maritimes, Antibes) with the same characters as mentioned above. This is far from sufficient for a well-founded opinion about *C. farolita*, but it is not inconceivable that this species is only a forma of *C. obtusa*. Probably it is not a forma of *C. terebellum*, although Nordsieck (1972) and Van Aartsen (1977) indicate such a relationship.

Chrysallida eximia (Jeffreys, 1849)

(fig. 35)

Rissoa eximia Jeffreys, 1849, Ann. Mag. Nat. Hist. (2): 299.

General description (after 291 shells from 3 localities). — The shell is conical with a somewhat turreted profile and a blunt top. The protoconch is of type B. There are three to four convex teleoconch whorls with a deeply excavated suture, its direction is almost horizontal on the initial whorls, slightly oblique on the lower ones. The ribs are about as broad as their interstices, vertical and straight or somewhat curved. They end at the last spiral ridge, at the upper edge of the aperture or, rapidly decreasing and disappearing after that spiral. The spirals are more pronounced than in many other *Chrysallida*, but generally not equal to the ribs. The initial whorls have two spiral ridges, the upper one on the middle of the whorl, the other one halfway the first and the abapical suture. Sometimes there is a finer third spiral, hidden within the suture and thus difficult to observe. The last whorl has three or four spiral ridges: the highest one halfway the adapical suture and the aperture, the third at the same level as the upper edge of the aperture, the second in between. If there is a fourth, finer spiral, it is located below the third one. The aperture is oval-spherical. The tooth is very insignificant or even absent. There is a narrow umbilical chink.

Length 1.4-2.6 mm, LW 52-64%, A 27-36%, L/B 2.1-2.5, B/b 1.5-1.9 (based on 9 shells).

Differential diagnosis. — Because of its northern distribution, *C. eximia* cannot be confused with Mediterranean and Lusitanian species (the record of Rolan Mosquera, 1983, is questionable, because the shape of the illustrated shell is completely different; it is probably *C. clathrata*) like *C. jeffreysiana* (also convex whorls, but without spirals) and *C. emaciata* (equally convex whorls, but on each whorl one spiral less, thinner and differently located, cf. *C. emaciata*). *C. clathrata* has the same spiral-pattern, also somewhat coarser than normal; however, the shell is more slender, the whorls are not (so) convex, the initial whorls are higher, the ribs broader and the aperture is not spherical.

Material examined (locality and number of specimens). — Norway: Troms, Tromsø, beach/19 (LH); Trondheim Fjord, Grande Viken, depth 50-100 m/270 (MK), Storfosna, depth 90 m/2 (NNM).

Distribution. — From north Norway to the British Isles (Nordsieck, 1972; Fretter, Graham & Andrews, 1986).

Chrysallida clathrata (Jeffreys, 1848)
(fig. 36)

Odostomia clathrata Jeffreys, 1848, Ann. Mag. Nat. Hist. (2) 2: 345.

General description (after 48 shells from 11 localities). — The shell is rather slender, oval-conical, with a blunt top. The protoconch is of type B. There are four (rarely five) almost flat or slightly convex teleoconch whorls. The suture is deep and somewhat open, its inclination is variable, but generally strongly oblique, which gives the shell a screw-shaped appearance. The initial whorls are relatively higher than in most *Chrysallida* of about the same length. The ribs are more or less vertical; they are slightly curved, on the last whorl somewhat sinuous. The ribs are moderately broad and high, variable in number, thus the interstices vary from narrow to broader than the ribs. In most cases, the ribs continue to the base, occasionally they fade away around the periphery. Although the spiral ridges are only present between the ribs, they are nevertheless more pronounced than in most other *Chrysallida*. The oldest teleoconch whorl has one spiral, just above the suture. The last whorl has three spiral ridges, the lowest one at the level of the upper side of the aperture, the highest one just under the middle of the distance suture-upper edge of aperture, the central spiral just in between. The other whorls have two spiral ridges, the apical one clearly under the middle of the whorl. All these spirals are rather widely spaced. Apart from the main spirals, there are many microspiral-striae between the ribs on all whorls (only visible on fresh and clean shells). The aperture is oval; only when turning the shell far to the left, a very faint tooth-pleat can be seen. There is an umbilical groove, often hidden behind the columellar lip.

Length 1.5-2.6 mm, LW 48-59%, A 25-31% L/B 2.6-3.0, B/b 1.3-1.6 (based on 12 shells).

Discussion. — Unfortunately an original description gives often more problems and questions than certainty, which also applies to *C. clathrata*. Jeffreys (1848) writes about the colour of the shell: “rufescenti-fusca”, i.e. dark reddish brown, and he mentions: “6 costellis”, with 6 spiral ridges. He has corrected these mistakes in a later work (Jeffreys, 1867:148; illustration in 1869, pl. 74 fig. 9).

Differential diagnosis. — Considering the main characters of *C. clathrata*, identification is not difficult: the high initial whorls, a somewhat ‘screw-shaped’ appearance, the three, more prominent, spiral ridges on the last whorl and two on the others, and a very faint tooth-pleat.

C. jeffreysiana has about the same appearance, but is on average larger, coarser, and has no spiral ridges.

C. emaciata is more slender, has more convex whorls and the initial whorls are clearly shorter. There is a more prominent tooth and spiral striae on the base.

C. eximia, cf. there.

The shells of *C. obtusa* from the Canary Islands with three spirals on the last whorl

and two on the penultimate whorl, differ from *C. clathrata* by having flat whorls, a narrow, shallow and not very oblique suture. The older whorls appear to be not so high as in *C. clathrata* and there is indeed a hidden, but prominent tooth.

All other *Chrysallida* with three spiral ridges on the last whorl and two on the penultimate one, are very different in shape.

Material examined (locality and number of specimens). — Portugal: Algarve, Praia da Alvor/3 (MK).

Spain: Murcia, Cartagena/1 (PO).

France: Bouches-du-Rhône, Lauron/2 (LH), Cap Couronne/10 (LH); Alpes-Maritimes, Antibes/1 (LH).

Italy: Savona, Laigneglia/13 (MK).

Malta: Gregno Bay, depth 60 m/3 (LH), Rdum il-Qammieh/1 (LH).

Yugoslavia: Croatia, Vrsar/5 (PO), Starigrad Paklenica/8 (PO), Banići/1 (EH).

Distribution. — An uncommon species, to the authors only known from south Portugal and the Mediterranean. Fretter, Graham & Andrews (1986) report it from the Mediterranean north to the British Isles.

Chrysallida limitum (Brusina, 1879)
(figs. 38, 39)

Turbonilla limitum Brusina, 1879, Les Fonds de la Mer 3: 32, pl. 1 fig 1.

General description (after 41 shells from 3 localities). — A rather large and solid shell, slender, more or less scalariform and conical with a moderately blunt top. Resembles a *Turbonilla*. The protoconch is of type B. There are five to seven flat (sometimes even a little concave) teleoconch whorls. Each whorl is notably cylindrical; on the adapical side it is nearly as broad as on the base, thus the only less turreted specimens are rather cylindrical, the clearly scalariform shells have a more conical profile (cf. figs. 38, 39). The suture is narrow and deep, somewhat oblique. The ribs are straight and vertical, sometimes on the lower whorls slightly curved and inclined to the right. Often the ribs are broadened and thickened at both ends, causing the whorls to show a concave profile. The ribs are about as broad as the interstices; on the last whorl abruptly terminating on the periphery (occasionally decreasing and disappearing in the direction of the base). The last whorl has three spiral ridges between the ribs, the penultimate whorl two, just above the abapical suture. The initial whorls have one spiral. All spiral ridges are narrow and often vague, thus difficult to see. The form of the aperture is variable: narrow oval, egg-shaped or rhomboid. There is a distinct tooth and no umbilicus.

Length 2.4-3.7 mm, LW 46-57%, A 24-31%, L/B 2.4-2.9, B/b 1.4-1.7 (based on 11 shells).

Discussion. — Some authors have used the name *Chrysallida graduata* (De Folin, 1870), instead of *C. limitum*, or as a synonym of this species. Although the general shape of *Oceanida graduata* is not very different from that of *C. limitum*, the first species is no *Chrysallida* at all, but a member of the Eulimidae (cf. Warén, 1983).

Differential diagnosis. — *C. limitum* resembles a *Turbonilla*, e.g. *T. gradata* B. D. & D., 1833 (cf. Van Aartsen, 1981, fig. 21), because of its general appearance and ribs. The protoconch, however, is different (cf. Introduction) and *C. limitum* has a prominent tooth, which a *Turbonilla* never has. Moreover, a *Turbonilla* never has some spiral

ridges exclusively just above the sutures. Because of its solid character, its length and its turreted profile, confusion with other *Chrysallida* is limited to *C. terebellum*. But, *C. terebellum* is never scalariform, its (also straight) ribs incline much more to the right and it never has three spirals on the last and two on the penultimate whorl. Furthermore, *C. terebellum* generally has an umbilical chink and each whorl is conical, not cylindrical like those of *C. limitum*.

Material examined (locality and number of specimens). — Turkey: (SE. Turkey), Mersin/20 (LH, MK), Iskanderun/1 (LH).

Israel: Haifa/20 (LH).

Distribution. — So far known from the easternmost part of the Mediterranean Sea.

Chrysallida colungiana Nordsieck, 1972
(fig. 37)

Chrysallida colungiana Nordsieck, 1972, Die europäischen Meeresschnecken: 94, pl. P1 fig. 14
Syn.: *Chrysallida dollfusi* (Kobelt, 1887, non Cossmann, 1886).

General description (after one shell). — The shell is ovoid-conical, somewhat turreted. The protoconch is of type B, tending to C. There are four slightly convex teleoconch whorls, separated by a narrow, deep suture. In this shell (cf. Discussion below) the ribs are flat, broader than the interstices. They are about straight and vertical, or somewhat sinuous, on the last whorl fading above the edge of the aperture. The last whorl has three spiral ridges at and above the periphery, the penultimate whorl two, near the abapical suture. The two oldest teleoconch whorls both have one spiral. The aperture is rather large, egg-shaped. There is no tooth and a clear umbilicus.

Length 2.7 mm, LW 59%, A 37%, L/B 2.1, B/b 1.9.

Discussion. — Unfortunately, the authors have only one shell available for the description; for that reason most data are not very sure. There is no uniform opinion about *C. colungiana* in the literature. Although the investigated shell is similar to the specimen described and illustrated by Rolan Mosquera (1983), it differs from the drawing and original description of Nordsieck, who states that the species has narrow ribs and broad intervals and a small tooth. The illustration shows a shell with a distinct turreted profile and clear convex whorls, the last whorl bearing four spiral ridges. In Van Aartsen (1977) the spiral ridges on the last whorl vary from one to four (the drawing shows three spirals) and a prominent tooth is illustrated.

Material examined (locality and number of specimens). — Adriatic sea: 42°31'N, 16°08' E, depth 110 m/2 (one juvenile) (ZMA).

Distribution. — According to Nordsieck Colunga (Biscaya), Lusitanian and Mediterranean area.

Chrysallida spec. A
(fig. 40)

General description (after one shell). — A tall, slender, cylindrical shell with a pointed top, *Turbonilla*-like. The protoconch is of type B, tending to A (a part of the first half whorl is visible). There are eight short and slightly convex teleoconch whorls; the suture is narrow and oblique. On the three oldest whorls the ribs are almost

straight and vertical, the lower whorls have sinuous ribs, inclined to the right. They are broader than the interstices and on the last whorl they finish at the upper edge of the aperture on the level of the lowest one of the three spiral ridges. The penultimate and the antepenultimate whorls have two spirals just above the abapical suture (a third spiral is located within the suture). The other initial whorls have one spiral ridge. The aperture is narrow oval, there is a clearly visible tooth (pleat) and no umbilicus.

Length 4.3 mm, LW 35%, A 22%, L/B 3.6, B/b 1.2.

Discussion. — Although there is only one specimen available, it is not improbable that *C. spec. A* is a valid species. As regards its characters it differs from all other *Chrysallida*.

Differential diagnosis. — The shape of the shell, the rib-pattern, the pointed top, short whorls and length give this specimen a *Turbonilla*-like appearance. The situation of the protoconch, the tooth and spiral pattern do place this species within the genus *Chrysallida*.

C. terebellum has a larger last whorl (LW 40% versus 35% at the same length). The lower whorls have less sinuous ribs and these whorls have also one spiral ridge less.

C. spec. A differs from *C. limitum* by its greater length, its much more slender shape, the more convex whorls and its non-scalariform profile, its more sinuous ribs and less prominent tooth.

For differences with *C. spec. B* cf. there.

Distribution. — Only known from Israel: Haifa Bay (LH).

Chrysallida spec. B

General description (after 4 shells from 3 localities). — The shell is rather slender, cylindrical, with a pointed top. The protoconch is of type B, tending to A. There are five of six flat teleoconch whorls; the suture is not very narrow and deep, somewhat inclined. The ribs are straight and vertical (sometimes on the last whorl a little flexuous), very close to each other, the interstices only excavated lines. The ribs are decreasing and disappearing on the last whorl just below the periphery. The initial whorls have one spiral ridge near the abapical suture, the penultimate whorl one or two spirals, the last whorl has three spiral ridges, the lowest one at the same level as the upper edge of the aperture. All spirals are thin and vague. The aperture is narrow oval; there is a clearly visible tooth and in some shells an umbilical chink.

Length 2.3-3.2 mm, LW 45-53%, A 27-32%, L/B 2.6-3.1, B/b 1.4-1.5 (based on 4 shells).

Discussion. — How far *C. spec. B* is a valid species and not a forma of *C. limitum*, is, in the absence of a number of specimens, impossible to verify.

Differential diagnosis. — *C. spec. B* differs from *C. limitum* by its less coiled protoconch, its more slender and not turreted shape, its thinner, more 'elegant' ribs and the very narrow spaces in between.

It differs from *C. indistincta* (cf. *C. simulans*) by its tooth and pointed top.

C. spec. B differs from *C. spec. A* by being smaller, its very flat whorls and its thin, straight, vertical ribs.

Material examined (locality and number of specimens). — Cyprus: Limassol/2 (LH).

Turkey: (SE. Turkey), Mersin/1 (LH).

Israel: Haifa Bay/1 (LH).

Distribution. — So far known only from the easternmost part of the Mediterranean Sea.

Chrysalida indistincta (Montagu, 1808)
(figs, 11, 12, 43-45)

Turbo indistinctus Montagu, 1808, Testacea Britannica Suppl.: 129.

