

On taxonomy and variability of Recent European species of the genus  
*Bittium* Leach (Mollusca, Gastropoda, Prosobranchia)

A. VERDUIN

Rijksmuseum van Natuurlijke Historie, Leiden

INTRODUCTION

Because of the variability and great similarity of the forms involved, the taxonomy of the Recent European and North African representatives of the genus *Bittium* Leach in Gray, 1847, is far from satisfactory. Of course, shells of *B. lacteum* (Philippi, 1836) and *B. latreillii* (Payraudeau, 1826) can always be recognized with certainty (see Gründel, 1976; Verduin, 1976; and with regard to the larval shells of the latter species, Richter & Thorson, 1975). But among the remaining forms, indicated in this paper as *B. reticulatum* s.l., it proved to be very difficult indeed to distinguish conchological borderlines along which adult shells can be satisfactorily separated into a number of good species. Evidently, conchological differences between the adult shells of the species involved are not sufficiently obvious to be recognized with predominantly semi-intuitive methods<sup>1</sup>, of old widely used in taxonomy. This explains most of the differences between opinions published previously (e.g., Risso, 1826: 157; Bucquoy, Dautzenberg & Dollfus, 1884: 212; Locard, 1892: 120; Priolo, 1956: 286; Nordsieck, 1976; Piani, 1980: 135), and the results of a more factual<sup>1</sup> approach, offered below.

As regards larval shells, the situation is rather complicated. Though it has been demonstrated that among larval shells of *Bittium* a number of species may be distinguished, identification of some of these proved to be difficult because of the unsatisfactory taxonomy of the adult shells. Shells of *B. latreillii* may be identified with certainty by their sculpture, even if very young. Thus, it is not difficult to verify that Richter & Thorson's (1975: 128) identification of the protoconchs of that species is correct. The larval shells figured by Richter & Thorson s.n. *B. reticulatum*, however, differ from those ascribed to that species by Babio & Thiriot-Quévieux (1974: 536). I had the opportunity to examine the adult shells used by Richter & Thorson for the identification of their larval shells, now in the Natur-Museum Senckenberg, Frankfurt/Main. The adult shells which they identified as *B. reticulatum* in my opinion belong to *B. jadertinum* (Brusina, 1865). The adult shells which they identified as *B. jadertinum*, certainly belong to *Cerithidium submammillatum* (Rayneval & Ponzi, 1854), which is a senior synonym of *Bittium pusillum* (Jeffreys, 1860) (see Van Aartsen & Verduin, 1982). In fig. 1 one of the shells of *C. submammillatum* used by Richter & Thorson is shown next to a very small, but seemingly full-grown specimen of *B. jadertinum*.

<sup>1</sup> The words "intuitive" and "factual" refer to the way specific characters are established. With intuitive methods, the author relies mainly on his impressions. In the factual approach, he bases his views on an adequate amount of factual information and a scientific species concept. Generally, both methods may only lead to different results if the specific characters involved are not very obvious.

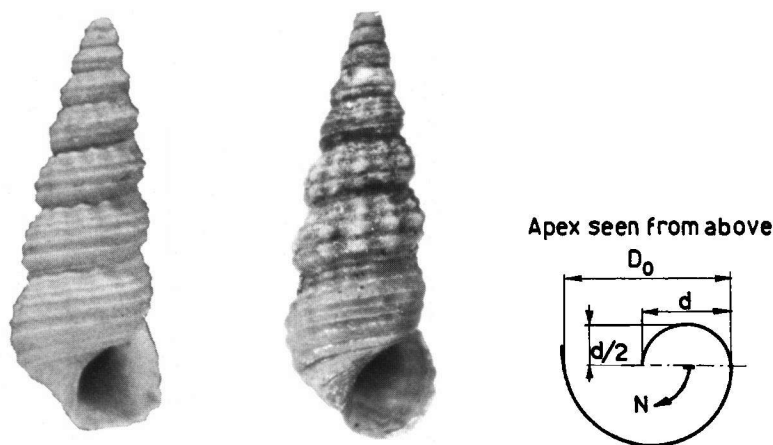


Fig. 1 (left). A small specimen of *Cerithidium submammillatum* (Rayneval & Ponz), left as compared to a small specimen of *Bittium jaderinum* (Brusina), right; magnification 20 x. See also table 2.

Fig. 2 (right). Definition of measurements  $d$  and  $D_0$ , and of number of whorls  $N$ .

Babio & Thiriôt-Quévieux have reported the presence of two species of *Bittium* among protoconchs collected near Roscoff, NW. Bretagne, France, one of which the authors identified as *B. reticulatum*. The other species was identified by Cabioch & Babio (1975: 3) as *B. simplex* (Jeffreys, 1867). The protoconch shown by Babio & Thiriôt-Quévieux on pl. III figs. A and D, however, only measures about  $d = 0.06$  mm and  $D_0 = 0.10$  mm (fig. 2), which is much smaller than the apical dimensions of the shells of *B. lacteum simplex* examined by me, which at Guernsey vary from about  $d = 0.13$  mm and  $D_0 = 0.26$  mm to  $d = 0.17$  mm and  $D_0 = 0.30$  mm. Yet, the number of whorls of the protoconch shown by Babio & Thiriôt-Quévieux, i.e. one and a half, can only apply to *B. lacteum simplex*. I therefore believe that the magnification factor given by Babio & Thiriôt-Quévieux is not correct.

Except for that of *B. latreillii* and *B. lacteum simplex*, I did verify no identification of larval shells.

#### MATERIAL EXAMINED

This investigation is based on adult shells only. Samples from the following collections were examined: (1) Ph. Dautzenberg, in the Koninklijk Belgisch Instituut voor Natuurwetenschappen, Brussels; (2) British Museum (Natural History), London; (3) Rijksmuseum van Natuurlijke Historie, Leiden; (4) Schelpenmuseum "In de Schulp" (B. Entrop colln.), The Hague (Scheveningen); the private collections of (5) Dr. J.J. van Aartsen, Dieren; (6) Mr. A.W. Lacourt, Leiden; and (7) myself. I am very much obliged to these persons and institutions for the loan of their material. I also want to thank the National Museum

of Natural History, Washington, D.C. (U.S.A.), and the Natur-Museum Senckenberg, Frankfurt/Main, for the loan of additional material, and Ms. K. Way of the British Museum (Natural History) and Ms. C.H. Brock of the University of Glasgow for their help.

## RESULTS

The main question to be answered in this paper is, of course, by which characters adult shells of the species involved can be distinguished from each other. As regards *B. lacteum simplex* (Jeffreys, 1867), the answer is easy, because there can be no doubt whatsoever that the shells examined, including the type material in the Jeffreys collection (National Museum of Natural History, Washington), are conspecific with those which I discussed and figured before (Verduin, 1976: 138) as *B. lacteum hanleyanum* Monterosato, 1889, and consistently differ from *B. reticulatum* s.l. in the distinctly larger apical dimensions. Moreover, *B. lacteum simplex* is always completely devoid of varices.

Among *B. reticulatum* s.l., however, there proved to be no completely specific characters by which the complex may be easily subdivided into a number of distinct units. Yet, as will be demonstrated below, three good species may be distinguished among *B. reticulatum* s.l., i.e. *B. jadertinum*, *B. scrabum* and *B. reticulatum* s.s. Figs. 13a-e represent a sample from Roscoff, NW. Bretagne, France, which, judging from the appearance of the shells, may have been collected alive. Though at first sight the sample is very homogeneous indeed, as is illustrated by figs. 13c-e, two clusters appear in fig. 13b, clearly demonstrating the presence of two distinct forms among the sample. The same conclusion may be drawn from the bimodality of the histograms shown in fig. 13a. In my opinion, both forms must be considered distinct species because there seems to be no other reasonable explanation of the fact that they differ in two seemingly independent aspects: in the maximum length as well as in the number and position of the varices. Of course, sexual dimorphism might also be a suitable explanation, but it does not apply because the frequency ratio of both forms is not sufficiently constant among the other samples examined.

Once recognized, the small form with only few, terminally situated varices proved to occur among many samples, from Scotland to Israel, and to Agadir, SW. Morocco, and the Canaries. Because of the words "rare varicosa" in the original diagnosis, and because of the small dimensions mentioned by Brusina, I consider it conspecific with *B. jadertinum* (Brusina, 1865). Figs. 3a-c represent a sample washed ashore at Torremolinos, 15 km SW. of Málaga, S. Spain, which even consists exclusively of *B. jadertinum*. Similar samples are from Getarés, a few km S. of Algeciras, S. Spain (about 65 shells washed ashore, colln. 7, no. 0041), and from Cala Burras, about 30 km SW. of Málaga (61 shells in colln. 5, no. 10174a).

Yet, the precise conchological borderline between *B. jadertinum* and the other species in the sample from Roscoff, which will be identified below as *B. reticulatum* (Da Costa, 1778) s.s., is not very clear in samples from other localities. This is illustrated by figs. 6a-e, which represent a sample washed ashore at Port le Niel, 10 km S. of Hyères, SE. France, among which the borderline between *B. jadertinum* and *B. reticulatum* s.s. almost completely disappears. Nevertheless, the bimodality of the histogram on the right in fig. 6a still points to the presence of two distinct species, one of which is *B. jadertinum*.

Figs. 4a-f represent a sample from Agròpoli, 40 km SE. of Salerno, Italy, which contains five shells with large values for  $V_1$ , in addition to a great number of shells

which obviously belong to *B. jadertinum*. Though these five shells cannot be distinguished from *B. reticulatum* s.s., I believe them to belong to *B. jadertinum*. This opinion is mainly based upon the limited length and the small number of varices of all five shells. In this respect, fig. 4b clearly differs from e.g. the samples represented by figs. 6b and 10b (the latter washed ashore in the harbour of Ródhos, Greece), which clearly contain both *B. jadertinum* and *B. reticulatum*. Another argument for the occasional occurrence of shells with large values for  $V_1$  among *B. jadertinum* is provided by a very large sample from Cumbræ, Scotland (colln. 2), which also seems to belong entirely to *B. jadertinum* (the length of the shells in the sample never exceeds 8.1 mm, the number of varices per shell never exceeds four), and among which also a small percentage of the shells have large values for  $V_1$  without differing in any other respect from the remaining shells.

