

On the systematics of recent Rissoa of the subgenus
Turboella Gray¹, 1847, from the Mediterranean and
European Atlantic coasts

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¹ For footnote 1 p.t.o.

ABSTRACT

This paper is a critical evaluation of part of the subgenus *Turboella* of the genus *Rissoa*. The species *R. parva* (da Costa), *R. inconspicua* Alder, *R. dolium* Nyst, *R. radiata* Ph., *R. lineolata* Mich., *R. pulchella* Ph., *R. benzi* (Arad. & M.), *R. margimimia* (Nords.), *R. munda* (Monts.), and *R. marginata* Mich. are retained. The variability of these species is discussed and illustrated. There are two pairs of sibling species: *R. radiata* and *R. munda*; *R. pulchella* and *R. marginata*. The partners of each pair are often separable only by the apical dimensions.

The identity of *R. ebrenbergi* Ph., *R. simplex* Ph. and *R. obscura* Ph. remains unknown.

R. radiata balkei n. subsp. is described from the Atlantic coast between W. Africa and Bretagne, France.

¹ In contrast to what Coan (1964: 166) implies, *Turboella* Leach (in Gray, Oct. 1847: 271) is not an available name. It was published without description, definition or indication as required by Art. 12 of the International Code of Zoological Nomenclature. According to Sherborn (Index Animalium) the specific names arranged by Leach under *Turboella* are all nomina nuda; except for *T. rufilabris* none of them is accompanied by a reference or author's name, while "*T. rufilabris* Risso" must be a lapsus as Risso never published this name, nor any other generic name combined with the specific epithet *rufilabris*. Coan selected "*T. calathriscus* (Montagu, 1803)" as the type of *Turboella* Leach, 1847, implying that Leach's *Turboella calathriscus* is a new combination for *Turbo calathriscus* Montagu, 1803. In the first place Leach gave no indication whatever that his *Turboella calathriscus* had been described before, and secondly, Montagu spelled the specific epithet of his species *calathriscus* without an *r*. It seems altogether justified therefore to follow Sherborn and consider all of the specific names cited by Leach under *Turboella* nomina nuda, and thus *Turboella* Leach, 1847, is an unavailable name.

Turboella Gray (Nov. 1847: 152), however, is an available name, having the type species *Turbo parva* Montagu by original designation. The generic name *Sabanaea* Leach (in Gray, Oct. 1847: 270) is also an available name as, although it was published without description or definition, it was accompanied by an indication, viz., the names of previously published species that were included by Leach in this genus. Gray (Nov. 1847: 152 and 159) mentioned the genus several times as *Sabanea* but made no type selection for it. Von Frauenfeld's words (1867: 12) cannot be considered a designation of *S. flammea* Frauenfeld, 1867, or *Rissoa fulva* Michaud, 1832, as type species of *Sabanaea* Leach. Besides, it would not have been a valid designation because neither specific name was originally included in *Sabanaea*. For the same reasons *R. parva* (da Costa) cannot be accepted as type species of *Sabanea* Leach (as incorrectly spelled by M.) on the basis of Monterosato's words (1843: 138). So far as I know no valid type selection has ever been made for the genus, and therefore I now select *Turbo cingillus* Montagu, 1803, as the type species, so that *Sabanaea* Leach, 1847, becomes a junior objective synonym of *Cingula* Fleming, 1828.

Without further explanation, Nordsieck (1968: 51) classified *Turboella* as a full genus, which he subdivided later on into six subgenera (1972a: 195 ff.). In my opinion his genus *Turboella* contains at most 20 good species, which are so closely allied that it seems useless to arrange them in subgenera. I therefore prefer to consider *Turboella* a subgenus of the genus *Rissoa*.

The systematic position of *R. interrupta* (Adams) in respect to *R. parva* is discussed, but could not be established.

By subsequent designation of *Turbo cingillus* Montagu, 1803, as type species, the genus *Sabanaea* Leach, in Gray 1847, is made a junior objective synonym of *Cingula* Fleming, 1828.

INTRODUCTION

If, for one reason or another, insufficient attention has been paid to the stability and specificity of the characters, a systematic chaos may result within a group of very similar and variable taxa. The only way out of such a chaos is the examination of as much material of the group as possible, in order to decide what taxa should really be distinguished. Afterwards the proper names can be established. This paper is the result of such an approach with regard to part of the subgenus *Turboella*.

A fully unexpected outcome of the investigation was the discovery of sibling species², of which the shells can only be separated reliably by the dimensions of the embryonic whorls. That the sibling partners really are reproductively isolated, is strongly suggested by the following arguments. (1) There seem to be no specimens with intermediate apical dimensions. (2) The geographical variability shows marked differences. On the one hand the partners are often very similar where they occur together, notwithstanding differences between populations from different locations. On the other hand, the partner with a coarse apex possesses a number of local, but seemingly not geographically isolated forms, which are unknown in the partner with a fine apex. Often, the latter is rare or absent at those localities. (3) Occasionally, striking differences in the local variability of two sibling partners do occur where they are found together.

Afterwards, I learned that in 1968 Mrs. N. Rehfeldt had already pointed out that in the Roskildefjord in Denmark two "types" of *Rissoa membranacea* (J. Adams, 1800) must be distinguished, of which the shells are very similar, but which show differences in the apical dimensions identical to those found in the sibling species discussed above. Moreover, she found remarkable differences as regards the larval phase of both "types", of which the one with a coarse apex has no pelagic larval phase, in contrast to that with the fine apex. It stands to reason that, if within the genus *Rissoa* the presence of a coarse apex were generally correlated to the absence of a pelagic larval phase, and

² Sibling species are sympatric forms which are morphologically very similar or indistinguishable, but which possess specific biological characteristics and are reproductively isolated (Mayr, 1964: 200).

the other way round, this would neatly explain the apparently greater effectivity of geographical isolating mechanisms within species with a coarse apex. However, this is just speculation³.

It is a pleasure to thank most gratefully all those who made their collections available or assisted in other respects. To the director and staff of the Rijksmuseum van Natuurlijke Historie at Leiden I am obliged for their hospitality. Of these I want to make special mention of Dr. E. Gittenberger for his ample and valuable advice, and of Prof. Dr. L.B. Holthuis for solving a complicated nomenclatorial problem. I wish to thank Mrs. Dr. W.S.S. van der Feen-van Benthem Jutting and Dr. A.C. van Bruggen for criticism of the manuscript.

MATERIAL AND METHODS

- I adhered as strictly as possible to the systematic concept advocated by Mayr (1964: 106, 120).
- The investigation was solely based on dry material.
- The following collections were studied: (1) Ph. Dautzenberg's, now in the Institut Royal des Sciences Naturelles de Belgique, Bruxelles⁴; (2) Naturhistorisches Museum, Wien, including Schwartz von Mohrenstern's material; (3) Natur-Museum Senckenberg, Frankfurt/Main; (4) Rijksmuseum van Natuurlijke Historie, Leiden; the private collections of (5) Dr. J.J. van Aartsen, (6) Mrs. M.C. Fehr-de Wal, (7) Mr. M.C. Cadée, and (8) of myself; a few specimens Dr. F. Nordsieck lent to me.
- I originally supposed that *R. dolium*, *R. parva* (incl. *R. interrupta*), *R. lineolata*, and *R. inconspicua* were well-delimited taxa. Consequently, I intended to study only a restricted amount of material of these species. Later on, when I realized that it was necessary to study more material of some of them, it was too late to make up for this omission. I hope to do this in due time.

TERMINOLOGY

A few terms used in the text are illustrated in figs. 1 and 2. Attention should be paid to how the number of whorls has been

³ Judging from the figures, Richter & Thorson (1975: 124-126, pl. 2 figs. 6-8) indeed did find no veligers of the genus *Rissoa* with a coarse apex in the plankton of the Golfo di Napoli.

⁴ The spelling of geographical names is as recommended by the Times Atlas of the World.

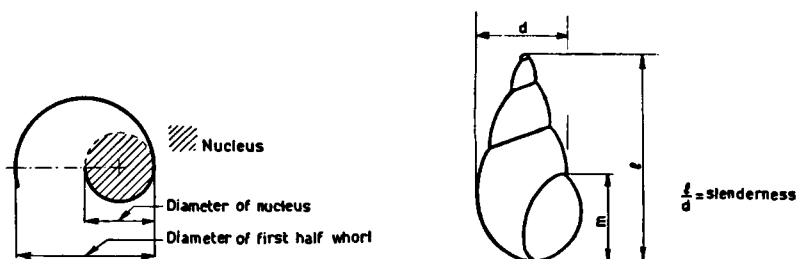


Fig. 1. Nucleus and first half whorl. Fig. 2. Main dimensions and slenderness.

counted and the slenderness has been measured. The slenderness is defined in such a way that the interference of the variable thickness of the labial rib is excluded from the measurements.

Shells which are still in possession of a periostracum are termed fresh; those which are not, dead.

The number of ribs per whorl has always been counted on one full turn, ending at the last rib before the labial one.

Successive states of convexity of whorls, i.e. of the contour of a whorl including ribs, are indicated by the terms flat (compare plate VI, no. 3a), slightly (pl. VIII, no. 3c), moderately (pl. VIII, no. 1b), distinctly (pl. III, no. 4b) and very convex (pl. I, no. 5b).

OBSERVATIONS AND RESULTS

Rissoa parva (da Costa, 1778) and *Rissoa interrupta* (Adams, 1798)

Though at many localities intermediate forms can be found, these by no means convey the impression that they belong to a real common gene-pool with both *R. parva* and *R. interrupta*. In order to illustrate this point, I analyzed a large sample from Quiberon, Bretagne, France (coll. 8). First, completely ribless specimens were extracted from the sample. According to current opinions, these represent *R. interrupta*. They comprised about 23% of the whole sample. The remaining specimens were, to the best of my ability, split up into *R. parva* (about 60%) and intermediates (about 17%). Specimens with well developed, regular ribs on the lower whorls with a gradual transition to the ribless upper whorls, were identified as *R. parva*. The intermediates are characterized by faint ribs and/or irregular ribs and/or a conspicuously low number of

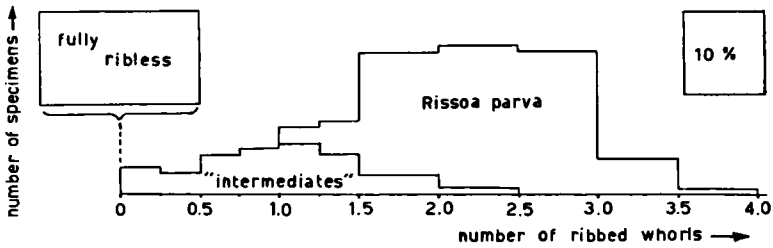


Fig. 3. Sample consisting of *Rissoa parva* (da Costa) and *Rissoa interrupta* (Adams), Quiberon, Bretagne, France.

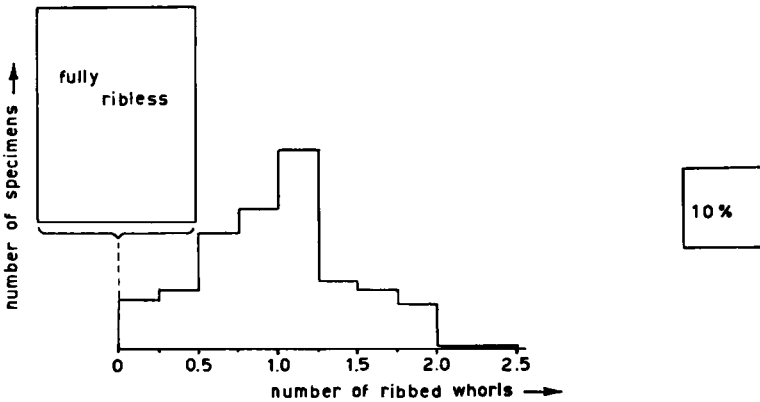


Fig. 4. *Rissoa interrupta* (Adams), Gullmarfjord, Sweden.

ribbed whorls and/or abrupt transitions in the ribbing and/or by the ribs ending at about half a whorl or more before the labial rib. Next, the number of ribbed whorls of both the intermediates and *R. parva* was counted. The results are presented in fig. 3. The appearance of a pronounced discontinuity at 1.5 ribbed whorls supports the presumed existence of a borderline between intermediates and *R. parva*, thus singling out rather convincingly the latter as truly separated from the rest.

The systematic position of the intermediates became only clear when I examined a sample from Gullmarfjord, Sweden (coll. 4). This sample, ribbed specimens as well as ribless ones, obviously belongs entirely to only one species. It differs also in other respects from the sample from Quiberon. Not only is the average number of ribbed

whorls considerably lower, but the ribs are also less prominent and somewhat more close-set (see plate I, nos. 1 and 2). Fig. 4 shows the number of ribbed whorls in the sample from Gullmarfjord. The similarity between this graph and the parts of fig. 3 which relate to both the completely ribless specimens and the intermediates, is most striking. This suggests that *R. interrupta* is a separate species, of which the pattern of variability shown in fig. 4 is representative. The existence, in northern seas, of populations which completely lack ribbed individuals (Dautzenberg & Fischer, 1912: 208), remains however to be explained.