Syn.: *Chrysalida flexuosa* (Monterosato, 1874), and not "Jeffreys in Monterosato".

Chrysalida simulans (Chaster, 1898).

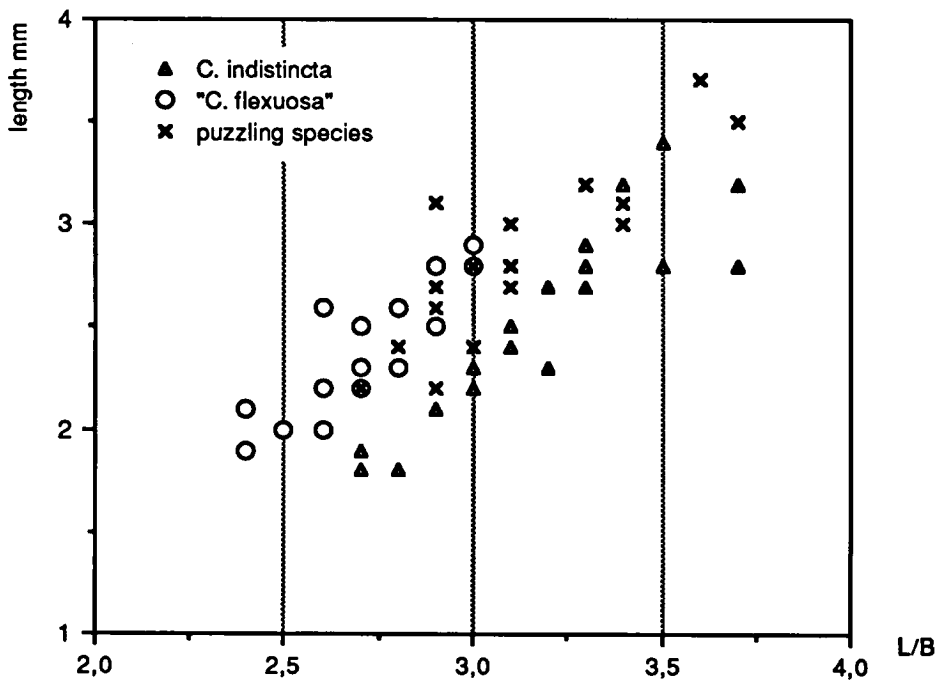
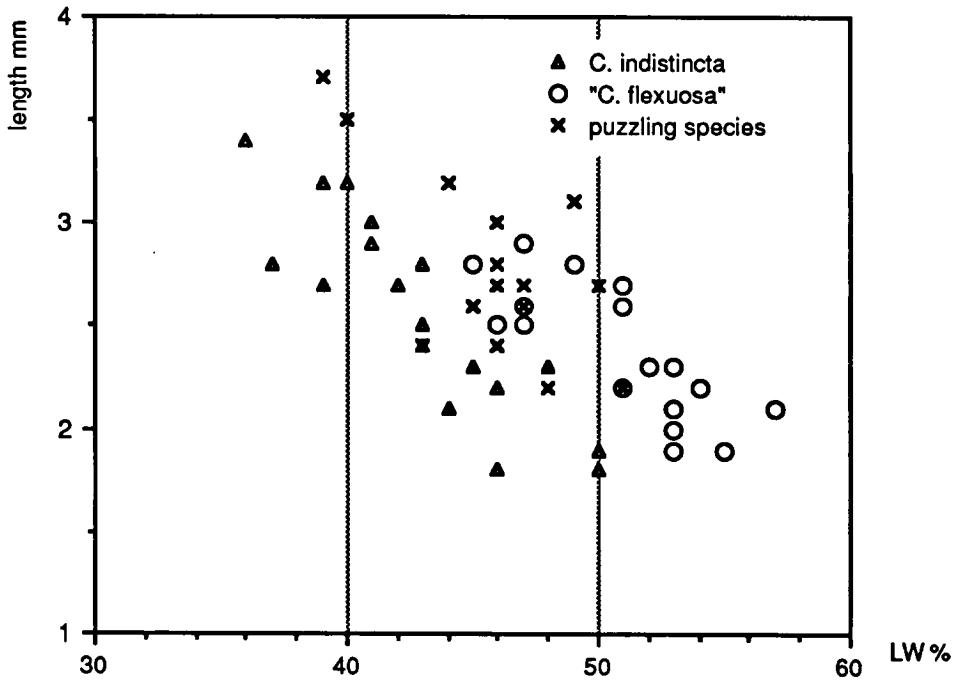
Chrysalida palazzii Micali, 1983.

General description (after 347 shells from 29 localities). — The shape of the shell is variable, from slender cylindrical to compact, broad, slightly conical, with a blunt top. The protoconch is of type B. There are four to six (seldom seven) flat or a little convex teleoconch whorls. In most slender specimens the whorls are constricted at about 1/3 of their height, measured from the abapical suture. The largest breadth of the whorls is thus clearly below the middle. As a result, the shells have a stepped appearance. Independent of the shape of the shell, the suture is variably wide and deep, but always oblique. On the initial whorls the ribs are occasionally straight, generally curved, and vertical to somewhat inclined to the right. On the lower whorls they become sinuous and more oblique. Vertical and straight ribs occur only rarely on the last whorl. The ribs fade away on the periphery of the last whorl or somewhat lower. The interstices are as broad as, or narrower than, the ribs. The last whorl bears four to seven spiral ridges of which the outermost are generally very vague and hardly visible. The upper part of this whorl has no spirals, on its lower part they decrease and disappear on the base. The penultimate whorl has three (rarely four) spiral ridges on its lower half. The initial whorls have two to three spirals, the oldest teleoconch whorl one. The aperture is rhomboid. There is no tooth and generally an insignificant umbilical slit.

Length 1.8-3.7 mm, LW 36-57%, A 20-34%, L/B 2.4-3.7, B/b 1.2-1.5 (based on 85 shells).

Discussion. — In its most pronounced appearance, *C. indistincta* is clearly different and separable from *C. flexuosa*. According to Van Aartsen (1977) the latter species has nearly straight and vertical ribs. The whorls are almost flat; L/B less than 2.7, instead of more than 2.7 for *C. indistincta*. Unfortunately, there are intermediate forms which cannot be identified as one of the two species. Their number is large: 95 (c. 27%) of all specimens investigated.

Some observations of the present study do not agree with the statements by Van Aartsen on *C. flexuosa*, e.g. $L/B < 2.7$. The diagram in fig. 12 shows that almost half of the investigated shells has an L/B ratio larger than 2.7. Furthermore he writes: "whorls nearly flat ... ribs are nearly straight and vertical". First, this is surprising because of the name of the species, *flexuosa* (flexuous, sinuous). Indeed, Monterosato (1874:267) mentions: "un petit nombre de côtes flexueuses ... tours renflés ...", i.e. a small number of flexuous ribs ... convex whorls (instead of flat ones). In practice one observes that most *C. flexuosa* specimens have more or less sinuous ribs. Some of the shells have rather flat whorls indeed, but in many others they are somewhat convex.



All samples investigated were split into typical *C. indistincta* and typical *C. flexuosa*. As mentioned above, a rather large group remained. Figs. 11 and 12 give an impression of the LW and L/B ratio. It is clear that the typical specimens of the two species are well separated, but that the puzzling specimens connect *C. flexuosa* and *C. indistincta*, particularly in the L/B diagram. Although many of the puzzling shells resembled mostly *C. indistincta*, their L/B and LW values would classify them often under *C. flexuosa*, and the reverse.

Taking all of this into consideration, it appears that both taxa are nothing but various forms of one species. The name *C. indistincta* is the oldest name available.

C. simulans (Chaster, 1898) was described as different from *C. indistincta* by its coarser ribs, its less convex whorls and its length of 2.2 mm (these characters are within the variability of *C. indistincta*), three spiral ridges on the last whorl and two on the others. The authors are acquainted with this type of shell: Spain, Taragona, San Carlos/1 (MK); Balears, Formentera/3 (ZMA). France: Hérault, Cap d'Agde/1 (MK), Turkey: Mersin/3 (LH). The only difference with *C. indistincta* (one spiral less on each whorl) does not seem to be sufficient at all to give this shell the status of a separate species.

C. palazzii Micali, 1983, is only known from the literature. The difference with *C. indistincta* is limited to the basal half of the last whorl, where spiral ridges and ribs both continue noticeably to the base of the shell. For the time being this species has to be considered (at most) a form of *C. indistincta*. An extensive and comparative investigation of the anatomy, habitat and breeding of the animals, may perhaps change this opinion.

Differential diagnosis. — Because of the many spiral ridges of *C. indistincta* and its more or less cylindrical shape, confusion with *C. sigmoidea*, *C. juliae* and *C. sarsi* is possible. All other *Chrysallida* with about the same profile, have fewer spirals (e.g. *C. nanodea*), or are much more conical or compact (e.g. *C. decussata*, *C. maiiae*).

C. sigmoidea resembles *C. indistincta*; however, the ribs are much more sinuous, further from each other and there are many barely visible spiral striae over the whole surface.

C. juliae (and *C. sarsi*) differs from *C. indistincta* by its more flexuous and closer ribs, the somewhat convex whorls and the better visible spiral ridges. At equal length, L/B is lower for *C. juliae* (the shell is more squat).

C. sarsi has a much more pronounced and higher last whorl, as a result of which the shell has a more conical profile (B/b 1.5-1.9 versus 1.2-1.5).

Material examined (locality and number of specimens). — Sweden: Gäsö Fjord/2 (LH).

Ireland: Donegal, Malin Head/5 (ZMS).

Great Britain: Devon, Cawsand Bay/2 (NNM); Cornwall, Falmouth/1 (NNM).

Germany: Helgoland/4 (MK).

France (Atlantic): Côtes-du-Nord, St. Jacut/2 (LH); Vendée, Jard-sur-Mer/19 (LH); Gironde, Bassin d'Arcachon/5 (NNM).

Figs. 11-12. *Chrysallida indistincta* (Spain, Santander, Laredo); 11 (top) LW, many puzzling specimens mostly resemble *C. indistincta*, these are classified between '*C. flexuosa*' in this diagram. 12 (bottom) L/B, the two forms are well separated, but the intermediate forms (puzzling species) connect them.

Spain (Atlantic): Santander, Laredo/ 132 (EH, HA, LH, MK); Oviedo, Gijón/1 (HA); Pontevedra, Ria de Arosa /26 (NNM).

Portugal; Algarve, Lagos/17 (HA), Praia da Alvor/15 (MK), Praia da Rocha/20 (LH).

Spain (Mediterranean): Cadiz, Gétarès/5 (LH); Taragona, San Carlos/26 (LH, MK); Baleares, Formentera/3 (ZMA).

France (Mediterranean): Hérault, Cap d'Agde/2 (MK); Bouches-du-Rhône, Cap Couronne/5 (HA).

Italy: Savona, Laigneglia/2 (MK).

Yugoslavia: Croatia, Vrsar/15 (PO), Biograd/2 (EH), Sorto/1 (NMM), Baniči/4 (EH), Slano/24 (EH).

Greece: Athens, Lagonisi/1 (LH).

Turkey: (SE. Turkey), Mersin/3 (LH).

Canary Islands: S. of Lanzarote, depth 82 m/1 (NNM); SW. of Palma, depth 50 m/1 (NNM).

Distribution. — From southern Norway and southwest Sweden, south to the Canary Islands and the Mediterranean.

Chrysallida juliae (De Folin, 1872)
(figs. 48, 49)

Truncatella juliae De Folin, 1872, Les Fonds de la Mer 2: 49, pl. II fig. 4.

General description (after 315 shells from 7 localities). — The shell has a more cylindrical than conical appearance and a blunt top. The protoconch is of type B, tending to C. There are four to six rather convex teleoconch whorls. The suture is moderately wide and deep, oblique and occasionally almost horizontal. On the initial whorl(s), the ribs are vertical, on the lower ones they are inclined to the right. All ribs are sinuous and close-set, particularly on the last whorl(s). They are equally broad, often somewhat broader than the very narrow interstices. On the last whorl the ribs continue to the base. The final spiral ridges are sometimes hardly visible. Some seven cover the lowest 2/3 of the last whorl, half-way the aperture they fade away, the ribs likewise. The penultimate whorl has three or four spirals on the lower half of the whorl. In the largest specimens the next whorl has three spirals, in other cases there are less. The oldest whorls always have less than three spiral ridges. The aperture is oval-spherical, there is no tooth and generally an insignificant umbilical chink.

Length 1.9-3.5 mm, LW 38-56%, A 25-35%, L/B 2.3-3.3, B/b 1.3-1.6 (based on 42 shells).

Discussion. — Although the original description was dated 1871 and issue no. 2 is from 1875, the real date of publication is 1872 (cf. Winckworth, 1941).

The authors do not agree with Van Aartsen's (1977) statement that this species is "Turbonillalike": the whorls are too convex, the last whorl too high, rib and spiral pattern are completely different, as is the shape of the aperture. Furthermore, the most significant difference is the top of the shell. *Turbonilla* has a pointed protoconch and narrow initial whorls. *C. juliae* has an obtuse protoconch and a broad initial whorl. The statement $L/B > 2.7$ is only partly correct. The authors have found this ratio only in shells with a length of 2.7 mm or over, so that this character is therefore useless in an identification key.

Nordsieck (1972) describes *C. juliae* under the name *C. terebellum*, a totally different species, and considers *C. indistincta* a synonym of *C. juliae*, which is also incorrect (this is the same error which Jeffreys makes in 1884).

Differential diagnosis. — *C. juliae* can only be confused with species with many spiral ridges (more than three on the last whorl). Because of its rather cylindrical shape and blunt top, there are no problems with *C. decussata*, *C. maiiae* and *C. fisheri*.

C. stefanisi is scalariform and has ribbon-like spirals over the total height of the whorls.

C. sigmoidea, apart from its many spiral striae, is much more slender, and has far fewer (but also sinuous) ribs with much larger interstices.

The spaces between the ribs of *C. indistincta* are also broader, the larger specimens are more slender than *C. juliae*. The ribs are less sinuous and more vertical. The largest breadth of its whorls is in a more abapical direction, close to the suture.