As has been shown above, the samples from Roscoff, Port le Niel and Ródhos represented by figs. 13a-e, 6a-e and 10a-c respectively, contain a second species in addition to *B. jadertinum*. This second species does also occur in many other samples, from Bantry, Ireland (32 specimens, plus 4 shells of *B. jadertinum*, see fig. 28), to far into the Mediterranean. It differs from *B. jadertinum* in average greater length, larger values for  $V_1$  and more varices. In my experience, it is the only British species which meets Da Costa's diagnosis and distribution of *B. reticulatum* (Da Costa, 1778) rather satisfactorily, and therefore I consider it conspecific with that species. In many respects it proves to be rather variable. The shell shown in fig. 10c, from Ródhos, is representative for shells of *B. reticulatum* s.s. from many Mediterranean localities, especially for shells dredged at some depth (many samples in colln. 5: Kastós, Greece, depth 45 m, no. 14591; south coast of Sicily, depth 50 m, no. 13567, figs. 11a-b; Gaeta, Italy, depth 12 m, no. 14462, fig. 12a; central Tuscan Sea, depth 250 m, no. 14128; Moneglia (Genoa), depth 30 m, no. 15079). On the lower whorls all four spiral ridges are usually about equally well developed, with the result that the whorls are somewhat flattish. Often the shells have a slightly scalariform appearance. Moreover, the shells are remarkably slender as compared to those of other species of *Bittium*. Among samples washed ashore, however, the characters just mentioned often are weak or absent, so that among such samples shells of *B. reticulatum* s.s. may be very similar indeed to those of *B. jadertinum*. This is illustrated by the shells shown in figs. 6c-e.

Figs. 21a-g represent a sample washed ashore on the muddy sand flats S. of Fuseta, 16 km E. of Faro, S. Portugal. The shells with few varices, which appear on the left in fig. 21b, belong to a third species, i.e. *B. scabrum*, which will be discussed below. There can be little doubt, however, that the shells on the right in fig. 21b belong to *B. reticulatum* s.s. Though the shells shown in figs. 21c-e are not particularly slender, and though in one of these shells the subsutural spiral ridge is underdeveloped, most of the characters of *B. reticulatum* s.s. can be recognized in them. The shell of fig. 28, which represents a sample from Bantry, Ireland, is obviously conspecific with the shells from Fuseta shown in figs. 21c-e. The shell of fig. 26 represents a sample of 54 specimens of *B. reticulatum* s.s. washed ashore at Kerhostin, a few km N. of Quiberon, S. Bretagne, France. Shells in this sample measure up to 14.5 mm. In another sample of *B. reticulatum* s.s. labelled: "*Bittium reticulatum* da Costa/Tenby/Cooper colln. 84" (colln. 2), from Wales, U.K., the shells even measure up to 17.5 mm.

Fig. 13e shows a specimen of *B. reticulatum* s.s. from Roscoff, NW. Bretagne. As has been remarked before, it has a great similarity to *B. jadertinum*. Yet, it does not differ essentially from the shell from Bantry, shown in fig. 28.

The shell of fig. 27 represents a sample of 19 specimens of *B. reticulatum* s.s. from Helford Ricer, Cornwall, England, which have the two subsutural spiral ridges more or less united, a phenomenon I have never seen in any other sample.

The shells of figs. 17b, 19b and 22b will be discussed in the chapter on puzzling samples.

We now come to the third species among *B. reticulatum* s.l., i.e. *B. scabrum* (Olivi, 1792). Figs. 20a-e represent a sample washed ashore at Grado, 25 km W. of Trieste, northern Adria, which clearly differs from all samples of *B. reticulatum* s.s. in the high percentage of shells which are completely devoid of varices. Moreover, nearly all shells differ from those of Mediterranean *B. reticulatum* s.s. in the poorly developed subsutural spiral ridge, the somewhat less slender habitus and the colour, which usually is a conspicuous, uniform deep brown. The sample differs from *B. jadertinum* in the larger dimensions of the shells, the poorly developed subsutural spiral ridge in nearly all shells, the inequidistant spiral ridges in the shells with four spiral ridges on the lower whorls, the general appearance of the tubercles, and the colour of the shells. The sample from Grado agrees excellently<sup>2</sup> with the descriptions and figures of *B. scabrum* in Bucquoy, Dautzenberg & Dollfus (1884: 214). It is not the only sample of that species which I saw from the Mediterranean. Colln. 1 contains a large sample of similar shells from Corsica, labelled: "Bittium/Etang de Diane/gal/de Lamothe leg. e ded." Moreover, there can be no doubt that the forma *B. paludosum* Bucquoy, Dautzenberg & Dollfus, 1884, is conspecific with *B. scabrum*, as is illustrated by the shell of fig. 29. The fact that I did not find a single sample among the extensive Mediterranean material studied, which was even approximately intermediate between *B. scabrum* on the one hand and *B. jadertinum* or *B. reticulatum* s.s. on the other hand, is my first argument for the thesis that *B. scabrum* is a distinct species. Along the European Atlantic coast, however, it is sometimes much more difficult to distinguish *B. scabrum* from *B. reticulatum* s.s., as will be discussed below.

A second argument for the separate identity of *B. scabrum* is to be found in a sample washed ashore in the large lagoon Amvrakikós Kólpos, Greece, at a locality about 8 km N. of Prévesa. In addition to an inseparable mixture of shells of both *B. jadertinum* and *B. reticulatum* s.s. (see the graph shown in fig 8b), the sample contained rather different shells almost without varices (fig. 30). Though the latter shells are far smaller than is usual in *B. scabrum*, and though they are of a different, almost orange colour, their sculpture is very similar indeed to that of the shells of *B. scabrum* shown in figs. 20d and 29. I strongly believe them to be an atypical form of *B. scabrum*. Because the shells of *B. jadertinum* and *B. reticulatum* s.s. from the same locality are also somewhat atypical, I am inclined to presume that the local habitat, in a shallow out-of-the-way place of an inland sea, was not very favorable, resulting in atypical shells. Anyway, the sample supports the opinion that three species may be distinguished among *B. reticulatum* s.l.

A third argument for the distinct status of *B. scabrum* is provided by fig. 21a, which represents the sample washed ashore at Fuseta, mentioned before. The conspicuous bimodality of the histogram at the right clearly points to the presence of two distinct forms. The shells with few, terminally situated varices (see fig. 21b) show all characters

<sup>2</sup> It should be noted that the number of spiral ridges per whorl is not strictly limited to three, as is occasionally suggested in the literature (Monterosato, 1884: 122; Carus, 1893: 361).

in which *B. scabrum* differs from *B. jadertinum*. A few of such shells have been figured (figs. 21f-g).

A similar argument is to be found in a large sample, washed ashore at Lagos, S. Portugal, which is represented by figs. 22a-c. According to characters of the sculpture of the body whorl (especially the width of the spiral ridges as compared with that of the interstices; furthermore the inequidistant spiral ridges, the development of the subsutural spiral ridge and the distinctness of the abapical edge of the spiral ridges), the sample could be convincingly divided into (A) an immense number of small shells, represented by fig. 22b, and (B) a far smaller fraction of larger shells, represented by fig. 22c. A small part of fraction (A) has been measured; the histograms are shown below the horizontal line in fig. 22a. Obviously, the great majority of the shells in fraction (A) belongs to *B. jadertinum*. The few shells which do not belong to that species will be discussed in the chapter on puzzling samples. Among fraction (B) no shells occur with values for  $V_1$  in the range  $1.1 \leq V_1 \leq 1.8$ . This allowed me to subdivide fraction (B) as shown in the histograms above the horizontal line in fig. 22a. Obviously, two forms occur among fraction (B), of which the one with  $V_1 < 1.1$  belongs to *B. scabrum*. The form with  $V_1 > 1.8$  belongs exclusively, or almost so, to *B. reticulatum* s.s.

All considered, there seems to be decisive evidence that *B. scabrum* is a distinct species, notwithstanding the fact that the conchological borderline with *B. reticulatum* s.s. is not always very sharp.

From the above it may be concluded that *B. scabrum* does also occur on the European Atlantic coasts. This conclusion is strongly supported by two small samples from St. Lunaire, N. Bretagne, France (9 shells in colln. 4, no. 1805) and St. Jacut, a few km W. of St. Lunaire (7 shells in colln. 4, no. 4683) respectively, which I found very similar indeed to the Mediterranean specimens of *B. scabrum*. The same is true for a sample of 26 shells in colln. 1, labelled: "*Bittium reticulatum* Da C. var./Lagoa d'Obidos (Portugal)/Choffat leg." The Lagoa d'Obidos is 80 km N. of Lisboa. In the three samples just mentioned, the number of varices per shell is very small. This is different in a sample washed ashore in the very small Lagoa de Albufeira, near Alfarim, about 5 km N. of Sezimbra and 25 km S. of Lisboa (figs. 23a-b). Except for the greater range of variation of the number and position of the varices, the shells in this sample are rather similar to *B. scabrum* in the sample from Fuseta (figs. 21f-g). It is reasonable to consider them conspecific, though the shells from Alfarim differ from most Mediterranean representatives of *B. scabrum* in the better developed subsutural spiral ridge and the higher percentage of shells with varices.

I could find no support for Monterosato's (1884: 122) opinion that *B. exiguum* Bucquoy, Dautzenberg & Dollfus, 1884<sup>3</sup>, is a distinct species. Monterosato reports the form from a number of North African localities, among which Tunisia and the Golfe de Gabès. I examined a few samples from the two localities last mentioned, and measured the shells in two of these (figs. 5a-c and 7 respectively). Except for the somewhat greater length of some of the shells, and the presence of two shells which may belong to *B. reticulatum* s.s., the histograms of fig. 5a are completely similar to those of *B. jadertinum* from other Mediterranean localities. The conclusion that *B. exiguum* is no more than a

<sup>3</sup> *Cerithium scabrum* var. *exigua* Monterosato, 1878, is a nomen nudum. The description by Bucquoy, Dautzenberg & Dollfus (1884: 215) precedes that by Monterosato (1884: 122).

local, slender form of *B. jadertinum* (and possibly *B. reticulatum* s.s.) is also supported by the sculpture and habitus of the two shells of figs. 5b-c, which have been selected to show the range of variation of the slenderness of the shells in the sample. I am inclined not to attach taxonomical importance to the fact that in many shells one or two subsutural spiral ridges are remarkably weak, because all forms with sculpture intermediate between that and the normal sculpture of *B. jadertinum* are present in great quantities. The dimensions of the apices do not differ from those of *B. jadertinum* and *B. reticulatum* s.s. from other localities.

The sample from Tunisia represented by fig. 7 contains a larger percentage of *B. reticulatum* s.s., but does not differ from other Mediterranean samples of *B. jadertinum* plus *B. reticulatum* s.s., except for a slightly increased mean slenderness of the shells.

The shell of fig. 25 represents a sample from Nabeul, 65 km SE. of Tunis (colln. 5, no. 9394), which contains no particularly slender shells at all. Thus, all intermediate forms between exceptionally slender shells and normal shells of *B. jadertinum* are present in great numbers among the samples from Tunisia examined.

#### PUZZLING SAMPLES

In the above, I have presented the main results of this investigation, and the way I think these should be understood. Now, a few samples will be discussed which do not fit naturally into the picture outlined above.