Only when the above had been written, I got acquainted with the interesting paper by G.D. Wigham (1975b) on shell-forms in *R. parva*. It contains the results of the morphological examination of samples collected in situ at more or less regular intervals at a number of localities near Plymouth and Pembroke. The series from Wembury, near Plymouth, is by far the most complete and important one, comprising 18 samples collected from August 1971 to June 1973 inclusive. The seasonal distribution of the ribbed and the smooth shells proved to be not constant. During summer and autumn the ribbed form prevailed, during late winter and early spring the smooth form dominated. Wigham explains his results by assuming that the metabolic processes underlying rib-formation in *R. parva* respond to the momentary exposure or environmental conditions in such a way, that rib-formation is more or less abruptly stopped if the exposure or environmental stress exceeds a certain, individually variable threshold, and the other way round. Stress factors are low temperature, wave action, food scarcity and, probably, pollution. A genotypical interpretation is discarded with the words: "That we are not simply dealing with two separate populations, whose annual life-cycles are out of phase, is shown by the presence of transitional forms, in which the direction of shell change is towards ribbing (smooth transitional) in the summer and the production of a smooth shell (ribbed transitional) during the winter period. Ribbing has also been shown to be favoured by summer conditions in that the duration of smooth-shelled phase [i.e. first stage of development of post-settlement individuals, A.V.] is reduced in this season, while it is extended in winter". In my opinion, the latter sentence does not really tell against a genotypical interpretation. Wigham's main argument is based on graphs, which show the seasonal variation in the proportions of smooth adult, "smooth transitional" and "ribbed transitional" shell forms at Wembury. Fig. 5 presents the seasonal variation in the density sensu Wigham (number of specimens/g dry wt. algae) of these forms, as calculated⁵ from Wigham's data. From this figure it will be clear that one may doubt whether Wigham's data do really support his explanation. "Smooth transitional" shells do not precede ribbed adult

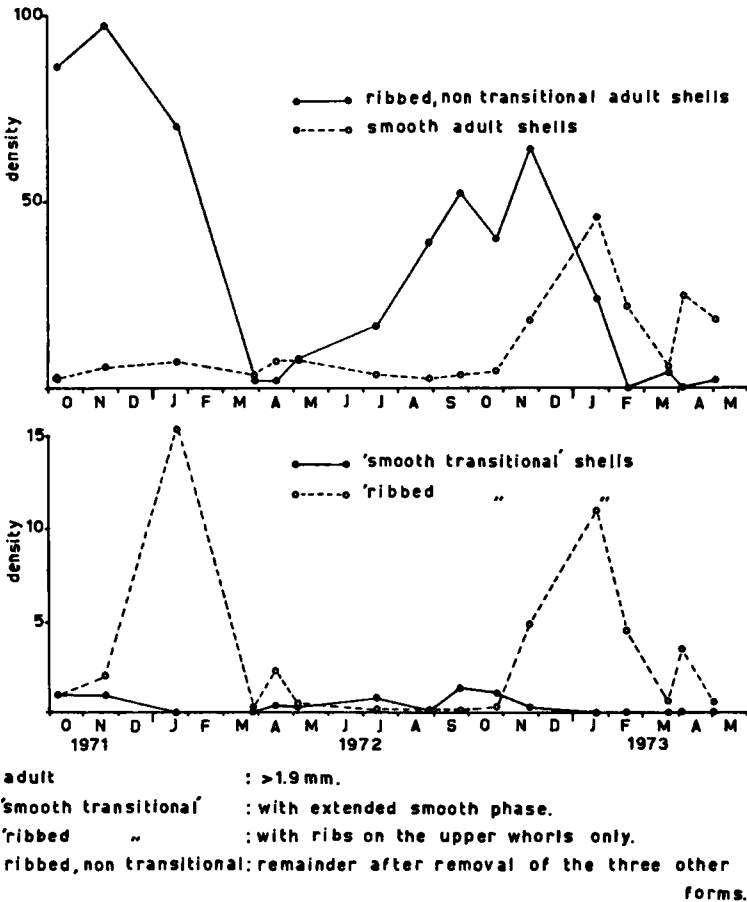


Fig. 5. Seasonal variation in the density (numbers/g dry wt. algae) of four forms of *Rissoa parva* (da Costa) s.l. on *Lomentaria articulata* at Church Reef, Wembury near Plymouth (South Rock site), as calculated from Wigham's data (1975a and b). The density of the total of the four forms in October and November 1971 was extrapolated from fig. 6 in Wigham, 1975a.

⁵ This calculation is based on figs. 6 and 8 in Wigham, 1975a, and on text-figs. 2 and 5 and table 1 in Wigham, 1975b. It is assumed that fig. 6 refers to total numbers of specimens in the samples regardless the size of the shells, that text-fig. 5 refers to adult shells collected on *Lomentaria articulata* at South Rock, and that the percentage in that figure is related to the total number of adult shells.

ones, nor do "ribbed transitional" shells precede smooth adult ones. Fig. 5 rather suggests the existence of a fixed relationship between the numbers of 'smooth transitional' shells and ribbed, non transitional, adult ones as well as between those of "ribbed transitional" shells and smooth adult ones. Calculations of probabilities proved that two observations are irreconcilable to the latter point of view, i.e., the high numbers of "ribbed transitional" shells in January 1972 and of smooth adult shells in May 1973. At least the former observation, however, is one of the irregularities which exist in the curves of fig. 5. As long as the origin of these irregularities is not understood, it is not possible to decide which point of view is the better one.

Both *R. parva* and *R. interrupta* are characterized by a particular colour pattern at the outer lip, the so called "falciform streak" (Jeffreys, 1867: 24), which seems to be a very reliable character indeed. The diameter of their nucleus is about 0.09 mm and that of their first half whorl about 0.16 mm. I could find no individuals with a coarse apex among about 160 specimens of *R. parva* s.s. (60 from Agadir; 20 from Torremolinos, 15 km S.W. of Málaga; 30 from Sezimbra, 30 km S. of Lisboa; 50 from Quiberon) and among about the same number of *R. interrupta* (50 from Agadir; 60 from Penthièvre near Quiberon; 50 from Gullmarfjord). In *R. parva* the number of ribs per whorl varies from 8.5 to 14 in the samples mentioned, averaging 11.5 at Agadir and 11.1 at Torremolinos and at Quiberon. Among the sample of *R. interrupta*⁶ from Gullmarfjord the number of ribs per whorl varies from 11.5 to 15, averaging 12.7; among that from Quiberon from 9 to 13, averaging 11.2.

Though Nordsieck (1972a: 200) denies the occurrence of *R. parva* in the western part of the Mediterranean, it has been convincingly reported from that region (see e.g., Carus, 1889: 324). I myself found the species to be not rare at Torremolinos.

As to *R. interrupta*, Nordsieck (1972a: 201) also denies its occurrence in the Mediterranean. On the other hand it has been reported by Aradas & Benoit (1870: 196) from Malta, by Locard (1891: 173) from the French Mediterranean coast, by Hidalgo (1917: 606) from Cartagena, and by Spada et al. (1973: 39) from Lampedusa. I saw two specimens from the French Mediterranean coast (coll. 2) and one specimen from Umbria, Italy (coll. 1).

Dr. F. Nordsieck was so kind as to lend me "den Typus" of *R. allermonti crassa* (Nordsieck, 1972a). It was found at Oléron, France, and has an undeniable falciform streak. I regret not being able to distinguish it from *R. interrupta*. The length of the shell is 3.0 mm, the

⁶ The ribless specimens are not included in these measurements.

slenderness 2.15. The ratio m/l is 0.38. The shell is devoid of ribs, except for a strong labial rib. There are 6.25 moderately convex whorls. The umbilical chink is very slight. The shell is somewhat transparent and of a whitish colour with vague, oblong, longitudinal brown spots just below the suture. I have selected this shell as lectotype and have marked it as such.

Rissoa dolium Nyst, 1843

This species is usually easily recognized by a characteristic combination of features, such as the small dimensions (1.35 to 3.35 mm), the slenderness (1.85 to 2.40), the distinct convexity of the whorls, the number of ribs per whorl (12 to 20), the often purple apex and, last but not least, the high number of ribbed whorls (exceptionally less than two, often three or more). The labial rib is usually, but not always, absent or faint. Sometimes there are a few fine spiral striae between the lower ends of the ribs. Completely brown specimens are not very rare.

It is hard to avoid the impression that Nordsieck (1972a: 204) mistook this brown variety, already mentioned by Monterosato (1884: 56) and Bucquoy, Dautzenberg & Dollfus (1884: 276), for *R. obscura* Philippi, 1844⁷, and changed the description as to fit his views (Nordsieck: $l = 2.2$ mm and $l/m =$ nearly 4; Philippi's figure: $l = 3.9$ mm and $l/m = 2.8$).

I examined more than 200 specimens from localities all over the Mediterranean (including 8 specimens from Kyrenia, Cyprus; 44 from Paphos, Cyprus; 25 from Grado near Trieste, and 104 from Calpe, 25 km S. of Denia, E. Spain), without finding one with a coarse apex. The average number of ribs per whorl is 15.8 at Paphos, 16.3 at Grado and 15.6 at Calpe. These averages illustrate the limited geographical variability of the species. *R. dolium* is figured on plate I, no. 3.

Occasionally it may be difficult to distinguish the species from *R. radiata*. In those cases the form of the apex is decisive, the nucleus protruding more from the first half whorl in *R. dolium* than in *R. radiata*.

Rissoa inconspicua Alder, 1844

This species is usually characterized by the fine and numerous longitudinal ribs, often finer and more numerous on the penultimate

⁷ Dr. R. Kilias wrote to me that the Zoologisches Museum der Humboldt-Universität in Ost-Berlin possesses no specimens of *R. obscura* ex coll. Philippi.

whorl than on the last one. Nearly always there is an, often well developed, labial rib. Specimens with remarkably strong spiral ribs between the lower ends of the longitudinal ones, which produce a reticulated appearance, are not rare, neither in the Mediterranean nor on the Atlantic coasts.

I have examined several hundreds of specimens. About half of these were dredged at St. Raphaël, S.E. France (dragage Claudon, coll. I). The remaining ones came from Dalmatia (about 55 specimens); Palermo (60); Calpe, 25 km S. of Denia, E. Spain (75); Tarifa, S. Spain (100); Ria de Arosa, N.W. Spain (50); Santander and Zarauz, at respectively 145 and 15 km W. of St. Sebastian, Spain (170); various localities on the coast of Bretagne, France (20); Falmouth, Great Britain (4); Gullmarfjord, Sweden (1); and in small quantities from a few other European localities. Moreover, there were three specimens from Iquique (? Chili, A.V.) and three from Bahia (? Brazil, A.V.), which had belonged to Schwartz von Mohrenstern, who, however, did not mention them in his monograph (1863: 34).

All the specimens examined have fine tops, the nucleus measuring about 0.08 mm, the first half whorl about 0.15 mm. The length of only a few specimens exceeds 2.0 mm, the majority being considerably smaller. Remarkable in this species is, that occasionally giant individuals occur. Though these obviously are outside the normal range of length variability, this usually is the sole character by which they are distinguished. Sometimes they are connected to the normal range of length variability by a few intermediates, as in the sample from Tarifa (coll. 8), see fig. 6. This sample also contains the largest specimen I have seen. Its length is 2.9 mm.

The variability of the ribs is another remarkable feature of *R. inconspicua*. Not only do the ribs vary from well developed to barely visible or even fully absent, but also the number of ribs per whorl is extremely variable. However, there exists a difference between Mediterranean and Atlantic samples as regards the percentage of specimens with well developed ribs. This is low in Atlantic samples, e.g., 25% in that from Santander, while it may reach as much as 80% in some Mediterranean ones, such as those from Palermo and Dalmatia. On the other hand the picture is not consistent in the whole Mediterranean, as witnessed by the sample from Calpe with 29%. Nevertheless it is surprising that Monterosato (1890: 7) did not mention this phenomenon when he wrote:

"*Sabanea prismatica*, Monts. = *R. inconspicua* (non Alder) Schw. Comune in tutto il Mediterraneo nei fondi fangosi. Si distingue dall' *inconspicua* vera, per le sue numerose costoline, stria spirale, epiderme lucente, forma ventrosa, apice acuminata ecc."



Fig. 6. *Rissoa inconspicua* Alder, Tarifa, S. Spain, 55 Specimens.

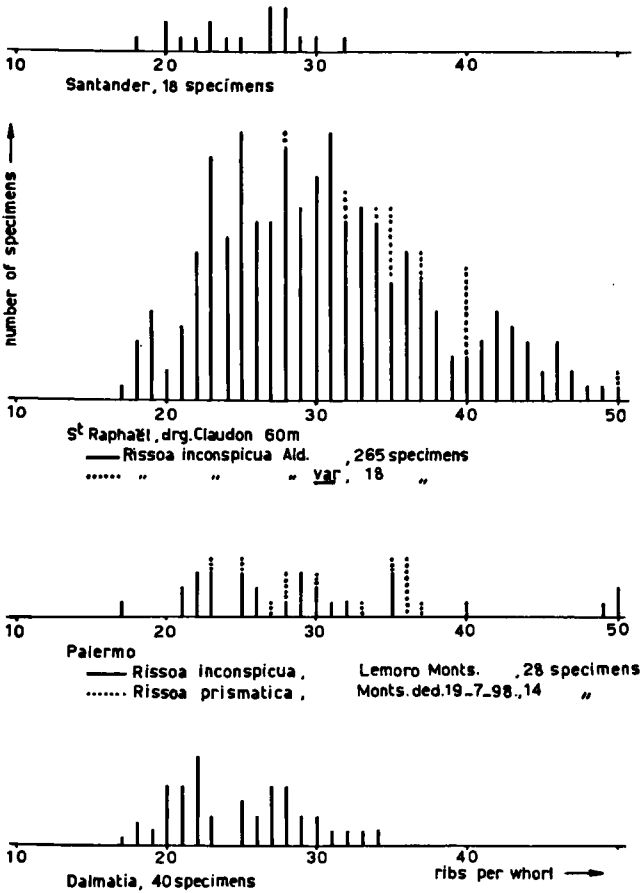


Fig. 7. *Rissoa inconspicua* Alder.

Probably Monterosato has overlooked that Schwartz (1863: 34) has described and figured *R. inconspicua* after original specimens from Cuming's collection, which were identical to specimens Hanley sent to Schwartz as typical for the species, and that Schwartz mentioned fewer ribs than did Alder. I found Hanley's shells in Schwartz's collection (no. 26059). They included specimens of another species, which Jeffreys (1867: 29) has identified as *R. albella* Lovén, 1846. This proves that at least Hanley's specimens were of northern origin, *R. albella* being a northern species.

Though I examined a sample of 21 specimens from Palermo, labeled: "*R. prismatica*, Monterosato ded. 19-7-'98" (coll. 1), I did not find the dividing-line indicated by Monterosato. It is true that, on the whole, the apices of Mediterranean specimens are somewhat more acute than those of most Atlantic specimens, but the differences are very slight indeed.

In Dautzenberg's collection I found three lots without dates from "St. Raphaël, dragage Claudon", marked as follows: (1) "*R. inconspicua* Alder, 60 m"; (2) "*R. inconspicua* Alder var, 50 m"; (3) "*R. inconspicua*, var, 60 m". A fourth lot was marked "*Sabanea prismatica* Monts./St. Raphaël drag. y. 50m. di fon / Monterosato". Each of the first three lots contains a very large number of shells and is accompanied by a second, probably older label, reading: "*Rissoa*. drg y 60 m". The fourth lot contains only 25 specimens. The first lot, which Dautzenberg apparently considered to represent the true *R. inconspicua*, consists nearly exclusively of dead, whitish opaque, shells with well developed ribs. Both the second and third lot contain shells with weak or even absent ribs. They only differ in that the shells in the second lot are predominantly of the dead type, and those in the third lot are fresh, transparent and of a greenish-grey colour. The fourth lot contains dead shells, with all states of development of the ribs. I am unable to really separate the four lots and therefore believe that at least the first three originally belonged to one sample, Dautzenberg having made a mistake when mentioning the depth they were dredged from on the final label. See also fig. 7.