The difference with *C. sarsi* causes more problems; without comparison and measurements the two species cannot be separated (fortunately the distribution of both species is partly exclusive, see below). *C. juliae* can be somewhat larger, the suture is somewhat deeper and the shells are more slender and cylindrical (B/b 1.3-1.6 as compared with 1.5-1.9 for *C. sarsi*). The one important character is LW; for *C. juliae* 38-56%, for *C. sarsi* 52-69%. Although these figures partly overlap, this does not cause problems in practice, since an LW value of 52-56% (and a B/b 1.5-1.6) for *C. sarsi* only occurs in the largest (2.5-2.7 mm) specimens and for *C. juliae* only in the smallest (1.9-2.1 mm) shells measured. Nevertheless, the recommended procedure is comparison of shells of about equal length. The much higher last whorl of *C. sarsi* (compare figs. 46 and 48) is then very marked.

Material examined (locality and number of specimens). — France (Atlantic): Morbihan, Penthièvre/3 (LH).

Spain (Atlantic): Santander, Laredo/232 (HA, LH, MK, PO).

Portugal: Algarve, Praia da Alvor/1 (MK).

France (Mediterranean): Hérault, Mèze/1 (LH); Bouches-du-Rhône, Le Grau-du-Roi/19 (LH).

Turkey: (SE. Turkey), Mersin/3 (LH, MK).

Distribution. — From south Brittany, south to the Mediterranean.

Chrysallida sarsi Nordsieck, 1972
(figs. 46, 47)

Chrysallida sarsi Nordsieck, 1972, Die europäischen Meeresschnecken: 98, pl. P II fig. 4.

General description (after 757 shells from 11 localities). — The shell is ovoid-conical with a blunt top. The protoconch is of type B, tending to C. There are three or four slightly convex teleoconch whorls, the last one often more convex than the others. The suture is narrow and shallow, more or less oblique. The ribs are rather thin, numerous and close together, the interstices as broad as, or narrower than, the ribs. On the first whorl the ribs are occasionally straight, on the other whorls they are always sinuous. Their position is vertical or inclined to the right. Around the periphery of the last whorl, the ribs and spiral ridges both decrease and disappear. The spirals are thin, sometimes hardly visible. On the last whorl there are seven to nine spiral ridges on its lower 2/3. The penultimate whorl has three to four spirals on its lower half and the

antepenultimate whorl (on shells with four whorls) two or three. The oldest teleoconch whorl has no spirals, or one just above the abapical suture. The aperture is rather high, drop-shaped, without either a tooth or a pleat. Generally there is an insignificant umbilical groove.

Length 1.9-2.7 mm, LW 52-69%, A 29-42%, L/B 2.0-2.7, B/b 1.5-1.9 (based on 42 shells).

Discussion. — In spite of the small (but constant) differences with *C. juliae*, *C. sarsi* is a valid species (cf. also Van Aartsen, 1977). This was recently confirmed by Dr. A. Warén (personal communication to H.P.M.G. Menkhorst), after an investigation of specimens from Iceland.

Fretter et al. (1986) remark that *C. sarsi* is possibly a form of *C. indistincta*; this is probably due to a mistake.

Differential diagnosis. — See differential diagnosis of *C. juliae*. *C. sarsi* differs more from *C. sigmoidea* than from *C. juliae*, by its much higher last whorl. Also the difference between *C. sarsi* and *C. indistincta* is larger, because of the much more conical character of *C. sarsi* (B/b 1.5-1.9 versus 1.2-1.5).

Material examined (locality and number of specimens). — The Netherlands: Friesland, Terschelling/199 (MK, NNM); Noord-Holland, Texel/46 (NNM), Camperduin, dredge, "living" specimens/102 (NNM); Zuid-Holland, beaches/39 (EH, LH), Noordwijk/12 (NNM), Katwijk/7 (NNM), Scheveningen/150 (LH, NNM), Oostvoorne/3 (ZMS); Zeeland, Schouwen-Duiveland/71 (NNM).

France: Côtes-du-Nord, Ile Grande (near Trébeurden)/1 (ZMS).

Spain: Santander, Laredo/125 (HA, LM, MK, PO).

Distribution. — From the Netherlands, south to NW. Spain. Rare in Brittany and the only rather common *Chrysallida* on the Dutch coast (*C. sarsi* has the same distribution as *C. juliae*, from the south of Brittany to NW Spain). Nordsieck (1972) reports the species as from the north of Norway to Biscaya.

Chrysallida spec. C
(fig. 41)

General description (based on one immature specimen). — The shell is ovoid-conical, somewhat turreted, with a blunt top. The protoconch is of type B. There are three slightly convex teleoconch whorls, the last one is high (also when compared with other juvenile *Chrysallida* with about the same general shape). The suture is wide, deep and oblique. The ribs are very thin and sharp. They are straight and nearly vertical or a little inclined to the left. The interstices are very broad, twice or three times as broad as the ribs. On the last whorl the ribs continue to the base. The first whorl has one very faint spiral ridge near the abapical suture, the second whorl has, on the ventral side, one spiral and, on the dorsal side, two spirals. The lower one at some distance from the abapical suture, the other one at the same distance from the second spiral ridge. The last whorl has eight spiral ridges, from the base of the shell to about halfway the adapical suture and the upper edge of the aperture, the first three to four spirals noticeably far from each other. All these spiral ridges are almost as broad as the (narrow) ribs. Beyond the normal spirals, there is still another spiral ridge on the upper side of the penultimate and last whorl, obscure but much broader and flatter than the other ones. The aperture is egg-shaped, there is an indistinct tooth-pleat deep within the aperture, thus only visible when turning the shell to the left.

Length 1.3 mm, LW 68% (62), A 45% (37), L/B 2.0 (2.0), B/b 2.2 (1.8).

Discussion. — Because it is only possible to compare the ratios with those of other juvenile *Chrysallida* with the same length and shape, the authors have selected *C. penchynati* (cf. differential diagnosis); its ratios are given in brackets.

Differential diagnosis. — Considering the general shape of the shell only, *C. penchynati* is obviously the most closely related species in the genus; however, the spiral pattern is completely different. *C. spec. C* has a higher last whorl and aperture, a narrower first teleoconch whorl (B/b is higher) and fewer ribs. Considering both the spiral pattern and general shape *C. spec. D* is larger, coarser, has more convex whorls, has more and broader ribs. *C. spec. D* has no spiral ridge on the upper side of the whorls, the other spirals on the last whorl are less distinct and much closer to each other. The tooth-pleat is more pronounced.

All other *Chrysallida* are much more different from *C. spec. C*.

Material examined (locality and number of specimens). — Turkey: (SE. Turkey), Mersin/1 (LH).

Chrysallida spec. D
(fig. 42)

General description (after 92 shells from 2 localities). — The shell is ovate conical with a blunt top. The protoconch is of type C, tending to B. There are four slightly convex or flat teleoconch whorls, which are somewhat constricted near the suture, which is deep and rather wide; its inclination is variable. The ribs are narrow, occasionally moderately broad, the interstices as broad as the ribs, but generally much broader. Their position is vertical or somewhat prosocline. On the initial whorls they are straight, on the last one occasionally straight, often a little sinuous. They continue to the base or fade around the periphery of the last whorl. The first teleoconch whorl has no spiral ridge, or one just above the abapical suture. The second whorl has one to three spirals, limited to the lower part of the whorl. The penultimate whorl has three to five spiral ridges. In the case of three spirals, they cover the lower half of the shell; if there are five, somewhat more than 2/3 is covered. The last whorl has 10-15 spiral ridges, starting just below the apical suture and continuing to the base. The uppermost spirals are rather far from each other, the lower ones more and more close together. All spiral ridges are situated between the ribs; only on the very base of the shell, where the ribs (if continuing that far) are reduced to lines, the (much robuster) spiral ridges cross over the ribs. The aperture is egg-shaped. There is a tooth, of which the tip is generally visible. After turning the shell, the tooth can clearly be seen. Almost invariably there is a small umbilical groove.

Length 1.8-2.4 mm, LW 53-62%, A 31-37%, L/B 2.3-2.6, B/b 1.3-1.7 (based on 11 shells).

Discussion. — *Chrysallida spec. D* is undoubtedly an immigrant from the Red Sea. The specimen from Haifa Bay, which still contains remains of the animal, is completely identical with the other 91 shells from the Gulf of Suez. Because there is only one Mediterranean shell to investigate, the description above is therefore largely based on the Red Sea sample.

Differential diagnosis. — As far as its general shape is concerned, *C. spec. D* mostly resembles *C. penchynati*. This species, however, is smaller and more slender: L and B

are both proportionally smaller, so that L/B is about equal for both species. Nevertheless, the large number of spiral ridges of *C. spec. D* is conclusive.

C. juliae has comparable spirals which, however, already fade away on the periphery of the last whorl, whereas they generally continue, well-visible, to the base in *C. spec. D*. The ribs of *C. juliae* are more close-set, are more sinuous and are inclined to the right or vertical. In *C. spec. D* they are either vertical or inclined to the left. *C. juliae* has no tooth.

For the differences with *C. spec. C*, cf. there.

Material examined (locality and number of specimens). — Israel: Haifa Bay/1 (LH).

Egypt: Red Sea, Gulf of Suez, Safaga/91 (LH, ZMS).

Distribution. — Red Sea and the easternmost part of the Mediterranean.

Chrysallida decussata (Montagu, 1803)
(fig. 50)

Turbo decussatus Montagu, 1803, Testacea Britannica 2: 322, pl. 12 fig. 4.

General description (after 147 shells from 12 localities). — The shell is oval-conical, with a rather pointed top. The protoconch is of type B. There are three or four slightly convex and turreted teleoconch whorls. All whorls are high, particularly the last one. The suture is moderately narrow, but deep, almost horizontal to strongly oblique. The first teleoconch whorl is generally smooth, the lower ones have ribs, as broad as the interstices. On the last whorl they are sinuous, continuing to the base. Their direction is vertical to somewhat prosocline. On the initial whorls the ribs are straight to slightly curved. The spirals are clearly visible, but always considerably thinner than the ribs. They are not close together; the interspaces are about as broad as the spaces between the ribs, so that squares are formed. On the last whorl there are 9-12 spiral ridges, from the base to just under the adapical suture. The penultimate whorl has four to five spirals on its lower 2/3 part. In shells with four whorls, the next one shows one to three spiral ridges on its abapical half. The first teleoconch whorl is always smooth. The aperture is elongated egg-shaped and rather high. There is a small tooth-pleat, only visible on turning the shell to the left. There is no umbilicus, occasionally an insignificant groove.

Length 1.9-3.1 mm, LW 59-70%, A 34-44%, L/B 2.0-2.5, B/b 1.9-2.8 (based on 27 shells).

Discussion. — Neither on the shells investigated (147, juveniles included), nor on three different SEM photographs of *C. decussata* spiral ridges equally strong as the ribs, and over the total height of all whorls (Van Aartsen, 1977) could be observed.

Differential diagnosis. — Identification of *C. decussata* cannot be too difficult: the many spiral ridges, the ovoid-conical shape and relatively pointed top, and the rather high, tumid whorls provide enough differences with other *Chrysallida*. At most, confusion could occur with *C. sarsi* (and to a lesser extent, with *C. juliae*) and *C. maiae*. The last species is larger, coarser, has broader straighter ribs, has more, and more prominent, spiral ridges, even over the total height of the initial whorls, and a pronounced tooth.

C. sarsi is less conical: at the same length, B/b 1.8 as compared with 2.4; the last

whorl is clearly shorter: LW 60% versus 66%. The top of *C. sarsi* is much more obtuse and there are more sinuous ribs, close together.

The differences with *C. juliae* are even greater: this species is still more cylindrical and the whorls are still shorter.

Material examined (locality and number of specimens). — Great Britain: Shetland/3 (NNM); Devonshire, Plymouth/2 (NNM).

France: Ille-et-Vilaine, Le Vivier-sur-Mer/1 (LH); Côtes-du-Nord, St. Jacut/8 (LH), Trébeurden/3 (LH); Finistère. Kerséquénou/1 (LH), Ile Tudy/73 (LH); Morbihan, Penthièvre/21 (LH, ZMS).

Spain (Atlantic): Pontevedra, Ria de Arosa/28 (NNM).

Portugal: Algarve, Praia da Alvor/5 (MK).

Spain (Mediterranean): Gerona, Rosas/1 (MK).

Egypt: Mersa Matruh/1 (NNM).

Distribution. — From Shetland along the Atlantic coast south to the Mediterranean. Absent in the North Sea (all identifications from the Dutch coast are mistakes and in fact *C. sarsi*). Rare in the Mediterranean Sea.

Chrysallida pirinthella (Melvill, 1910)

Pyrgulina pirinthella Melvill, 1910, Proc. Malac. Soc. Lond. 9: 201, pl. 6 fig 9.

General description (from literature only). — The shell is small, cylindrical, somewhat turreted, with a blunt top. The protoconch is probably of type C, or type B tending to C. There are four teleoconch whorls, flat in the middle part and strongly bent inwards near the upper and lower suture, which is impressed and oblique. The ribs are straight and almost vertical or slightly prosocline; they continue (?) to the base of the last whorl and are as broad as the interstices. The entire surface of all whorls is covered with spiral ridges, crossing the ribs. The aperture is oval; there is a clear tooth and probably an umbilical chink. Length 1.5-2.0 mm.

Discussion. — The authors are not acquainted with this species at all. Only the original description and the note of Van Aartsen, Barash & Carrozza (1989) are available. The last mentioned authors spell the name as *C. pirintella*, which is wrong. Melvill had described the spiral ridges on the last whorl as disappearing below the periphery.

Differential diagnosis. — Because of its many spiral ridges on all the whorls, its more or less cylindrical profile, its small size and its distribution, confusion only may occur with *C. fischeri*, *C. stefanisi* and *C. spec. D.*

C. fischeri has a pointed top, the protoconch is of type B tending to A, thus less coiled, the whorls are not scalariform, its profile is more pupoid.

C. stefanisi is more compact, the whorls are much more scalariform, the spiral ridges are broad, ribbon-like and the shell has only an insignificant tooth-pleat.

C. spec. D. has a more oval-conical profile, the whorls are more convex, not turreted. On the initial whorls only the lower part of the whorls is covered with spiral ridges.

Distribution. — Persian Gulf, Red Sea. Since 1984 a few specimens have been found in Haifa Bay, Israel.

Chrysallida sigmoidea (Monterosato, 1880)
(fig. 55)

Odostomia sigmoidea Monterosato, 1880, Bull. Soc. Malac. Ital. 6:71.