One of the samples to be discussed here belongs to colln. 1 and is labelled: "Bittium reticulatum Da Costa/Fours à Chaux/dd. 8. 95." It is from St. Servan<sup>4</sup>, at the easterly border of the Rance, a few km S. of St. Malo, N. Bretagne, France. The sample is represented by figs. 17a-b. It clearly differs from *B. scabrum* in the four well developed, broad, equidistant spiral ridges on the whorls of most shells, and in the pale, sandy colour. As compared to *B. reticulatum* s.s. from Roscoff (figs. 13a-b), the sample differs in the low number of varices and in the small values for  $V_1$  in the great majority of the shells. Moreover, the shells are somewhat less slender (figs. 13e and 17b). Another sample, from nearly the same locality and labelled: "Bittium reticulatum da Costa/Région de St. Servan" (colln. 1), is represented by figs. 16a-b. This sample is in many respects intermediate between those from Fours à Chaux and Roscoff (figs. 17a and 13a respectively). From this observation, I conclude that the samples from St. Servan represent a local form of *B. reticulatum* s.s., in combination with some specimens of *B. jadertinum*. I have seen similar samples from both sides of the English Channel (figs. 15, 18 and 19a). A shell from Torbay, SW. England, is shown in fig. 19b.

Yet, the concentration of shells at the upper left in fig. 16b still puzzles me. They seem to be separated from those of *B. reticulatum* s.s. by a zone with few shells, indicated by two arrows in fig. 16b. They differ from *B. jadertinum* in the large dimensions. Similar shells occur among samples from Fours à Chaux (figs. 17a-b), St. Lunaire, 5 km W. of St. Servan (colln. 7, no. 0034) and Val André, 40 km W. of St. Servan (fig. 15). Because I

<sup>4</sup> I failed to find Fours à Chaux in any of the geographical works consulted. The locality, however, is mentioned several times by Dautzenberg & Durouchoux (1914: 30, 35, 62 and 63) in connection with St. Servan.

have not seen such shells from anywhere else, I am inclined to consider them a local form of *B. jadertinum*.

Two other samples which puzzled me are represented by figs. 24a-c. I measured the shells in one of these<sup>5</sup> samples, labelled: "Bittium reticulatum Da C./Croisic St. Goustan" (colln. 1). Both samples are very similar indeed, and have probably been dredged near Le Croisic, 25 km W. of St. Nazaire, S. Bretagne, France. There is no indication whatsoever that the samples contain more than one species. They are intermediate between *B. scabrum* and *B. reticulatum* s.s. As compared to *B. scabrum*, the average of the values for  $V_1$  is extremely high. To a lesser extent, the same is true as regards the average number of varices per shell. Moreover, the subsutural spiral ridge is usually more or less well-developed. As compared to *B. reticulatum* s.s., however, the average number of varices per shell is very low indeed. Also, the shells have the conspicuous, deep brown colour which is often seen among *B. scabrum*. This is the first reason why I am strongly inclined to believe that the samples belong to that species. After all, only the average values of some of the characters are different; the range of variation of these characters, on the other hand, is hardly outside that of other samples of *B. scabrum*. Samples of *B. reticulatum* s.s. with few varices per shell, on the contrary, are rare, and only known from the English Channel, which is quite a distance from Croisic. Moreover, such samples differ considerably from those from Croisic as regards colour and sculpture. Also, all samples of *B. reticulatum* s.s. examined contained at least one other species of *Bittium*, which is not so as regards the samples from Croisic. Finally, *B. scabrum* seems to have a far more discontinuous distribution than *B. reticulatum* s.s. Consequently, local forms as a result of geographical isolation are more likely to occur among the former species.

Among a number of European Atlantic samples of *B. jadertinum* variable percentages of similar shells occur which, however, differ in larger values for  $V_1$  and/or larger numbers of varices per shell. This type of sample is represented by fig. 14. Another such sample is fraction (A) of the sample washed ashore at Lagos, discussed before (fig. 22a, below the horizontal line). Obviously, the great majority of the latter fraction belongs to *B. jadertinum*, but among the shells measured two shells occur with as many as six varices. These shells measure 3.95 and 4.8 mm, with  $V_1 = 1.95$  and  $V_1 = 2.6$  respectively. One of these shells is shown in fig. 22b. It is difficult to establish the identity of this type of shells. There is no indication that they might belong to a species different from *B. jadertinum* or *B. reticulatum* s.s. As far as high values for  $V_1$  are correlated with high numbers of varices (fig. 14), there is not much reason to believe that they might belong to *B. jadertinum*. Thus they must represent a form of *B. reticulatum*, possibly grown from larvae which had settled in an unfavourable habitat. If so, the shells of *B. reticulatum* s.s. in the fractions (A) and (B) among the sample from Lagos must originate from different populations or different geological periods. Because there is a slight difference in the state of preservation of both fractions, and because seemingly subfossil shells of *B. reticulatum* s.s. (the slender Mediterranean form of fig. 10c) are common at many localities in SW. Europe

<sup>5</sup> The other sample is labelled: "Bittium reticulatum Da C./Croisic St Goustan, sur les Zostères/dd. 8-87", and contains two other labels with the data 9-88 and 9-97, indicating that it has been collected at different times (colln. 1).



(Cadiz, colln. 3; Santander, colln. 7; Les Landes, collns. 6 and 7), the latter possibility certainly may reflect the truth.

Fig. 31 shows a shell in a large sample in colln. 1, labelled: "*Bittium reticulatum* Da Costa var?/Zostères, pres de l'île Ourö, Danemark/H. Sell leg." The shells in this sample are characterized by their large dimensions (length to 11 mm) and by the varices, which are absent, or few and terminally situated. I find it difficult to decide with which species they are connected. Colln. 3 contains quite a number of other samples of *Bittium* from Norway, Sweden and Denmark. From these samples I infer that both *B. jadertinum* and *B. reticulatum* s.s. live in the northern North Sea. Though some of these samples contain rather large numbers of shells, none of them contains shells which measure over about 8 mm. Neither has the sample from Ourö any resemblance to *B. scabrum*. All considered, I believe that it represents an adaptation of *B. jadertinum* to an unusual habitat.

#### F. NORDSIECK'S VIEWS ON BITTIUM

In 1976, F. Nordsieck published a paper on European *Bittium*, which was also the basis of the part on *Bittium* in his latest book (Nordsieck, 1982). In my experience, Nordsieck's taxonomy generally is of a highly intuitive character. In his 1976 paper on *Bittium*, for instance, he distinguishes quite a number of species and subspecies without producing any arguments or factual data for his views. On the contrary, the vagueness of the conchological borderlines between his taxa induced him to assume that the speciation processes among the *Bittium* aggregate had not yet been completed. Unfortunately, he does not explain the mechanism of the speciation processes involved, though it is very difficult indeed to understand along which lines continuous sympatric speciation among marine species with a pelagic larval phase might be effected in an area encompassing almost all European seas. In particular if hybrids do occur, as reported by Nordsieck. One therefore may consider the possibility that Nordsieck introduced these alleged incompleting speciation processes as a "deus ex machina" in order to cover up the weak factual basis of his taxonomical views. This may have been the reason why Piani (1980: 135) did not follow Nordsieck. According to Piani, *B. latreillii*, *B. jadertinum* and *B. scabrum* are subspecies of *B. reticulatum*. Because all four species are sympatric in large parts of their range, and because sympatric subspecies are a *contradictio in terminis*, this, however, does not make sense. Possibly, Piani also considers the absence of obvious, clear-cut conchological borderlines among the *Bittium* complex sufficient proof for the presence of nondescript incompleting speciation processes.

Nordsieck left little undone to prevent verification of his opinions. His diagnoses and figures are usually insufficient for recognizing his taxa with reasonable certainty. He almost never specified the collections in which the type material of his new taxa is to be found, though most of it seems to be in private collections. The whereabouts of his private collection of Recent shells, which may contain many types, is not known, not even in the Natur-Museum Senckenberg. Types have never been designated, though he has been asked to do so. This, of course, is a ridiculous situation because scientific opinions should be open to verification as far as possible. This in itself should already be sufficient reason not to take Nordsieck's views seriously. But also the outcome of independent

investigations, such as the one presented here, usually does not support Nordsieck's views. I did find no indication whatever that the speciation processes among *Bittium* have not yet been completed and that many specimens should be considered hybrids. Moreover, a number of species and subspecies mentioned and/or introduced by Nordsieck seems to be completely superfluous. There is a world of difference between the conchological delimitation of the nominal species as derived from this investigation and as given by Nordsieck. Nordsieck, for instance, does not mention the characters by which *B. latreillii* can always be easily identified with certainty. He also failed to recognize the taxonomical importance of the number and position of the varices in other species. Neither did he mention the large dimensions of the apical whorl in *B. lacteum*, or did he mention the Atlantic forms of that species. Thus, Nordsieck's views are almost completely incompatible with the conclusions from this investigation.

I did ask twice for the loan of the type material of *B. atticum* Nordsieck, 1977, but called forth no response. The original diagnosis mentions  $1\frac{1}{2}$  whorls of the protoconch. This points to a close relationship with *B. lacteum*, rather than with *B. jadertinum*, *B. scabrum* or *B. reticulatum* s.s. Some of the other characters, i.e. the colour, the number of spiral ridges per whorl and the fact that no varices are mentioned or figured, do support this view, but other characters do not. Thus, we have only Nordsieck's opinion to rely upon as regards the taxonomical status of *B. atticum*.

#### SYSTEMATIC PART

##### *Bittium lacteum simplex* (Jeffreys, 1867)

Type. A lectotype is designated below; it is in the National Museum of Natural History, Washington, D.C., Jeffreys colln. no. 62121.

As has been mentioned above, *B. lacteum simplex* is a junior synonym of *B. lacteum hanleyanum* Monterosato, 1889, described and figured in Verduin, 1976: 138.

From among a sample of 7 shells in the National Museum of Natural History, Washington, D.C., labelled: "*Cerithium reticulatum* var. *simplex*/Guernsey/McInt./British Islands 62121 Jeffr. Colln.", one shell had been separated and marked "Lectotype". I do not know who did this, but the designation does not seem to have been published. Certainly it is not mentioned by Warén (1980), who published on the Jeffreys collection in Washington. Because the shell concerned has a damaged apex, and because characters of the protoconch are of taxonomic importance, I have separated another specimen from among the six remaining shells, which are marked "syntypes", and labelled it: "Lectotype, Verduin 1982". It measures 7.35 mm, has 10.1 whorls, and its apical dimensions (fig. 2) are  $d = 0.15$  mm and  $D_0 = 0.26$  mm. The six other shells in the sample, plus a large sample labelled: "*Cerithium reticulatum* var. *simplex*/Guernsey/British Islands 62105 Jeffr. Colln." in the same museum, which are also marked "syntypes", are to be considered paralectotypes.