Nordsieck (1972a: 196, 197) distinguished *R. inconspicua* Alder, *R. inconspicua distans* (Nordsieck, 1972), *R. densa* (Nordsieck, 1972) and *R. prismatica* Monterosato. As to *R. inconspicua distans*, he wrote to me that the type specimen had been figured by Ziegelmeier (1966: plate 6, nos. 6a-b). However, there can be no doubt that Ziegelmeier figured specimens of *R. albella* Lovén. The figures themselves, the dimensions and distribution given by Ziegelmeier and his addition of the words ("*R. albella* Lovén)" behind the name *R. inconspicua* Alder prove this. Dr. F. Nordsieck was so kind as to lend me a specimen of *R.*

inconspicua distans from his own collection. It comes from the Channel, and is somewhat beach-rolled and bleached, but still shows a faint but unmistakable falciform streak. I cannot distinguish it from costulate specimens of *R. interrupta*.

Nordsieck's description of *R. inconspicua* proper deviates from that by Alder as well as from that by Schwartz; the length of 3.5 mm mentioned by Nordsieck is exceptional. Furthermore his features distinguishing between *R. inconspicua*, *R. densa* and *R. prismatica* are too vague to be specific. For example, the number of ribs per whorl may even vary in one and the same individual. In a specimen from Palermo (coll. 1) the costulation changes gradually from about 25 per whorl to about 50 within little more than one whorl, the uppermost part of that whorl showing the higher density. I saw similar specimens from La Ciotat, S.E. France, and St. Raphaël.

Kobelt (1887), Locard (1891), Carus (1893), Hidalgo (1917), nor Priolo (1954) mention *R. prismatica* or any other form split off from *R. inconspicua*. The first three authors may not yet have been acquainted with Monterosato introducing *R. prismatica*, which he has done in, or possibly shortly before, 1890⁸. Priolo must have overlooked it, not even mentioning *R. prismatica* in the synonymy of *R. inconspicua*.

Fig. 7 contains the results of some rib-counts. In interpreting these, it should be remembered that in Atlantic samples more often than in Mediterranean ones, high numbers of ribs could not be counted because of the ribs being too weak. Considering this, the results of the rib-counts agree well with my general impression that we are dealing with only one⁹ species, which has been excellently described by Alder (1844: 323). The Mediterranean populations cannot even be considered to have the status of subspecies, because the differences with the Atlantic populations do not seem to cover a sufficient percentage of the individuals.

I felt unable to distinguish the specimens from Iquique and Bahia, mentioned in the beginning, from European ones. See also note 23.

Rissoa radiata Philippi, 1836

Schwartz von Mohrenstern (1863: 37) states that he described and figured the species from original specimens, which were completely

⁸ Nordsieck (1972a: 196) erroneously mentions 1884.

⁹ This conclusion does not include *R. variegata* Schwartz (1863: 28), *Sabanea consimilis* Monterosato (1890: 7) and *S. apicina* Monterosato (1890: 7), which I did not yet have the opportunity to examine.

identical to a few shells which he obtained as original specimens from Dunker¹⁰. Indeed, in Schwartz's collection there is a tube with four fresh shells (see plate I, nos. 4a-b), labelled: "Rissoa radiata Phil. Sicilien, Orig. Ex. / 26085 Coll. Schwartz von Mohrenstern". The diameter of the nucleus of these shells is about 0.08 mm, that of the first half whorl about 0.15 mm. Though there can be no doubt that they are really *R. radiata*, they show a number of differences as compared to the original diagnosis: (a) the labial rib is variable and may be well developed; (b) the longitudinal ribs are variable in that completely ribless shells occur, while on the other hand the ribs are not necessarily obsolete or restricted to the upper whorls only; (c) there may be a slight umbilical chink.

Comparison of 36 other specimens from the type locality Palermo and numerous specimens from many other Sicilian and Mediterranean localities (see plate I, nos. 5-7; plate II, nos. 1-4; plate III, nos. 1-3; and figs. 8-10), leads to the following additional conclusions: (d) the number of ribs per whorl varies from 10 to 20, averaging about 14; (e) the length varies from about 1.8 to 5.3 mm; (f) the slenderness varies from 1.80 to 2.25, deformed specimens can even reach 2.55; (g) the convexity of the whorls usually varies from flat to moderately convex, though occasionally the whorls may be very convex; (h) the ribs are usually about straight and can be anything from vertical to distinctly oblique; (i) there are often a few delicate spiral striae between the lower ends of the ribs on the last whorl; (j) in the Aegean Sea and in the Adriatic ribless specimens seem to be rare or absent. At Palermo and Trapani, both on Sicilia, however, they account for about 40% of the populations.

Notwithstanding the extreme variability of the species, I do not doubt that we are dealing with one species only. In my opinion, Schwartz (1863) wrongly divided it into *R. radiata* Ph., *R. pulchella* Philippi, 1836, and *R. simplex* Philippi, 1844, on the strength of distinctions which, by their subtlety, get fully lost in a variability he completely misjudged. As to *R. pulchella*, there are strong indications that Schwartz has misunderstood the species. The words: "testa ventricosa; apertura spiram vix aequante" and a ratio length/width of 1.67 (Philippi, 1836: 155 and plate X fig. 12; 1844: 127) apply very satisfactorily to specimens of the true *R. pulchella* from the type locality Militello, discussed below, but do not apply to the great majority of the shells labelled *R. pulchella* in Schwartz's collection. Schwartz (1863: 33) even replaced the above mentioned words by:

¹⁰ There are a few specimens from Philippi's collection in the Zoologisches Museum der Humboldt-Universität in Ost-Berlin. I have not seen them.

"testa anfractibus convexis" and changed the ratio length/width into 2.04 (close to that of *R. radiata*, which he puts at 2.10), thus adapting the diagnosis to the shells in his collection, which however, clearly are *R. radiata*.

As to *R. simplex*, I can see no reason to separate the specimens in Schwartz's collection (all from outside Sicilia) from the ribless form of *R. radiata*. Nor did I find in the other collections any indication of *R. simplex* existing as a separate species¹¹.

Concerning *R. plicatula* (Risso, 1826), all specimens in Schwartz's collection were labelled "subfossile", which is in agreement with his paper (1863: 37). Schwartz himself (1863: 34) already stressed the similarity to *R. pulchella*, *R. plicatula* being larger and somewhat differently coloured. I found his specimens of *R. plicatula* very similar to *R. radiata* indeed. They have the same apical dimensions, the differences in colour are negligible, and only a few individuals of *R. plicatula* surpass the length of recent *R. radiata*. The largest specimen measures 6.5 mm.

As to *R. plicatula* as a recent species, I found six specimens which were identified by Monterosato, all in coll. 1. Three specimens from Palermo in my opinion cannot be distinguished from *R. radiata*. The three other specimens, from Messina, have coarse apices and belong to the sibling partner of *R. radiata*, i.e. *R. munda* Monts., discussed below. Thus there seems to be little evidence indeed of the existence of *R. plicatula* as a recent species.

Coll. 1 contained an interesting lot, marked: "Rissoa seminuda Monts., sponges, Gabès". It consisted of *R. radiata* and its sibling partner with a coarse apex, *R. munda*. Both species in the sample are very similar, except for the fact that all 46 specimens of *R. radiata* possess longitudinal ribs, compared with only 9 out of 82 of *R. munda*, and except of course for the apical dimensions. This proves that, in spite of the remarkable similarity, both species must be considered genetically separated.

It should be remarked that in both species in the sample the colour-pattern often differs from the usual one, compare plate VI, no. 3a. A specimen of *R. radiata* is figured on plate III, no. 2.

In fig. 8 the distribution of the number of ribs per whorl in a few samples from different localities is presented. Fig. 10 shows the relationship between the mean number of ribs per whorl and the average

¹¹ There is one specimen of *R. simplex* ex coll. Philippi from the type locality Magnisi in the Zoologisches Museum der Humboldt-Universität in Ost-Berlin. I did not see it.

length of the shells in these samples. In general, the number of ribs per whorl seems to be lower as the shells are longer. In order to verify this conclusion, I divided the sample from Punta Mika (near Zadar, Yugoslavia) into three groups, according to the length of the shells. The results of the measurements are presented in figs. 9 and 10. They are in favour of the above conclusion.

Additional measurements revealed that in the sample from Punta Mika the number of ribbed whorls, on the average, increases as the length of the shells increases. This, of course, is no surprise, because one might expect longer shells to have more whorls, and therefore also more ribbed ones. This correlation proved to be so strong, that fig. 9 would have hardly changed if the shells had been grouped according to the number of ribbed whorls instead of the length. Therefore, we might have concluded as well, that on the average the number of ribs per whorl is lower as the number of ribbed whorls is larger.

I took no measurements as regards the correlation between apical angle and number of ribs per whorl, which, according to Smith (1971: fig. 2), exists in the genus *Rissoa*.

The precise delimitation of *R. radiata* is not easy. Though usually the species is well recognizable, one occasionally is confronted with doubtful specimens. This aspect is discussed sub *R. dolium*, *R. lineolata* and *R. pulchella*. As a conclusion, the individuals figured on plate I, nos. 5b and 7a, plate II, no. 2 and plate III, nos. 1 and 3b, belong to *R. radiata*, notwithstanding the remarkable convexity of the whorls, and, as regards the specimen from Sfax, its shape and its curved ribs.

As to the occurrence of *R. radiata* outside the Mediterranean, I saw one specimen from the Black Sea (Varna, coll. 2) which I consider to belong to that species. Dautzenberg (1910: 166) reports it from England, the Golfe de Gascogne, Portugal, and West Africa, though he did not yet mention the species in his paper on the fauna of the Golfe de Gascogne (1891). In his collection I did find no samples from the first three localities mentioned by him. Those from the fourth locality all originate from the Gruvel expedition in 1908. They consist of 7 specimens from Port Étienne, 5 from Ile d'Arguin, 6 dredged from the Baie de Cansado (near Port Étienne), 11 from El Memghar and 4 subfossil ones from Nouakchott. To my opinion neither of these samples is fully identical to Mediterranean ones, nor are they all mutually identical. True enough, the specimens from Port Étienne, Ile d'Arguin and Baie de Cansado link up rather well with the Mediterranean form, but as far as can be judged from the partially not very well preserved specimens, the spiral sculpture between the ribs tends to be

somewhat coarser and to cover the entire length of the interstices. In addition to that, one specimen even possesses punctuated spiral striae on the base of the shell, thus strongly reminding one of *R. similis* Scacchi, 1836, as regards the sculpture. All specimens in these samples are ribbed. Though they seem to be a subspecies of *R. radiata*, the amount and quality of the material available make me hesitate to classify them formally as such.

We disregard the specimens from Nouakchott because of uncertain age, small number and mediocre preservation, and turn our attention to those from El Memghar. These distinguish themselves from those discussed above by lack of spiral sculpture, evenly rounded and more convex whorls and less developed ribs, four specimens even being fully smooth. The sample no more links up with Mediterranean samples. It, however, has a great affinity to a group of three samples from European Atlantic localities. On the whole, the differences between these Atlantic samples and the Mediterranean form of *R. radiata* are such, that it seems justified to distinguish them as a subspecies.

***Rissoa radiata balkei*¹² nov. subsp.**

. Shell: Oblong, with ovoid spire, not very solid, somewhat translucent when fresh. Length: 1.7 – 3.9 mm. Slenderness: 1.65 – 2.15.

Apex: Form and dimensions of the embryonic whorl are very similar to those of the Mediterranean form; the diameter of the nucleus is about 0.09 mm, that of the first half whorl about 0.15 mm.

Whorls: From 4.5 on small specimens to 6.5 on large ones. They usually are moderately, sometimes, however, slightly or distinctly convex. The suture is often remarkably deep. The whorls usually are evenly rounded and never sagging, as they are often in the Mediterranean form.

Aperture: m/l from 0.39 to 0.42, exceptionally more. The peristome is continuous. The umbilical chink is very faint or absent.

Sculpture: The shells often have a fairly strong labial rib. The longitudinal ribs may be moderately prominent, but are often obsolete or completely absent. When available, they number from 13 to 21 per whorl, on the average about 17. They end at the periphery. There usually are 1.3 or less, seldom more than 1.7 ribbed whorls, which need not include the last whorl.

Some of the shells have faint, distant spiral ridges, which give them a particular kind of rough surface and a somewhat polygone outline.

¹² In honour of Mr. N.W. Balke, who guided my first steps into this fascinating hobby.

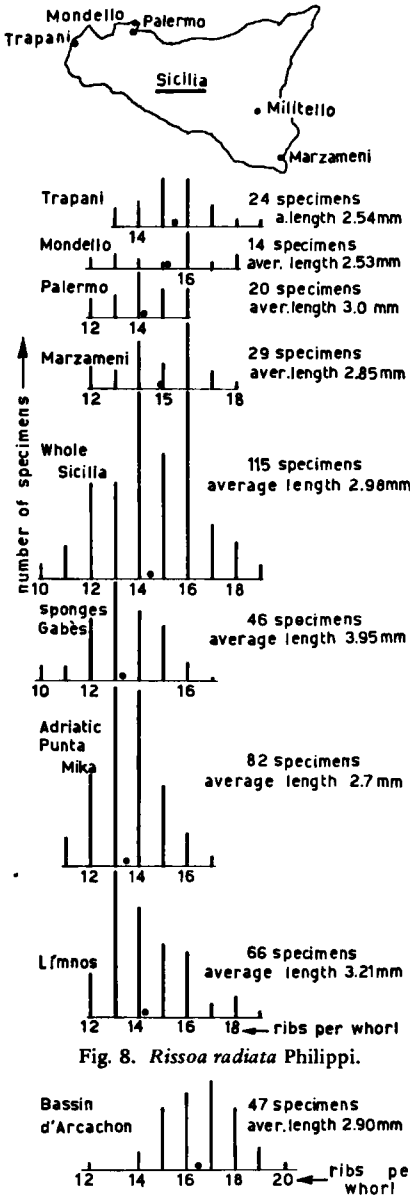


Fig. 8. *Rissoa radiata* Philippi.