General description (after 18 shells from 4 localities). — The shell is long, slender, cylindrical with a very blunt top. The protoconch is of type B. A part of its whorl protrudes as a loop on top of the first teleoconch whorl. There are four to seven, sometimes even as much as nine, teleoconch whorls. The adapical 2/3 part of the whorls is flat, just to the periphery; from this point the lower part is more convex, curving inwards to the narrow and oblique suture. The ribs are as broad as the spaces in between, sinuous on all whorls and strongly flexuous on the last one, fading away near the upper edge of the aperture. The spiral ridges are difficult to observe, rather faint and spiral striae, close together, between the ribs over the whole surface of all whorls. On the base of the shell, where the ribs become obscure and turn into lines, the spiral threads run over these ribs. The aperture is small, elongated ovate to spherical. There is neither a tooth, nor an umbilicus.

Length 2.4-5.6 mm, LW 30-46%, A 15-26%, L/B 2.8-4.4, B/b 1.1-1.4 (based on 12 shells).

Discussion. — Four years before Jeffreys, Monterosato already had described *C. sigmoidea*, short indeed, but to the point: "... con l'apice bruscamente troncato a sottilissime striae spirali e a coste sigmoidee". (with a very obtuse apex, with extremely thin spiral lines and with sinuous ribs). Monterosato classified this species with the genus: "*Pyrgulina* A. Adams = ? *Parthenia* Lowe", together with *Odostomia flexuosa* and *O. fenestrata*. These two, however, are long and slender *Chrysallida* without a tooth. Because the shells, mentioned by Monterosato, are from the Porcupine Expedition, they are probably the same specimens, described by Jeffreys in 1884. Consequently the authors consider Monterosato, 1880, to be the author and not Jeffreys, 1884 (cf. Van Aartsen, 1977, who gave no date, and Nordsieck, 1972, who erroneously classified it as *Turbonilla*), or even Monterosato in Jeffreys, 1884 (cf. Piani, 1980).

Differential diagnosis. — Because of the absence of a tooth, its long, slender shape, and its many short and rather flat whorls, *C. sigmoidea* strongly resembles a decollate *Turbonilla*. The top is very truncated, whereas a top of *Turbonilla* is pointed, with a very different protoconch. Moreover, there is no *Turbonilla* with such wavy ribs.

Confusion with other *Chrysallida* is hardly possible, most species with many spirals have a very different shape (*C. maiiae*, *C. fischeri*, *C. stefanisi*, *C. decussata*, *C. sarsi*), or have, besides many spiral striae, also some real spiral ridges (i.e. *C. emaciata*, which is also much smaller and has pronounced convex whorls).

As far as *C. juliae* and *C. indistincta* are concerned, the largest specimens of both species are about as long as *C. sigmoidea* and have five to six whorls. However, the whorls of *C. juliae* are more convex and robust (much broader at equal length) and the spirals are more prominent and are further from each other. The latter also applies to *C. indistincta*, which has flat whorls, but ribs which are much more straight than those of *C. sigmoidea* (and *C. juliae*).

Material examined (locality and number of specimens). — Spain ((Atlantic): Santander, Laredo/2 (LH).

Portugal: Algarve, Praia da Alvor/3 (MK), Praia da Rocha/9 (EH, LH).

Spain (Mediterranean): Cadiz, Gétarès/4 (LH).

Distribution. — The authors only know this species from the Iberian Peninsula. Nordsieck (1972) records the Atlantic and Mediterranean. Fasseaux (1974) reports it from France: Côtes-du-Nord, Erquy.

Chrysallida maiae Hornung & Mermod, 1924)
(fig. 54)

Pygulina Maiae Hornung & Mermod, 1924, Ann. Mus. Civ. Stor. Nat. Genova 51: 296, fig. 11.

General description (after 91 shells from 4 localities). — A solid shell, longer and broader than most other *Chrysallida* (L/B “normal” since both are higher than average). Its shape is ovoid-conical, with a pointed top. The largest specimens (over 3.5 mm) have a somewhat more cylindrical profile. The protoconch is of type C. There are four to five flat and turreted teleoconch whorls, the suture is almost horizontal and narrow. The straight and vertical ribs are as broad as, or somewhat smaller than, the interstices. On the last whorl, they continue to the base; however, on the periphery they become vague. Apart from the smooth protoconch and the ribs, the whole surface is covered with fine, sharp, close-set spiral threads. The aperture is large and egg-shaped with a pronounced tooth. There is no umbilicus. Part of the specimens show, on the inner side of the outer lip, two lamella-like teeth. They lie rather deep and end far before the edge of the aperture.

Length 3.0-4.2 mm, LW 50-60%, A 31-35%, L/B 2.2-2.5, B/b 1.3-1.7 (based on 8 shells).

Discussion. — *C. maiae* is an immigrant from the Red Sea. According to Barash & Danin (1977), the first record on the Israeli coast was 1958, followed by Iskanderun, SE. Turkey in 1968. Nevertheless, one of the authors has a sample, collected in Iskanderun in 1963, and NNM has shells from Atlit (near Haifa), Israel, already found in 1935 (!).

Differential diagnosis. — By its limited distribution area and because of its many spiral threads, its solid character, its ovoid profile and pronounced tooth, confusion with other *Chrysallida* is at most limited to *C. stefanisi*. This species, however, is much smaller and has a larger last whorl (LW 65-71% versus 50-60%). For more differences cf. under *C. stefanisi*.

Material examined (locality and number of specimens). — Turkey (SE. Turkey), Mersin/8 (LH, MK), Iskanderun/2 (LH).

Israel: Haifa/78 (LH), Atlit/3 (NNM).

Distribution. — The easternmost part of the Mediterranean. According to Hornung & Mermod (1924) Red Sea and Ethiopia.

Chrysallida interita nom. nov.
(fig. 53)

Acteon pygmaea De Grateloup, 1838, Actes Soc. Linn. Bordeaux 10 (53): 282, (1840) pl. 6 figs. 77, 78, nec *Acteon pygmaeus* Lea, 1833.

General description (after 76 shells from 2 localities). — For information see under (general description and discussion of) *C. stefanisi* (Jeffreys, 1869).

Length 2.0-4.0 mm, LW 56-67%, L/B 2.0-2.4, B/b 1.6-2.0 (based on 8 shells).

Discussion. — Although the authors describe Recent species only, they make an

exception for *C. pygmaea*, because of the confusion in the literature. Unfortunately the name *C. pygmaea* is disputable, because *Acteon pygmaea* De Grateloup, 1838 (a spelling mistake: *Acteon* is masculine) is preoccupied by *Acteon pygmaeus* Lea, 1833. Since the authors are of the opinion that there are two different species (cf. *C. stefanisi*), it is not possible to substitute *C. pygmaea* (De Grateloup, 1838) by *C. stefanisi* (Jeffreys, 1869) (cf. Van Aartsen & Giannuzzi-Savelli, 1991). Therefore it is necessary to give *C. pygmaea* a nomen novum. The authors propose the name *Chrysallida interita* (from Lat. *interire*, become lost, become extinct, referring to the difference between the fossil *C. pygmaea* and the Recent *C. stefanisi*).

Differential diagnosis. — *C. interita* could be confused with a juvenile *Turbonilla scalaris* (Philippi, 1836); however, *Turbonilla* has a different protoconch, a much more rhomboid aperture and no tooth. The spiral ridges of *T. scalaris* are very thin, far from each other; they can be confused with the thread-like spaces between the flat, broad spiral ridges of *C. pygmaea*.

According to Van Aartsen (1977), the similarity in shape is possibly the motive for the name *C. brevicula* (Jeffreys, 1883), a junior synonym of (a juvenile) *T. scalaris* (Philippi, 1836) (see also Nordsieck, 1972).

Material examined (locality and number of specimens). — Germany: Westfalen, Dingden, brook-bed Königsmühle. Miocene, Dingdener Schichten/75-3 samples (NNM).

France: Landes, St. Paul-les-Dax. Miocene, Burdiglian/1 (NNM).

Chrysallida stefanisi (Jeffreys, 1869)
(figs. 51, 52)

Rissoa Stefanisi Jeffreys, 1869, British conchology 5: 208, pl. 6 fig. 31

Syn.: *Rissoa costulata* Wood, 1848, non *R. costulata* Alder, 1844.

Menestho Jeffreysii Bell, 1871.

General description (after 24 shells from 7 localities). — The shell is compact, somewhat conical and scalariform, with a blunt top. The protoconch is of type B, tending to C. There are three slightly convex teleoconch whorls; the last one is high. They strongly constrict near the upper sutures, which makes the shell scalariform. The suture is deep and oblique. The ribs are variable in number and breadth, the interstices therefore likewise, more than twice as broad as the ribs to even narrower than the ribs. These are vertical and straight or hardly curved. On the last whorl, around the periphery, the ribs become narrow and vague but, continuing to the base, always visible. Sometimes the ribs are not only narrow, but also high and sharp. On the upper side of all whorls, on the shoulder, they are bent inwards, meeting the shell-axis at an angle of 90°, deep within the suture so that this has a serrated appearance. With the exception of the protoconch, the whole shell is covered with spiral ridges, crossing the ribs. They are broad and very flat (ribbon-like), close together; the spaces between are only excavated lines. Therefore it seems to the superficial observer, that the spirals are only thin lines. The aperture is oval, there is a very faint tooth-pleat, only visible on turning the shell. On some specimens there are about eight lamella-like pleats, inside the outer lip. There is a clear umbilical groove, on juveniles even a round umbilicus.

Length: 2.1-2.8 mm, LW 65-71%, A 37-41%, L/B 1.8-1.9, B/b 2.1-2.4 (based on 11 shells).

Discussion. — The name *C. pygmaea* (see preceding species *C. interita*) for the recent species, must be due to a misunderstanding. De Grateloup (1838) has described *C. pygmaea* as a result of investigations of Miocene shells from SW. France. This species is related to the Recent shell indeed, but different in too many details to be identical. On the other hand, there are no significant differences between the Recent species *C. stefanisi* and shells from the Pliocene.

—A: metrical differences

	<i>C. pygmaea</i>	<i>C. stefanisi</i>
Length	2.0-4.0 mm	2.1-2.8 mm
LW	56-67%	65-71%
L/B	2.0-2.4	1.8-1.9
B/b	1.6-2.0	2.1-2.4

—B: the position of the protoconch — *C. pygmaea*: very intorted, type C; *C. stefanisi*: type B, tending to C, therefore less coiled.

—C: general shape — *C. pygmaea* has almost flat whorls, *C. stefanisi* slightly convex whorls. *C. pygmaea* is much more scalariform, has generally higher ribs, is more cylindrical (cf. B/b) and the tooth is more pronounced.

—D: shells with the characters of *C. pygmaea* are not known from the Pliocene (fide A.W. Janssen). It is most improbable that this species, after an absence of millions of years (as far as known), has returned recently.

The Pliocene precursor of the Recent species has been mentioned for the first time in 1842 by Wood as *Rissoa costellata*. Neither description nor illustration is given and therefore this has to be considered a nomen nudum. The second mention by Wood is dated 1848. He has renamed the species *C. costulata* and gives a description in great detail; nevertheless, the name is preoccupied by *C. costulata* Alder, 1844 (itself a junior synonym of *R. guerini* Récluz, 1843). Jeffreys in 1869 has changed the name to *R. stefanisi*. This is the next available valid name, although the comment is given in an unfortunate context. There is a great confusion around *C. stefanisi*: Rolan Mosquera (1983) e.g. considers *R. stefanisi* Jeffreys, 1869, a synonym of *Apicularia subcostulata* (Schwartz, 1864), which is a junior synonym of *Rissoa guerini* Récluz, 1843. Even Van Aartsen & Gianuzzi-Savelli (1991) consider *C. pygmaea* and *C. stefanisi* identical.

Differential diagnosis. — By its many clear spiral ridges over the total height of all whorls, *C. stefanisi* can only be confused with *C. maiae*, *C. fischeri* and to a lesser degree *C. sigmoidea* and *C. decussata*. According to Van Aartsen (1977), the last-mentioned species has spiral ridges all over the whorls; in fact, the uppermost part of the lower whorls bears no spirals and the first teleoconch whorl is smooth. The shell is oval-conical, only slightly turreted (not clearly scalariform) and has a pointed top.

C. maiae is much more compact, larger, has an oval-conical profile with a pointed top. The spiral ridges are separate spiral threads, only between the ribs, and there is a pronounced tooth. *C. stefanisi* has an insignificant tooth-pleat, ribbon-like spiral ridges, crossing the ribs, a blunt top and a scalariform profile.

C. fischeri, cf. there.

C. sigmoidea is slender, cylindrical, with a short last whorl (LW 47% versus 64%). The ribs are sinuous, not straight, the spiral ridges only striae, close together and not ribbon-like.

Material examined (locality and number of specimens). —

— Fossil shells:

Belgium: Antwerpen, Kanaaldok B1-B2. Pliocene, Zanden van Luchtbal/18 (NNM).

— Recent shells:

“Adriatic Sea”, dredge/1 (NNM).

Italy: Sicily, Sciacca/1 (NNM).

Canary Islands: SW. of Hierro, depth 1370 m/1 (NNM); Lanzarote, depth 110 m/1 (NNM).

Madeira: S. of Madeira, depth 1100 m/1 (NNM).

Azores: E. of Santa Maria, depth 65 m/1 (NNM).

Distribution. — A rare species, probably only from deep water in the Mediterranean and around the Canary Islands, Madeira and the Azores.

Chrysallida fischeri (Hornung & Mermod, 1925)
(fig. 56)

Pyrgulina Fischeri Hornung & Mermod, 1925, Ann. Mus. Civ. Stor. Nat. Genova 52: 27, fig. 3.

General description (after 27 shells from 8 localities). — The shell is slender, cylindrical, with a pointed top. The protoconch is of type B, tending to A; often a part of the first half whorl is visible. There are five to six flat to slightly convex teleoconch whorls. The ribs are straight and vertical or somewhat prosocline, about as broad as the interstices. On the last whorl they decrease and disappear around the periphery. Except on the base of the last whorl, the first teleoconch whorl and the protoconch, the whole surface of the shell is covered with spiral ridges. The aperture is narrow rhomboid. There is a rather prominent tooth, no umbilicus.

Length: 2.2-2.7 mm, LW 46-54%, A 23-26%, L/B 2.8-3.1, B/b 1.2-1.3 (based on 7 shells).

Discussion. — The authors are unacquainted with *C. fischeri* from the Mediterranean area; only specimens from the Red Sea were investigated.