If *Cerithium reticulatum* var. *lactescens* Jeffreys, 1867, is synonymous with *C. reticulatum* var. *simplex* Jeffreys, 1867, as is suggested by Warén (1980: 25), I herewith give priority to the name *simplex*, in accordance with Article 24a of the International Code of Zoological Nomenclature.

Except for specimens from Guernsey and Herm, I saw only one other British specimen of *B. lacteum simplex*, viz., from Tenby, SW. Wales (colln. 2). The nearest other locality from which I saw the subspecies is Peniche, 75 km N. of Lisboa, Portugal, where it is far from rare. It has also been reported from Roscoff, Bretagne, France, by Cabioch & Babio (1975) and by Bouchet et al. (1978).

*Bittium l. lacteum* (Philippi, 1836) has been previously discussed by Verduin (1976).

*Bittium jadertinum* (Brusina, 1865)

Because of the words "canali nullo" one cannot be sure whether Brusina's diagnosis (1865: 16) really applies to a species of the genus *Bittium*, and not to *Cerithidium submammillatum*. The Brusina collection is supposed to be in the Agram museum (Yugoslavia). Unfortunately no type material of the present taxon has been obtained for study. Because *B. jadertinum* and *C. submammillatum* have always been considered different species, I feel justified, however, to use the well-known name *jadertinum* for the European species of *Bittium* which is characterised by its small dimensions and small number of varices.

- Length: 3.5-8 mm. Very slender specimens from the Golfe de Gabès, Tunisia, measure up to 10 mm. It may be possible that locally larger shells occur, see sub "puzzling samples".

- Slenderness: not particularly slender. Very slender shells occur in the Golfe de Gabès, Tunisia.

- Number of varices: usually up to three, occasionally up to five.

- Position of varices: usually less than 1.6 whorls between uppermost varix and aperture.

- Subsutural spiral ridge: usually well developed on the lower whorls.

- Spacing of the spiral ridges: spiral ridges on the body whorl usually about equidistant.

- Colour: often somewhat variegated.

A number of shells is shown in figs. 3c, 4c-f, 5b-c, 6c, 13c-d and 25.

The species is washed ashore in great numbers at many localities in the whole Mediterranean, along the Atlantic coasts of Europe and North Africa, and in the North Sea. It is often found together with *B. reticulatum* s.s.

*Bittium reticulatum* (Da Costa, 1778) s.s.

Da Costa's diagnosis and figure are of insufficient quality to decide with reasonable certainty to which species they refer. Ms. K. Way [British Museum (Natural History)] informed me that she had been unable to locate type specimens in either the type, general, or Pennant collections. Ms. H. Brock (Dept. of the History of Science, University of Glasgow) searched in vain the Da Costa correspondence of the British Museum for information about what shells John Anderson of Glasgow University had bought from Da Costa. Neither do adequate records exist of what the Hunterian Museum in Glasgow received. The provenance of the shells of *B. reticulatum* in the Glasgow collections is not known. Thus, all type material of *B. reticulatum* seems to have been lost. Yet, I have not designated a neotype because I would prefer a neotype from among alcohol material, so as to also contain information about the soft parts and, if possible, about the colour

of the animal and the habitat. As no such material is at my disposal, I confine myself to proposing to use the specific name for the species defined by the following data.

- Length: usually 5-12 mm, locally up to about 17 mm. Some Atlantic samples, however, contain, in addition to *B. jadertinum*, variable percentages of small shells which may belong to *B. reticulatum* s.s., see sub "Puzzling samples".

- Slenderness: shells from the Mediterranean, and seemingly subfossil shells from SW. Spain and from the SE. and E. coast of the Bay of Biscay may be rather slender and somewhat scalariform; otherwise not particularly slender.

- Number of varices: usually about 3-18.

- Position of varices: usually more than 1.8 whorls between uppermost varix and aperture.

- Subsutural spiral ridge: usually well-developed on the body whorl.

- Spacing of the spiral ridges: second spiral ridge, counted from the sutures downward, usually shifted in upward direction, which results in inequidistant the spiral ridges.

- Colour: often somewhat variegated, in particular in the Mediterranean.

A number of shells is shown in figs. 6d-e, 10c, 13e, 17b, 19b, 21c-e, 22b, 26, 27 and 28.

The species is washed ashore in great numbers at many localities in the Mediterranean, along the European Atlantic coasts and in the North Sea. It is usually found together with *B. jadertinum* or, occasionally, with *B. scabrum*.

#### *Bittium scabrum* (Olivi, 1792)

As regards the identity of *B. scabrum*, I fully rely on the excellent description and figures of specimens from the type locality by Bucquoy, Dautzenberg & Dollfus (1884: 214, pl. 25 figs. 1-2).

- Length: usually 6-13 mm, locally up to about 17 mm.

- Slenderness: usually somewhat less slender than *B. jadertinum* and *B. reticulatum* s.s.

- Number of varices: usually up to six. Often, the greater part of the sample has no, or only a few varices.

- Position of varices: variable, often less than 1.8 whorls between uppermost varix and aperture. Locally, the average number of whorls between uppermost varix and aperture may be considerably more.

- Subsutural spiral ridge: usually not well developed. In Mediterranean samples usually weak or absent.

- Spacing of the spiral ridges: if the subsutural spiral ridge is present, the second spiral ridge, counted from the suture downward, has shifted in upward direction, which results in inequidistant spiral ridges.

- Colour: often of a conspicuous uniform deep brown colour.

A number of shells is shown in figs. 20c-e, 21f-g, 22c, 24b-c, 29 and 30.

Locally the species is washed ashore in great numbers in the Mediterranean and along the European Atlantic coasts, possibly as far north as Great Britain. Not known from the North Sea. Along the European Atlantic coasts it may be accompanied by *B. reticulatum* s.s.

*Bittium latreillii* (Payraudeau, 1826)

This species has been dealt with previously (Verduin, 1976). I have not examined any syntypes. Dr. Ph. Bouchet, Paris, wrote me that these must be considered lost. The measurements and colour mentioned by Payraudeau (1826: 143), in combination with the words "transverse quadri seu quinquestriatis", however, characterize the species beyond reasonable doubt.

## SUMMARY

With conchometrical means it is demonstrated that among *Bittium reticulatum* (Da Costa, 1778) s.l. three good species may be distinguished. These are *B. reticulatum* s.s., *B. jadertinum* (Brusina, 1865), and *B. scabrum* (Olivi, 1792). A lectotype has been designated for *B. lacteum simplex* (Jeffreys, 1867). *B. latreilli* (Payr.) and *B. l. lacteum* (Phil.) have been discussed previously (Verduin, 1976).

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#### Over de taxonomie en variabiliteit van recente Europese *Bittium*-soorten

De onderhavige studie vormt met een vorige (Verduin, 1976) min of meer een eenheid. In laatstgenoemde studie werd aangetoond dat schelpen van *B. latreillii* (Payraudeau, 1826) altijd kunnen worden herkend aan de wijze waarop de tweede subsuturale spiraalrib ontstaat (Verduin, 1876: fig. 2, de met *b* aangegeven spiraalrib). Tevens werd aangetoond dat *B. l. lacteum* (Philippi, 1836) door een reeks tussenvormen is verbonden met schelpen die plaatselijk in grote aantallen aanspoelen langs de Atlantische kust van Marokko en Zuid-Europa (bijv. Sezimbra, 30 km Z. van Lissabon; Peniche 75 km N. van Lissabon), en die als *B. lacteum hanleyanum* Monterosato, 1889, gedetermineerd werden. *B. lacteum* onderscheidt zich door de grote afmetingen van de topwinding, door de afwezigheid van varices, en door de wijze waarop de subsuturale spiraalrib zich in tweeën deelt (Verduin, 1976: fig. 4, met *b* aangegeven). In de huidige studie wordt aangetoond dat de naam *B. l. hanleyanum* moet worden vervangen door het oudere synoniem *B. lacteum simplex* (Jeffreys, 1867), een vorm die van de Kanaaleilanden werd beschreven.

Ten behoeve van deze studie werden van grote aantallen schelpen die niet tot beide bovenstaande soorten behoren, drie eigenschappen bepaald: de lengte (length), het aantal varices (number of varices) en het aantal windingen  $V_1$  tussen de bovenste varix en de mondrand (number of whorls  $V_1$  between uppermost varix and aperture). De resultaten zijn weergegeven in een aantal histogrammen en grafieken. Voorts werden aanvullende waarnemingen gedaan aan de sculptuur van de laatste winding, zoals de onderlinge afstand van de spiraalribben, de breedte van de spiraalribben, de mate waarin ze scherp begrensd zijn, de aard van de knobbels en de mate waarin de subsuturale spiraalrib ontwikkeld is. De zo verkregen gegevens kunnen moeilijk anders geïnterpreteerd worden dan dat er binnen het onderzochte materiaal drie soorten moeten worden onderscheiden, waarvan de schelpkenmerken elkaar enigszins overlappen. In het algemeen kan men zeggen dat de schelp van *B. jadertinum* (Brusina, 1865) kleiner is dan 8 mm, weinig (0-3, zelden meer) varices heeft die zich alle op de laatste 1,6 windingen bevinden, en vier goed ontwikkelde, wat platte en brede, equidistante spiraalribben heeft, beoordeeld aan de situatie ter plaatse van het einde van de voorlaatste winding. De schelp van *B. scabrum* (Olivi, 1792) is groter, heeft zelden een goed ontwikkelde subsuturale spiraalrib op de laatste winding, heeft gewoonlijk smalle, niet scherp begrensde spiraalribben met puntige knobbels en onderling ongelijke afstanden doordat de tweede subsuturale spiraalrib iets naar boven is verschoven. Voorts heeft *B. scabrum* gewoonlijk een opvallend uniforme, intens bruine kleur, kan het aantal varices wat groter zijn dan bij de vorige soort (doch gewoonlijk niet meer dan 6), en zijn de varices wat minder gebonden aan het onderste deel van de schelp. *B. reticulatum* (Da Costa, 1778) s.s. heeft gewoonlijk drie of meer varices (tot wel 20 per schelp!), en  $V_1 > 1,8$ . De sculptuur heeft veel van die van *B. scabrum*, doch de subsuturale spiraalrib is gewoonlijk goed ontwikkeld, de knobbels zijn gewoonlijk minder puntig en de spiraalribben zijn vaak scherp begrensd. De lengte is vergelijkbaar met die van *B. scabrum*, maar de soort is nogal variabel en vertoont soms ook grote gelijkenis met *B. jadertinum*. Vaak zal het niet mogelijk zijn elke individuele schelp met redelijke zekerheid te determineren.