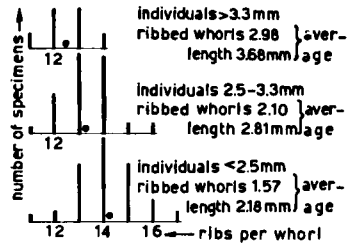


Fig. 9. *Rissoa radiata* Philippi, sample from Punta Mika near Zadar.

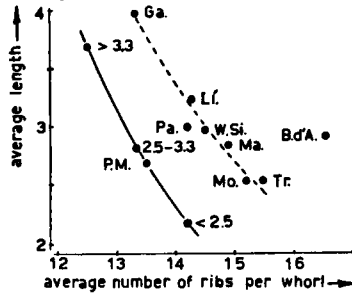


Fig. 10. *Rissoa radiata* Philippi. Derived from figs. 8-11.

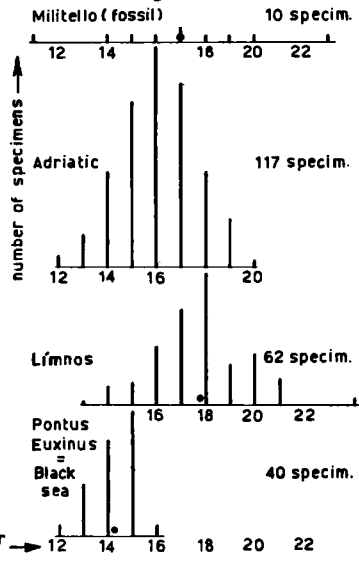


Fig. 12. *Rissoa pulchella* Philippi.

Fig. 11. *Rissoa radiata balkei* nov. subsp.

Some specimens may be somewhat angled at the periphery. This sculpture, illustrated by plate III, no. 4c, is fully different from the spiral striae between the lower ends of the ribs which can be seen in the Mediterranean form. That sculpture is absent on the taxon described here, be it that incidentally traces of it can be found.

Colour: The background is whitish in dead shells, horny in fresh ones. On dead specimens one usually can see narrow, brown, longitudinal lines, often interrupted at the periphery and ending halfway down the base.

This description is based on about 60 specimens from the type locality Ria de Arosa, N.W. Spain, 1.1 km S.E. of the buoy at Las Hermanas, depth: 4 m (coll. 4). A holotype has been designated from this sample; with paratypes, it has been figured on plate III, nos. 4a-d. The other European Atlantic samples are from the Bassin d'Arcachon, France (coll. 1 and 8), see plate III, nos. 5a-c, and from the mouth of the river Rance, Bretagne, France (St. Lunaire, Dinard, St. Servan, St. Suliac, all in coll. 1). As to the origin of a few other French samples in coll. 1, I am not fully sure because geographical names of very local importance seem to have been used on the labels, names which I failed to find on maps. Three small samples in coll. 8, from Agadir, from Torremolinos, 15 km S.W. of Málaga, Spain, and from Sezimbra, 30 km S. of Lisboa, possibly belong to the same species. It should be remembered that the relative abundance of *R. parva* did already suggest the possibility of Atlantic influences at Torremolinos.

Individuals of *R. radiata balkei* are not always easily separable from other taxa. Certain ribless specimens from Ria de Arosa can e.g., only be distinguished from *R. inconspicua* by their narrow colour lines. Other specimens from Ria de Arosa and from the Rance area are very similar to smooth representatives of *R. interrupta*. They, however, lack the falciform streak. Many specimens from the Bassin d'Arcachon have a remarkable similarity to some specimens of *R. radiata* s.s. from Trapani and Palermo (both on Sicilia), as illustrated by plate I, no. 4 and plate III, no. 5. In addition to a considerable local variability the taxon also has a remarkable geographical variability. Thus, in contrast to the sample from the Bassin d'Arcachon which links up well with the specimen from Ria de Arosa figured on plate III, no. 4a, the sample from El Memghar is more like the specimens figured on plate III, nos. 4b-c. This geographical variability suggests that the populations are more or less geographically isolated.

I verified that *R. inconspicua distans* (Nordsieck) and *R. allermonti crassa* (Nordsieck) are different taxa, see sub *R. inconspicua* and *R. parva* respectively. One would expect the taxon to be mentioned in papers by Dautzenberg & Durouchoux (1900 and 1914) on the mala-

cofauna of the surroundings of St. Malo, the more so because the name of Durouchoux is mentioned on the labels of samples from that area in coll. 1. However, it is not mentioned by these authors. The same holds for the paper by Amanieu & Cazaux (1962) on rare animals observed at Arcachon in 1961 and 1962.

Fig. 11 shows the results of some rib-counts.

Rissoa lineolata Michaud, 1832

This species is abundant in the neighbourhood of Sète and Agde, S.E. France, the original localities mentioned by Michaud (1832: 11). Like *R. radiata*, it is very variable as regards length, slenderness, ribs, convexity of the whorls, spiral sculpture between the ribs, and umbilical chink. In general it differs from *R. radiata* in the larger dimensions, the seemingly greater fragility, the more convex whorls, the more distinct umbilical chink, the more developed colour lines, the absent or otherwise broad flat labial rib, the curved and more numerous ribs, and the absence or obsolescence of spiral sculpture between the ribs. If in *R. lineolata* part of the body-whorl is ribbed, it often occurs that the ribs closest to the aperture are more close-set and weaker than elsewhere on the shell, and extend somewhat further below the periphery than in *R. radiata*. Moreover, *R. lineolata* is usually regularly conical down to the last whorl, which often tends to be somewhat inflated. The form and dimensions of the apex of *R. lineolata* are identical to those of *R. radiata*. See also plate IV, nos. 1a-c.

Coll. 1 contains a lot of about 100 specimens from the Etang de Diane, Corse, labelled *R. lineolata* var. *brevis* Monterosato, which I too do not hesitate to identify as *R. lineolata*. See plate IV, nos. 2a-b. Concerning six specimens (coll. 3, nos. 233248 and 233252) from the Lago del Fusaro, near Napoli, I have no more doubt as to their identity. See plate IV, nos. 3a-b. Nevertheless, neither form is fully identical to that from the localities mentioned by Michaud. Nor are they mutually identical.

In the main harbour of Ródhos I found 24 specimens of what I consider to be also *R. lineolata*, see plate IV, nos. 4a-b. They could be separated satisfactorily from specimens of *R. radiata* from the same locality. Again, this form is not completely identical to those mentioned. Thus the species strongly gives the impression to occur at a limited number of geographically separated localities.

A sample of 43 specimens from Fornells on Menorca, Spain (coll. 4) is important for the determination of the borderline between *R. radiata*

and *R. lineolata*. Certain shells in the sample are very similar to *R. lineolata*, others positively are *R. radiata*, and the remaining shells consist of intermediates connecting both extremes. I found it utterly impossible to properly divide the sample into two species. It therefore must be concluded that occasionally the range of variability of *R. radiata* touches on, or even overlaps that of *R. lineolata*. See plate III, no. 1. On plate I, no. 5b another specimen of *R. radiata* is shown which is very similar to *R. lineolata*. Table 1 gives a detailed comparison of both species.

Rissoa pulchella Philippi, 1836

In the Mediterranean a species occurs with the following characters:

Shell: Oval, with short, conical spire, solid, little or not transparent, somewhat glossy. Length: 1.8-4.6 mm; slenderness: 1.7-2.0; m/l: 0.40-0.45

Apex: The embryonic whorl is similar to that of *R. radiata*. The diameter of the nucleus is about 0.09 mm, that of the first half whorl 0.16 mm¹³.

Whorls: From 5 in small specimens to 6.5 in large ones. They are usually slightly to moderately convex and evenly rounded. The last one gradually passes on into a straight contour of the base. If the labial rib is very strong, it can be seen to encircle the lower end of the columella, thus causing a slight but distinct bulge on the lower end of the contour of the base.

Sculpture: The labial rib is usually strong or very strong, but occasionally it may be moderate or even weak. The longitudinal ribs occupy from 3/4 to 3 whorls and with few exceptions disappear at 1/4 whorl or less before the labial rib. They number from 12 to 21 per whorl, exceptionally even more. They disappear at the periphery, are straight to distinctly curved like a reversed S and vary from vertical to distinctly oblique. Usually the number of ribs per whorl has a tendency to increase on the lower whorls. On specimens from Limnos, however, it tended to decrease slightly. The interstices between the ribs often are conspicuously spirally striate; the striae are confined to the lower ends of the interstices and usually continue as far as the labial rib.

Aperture: Roundish oval, somewhat expanded below. The peristome is slightly reflected on the columella; the umbilical chink is very slight or absent. There is a distinct angle between the columella and the parietal part of the aperture.

¹³ If the apex is considerably coarser, see sub *R. marginata* Michaud.

Colour: The main colour varies from whitish to bright brown with occasionally lighter coloured ribs. The labial rib is whitish and usually continues as a whitish band around the lower end of the columella. On lighter coloured shells, small brown or yellowish blotches or short, broad, longitudinal bands of the same colour often are visible just below the suture, between the ribs or at every second interstice. These blotches continue as far as the labial rib; the last one is far greater and darker, and often extends upon the labial rib. At the lower end of the labial rib a second brown spot is found, which often also extends upon the labial rib and usually is visible at the inside of the mouth too. The apex is sometimes tinged with violet, as may be the labial edge of the mouth and the lower part of the columella.

The species is figured on plate V, nos. 2 and 3.

Coll. 1 contains a tube with 11 shells, labelled: "Rissoa pulchella typique/fossile de Militello Sicile/Monterosato ex coll. Brugnone IV.10". These specimens diverge from the original description of *R. pulchella* in that:

— The labial rib is absent on three specimens, moderately developed on four, strong on two, and very strong on one. It should, however, be remembered that Philippi used the words "labro simplo" also for *R. radiata*.

— The length ranges from 2.5 to only 3.1 mm. The original figure measures 4.2 mm.

— The umbilical chink is faint. It should, however, be remembered that Philippi used the words "testa subperforata" also for *Alvania lactea* (Michaud, 1832), which does not have an umbilical chink at all.

— The whorls are somewhat less convex than figured by Philippi.

— The angle between the columella and the parietal part of the aperture does not appear in Philippi's figure.

Nevertheless the shells agree rather satisfactorily with Philippi's description (1836: 155). For this reason, and because Militello is the type locality of *R. pulchella*, we may accept them as true representatives of Philippi's species¹⁴. A few individuals which are representative for the lot, are figured on plate V, nos. 1a-d.

Though the shells from Militello differ from recent specimens as regards small dimensions, greater variability of the number of ribs per whorl (from 11 to 23), greater variability of the labial rib, and the ovoid shape of seven specimens, the resemblance to recent material is

¹⁴ Dr. R. Kilius wrote to me that there is a specimen of *R. pulchella* in the Zoologisches Museum der Humboldt-Universität in Ost-Berlin, which is marked as a type. I have not seen it.

such as to justify retaining the name for recent Mediterranean material. The more so, because Philippi himself reported his species to live at Palermo and Magnisi (1844: 127), which proves that he too saw no substantial differences between his fossil and his recent¹⁵ specimens.

Coll. 3 contains a sample, labelled "Turboella ehrenbergi Phil., Pontus Euxinus. Nr. 233160"¹⁶. These 140 shells from the Black Sea undoubtedly belong to the species described above, notwithstanding the low average number of ribs per whorl (fig. 12² and plate V, nos. 4a-b).

Occasionally it may be difficult to separate individual specimens of this species from *R. radiata*. In my opinion specimens in which the penultimate whorl is not evenly rounded should be considered *R. radiata*. Specimens in which the ribs disappear at more than about 1/4 whorl before the labial rib, and/or which have relatively long, narrow, brown lines between the ribs, should only be admitted to *R. pulchella* on the strength of convincing additional evidence. Small specimens of *R. pulchella* can usually be separated from *R. inconspicua* by the lower number of ribs per whorl, by a tendency of that number to increase on lower whorls, by the ribs disappearing at about 1/4 whorl or less before the labial rib, and by the often more contrasting colours.

An interesting illustration of the difficulties one meets in separating *R. pulchella* from *R. radiata* is shown by five samples labelled "Sfax, 12 KL 18MPR"¹⁷, in coll. 1. The greater part of the 39 specimens in these samples clearly belong to *R. radiata*. The specimen figured on plate III, no. 3b, however, differs from the great majority by its *pulchella*-like habitus and its curved, oblique ribs. It has, however, narrow longitudinal colour lines and is more or less convincingly connected to the usual form of *R. radiata* by a few intermediates, see plate III, no. 3a. Because I did not find other indications of *R. pulchella* occurring in those regions, it must be concluded that the specimen under discussion is *R. radiata*.

¹⁵ Because *R. pulchella* is rare or absent on Sicilia as a recent species, Philippi's specimens probably belonged to the sibling partner *R. marginata*. As on Sicilia the latter is very similar to the fossil material of *R. pulchella* (except, of course, for the apical dimensions), this is of no consequence for the conclusion.

¹⁶ Dr. R. Kilius wrote to me that there are no original specimens of *R. ehrenbergi* in the Zoologisches Museum der Humboldt-Universität in Ost-Berlin.

¹⁷ Probably meaning that the samples were collected at 12 km from Sfax, at a depth of 18 m.

***Rissoa benzi* (Aradas & Maggiore, 1843)**

This species is represented in coll. 1 and 3 by altogether 18 specimens, all from the type locality Messina. They satisfactorily meet the original description, as reproduced by Priolo (1954: 192). The length varies between 3.1 and 4.0 mm, the slenderness between 1.6 and 1.85. One specimen has ribs on about 3/4 whorl, the density being estimated at 18 or 19 per whorl. This specimen and one other show a very superficial spiral sculpture on the periphery. For the rest the shells are completely smooth. The embryonic whorl is similar to that of *R. radiata*. The umbilical chink is well developed and occasionally forms an open umbilicus. The whorls are usually distinctly convex, with a slightly inflated body whorl. Of a few individuals, however, the whorls are less convex. The colour is pale brown. Some shells show longitudinal colour bands of a darker brown, which bands are about as broad as their interstices and which are not narrow as in *R. radiata*. Often the upper whorls also are of a darker shade of brown. See plate VI, nos. 1a-b.

