

A HISTORICAL REVIEW OF THE  
MOLLUSKS OF LINNAEUS

PART 7. CERTAIN SPECIES OF THE  
GENUS *TURBO* OF THE  
CLASS GASTROPODA

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## COLLATERAL NOTES

THE AUTHOR REGRETS that he is compelled to conclude this series of papers on the Linnaean mollusks with the present paper, which covers approximately one-third of the species contained in the genus *Turbo* Linné. Because of the deterioration of my eyesight, it has become impossible to carry out the research necessary to monograph the remaining Linnaean genera. In bringing my work to this unexpected conclusion, I must express my grateful thanks to all those whose advice and encouragement have been of such assistance to me, and to all those who have been good enough to say that my efforts have been of some help in their understanding of Linnaeus' shells.

1. Frequent references have been made in this series of papers to the difficulties encountered in translating Linnaeus' descriptions of mollusks and in endeavoring to make his language apply to all of the features of the species that we must assume, from other evidence, that he had before him when he wrote. By "other evidence" is meant the existence of an unquestioned or a "probable" holotype in his collection now in London or his citation of a synonymy or locality conforming to the species now accepted as the representative of the Linnaean name. The citation of such a synonymy or locality is, of course, somewhat less weighty evidence for identification than the presence of a holotype in the collection. It seems to the writer that it would be useful to refer to some of these difficulties of translation in order that he may not be accused of being over-critical of the Linnaean diagnoses.

The imperfections of the descriptions stem from several causes. First, Linnaeus was not an accomplished Latinist, but the most important cause is the fact that he, in common with the other scientists of the eighteenth century, did not consistently employ the classical form of Latin in his spelling, his vocabulary, or in his sometimes tortured locutions. His Latin was a later outgrowth of the medieval Latin of the Schoolmen and contains many cases of curious syntax and peculiar grammatical construction which can be described only as barbarous Latin. Instances might be multiplied. As a single example, I quote the subdescription under *Voluta mitra*

(1767, p. 1193, no. 426),<sup>1</sup> in which the alleged poisonous character of the animal is noted: "Instrumento venenato tangendum et carnes edentum laedit. R." This may be roughly translated as: "It injures anyone who touches it and eats its flesh." It is impossible for a classicist to translate the sentence accurately.

An equally serious stumbling block to an intelligible translation is Linnaeus' compressed and "telegraphic" style and his confusing punctuation. The omission of prepositions and connectives and the apparent misplacement of commas and other marks of punctuation often make it impossible to parse his sentences or even to determine his exact meaning. In this connection it should again be noted (see Dodge, 1955, pp. 7-9) that his subdescriptions are less unwieldy in this respect than his so-called main descriptions, and, for this writer, this fact adds great weight to the theory that the main descriptions may have been designed merely as a long polynomial specific name and that the name in the page margin, whether adjectival or a noun, was a mere descriptive guidepost.

Two further frequently recurring examples of confusing phraseology, among the many in his descriptions, may be noted. The first is the misuse of the words "postice" and "antice" and their derivatives. Linnaeus was almost completely ignorant of the anatomy of the animal and its orientation within the shell and, in the majority of cases, reversed the true application of the terms. Secondly, the phrase "anfractus continguis" which he used for many of the gastropods is confusing and indeed unnecessary, as the phrase might be applied to any gastropod shell, with the possible exception of those few species in which the whorls are partially "unwound" as in the species of several of the genera of land shells, no members of which are included in the "Systema naturae." The use of the phrase is particularly equivocal in the case of four species of the genus *Turbo* (*clathrus*, *ambiguus*, *crenatus*, and *uva*), as the whorls of these

<sup>1</sup> Owing to the peculiar arrangement of the diagnoses of *V. episcopalis* and *V. papalis* in the twelfth edition of the "Systema" (see Dodge, 1955, p. 121), it is difficult to say whether this subdescription applies to both species or to *papalis* alone.

species are no more or no less contiguous than those of Linnaeus' other *Turbo* species, in none of which is the expression used. The use of this phrase for the four species mentioned and the substitution of "anfractibus distantibus" for *T. scalaris*, the species next before *clathrus* in the "Systema," are completely meaningless, as the only distinction in this respect between the two species is that *scalaris* is somewhat more turreted and "step-like."

Another weakness of the descriptions which has undoubtedly delayed or hampered the identification of species is the fact that Linnaeus sometimes described the size of the minute species by such words as "minutus," "magnitudine seminis Hordei," "magnitudine pisi," and similar comparisons, or by the use of a similarly descriptive specific name such as *Ostrea minuta* and *Solen minutus*, whereas in the cases of many other equally minute shells he gave no indication of size, as in the descriptions of *Turbo auriscalpium* and *Trochus perversus*. For the largest shells the size is almost never stated in the description and, and in only two cases, *Strombus gigas* and *Chama gigas*, is the size suggested by the specific name. A most helpful addition to Linnaeus' descriptions would have been the adoption of a consistent policy of giving some indication of size for the very large or very small species, whether by specific name, by measurement, or by comparison with another shell or other object.

While the above examples of Linnaeus' defective descriptions and his bad Latin are selected at random, they will serve to underline the general statement that the problem of accurate translation and the difficulty of tying many of his names to known species are serious.

I have heretofore taken the position, to which I still adhere, that a clear and unequivocal description is, with the exception of a properly documented holotype in Linnaeus' collection, the most cogent evidence for the identification of a species, as I consider that it has far more weight than the great majority of his synonymies and localities. Many of the descriptions, however, are most unclear, and in these cases, and in the absence of a holotype, we are forced to rely on the cited figures and the locality. In cases in which

either or both of these are missing, or the synonymy is grossly discordant or entirely incorrect, we may suggest only a tentative identification or treat the species as a *species dubia*.

Finally, I should refer to a stumbling block that was in no sense the fault of Linnaeus. The printing of both the tenth and twelfth editions of the "Systema" is often less clear than in many of the other pre-Linnaean and contemporary works. Individual letters are often blurred, incomplete, or even missing, and in frequent instances commas cannot be distinguished from semicolons or periods. This latter defect makes it difficult to separate the several phrases of a description, and two different readings might therefore be suggested.

2. In Part 5 of this series of papers (Dodge, 1957, p. 123) the writer noted that a form of *Murex rubecula* Linné had been several times reported from Florida, Yucatan, and the West Indies. This form was first listed by Mörch (1877, p. 29) as "*Triton rubecula* L. occidentale" from St. Thomas, Virgin Islands. I referred to the fact that this form had been treated by some writers as a good subspecies of *rubecula* or even as a good species. Since the publication of my paper, I have received from Dr. William H. Clench (personal communication, November, 1957) a suggestion which not only merits consideration but seems to be unquestionably correct.

Dr. Clench argues that in using the Latin word "occidentale" Mörch did not intend thereby to name a subspecies but merely to locate the western Atlantic form geographically. In other words, Mörch's position may well have been that the same species in two different forms was found in the two faunal regions, the typical *rubecula* being an Indo-Pacific shell. Mörch was a priest and therefore accustomed to use Latin, and I agree that the use of the Latin word "occidentale" in this connection does not necessarily have any nomenclatural significance. This theory is strengthened by the manner in which he listed the name, with the "L." for Linnaeus preceding the descriptive word "occidentale," and his failure to attribute the "subspecific" name to himself by the use of his own name or of "nobis." The above does not, of course, eliminate the possibility that the western Atlantic

form may be a good species or a subspecies of typical *rubecula*. It is merely an explanation of Mörch's apparent purpose in using the geographical word referred to.

After the communication from Dr. Clench was received, Clench and Turner (1957) published their paper on the genus *Cymatium* in the western Atlantic, and in this latest treatment of the western form of *C. rubecula* it is given subspecific rank by these authors, under the name "*Cymatium rubeculum occidentale*, new subspecies," the Mörch name being treated by them as a *nomen nudum*. Tryon (1881, p. 12) said: "Mörch made a variety, *occidentale*, but it has no distinctive characters." Tryon was in error on two counts: Mörch did not erect a variety or a name falling in any of the taxonomic units. Moreover, *occidentale* does possess distinctive characters which are pointed out by Clench and Turner.

Clench and Turner's style of citing the subspecies will obviate the confusion which the use of a new name might entail.

3. In the Collateral Notes to Part 6 of this series of papers (Dodge, 1958), I quoted two adverse criticisms, by Swainson and Cuvier, respectively, of Gmelin's "thirteenth edition" of the "Systema naturae." Since the publication of that part, I have found another similar reference which deserves quotation. Lamarck (1810, vol. 15, p. 22) said of Gmelin's catalogue: "There is in this work so much confusion in the synonymies, so many

defective or insufficient specific characters which seem to have been based merely on figures, that a new determination of species, at least covering the invertebrates, is now greatly to be desired for the advancement of zoology."

4. In connection with several of the species discussed in this series of papers, additional or corrective data have been included as Collateral Notes in parts published subsequently to the parts in which the detailed discussion of these species appeared. In order to permit the reader to locate readily all mentions of the species in question, these *additional* references are listed below:

- ater*, *Strombus* (Part 6): Bull. Amer. Mus. Nat. Hist., vol. 116, art. 2, p. 158, footnote 1.
- mercatoria*, *Voluta* (Part 4): *Ibid.*, vol. 111, art. 3, p. 157.
- monilis*, *Voluta* (Part 4): *Ibid.*, vol. 111, art. 3, p. 157.
- paupercula*, *Voluta* (Part 4): *Ibid.*, vol. 111, art. 3, p. 157.
- rubecula*, *Murex* (Part 7): The present paper, p. 212.
- sanguisuga*, *Voluta* (Part 4): Bull. Amer. Mus. Nat. Hist., vol. 111, art. 3, p. 157.
- succinctus*, *Strombus* (Part 5): *Ibid.*, vol. 113, art. 2, p. 78.
- terebellum*, *Bulla* (Part 4): *Ibid.*, vol. 111, art. 3, p. 157.
- terebellum*, *Conus* (Part 4): *Ibid.*, vol. 111, art. 3, p. 157.

## CLASS GASTROPODA

### GENUS *TURBO* LINNÉ

#### *Turbo obtusatus*

1758, *Systema naturae*, ed. 10, p. 761, no. 526.

1767, *Systema naturae*, ed. 12, p. 1232, no. 605.

LOCALITY: "In O. Septentrionali" (1758, 1767).

"T. testa subrotunda laevi: superne ventricosiore obtusissima, margine columnari plano."

*Turbo obtusatus* was described in identical terms in the tenth and twelfth editions of the "Systema," with no synonymy in either edition, and as coming from the "northern ocean." The common *Littorina obtusata* of both sides of the northern Atlantic Ocean is today accepted as the *Turbo* described by Linnaeus, although the somewhat equivocal language of the description and the lack of a synonymy would make any identification based on the Linnaean diagnosis alone somewhat questionable. The accepted identification is, however, confirmed by the presence of a properly documented specimen of the *L. obtusata* of all authors in the Linnaean collection in London.

It is generally accepted today that *Nerita littoralis* Linné, "from the coasts and rocks of the European sea," is the same species, and it appears in almost all synonymies of *L. obtusata*. *Nerita littoralis* was provided in the twelfth edition of the "Systema" with a so-called fresh-water form, by the addition of the following to the subdescription: "eadem minor in lacubus dulcibus." This form is discussed below.

I seriously question whether *littoralis* may be accepted as being equal to *obtusatus*. It is admitted that the descriptions of the two species contain some similar details. The shell is said to be "laevi" in both cases. In the description of *obtusatus*, however, only slight importance should be attached to the word, as most specimens, including the documented specimens in the Linnaean collection, bear extremely fine striae over the entire shell which can often be seen only with the aid of a lens. Linnaeus may not have noticed them or, if he did, did not deem it necessary to mention a feature so little apparent. The phrase "superne ventricosiore obtusissima" in the description of *obtusatus* recalls the "vertice carioso" of that of *littoralis*, indicating that

the obtuseness of the apex in both shells was due to wear, a state that is usually observed in older shells of *obtusatus* and is seen in Linnaeus' own specimens. The "labiis edentulis" of *littoralis* is not mentioned for *obtusatus*, although it is a distinctive feature of that shell. Because of these differences and in spite of the somewhat equivocal similarities, I see nothing in the two descriptions that suggests that the two names referred to the same species.

The most weighty piece of evidence as to the specific separation of the two names is found in the synonymy of *littoralis*. None of the several shells there pictured or described can be accepted for *obtusatus*. The figure cited from Lister's work on the English fauna (p. 164, pl. 2, fig. 3) involved an error of transcription or a misprint. According to Hanley (1855, p. 399) the citation must have been meant for figure 11 on the same plate, "for that drawing belongs to the referred-to description." Figure 3 had already been cited by Linnaeus for *Helix nemoralis*, which it greatly resembles, and does not at all conform to the description of *littoralis*. Even as to the substituted figure 11, Hanley was in error. That figure shows a minute shell with a very high spire. Significantly, figure 12 on the same plate might be taken for *obtusatus*.

The figure cited from Lister's "Conchology" ("t. 4, s. 8, f. 39"), which is more simply stated in the later editions as "plate 646, fig. 39," represents another error. Hanley concluded that Linnaeus must have meant "s.5" [section 5] instead of section 8. Neither figure conforms in any respect with the description of *N. littoralis*. Figure 39 in section 8 resembles *Trochus caelatus* Gmelin (*Astraea caelata*). The substituted figure 39 was probably meant for *Turbo petholatus*.

The reference to Petiver ("67, n. 717") could not be isolated by the writer.

The figures from Gualtieri (pl. 4, figs. LL) show a small *Nerita*-like shell which I am not able to identify, although one figure is enlarged. In Gualtieri's pertinent text the shells are called "*Neritarum fluviatilibus varietatis*" and referred to another figure from Lister's English work (p. 136, pl. 2, no. 20). The latter figures are so small as to be un-

recognizable. Gualtieri's figures were apparently cited by Linnaeus to support the latter's "small fresh-water variety."

The reference to the "Fauna suecica" ("2195"), being unsupported by a figure, is not conclusive. Linnaeus merely referred to the *Nerita littoralis* of the twelfth edition of the "Systema" in the words: "Nerita littoralis, testa laevi, vertice cavernoso, labii edentula."

The citation of "261" from Linnaeus' "Östländska och Gothländska Resa" is a short description of a "small Nerita (*Nerita littoralis*), in various colors, found in great numbers on the west coast [of Gothland]." I suggest that this was some form of the European *obtusatus* and, if this is so, is the only reference in the synonymy of *littoralis* that can be said to tie *obtusatus* to *littoralis* even tentatively.

In using the *Nerita* as a synonym of *Turbo obtusatus*, I can derive scant comfort from the above heterogeneous synonymy. We must then look to the Linnaean collection for a possible identification of *littoralis*. Bequaert (1943, p. 19) reported that the types of both *obtusatus* and *littoralis* are present in that collection. An examination of the microfilm of the collection does not entirely bear this out. Several specimens of *obtusatus* are present, properly documented. One of these specimens is reproduced in color by Hanley (1855, pl. 3, fig. 6) and is accurate except that it presents only the dorsal aspect of the shell. I cannot isolate the specimen or lot referred to as the "type" of *littoralis*. It or they may appear on one of the sections of the film in which numerous small and undocumented shells were photographed in mixed lots, some lying under others and thus partly or entirely hidden. Hanley (*op. cit.*, p. 399) referred to these specimens as follows: "Very many specimens of the *Littorina neritoides* (Donov., vol. 1, pl. 20, fig. 2) are present in the Linnaean cabinet, but whatever markings may have once been observable on them or their receptacle have now been obliterated. The dwarf freshwater [!] variety, an account of which Gualtier [pl. 4, figs. LL], who has represented *Neretina fluviatilis* or some closely allied congener, was probably quoted, was not mentioned in the tenth edition." Hanley was in error in his reference to Don-

ovan. The species described by Donovan and shown on the plate mentioned were called *Nerita littoralis* by him and not *neritoides*. Donovan nowhere mentioned a *Nerita neritoides*. We cannot be sure what Hanley saw in the collection in 1855 which he attributed to "*neritoides*." Certainly they are not visible on the film of the collection, and there is nothing present which is marked for *littoralis*. The collection, therefore, affords no further evidence as to the identity of that name. He treated *littoralis*, however, as a good species and said: "The extreme abundance and Swedish locality of this shore-frequenting shell seems to have caused its early recognition, despite of an utterly insufficient description and an erroneous synonymy."