Differential diagnosis. — *C. fischeri* can only in detail be separated from *Turbonilla edgarii* (Melvill, 1896) (four specimens studied) (Van Aartsen, Barash & Carrozza, 1989), also an immigrant from the Red Sea. The latter species is more compact (L/B 2.6), somewhat more conical (notably by its narrow initial whorls), has a shorter last whorl (LW 44%) and its tooth is only a pleat (very unusual for *Turbonilla*). The protoconch, nevertheless, is of type A II (helicoid), unlike *Chrysallida*.

C. maiiae is much larger, coarser and more compact. The shell is oval-conical, the protoconch of type C, the ribs continue to the base and the spiral ridges are much more prominent and sharp.

C. fischeri and very cylindrical *C. doliolum* both have strongly similar forms; however, the latter species differs by its colour bands and the absence of spiral ridges.

C. sigmoidea is larger, has a very obtuse top, has sinuous ribs and the spiral striae are vague.

C. stefanisi has only three whorls, more or less scalariform. The ribs are higher and sharper and continue to the base. The spiral ridges are broad, flat ribbons, its top is rather blunt, the protoconch much more coiled (type B tending to C, versus B tending to A).

Distribution. — So far known only from the Red Sea and the west coast of Israel.

Chrysallida fenestrata (Jeffreys, 1848)
(fig. 57)

Odostomia fenestrata Jeffreys, 1848, Ann. Mag. Nat. Hist. (2) 2: 345.

General description (after 223 shells from 16 localities). — The shell is rather long, slender and, since the top is more pointed than in most other *Chrysallida*, conical. The protoconch is of type B, strongly tending to A (planorboid or A1); a part of the first half whorl is visible. There are five to seven teleoconch whorls; the upper 2/3 of these whorls is straight, the lower part is convex, because it is bent strongly inwards to the suture, which is open, deep and oblique. The ribs are about as broad as the interstices, in almost vertical position. They are somewhat undulating on the last whorl, curved or nearly straight on the initial ones. The last whorl has three (occasionally four) spiral ridges. Two of these, situated at some distance above the upper edge of the aperture, are pronounced, almost as broad as the ribs. The third ridge is on the same level of the upper side of the aperture, the occasional fourth spiral ridge at some distance below. In most shells the ribs continue to the third spiral, sometimes just to the second one, sometimes, decreasing into lines, they continue almost to the base of the shell. The initial whorls have two pronounced spiral ridges on the periphery. All these spirals run over the ribs, forming tubercles on the crossings. The aperture is small, rhomboid. There is no tooth, occasionally an insignificant umbilical slit.

Length 2.4-3.8 mm, LW 37-48%, A 19-25%, L/B 2.8-4.1, B/b 1.2-1.5 (based on 18 shells).

Differential diagnosis. — Because of its characteristic shape, *C. fenestrata* cannot easily be confused with any other *Chrysallida* but, on the contrary, it looks like *Turbonilla*, by its tall, slender, pointed appearance and the absence of a tooth. However, the protoconch of a *Chrysallida* disappears more into the first teleoconch whorl, and there is no *Turbonilla* with such pronounced spiral ridges as *C. fenestrata* has.

Material examined (locality and number of specimens). — Great Britain: S. Devon/1 (NNM), Torbay/4 (NNM), Cawsand Bay/2 (NNM).

France (Atlantic): Ille-et-Vilaine, Les Viviers-sur-Mer/1 (ZMS), St. Servan/10 (NNM), St. Lunaire/20 (ZMS); Côtes-du-Nord, St. Jacut/9 (LH); Gironde, Bassin d'Arcachon/16 (NNM).

Spain (Atlantic): Santander, Laredo/38 (EH, LH, MK, PO); Pontevedra, Ria de Arosa/25 (NNM).

Portugal: Algarve, Praia da Rocha/38 (LH).

Spain (Mediterranean): Taragona, San Carlos/51 (EH, LH, MK).

France (Mediterranean): Bouches-du-Rhône, Ste Croix/1 (LH).

Italy: Giulia, Grado/1 (EH).

Yugoslavia: Croatia, Vrsar/5 (PO).

Tunesia: ?/1 (NNM).

Distribution. — From the Mediterranean (rare in the central and more eastern parts) north to the British Isles. Also known from Mauretania (NNM).

Chrysallida excavata (Philippi, 1836)
(figs. 58, 59)

Rissoa excavata Philippi, 1836, Enumeratio molluscorum Siciliae ... 1: 154, pl. 10 fig. 6.

General description (after 1227 shells from 39 localities). — The shape of the shell is variable, but very typical: scalariform with a spiny profile; conical or cylindrical and

a blunt top. The protoconch is of type B, tending to C. There are four to six whorls, clearly turreted and, because of the spines on the ribs, with a somewhat concave profile. The ribs are narrow and high, generally rather far from each other, so that the interseices are often twice as broad as the ribs. On the apical level of each whorl, they strongly curve inwards, forming a nearly flat shoulder, to the suture which is wide, deep and moderately oblique. The ribs are prosocline, particularly so at the lower part of the whorl (after crossing the spiral ridge). Sometimes, the ribs continue to the base; sometimes they end on the last whorl at the last spiral ridge; more often, from that point onward to the base, they are reduced to thin lines only. On the initial whorls there are two pronounced spiral ridges (almost equal to the ribs). The upper, broadest one, on the shoulder of the whorls, the other one on 1/3 of their height, in apical direction. The last whorl has five spirals. The initial one is on the shoulder too, the third one is on the same level as the upper side of the aperture, the second spiral ridge is just between them. The last two (sometimes more or less faint) are opposite the aperture, of which the lower one parallels the columellar side of the aperture. Where ribs and spiral cords cross each other, there are spiny tubercles, to such an extent that at the apical side of the whorls, where the most pronounced ridge is located, the largest breadth of the whorl is measured. Within the squares, formed by ribs and spiral ridges, one can see a microsculpture of spiral striae (only visible on fresh shells). The aperture is rhomboid, the outer lip is angulate because of the protruding spirals. The modest tooth is generally only visible after turning the shell. There is no umbilicus.

Length: 1.7-3.6 mm, LW 49-62%, A 26-38%, L/B 1.8-2.5, B/b 1.4-2.0 (based on 28 shells).

Differential diagnosis. — In spite of its characteristic shape, *C. excavata* could be confused with other *Chrysallida* which are provided with very pronounced spiral ridges, e.g. *C. fenestrata*, which, apart from its totally different, non-scalariform *Turbonilla*-shape, has on the initial whorls two spirals at the bottom of the whorl. Somewhat more difficult is the difference with the (rare) *C. ghisottii*. This species, however, is more compact, resembles an *Alvania* and shows three instead of two spiral ridges on the penultimate whorl and on the last whorl above the aperture. Its protoconch is more intorted (clearly type C).

Confusion with juvenile *Bittium lacteum* (Philippi, 1836) is not inconceivable. The tooth and coiled protoconch of *C. excavata*, nevertheless, are decisive.

Material examined (locality and number of specimens). — France (Atlantic): Côtes-du-Nord, St. Jacut/1 (LH), Trébeurden/1 (LH); Morbihan, Penthièvre/10 (LH).

Spain (Atlantic): Santander, Laredo/32 (EH, LH, MK, PO); Pontevedra, Ria de Arosa/3 (NNM).

Portugal: Algarve, Praia da Alvor/17 (MK), Praia da Rocha/6 (LH).

Spain: (Mediterranean): Cadiz, Cadiz/1 (NNM), Tarifa/1 (NNM), Gétarès/175 (LH, MK); Murcia, Cartagena/31 (PO); Alicante, Javea/4 (MK); Taragona, San Carlos/3 (MK); Gerona, Rosas/16 (MK).

France (Mediterranean): Pyrenées-Orientales, Banyuls-sur-Mer/15 (MK); Bouches-du-Rhône, Lauron/45 (LH), Cap Couronne/23 (LH), Ste. Croix/55 (LH), Sausset-les-Pins/129 (LH, MK, NNM, ZMS); Var, Le Bruscat/21 (LH); Alpes-Maritimes, Antibes/111 (LH, ZMS).

Italy: Savona, Laigneglia/18 (MK); Giulia, Grado/1 (EH); Grosseto, Isola Argenterola/3 (EH); Taranto, Torre d'Ovo/8 (LH); Sicily, Mondello/27 (LH), Trapani/17 (MK, PO).

Malta: Rđum il-Qammieh/5 (LH).

Yugoslavia: Slovenia, Savudrija/21 (LH); Croatia, Vrsar/76 (EH, PO), Starigrad Paklenica/225 (PO), Biograd/2 (EH), Solta/1 (NNM), Baniči/62 (EH), Slano/16 (EH).

Greece: Athens, Lagonisi/18 (LH); Kefallinia, Lassi/13 (MK); Crete, Stavros/13 (MK).

Canary Islands: SW. of Selvagem Grande, depth 645 m/1 (NNM).

Distribution. — Common in the entire Mediterranean, uncommon in the Lusitanian area, north to Brittany (rare). Very rare and probably only in deeper water around the Canary Islands. Fretter, Graham & Andrews (1986) report occurrence north to the British Isles.

Chrysallida ghisottii (Van Aartsen, 1984)
(fig. 60)

Folinella ghisottii Van Aartsen, 1984, Boll. malac.20: 137

Syn.: *Chrysallida canaliculata* (Philippi, 1836).

Chrysallida intermedia (Brusina, 1869) nec (Deshayes, 1861).

General description (after 25 shells from 8 localities). — The shell is compact, conical, with a turreted profile and a very blunt top. It gives the impression of an *Alvania*, rather than that of a *Chrysallida*. The protoconch is of type C. There are three to four teleoconch whorls which, irrespective of the prominent spiral ridges, are flat. The whorls are shouldered; the last one is high. The suture is broad and deep, excavated, almost horizontal. As usual, the number of ribs is variable. Dependent on their number, the interstices are narrower, equal or broader than the ribs. They are prosocline; looking from the top to the base of the shell, the angle between the ribs and the axis of the shell becomes larger after every crossing of rib and spiral ridge. The ribs continue to the base, but become considerably thinner below the periphery of the last whorl. Generally the spiral ridges are stronger than the ribs; on the crossing small tubercles are formed. The first teleoconch whorl (in the case of four whorls, the first two) has two spiral cords, one on the apical shoulder, the other just above the abapical suture. The penultimate whorl has three spirals, two in the same position as on the initial whorl(s) and one (much less pronounced) in between. The last whorl also shows three (rarely four) spiral ridges above the aperture, equidistant, the middle one thinner than the others. Underneath, at the same height as the upper side of the aperture, there is a fourth spiral cord and, further to the base, next to the aperture, three (sometimes four) more. Thus, on the last whorl, there are seven to nine spirals. The aperture is high, oval; the outer lip angular because of the protruding spiral ridges. The tooth is only visible after turning the shell. There is no umbilicus.

Length 2.3-3.0 mm, LW 60-70%, A 37-42%, L/B 1.8-2.1, B/b 1.9-2.3 (based on 11 shells).

Discussion. — According to Van Aartsen (1984), *Odostomia intermedia* Brusina, 1869, is preoccupied by *Odostomia intermedia* Deshayes, 1861, and he proposed the new name *Folinella ghisottii*; concerning the genus name *Folinella*, cf. evaluation. Van Aartsen (1984, 1985) indicates the differences between the fossil *Rissoa canaliculata* Philippi, 1836, and the Recent species under discussion, which implies that this name cannot be used for the latter.

Differential diagnosis. — The problems caused by resemblance with some *Alvania* species, e.g. *A. fischeri* (Jeffreys, 1884), is solved by the presence of the typically coiled, intorted protoconch of *C. ghisottii* and its tooth.

C. ghisottii can also easily be distinguished from *C. excavata*, the last species is much more slender/cylindrical (B/b 1.2 versus 2.0 at equal length). Furthermore, the spiral ridges above the aperture of *C. excavata* are more protruding, and the penultimate whorl has only two spiral cords versus three in *C. ghisottii*.

Material examined (locality and number of specimens). — France: Bouches-du-Rhône, Sausset-les-Pins/1 (MK).

Italy: Foggia, Gargano peninsula/2 (LH); Taranto, Torre d'Ovo /1 (LH); Sicily, Gandoli/1 (NNM).

Yugoslavia: Croatia, Rovinj/1 (PO), Baniči/7 (EH), Slano/11 (EH).

Greece: Athens, Lagonisi/1 (LH).

Distribution. — A rather rare species, only known from the Mediterranean.

Chrysallida canariensis Nordsieck & Talavera, 1979
(fig. 61)

Chrysallida canariensis Nordsieck & Talavera, 1979, Moluscos marinos de Canarias y Madera (Gastropoda) 185, pl. 45 fig. 9.

General description (after 138 shells from 3 localities). — The shape of the shell is very constant, ovoid-conical. It gives an impression of a small, slender *Alvania leacocki* (Watson, 1873). The protoconch is of type B, covered with five relatively pronounced spiral threads, like those of some *Manzonina* species from the Canary Islands (e.g. *M. madeirensis* or *M. pelorum*, both Moolenbeek & Faber, 1987), a rather uncommon feature for *Chrysallida*. There are four straight teleoconch whorls, the last one is high. The suture is deep and wide, only slightly oblique. Above the aperture, the ribs dissolve into rows of knobs in a somewhat prosocline direction. The interstices are almost absent. Around the upper side of the aperture, the ribs abruptly change into thin lines, between the spiral ridges present there. The initial whorls all have four spiral cords, consisting of the same tubercles as the ribs have, in fact the almost conjugating semispherical knobs are the only representatives of both ribs and spiral ridges. On the last whorl, between the adapical suture and the upper edge of the aperture, there are four tuberculated spiral cords. Below these, towards the base of the shell, there are about five more smooth and broad spiral ridges (broader than the intervals), fading away to the base. The aperture is egg-shaped, the outer lip is S-shaped in profile. The tooth is only visible after turning the shell. There is no umbilicus.

Length 2.0-2.4 mm, LW 62-66%, A 37-39%, LW 2.1-2.3, B/b 1.8-1.9 (based on 5 shells).

Differential diagnosis. — There is some resemblance with *Alvania*. For the differences, cf. *C. ghisottii*. Because the close-set large tubercles, there is no confusion possible with other *Chrysallida*. The only species with spiral lines on the protoconch, *C. moolenbeeki*, has a completely different appearance.

Material examined (locality and number of specimens). — Canary Islands: Fuerteventura, Corralejo/2 (LH); Hierro/6 (NNM); Tenerife, Playa de las Americas/130 (LH, MK, PO).

Distribution. — Only known from shallow water around the Canary Islands.