As to the habitat and distribution of the species, there is some confusion. Aradas & Benoit (1870: 195) wrote "Vive nei mari di Messina e della Penisola Magnisi; non rara". Sulliotti (1889: 33), however, only mentions it from a "pantano piccolo presso il Faro di Messina", which is in agreement with the label accompanying a sample in coll. 1, reading: "Ris. (Sabanea) Benzi, Aradas. Laghetti del faro Messina, sola localita! (dedit Dr. Aradas)", in the handwriting of Monterosato. It seems wise to stick to the latter opinions as long as there is no solid evidence to the contrary, and to distrust statements as those by Aradas & Benoit, Coen (Adriatic; 1933: 32) or Pallary (Egypt; 1912: 120).

The species has been united to the northern species *R. albella* Lovén. It indeed shows a remarkable similarity to specimens from Niøe Bredning, Denmark (coll. 4), which, however, have very convex whorls. The geographical distance¹⁸ between the distribution areas of both species nor the probably very narrow ecological amplitude of *R. benzi* plead for such a close relationship. It is probable that *R. benzi* is more closely allied to a Mediterranean species. If so, its resemblance to the ribless form of *R. marginata* from the Etang de Berre (plate VIII, no. 1d) would point to *R. pulchella* as its nearest relative. Its resemblance to some specimens of *R. lineolata* from the Etang de Diane can, however,

¹⁸ It is true that Jeffreys (1884: 119) mentions *R. albella* from the Adventure Bank near Sicilia, but he does not consider it to be identical to *R. benzi*.

not be denied. In this situation it seems best to consider *R. benzi* a separate species for the time being.

Rissoa margiminia (Nordsieck, 1972)

Coll. 5 and 6 contain samples of a species which resembles *R. pulcbella*, but which distinguishes itself consistently by the dimensions, which range from 1.75 to 2.8 mm only; the less developed labial rib, which is usually moderately strong, sometimes strong and rarely very strong; the somewhat angular lower left corner of the aperture; the spiral sculpture which is usually absent; the very constant colour, which is pale yellowish white, with vague, darker yellow blotches right below the suture at about every second rib or interstice; and the weakly developed ribs, so that it is difficult to count these.

In my opinion these differences justify full species status, the more so because the taxon in question seems to show little variability. The shells are oval, with a short conical spire, rather solid, slightly transparent and somewhat glossy. The slenderness ranges from 1.65 to 1.9. Usually there are longitudinal ribs, which cover between 0.75 to 1.5 whorls, and which disappear at the periphery. These are straight and about vertical, and always end at a distance of 1/4 whorl or less before the labial rib. There are 12 to 18 ribs per whorl. Occasionally there is a weak spiral sculpture between the lower ends of the ribs. The embryonic whorl is similar to that of *R. radiata*. There are 4.5 to 5.25 whorls, which are only slightly convex and evenly rounded. The aperture is oval, somewhat expanded below. The peristome is continuous and slightly reflected on the columella. The shells are not rimate. There is a distinct angle between the columella and the parietal part of the aperture. The species is figured on plate VI, nos. 2a-e.

The above description is based on about 50 specimens from Haifa in coll. 5. Dr. F. Nordsieck wrote to me that "die Typen" of his species were in coll. 3. Dr. A. Zilch informed me that there were only 12 syntypes in that collection (no. 242138), which he kindly sent to me for examination. I found that one of these belongs to *R. dolium*; another is a juvenile of *R. similis* Scacchi. The remaining ten specimens belong to the species under discussion.

The designation of Sfax as the type locality (Nordsieck, 1972b: 230) is not valid. In his letter, Nordsieck himself mentions the Shiqmona Bay (near Haifa) in relation to "die Typen". Indeed, all syntypes in coll. 3 are from that locality. From Zilch's letter I infer that there are *no* specimens from Sfax in coll. 3. This affirms my strong surmise, based on my own investigation, that *R. margiminia* does not occur at Sfax. In

order to put an end to all uncertainty, I designated a lectotype from among the syntypes is coll. 3, thus establishing Shiqmona Bay as the type locality. The lectotype is figured on plate VI, no 2a.

***Rissoa munda* (Monterosato, 1884)**

This is the sibling partner of *R. radiata* with a coarse apex. Coll. 1 contains a sample of eight specimens of this species, which is labelled: "Mundella munda Monts./Sfax, Monterosato 2-III-17". The shells are completely identical to the majority of the shells in two very large samples, one in coll. 3 (no. 193125), and one in coll. 1, labelled: "Rissoa, Sfax, Bedi legit". Representative specimens of the latter sample are figured on plate VI, nos. 4a-d. The length of the specimens varies from 2.1 to 5.8 mm¹⁹, the slenderness from 1.75 to 2.4. The percentage of ribless specimens is about 70. On the remaining specimens the number of ribs per whorl varies from 12 to 18, averaging 14.7. The shells are somewhat transparent and not very solid. Nearly all of them lack a labial rib. They have narrow longitudinal colour lines, which often form a zigzag. For the remainder the shells are whitish. There are no spiral striae, not even between the lower ends of the ribs. The diameter of the nucleus is about 0.14 mm, that of the first half whorl about 0.24 mm.

There can be little doubt that the specimens with a coarse apex in the sample marked "Rissoa seminuda Monts., eponges, Gabès", discussed sub *R. radiata*, belong to the same species. These specimens are more solid. The labial rib is usually poorly developed, often absent, and occasionally moderately to strongly developed. There is a tendency to broad longitudinal brown bands and to brown spots close to the outer lip. This lip is often of a violet colour. One specimen is uniform brown, except for the white base and the white labial rib. Specimens from this sample are figured on plate VI, nos. 3a-b.

¹⁹ In a sample which has been recently collected from dredged sand at Sfax (coll. 5, nos. 9175 and 9221), small shells (1.85-3.05 mm) predominate in such a way, that they create the strong impression to belong to a separate form. Shells of these dimensions are completely absent in the large sample in coll. 1. A few are present in that in coll. 3, of which they seem to be part and parcel. As yet it is not possible to decide how the matter stands. Judging from the state of preservation of the shells, it however seems possible that those of *R. munda* s.s. are of a somewhat greater geological age than those of the small form.

The differences between samples from Ródhos (coll. 8) and Puerto de Pollensa, Mallorca (coll. 6), are very small indeed. The specimens often have distinctly convex whorls and a labial rib. The ribs are usually well developed. The length of the specimens ranges from 1.9 to 4.3 mm, the slenderness from 1.75 to 2.4. The number of ribs per whorl in the sample from Ródhos varies from 11 to 17, averaging 14.1; that in the sample from Puerta de Pollensa ranges from 10 to 18, averaging 13.4. Specimens from Ródhos show spiral sculpture between the lower ends of the ribs; those from Puerta de Pollensa seldom do so. Representative specimens from Ródhos are figured on plate VII, nos. 4a-c. Notwithstanding the differences between these samples and those from Sfax and Gabès on the whole, the resemblance between individuals is sometimes striking. In my opinion, all samples belong to the same species. A more detailed justification of this opinion is given at the end of the discussion of this species.

Coll. 5 contains a fine sample from Sidi Daoud near Cap Bon, E. of Tunis. It fairly differs from those from Sfax and Gabès, but it links up well with those from Ródhos and Puerta de Pollensa. The labial rib, however, is usually weak or absent on specimens from Sidi Daoud, though occasionally it may be strong. The length of the specimens ranges from 2.2 to 4.1 mm, the slenderness from 1.65 to 2.2. The shells usually lack spiral sculpture between the ribs, of which there are 12 to 19 per whorl, averaging 15.8. The top may be tinged with violet. A few specimens are figured on plate VII, nos. 1a-d.

In addition to the usual narrow, often zigzagging, brown, longitudinal colour lines, some individuals show a broad, vague, brownish spiral band just below the periphery. It has a more or less distinct zigzag border to the whitish base of the shells. The lower ends of the longitudinal colour lines coincide with this border. The brownish spiral band tends to merge into a darker spot close to the outer lip. There may be a second brown spot at the outer lip, just below the suture.

This special colour pattern of some specimens from Sidi Daoud has been described so extensively, because in a sample of about 60 specimens from Sciacca, Sicilia (coll. 8), some specimens show a spiral row of clear, large, usually separated, dark blotches just below the periphery. Because the specimens in that lot also differ somewhat from those described above in the often very convex whorls, the low number of ribs per whorl (which ranges from 10 to 16 and averages only 12.9), the usually well developed labial rib, and the frequent absence of narrow axial colour lines, they might easily be considered a separate species. In my opinion, however, the occasionally aberrant colour pattern should

be considered an extreme case of the brownish spiral band found in the sample from Sidi Daoud. Nor seem the remaining differences to be sufficient to justify the creation of a separate species, the more so, because *R. munda* is represented at other localities on Sicilia by samples which are more or less intermediate between those from Sciacca and Sidi Daoud. A specimen from Sciacca is figured on plate VII, no. 3.

On plate VII, nos. 2a-b, two out of thirteen mutually very similar shells from Napoli and Capri (coll. 1) are figured, which link up fairly well with the ribbed specimens from Gabès. They, however, distinguish themselves by the low number of ribs per whorl which varies from 8 to 13, averaging 10.8, by the very strong labial rib, by the absence of ribless specimens, and by the colour. The base of the shells is white, with a sharp border to the pale brown background of the remainder of the shell. The ribs are white and there are two dark brown blotches at the white labial rib. The edge of the aperture is dark brown. Sometimes, the pale brown background merges into a somewhat darker spiral band below the periphery.

Samples from Porto Vecchio, Corse, and Bay Alilas²⁰, Zante (both coll. 1), contain similar but considerably less well preserved specimens. Those from Porto Vecchio, however, only measure up to 3.6 mm. Those from Bay Alilas are mixed with specimens which seem to be intermediate to specimens from Gabès. Unfortunately, the material available is not of sufficient quantity and quality for definite conclusions as to these intermediate forms.

Of a sample of eight specimens from Marsa Matrûh, N.W. Egypt (coll. 4), five are similar to the small form from Sfax. As regards the three remaining specimens, it cannot be decided with certainty whether they belong to *R. munda*, or not.

In the foregoing the connexion has been described between a number of what I believe to represent local forms of *R. munda*. Of course, the collections which I consulted contain more samples than mentioned. These, however, are of less importance, generally corroborating my views without really elucidating or complicating the situation.

The abundance of local forms of *R. munda* can be explained satisfactorily by assuming a remarkable susceptibility of the species for geographic isolating mechanisms, as already discussed in the introduction.

²⁰ I did not succeed in locating this name, neither on Zákynthos, Greece, nor anywhere else.

If so, the systematic position of the local forms largely depends upon to what degree a genetic isolation between them has developed. This, however, we do not know. My personal guess is that the local forms might be considered at best subspecies. Because, in my opinion, systematics should reflect nature as reliably as possible, it seemed not very useful to break up the species into a considerable number of subspecies, as long as we have no more information about the character of the geographic isolating factors and about the natural boundaries between the local forms²¹. I therefore have only distinguished between "forms". In referring to these, samples identical to those from Sfax can be indicated as *R. munda* s.s. and *R. munda* forma *minor* respectively, the others by the locality they come from.

Rissoa marginata Michaud, 1832

This is a sibling partner of *R. pulchella*, from which it often can only be separated by the dimensions of the embryonic whorl. The diameter of the nucleus is about 0.13 mm, that of the first half whorl about 0.25 mm.

There can be little doubt that Michaud (1832: 13) described either this species or *R. pulchella*. The type locality is Sète at about 130 km west of Marseille. Because *R. pulchella* is rare or absent on the French Mediterranean coast west of Marseille, we retain Michaud's well-known name for the species with a coarse tip.

Around the delta of the river Rhône²², the species shows considerable variation, comprising specimens with distinctly convex whorls, or a somewhat inflated body-whorl, a slenderness as low as 1.55, an ovoid habitus, obsolete and at the same time more numerous ribs, the ribs disappearing at more than 1/4 whorl before the labial rib, completely absent ribs, absent labial rib, absent spiral sculpture between the ribs, a more or less dark reddish-brown colour, or with numerous long, dark brown, longitudinal bands which are about as broad as their interstices. These colour bands are never conspicuous and are not narrow.

²¹ For general remarks as to the occurrence of local forms in the Golfe de Gabès, see Ghisotti, 1972.

²² 3 specimens from Pinet, Bassin de Thau. Coll. 4.
20 specimens from Etang de Berre, Côte de Provence, ex Monterosato. Coll. 3, no. 197115.

34 specimens from Etang de Berre, St. Chamas. Coll. 1 and 4.

11 specimens from Etang de Berre, Martigues. Coll. 2, Schw. v. M. 26041.

35 specimens from la Seyne, near Toulon. Coll. 1.

All 20 specimens from Etang de Berre, Côte de Provence, are ribless and thin, except for one which has a few obsolete ribs. The labial rib is usually absent, seldom moderately developed. They have the colour bands described above. The similarity to *R. benzi* is remarkable, but they have only a slight umbilical chink. Spiral striae are lacking. Compare plate VIII, no. 1d.

The other samples from the Etang de Berre, i.e., those from St. Chamas and Martigues, are very different from that from the Côte de Provence. The extreme variability of the sample from St. Chamas is illustrated by plate VIII, nos. 1a-e. Among others, it contains two ribless specimens similar to those from the Côte de Provence, and one which very much reminds one of some specimens from Grado, northern Adriatic, to be discussed below.

I did not succeed in finding much system in the variability within the samples from the delta of the river Rhône. On the contrary, I gained the strong impression that the characters listed above all change independently, but for the ribless specimens which seem to be confined to the Etang de Berre. In other words, in my opinion all the examined specimens belong to one species only, the ribless specimens probably being a local form.

The 40 specimens in a sample from Grado, 30 km west of Trieste, are characterized by the slight convexity of the whorls, the ovoid contour of the shells, the number of ribs per whorl which ranges from 17 to 23, averaging 19.1, the slenderness which ranges from 1.6 to 1.9, the ribs disappearing at about a half whorl or more before the labial rib or being fully absent, the obsolete or absent spiral sculpture, and the colour. Many specimens are shining brown, with a white, often strong labial rib. This white colour extends to the bottom of the shell, thereby forming a white spot around the lower end of the columella. Larger specimens are more bleached and of a paler brown with numerous long, dark, longitudinal colour bands, which are about as broad as their interstices. See plate VIII, nos. 3a-c.

I saw similar specimens from Venezia (1 shell in coll. 1 and 1 in coll. 2) and from Poreč, Istria (1 shell in coll. 5).

Coll. 2 contains four specimens, labelled "R. marginata Mich./Dalm. (Salinen) / 26043 Coll. Schwartz v. Mohrenstern". They differ from those from Grado in that they are more fragile and lack a labial rib.