Several forms of the American *Littorina obtusata* are figured by Bequaert in his paper on the western Atlantic *Littorina* (1943, pp. 18-19, pl. 6, figs. 1-6). It ranges from Newfoundland and southern Labrador to southern New Jersey. The eastern Atlantic shell ranges from Novaya Zemla to the Strait of Gibraltar and is also found in the Baltic Sea. Possibly the shell reported by Linnaeus in the "Öländska och Gothländska Resa" as occurring on the west coast of Gothland was *obtusatus*.

Synonyms of the American shell are: *Turbo palliatus* Say, 1822; *Littorina arctica* H. P. C. Möller, 1842; *Littorina neritoides* De Kay, 1843, not *T. neritoides* Linné; and *Littorina peconica* S. Smith, 1860. For the numerous synonyms of the European *obtusatus*, see Dautzenberg and Fischer (1915). Bequaert (*loc. cit.*) adds *Turbo neritoides* Pulteney, 1813, as a further synonym not mentioned by them.

The species *obtusatus* is very variable, although none of its forms merits subspecific rank. Many writers, notably Jeffreys and Tryon, believed the European shell to be specifically distinct from that from the northern part of the American coast. The most recent opinion, by J. Colman (1932), is that it is impossible to differentiate the shells from the two sides of the ocean, which is borne out by the present writer's examination of a considerable series of specimens from both localities.

Bequaert's paper, above cited, should be read, as it contains much further data as to

the records, ranges, and habitats of the species.

#### *Turbo littoreus*

1758, *Systema naturae*, ed. 10, p. 761, no. 528.

1767, *Systema naturae*, ed. 12, p. 1232, no. 607.

LOCALITY: "In O. Europaeo, frequens ad littora Norvegiae" (1758, 1767).

"T. testa subovata acuta striata, margine columnari plano."

The meager description of *T. obtusatus* and *neritoides* are so similar and so equivocal that it is difficult to distinguish the two species from their descriptions alone. Once they have been identified, however, by evidence other than the descriptions, the definition of *littoreus*, which is alike in both editions of the "Systema," is probably sufficient to distinguish it from either of the others both by its position in Linnaeus' catalogue and by the significant word "striata" as contrasted with the "laevi" of *obtusatus* and the "glabra" of *neritoides*. It is still, however, an inadequate description. The stated locality, together with the locality fixed by the listing of the species in the "Wästgota Resa," which was cited for it, was probably the most important factor in its identification with the *Littorina littorea* of modern writers.

The synonymy is only partially usable. The figure from the "Wästgota Resa" (pp. 169, 199, pl. 5, fig. 4) and from Baster (1759-1785, vol. 3, p. 110, fig. 1) were not seen. The reference to Swammerdam consists of a description (1735-1738, vol. 1, p. 183) largely devoted to the anatomy of the animal and a figure (vol. 2, pl. 9, fig. 18), which was not referred to by Linnaeus, which may have been based on *littoreus* but, as drawn, cannot certainly be referred to that species. It is highly conventionalized.

The figures from Gualtieri (pl. 45, figs. G, two figs., dorsal and apertural aspects) are reasonably accurate and are further supported by Gualtieri's pertinent description and his reference to the figure from Lister's work on the English shells (p. 162, pl. 3, fig. 9), a good figure which was also cited by Linnaeus. Two further pairs of figures on the same plate of Gualtieri, figures A and C, show the color form having alternating light and dark brown bands. The failure to cite these latter figures is curious, as the speci-

mens in the London collection are of this form.<sup>1</sup> Linnaeus also cited the "Fauna Suecica" (1761, ed. 2, no. 2169), where the species is adequately defined.

Chemnitz (1780-1795, vol. 5, pp. 230-233, pl. 185, fig. 1852, nos. 1-8) figured both the unicolored form (nos. 1-4, 7-8) and the dark-banded form (nos. 5-6), all of which figures are characteristic and are the best that appeared before the use of photography. Bequaert (1943, p. 4) notes that the color is fairly constant in America, "usually a bistre-gray, the ridges often pale brownish or the shell with dark brown bands; in Europe sometimes entirely reddish orange." The banded pattern is more often seen in the juvenile shell. The species is also variable in the number, width, and distribution of the bands and in their suppression on certain portions of the shell, particularly near the parietal area.

Gmelin's *littoreus* (1791, p. 3588) was a composite species. For his typical *littoreus* he copied the description in the "Systema" and supplied a voluminous synonymy, including all the references cited by Linnaeus and, in addition, several other good figures or descriptions; the description of Fabricius' *Nerita littorea* (1780, p. 403, no. 405), Chemnitz' good figures, and two accurate figures from Schröter's "Flussconchylien" (1779, pl. 8, fig. 5, and pl. 11, min. C, fig. 5). He also added a figure from Argenville (1757, pl. 6, fig. L) which is questionable. Argenville called it "le Limaçon le plus rare," which would seem to disassociate it from *littoreus*. Gmelin then listed four lettered varieties:

Variety  $\beta$  is referred to a pair of Chemnitz figures (*tom. cit.*, pl. 185, fig. 1853) which show *T. obtusatus* Linné.

Variety  $\gamma$  is referred to other Chemnitz figures (pl. 185, fig. 1855, a-g). If any of these figures were based on specimens of *littoreus*, I am unable to recognize them as such.

Varieties  $\delta$  and  $\epsilon$  were, respectively, referred to figures from Lister's major work (pl. 1059, figs. 6 and 7), both of which are unrecognizable. Dillwyn (1823) said that these

<sup>1</sup> It is not certain that the specimens in the London collection are Linnaeus' types, as they are not documented in any way. However, they are the only specimens in the collection that agree with Linnaeus' descriptions and cited figures and are typical specimens of the *L. littorea* of authors.

figures "are quoted by Gmelin for varieties of *Turbo littoreus*, which they are completely unlike . . . [they] probably belong to the same nondescript species."

Dillwyn (1817, p. 817) continued to include figures of *obtusatus* or *neritoides* in the synonymy of *littoreus*, and also cited the equivocal Chemnitz figures (fig. 1855, a-g), following the example of Gmelin. In his comments he did, however, recognize that the shell has a variable color pattern and that the brown bands are more often associated with the young shell.

Lamarck (1822, vol. 7, p. 47) was the first to restrict the synonymy to acceptable figures of the species.

Hanley (1855, p. 326) found only unmarked specimens of *littoreus* in the Linnaean collection. To these he gave the name *Littorina vulgaris*, a name erected by Sowerby (1847-1887) and an exact synonym of *littoreus* Linné. These undocumented specimens may have been the shells upon which Linnaeus based his species, but they can be accepted as the syntypic lot only on a "probable" basis.

The species is now contained in the genus *Littorina* Férussac, 1822, and is the type species of that genus by subsequent designation, Blainville, 1828. Thiele (1931, p. 125) places it in the section *Algaroda* Dall, 1918, of the typical subgenus of *Littorina*.

As might be expected in the case of a shell with so extended a range and found in such enormous populations, it has acquired a voluminous synonymy. Its synonyms are too numerous to be listed here, but are given by Dautzenberg and Fischer (1912, pp. 181-187). *Littorina communis* W. Thompson, 1856, not of T. Brown, 1843, is an additional synonym not in the above list. *Litorina litorea* Menke, 1828, is an emendation of the spelling of both the generic and specific names. *Turbo ustulatus* is a name that immediately follows *T. littoreus* in Lamarck (*tom. cit.*, p. 48). It is described by Lamarck in his French description as follows: "Aside from its coloration, which is more intense and browner than the preceding [species], it is thicker and does not show any transverse fascicular lines." There is nothing in Lamarck's diagnosis that takes it out of the range of variation of *littoreus*. Deshayes (*in* Deshayes and Milne-Edwards, 1843, p. 214, footnote 1) reported that he had

examined Lamarck's type of this "species," then in the collection of Delessert, and determined that *ustulatus* was founded on some worn specimens of *T. littoreus*, and continued: "It is therefore necessary that this species should be expunged from our catalogues."

It will be noticed, in studying the treatment of *Littorina littorea* in the conchological works of the eighteenth and the first half of the nineteenth centuries, that an American locality is never suggested. The species is not indigenous to the western Atlantic but was introduced into North American waters some time before 1840, by either accident or design. The early American naturalists did not mention it. About 1857 it was first reported as an American shell in a published paper by John Willis as having been found in Nova Scotia, although later papers published reports of its presence in Nova Scotia in 1840 and in the Gulf of St. Lawrence in 1855. It spread rapidly southward, reaching the limit of its present American range, southern New Jersey, about 1892. The American shells do not seem to be distinguishable from those from the eastern Atlantic except in the color differences noted above and are no more susceptible of variation. The species is apparently circumboreal, for *Littorina squalida* Broderip and Sowerby, 1829, is, according to Dautzenberg and Fischer (*op. cit.*), the representative, or perhaps a subspecies, of *L. littorea* on the coast of Alaska, in Bering Sea, Kamchatka, and northern Japan. *Littorina squalida* was also reported from the boreal Pacific by Gray (1839, p. 139, pl. 34, fig. 12).

The reader is referred to Bequaert's excellent paper on "The genus *Littorina* in the western Atlantic" (1943, pp. 1-27) for a more elaborate account of the range, habitat, and variability of the species, and for the details of its introduction into American waters and the gradual extension of its western range. The present writer has drawn heavily upon the information supplied in that paper.

The best figures of the American shell are found in Bequaert (1943, pl. 1, figs. 1-11) and in Abbott ([1954], pl. 19, fig. B).

The European shell is figured by Jeffreys (1862-1869, vol. 5, pl. 65, fig. 4) and by Forbes and Hanley (1853, vol. 4, pl. 83, figs. 8-9, showing two color forms).

*Turbo littoreus* was not described in the "Museum Ulricaë."

#### *Turbo muricatus*

1758, *Systema naturae*, ed. 10, p. 761, no. 529.

1767, *Systema naturae*, ed. 12, p. 1232, no. 608.

LOCALITY: "In Europa australi" (1758, 1767).

"T. testa umbilicata subovata acuta cincta striis punctis eminentibus, margine columnari obtusiusculo."

It is suggested that the reader refer to the comments on *Trochus muricatus* (Dodge, 1958, pp. 176-177) in connection with the following discussion. The two species named *muricatus* by Linnaeus have been at times confused, largely, I suspect, because the Gualtieri figure (pl. 64, fig. H) cited by him for *Trochus muricatus* is a good figure of *Turbo muricatus* and is almost, if not quite, as characteristic of that species as the other Gualtieri figure (pl. 45, fig. E) cited for the *Turbo*. The shell now bearing the label "*Trochus muricatus*" in the Queen's collection at Uppsala is a specimen of the present species *Turbo muricatus*. Although it is conceded that the accuracy of the labels in that collection is extremely questionable, the presence of that specimen could have been a further source of confusion to the few conchologists who may have had an opportunity of examining it.

The descriptions of the two species are somewhat similar, but the one of the *Trochus* is too brief and unrewarding to enable us to identify it, whereas the description of the *Turbo* is, I consider, adequate in itself. The only two details that could be criticized are, first, that the word "umbilicata" is too strong an expression to describe the narrow umbilical slit of the species, which, in most juvenile and some adult individuals, is completely closed, leaving only a slight longitudinal furrow on the columella, a furrow so weakly defined in some cases as to be scarcely noticeable. Indeed, the Gualtieri figure cited for the species shows no hint of either an umbilicus or a depression in the columella left by a closed umbilicus. Second, the phrase "punctis eminentibus" would lead one to expect something more acute and salient than the low, rounded beading of *muricatus*. The specific name itself is, to this extent, inapt. Linnaeus habitually used the word to describe fea-

tures of a shell which were in no sense "pointed."

*Turbo muricatus* is now placed in the genus *Tectarius* Valenciennes, 1833, subgenus *Cenchritis* Martens, 1900, of which it is the subgenotype. *Echinella* Swainson, 1840, not of Bory de St. Vincent, 1824, and *Echinella* Roverto, 1899, are synonyms of *Tectarius*. For a considerable period in the middle of the nineteenth century, however, many writers used *Littorina* Férussac, 1822, for the present species. Deshayes (*in* Deshayes and Milne-Edwards, 1843, p. 199, footnote) said: "In spite of the unfortunately too short description of *Trochus muricatus* in the Muséum Ulricaë, it is impossible for me to identify this species and I suspect that it belongs in the genus *Littorina* as does the *Turbo muricatus*."

Linnaeus was in error as to the locality, as it is a native of the western Atlantic, being found in southern Florida, the lower Florida Keys, and in great abundance throughout the West Indies. It is also reported from Bermuda, and its southern range extends as far south as Trinidad. It should be noted, however, that, years before the publication of the "*Systema naturae*," Petiver (1702-1711, pl. 70, fig. 11) had called it the "Jamaica Wart-shell."

The "*Turbo muricatus* Linnaei" of Chemnitz (1780-1795, vol. 5, p. 171, pl. 177, figs. 1752-1753) is the true *Tectarius muricatus*. His description is unimpeachable, and his figures are the most accurate pictures of the species published before the use of photography. His references are all correct. He called attention to Linnaeus' incorrect locality and located the shell in the West Indies.<sup>1</sup>

The American locality for *muricatus* was adopted only in part by Gmelin (1791, p. 3589) who placed the species "in Mari Europam Americamque australem et Africam alluente." As to the African locality, both he and Chemnitz cited in their synonymies of *muricatus* Adanson's figure of "le Boson" (1757, pl. 12, fig. 2). Based on Adanson's description and figure, "le Boson" cannot be distinguished from *Tectarius muricatus* of the western Atlantic. This, then, is a further

<sup>1</sup> Chemnitz described and figured another species as "*Turbo muricatus oblique incurvatus. Rostrum corvi*" (*op. cit.*, vol. 4, p. 317, pl. 156, fig. 1478). This was *Murex aluco* Linné and was so referred by Chemnitz.

addition to the list of western Atlantic species which may occur also in the west African fauna. It has not been reported from that region since its inclusion by Adanson in his work on the mollusks of Senegal, and therefore his specimen may have come from the other side of the Atlantic and have been integrated in his collection by inadvertence. Fischer-Piette and his co-authors (1942, p. 269), in their report on the "retained" collection of Adanson (see Dodge, 1955, p. 53), reported the finding of four unquestioned specimens of *Tectarius muricatus* in that collection, three of which were labeled "le Boson 2570, Sénégal." They figured one of these specimens (pl. 10, fig. 3). They noted that it was a western Atlantic species which no writer except Adanson had reported from the west coast of Africa but added that the Paris Museum had four specimens of *Tectarius muricatus* with a label reading "extremely common on the Guinea coast on the rocks, out of water, at 25-30 paces from the shore," which had been collected by Rang in 1839. As to this report they said: "Rang did, in fact, collect mollusks in western Africa. This source is therefore certainly exact." It is to be noted that Guinea is much farther south than Senegal and therefore their two statements are not necessarily in conflict. These writers concluded by saying: "It is difficult to state whether it is a question of an accidental mixture by Adanson in his collection, or if we may await the re-discovery of this species in Africa." The question, therefore, of the west African locality of the species is still an unsolved problem.