Alle drie soorten hebben ongeveer hetzelfde verspreidingsgebied, dat zowel de Middellandse Zee als de Europese Atlantische kusten en de Noordzee omvat. *B. scabrum* lijkt echter te ontbreken in Groot-Brittannië en in de Noordzee. In tegenstelling tot de beide andere, is *B. scabrum* nogal discontinu verspreid. Plaatselijk is de soort zeer algemeen (het uiterste noorden van de Adriatische Zee; de Zuid-Franse étangs; enkele andere plaatsen in de Middellandse Zee; enkele plaatsen langs de kusten van Portugal en West-Frankrijk), elders lijkt zij volkomen afwezig. *B. reticulatum* s.s. lijkt steeds samen met *B. jadertinum* of, een enkele keer, met *B. scabrum* voor te komen. De beide andere soorten komen ook wel alleen voor. *B. jadertinum* is ook bekend van Zuidwest-Marokko en de Canarische Eilanden.

Er zijn nogal wat aanwijzingen dat van alle drie soorten hier en daar lokale vormen voorkomen. Het gaat echter te ver deze in een samenvatting te bespreken.

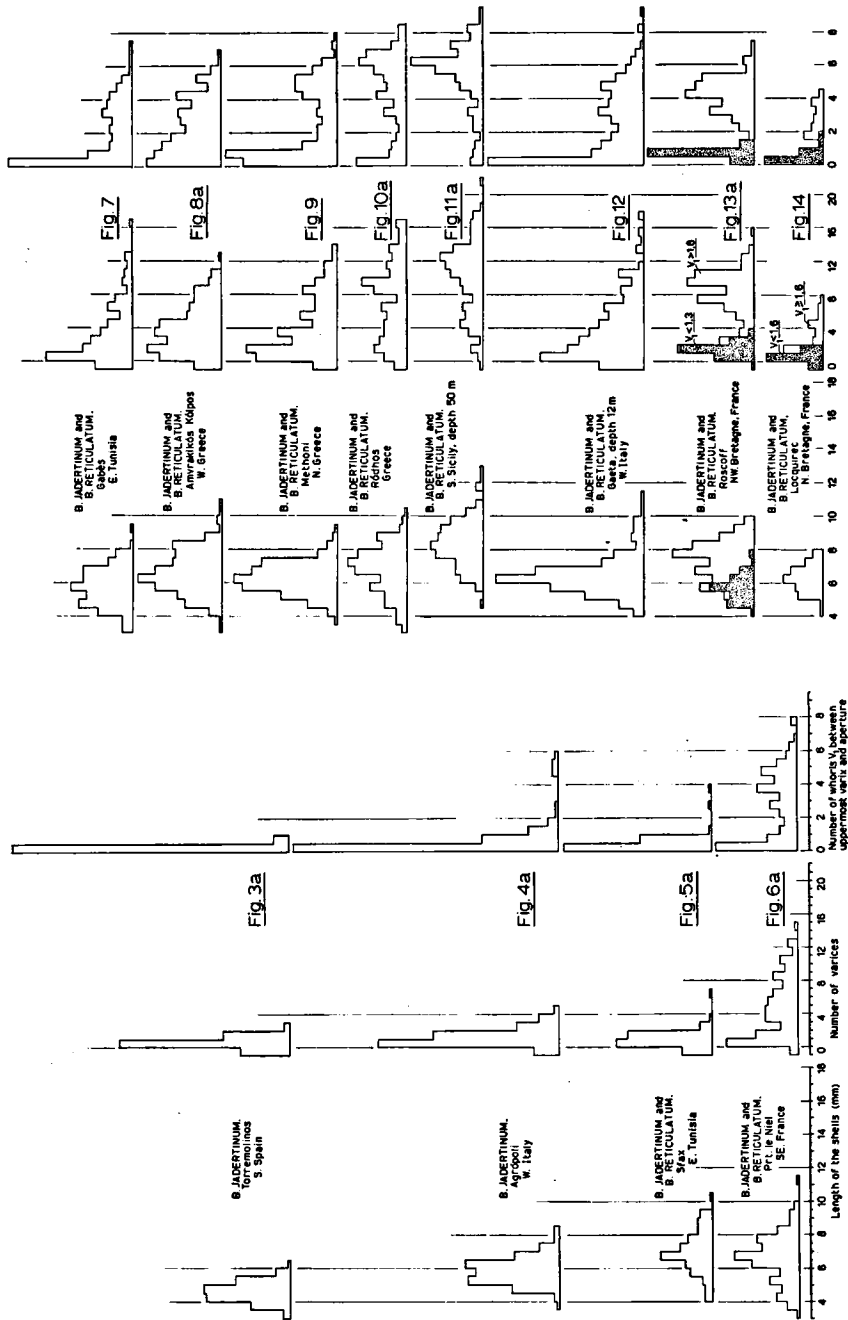
Fig.	Data from the label	Coll. no.	Number of shells measured	Precise locality
3	Torremolinos 1/7/72, no. 0015	7	118	15 km SW. of Málaga
4	Agròpoli 4/9/69, no. 0002	7	161	40 km SE. of Salerno
5	Sfax, no. 9173	5	92	E. Tunisia
6	Prt. le Niel 9/6/61, no. 0141	7	139	10 km S. of Hyères
7	Cerithiolum jadertinum/Gabès, pl. S. Oued	1	147	E. Tunisia
8	Prévesa/Nikopolis 9/7/74, no. 0002	7	199	8 km N. of Prévesa
9	Methoni 30/7/74, no. 0003	7	202	50 km SW. of Thessalonîki
10	Rhodos haven 20-24/7/74, no. 0051	7	147	Mandraki harbour
11	South coast of Sicily, depth 50 m, no. 13567	5	138	
12	Gaeta, depth 12 m, no. 14462	5	229	63 km NW. of Napoli
13	<i>Bittium reticulatum</i> da C./Herbiers de Roscoff/ dd VII-IX-22	1	189	50 km NE. of Brest
14	<i>Bittium reticulatum</i> (Da Costa)/Locquirec, Bretagne/25-8-57/no. 1536	4	63	18 km NE. of Morlaix
15	<i>Bittium reticulatum</i> da C./Val André/ dd VII-IX-1919	1	64	40 km W. of St. Malo
16	<i>Bittium reticulatum</i> da Costa/Région de St. Servan	1	184	5 km S. of St. Malo
17	<i>Bittium reticulatum</i> Da Costa/Fours à Chaux/ d.d. 8.95	1	132	5 km S. of St. Malo
18	<i>Bittium reticulatum</i> (da Costa)/Kimmeridge Bay, Dorset/Rowe-Weiner Coll./58 Specs/ Acc. No. 1480	2	48	25 km E. of Weymouth
19	<i>Bittium reticulatum</i> Da Costa/Torbay/ Mr. Alder 1911.10.26.14859-14878	2	61	Torquay
20	Grado 30/5/62, no. 0004	7	154	25 km W. of Trieste
21	Fuseta 23/7/77, nos. 0011 & 0012	7	371	16 km E. of Faro
22	Lagos 22/7/77, nos. 0108 and 0112	7	122+70	Portugal
23	Alfarim 19/7/77, no. 0008	7	126	Lagoa de Albufeira, 5 km N. of Sezimbra
24	<i>Bittium reticulatum</i> da C./Croisic St. Goustan	1	79	25 km W. of St. Nazaire

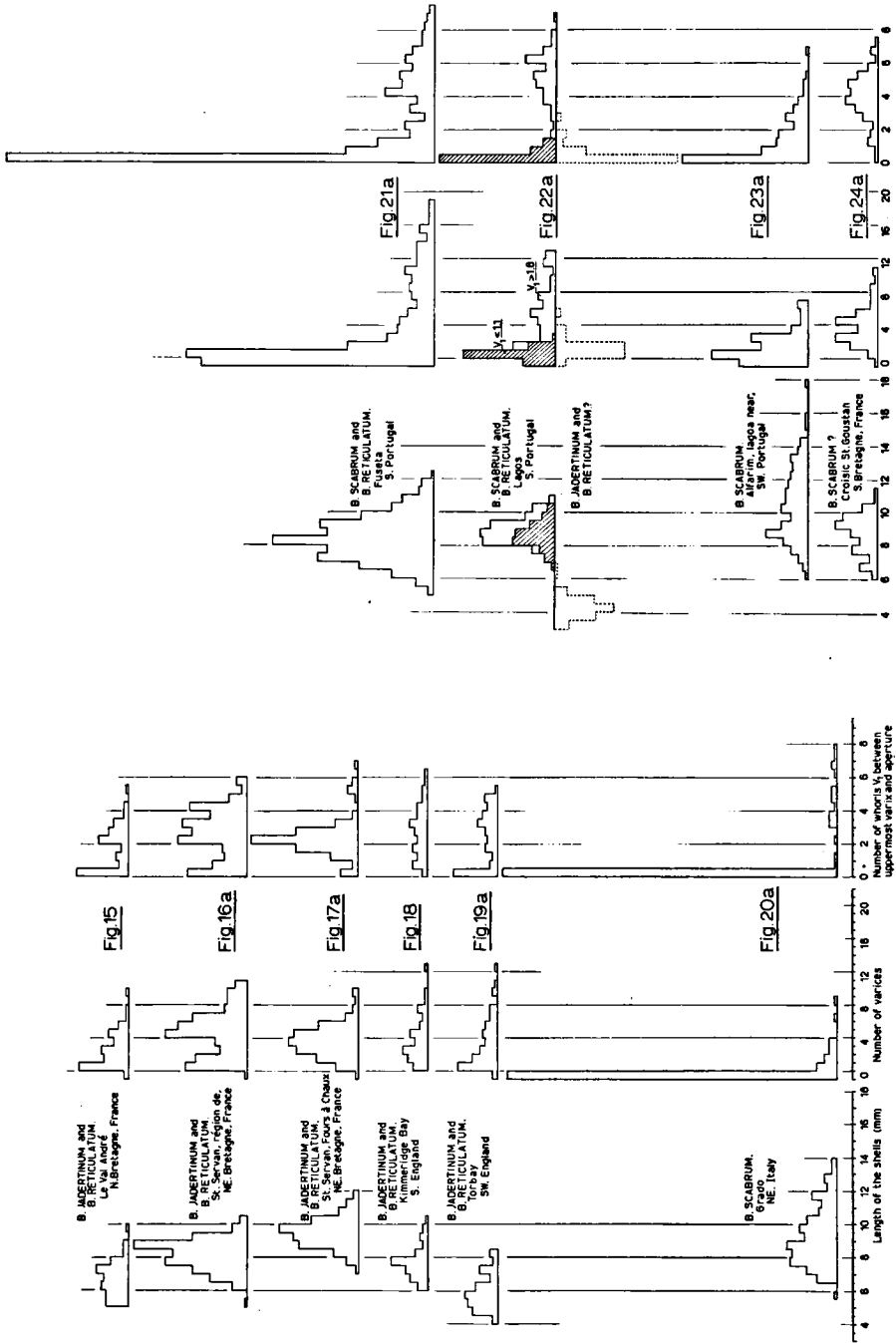
Table 1. Data on the samples measured.