Coll. 1 contains five specimens, labelled "Rissoa salinae Stoss., pr. Trieste, Monterosato ded. 19-7-98". They show a remarkable similarity to the ribless specimens from the Etang de Berre, but have 16 to 23 ribs per whorl. These ribs vary between obsolete and distinct; one shell has

only ribs on part of one whorl. Moreover, the shells have a more greenish colour and four of them are ovoid. They differ from the form from Grado by their fragility, the absence of a labial rib, the colour and by one individual not being ovoid. A normal specimen of *R. marginata* has also been collected at Trieste (coll. 2, Schw. v. M. 26078), so that it would be interesting to have more detailed information concerning the locality and ecology of *R. salinae*. As yet, it seems to be another local form of *R. marginata*. See plate IX, nos. 3a-b.

More to the south, at Sfax in Tunisia, we are confronted with what in my opinion is also a form of *R. marginata*. These shells are characterized by often distinctly convex whorls which sometimes are somewhat shouldered, the number of ribs per whorl which ranges from 16.5 to 26, averaging 20.3, obsolete spiral sculpture, an usually absent or poorly developed labial rib which, however, occasionally is strong, and a whitish colour, often with short, broad, longitudinal, pale yellow bands below the suture and a spiral row of spots of that colour at the periphery. Sometimes there is a third spiral row of such spots on the base, which spots may be united so as to form a zigzag spiral band. The ribs often disappear at about $3/4$ whorl before the edge of the mouth and are usually slightly curved. Occasionally the shells are ovoid. The number of ribs per whorl tends to be higher on the penultimate whorl than on the ultimate one.

Dr. J.J. van Aartsen wrote to me that a similar sample from Sfax, in the Jeffreys collection in the National Museum of Natural History in Washington (lot no. 332286), has a label in the handwriting of Monterosato, mentioning the name *Sabanea targioni* (Appelius). The form, however, seems to be connected to *R. marginata* by a series of ten specimens in coll. 1, labelled "Rissoa targioni (Appel.) Monts. v. minor Monts., Messine, Monterosato ded. 19-7-98". The length of these shells varies from 2.4 to 3.1 mm, the slenderness from 1.55 to 1.75. There are 14 to 20 ribs per whorl, averaging 16.7. The labial rib is absent in two specimens, moderate in seven and strong in one. The ribs disappear at about $1/4$ whorl or less before the labial rib. The shells usually have spiral sculpture, distinctly convex whorls, and, sometimes, an ovoid outline. One individual is very similar to shells in the sample from Sfax, others cannot be distinguished from certain specimens from la Seyne, near Toulon. Compare plate VIII, no. 2, and plate IX, nos. 4a-c and 5a-c.

The name *R. targioni* is found on two more samples, both in coll. 1. One contains two specimens from Messina which cannot be distinguished from *R. marginata* s.s. The other, labelled "Rissoa (*Sabanea*) *targioni* (Appelius) Monts. Messine. Monterosato 2.III.17", contains seven shells

which are identical to the ribless specimens from the Etang de Berre. Because it rather differs from the other samples from Messina which are labelled *R. targioni*, because it seems improbable that exactly the same form should occur at both localities, and because the presence of this form in the Etang de Berre seems to be well established, I suppose that the latter sample from Messina has an erroneous label.

The sample from Pontus Euxinus (Black Sea), discussed under *R. pulchella*, contained six specimens of *R. marginata*, see plate IX, nos. 2a-b. Though they belong to still another local form, their affinity to certain specimens from St. Chamas is evident.

A sample from Katákolon, 15 km west of Pírgos, Greece, comprising 19 specimens (coll. 8), is distinguished by the small dimensions of the specimens. The length ranges from 1.75 to 3.05 mm, averaging 2.3 mm. The number of ribs per whorl varies from 14 to 18. One shell has a remarkable, continuous, brown colour band below the suture. One specimen is figured on plate VIII, no. 6.

Samples from Paphos and Kyrenia, Cyprus, containing 23 adult specimens (coll. 8), are characterized by even smaller dimensions of the shells, which measure from 1.7 to 2.6 mm. Moreover, these shells are characterized by the high number of ribs per whorl, which ranges from 16 to 25, averaging 20.4. One shell is figured on plate VIII, no. 4.

As in *R. munda*, all these forms, however different they may be, have in common that they seem to be purely local and of a very close relationship indeed. I therefore take it that they belong to one species only, which is very susceptible to geographic isolating mechanisms.

Table 1. Comparison between *R. lineolata* Michaud and *R. radiata* Philippi.

	locality	length mm	slenderness	ribs per whorl	ribbed whorls	habitus of ribs
<i>R. lineolata</i>	Etang de Berre(a)	3.6?-5.7	1.75-2.1	15-20	0-3.5	distinctly curved to fairly straight
	Palavas (b)	3.4?-6.6	1.75-2.25	13-23	0-3.5	
	Etang de Diane (c)	2.6-5.5	1.7-2.25	12.5-18	0-4	slightly curved
	Lago del Fusaro (d)	4.2-4.7	1.75-2.0	13-18	1.5-3.5	slightly curved to straight
	Ródhos(e)	3.1?-5.2	1.8-2.3	13-15	0-3.5	
<i>R. radiata</i>	general	1.8-5.3	1.8-2.25	10-20	0-3.5	about straight
	Fornells (f)	2.6-4.8	1.7-2.0	15-18	0-3	slightly curved on one shell
	Trieste (g)	4.0	2.3	16	2.5	slightly curved
	Privlaka (h)	3.7-4.1	2.05-2.20	14.5-16.5	1.5-3.0	curved on two shells
	Palermo (i)	4.4	2.0	14	1.5	slightly curved

- (a) La Mède, France, about 50 specimens. Coll. 8
 (b) France, more than 100 specimens. Plate IV, no. 1
 (c) Corse, about 100 specimens. Plate IV, no. 2
 (d) Near Napoli, 6 specimens. Plate IV, no. 3
 (e) Main harbour, 24 specimens. Plate IV, no. 4

Table 1. ctd.

labial rib	spiral sculpture	umbilical chink	convexity of whorls	habitus of whorls
usually absent, otherwise broad and flat, seldom narrow and prominent, never strong	usually absent, otherwise slight	moderate	slightly to very convex	mainly evenly curved, sometimes sagging
			slights to distinct	
		slight but distinct	moderate to distinct	
slight to very slight				
absent or very weak	absent	moderate		
absent to strong	usually present	slight to absent	usually slight to moderate	usually sagging
weak	absent		slight to moderate	evenly curved
absent to moderate	absent on one shell	slight	distinct	
weak	absent		very convex	

- (f) Menorca, 8 selected shells resembling *R. lineolata*. Plate III, no. 1.
 (g) Aberrant specimen. Plate II, no. 2.
 (h) Near Zadar, 3 selected shells resembling *R. lineolata*. Plate I no. 7a.
 (i) Aberrant specimen. Plate I no. 5b.

Table 2. Summary of the discriminating characters of the discussed species.

<i>Rissoa</i> (<i>Turboella</i>)	length (mm)	often spiral striae between ribs	slenderness (see fig. 2)	whorls often sagging	number of ribs per whorl	body-whorl often somewhat inflated	number of ribbed whorls	often narrow axial colour lines	ribbed part of body-whorl ²
<i>parva</i> (da Costa, 1778)	1.8-5.0	+	1.7-2.4	-	8½-14	-	1-4	-	>0.5
<i>interrupta</i> (Adams, 1798)	do.	+	do.	-	do.	-	0-2.5	-	<0.5
<i>dolium</i> Nyst, 1843	1.3-3.4	-	1.8-2.4	-	12-20	-	>2	+	>0.5
<i>inconspicua</i> Alder, 1844	1.2-2.9	+	1.7-2.2	-	16-50	-	0-2.5	-	var
<i>radiata</i> Philippi, 1836	1.8-5.3	+	1.8-2.3	+	10-20	-	0-3.5	+	var
<i>radiata balkei</i> nov. subsp.	1.7-3.9	-	1.6-2.2	-	13-21	-	0-1.7	+	var
<i>lineolata</i> Michaud, 1832	2.6-6.6	-	1.7-2.3	+	13-23	+	0-4	+	var
<i>pulchella</i> Philippi, 1836	1.8-4.6	+	1.7-2.0	-	12-21	-	¾-3	-	>¾
<i>benzi</i> (Aradas & Maggiore, 1843)	3.1-4.0	-	1.6-1.9	-	18	+	0-0.5	-	0
<i>margininia</i> (Nordsieck, 1972)	1.7-2.8	-	1.6-1.9	-	12-18	-	¾-1.5	-	>¾

¹ ab(sent); we(ak); mo(derate); st(rong); v(ery) st(rong).

² var(iable); sl(ight); mo(derate); di(stinct); ve(ry convex).

³ A(tlantic coast of Europe and N.W. Africa); M(editerranean); B(lack) S(ea).

- All specimens listed above have a fine apex. The diameter of the nucleus is about 0.09 mm, that of the first half whorl about 0.15 mm. See fig. 1. *R. munda* (Monterosato, 1884), and *R. marginata* Michaud, 1832, are sibling species of *R. radiata* and *R. pulchella* respectively, from which species they can be separated by their coarse apex. The diameter of the nucleus is about 0.14 mm, that of the first half whorl about 0.24 mm. Both *R. munda* and *R. marginata* possess many local forms. Forms from different localities may

Table 2. ctd.

often darker spots below suture	labial rib ¹	nucleus more prominent	convexity of whorls (see Terminology) ²	distribution ³	figured on plate	additional remarks
-	st		di-ve	A M	I, 1	Falciform streak on labial rib. Spiral striae absent or covering the entire height of the interstices between the ribs.
-	we-st		sl-mo	A ? M	I, 2	
-	ab-we	+	di	M	I, 3	
+	st	+	mo	A M		Spiral striae may be remarkably strong, so as to produce a reticulated appearance.
-	ab-st		var	M	I, 4-7 II, 1-4 III, 1-3	A very variable species.
-	ab-mo		sl-di	A	III, 4-5	Sometimes with faint distant spiral ridges, see plate III, no. 4c.
-	ab-we		var	M	IV, 1-4	Umbilical chink often well developed. Only known from four localities.
+	st-v.st		sl-mo	M BS	V, 1-4	
-	ab		mo-di	M	VI, 1	Open umbilicus. Only known from Messina.
+	mo-st		sl	M	VI, 2	No umbilical chink. Weak, flat ribs. Only known from Haifa.

differ considerably.

- Aberrant specimens are not rare. The ribbed part of the body-whorl, the labial rib, the convexity of the whorls nor the colour pattern are very constant characters. Thus it may happen that single specimens cannot be identified reliably.
- It is not yet established whether *R. interrupta* is a separate species, of whether rib formation in *R. parva* is subject to exposural or environmental stress. Anyway, there is no sharp morphological border-line between shells of both forms. In case of doubt it is recommended to consider shells with less than 1.5 ribbed whorls, and/of faint or irregular ribs, to belong to *R. interrupta*.

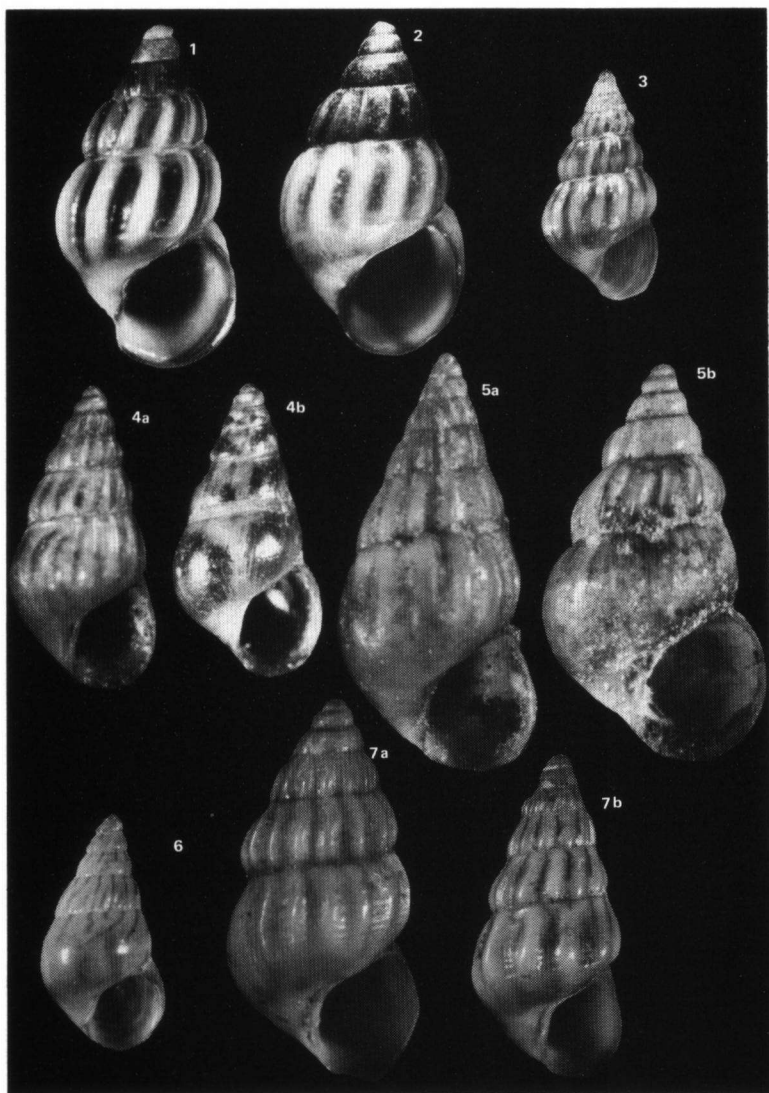


Plate I. 1, *Rissoa parva* (da Costa), Quiberon, Bretagne, France.

2, *Rissoa interrupta* (Adams), Gullmarfjord, Sweden.

3, *Rissoa dolium* Nyst, Trapani, Sicilia.

4 - 7, *Rissoa radiata* Philippi. 4, Original specimens from Sicilia (ex coll. Schwartz von Mohrenstern 26085). 5, Palermo. 6, Marzameni, Sicilia. 7, Privlaka 25 km N.W. of Zadar, Jugoslavia. All figures x 12.