Lamarck (1822, vol. 7, p. 47) was even more vague than Gmelin, as he stated the locality of *Turbo muricatus* as "L'Océan Atlantique, etc.," and this locality was repeated by Deshayes in the second edition of the "Histoire naturelle." Since that time, however, the European locality has disappeared from the literature.

The species usually lives along rocky coasts and is generally found at or above the high-water line but in stations where it is reached by the spray. Even when deprived of the effect of spray, it can tolerate dryness and heat for considerable periods of time. On the island of New Providence in the

Bahamas and on other islands of the group the writer has found it in great numbers on bushes well removed from the beach and as much as 70 feet above the mean high-water line. The largest shells, however, must be sought in stations where they can be reached by the tide and thus supplied with a greater amount of nourishment.

Hanley (1855, p. 327) first isolated the species in the Linnaean collection in London, where it was represented by an unmarked specimen which was, however, contained in a tray marked for *Turbo muricatus*. It has been accepted as Linnaeus' type, but, as the shell itself was undocumented, it must be so considered on a "probable" basis only.

The best recent figures of the species are the photographic figures in Clench and Abbott (1942, pl. 1, fig. 4), and in Abbott ([1954], pl. 19, fig. G).

It was not described in the "Museum Ulricae," although, as said above, the Uppsala collection now contains a specimen of it labeled *Trochus muricatus*.

#### *Turbo cimex*

1758, *Systema naturae*, ed. 10, p. 761, no. 530.

1767, *Systema naturae*, ed. 12, p. 1233, no. 609.

LOCALITY: "In M. Mediterraneo; minutus" (1758, 1767).

"T. testa imperforata ovata striis decussatis: punctis eminentibus."

The description of this species, which is identical in the tenth and twelfth editions of the "*Systema naturae*," conforms in its somewhat meager details to the shell that is the *Alvania cimex* of all modern authors, and, read in connection with Linnaeus' Mediterranean locality and his description of it as "minutus," is sufficiently graphic to point to that shell. If any criticism may be made, it is only in the use of the word "eminens." The meaning of the word "eminens," "produced" or "pointed," scarcely describes the low, rounded beading of the species. Linnaeus, however, used this word habitually for such a feature. In *Turbo* the word was used equally inaptly for *T. muricatus*.

The synonymy is only half correct. Of the two figures cited, those from Gualtieri (pl. 44, figs. X, dorsal and apertural aspects) are satisfactory except that they do not show the color pattern of the fresh shell, the two

brick-red spiral bands of the body whorl, and the single such band on the last whorl of the spire. The color of these bands is, however, extremely fugitive and is seldom seen on beach-worn specimens. This accounts for the number of colorless figures of the species and for the occasional description of the shell as "alba" in the early literature. The figure from Adanson (pl. 10. fig. 6), which was added in the twelfth edition, is not *cimex*. It was called "le Soni" by Adanson (1757, p. 151), and appears to be a buccinid. Fischer-Piette and his co-authors (1942, p. 247), in their discussion of Adanson's "retained" collection of Senegal shells (Dodge, 1955, p. 53), commented on this name as follows: "Linnaeus cited 'le Soni' in his synonymy of *Turbo cimex*, which is a *Rissoa*. Bruguière gave a Linnaean consecration to the name created by Adanson.<sup>1</sup> Deshayes (1832, Hist. Nat. des Vers, vol. 3, p. 964) limited himself to saying that 'le Soni' seemed to belong to the genus Buccin. Since then it does not seem that 'le Soni' has been referred to." They place Adanson's shell in *Chauvetia* Monterosato, 1884, a genus in the Buccinidae.

The *cimex* of modern writers is contained in *Alvania* Risso, 1826, of which it is the type species, as *A. freminvilleae* Risso.<sup>2</sup> Tryon and

many other writers have treated *Alvania* as a subgenus of *Rissoa* (Fréminville) Desmarest, 1814. I accept it as a good genus.

The addition of the incorrect figure of Adanson's "Soni" to Linnaeus' synonymy in the twelfth edition may have rendered his diagnosis ambiguous to some of the early writers and may have been the cause of their failure to identify *cimex*. Neither Martini nor Chemnitz referred to it. Da Costa (1778, p. 104, pl. 8, figs. 6, 9) described and figured a "*Turbo minimus albus cancellatus*," which he referred to *T. cimex* Linné, as "milk-white" and as having "deep latticed work." His figures are too small to analyze and are drawn as sinistral. He located the species in Guernsey, Cornwall, the Mediterranean Sea, and Senegal. I cannot find sufficient information in either his description or his figures to permit the use of the name *cancellatus* as a synonym of *cimex*, although it has frequently appeared in synonymies. Schröter (1783–1786, vol. 2, p. 8) listed *Turbo cimex*, but did not figure it. His description indicates that he was not familiar with the species. Röding (1798), Pulteney (1799), and Link (1807) omitted the species, although Röding and Link were limited by the contents of the collections that they were describing. Gmelin's subdescription of *Turbo cimex* (1791, p. 3589) seems to indicate that he knew the species, as he added details that had not appeared in the "Systema": "Albida, labro intus albo limbato," and "spirae infractu primo sequentibus 4–5 majore." Moreover, while accepting the Gualtieri figure cited by Linnaeus, he properly queried the Adanson figure.

Donovan (1799–1803, vol. 1, pl. 2, figs. 1, natural size and enlarged) described and figured a *Turbo cimex* Linné which he also located in Guernsey, Cornwall, and the Mediterranean Sea. His enlarged figure shows a latticed or decussated sculpture made up of fine spiral and longitudinal lines with what appear to be deep fenestrations between the crossings, rather than the sym-

<sup>1</sup> Fischer-Piette and his co-authors were in error as to Bruguière's conception of "le Soni." He described a *Buccinum soni* (1789, 1792, p. 283) which he referred to the "Soni" of Adanson, but did not mention Linnaeus or refer to the "Systema naturae" or to *Turbo cimex*. Bruguière added: "I know a variety of this shell in the cabinet of M. le chevalier de la Marck, which, without being sufficiently distinguishable from the first to justify its separation, differs nevertheless in several particulars." The "variety" may possibly have been Lamarck's *Turbo cancellatus*, mentioned below, which Lamarck said was in his cabinet.

<sup>2</sup> In 1884 Bucquoy, Dautzenberg, and Dollfus (1882–1898, p. 282) designated *Alvania cimex* as the type species of *Alvania*. That name was technically ineligible, as it did not appear on Risso's original list of species. It is, however, generally agreed that Risso's *A. freminvilleae*, *europaea*, and *mamillaris* are all conspecific with *cimex* Linné. Accordingly Gordon (1939, p. 29) designated *A. freminvilleae* as the type species, saying: "This will not affect the practical use of *A. cimex* as the genotype but will clearly define the status of the genus *Alvania* in accordance with the Rules of Zoological Nomenclature." Thiele (1931, p. 162) had already cited *A. montagui* Payraudeau, 1826, as typical of the genus, evidently being under the impression that Monterosato's mention of that species (1884, p. 19) was a type designa-

tion and that it was earlier than Bucquoy, Dautzenberg, and Dollfus' selection of *A. cimex* as type species. Not only was Monterosato's listing not a type designation, as it was merely the first name in his list of species, but the name *montagui* was not on Risso's original list, either as a good species or as a synonym.

metrically disposed beading of *cimex* Linné. The enlarged figure may have been based on a worn specimen of the Linnaean species, but, as in the case of Da Costa's *cancellatus*, it is not sufficiently convincing to be accepted as such. Donovan cited *cancellatus* as a synonym. Montagu (1803, vol. 1, p. 315) also described a *Turbo cimex*, citing for it both the Da Costa and Donovan references. In spite of his failure to supply a figure, his description is fairly characteristic, and I am more inclined to accept it as describing *cimex* Linné than the species of his two British predecessors. All the species of the three British writers mentioned have been frequently cited as synonyms of the Linnaean *cimex*, and it is true that that shell is found in Britain. Tryon (1887, p. 359) cited Montagu's *Turbo calathiscus* (1808, p. 132) for *cimex* Linné but did not cite either the Da Costa or the Donovan species. *Turbo calathiscus* is a name also frequently cited for *cimex* and, I suggest, properly so. Tryon did place *cancellatus* Da Costa and *cimex* Donovan in the synonymy of *Alvania* (*Acinopsis*) *crenulata* Michaud, 1832. Michaud's *crenulata* cannot, however, be associated with any of the names mentioned. Its sculpture consists of prominent rounded axial ribs which cover approximately the upper three-quarters of the body whorl, instead of the symmetrical beading of *cimex* Linné and the two British shells.

The name *cimex* was also omitted by Lamarck. He placed some of its congeners in his *Melania*, 1799, in his 1822 work, as he was apparently not aware of the erection of *Rissoa* by (Fréminville) Desmarest<sup>1</sup> in 1814, in which genus *cimex* Linné was placed by many writers both before and after Risso described *Alvania* in 1826. Lamarck's *Turbo cancellatus*, based on its description and its Mediterranean locality, may have been

*cimex* Linné, but his failure to cite references makes it an equivocal species.<sup>2</sup>

Deshayes (*in* Deshayes and Milne-Edwards, 1838, pp. 460-461) commented on the name *cimex* Linné only by "presuming" that it should be "sought for among the Mediterranean species of *Rissoa*." He continued: "Although I have a strong suspicion that the species is the same as that called *Rissoa cancellata* by Desmarest and *Turbo cancellatus* by Lamarck, I am still in doubt because of the extreme brevity of the Linnaean description and because the synonymy in the *Systema naturae* appears to be incorrect . . . I think, and repeat an opinion already stated by me, that those Linnaean species which it is impossible to identify without having seen the shells on which the species was based, should be definitely abandoned and given the status of *incertae sedis* until new information is available." Deshayes' only further reference to the present species was by citing it in the synonymy of *Rissoa cancellata* Desmarest, along with *T. cancellatus* Lamarck, *T. cimex* Gmelin, *T. cimex*, pars, Dillwyn, and *T. cancellatus* Da Costa, but all of these synonyms were followed by a question mark except that of Da Costa.

Deshayes' desire for "new information" may have been later satisfied by Hanley's report (1855, p. 327) on the specimens of Montagu's *calathiscus* in the Linnaean collection in London. Hanley first rejected the Adanson figure and accepted that of Gualtieri. Inasmuch as the underlining in Linnaeus' working copy of the "Systema" shows that Linnaeus did possess a specimen of *cimex*, Hanley sought to isolate the species in Linnaeus' cabinet, and "search was made for the shell generally regarded by Montagu and the English conchologists as the veritable species of Linnaeus." He did not find what he considered to be the species of these writers, but "a large parcel of the *Rissoa calathiscus* (Philippi, Moll. Sicil. vol. 2. p.

<sup>1</sup> Deshayes (*in* Deshayes and Milne-Edwards, 1838, pp. 460-461) in his introductory remarks to the genus *Rissoa* attributed that name to Fréminville, although he continued by saying: "This genus, established by M. de Fréminville for several little shells observed by M. Risso . . . was described in 1814 by M. Desmarest, in the new bulletin of the society philomatique." I have been unable to determine what Deshayes meant by the word "established" ["établi"]. I am not aware of any published works of Fréminville and no further explanation is supplied by Desmarest's paper (1814).

<sup>2</sup> *Turbo cancellatus* Lamarck (1822, vol. 7, p. 49) was referred to as "ex D. Beudant." This probably refers to François Sulpice Beudant, a geologist and mineralogist and a contemporary of Lamarck, who may have supplied Lamarck with a specimen of the shell, in spite of the initial "D." I know of no other Beudant in the sciences.

125; *R. granulata*, vol. 1. p. 153) was found enveloped in a leaf torn from some Swedish book, and as these shells perfectly answer to the description, and none other in the collection correspond with the definitions, no reasonable doubt can be entertained of their typical authority. Moreover, Mörch, in one of his critical catalogues (Yoldi) has suggested the probability of this synonym."<sup>1</sup>

As to Hanley's conclusion: The *calathiscus* of Philippi is, I consider, the same as *calathiscus* Montagu and is, in my opinion, *cimex* Linné. Thus far I agree with Hanley. I also feel that the available evidence is probably sufficient to show that Linnaeus himself placed the specimens in the collection. We know that Linnaeus possessed this species, and the specimens in question are the only ones in the collection that conform to the description of *cimex* in the "Systema." There is, moreover, no available evidence that the specimens were added to the collection by another hand. Under the rule for the establishment of Linnaeus' types that has been adopted in these papers, however, these specimens may be accepted as Linnaeus' syntypic lot only on a "probable" basis, as they are entirely undocumented except in so far as the Swedish paper in which they were wrapped might be construed as "documentation," a fact of very little evidential value.

The many names that have been given to the minute species of *Alvania*, the defects of many of the figures, the inadequacy of most of the descriptions, and the divergence of opinion of authors in synonymizing *cimex* and its close congeners convince the writer, at least in the case of *cimex*, that the selection of unquestionable synonyms is a highly inconclusive and difficult project. Most of the synonyms that have been cited by writers after Hanley are to a greater or less degree equivocally described and figured. The following have been traditionally used: *Turbo cancellatus* Da Costa, 1778; *T. calathiscus* Montagu, 1808, and *cimex*, 1803; *Rissoa cancellata* Desmarest, 1814; *Alvania europaeo*,

*freminvillea*, *mamillaris*, and *verrucosa* Risso, 1826; *Turbo cancellatus* Lamarck, 1822; *Rissoa crenulata* Michaud, 1830; *R. granulata* Philippi, 1836. Of this list only the *Alvania* species of Risso, with the possible exception of *verrucosa*, and *T. calathiscus* Montagu and Philippi are acceptable to the writer as synonyms. I would accept none of the others, except with considerable hesitation, and would definitely expunge *crenulata* Michaud from the list.

The species is primarily a native of the Mediterranean Sea, as Linnaeus stated, but its range is extended to the Atlantic coast of Europe as far as southern Britain.

Good figures of this species are scarce, as most of them are reproduced in natural size only, which, in the case of such a minute shell, does not adequately show its diagnostic features. It is passably figured by Reeve (1843-1878, vol. 20, *Rissoa*, pl. 1, sp. 2), by Bucquoy, Dautzenberg, and Dollfus (1882-1898, pl. 33, figs. 10-23),<sup>2</sup> and by Tryon (1887, pl. 65, figs. 11-12). Tryon's figures are good enlarged pictures of the dorsal and apertural aspects of the shell.

*Turbo cimex*, in common with virtually all of the minute species, was not present in Queen Louisa Ulrica's collection and is therefore not described in the "Museum Ulricae."

#### *Turbo pullus*<sup>3</sup>

1758, *Systema naturae*, ed. 10, p. 761, no. 531.  
1767, *Systema naturae*, ed. 12, p. 1233, no. 610.