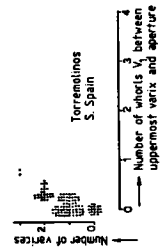
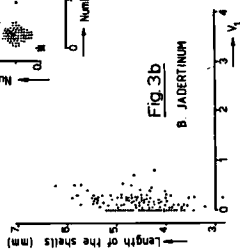
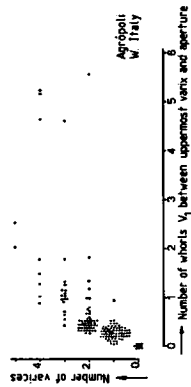
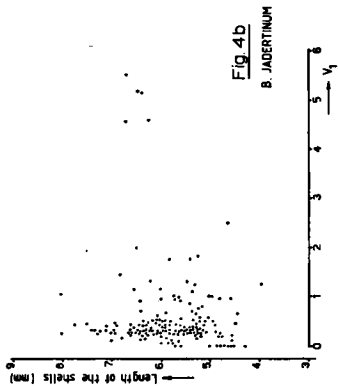
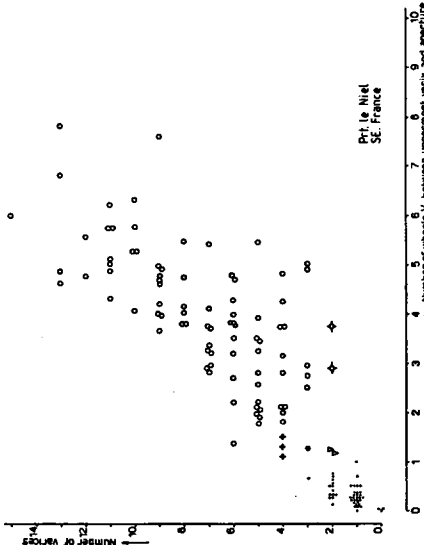
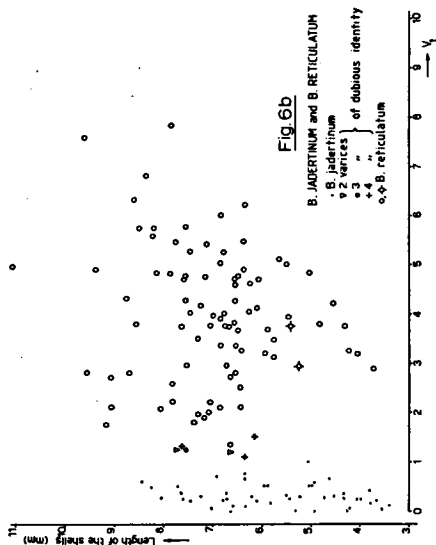
Fig.	Species	Length (mm)	Number of varices	V <sub>1</sub>	Data from the label; precise locality	Colln. no.
1. L.	<i>Cerithidium submamillatum</i>	2.65	1	0.10	<i>Bittium jadertinum</i> Brus./Zara	Senckenberg
1 R.	<i>B. jadertinum</i>	2.85	2	0.25	Torremolinos 1/7/72, no. 0015	7
3c	" "	5.50	2	0.30	" " "	7
4c	" "	6.55	1	0.20	Agrópoli 4/9/69, no. 0002	7
4d	" "	6.20	2	0.50	" " "	7
4e	" "	7.65	2	0.40	" " "	7
4f	" "	7.80	2	0.40	" " "	7
5b	<i>B. jadertinum</i> forma exiguum	8.75	2	0.55	Sfax, no. 9173	5
5c	" "	6.20	2	0.50	" "	5
6c	<i>B. jadertinum</i>	6.80	2	0.70	Prt. le Niel 9/6/61, no. 0141	7
6d	<i>B. reticulatum</i>	8.10	10	5.80	" " " "	7
6e	" "	6.65	6	3.80	" " " "	7
10c	" "	8.30	16	6.70	Rhodos haven 20-24/7/74, no. 0051	7
13c	<i>B. jadertinum</i>	5.00	2	0.65	<i>Bittium reticulatum</i> da C./Herbiers de Roscoff/dd VII-IX-22	1
13d	" "	6.95	2	0.70	" " " "	1
13e	<i>B. reticulatum</i>	8.60	13	5.75	" " " "	1
17b	" "	9.80	5	2.70	<i>Bittium reticulatum</i> Da Costa/Fours à Chauv/d.d. 8.95	1
19b	" "	7.70	11	5.15	<i>Bittium reticulatum</i> Da Costa/Torbay/Mr. Alder/1911.10.26.14859-14878	2
20c	<i>B. scabrum</i>	12.65	1	0.25	Grado 30/5/62, no. 0004	7
20d	" "	11.50	1	0.50	" " "	7
20e	" "	9.40	0	-	" " "	7
21c	<i>B. reticulatum</i>	11.15	10	5.40	Fuseta 23/7/77, no. 0011	7
21d	" "	11.75	18	8.45	" " "	7
21e	" "	6.40	12	4.55	" " "	7
21f	<i>B. scabrum</i>	8.50	1	0.15	" " no. 0012	7
21g	" "	10.15	0	-	" " "	7
22b	<i>B. reticulatum</i>	4.65	6	2.30	Lagos 22/7/77, no. 0112	7
22c	<i>B. scabrum</i>	10.0	1	0.50	" " no. 0108	7
24b	" "	11.55	3	6.50	<i>Bittium reticulatum</i> /Croisic-St. Goustan/sur les zostères/dd. 8.87	1
24c	" "	11.1	1	0.70	" " "	1
25	<i>B. jadertinum</i>	4.15	2	0.25	Nabeul, no. 9394; 65 km SE. of Tunis, Tunisia	5
26	<i>B. reticulatum</i>	13.0	10	8.05	Kerhostin 8/60, no. 0014; a few km. N. of Quiberon, S. Bretagne	7
27	" "	12.80	13	7.25	<i>Bittium reticulatum</i> Da Cos./Helford Ricer, Cornwall/1884/1911.10.26.14879-14894	2
28	" "	10.30	18	7.00	<i>Bittium reticulatum</i> Da Costa/Bantry, Ireland/1911.10.26.14839-14858	2
29	<i>B. scabrum</i>	9.70	0	-	Palavas 4/6/61, no. 0022; 11 km S. of Montpellier	7
30	" "	5.55	0	-	Prévesa/Nikopolis 9/7/74, no. 0001; W. Greece	7
31	Unknown	9.50	0	-	<i>Bittium reticulatum</i> da Costa var?/Zostères, près de l'île Ourö, Danemark/H. Sell leg.	1

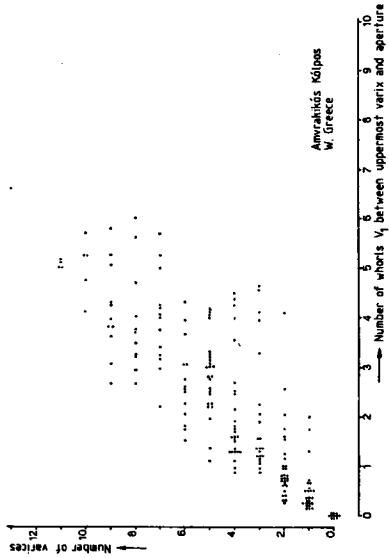
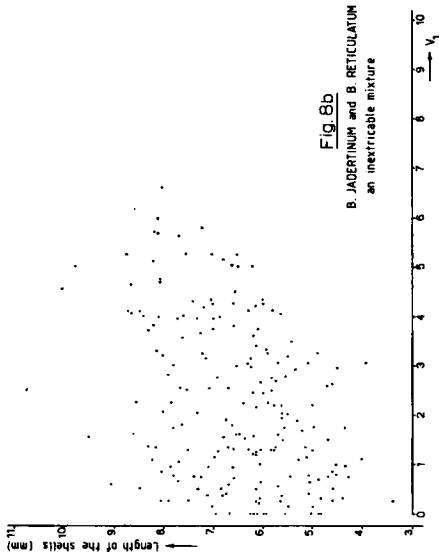
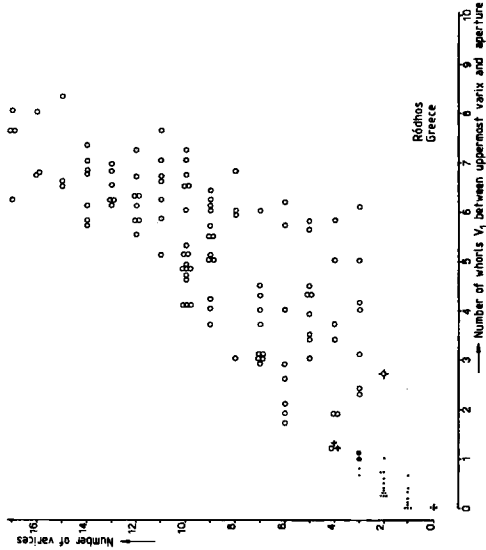
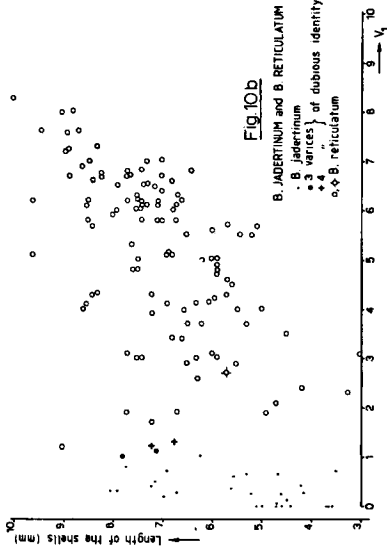
Table 2. Data on the figured shells.