Chrysallida moolenbeeki Amati, 1987
(fig. 62)

Chrysallida moolenbeeki Amati, 1987: Conchiglia 19 (204-205): 3-6, fig. 5-8.

General description (after 19 shells from 1 locality). — The shell is small, conical, with a blunt top. The protoconch is of type B, covered with four relatively heavy spiral ridges. There are two-and-a-half to almost four slightly convex teleoconch whorls, on the upper and lower side abruptly bending inwards. This gives the shell a somewhat turreted profile. The suture is deep and variably oblique (sometimes nearly horizontal, sometimes strongly inclined). The ribs are narrow, dependent on their number, the interstices are as broad as, or narrower than, the ribs. These are vertical or a little prosocline, on all whorls somewhat curved, and fading on the periphery of the last whorl. The initial whorls have one spiral ridge, just above the abapical suture (occasionally a second spiral line is visible, hidden in the suture of the penultimate whorl). The last whorl has two spiral ridges, the lower one on the same level as the upper edge of the aperture. The aperture is oval-spherical; the insignificant tooth-pleat is only visible after turning the shell. There is sometimes a faint umbilical slit.

Length 1.3-1.6 mm, LW \pm 60%, A \pm 35%, L/B \pm 2.2, B/b \pm 1.6 (based on 3 shells).

Discussion. — From this rare and, as far as we know, local species, there are only three adult shells (\geq 1.3 mm) available, so that the ratios could be assessed only approximately.

Differential diagnosis. — There are only two European *Chrysallida* with spiral threads on the protoconch; however, *C. canariensis* is completely different, *Alvania*-like.

C. moolenbeeki with a damaged protoconch is hardly separable from *C. penchynati* (cf. figs. 34 and 62). The latter species has a somewhat straighter profile, on the last whorl the ribs continue more and much clearer to the base, and, because *C. penchynati* has a narrow aperture, the shape of the shell seems to be more slender.

There is only a superficial resemblance with *C. emaciata*, because this shell is much more slender, cylindrical, has more convex whorls and many spiral striae on the base of the last whorl.

Material examined (locality and number of specimens). — Italy: Livorno, Isola di Capraia, depth 300 m/19 (HA,ZMA).

Distribution. — Tyrrhenean Sea, dredged at a depth of 30-300 m.

EVALUATION

The foregoing clearly shows that the determination of the various *Chrysallida* species is not possible by using ratios only. Although there are consistent differences in particular ratios between some species, there is a lot of variation and a combination with other characters is to be preferred. In case the ratios or percentages in different species need to be compared to each other, shells of about the same length should always be used. For example, a juvenile *C. juliae* (L 1.1 mm) has an LW of about 65%, and a large *C. sarsi* (L. 2.7 mm) an LW of 52%. There is a small overlap in LW values for the two species, viz. 52-56%, which, however, in *C. sarsi* only occurs in the largest

(2.5-2.7 mm) specimens, and in *C. juliae* only in the smallest shells measured (1.9-2.1 mm).

The order in which the species are described above is only chosen for practical reasons, making it easier for the reader to compare the species with more or less corresponding characters. We do not want to create the impression that these species are also closely related. However, in some cases, relationship must not be excluded.

The name *Chrysallida* has been used on purpose; many other authors have used names like *Folinella* (*Ividella?*), *Partulida* and *Tragula* for *C. excavata*, *C. spiralis*, and *C. fenestrata*, respectively. Probably with the same right other very different (from what?) species could be placed in other nominal genera, like *C. canariensis* because of the distinctive sculpture and the spirals on the protoconch, or *C. doliolum* because of the presence of colour bands and the absence of any spirals, or *C. maiiae* because of the unique shape. It would only make the confusion greater.

We are of the opinion that a further subdivision of the genus *Chrysallida* s.l. only becomes significant when more knowledge of the animals is obtained, like their way of reproduction and anatomy, their way of life and their possibly specific host species, etc. Once we have a better understanding of all these aspects, it may even be conceivable that the presently used name *Chrysallida* has to be replaced.

ACKNOWLEDGEMENTS

The foregoing could not have been written without the assistance of many people. In the first place we commemorate our friend W.M. Wagner, who died in August 1991 after suffering from a wasting disease. He was the fellow-author of this article, which was already in an advanced stage at the time of his death. Until the end his constructive enthusiasm has been a great stimulant to us. His explicit wish, not to be mentioned as a posthumous co-author has to be respected by us.

We thank Mr H.J. Hoenselaar, Mr H.P.M.G. Menkhorst and Mr W. van Putten, as well as the Nationaal Natuurhistorisch Museum, the Zeemuseum Scheveningen and the Zoölogisch Museum Amsterdam for the loan of often valuable material.

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We hope that, also by all their exertions, this article will enable the reader to determine the described *Chrysallida* species more easily, and that this will lead to further studies on this fascinating part of malacology.

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EXPLANATION OF FIGURES 13-62

Figs. 13-14. *Chrysallida doliolum* (Phil., 1844); 13, a very cylindrical shell, L 2.2 mm, France, Alpes Maritimes, Antibes (LH); 14, a more conical specimen, L 2.6 mm, ibidem (LH). Fig. 15. *C. doliolum* s.l., a forma (?) with two colour bands on the last whorl, L 3.4 mm, Yugoslavia, Croatia, Banići (EH). Figs. 16-17. *C. jeffreysiana* (Monts., 1884), L 3.2 and 2.6 mm respectively, Canary Is., Lanzarote, Arrecife (LH). Figs. 18-19. *C. spiralis* (Mont., 1803), two different forms from one locality, L 2.7 and 2.3 mm respectively, Norway, Trondheimfjord, Grande Viken (MK). Fig. 20. *C. brusinai* (Cossm., 1921), note the deeply excavated suture and the broad interspaces between the spiral ridges, next to the aperture, L 1.9 mm, Spain, Taragona, San Carlos (LH). Fig. 21. *C. emaciata* (Brus., 1866), note the spiral striae on the base of the shell and the convex whorls, L 2.1 mm, France, Var, Le Brus (LH). Fig. 22. *C. suturalis* (Phil., 1844), almost flat whorls and ribs close together, L 2.3 mm, ibidem (LH). Figs. 23-24. *C. terebellum* (Phil., 1844); 23, L 4.1 mm, Yugoslavia, Croatia, Vrsar (EH); 24, the Atlantic form is very *Turbonilla*-like, L 3.0 mm, France, Côtes-du-Nord, St. Jacut (LH). Figs. 25-26. *C. interspatiosa* n. sp.; 25, holotype (NNM 56612), L 2.4 mm, Azores, S. of São Miguel, depth 480 m; 26, paratype (NNM 56613), L 1.5 mm, ibidem.

Figs. 27-29. *C. nanodea* (Monts., 1878), different forms; 27, the ribs on the last whorl are clearly flexuous and on the initial whorls inclined (note the second spiral ridge in the abapical suture of the penultimate whorl), L 3.5 mm, Spain, Taragona, San Carlos (MK); 28, the ribs are nearly straight and vertical, L 2.8 mm, ibidem (MK); 29, an intermediate form with vertical and flexuous ribs, L 2.2 mm, Yugoslavia, Croatia, Slano (EH).

Figs. 30-32. *C. obtusa* (Brown, 1827), this species is very variable in shape and rib-pattern; 30, L 2.2 mm, Spain, Cadiz, Gétarès (MK); 31, L 2.5 mm, Norway, Trondheimfjord, Grande Viken, depth 50-100 m (MK); 32, L 2.3 mm, Yugoslavia, Croatia, Slano (EH). Fig. 33. *C. intermixta* (Monts., 1884), note the spiral striae between the prosocline ribs with broad interstices; the spiral striae on the base are exceptional and very vague, L 2.4 mm, France, Alpes-Maritimes, Antibes (LH). Fig. 34. *C. penchynati* (B., D. & D., 1883), a small species clearly different from *C. obtusa*, L 1.8 mm, ibidem.

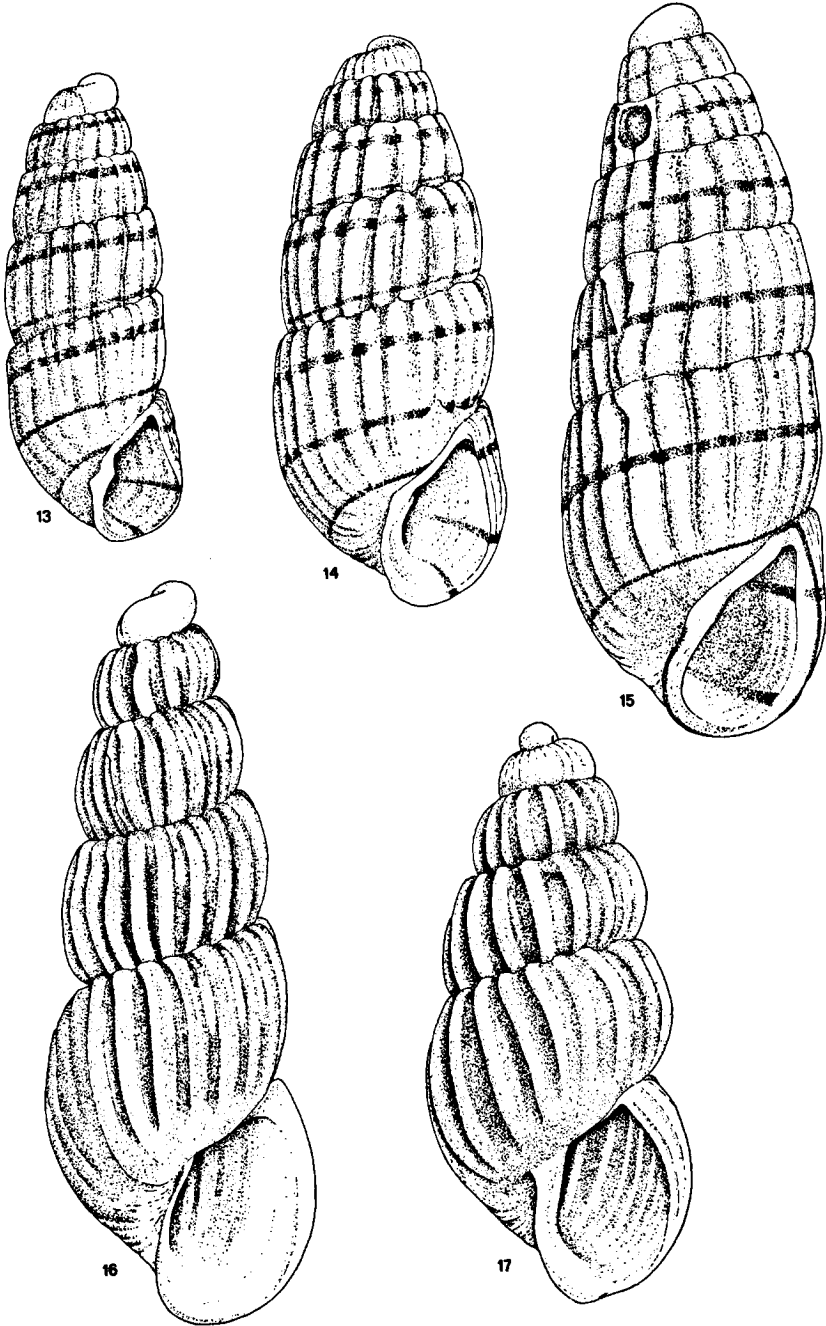
Fig. 35. *C. eximia* (Jeffer., 1849), L 2.0 mm, Norway, Trondheimfjord, Grande Viken (MK). Fig. 36. *C. clathrata* (Jeffer., 1848), note the higher initial whorls and broader ribs as compared to *C. eximia*, L 2.5 mm, France, Bouches-du-Rhône, Lauron (LH). Fig. 37. *C. colungiana* Nordsieck, 1972, L 2.7 mm, Adriatic Sea, depth 110 m (ZMA). Figs. 38-39. *C. limitum* (Brus., 1879); 38, a very characteristic specimen, L 3.1 mm; 39, L 2.7 mm, both Israel, Haifa Bay (LH).

Fig. 40. *C. spec. A*, a very tall and slender species, apparently different from *C. limitum*, L 4.3 mm, Israel, Haifa Bay (LH). Fig. 41. *C. spec. C*, a small (juvenile) shell with very widely spaced ribs and spiral ridges, L 1.3 mm, Turkey, Mersin (LH). Fig. 42. *C. spec. D*, L 2.1 mm, Egypt, Red Sea (LH). Figs. 43-45. *C. indistincta* (Mont., 1808); 43, a specimen with almost flat whorls and straight and vertical ribs, L 1.8 mm, Yugoslavia, Croatia, Slano (EH); 44, the 'real' *C. indistincta*, note the largest breadth of the whorls just above the abapical sutures, L 2.7 mm, Spain, Santander, Laredo (LH); 45, an intermediate form, L 2.2 mm, Yugoslavia, Croatia, Slano (EH).