<sup>1</sup> Bucquoy, Dautzenberg, and Dollfus figure several "varieties" of *cimex*. Figures 13-14, which they call "var. *fasciata* Philippi," shows brown bands just below the suture. I conceive this to be the typical *cimex*. Figure 16, which they designate as "var. *lactea* Philippi," is white and without subsutural bands. Unless this form represents merely a bleached specimen, it is a form with which I am not familiar. The all-white specimens in the collection of the American Museum of Natural History and in the writer's collection seem to have been somewhat worn.

<sup>2</sup> The Latin word "pullus" is both a noun meaning "a young (and hence small) animal," and an adjective meaning "blackish," "grayish black," "dark green," or any dark color. It seems obvious to the writer that Linnaeus, considering the brilliant and highly variable color and color pattern of *Turbo pullus*, must have intended to use the name as a noun. Moreover, Linnaeus capitalized the word, a practice which, throughout the "Systema," was consistently carried out whenever he used a noun as a specific name. Many writers, however, have

<sup>1</sup> In the Yoldi catalogue (1852, 1853, vol. 1, p. 44) under *Alvania* Risso, Mörch listed *A. calathiscus* Montagu as a good species, with two synonyms: *T. cimex* Linné with a query, and *A. europaeo* Risso. As Mörch queried the first synonym, Hanley's characterization of it as a "probability" is misleading.

LOCALITY: "In M. Mediterraneo" (1758, 1767).

"T. testa imperforata ovata laevi, apertura antice diducta... Testa magnitudine seminis Carthami nitida, picta varie fasciis maculisque purpurascens fuscis albidisve. Apertura antice angulum format, uti T. petholatus, cui valde affinis."

The description and subdescription of this species are identical in the tenth and twelfth editions of the "Systema." In spite of the absence of references, the description, together with the Mediterranean locality, is sufficient to define the species. Only two details need be noted: Linnaeus confused the proper conception of the orientation of the shell, as for "antice" he should have used "postice." The comparison of the shell with *T. petholatus* (see p. 224, below), a shell that reaches a height of almost 3 inches, is confusing. Indeed their only similarity is the great variability of both in color and color pattern, and the attenuation of the posterior end of the columella and outer lip in both, a feature mentioned by Linnaeus for *pullus*. The two species belong in different subfamilies of the Turbinidae, *petholatus* in the Turbininae and *pullus* in the Phasianellinae.

The extreme color variability of *T. pullus* is graphically expressed in the subdescription. In the series of specimens before the writer, the range in the arrangement of the color, as well as the range in the color itself, is so wide that no two specimens can be said to have a similar pattern.

Hanley (1855, p. 327) was unnecessarily skeptical as to the value of the description as a guide to identification, saying: "Notwithstanding that the absence of synonyms and of descriptive detail would seem to render the identification of this minute species an almost hopeless task, the locality, being taken as a limiting characteristic, has accomplished it. For the richly variegated coloring, minuteness of size, form of the mouth, and

perfect smoothness of surface, are features combined in so few Mediterranean shells that almost universal assent points to the *Phasianella pullus* as its representative." Hanley cannot have read the description carefully, as all the details mentioned by him are found there.

Lamarck's *Phasianella* was erected in 1804 (p. 295), and, while he retained the present species in *Turbo* in his major work in 1822, most of his successors, until comparatively recent times, placed it in *Phasianella*<sup>1</sup>: Payraudeau, 1826; Philippi, 1836, as of Payraudeau; Reeve, 1862; Weinkauff, 1868; Jeffreys, 1869; Bucquoy, Dautzenberg, and Dollfus, 1884; and Tryon, 1888, the last two authors citing it as *Phasianella (Tricolia) pulla*.

In 1826 (p. 122) Risso had erected the genus *Tricolia* for a small list of species, including *T. pullus* Linné, the latter being designated as type by Gray in 1847. Gray misspelled the name as *Tricolea* in his text, and as *Tricolaea* in his "Index of genera." For many years *Tricolia* was used, if at all, only as a subgenus of *Phasianella*, but in 1928 Woodring (p. 418) separated it from *Phasianella* as a good genus and even erected the family Tricoliidae to contain it. Grant and Gale (1931, p. 813) say of Woodring's treatment: "As the basis of separation is largely one of great difference in the sizes of the respective genotypes, the two genera are here retained in the one family, Phasianellidae. The type of *Phasianella* Lamarck, according to Woodring, is *Buccinum australe* Gmelin, which is a giant in comparison with the California Recent and fossil species that have been called *Phasianella*, and it appears natural to make a generic distinction in this case." The conclusion of both Woodring and Grant and Gale as to the separate generic validity of *Tricolia* has been followed by most modern systematists, and Grant and Gale's opinion that the two genera should be retained in one family, Turbinidae, subfamily

apparently treated the word as an adjective and, when using it in combination with a feminine genus, have given it the feminine form "pulla." Hanley was one of the few authors who treated it as a noun, as he called the present species *Phasianella pullus*. Risso, who placed the species in his *Tricolia*, also gave it the style *Tricolia pullus*. The common error, however, has persisted in many recent works. The latest use of it as a noun was by Robertson (1958, p. 261), who points out the reason for that use in a footnote.

<sup>1</sup> Deshayes (*in* Deshayes and Milne-Edwards, 1843, p. 217), while he followed Lamarck in listing the species in *Turbo*, added a footnote: "This shell is not a *Turbo*, but a true *Phasianella* which is very abundantly distributed in the European ocean." He had already, in an earlier work (1836, p. 145) called the species *Phasianella pulla*.

Phasianellinae, is, I suggest, the proper practice, although the Tricoliidae are used by some writers. I have not seen any discussion of the soft parts of any of the *Tricolia* species, but I can detect no difference in shell characters that would differentiate them from the species in *Phasianella*, except for the striking difference in size of the types. The American West Coast conchologists have apparently disagreed with Woodring and retain the genus *Tricolia* as a subgenus of *Phasianella* in the Phasianellinae.

The following appear to be exact synonyms of *Tricolia* Risso: *Eutropia* Humphrey, 1797; *Tricoliella* Monterosato, 1884; and *Eudora* Leach, 1852.

The species *T. pullus* is found in abundance in the Mediterranean and Adriatic seas and has been reported from the Black Sea. It is also found in the Azores and Canary Islands and along the Atlantic coast of Europe as far north as the southern coast of England. I have seen reports of the species from the North Sea.

The first post-Linnaean figures of the species are found in Da Costa (1778, pl. 8, figs. 1, 3), but they are shown as sinistral and are too small and crudely drawn to be instructive. Da Costa's description, however, together with his descriptive specific name *Turbo pictus*, strongly suggests the *T. pulla* of Linnaeus, and that name was cited in Da Costa's synonymy. As in the case of the preceding species, *Turbo cimex*, neither Martini nor Chemnitz referred to *pullus*. Born (1780, p. 342, pl. 12, figs. 17-18) supplied a good description, although his figures are too small to be enlightening. The British form of the species is figured by Donovan (1799-1803, vol. 1, pl. 2, figs. 2-4, five figs.). Three of these figures are enlarged and graphically show three of the known color forms, one of them being an apertural view. Donovan cited *pullus* Linné and *pictus* Da Costa as synonyms.

Hanley (1855, p. 328) found many undocumented specimens of this species in the Linnaean collection in London. As no other shells in the collection conform to the details of the Linnaean description, and as the serial number of *T. pullus* was underlined in Linnaeus' working copy of the twelfth edition, indicating an owned species, these specimens

may be accepted as Linnaeus' syntypic lot on a "probable" basis.

As *Tricolia pulla* is sharply differentiated from all other minute Mediterranean species by the variability and brilliance of its coloring, the listing of synonyms is simpler than in the case of the preceding species, *Alvania cimex*. The following may be considered as unquestionable synonyms: *Turbo pictus* Da Costa, 1778; *T. flammeus* von Salis, 1793; *Phasianella punctata* Risso, 1826; *P. pullulus* Anton, 1839; *P. tenuis* Philippi, 1844; *Eudora varians* Leach, 1852; and *P. crassa* Brusina, 1864.

The species is figured by Reeve (1843-1878, vol. 13, *Phasianella*, pl. 6, figs. 20a-f) and by Tryon (1888, *Phasianella*, subgenus *Tricolia*, pl. 38, figs. 56-60), both sets of figures illustrating several of the types of color pattern.

In common with most of the minute species *T. pullus* was not contained in Queen Louisa Ulrica's collection and consequently is not described in the "Museum Ulricae."

#### *Turbo petholatus*

1758, *Systema naturae*, ed. 10, p. 762, no. 533.  
1767, *Systema naturae*, ed. 12, p. 1233, no. 612.  
LOCALITY: "Ad Barbados" (1758, 1767).

"T. testa imperforata ovata laevi nitida, anfractibus sursum subangulatis."

The word "nitida," read in connection with the phrase "anfractibus sursum subangulatis," is probably sufficient for the identification of this species. All forms of *petholatus* show a more or less wide and deep subsutural constriction of the body whorl, and in some forms this feature appears, although less noticeably, on the lower whorls of the spire. The point of transition between the tumid portion of the body whorl and the depressed and constricted area usually produces a very obtuse angulation, although this "angulation" varies from an evenly rounded feature to an extreme form which justifies the term "subangulatis." Linnaeus' use of the word indicates that he was describing one of the somewhat angulated forms of the species, and this conclusion is confirmed by the marked type in the Linnaean collection in London.

The description is disappointing in its failure to mention the highly variable color

of the species and the great range and intricacy of its color pattern, noticeable when a considerable series of individuals is examined, as well as in its failure to note the distinctive greenish yellow stain on the columella and peristome. Moreover, the description did not mention the operculum of the species which is so unusual in the distribution of its colors that it has received a vernacular name of its own, the "Cat's Eye," and is prized as a curiosity. While Linnaeus' own type specimen lacked the operculum, it was retained in the specimen he examined in the collection of Queen Louisa Ulrica and was described in detail in the "Museum Ulricae." The first post-Linnaean writer to mention it was Chemnitz, and it has been referred to by many later writers either in their descriptions of *petholatus* or in their comments on the species.

Linnaeus' locality was erroneous, as the species is a native of the Indian and west Pacific oceans, ranging from the Red Sea to the Philippines and New Caledonia. The form of the shell from the latter island is one in which the angulation of the body whorl is so pronounced that the shell has a turreted appearance and accordingly the spire seems more produced. Fischer (1873, p. 52) said that this variety "constitutes, perhaps, a distinct species." He added: "It shows constantly the same more slender form and the same coloration. By its white peristome and columella<sup>1</sup> it marks the transition between *Turbo petholatus* and *Turbo reevei*. It is abundant at New Caledonia and the island of Annaa in the Paumotu archipelago." The present writer has not seen any other record from as far east as the Paumotus. Fischer (*loc. cit.*) names this southern form "Variety caledonica," a name that has since been sparingly used.

The species was called by the early conchologists, both before and after Linnaeus, "the Nassau shell" (Petiver), "Petholata vel

Nassavica" (Hebenstreit), "Cochleae Nassovicae" (Seba), and "Le Ruban dit de Nassau" (Favanne). These names did not indicate a western Atlantic locality in the Bahama Islands, as might be supposed, as the "Nassau" of these writers refers to the Nassau, or Poggy, Islands off the west coast of Sumatra, where the Dutch collectors first found the shell (see Lister, Favanne), even though other writers had used a western Atlantic locality (Favart d'Herbigny [Jamaica] and Linnaeus [Barbados]). The western locality was retained for some time. Gmelin (1791, p. 3590) placed it in the "insulas maris indici et Americam australem alluentis," and Lamarck (1822, vol. 7, p. 43) "les mers del'Inde et de l'Amérique australe."

Linnaeus' synonymy was almost completely accurate.

The reference to Belon (1553, p. 340, error for 430) is a figure too crude to be identified, except that it is apparently a picture of a *Turbo* species. Belon's description does not suggest a specific identification, unless the words "carnem patulam ambiente" refer to the color and shape of the columella and peristome and might suggest *Turbo rugosus* or *sarmaticus* Linné, in both of which species the columella and parietal area often show a variable shade of pink or red.

The Rumphius figures (p. 19, figs. D, 5, 6, 7) all show acceptably characteristic forms of *petholatus* including the more noticeably angulated form (fig. 6).

The drawing from Argenville (1742, pl. 9, fig. K) is clearly *petholatus*. Linnaeus did not refer to another equally characteristic figure (fig. G) on the same plate. Both figures plainly show the subsutural concavity, although Argenville did not refer to it in his description of either figure.

Klein's figure (pl. 2, fig. 51) is crudely drawn, as are most of his figures, but may be accepted as showing *petholatus*.

Some of the Seba figures (pl. 74, figs. 23-29) have a color pattern that is somewhat fanciful, but all appear to have been based on forms of *petholatus*. Hanley (1855, p. 329) suggested that figures 24, 25, and 28 "must be erased," but I think that he must have been influenced only by the uncharacteristic color patterns of these figures, a common fault of Chemnitz' draftsmen.

<sup>1</sup> The colors stated above for the aperture of the two forms is not constant in either. One specimen from New Caledonia (the American Museum of Natural History, unnumbered lot) shows the typical yellowish green columella and peristome of the more northern form. Moreover, in two fresh specimens from the Philippines (A.M.N.H. Lot No. 47215), which are not form *caledonica*, these parts are white, as in the majority of specimens from New Caledonia.

The figures from Regenfuss (pl. 8, fig. 18, and pl. 9, fig. 25, error for figs. 27, dorsal and apertural aspects) are the clearest and most accurate figures in the synonymy.

An additional figure was added by Linnaeus in a manuscript note in his working copy of the twelfth edition, "List. 584, f. 39." This figure was clearly based on a specimen of *petholatus*.

The subdescription of *petholatus* in the "Museum Ulricae" cured the inadequacy of the "Systema" description by its added details. The phrases "picta cingulis nigro-variegatis," "Apertura integra, flava," "intus alba argentea," "variat colore omnino testaceo-luteo absque annulo anfractuum," and the detailed description of the inner and outer faces of the operculum leave no doubt as to the identity of the "Museum Ulricae" specimen. The synonymy in the "Museum Ulricae" retained only the Argenville figure cited in the "Systema" and substituted for the original Rumphius figure another from the same work (pl. 19, fig. 1) which is possibly an error of transcription, although it might be taken for a badly drawn figure of the chocolate-colored form of *petholatus* which is well figured by Chemnitz (1780–1795, vol. 5, pl. 183, figs. 1830–1831). The Rumphius figures cited in the "Systema" are much more characteristic. At the end of the subdescription in the "Museum," Linnaeus added the reference "Rumph. 72. t. 10, f. B." The "72" refers to Rumphius' page. The figure is entitled "Umbilicus marinus niger" and shows only the operculum of the species. A specimen of the more obtusely angulated form of *petholatus* is today present in the Uppsala collection, properly labeled.

*Turbo petholatus* was immediately recognized by Linnaeus' followers, and its later history has been almost completely uneventful. Röding placed it and others of its closely related congeners in his genus *Lunatica*, 1798, a name that has been only sparingly used. Montfort (1810) placed it in his *Sabot*, another name that had only a short currency, except for its use by the French conchologists as the vernacular name for *Turbo*. Aside from these temporary and little-used names, the species has remained in the genus *Turbo* Linné in the works of all authors.

The writer has been unable to trace the der-

ivation of the name *petholatus*, except for the comment of Chemnitz (*tom. cit.*, p. 222): "It is also called Petholaschnecken because, according to Rumphius' assertion,<sup>1</sup> its mixture of colors and markings has a great similarity to the clothing of the Malays and also to the great snake which is called *Oelar Pethola*, which gave it its name." Neither "Oelar" nor "Pethola" is a generic or specific name in herpetology. I assume that it is of Malayan origin, the local or vernacular name for a well-known snake. The early French conchologists, using a parallel derivation, called *petholatus* "Le Peau de Serpent."