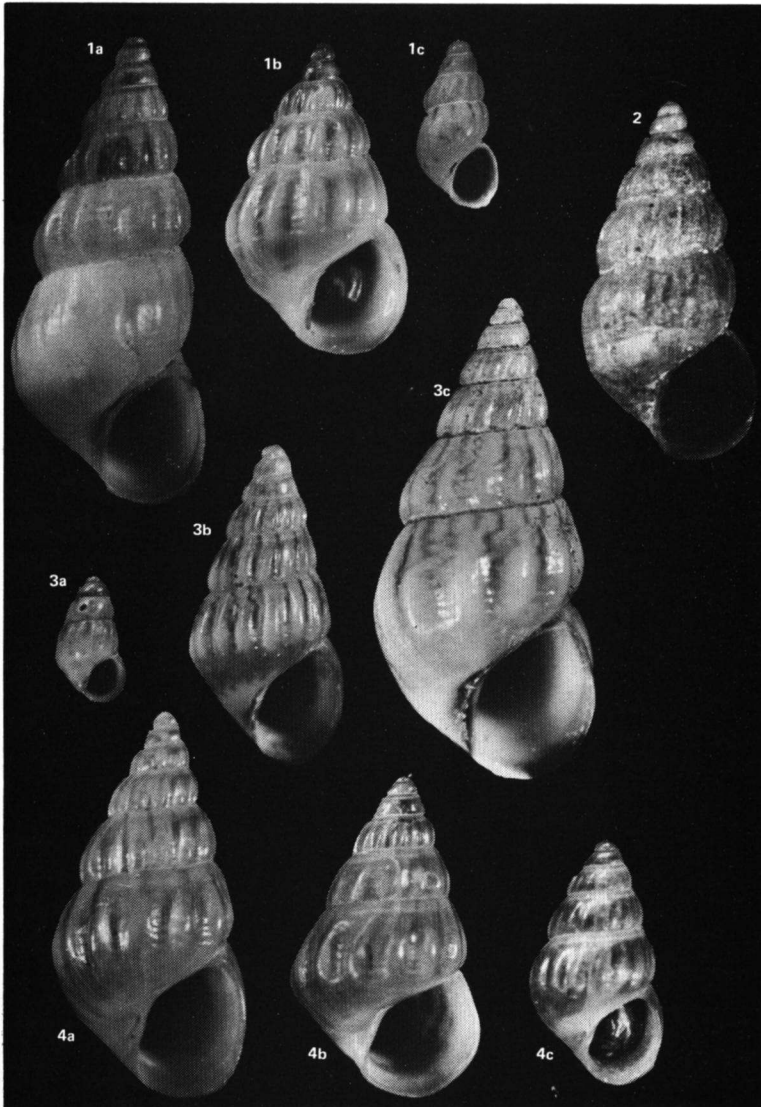


Plate II. *Rissoa radiata* Philippi. 1, Biograd, 25 km S.E. of Zadar, Jugoslavia. 2, Trieste. 3, Methoni, 50 km S.W. of Thessaloníki. 4, Ródhos, harbour. All figures x12.

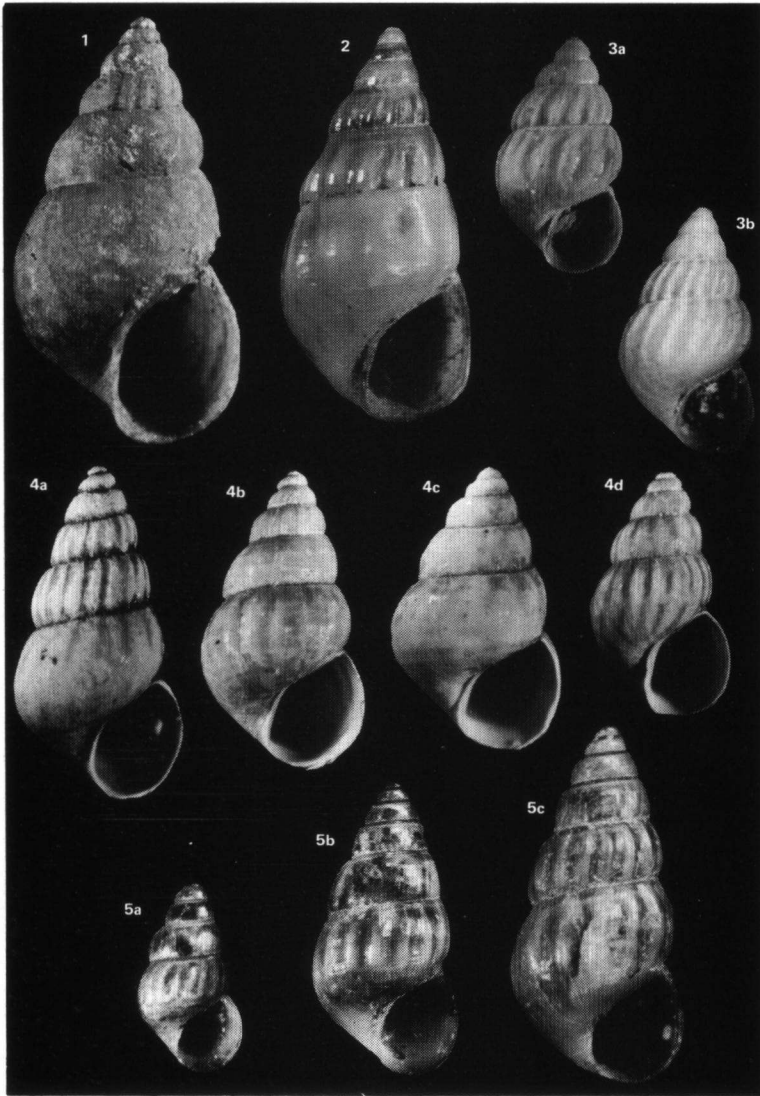


Plate III. 1 – 3, *Rissoa radiata* Philippi. 1, Fornells, Menorca. 2, Gabès, sponges. 3, Sfax.

4 – 5, *Rissoa radiata balkei* nov. subsp. 4, Ria de Arosa, N.W. Spain. 4b, Holotype. 5, Bassin d'Arcachon, W. France.

All figures $\times 12$.

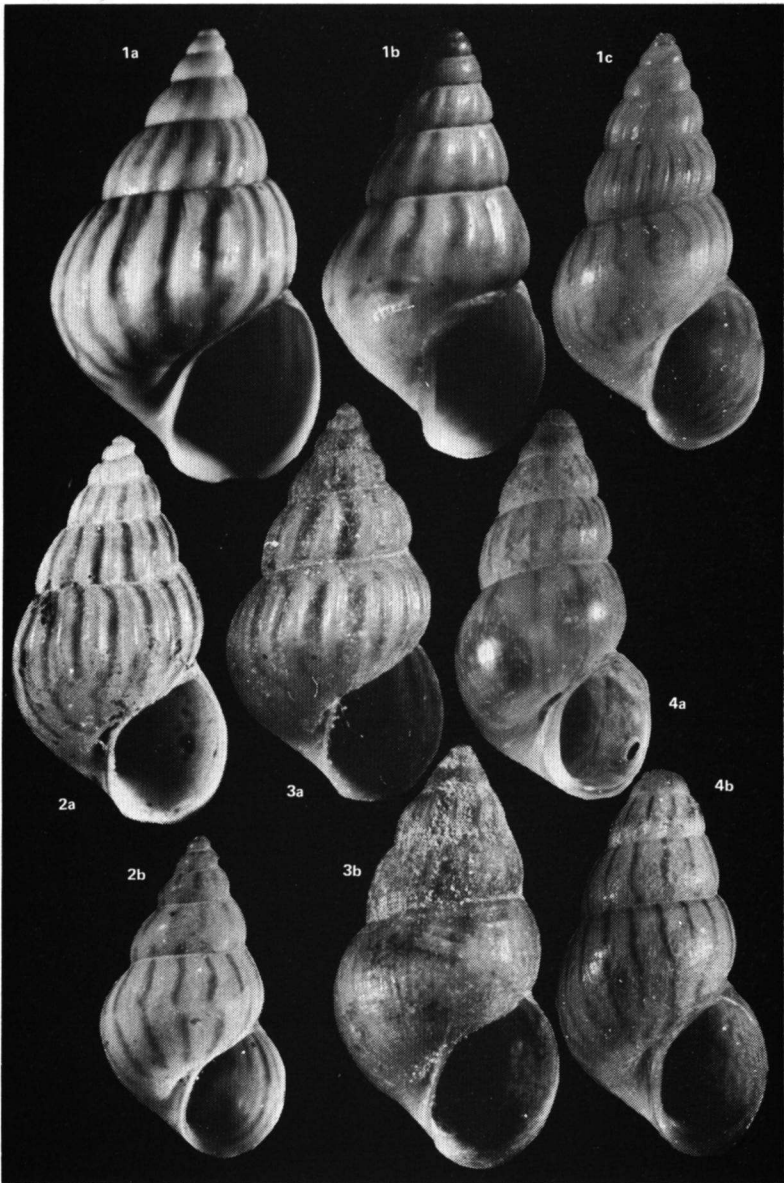


PLATE IV. *Rissoa lineolata* Michaud. 1, Palavas, S. France. 2, Etang de Diane, Corse. 3, Lago del Fusaro, near Napoli. 4, Ródhos, harbour. All figures x12.

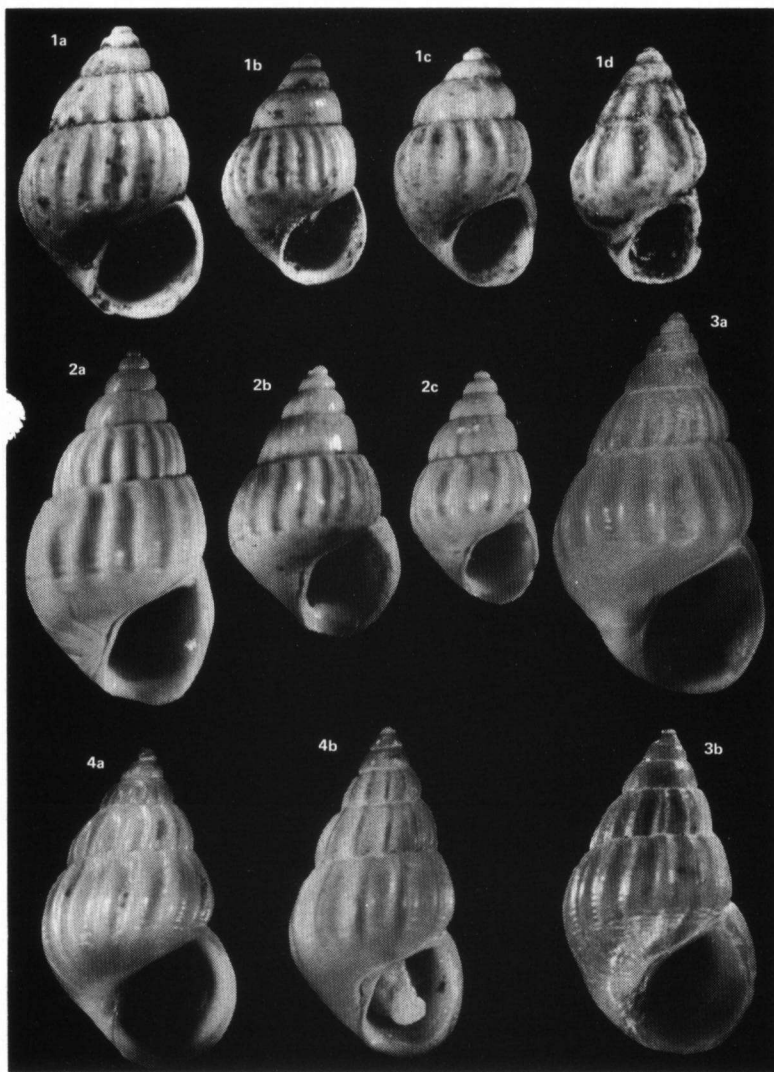


Plate V. *Rissoa pulchella* Phillipi. 1, Militello, Sicilia, fossil. 2, Bay near Moudhros, Límnos, Greece. 3, Poreč, W. Istra, Jugoslavia. 4, Black Sea. All figures $\times 12$.

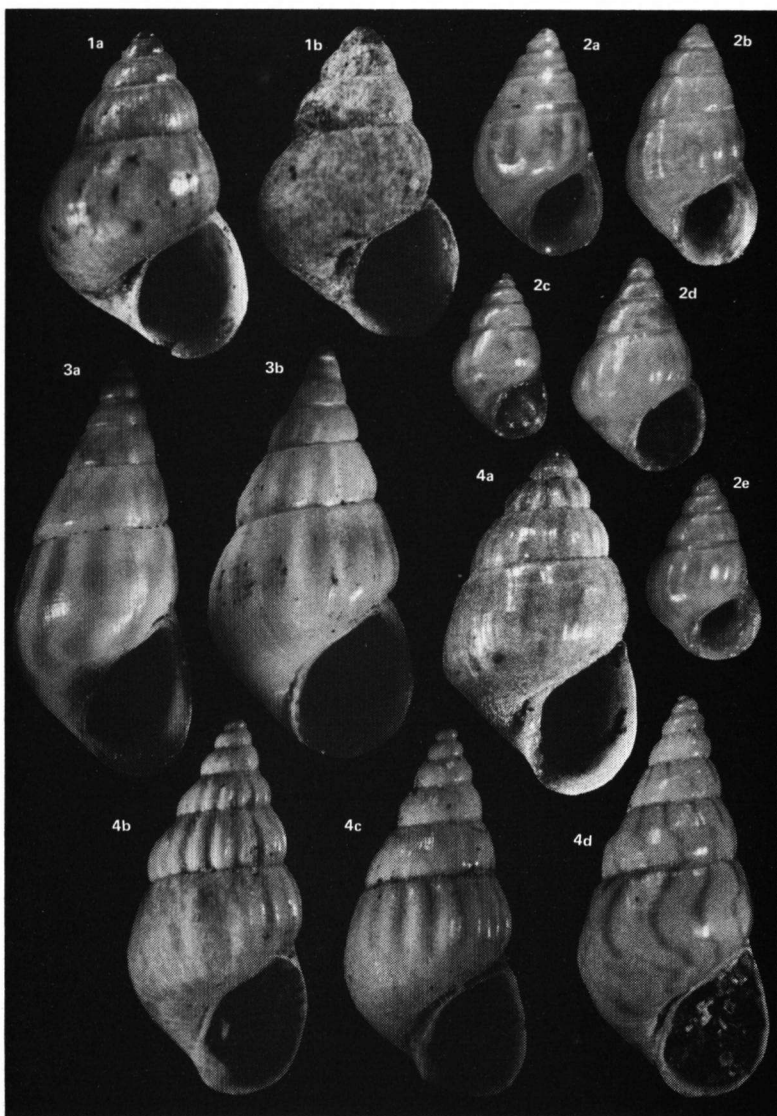


Plate VI 1, *Rissoa benzi* (Aradas & Maggiore), Messina.
 2, *Rissoa margiminia* (Nordsieck), Haifa. 2a, Lectotype.
 3 - 4, *Rissoa munda* (Monterosato). 3, Gabès, sponges. 4, Sfax
All figures x12.