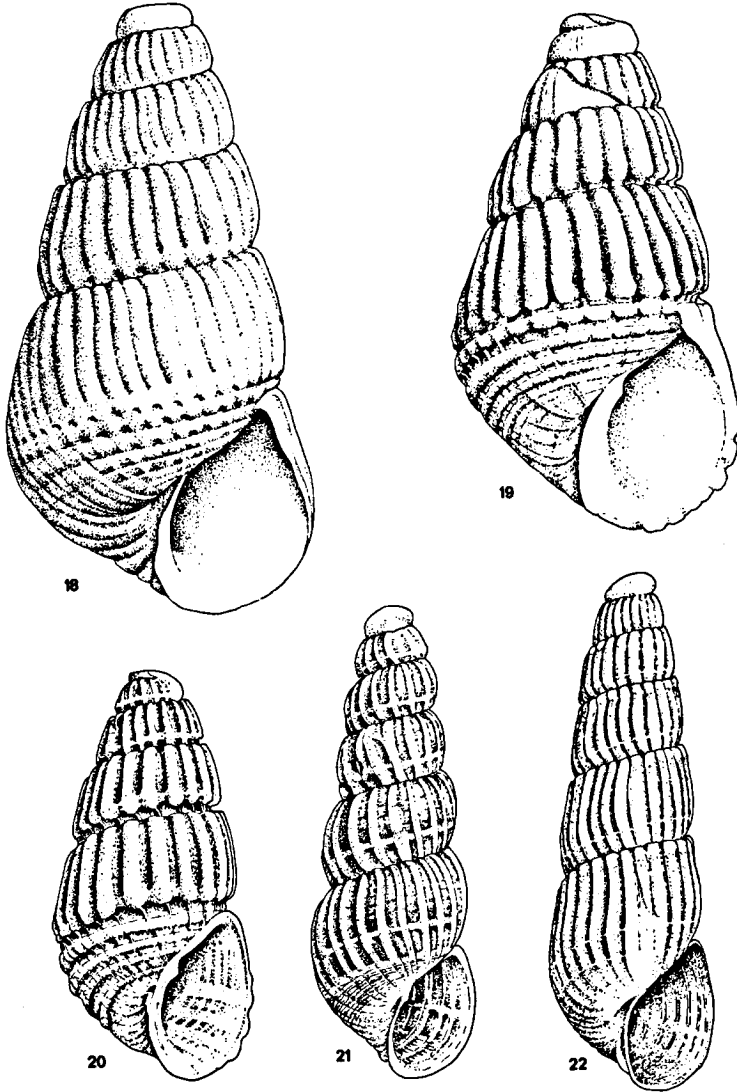
Figs. 46-47. *C. sarsi* Nordsieck, 1972; 46, L 2.5 mm, the Netherlands, Zuid-Holland (LH); 47, L 2.2 mm, Spain, Santander, Laredo (MK). Figs. 48-49. *C. juliae* (De Folin, 1871); 48, this shell is of about the same length as *C. sarsi* (cf. fig. 46), the last whorl is clearly shorter, L 2.3 mm, Spain, Santander, Laredo (LH); 49, a small specimen (identification is only conclusive after comparison with *C. sarsi* of about the same length), L 1.8 mm, Spain, Taragona, San Carlos (MK). Fig. 50. *C. decussata* (Mont., 1803), the oval-conical shell, the rather pointed top and the large last whorl make identification easy, L 2.4 mm, France, Morbihan, Penthièvre (LH).

Figs. 51-52. *C. stefanisi* (Jeffer., 1869); 51, L 1.5 mm, Italy, Sicily, Sciacca (NNM); 52, a fossil specimen, L 2.4 mm, Belgium, Antwerp, Pliocene (NNM-RGM 229.802). Fig. 53. *C. interita* nom. nov., L 3.2 mm, Germany, Westfalen, Dingden, Miocene (NNM-RGM 229.801). Fig. 54. *C. maiae* (Horn. & Merm., 1924), a very characteristic shape; in contrast to the two preceding species, the spiral ridges do not cross the ribs, L 3.3 mm, Israel, Haifa Bay (LH). Fig. 55. *C. sigmoidea* (Monts., 1880), the shell is cylindrical and has a very obtuse top; the spiral striae are barely visible, L 3.0 mm, Portugal, Algarve, Praia da Rocha (LH). Fig. 56. *C. fischeri* (Horn. & Merm., 1925), L 2.2 mm, Egypt, Red Sea (NNM).

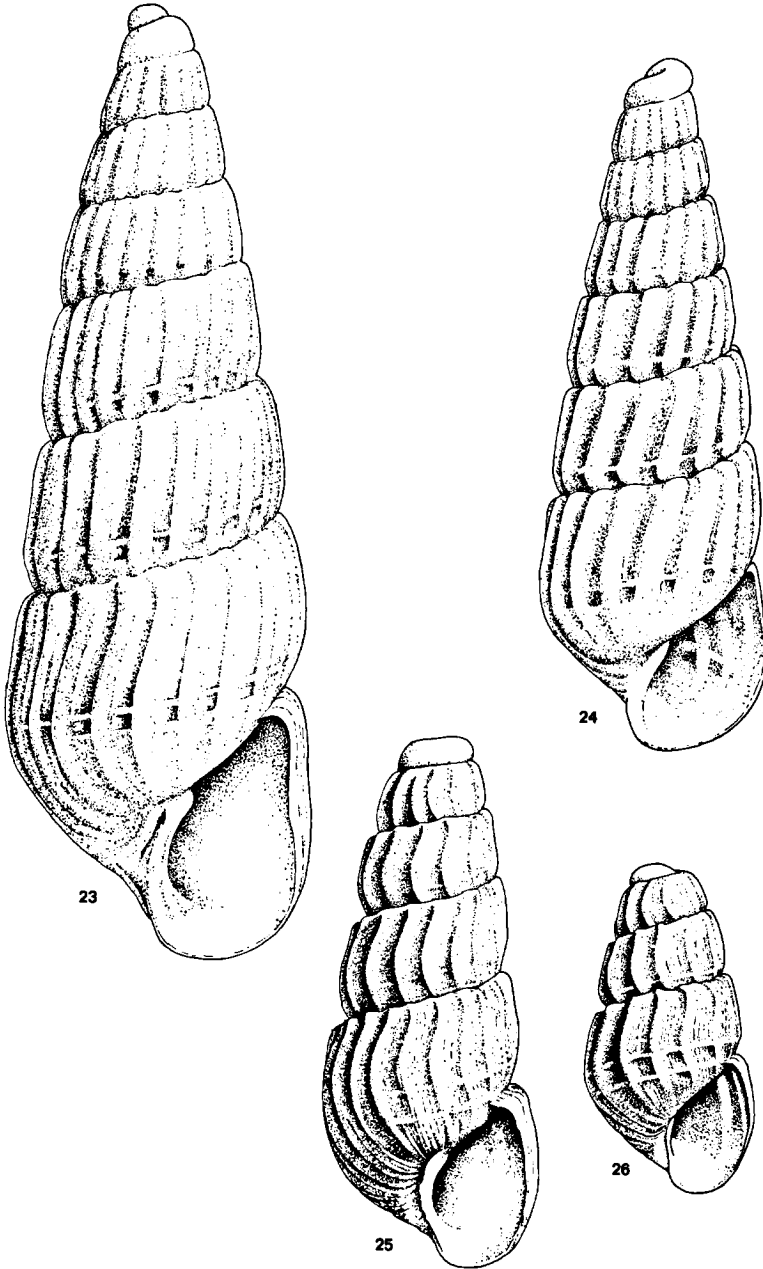
Fig. 57. *C. fenestrata* (Jeffr., 1848), note the pointed top and the less coiled protoconch (cf. fig. 58), L 2.7 mm, Spain, Santander, Laredo (LH). Figs. 58-59. *C. excavata* (Phil., 1836); 58, L 1.9 mm, Spain, Murcia, Cartagena (PO); 59, L 3.2 mm, Yugoslavia, Croatia, Baniči (EH). Fig. 60. *C. ghisottii* (Van Aartsen, 1984), the shell is more compact than *C. excavata* and has more spiral ridges; LW and A are higher, L 2.6 mm, Yugoslavia, Croatia, Slano (EH). Fig. 61. *C. canariensis* Nords. & Talavera, 1979, an *Alvania*-like appearance and spiral ridges on the protoconch, L 2.4 mm, Canary Is., Tenerife, Playa de las Americas (MK). Fig. 62. *C. moolenbeeki* Amati, 1987, the only remarkable features of this species are the spiral ridges on the protoconch, L 1.6 mm, Italy, Livorno, Isola di Capraia, depth 300 m (ZMA).



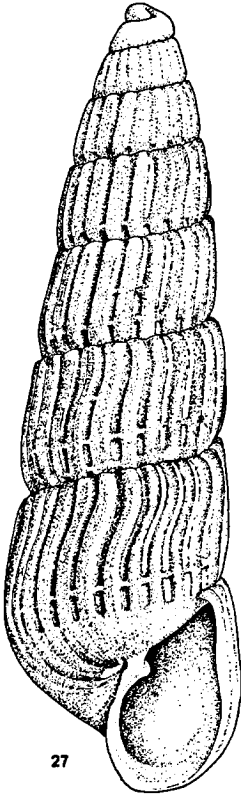
13-15, *C. doliolum*; 16-17, *C. jeffreysiana*.



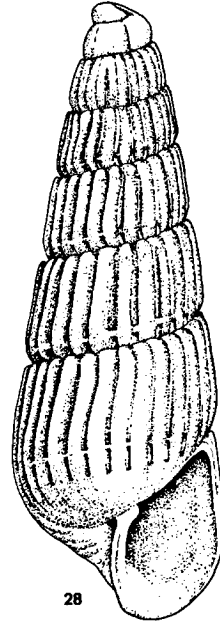
18-19, *C. spiralis*; 20, *C. brusinai*; 21, *C. emaciata*; 22, *C. suturalis*.



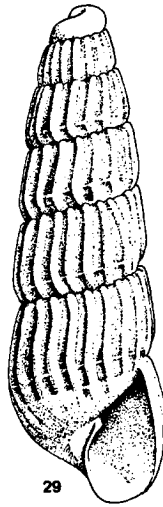
23-24, *C. terebellum*; 25-26, *C. interspatiosa*.



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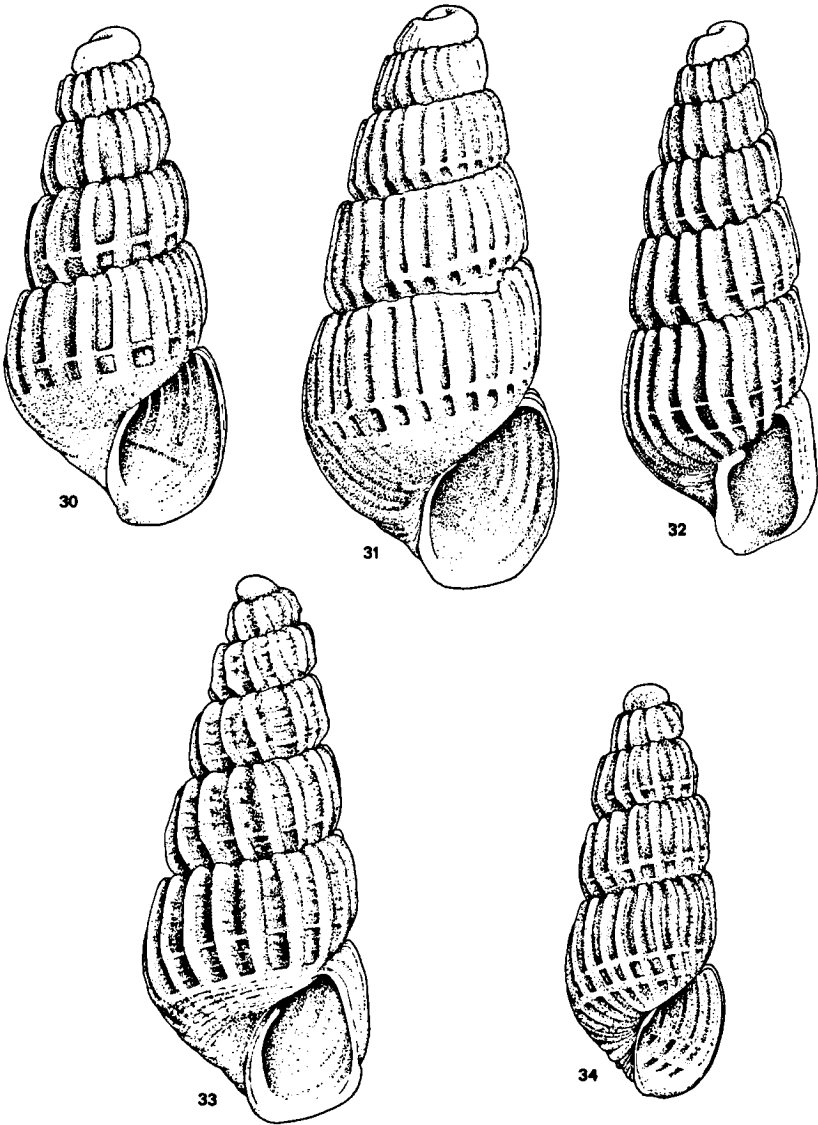


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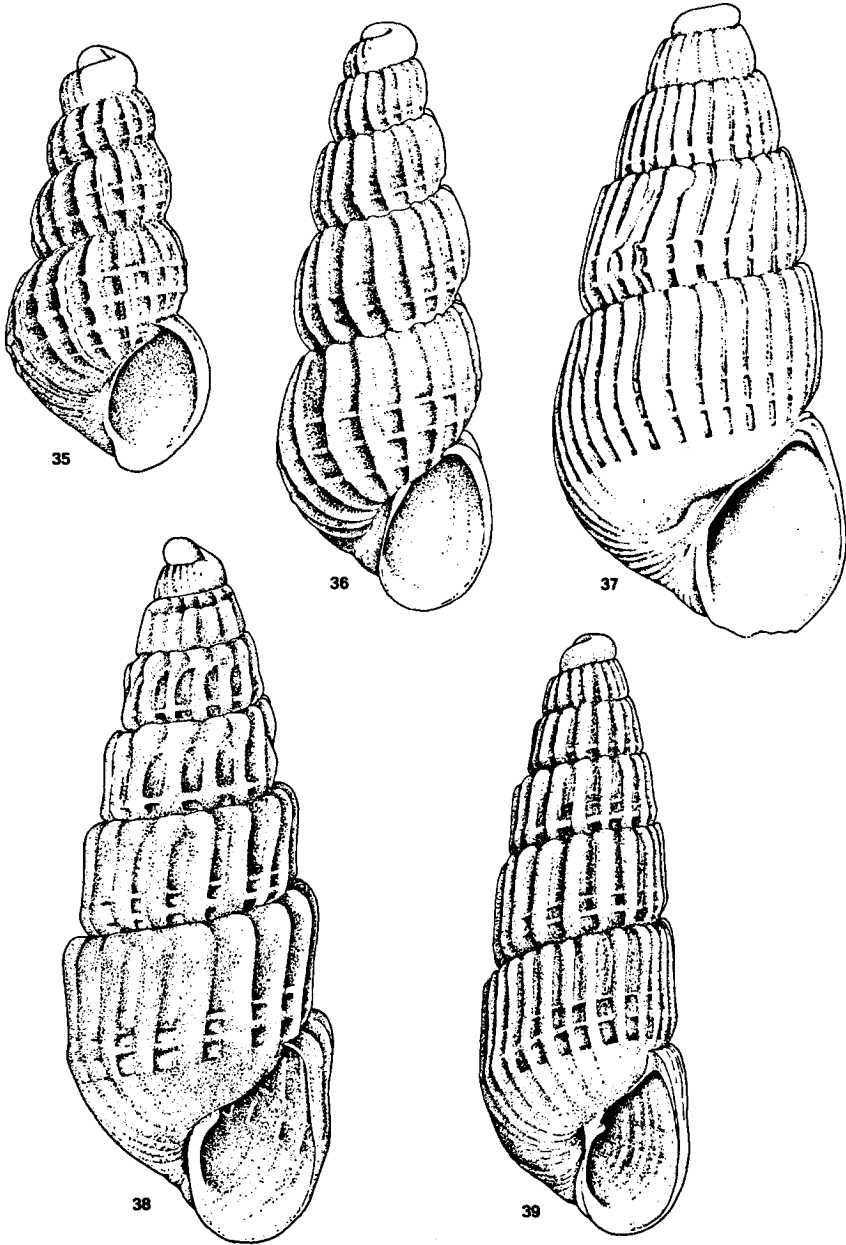