Synonyms of this species are: *Helix regia* Herbst, 1787; *Lunatica marmorata* Röding, 1798, not *Turbo marmoratus* Linné, 1758; *L. porphyria*, *cingulata*, *sericea*, *denigrata*, and *petholata* Röding, 1798; *Turbo variabilis* Reeve, 1842, not Grateloup, 1828; *T. reevei* Philippi, 1846<sup>2</sup>; *T. militaris* Reeve, 1848; *T. calcedonicus* Fischer, in Kiener, 1875.<sup>3</sup>

The species is well figured by Fischer (1873, pl. 24, figs. 1, 1a, 1b), by Reeve (1843–1878, vol. 4, *Turbo*, pl. 3, sp. 12), and by Tryon (1888, pl. 40, fig. 14).

<sup>1</sup> The original comment of Rumphius (1711, p. 71), in Dutch, suggests a possibly different meaning of the word "Pethola." He said of the present species: "*Cochlea petholata*. Maleits [Malay]. Bia Pethola is . . . very smooth and painted in various colors like the Pethola clothing and the great snake Oelar Pethola." "Pethola clothing" might mean the type of predominantly brown and red batik clothing worn by many groups of the Malay people, or we might suggest that "Pethola" was an ancient vernacular name for the Malays or one of their political or ethnological groups.

<sup>2</sup> Philippi's *reevei* was a substituted name for *variabilis* Reeve, a homonym of *variabilis* Grateloup, a fossil *Turbo*.

<sup>3</sup> Adam and Leloup (1938, p. 31) list *Lunatica aruginosa* Röding, 1798, as a further synonym of *petholatus* Linné. Röding referred this name to a figure from Chemnitz (*tom. cit.*, p. 223, pl. 183, fig. 1833) who called it "*Cochlea Nassovica viridescens*," grouping it among the forms of *Turbo petholatus*. Neither the description nor the figure of this shell by Chemnitz suggests any form of *petholatus* seen by the writer in any specimen or figure. Figure 1833 is of a brilliant green shell with an angulated body whorl and prominent pale green longitudinal ribs. It resembles *petholatus* neither in color nor sculpture, the only resemblance being in the presence of a subsutural concavity of the body whorl and the fact that the tip of the spire is brilliant red, a feature sometimes seen in some forms of *petholatus*. Aside from these two details, the Chemnitz figure bears a great resemblance to *Astraea tuber* (Linné).

**Turbo chrysostomus**

1758, *Systema naturae*, ed. 10, p. 762, no. 535.

1767, *Systema naturae*, ed. 12, p. 1223, no. 614.

LOCALITY: "In O. Asiatico" (1758, 1767).

"T. testa imperforata subovata rugosa: anfractibus bifariam spinulis fornicatis cincta . . . Faux saepius in adultis aurea est; anfractus superni plicati."

The entire subdescription was added in the twelfth edition, and the word "bifariam" was substituted for the "duobus" of the tenth edition. The description, as thus amplified, is passably characteristic of the species, with the exception of the word "imperforata." The great majority of specimens have a small and narrow perforation at the posterior end of a deeply excavated umbilical area. "Subperforate" would have been an apt term. Moreover, the description does not take account of the great variability of the most noticeable feature of the shell. It is thickly spirally lirated, with slightly wrinkled and indistinctly beaded cords, these being unequal in size. The typical form described by Linnaeus has one coarser and heavier subcoronal carina just below the shoulder of the body whorl bearing prominent vaulted and recurved irregular spines, and a second less salient carina similarly but less prominently spinose at or just below the periphery of the whorl. In another form, however, this lower row of spines is almost or entirely obsolete. In others there are three or at times four such spinose carinae. All of the spinal lirations and their interspaces are very finely longitudinally striated by thin, flexuous lamellae which disappear or become only faintly visible in worn specimens except in the interspaces. The spiral lirations become increasingly heavy at the lower angle of the body whorl and on the base of the shell, the two lowest bordering the umbilical depression being the heaviest. The penultimate whorl bears only one coronal row of spines, and the next whorl, in unworn specimens, has obsolete spines. The specimens of *chrysostomus* in the Linnaean collection in London are much worn, and the sculpture is not clearly shown on the microfilm of that collection, but it appears that they were of the form with two spinose carinae which Linnaeus described.

Linnaeus' comment on the color of the

aperture, "Faux saepius in adultis aurea est" indicates that his lot must have contained some bleached specimens, as the golden yellow of the aperture is a constant and diagnostic feature of the species, although the color is somewhat pale in some individuals. From this color was derived the early vernacular names of the shell, "Os aureum," "Bouche d'Or," and "Goudmond." These or similarly descriptive names were used as early as Petiver (1713).

Linnaeus' synonymy is composed of good and bad figures.

Those from Rumphius (pl. 19, fig. E), Argenville (1742, pl. 9, fig. D), and Seba (pl. 74, figs. 9-11) may be accepted as showing *chrysostomus*. The Klein figure (pl. 7, fig. 126) is to the writer unidentifiable. The pair of figures from Gualtieri (pl. 62, fig. H) shows a shell with four rows of spines on the body whorl. This form is occasionally found in *chrysostomus*. Gualtieri's description contains no reference to the color of the aperture, as might have been expected if he had had a specimen of that shell before him.<sup>1</sup>

The description of *T. chrysostomus* in the "Museum Ulricae" is, as usual, amplified and states many characteristic features not covered by the description in the "Systema": "Scabri, sulcis longitudinalibus obtusis, striis transversis lamellosis tenuissimis imbricatis. Sulci ad basin profundiores crassiores," "Spinae duplici serie longitudinali, obtuse ex squamis fornicatis: in superiore serie majoribus," and "Apertura . . . postice reflexa obtusissima, margine albo; Fauce fulva aurea."<sup>2</sup> Linnaeus here repeated that the species lacked an umbilicus, but explained this statement by saying: "Umbilicus nullus, quamvis cavitas inter rugas baseos et labri [i.e., columella]." Apparently he was describing only the umbilical depression herein

<sup>1</sup> The Gualtieri figures closely resemble *Turbo spinosus* Gmelin (1791, p. 3594). This species was characterized by its author as "chrysostomo affinis," but also as having an "apertura argentea." Tryon (1888, p. 200) lists *spinosus* among his synonyms of *chrysostomus*, but the aperture of the *T. spinosus* of authors, at least, has constantly a silvery aperture, and I cannot associate it with the present species.

<sup>2</sup> Note that Linnaeus habitually gave to the words "longitudinale" and "transversale" meanings which are the exact reverse of those used in the modern method of describing sculpture.

mentioned above, and the specimen before him had no true perforation, or one so small that he deemed it unworthy of mention. Two specimens of *T. chrysostomus* are found in the Uppsala collection today, properly labeled. They are of the form with two rows of spines. No umbilicus is apparent in the microfilm figures.

The species was immediately recognized. It is apparent that the excellent description in the "Museum Ulricae" was the deciding factor in its identification rather than the description or the synonymy in the "Systema." The earliest post-Linnaean description of what was undoubtedly *T. chrysostomus* was that of Favart d'Herbigny (1775, vol. 1, p. 98). D'Herbigny described it as having four rows of spines and called it the "Bouche d'Or," although he did not refer it to the *chrysostomus* of Linnaeus. Born (1778, p. 349; 1780, p. 344) was the first to give it the Linnaean name and refer it to the "Systema" species. He supplied no figure and followed Linnaeus in giving it two series of spines and calling it an imperforate species. The first post-Linnaean writer to describe it adequately, to give a complete list of references, and to supply a reasonably characteristic figure was Chemnitz (1780-1795, vol. 5, pp. 178-181, pl. 178, fig. 1766). Chemnitz' figure shows a shell that is somewhat too narrow and with a spire somewhat too produced, but in other respects it is clearly *chrysostomus*. The golden yellow aperture is reproduced, as is the obtusely pointed posterior junction of the outer lip and columella. No umbilicus is apparent in the figure, although Chemnitz in his comments mentions a "deep umbilicus," which may refer only to the excavated umbilical area.

Dillwyn (1817, pp. 825-826) included *Turbo spinosus* Gmelin in the synonymy as a "junior" form, referring for *spinosus* not only to Gmelin's listing but to the Chemnitz figure which had been Gmelin's only reference (*tom. cit.*, p. 204, pl. 181, fig. 1797), a figure that is generally accepted as being *spinosus*. Chemnitz had called it, however, the "Bouche d'Argent épineuse," and said of it: "From the outside this shell much resembles the well-known Gold Mouth... only the silver color of the aperture very easily demonstrates that it is not a Gold

Mouth, but belongs to the group of the Silver Mouths." I do not consider it a synonym.

Deshayes (*in* Deshayes and Milne-Edwards, 1843, p. 189) added a further Gmelin species, *Turbo echinatus* (1791, p. 3591), to the synonymy of *chrysostomus*. I am also forced to reject this name as a synonym. It was referred by Gmelin to a plate from Martyn (1784 [-1792], vol. 1, pl. 26) which shows a *Turbo* in which the "spines" consist of open-ended, flattened tubes lying parallel to the transverse axis of the shell. I cannot identify the species and consider it unidentifiable. Gmelin added a variety  $\beta$  which he referred to another Martyn plate (pl. 30). This latter figure is the *Astraea heliotropium* of Martyn, a species so remote from anything resembling the figure cited for the "typical" *echinatus* that it is not understood how Gmelin could have associated the two figures. Gmelin's *echinatus* is too badly defined to permit one to use it as a synonym of any species.<sup>1</sup>

Most writers today retain *T. chrysostomus* in *Turbo*, *sensu stricto*. Tryon (1888, p. 200) placed it in his "group" *Senectus* Swainson, 1840, and Thiele (1931, p. 67) in section *Marmorostoma* Swainson, 1829, which is identical with *Senectus*, 1840. Adam and Leleup (1938, p. 32) used *Senectus* as a good subgenus.

With the elimination of *spinosus* and *echinatus* Gmelin, *chrysostomus* is left without a specific synonym.

It is figured by Reeve (1843-1878, vol. 4, *Turbo*, pl. 7, sp. 28) and by Tryon (1888, pl. 40, fig. 19).

#### *Turbo tectum persicum*

1758, *Systema naturae*, ed. 10, p. 762, no. 536.

1767, *Systema naturae*, ed. 12, p. 1234, no. 615.

LOCALITY: Not given in either edition.

"T. testa imperforata ovata: spinis obtusis depressis, subtus papillosa... Operculum hujus Umbilicus veneris incarnatus."

The subdescription was added in the twelfth edition. The description is scarcely

<sup>1</sup> Tryon (1888, Index to the Turbininae, p. 276) makes *A. heliotropium* Martyn equal to *T. echinatus* Gmelin. This seems to involve an error of transcription, as *heliotropium* was referred by Gmelin only to the "variety," which bears no relation to Gmelin's "typical" species.

adequate to define the species known as *tectum-persicum* today. In the expression "spinis . . . depressis" the word "depressis" is equivocal, as the spines of the *tectum-persicum* of authors, while blunt, are in no sense depressed and are, in fact, even more markedly deflected upward than the spines of the next species, *T. pagodus*, for which the word was not used. A mention of this upward flexure of the spines would have improved the description. It is not understood why Linnaeus called the present species "ovata," whereas he said that *pagodus* was "conica." The two species are alike in shape. Moreover, the phrase "spinis concatenatis," used for *pagodus*, might have been used for this species with equal accuracy. The subdescription is, to this writer, untranslatable. The species has two rows of spines on the two anterior whorls, with a subsidiary subsutural series of very blunt tubercles.

It is suggested that the comments on this species be read in connection with the discussion of *pagodus*, as the two have many identical characters and have been confused. The most important distinction between the two is their great disparity in size, *pagodus* attaining a height of over 2 inches, while *tectum-persicum* rarely exceeds 1 inch. This comparison is not referred to in the description of either.

No locality is given by Linnaeus, and the single figure in the synonymy (Argenville, 1742, pl. 11, fig. P) is equivocal, as the rows of spines in that drawing are too few in number and are shown as narrow and acutely pointed rather than broad and rounded. Argenville's description (p. 263), "A little 'Cul de Lampe,' with many whorls bearing spines," is completely innocuous. Linnaeus did not cite a passably good pair of figures from Gualtieri (pl. 60, figs. M, dorsal and apertural views), although we know that Gualtieri's work was available to him and was constantly cited by him. Because of this vague diagnosis the species was not immediately recognized by those unfamiliar with the more adequate description in the "Museum Ulricaë."

The diagnosis in the "Museum Ulricaë" fills many of the gaps left by the "Systema" and presents an acceptable picture of *tectum-persicum*. I refer particularly to the phrases

"maxime inaequalis spinis," "spinae . . . adscendentibus, summo margine nodosae," "apertura margine acuto," and "Labium interius tuberculo unico obsoleto." The last phrase quoted refers to a feature that later must have induced Lamarck to place both *tectum-persicum* and *pagodus* in the genus *Monodonta*, as the slight constriction of the columella as it joins the base of the aperture gives the appearance of a truncation or a slight swelling which Lamarck may have treated as a "tooth." The only equivocal details of the description are, first, the word "pellucidis" as applied to the spiral chain of spines, and, second, the phrase "Faux alba, minime argentea." The aperture of this species as well as that of *pagodus* is a golden brown in unbleached specimens, outwardly bordered by white. The last phrase quoted concludes with the words "sulcis exarata." This feature is found in all individuals of *pagodus* but is much less evident in *tectum-persicum*. A specimen of the *tectum-persicum* of authors, properly labeled, is today present in the collection at Uppsala.

Favanne (1780, vol. 2, p. 341, pl. 13, fig. F) supplied what may have been the first post-Linnaean description and figure of this species. The figure is probably based on a specimen of the shell and was called "la petite Pagode" by Favanne.

Born (1780, p. 344, pl. 12, figs. 19–20) described and figured a "*Turbo tectum-persicum*" which was a quite different species. Both his description and figure apply to an *Astraea* species that is undoubtedly the *A. americana imbricata* of Gmelin.<sup>1</sup> Chemnitz (1780–1795, vol. 5, pp. 30–32, pl. 162, figs. 1531–1533), in describing the latter species,<sup>2</sup> cited for it Born's "*tectum-persicum*" and said in a footnote (p. 31): "Herr Hofrath von Born, who supplies a good figure and an accurate description of this shell in his work '*de Testaceis Mus. Vindob.*' seems to have

<sup>1</sup> Gmelin (1791, p. 3581) described as good species both *Trochus imbricatus* (no. 93) and *americanus* (no. 94). It is now generally considered that *imbricatus* is merely a subspecies of *americanus*; the latter is found on the Florida Keys and the subspecies *imbricatus* in the West Indies.

<sup>2</sup> Chemnitz did not use either of the Gmelin names for the latter species, calling it "Der tiefgefaltete, runzelvolle, gefurchte, westindische doppeltrinnenförmige Kräusel."

been deceived in this species when he maintained that this was the shell which is called *tectum-persicum* in Linnaeus' *Systema Edit.* 12. no. 615, and for which Argenville supplied pl. 8, fig. P. The *tectum-persicum* of Linnaeus is truly a *Turbo*, and the shell of which we are speaking is certainly a *Trochus*, and is unanimously known as such by all other conchologists." Chemnitz' own figures (figs. 1531-1533), while conventionalized drawings, are probably based on the *A. americana imbricata* of Florida and the West Indies.