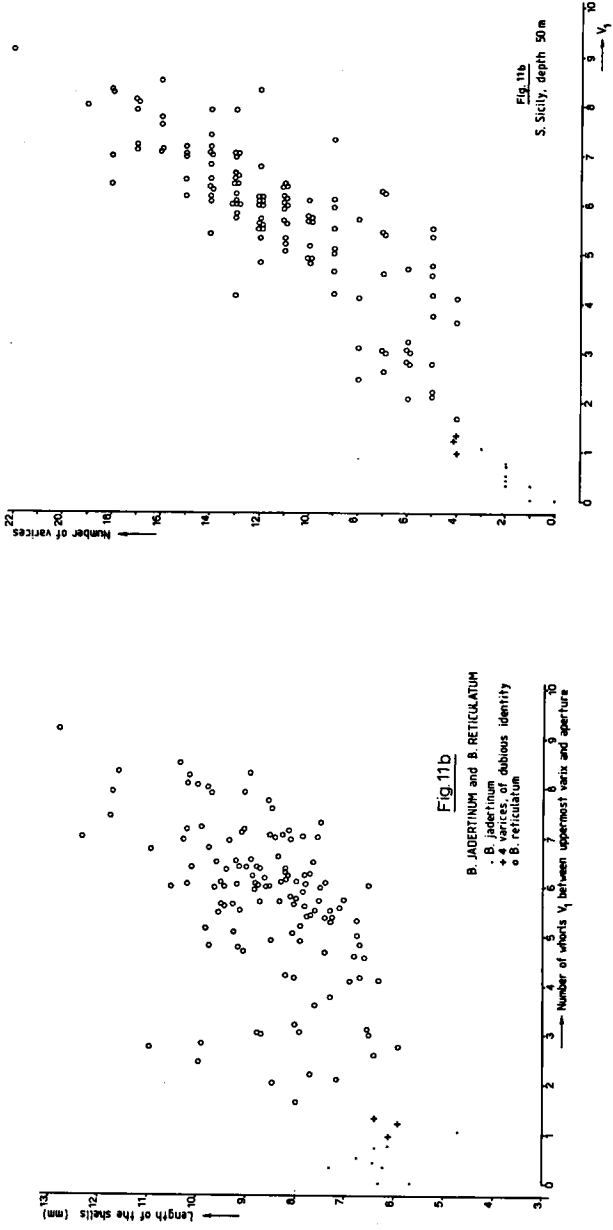


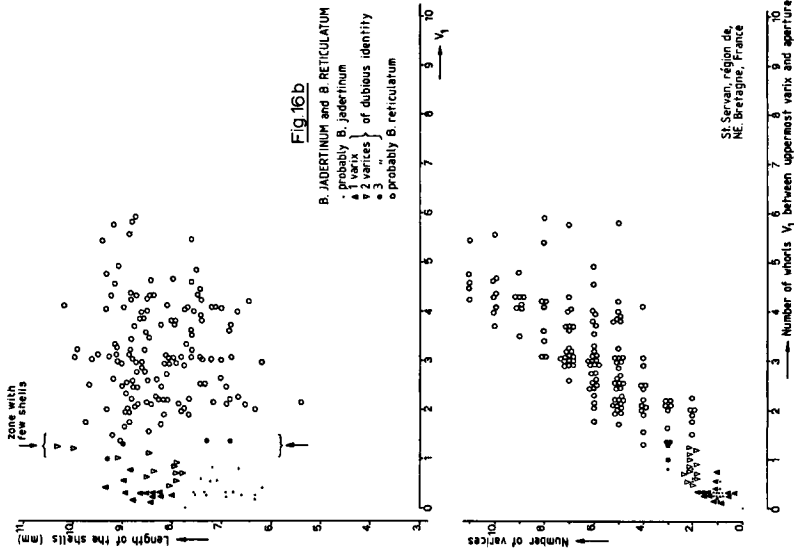
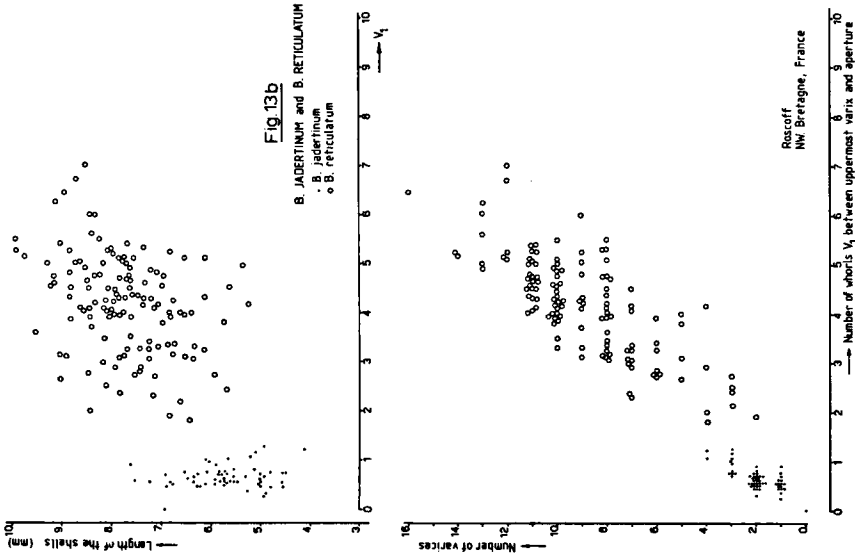


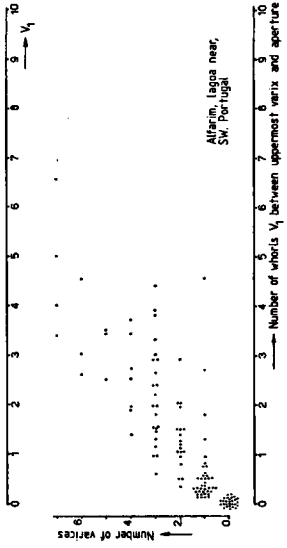
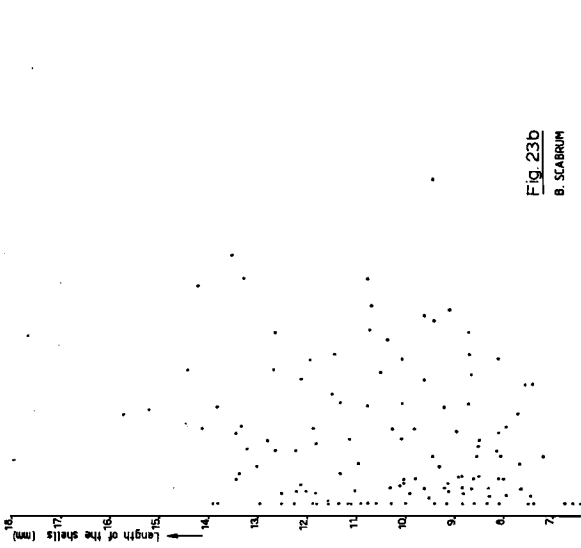
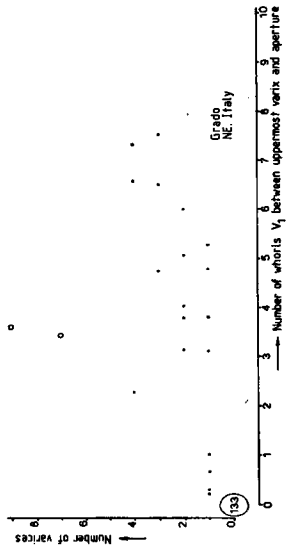
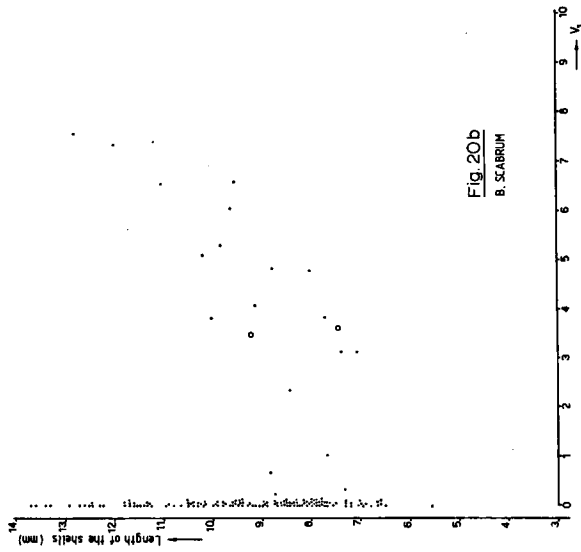


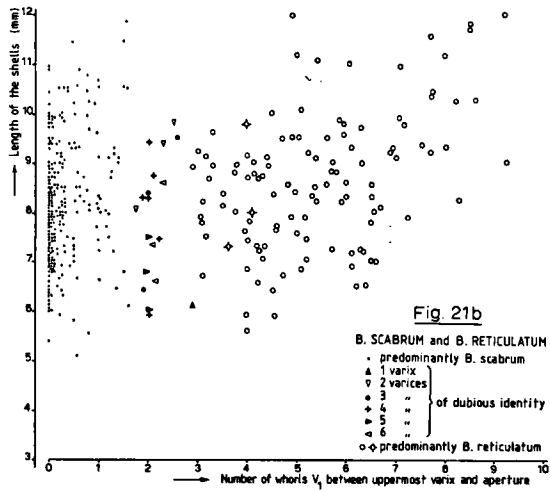
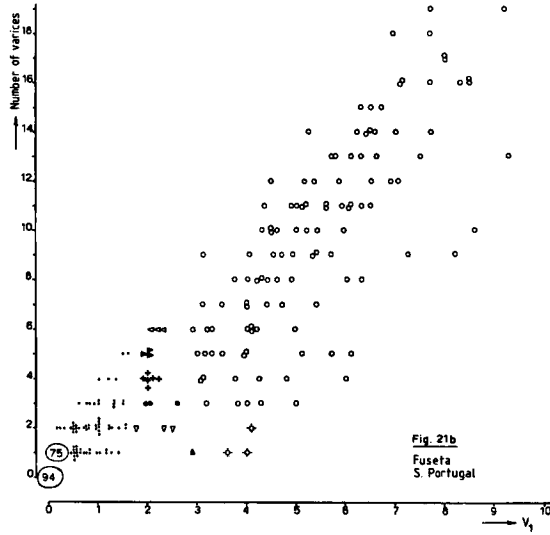