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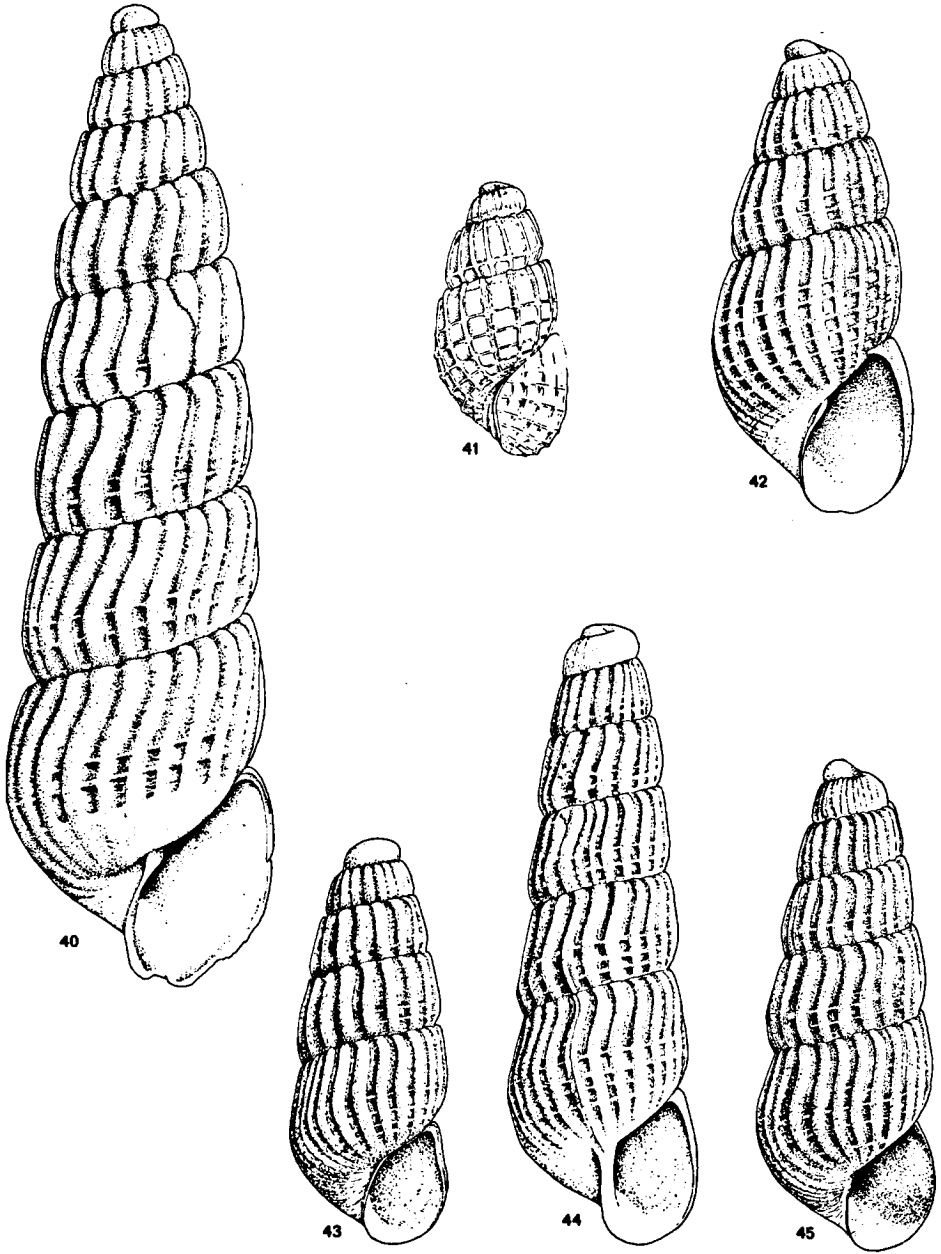
27-29, *C. nanodea*.



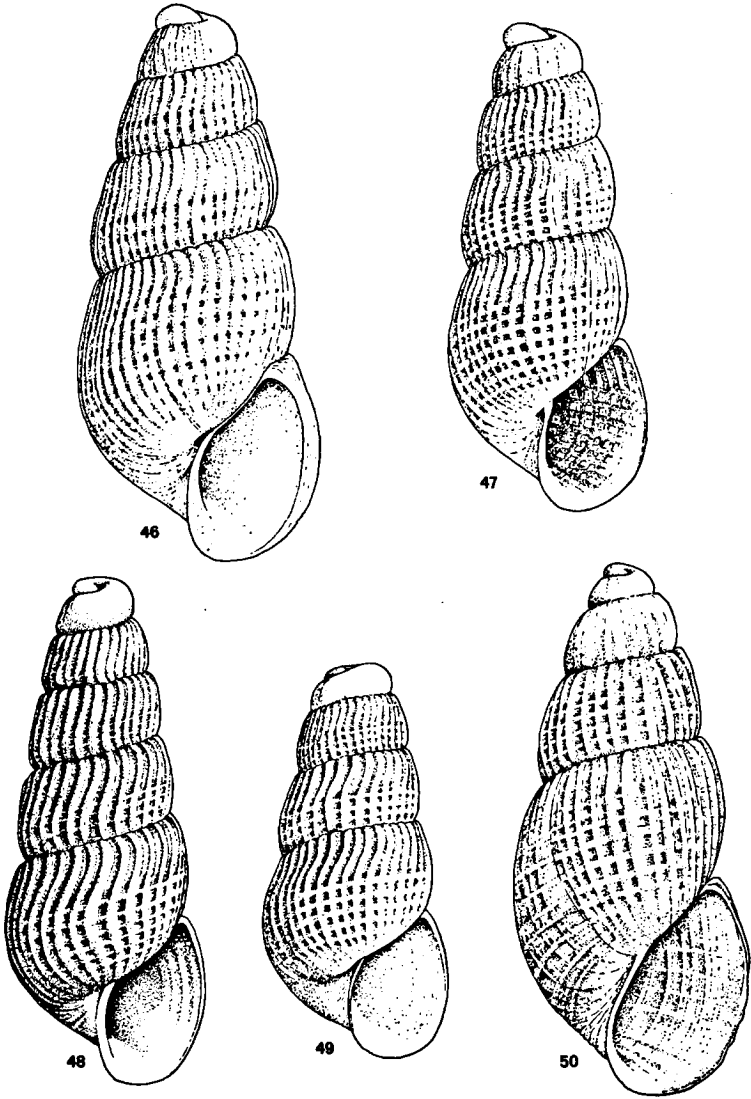
30-32, *C. obtusa*; 33, *C. intermixta*; 34, *C. penchynati*.



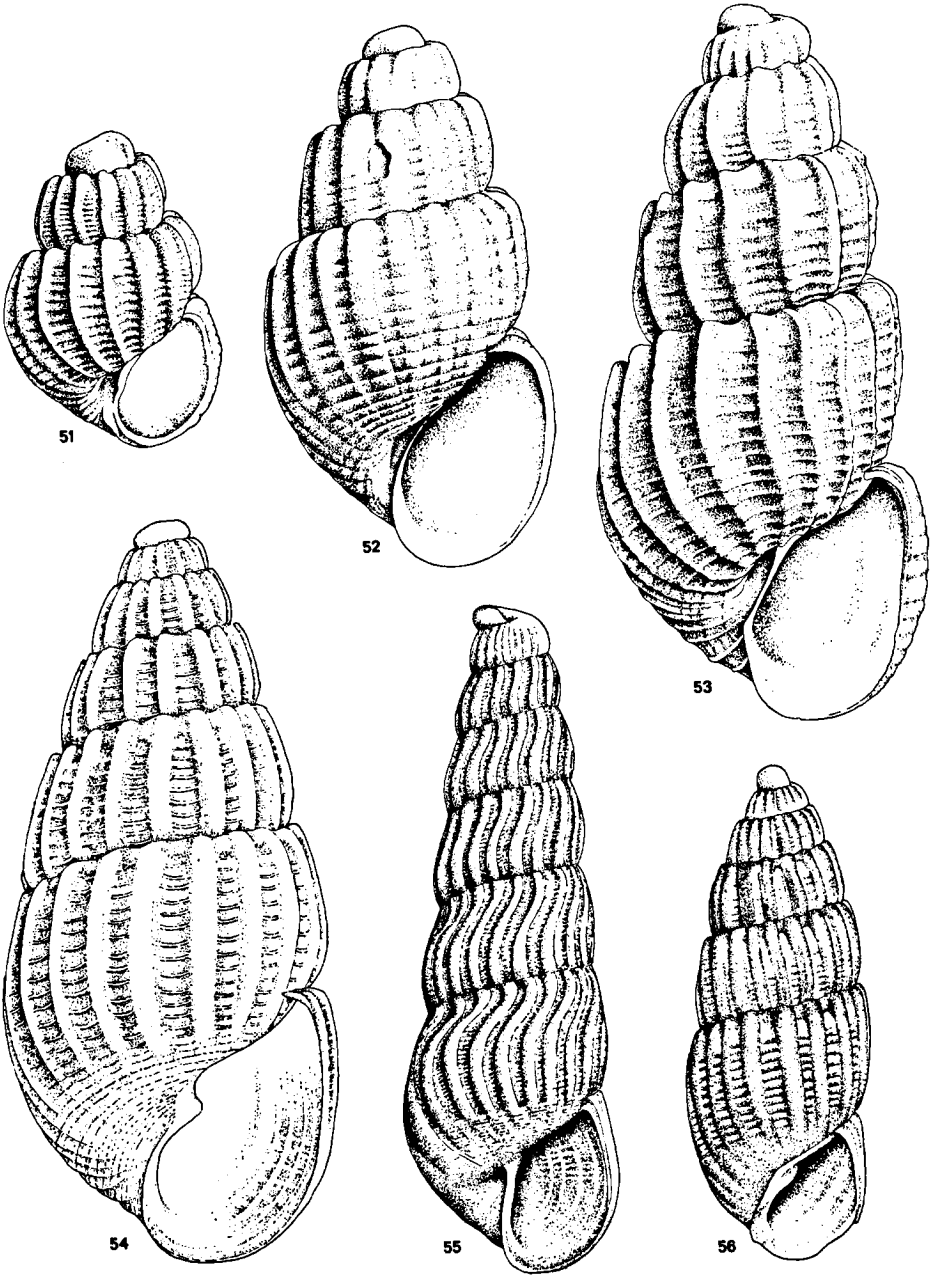
35, *C. eximia*; 36, *C. clathrata*; 37, *C. colungiana*; 38-39, *C. limitum*.



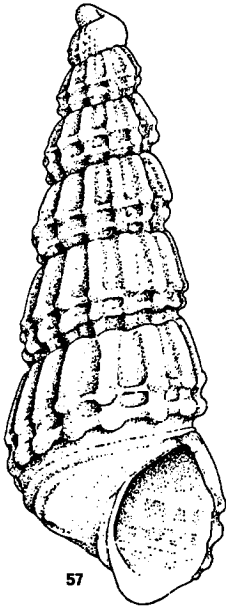
40, *C. spec. A*; 41, *C. spec. C*; 42, *C. spec. D*; 43-45, *C. indistincta*.



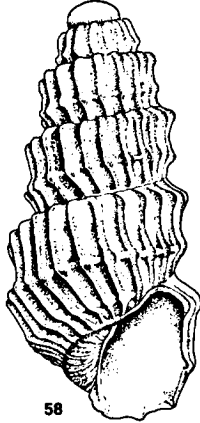
46-47, *C. sarsi*; 48-49, *C. juliae*; 50, *C. decussata*.



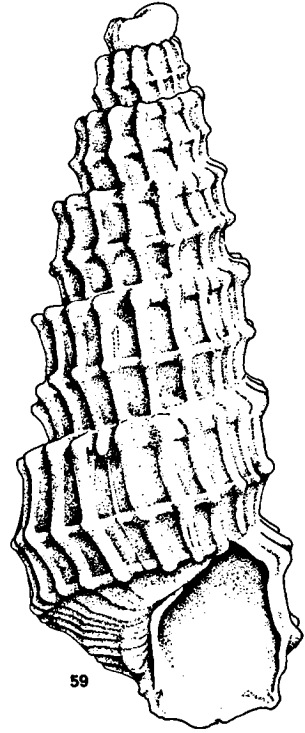
51-52, *C. stefanisi*; 53, *C. interita*; 54, *C. maiae*; 55, *C. sigmoidea*; 56, *C. fischeri*.



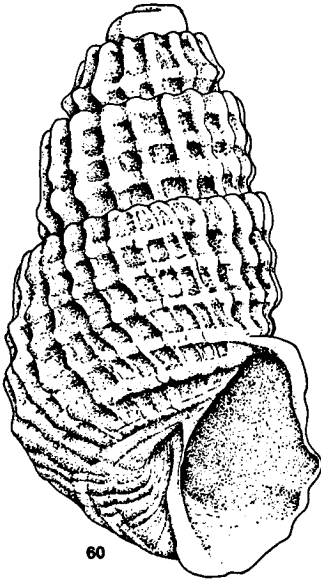
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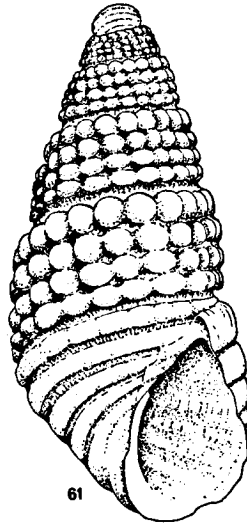
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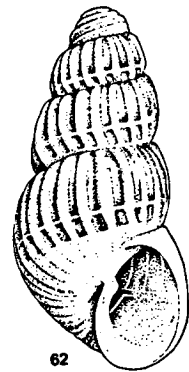
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57, *C. fenestrata*; 58-59, *C. excavata*; 60, *C. ghisottii*; 61, *C. canariensis*; 62, *C. moolenbeeki*.