Chemnitz' treatment of the true *Turbo tectum-persicum* is not entirely satisfactory (*tom. cit.*, p. 41, pl. 163, figs. 1543-1544). Although his names, "Die kleinere Pagode," "Trochus longaevus<sup>1</sup> minor," and "la petite Pagode," refer to *tectum-persicum* Linné and although he cited both the "Systema" and "Museum Ulricae" descriptions in his synonymy, his figures leave much to be desired. They have a gross similarity to the present species, but the arrangement of the spines is not clearly shown, and the spines themselves are too acute.

Dillwyn (1817, p. 826) supplied an entirely adequate description and cited all the references to the descriptions and figures of his predecessors, using them as acceptable synonyms of *tectum-persicum*, although the figures from Chemnitz, Gualtieri, and Argenville are, as said above, somewhat doubtful. His comments include another rejection of the "*tectum-persicum*" of Born: "The shell, which Born has figured for this species, is *Trochus imbricatus*."

Lamarck (1822, vol. 7, p. 32) moved *tectum-persicum* to his *Monodonta*, 1799. His description emphasized the upward flexure of the spines and the fact that those on the spire were more acuminate than those on the body whorl. He referred to the very questionable Chemnitz figures without a query, although he properly queried the Gualtieri figures.

<sup>1</sup> The word "longaevus," which Chemnitz and others also used for *pagodus*, refers to the theory, which seems to have been substantiated, that the species can exist for a long time out of the water. Rumphius had called *pagodus* "*Trochus papuanus longaevus*," and Seba quoted for it the name "Sabot a longue vie." This feature of both species has been referred to by later writers.

Deshayes, in the continuation of Bruguière's "Histoire naturelle des vers" (1830, 1832, vol. 3, p. 1080) had placed this species in *Trochus*, but in the second edition of Lamarck's "Histoire naturelle des animaux sans vertèbres" (in Deshayes and Milne-Edwards, 1843, p. 173) he followed Lamarck and included it in *Monodonta*. There is no indication in his treatment of *tectum-persicum* that he was dissatisfied with this placement, but in a footnote to his listing of *Monodonta pagodus* (p. 172) he said: "This species has not a nacreous aperture as in the other *Monodontas*; its columella is flat as in the *Littorinas* and its corneous operculum is in all respects similar to that of *Littorina littorea* . . . The two following species: *M. tectum-persicum* and *M. papillosa* should be placed along with it among the *Littorinas*."<sup>2</sup>

Linnaeus' *tectum-persicum* and its above-mentioned congeners were retained in *Littorina* by the majority of the mid-nineteenth-century writers after Deshayes. Hanley (1855, p. 330) continued to use *Monodonta*, but as a subgenus of *Littorina*, and in this he was joined by a few of his contemporaries. In 1833 Valenciennes erected the genus *Tectarius* for a single species, *T. coronatus*, and the species belonging to the *tectum-persicum* group were later added to his genus. Synonyms of *Tectarius* are *Hamus* (Klein) Herrmannsen, 1846; *Pagodus* Gray, 1839; and *Pagodella* Swainson, 1840.

Hanley (*loc. cit.*) found in the Linnaean collection in London an undocumented specimen of the *tectum-persicum* of all authors. This specimen may be regarded as Linnaeus' type of *Turbo tectum-persicum*, as the serial number of that species is underlined in

<sup>2</sup> In Lamarck's "Observations" on the generic definition of *Monodonta* (1822, vol. 7, p. 31) he said: "One should not confuse them [the *Monodonta* species] with the *Turbos*, their columella, truncate at the base, forming in the aperture a salient dentiform feature which characterizes them. Thus it is by the shape of their aperture that the *Monodontas* are distinguished from the *Trochus*, and it is by that of their columella that they differ from the *Turbos*." In the species *tectum-persicum*, while the columella gives the impression of being slightly truncate, the truncation is caused merely by the scarcely noticeable constriction of the columella as it curves into the base of the shell, and the "tooth" is thus more apparent than real. In *pagodus* there is not even any noticeable constriction at any point in its length.

Linnaeus' working copy of the twelfth edition of the "Systema," and the specimen uniquely conforms to the diagnosis in the "Systema" and the "Museum Ulricae." As it is undocumented, however, we are forced to call it only the "probable" type.

*Tectarius bullatus* (Martyn, 1784 [-1792], vol. 1, pl. 38) is a form close to *tectum-persicum* and has been confused with it. There has been a difference of opinion as to its exact systematic position. Reeve (1843-1878, vol. 10, *Littorina*, pl. 1, sp. 3) said of *tectum-persicum* that it was "intermediate in its characters between *L. bullata* and *pagodus*, and subject apparently to limited variation." Fischer (1880, p. 456) made it an exact synonym of *tectum-persicum*. Tryon (1887, p. 257) said of *tectum-persicum*: "Notwithstanding its rugose appearance, I think it probable that this will prove to be a mere variety of *T. bullatus*." *Tectarius bullatus* is approximately the same size as *tectum-persicum*, but its spines are more numerous, are displayed on a greater number of rows (four rows on the body whorl and penultimate whorl), and the spines themselves are slightly more acute and much less expanded horizontally. The degree of convexity of the base is less than in *tectum-persicum*, and the papillae on the basal striae are more numerous and smaller. The species possesses a dark subsutural band of color on the two anterior whorls made up of a spiral series of lamellose scales between the spines, which are evident in fresh specimens and simulate a deposit of foreign matter or the vestiges of a periostracum. The writer is strongly inclined to make *bullatus* a good species. It is closer to *tectum-persicum*, however, than to *pagodus*. As in both of these species, its aperture is lirate.

*Tectarius tectum-persicum* is figured in Fischer (1880, pl. 41, fig. 1), in Reeve (*tom. cit.*, pl. 1, fig. 3) and in Tryon (*tom. cit.*, pl. 47, fig. 52).

#### **Turbo pagodus**

1758, *Systema naturae*, ed. 10, p. 762, no. 537.

1767, *Systema naturae*, ed. 12, p. 1234, no. 616.

LOCALITY: "In O. Asiatico" (1758, 1767).

"T. testa imperforata conica, spinis obtusis concatenatis, subtus papilloso-striata."

The discussion of this species should be read in connection with that of the preceding

species, *tectum-persicum*, as the two shells are similar in many gross characters, although they show a great disparity in size.

The description of the present species, which is identical in the tenth and twelfth editions of the "Systema," is somewhat more helpful than that of *tectum-persicum*, although its added details apply equally to both species. The added word "concatenatis" is here used but was omitted from the description of *tectum-persicum*, although the spines of both are connected by a shelf-like carina. Secondly, the base of the present species is characterized as being "papilloso-striata," whereas the word "striata" was omitted for *tectum-persicum*. The base of both shells is both papillose and striated. Both species have a striated aperture, although the striations are less highly developed in *tectum-persicum*.

In addition to the disparity in size, *pagodus* attaining a height of  $2\frac{1}{2}$  inches, whereas *tectum-persicum* seldom exceeds 1 inch, the present species is distinguished by its more convex base, by the greater coarseness of its basal cords, by the fact that whorls of the spire bear only one row of spines instead of the two rows of *tectum-persicum*, and by the fact that the upward flexure of its more acute spines is less marked than in the latter species. The combination of the last two characters in *pagodus* and the greater prominence of its carinal shelf give the shell a distinctly turreted appearance which is not apparent in *tectum-persicum* with its more crowded spiral sculpture. In one form of *pagodus* both the spines and the coarse axial rugae from which they are developed are almost obsolete, and the carinae become the dominant sculptural feature. This form is shown in Thiele's figure (1931, p. 126, fig. 100) and is not typical of the species.

Linnaeus' synonymy for *pagodus* is entirely accurate. The Rumphius figure (pl. 21, fig. D), the figures from Gualtieri (pl. 62, figs. B, two figs., dorsal and basal aspects, and fig. C, a dorsal view), and the figure in Argenville (1742, pl. 11, fig. A) are all recognizable drawings of *pagodus*. Argenville's description (p. 262) and that of Gualtieri (facing pl. 62) are themselves confirmatory, except that Gualtieri used the phrase "intus candidus." The aperture of both *pagodus* and *tectum-persicum*

is golden brown except for a narrow outer band of white. The word "alba" or "candida" was used by several later writers.

This species was called "Papuanus" by Rumphius and Gersaint, referring to the locality where it was first found, "la Pagode" by Argenville and Favart d'Herbigny, and "le Toit chinoise" by these and other early French writers from its supposed resemblance to the roof of Chinese buildings decorated with pointed ornaments. Hebenstreit called *pagodus* "Der ausser dem Wasser lebende stachlichte Kräusel," and Seba referred to its further French vernacular name "Sabot à longue vie."

The species was immediately identified, partly because of its description and excellent synonymy in the "Systema" but chiefly, I suggest, by the clear description in the "Museum Ulricae." The latter description contained the significant phrases "obtuse striata, transversim rugosa" and "spinae serie duplici, plano-concatenatae . . . sursum flexae," and the comparison of size, omitted in the "Systema," and "Magnitudine praecedentem superat." The only questionable phrase in the "Museum Ulricae" description is "subtus decussatim papillosa." The word "decussatim" does not describe the appearance of the sculpture of the base.

Davila (1767, p. 125) supplied the first contemporary description of *pagodus* after Linnaeus, although he did not associate the shell he was describing with the Linnaean name. The first clear identification of the species was that of Born (1780, p. 345), and Chemnitz in the following year (1780-1795, pp. 38-41, pl. 163, figs. 1541-1542) not only tied the species to Linnaeus' *pagodus* in his synonymy but published the first post-Linnaean figures of the species, figures that can hardly be improved upon for accuracy. Chemnitz, not only in his figures but in his description, noted for the first time the golden-yellow color of the aperture. The fact that his predecessors had not mentioned this color makes one suspect that they had not seen specimens of the shell or that they had seen only bleached shells. In the series of more than 200 specimens examined by the present writer, however, none had a colorless aperture, even the beach-worn shells.

The nomenclatural history of the species

followed the same steps as described above for *tectum-persicum* except that Röding's *Cidaris* appears in its synonymy. Röding (1798, p. 84) listed a *Cidaris pagodus* which was based on two good figures from Chemnitz (1780-1795, vol. 5, pl. 163, figs. 1541-1542).

Hanley (1855, p. 331) found a specimen of the *Tectarius pagodus* of authors in the Linnaean collection in London. Although the shell itself was not marked with its name or serial number in the "Systema," the receptacle in which it was found was properly inscribed. As the specimen conforms in all respects with Linnaeus' description of *Turbo pagodus* and with the figures cited in the "Systema" and is the only shell in the collection so to conform, we are justified in considering it as the "probable" type. The writer has not been able to examine Linnaeus' own copy of the "Systema," and Hanley did not specify whether or not Linnaeus had indicated his ownership of the species by an underlining of its serial number, but, as it was a common and well-known species and Linnaeus' description is accurate and his synonymy is extremely persuasive, it is a fair assumption that he possessed a specimen.

The only specific synonym of the species is the *Monodonta bicolor* of Lamarck (1822, vol. 7, p. 31). In his French description Lamarck noted that "this is the only *Monodonta* species in which the truncation of the columella is moderate. It resembles the following species [*M. pagodus*] in its characters." The peculiarities of the columella of *pagodus* and *tectum-persicum* are referred to above (p. 229) under the latter species, and it should be noted that even Lamarck's word "moderate" ["médiocre"] is inapt for *pagodus*, as its columella narrows progressively, with no appearance of a constriction or truncation and with no suggestion of a "tooth." Lamarck's specific name *bicolor* is explained by him in his Latin description by the phrase "infernè alba superne nigricante." Fischer (1880, p. 454, pl. 40, figs. 2, central figs.) listed *T. bicolor* Lamarck as a good species, but said in his text (p. 455): "The shell described by Lamarck is a *Tectarius pagodus* in bad condition, the color of the penultimate whorl of which has been revealed by the wearing away of the outer layers of the shell." The present writer has not seen a specimen labeled "*bi-*

color" nor any specimen of *pagodus* showing the wear and revealed under color mentioned by Fischer, but the latter's explanation of Lamarck's name seems reasonable, and Fischer's own figures are entirely confirmatory and make it evident that he had seen such a specimen. Although the specific name *bicolor* was occasionally used for a short time after Lamarck, it was almost always treated as a synonym of *pagodus*.<sup>1</sup>

The species *pagodus* belongs in the genus *Tectarius* Valenciennes, 1833, and has been generally used in that genus, at least since the work of H. and A. Adams (1858), except for the few writers who continued to place it in *Littorina* Férussac, 1822. Synonyms of *Tectarius* are listed under *T. tectum-persicum* (p. 230) above.

*Turbo pagodus* is well figured by Reeve (1843-1878, vol. 10, *Littorina*, pl. 1, sp. 4), by Fischer (*tom. cit.*, pl. 40, fig. 1), by Tryon (1887, pl. 47, fig. 48), and by Kaicher (1956, pt. 3, pl. 1, fig. 7). The Chemnitz figures mentioned above are excellent and should be seen.

#### *Turbo pica*

1758, *Systema naturae*, ed. 10, p. 763, no. 542.

1767, *Systema naturae*, ed. 12, p. 1235, no. 622.

LOCALITY: "In M. Sardinico" (1758, 1767).

"T. testa umbilicata conico-rotundato laevi, denticulo umbilicali . . . Umbilicus canali duplici obtuso."

The description of *T. pica* is identical in the tenth and twelfth editions of the "Systema," and its details, briefly as they are stated, conform to the features of the *pica* of all authors with one exception. The word "laevi" is inaccurate. The young shells of *pica* are spirally striate, and fully matured shells also bear obliquely longitudinal striae, so that the sculpture appears as a moderate diamond-shaped decussation. Many young shells also show fine, spiral, incised lines which are visible only under magnification. The word "laevi" cannot be applied to a species so sculptured. The meaning of the subdescription is not clear.

The stated locality is erroneous, as the

species is confined to the western Atlantic, ranging from the Bahamas to Trinidad. Dead shells have been collected in southern Florida, which might indicate that the species has only fairly recently become extinct in that region. It has been found fossil in Bermuda. Clench and Abbott (1943, p. 9) note that it has been reported to occur along the northern coast of South America.<sup>2</sup> Buonanni had already located the species in the "Malabarico sinu."

It is curious that Linnaeus should have been in error as to the locality of *pica*, as almost 100 years before the tenth edition of the "Systema" Lister had described it as coming from Barbados. Sloane, in his "A voyage to . . . Jamaica" (1707, 1725), reported it from the latter island, and Klein, a contemporary of Linnaeus, called it "*Tigris barbadensis trochoides*." Clench and Abbott (1943, p. 8) selected the island of Martinique as the type locality. Chemnitz expanded the locality by reporting having received it from "Jamaica, Bahama and the island of Nevis," and also erroneously included "the Mississippi delta."