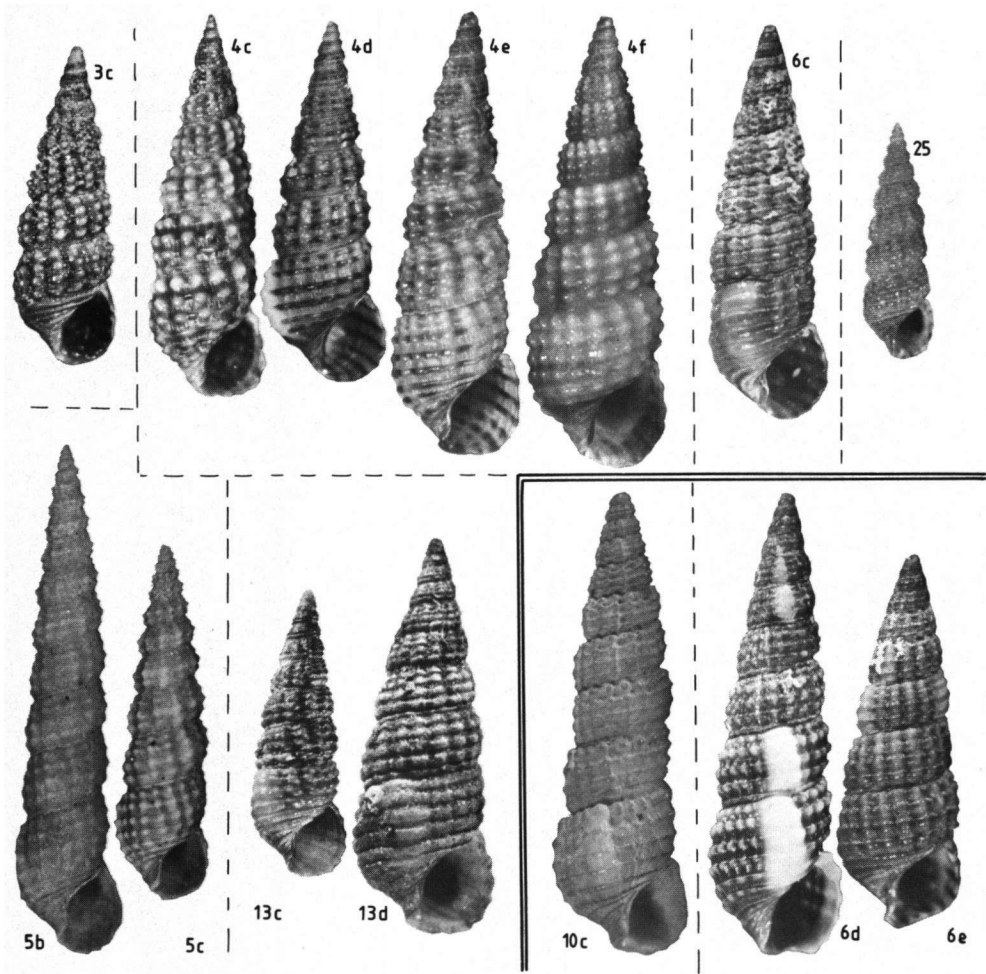




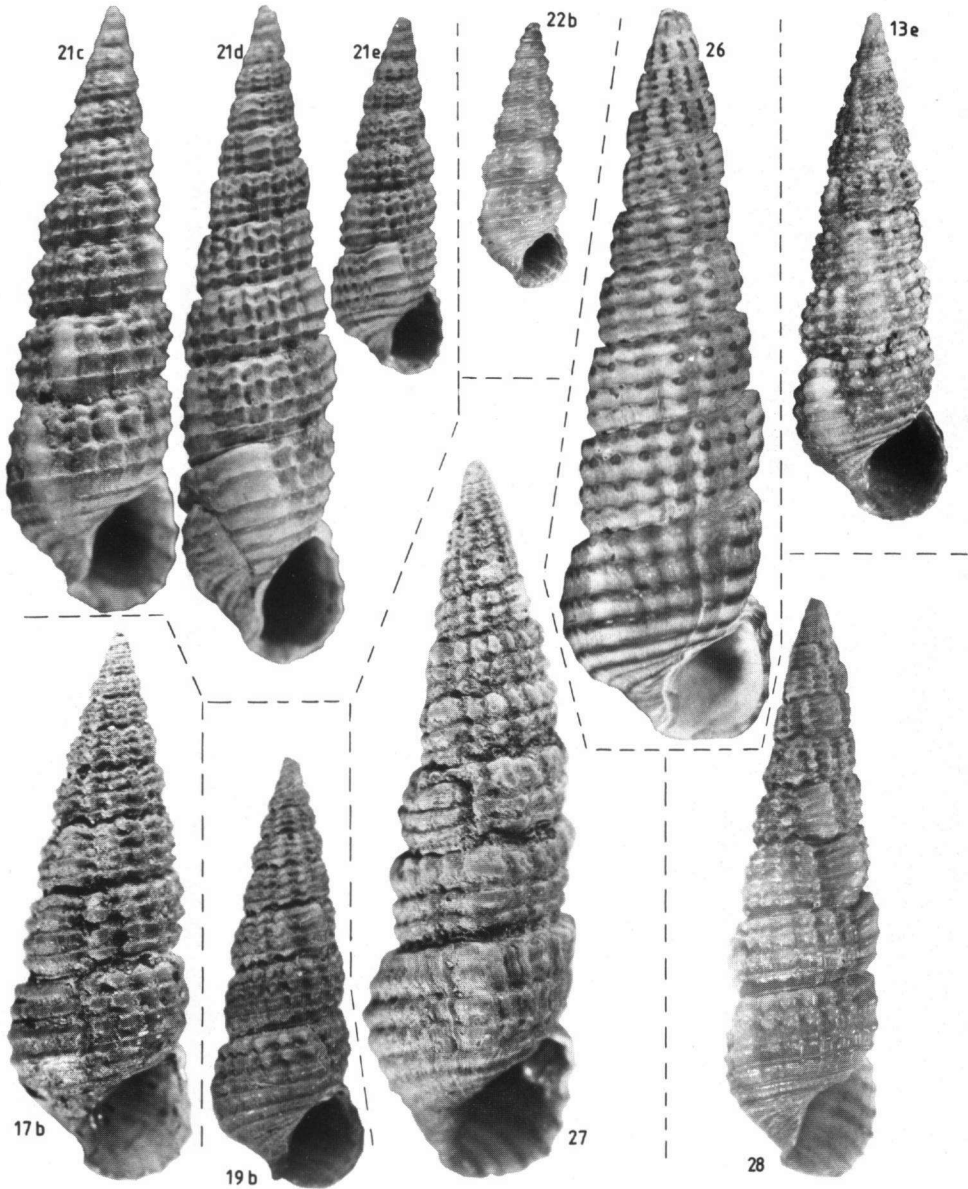




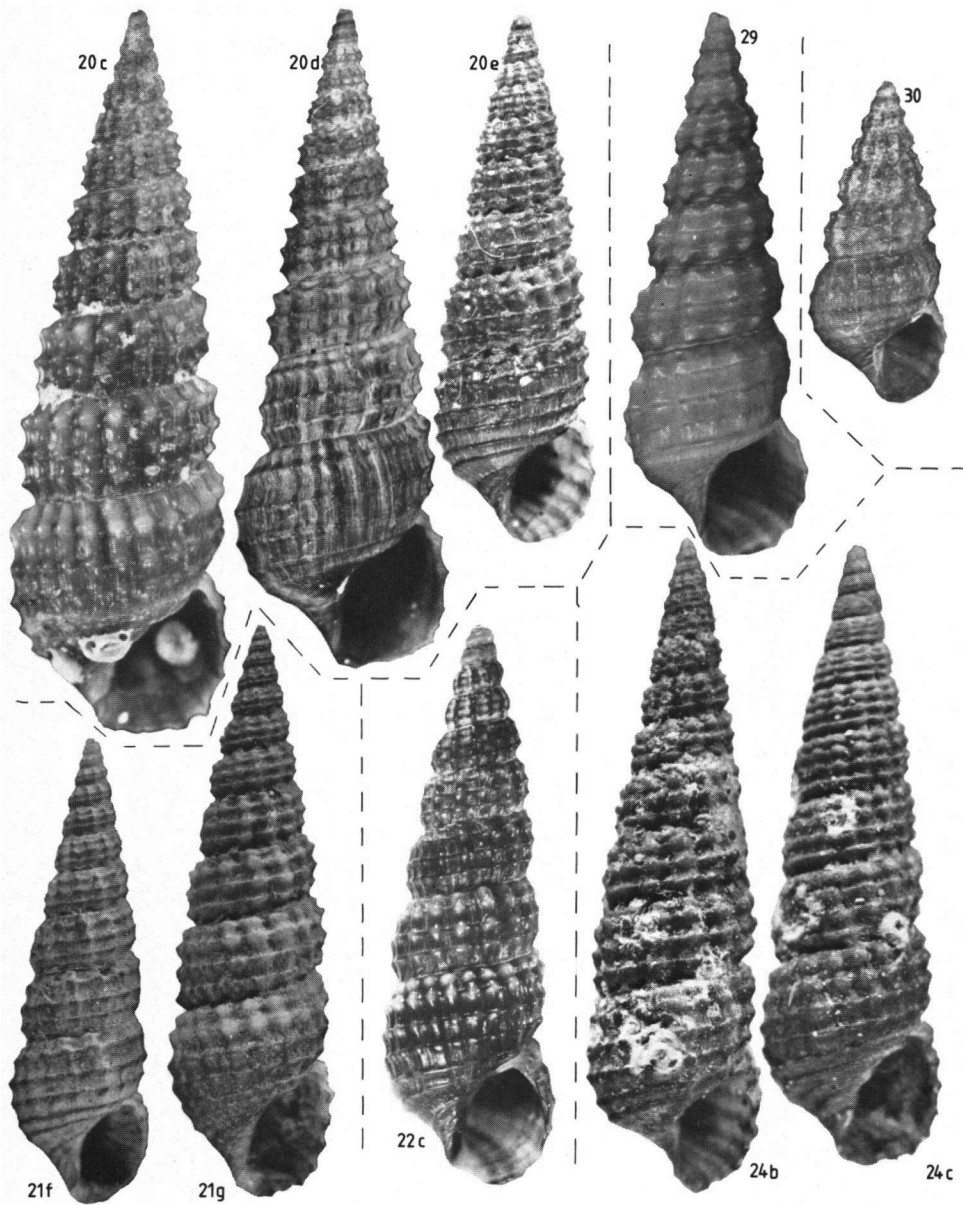




Figs. 3c, 4c-f, 6c: *Bittium jadertinum* from Mediterranean localities other than Tunisia. Figs. 5b-c, 25: *B. jadertinum* from Tunisian localities. Figs. 13c-d: *B. jadertinum* from European Atlantic localities. Figs. 6d-e, 10c: *Bittium reticulatum* s.s. from Mediterranean localities. See also tables 1 and 2. Magnification 7.5 x.



Figs. 13e, 17b, 19b, 21c-e, 22b, 26-28: *Bittium reticulatum* s.s. from European Atlantic localities. See also tables 1 and 2. Magnification 7.5 x.



Figs. 20c-e, 29, 30: *Bittium scabrum* from Mediterranean localities. Figs. 21f-g, 22c, 24b-c: *B. scabrum* from European Atlantic localities. See also tables 1 and 2. Magnification 7.5 x.

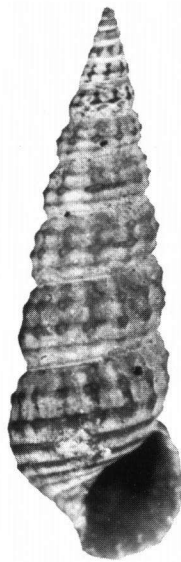


Fig. 31. *Bittium* from Ourö, Denmark. Unknown identity, but probably local form of *B. jadertinum*. See also table 2. Magnification 7.5 x.