Plate VII. *Rissoa munda* (Monterosato), 1. Sidi Daoud, near Cap Bon, Tunisia. 2, Capri. 3, Sciacca, Sicilia. 4, Ródhos, harbour. All figures x12.

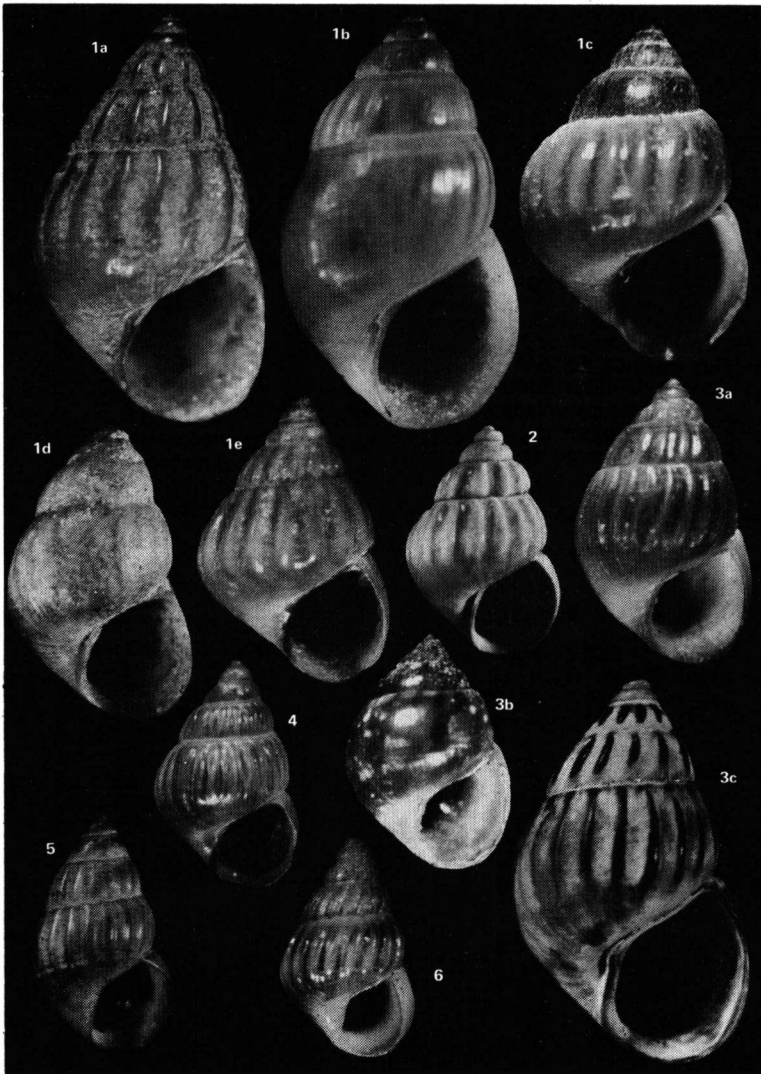


Plate VIII. *Rissoa marginata* Michaud. 1, St. Chamas, Etang de Berre, France. 2, La Seyne, near Toulon. 3, Grado, 25 km W. of Trieste. 4, Kyrenia, Cyprus. 5, Ródhos, harbour. 6, Katákolon, 15 km W. of Pírgos, Greece. All figures x12.



Plate IX. *Rissoa marginata* Michaud. 1, Poreč, W. Istra, Jugoslavia. 2, Black Sea
3, Trieste. 4, Messina. 5, Sfax. All figures x12.

REGISTRATION OF THE FIGURED SHELLS

Plate I:

1: Coll. 8, Quiberon 0073. 2: Coll. 4, Kristineberg 14.9.1961. 3: Coll. 8, Trapani 0151. 4: Coll. 2, Schw. v. M. 26085. 5: Coll. 2, Coll. Mus. Vindob. 79066. 6: Coll. 8, Marzameni 0037. 7: Coll. 8, Previlac 0074.

Plate II:

1: Coll. 8, Biograd 0042. 2: Coll. 3, No. 233249. 3: Coll. 8, Menthoni 0001. 4: Coll. 8, Rhodos haven ZO 0172.

Plate III:

1: Coll. 4. 2: Coll. 1. 3: Coll. 1, Sfax 12KL 18 MPR. 4: Coll. 4, Ria de Arosa 62/64, Reg. No. 2174, Sta. 1.597. 5: Coll. 1, Bassin d'Arcachon, Crassat d'Eyrac etc.; *Sabanea morleti* Monts. mss., ex Monts.

Plate IV:

1: Coll. 8, Palavas 0001. 2: Coll. 1. 3: Coll. 3, No. 233248. 4: Coll. 8, Rhodos haven ZO 0157.

Plate V:

1: Coll. 1. 2: Coll. 2, Edlauer 44468. 3: Coll. 5, No. 1325. 4: Coll. 3, No. 233160.

Plate VI:

1: Coll. 1. 2a: Coll. 3, No. 242138. 2b-e: Coll. 5, No. 442. 3: Coll. 1. 4: Coll. 1, Sfax, Bedi legit.

Plate VII:

1: Coll. 5, No. 9286. 2: Coll. 1. 3: Coll. 8, Sciacca 0174. 4: Coll. 8, Rhodos haven ZO 0198.

Plate VIII:

1: Coll. 1. 2: Coll. 1. 3: Coll. 8, Grado 0149. 4: Coll. 8, Kyrenia 0012. 5: Coll. 8, Rhodos haven ZO 0197. 6: Coll. 8, Katakolon 0001.

Plate IX:

1: Coll. 5, No. 1248. 2: Coll. 3, No. 243961. 3: Coll. 1. 4: Coll. 1. 5: Coll. 5, No. 9168.

SOME ABERRANT NAMES IN THE COLLECTIONS STUDIED;
SYNONYMS

Rissoa interrupta (Adams, 1798)

Names encountered:

- *R. inconspicua distans* (Nordsieck) for a specimen from the Channel which Dr. F. Nordsieck lent to me.

Synonyms:

- *R. parva* (da Costa, 1778), pars.
- *R. allermonti crassa* (Nordsieck, 1972).

Rissoa dolium Nyst, 1843

Names encountered:

- *R. ebrenbergi* Philippi, for a sample from Trieste (ex coll. Schw. v. Mohrenstern) in coll. 2, which contained 21 shells of *R. dolium* and 16 of *R. radiata* Philippi.

Synonyms:

- *R. obscura* Philippi, 1844, sensu Nordsieck, 1972, for completely brown shells.

Rissoa inconspicua Alder, 1844

Names encountered:

- *R. prismatica* Monterosato, for 21 shells from Palermo (ex Monterosato), 25 from St. Raphael, S.E. France, and 2 from Bastia, Corse, all in coll. 1.

Synonyms:

- *R. prismatica* (Monterosato, 1890).
- *R. densa* (Nordsieck, 1972).

Rissoa radiata Philippi, 1836

Names encountered:

- *R. ebrenbergi* Philippi, for 33 shells from Lesina, Italy, and a sample from Trieste containing 16 specimens of *R. radiata* and 21 of *R. dolium* (all ex coll. Schw. v. Mohrenstern) in coll. 2.
- *R. plicatula* (Risso) Schwartz, for 3 specimens from Palermo (ex Monterosato) in coll. 1.
- *R. pulchella* Philippi, for about 30 shells from Trieste (ex coll. Schw. v. Mohrenstern) in coll. 2, and for 3 shells from Sfax in coll. 1.
- *R. seminuda* (Monterosato) Dautz., for 13 specimens from Maharès, 25 km S.W. of Sfax, and for a large sample from Gabès, which contained *R. radiata* and *R. munda*, all in coll. 1.
- *R. simplex* Philippi, for 6 specimens from Trapani, Sicilia (ex Monterosato) in coll. 1, for 1 specimen from Dalmatia, 2 from Alger and a sample from Cap Couronne, S.E. France, containing 1 specimen of *R. radiata* and 1 of *R. dolium* (all ex coll. Schw. v. Mohrenstern) in coll. 2.
- *R. solidula* Monterosato ms., for 9 shells from Oran (ex Monterosato) in coll. 1.

Synonyms:

- *R. plicatula* (Risso, 1826) sensu Monterosato, 1884, et al., pars.

- *R. pulchella* Philippi, 1836, sensu Schw. v. Mohrenstern, 1863, et al.
- *R. simplex* Philippi, 1844, sensu Schw. v. Mohrenstern, 1863, et al.

Rissoa radiata balkei n. ssp.

Names encountered:

- *R. inconspicua* Alder var., for the specimens from the Rance area (ex Durouchoux) in coll. 1.
- *R. radiata* Philippi, for the specimens from El Memghar in coll. 1.
- *R. morleti* Monterosato ms., for the specimens from the Bassin d'Arcachon (ex Monterosato) in coll. 1.

Rissoa lineolata Michaud, 1832

Names encountered:

- *R. radiata* Philippi, for 10 shells from Martigues, S.E. France (ex coll. Schw. v. Mohrenstern) in coll. 2.
- *R. lineolata* Michaud var. *brevis* Monterosato, for a large sample from Etang de Diana, Corse (ex Monterosato) in coll. 1.

Rissoa pulchella Philippi, 1836

Names encountered:

- *R. ebrenbergi* Philippi, for 1 shell from Alger and many subfossil ones from Ródhos (all ex coll. Schw. v. Mohrenstern) in coll. 2.
- *R. marginata* Michaud, for one shell from Lovran, Jugoslavia, in coll. 1, and for 1 shell from the Adriatic (ex coll. Schw. v. Mohrenstern) in coll. 2.

Synonyms:

- *R. ebrenbergi* Philippi, 1836, non Philippi, pars.
- *R. marginata* Michaud, 1832, non Michaud, pars.

Rissoa munda (Monterosato, 1884)

Names encountered:

- *R. albella* Lovén, for 6 specimens from Messina (ex Benoit) in coll. 3.
- *R. ebrenbergi* Philippi, for 12 shells from Ródhos (ex coll. Schw. v. Mohrenstern) in coll. 2.

- *R. lineolata* Michaud, for a large sample from Sfax (det. Nordsieck) in coll. 3.
- *R. lineolata* Michaud var. *diaphana* Monterosato ms., for 3 shells from Lampedusa (ex Monterosato) in coll. 1.
- *R. marginata* Michaud, for 48 specimens from Sfax (det. Nordsieck) in coll. 3.
- *R. micra* Monterosato ms., for 4 shells from Lampedusa (ex Monterosato) in coll. 1.
- *R. parva* Mat., for 6 specimens from Capri (ex Conemenos) in coll. 1.
- *R. plicatopsis* Monterosato ms., for 5 specimens from Magnisi, Sicilia (ex Monterosato) in coll. 1.
- *R. plicatula* (Risso) Schw., for 3 shells from Messina and 1 from San Pietro, Sardegna (all ex Monterosato) in coll. 1.
- *R. pulchella* Philippi, for a sample which contained 4 shells of *R. munda* and 6 of *R. ? lineolata* from the Mediterranean (ex coll. Schw. v. Mohrenstern) in coll. 2.
- *R. radiata* Philippi, for 38 shells from Sfax in coll. 1, and for a mixture of *R. munda* and *R. radiata* from Alger (ex coll. Kobelt) in coll. 3.
- *R. seminuda* (Monterosato) Dautz., for 14 specimens from Sfax and for a large sample from Gabès, which contained *R. munda* and *R. radiata*, all in coll. 1.

Synonyms:

- *R. lineolata* forma *irregularis* (Nordsieck, 1972).
- *R. plicatula* (Risso, 1826), sensu Monterosato, 1884, et al., pars.

Rissoa marginata Michaud, 1832

Names encountered:

- *R. cerasina* Brusina, for 4 shells from Athos, Greece (ex Monterosato, ex Chaster) in coll. 1.
- *R. diversa* Monterosato, for 10 specimens from Palermo (ex Monterosato) in coll. 3.
- *R. ehrenbergi* Philippi, for a sample which contained 17 specimens of *R. marginata* and 3 of *R. pulchella*, Dalmatia (ex coll. Schw. v. Mohrenstern), and for 6 shells from an unknown locality (ex Brusina), all in coll. 2.
- *R. falsa* Monterosato ms., for 6 shells from Palermo and 12 from Magnisi, Sicilia (all ex Monterosato) in coll. 1.
- *R. pulchella* Philippi, for 7 specimens of *R. marginata* (mixed with 2 of *R. munda*) from Magnisi, Sicilia, for 3 specimens from Palermo (all ex Monterosato), for 35 specimens from la Seyne, S.E. France,

and 31 from Sfax, all in coll. 1; for 1 specimen from England²³, and 15 subfossil shells from Ródhos (all ex coll. Schw. v. Mohrenstern) in coll. 2, and for a mixture of 44 shells of *R. marginata* and 13 of *R. munda* from Sfax (det. Nordsieck) in coll. 3.

- *R. salinae* Stossich, for 5 specimens from Trieste (ex Monterosato) in coll. 1.
- *R. supracostata* Monterosato, for 11 shells from Sfax (ex Monterosato) in coll. 1.
- *R. targioni* (Appelius) Monterosato, for 2 specimens from Messina (ex Monterosato) in coll. 1.
- *R. targioni* (Appelius) Monterosato var. *minor* Monterosato, for 10 shells from Messina (ex Monterosato) in coll. 1.

Synonyms:

- *R. diversa* (Nordsieck, 1972).
- *R. ehrenbergi* Philippi, 1844, non Philippi, pars.
- *R. pulchella* Philippi, 1836, pars.

²³ On all labels in the Schwartz von Mohrenstern collection the number 1890 has been printed behind his name. Dr. J.J. van Aartsen suggested to me that the labels might have been rewritten in 1890, i.e. after Schwartz's death. If the person who rewrote the labels had difficulty in reading unfamiliar geographic names, this might explain the frequency of unlikely localities in the collection, such as *R. inconspicua* from Bahia and Iquique, *R. marginata* from England and *Alvania subcrenulata* Schwartz from Java. Unfortunately, any original labels have been destroyed.

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