The synonymy in the "Systema," with the exception of the Rumphius figure (pl. 21, fig. A), is correct. That figure shows *Trochus niloticus* Linné and, indeed, had already been cited for that species by Linnaeus. It is odd that, in adding to his synonymy in the twelfth edition, he should have included this discordant figure. The remaining references (Buonanni, pls. 29-30; Gualtieri, pl. 68, figs. B, four figs., dorsal and apertural aspects; Argenville, 1742, pl. 11, fig. G; Petiver, pl. 70, fig. 9; Lister, pl. 640, fig. 30; Adanson, pl. 12, fig. 7; and Regenfuss, pl. 6, fig. 66, pl. 11, fig. 57) were all based unquestionably on specimens of *T. pica*.<sup>3</sup> Clench and Abbott (1943, p. 6) selected the Gualtieri set of figures as the type figures. The figure from Adanson, which the latter called "le Livon" (1757, p. 185), is a very passable picture of *Turbo pica* and represents a further addition to the number of Antillean species that have

<sup>2</sup> See Clench and Abbott's paper for a more ample discussion of its reported occurrence, alive, in Florida, and of the "*Turbo picoides*" of Gould, described from California, but which may have been adventitious.

<sup>3</sup> A further figure from Regenfuss (pl. 4, fig. 42), a questionable drawing, had been cited for *pica* in the tenth edition but omitted in the twelfth.

<sup>1</sup> See Chenu (1859, 1862, vol. 1, p. 301) and H. and A. Adams (1858, vol. 1, p. 315). Adam and Leloup (1938, p. 82) are the most recent writers to synonymize *bicolor* with *pagodus*.

been reported, whether authoritatively or not, from West Africa. Fischer-Piette and his co-authors (1942, p. 286) in their discussion of the "retained" collection of Adanson (see Dodge, 1955, p. 53) said of this species: "We have found six specimens of *Livona pica*, most of them bearing numbers 2546 and 456 on labels for the 'Livon' from Senegal. Two of these labels were folded into the aperture of one of the shells. The largest specimen . . . is certainly the one figured by Adanson (reduced in size to 44 mm) . . . *Livona pica* is an Antillean species. Adanson says that 'le Livon' is 'very common on the islands of the Magdalene,' but this African locality has not been confirmed since then."<sup>1</sup> The figure of one of these specimens supplied by these authors (pl. 11, fig. 1) is unquestionably *Livona pica*. Adanson's own figure is less characteristic, as usual.

The specific name is the Latin word for the magpie and reflects the black and white color pattern of the shell. The French vernacular name was "la Pie" or "la Veuve" [the Widow]. Favart d'Herbigny (1775, vol. 3, no. 346, p. 655) called it the "burgau [Mother of Pearl] niger Americanus."

In spite of the incorrect locality and the presence of the word "laevi" in the description, the species was immediately recognized by Linnaeus' followers, undoubtedly because of the excellence of the synonymy, and, beginning with Favart d'Herbigny and Chemnitz, the American locality was accepted by virtually all later writers. Lamarck (1822, vol. 7, p. 44) and Deshayes (*in* Deshayes and Milne-Edwards, 1843, p. 193) used the broad and uninformative locality "l'Océan Atlantique équatorial." The first good post-Linnaean figures of the species were those of Favanne (1780, vol. 3, pl. 9, fig. F<sup>2</sup>) and of Chemnitz (1780-1795, vol. 5, pl. 176, figs. 1750-1751).<sup>2</sup>

Hanley (1855, p. 334) reported the finding of a specimen of the species in the Linnaean collection in London. It was authoritatively

marked for *Turbo pica* and may therefore be accepted as Linnaeus' type.

The species is now generally placed in the genus *Livona* Gray, 1847, of which it is the type species, by monotypy. *Meleagris* Montfort, 1810, not Fischer von Waldheim, 1835, *Cittarium* Philippi, 1847, for both of which *Turbo pica* is monotypic, and the *Livona* of authors, not of Gray, 1855, are synonyms. The name *Livona* Gray is derived from Adanson's species "le Livon."<sup>3</sup>

*Livona pica* has only one possible specific synonym, *Trochus picoides* Gould, 1853. Gould's name was based on specimens stated to have been collected by a Colonel Jewett at Santa Barbara, California. The shell has not been reported from the West Coast since that time, and the California conchologists do not use it either as a good specific name or as a synonym. It probably represents specimens of *Livona pica* from the western Atlantic that had been mixed with material from California.

Deshayes (*in* Deshayes and Milne-Edwards, 1843, p. 193), although he followed Lamarck in placing *pica* in *Turbo*, suggested that it was not a turbinid but a trochid, saying in a footnote: "If we are to believe the majority of authors this species has a corneous operculum, and consequently belongs in the genus *Trochus*, that is to say [the genus] containing all the species which have an operculum of that nature." The monotypic genus *Livona* has always been incorporated in the Trochidae.

The present species is figured by Fischer (1880, pl. 1, as *Trochus pica*, showing both shell and animal) and by Clench and Abbott

<sup>1</sup> The writer has not been able to locate the "islands of the Magdalene" off the west coast of Africa. It is probably a local or abandoned name.

<sup>2</sup> Chemnitz also figured an operculum (*op. cit.*, vol. 4, pl. 151, figs. 1420-1421), figures that Bosc and others cited for the operculum of *T. pica*. They more nearly resemble the operculum of *Turritella terebra* Linné.

<sup>3</sup> The status of the name *Livona* is still uncertain. Clench and Abbott (1943, p. 6) have clearly stated the problem and their remarks are here quoted in full: "Gray instituted the name first in 1841 (Synopsis of the contents of the British Museum, ed. 42, 1840 [1841]) without any definition. He defined it in 1842 (44th ed.) but did not cite any species. As their title would indicate, these were but guidebooks to the exhibition cases of shells in the British Museum, Gray, in 1847 (citation above [1847, November, Proc. Zool. Soc. London, p. 145]) published a list of genera with synonymies and included type designations. However, if the 1842 publication is eventually ruled out, the name of this genus will change to *Cittarium* Philippi, which appeared in February 1847, as Gray's generic list did not appear until November of the same year." Thiele (1931, p. 53) has adopted *Cittarium* for the species *pica*.

(1943, p. 7, pl. 1, figs. 1-3, apertural and basal views and operculum).

The subdescription of *Turbo pica* in the "Museum Ulricae" adds several confirmatory and useful details. The shell is there characterized as "ponderosa" and "parum convexa." The color pattern, omitted in the "Systema naturae," is described as "marmorata ex atro virescente et albo." The aperture is described as "intus argentea." The puzzling subdescription in the "Systema" is not used, but the umbilicus is correctly described as "perforatus ad centrum absque spiris."

#### *Turbo thermalis*

1767, Systema naturae, ed. 12, p. 1237, no. 629.

LOCALITY: "Prope Thermas Pisanas, in aquis dulcibus" (1767).

"T. testa umbilicata oblongiuscula obtusa, anfractibus teretibus laevibus... Testa seminis Brassicae paulo major, alba. Anfractus teretes, quaterni. Apertura orbicularis. Umbilicus minutus."

This species, which appeared for the first time in the twelfth edition of the "Systema," is the first of a series of eight non-marine species that Linnaeus placed in *Turbo*, a larger number than he included in any of his other genera with the exception of *Helix*.

The species was not immediately recognized in spite of the apparently ample description, probably because of the absence of any synonymy and the fact that it had not been described in the "Museum Ulricae," a work that clarified many of Linnaeus' names. Chemnitz did not list it. Gmelin (1791, p. 3603) was a mere copyist of the Linnaean description except for a few omissions in the subdescription, and there is nothing in these omissions to indicate that he had seen a specimen of *thermalis*. Schröter (1783-1786, vol. 2, p. 34) also copied Linnaeus' description and merely commented on the incongruity of including a shell said to be smooth ("laevibus") in the subgroup in *Turbo* characterized as "Cancellati." Dillwyn's synonymy for his *Turbo thermalis* (1817, p. 852) contained references to the shell called *Nerita piscinalis* by Müller, 1774, now *Valvata piscinalis*. This is a different species, which does not conform in its characters to Linnaeus' requirements for *thermalis*. It is orbic-

ular-conical in shape, whereas Linnaeus described *thermalis* as "oblongiuscula obtusa." Dillwyn was, however, confident that his *T. thermalis* was the *thermalis* of the "Systema," saying: "There does not appear to be much doubt that this is the *T. thermalis* of the 'Systema naturae' and, though so dissimilar in appearance, Linnaeus may probably have placed it next to *T. scalaris* on account of its deep umbilicus and of its having the whirls only slightly attached to each other." The sophistry of this latter statement should be apparent.

In 1816 (La Liste, p. 12) Lamarck established the genus *Paludina* for certain freshwater species, and in 1822 (vol. 6, pt. 2, p. 172) he stated the generic description of this group as follows: "Conoidal, with rounded or convex whorls, modifying the spiral cavity [? la cavité spirale]. Aperture subrotund-ovate and longer than it is wide, angulated above. Lips continuous, thin and erect. The orbicular operculum is corneous." His genus is now considered to be synonymous with *Viviparus* Montfort, 1810. One of Lamarck's *Paludina* species was *P. muriatica*, which bore the French vernacular name "Paludine saumâtre," reflecting the frequent habitat of the species in briny waters. Lamarck cited *Turbo thermalis* "Lin. Gmel. p. 3603" as its first synonym, and it is now agreed that it was identical with the *thermalis* of the "Systema." This identification was adopted by Philippi in 1844 (1836-1844, vol. 2, p. 122) largely, it appears, because Lamarck had said that his *muriatica* was even found in thermal springs and tolerated a temperature of 34° C. Hanley (1855, p. 338) very properly noted that if Lamarck attributed this statement to Linnaeus he had misread the original description, as Linnaeus had said only that the species was found *near* hot springs. He also said that the common identity of Philippi's shell with that of Linnaeus was questionable, as it was described as having the aperture "ovata, superne distincte angulata," whereas the aperture of Linnaeus' *thermalis* was described as "orbicularis." It should be noted, however, that Lamarck's generic description of *Paludina* contains the phrase "superne angulata" as applied to the aperture and that there is a posterior angulation in the aperture of the shell which is today accepted as

*thermalis* Linné. For the same reason Hanley dismissed the claims of *P. thermalis* Potiez and Michaud (1838–1844, vol. 1, p. 225, pl. 26, figs. 19–20) to be the same as *thermalis* Linné. It is to be noted in this connection that Potiez and Michaud did not accept *P. muriatica* Lamarck as a synonym of *thermalis* Linné, although the two names are now considered to cover the same species.<sup>1</sup> Deshayes (in Deshayes and Milne-Edwards, 1838, p. 515) said, in a footnote to *P. muriatica*: "Since it is well recognized that this species is really the *Turbo thermalis* of Linné, we must restore to it the Linnaean name and designate it by the name *Paludina thermalis*. Dillwyn, in his Catalogue, confused it with the species *Nerita piscinalis* of Müller, which is a *Valvata*." Hanley also referred to a manuscript reference ("Vandal. Patav. p. 115, pl. 3, fig. 1) added to the diagnosis of *thermalis* in Linnaeus' copy of the twelfth edition of the "Systema." The writer has not been able to check this reference, but from Hanley's comments on the cited figure and his digest of the text accompanying it the species described and figured does not appear to be *thermalis* Linné. Hanley, in conclusion, appeared to treat "this puzzling *Turbo*" as a *species dubia*, merely saying: "Whatever the species may prove, its genus will undoubtedly be *Paludina* in its extended Lamarckian signification."

I confess that *thermalis* puzzles me as well. However, the *thermalis* of authors is generally accepted as the species described by Linnaeus under that name, and this identification, although not free from doubt, seems to be the practical one under the circumstances.

*Turbo thermalis* is not described in the "Museum Ulricae," and no specimen of it is found in the Queen's collection in Uppsala.

It is now placed in the genus *Paladilhia* Bourguignat, 1865, type species *P. (P.) pleurotoma* Bourguignat.

I can find no useful figure of *P. thermalis*. The pictures that I have seen are all shown in natural size, which is too small to be instructive.

#### *Turbo uva*

1758, Systema naturae, ed. 10, p. 765, no. 553.

1767, Systema naturae, ed. 12, p. 1238, no. 636.

<sup>1</sup> Potiez and Michaud (1838–1844, vol. 1, pp. 255–256) said: "These two species are in our opinion distinct, for we cannot take *Pal. muriatica* Lam. for the species here in question."

LOCALITY: Not given in either edition.

"T. testa cancellata ovata obtusa; anfractibus contiguus: striis longitudinalibus imbricatis . . . Apertura unidentata."

The subdescription was added in the twelfth edition.

In a genus in which the species are as numerous as those of *Cerion* Röding, in which *Turbo uva* belongs, and in which specific differences are often so slight, it is scarcely possible to isolate a member of the group by an analysis of a description so short, generalized, and in certain details so erroneous as that of *uva*. It is particularly difficult because the entire genus is such a striking example of specific plasticity. In the most recent treatment of the genus, Clench (1957, p. 121) commented: "the characters generally held stable in most other groups of mollusks are, in this group, wildly rampant."

The main description of *uva* is not only insufficiently specific but contains details that, as applied to the *uva* of authors, are either equivocal or erroneous. The word "cancellata" is not understood. The sculpture of *uva*, as of all species in *Cerion*, is confined to longitudinal but non-continuous ribs, and there is no suggestion of a spiral series. It is barely possible that the combination of the well-defined suture and the short, node-like ribs which do not cross the suture appeared to Linnaeus to resemble a cancellated sculpture. Moreover, the word "imbricatis" does not apply to *uva*. There is no hint of imbrication anywhere on the shell. The subdescription, "Apertura unidentata," applies to many *Cerion* species. The whole description is not only too defective to be used as a factor in identification but is strangely inharmonious with the majority of the figures in the synonymy and with the undocumented specimen of the *uva* of authors in the Linnaean collection. In these papers the writer has taken the position that, as a general rule, the description should offer the most cogent evidence for the identification of a species. In the present case it seems necessary to accept the synonymy as controlling, particularly when it is supported by the "probable" type in the collection. We have two alternatives: either Linnaeus was actually describing our *uva* but for some unexplainable reason drafted the description as he did, or we must assume that he was describing some other species and chose the figures

in the synonymy as mere approximations, and, further, that the specimen in the collection was introduced by another hand. The acceptance of the first alternative is to some extent supported by his treatment of this name in the "Museum Ulricae." There the description is more detailed and closer to our *uva*, and two specimens of that shell are found in the Queen's collection at Uppsala labeled *Turbo uva*. I have already called attention, however, to the fact that the posthumous labeling of that collection must be treated with great reserve. In brief, the identification of the name *uva*, based either on the diagnosis in the "Systema" or on the "Museum Ulricae," with the shell known as *uva* today can be made only tentatively.

Linnaeus' synonymy in the "Systema" consisted of six figures. The two from Gualtieri (pl. 58, figs. D, dorsal and apertural views) and the pair from Seba (pl. 55, figs. 21a, b) are shown in sufficient detail to allow us, with some confidence, to accept them as having been based on the *uva* of authors. Petiver's figure (pl. 27, fig. 2) was not seen, as plate 27 was missing from the copy of Petiver available. Buonanni's drawing (pl. 140) is much less persuasive, as it shows a sinistral and otherwise distorted *Cerion*. Pfeiffer (1848, vol. 2, p. 324) cited it for *Pupa martiniana* Küster, 1844, a name that was not supplied with a locality. Clench (1957, p. 112) places it in the fauna of Grand Cayman Island. It is certainly not *uva*. Thus four of the six figures cited by Linnaeus may be tentatively accepted as showing the *uva* of authors. It is probable that the synonymy was the deciding factor in the identification of the name prior to Hanley's examination of the Linnaean shells.<sup>1</sup>

The specimen found by Hanley in the Linnaean collection in London (1855, p. 343) is the *uva* of all authors and, although it only vaguely conforms to Linnaeus' description, may be tied rather securely to his synonymy if one excludes the Buonanni figure. Although it is undocumented in any way, the serial

number of *uva* in Linnaeus' own copy of the "Systema" is underlined, indicating that he did own a specimen of the shell. We are therefore justified in treating it as his type specimen, although only on a "probable" basis. In any case this identification has been unquestioned since the publication of Hanley's work.

The great increase in the number of forms of *Cerion* receiving new specific names began soon after the publication of the last edition of the "Systema." So many of these new species diverge from *uva* in such slight detail that the early conchologists following Linnaeus confused some of them with *uva* and even with each other.

Müller (1773-1774, vol. 2, p. 108) described a *Helix fusus* which was identified by several of his followers with *uva* Linné. It was assuredly not *uva*. It has been considered by some writers to have been a streptaxid, near *Gibbus*. Pfeiffer (1848, vol. 2, p. 318) called it a "species ex descriptionibus et figuris citatis vix agnoscendae." The name has apparently been dropped. Earlier authors had placed it in *Pupa*, and Pfeiffer may have suspected that it was a *Cerion*. It is possible that it was the same shell described by Dillwyn (1817, p. 862) as *Turbo alvearia*, which the latter said was a land shell from Santo Domingo and Guadeloupe. His description strongly suggests a *Cerion*. He cited for it *Bulimus fusus* Bruguière, with no mention of Müller's *fusus*, and a figure from Lister (1770, pl. 588, fig. 49), and in his index to Lister (1823) he identified that figure as *alvearia*. The figure is certainly not *uva*. The identification of *fusus* Müller and *alvearia* Dillwyn is complicated by the fact that Dillwyn also cited for the latter species the same figure from Seba (fig. 21) that Linnaeus cited for *uva* and that probably does represent *uva*. I know of no later attempt to solve the identity of these two species.

Chemnitz (1780-1795, vol. 4, pp. 281-284, pl. 153, figs. 1439a, b) described a "Turbo *uva* Linnaei," but his figures do not show the *uva* of authors. I suggest that they were based on the shell that Bruguière later named *Bulimus mumia* (*Cerion mumia*).<sup>2</sup> Bruguière's

<sup>1</sup> It is improbable that non-Swedish conchologists, at least before Hanley had brought the Queen's collection to the general attention of western European writers, had seen this collection either at Uppsala or Drottningholm. Indeed it was not, as far as I can discover, mentioned in the literature up to that time, although the descriptions of its contents in the "Museum Ulricae" had been often quoted.

<sup>2</sup> This is not *Pupa mumia* Sowerby, 1834 (1821-1834, vol. 1, pl. 41, fig. 2, no locality given), which is *Cerion regium* (Benson, 1849) and *Pupa decumana* "Férussac" Pfeiffer.

species is a larger shell than *uva*, less obtuse at the apex, with more oblique longitudinal ribs, of a darker brown color, and with more developed parietal lamellae. Chemnitz said of his "*uva* Linnaei": "It has in its interior either a single tooth or none, or in some individuals two teeth." He also cited references to earlier writers who either did not state the number of teeth (Favart d'Herbigny), or who used such expressions as "*dente armatus*" (Buonanni, Gualtieri); "*unidentata*" (Lesser, Knorr, Linnaeus in the "*Systema*"); "*dente obsoleto*" (Linnaeus in the "*Museum Ulrica*"); "*bidens*" (Klein); and "*deux dents*" (Davila). Either Chemnitz had confused *uva* with one of the *Cerion* species having normally two teeth in the aperture, or he had in his lot of specimens some young individuals of *uva*, which often show two teeth. It is certain, however, that Chemnitz had at least confused *uva* with *mumia*.<sup>1</sup>

Born (1780, p. 354, and vignette E on p. 340) described *Turbo uva* in terms and with references that tie it to *uva* Linné, but his vignette figure is not drawn in sufficient detail to be cited usefully for that species.

Schröter's *Turbo uva* (1783-1786, vol. 2, pp. 40-42, unfigured) is as equivocal as that of Chemnitz, as none of his cited figures can be associated with the good figures in Linnaeus' synonymy. He cited Lister (1770, pl. 588, figs. 47-49), Knorr (1757-1772, pt. 6, pl.

23, fig. 4), Chemnitz (*tom. cit.*, pl. 153, figs. 1439a, b, already discussed), and the bad Buonanni figure cited by Linnaeus. Lister's figure 49 has also been discussed above and dismissed as not being *uva*. His figure 47 was called *Helix decumanus* Férussac by Dillwyn (1823) and figure 48 was called *Turbo mumia*. Without passing on the accuracy of Dillwyn's identifications, I consider that neither figure can be associated with *uva*. Deshayes (*in* Deshayes and Milne-Edwards, 1838, p. 181) also identified Lister's figure 47 with *decumana* Férussac.

In addition to *Bulimus mumia*, Bruguière described a *B. uva*. As he did not figure any of his species of *Cerion* in the portion of the "*Tableau encyclopédique*" that appeared before his death in 1798 (see Dodge, 1947b, p. 486) or that he supervised and approved, the identity of his *uva* must be determined by his text and synonymy. His text makes it clear that he properly distinguished *uva* from *mumia* (see footnote 1 on this page). His synonymy included all the references cited by Linnaeus for *Turbo uva*, but was considerably weakened by the use of *Helix fusus* Müller as a synonym, as well as the vague vignette figure of Born referred to above. The use of these latter figures was a common fault of many of the early writers.

Gmelin (1791, p. 3604) copied the description in the "*Systema*," referred to the *uva* of the "*Museum Ulrica*," and cited all the figures in Linnaeus' synonymy, including the bad Buonanni figure. He further nullified the probative effect of Linnaeus' good figures by adding the two figures from Chemnitz which, as said above, probably showed Bruguière's *mumia*. He also complicated his diagnosis by adding two undescribed varieties. Variety  $\beta$  was referred to another Chemnitz figure (*op. cit.*, vol. 9, pt. 1, p. 129, pl. 113, fig. 974) which is clearly not *uva*. Chemnitz located it in the East Indies and, by his reference to its habitat, "*Sie ist im ostindische Meersande gefunden worden*," intimated that it was a marine shell. His description does not at all apply to *uva*, and his figure, while it shows the sculpture of *uva*, is not based on that shell. Its aperture is strictly orbicular, is shown without teeth, and is central, turned neither to the right nor left. The shell itself is at once much more tumid than *uva* and has a sharper

<sup>1</sup> Schubert and Wagner (1829, p. 174, pl. 235, figs. 4122-4123) thus distinguished the two species: "This 'Windelschnecke' is a close relative of *Pupa mumia*, which in early days was considered by conchologists to be a variety of it. Bruguière was the first to separate it and to distinguish it from the other by the following characteristics:

1. *Pupa mumia* is larger, as it is 16-17 lines long [36.5-38 mm.] *Pupa uva* is only 11-12 lines long [24.375 to 27 mm].

2. The ribs or folds of the whorls run obliquely in *Pupa mumia*. In *Pupa uva* they are almost vertical.

3. The aperture of *Pupa mumia* shows two folds [Falten], the larger on the columellar lip and the smaller on the columella itself; *Pupa uva* has a tooth only on the columellar lip.

4. The aperture of *Pupa mumia* is always reddish yellow."

The distinction made by Bruguière and Schubert and Wagner as to the obliquity of the ribs is somewhat misleading. In *uva* the ribs are only slightly oblique on the upper whorls and almost completely straight on the last whorl. In *mumia* they are equally and markedly oblique on all whorls.

apex. Chemnitz called it "Der Tannenzapfen" ("The Pine Cone"). Deshayes (*in* Deshayes and Milne-Edwards, 1838, pp. 169–170, footnote) believed that it was a small species of *Cerithium* 2.5 mm. in height. I am unable to identify such a *Cerithium*, although several species of that genus approximate that size. The figure, however, is no closer to *Cerithium* than to *Cerion*. Gmelin's variety  $\gamma$  is referred to another pair of Chemnitz figures (*op. cit.*, vol. 9, pt. 1, p. 123, pl. 112, figs. 965, dorsal and apertural views) which Chemnitz called "Turbo uva terrestris sinistrorsa." The figures show a sinistral shell which otherwise resembles a very lightly sculptured *Cerion* with four apertural teeth. Chemnitz cited for it Müller's *Helix quadridens sinistrorsa* which Müller located in Italy. It is surely not a *Cerion*.

Gmelin's subdescription called his *uva* a marine shell, in spite of the fact that he included a variety said to be a land shell. Further, Müller's *quadridens*, to which Gmelin referred for variety  $\gamma$ , was later listed by Gmelin as a good species (p. 3610). I know of no sinistral *Cerion* and have seen no reports of a sinistral monstrosity in that genus. Thus Gmelin's treatment of *uva* not only described a composite species, but was in other respects even more confusing than that of Linnaeus.

Röding (1798, p. 90) erected the genus *Cerion*, which was, as established by him, an extremely heterogeneous group. For *C. uva* he referred to the *uva* of Gmelin and to the Lister figure 47 which Schröter had cited for *uva*, but which both Dillwyn and Deshayes later identified as *Pupa decumana* Férussac (*regium* Benson), and which is clearly not *uva*.

Röding's only other reference for his *uva* was to the pair of Chemnitz figures which were probably based on the shell to which Bruguière later gave the name of *Bulimus mumia*. Röding may have had a specimen of the *uva* of authors before him, but his inharmonious and largely incorrect synonymy raise more than a suspicion that he was in error.

Röding's *Cerion* is an extremely discordant group, as it contains representatives of at least four different genera. His *C. bidens* is based on *Turbo bidens* Gmelin, which is *Nerita bidens* Schweigger, in the Clausiliidae;

*C. botrys* is based on a Lister figure (pl. 585, fig. 43) which shows *Littorina littorea* (Linné); *C. pupa* is referred to *Helix pupa* Gmelin, a species now placed in the genus *Mastus* Beck, 1837, in the family Enidae; *C. vulgare* is referred to a figure from Knorr (1757–1772, pt. 6, pl. 25, fig. 4, no locality given) which may be taken as a fair picture of *C. uva* of authors; *C. apiarum* is referred only to *Turbo uva* Gmelin, probably meaning Gmelin's principal variety. Thus we find in his list of *Cerion* two names, *uva* and *apiarum*, referred to Gmelin's *uva*, one, *vulgare*, referred to a figure that is probably *uva* Linné, and three other names referred to species outside the Cerionidae. Moreover, his *uva* itself was provided with a synonymy that is two-thirds erroneous. I am not sure which of his fairly well-referred species was really Linnaeus' *uva*, but the generic name *Cerion* has been accepted as the earliest valid name for *uva* Linné and its congeneres. The accepted identification of his *uva* is unsatisfactory, but I adopt it, although unwillingly, only in order to avoid further confusion.

Beginning with Lamarck, the early nomenclatural history of this group must be discussed. In 1801 Lamarck erected the genus *Pupa* to receive *uva*. He did not mention the earlier *Cerion* Röding. In the same year Draparnaud also used *Pupa* as a genus. Inasmuch as Lamarck's name was published in January of that year while that of Draparnaud appeared in July, I consider the latter as a mere usage of the former. Neither refers to the other. In any case Draparnaud's genus covered only species in the Pupillidae and Clausiliidae.<sup>1</sup>

Lamarck's *Pupa* is also unavailable, as it is a homonym of *Pupa* Röding, 1798. The latter name covers species later included in *Solidula* Fischer von Waldheim, 1807, and bears no relation to the *Pupa* of either Lamarck or Draparnaud. The precedence of *Pupa* Röding over *Solidula* is beginning to be accepted for the group they cover. *Pupa* Lamarck was current for many years and was finally abandoned only when the Röding names in the "Museum Boltenianum" came to the general attention of conchologists with the publica-

<sup>1</sup> The dates of publication of *Pupa* Draparnaud and Lamarck are given on pages xlv and lxxvii of the "Index animalium" (sect. 2, pt. 1) by C. D. Sherborn.

tion of a photostatic copy of the work by Sherborn and Sykes in 1906, although Mörch, Hanley, and Henry and Arthur Adams in the middle years of the nineteenth century had mentioned it.

Link (1807, p. 131) was familiar with the Röding names, but amended *Cerion* to *Cerium*. He also cited the Gmelin reference and the Chemnitz figures of *mumia* for his *C. uva*, and it is therefore as composite a species as those of his predecessors.

Dillwyn (1817, p. 861) supplied a description for *Turbo uva* which, while correct in its broad details, might be read to cover many other species of the group. His synonymy was in part well chosen, as he referred to the acceptable Petiver, Gualtieri, and Seba figures cited by Linnaeus. He added, however, the extremely questionable Buonanni figure and the *Helix fusus* of Müller, neither of which can be associated with *uva*.

In 1822 Lamarck (vol. 6, pt. 2, p. 105) continued to place *uva* in *Pupa* and supplied a description that was tainted with the same lack of particularity in its diagnostic detail that characterized the earlier descriptions. Among other things, his word "creberrimis" as applied to the ribbing of the shell would probably not have been used had he known of the several other species of *Cerion* that are even more closely ribbed. His synonymy is excellent, except for the fact that he continued to cite the *Helix fusus* of Müller. The specimen on which his diagnosis was based is unfortunately lost.<sup>1</sup>

Deshayes (in Deshayes and Milne-Edwards, 1838, pp. 169-170) was the first to point out some of the errors of his predecessors. His remarks, contained in a footnote, are quoted in full: "The observations which I have just made on *Pupa mumia* may be repeated for *Pupa uva*. Linnaeus' synonymy appears to be correct so far as may be judged from the figures he cited.<sup>2</sup> Martini [here, and below, error for Chemnitz] is less accurate

and, as we have said, confused *Pupa uva* with the preceding species [*mumia*] and his synonymy, usually so correct, shows other errors. The synonymy of Born is more accurate; he nevertheless cited the figure from Martini that shows the preceding species. As for Schröter, his synonymy is as defective as that of Martini and confuses several species with that of Linnaeus. In copying Schröter Gmelin added to the confusion as he gave as a variety of *Pupa uva* [var.  $\beta$ ] a little species of Cerite, two lines in length and [var.  $\gamma$ ] a Maillot close to the *tridens* of Draparnaud.<sup>3</sup> The thing that makes Gmelin's carelessness evident is that after having cited the figure from Buonanni (fig. 140) for *uva* he later (p. 3610) cited the same figure for his *Turbo fusus*. Since the rectification of the synonymy by Bruguière the species is better understood and can be readily identified; nevertheless M. Férussac, in his great work, shows as a variety (pl. 153, figs. 8, 9, 10) a shell that, based on the plications of the aperture, seems to be a distinct species." This note by Deshayes is in entire accord with the writer's views on the inaccuracy of the earlier synonymies, except for his acceptance of the Buonanni figure in Linnaeus' synonymy as correct.

Deshayes (in Deshayes and Milne-Edwards, 1838, pp. 168-169), in his discussion of *P. mumia*, was also the first to refer to the multiplication of useless names in this group, saying: "There is great confusion among the larger species of Maillot, the majority being confounded under two or three specific names." This was only a foretaste of the immeasurably greater number of synonyms that we find today in *Cerion*. As was said by Clench (1957, p. 12): "Probably less than 20 per cent of the names now extant actually apply to valid species or subspecies." Clench also pointed out, as an example, that while his catalogue of *Cerion* lists 82 names that have been given to the *Cerion* fauna of the island of New Providence in the Bahamas, "probably no more than five or six species exist on this small island."

<sup>1</sup> I am advised by Dr. E. Binder of the Musée d'Histoire Naturelle of Geneva (personal communication, 1958) that the collection of that museum, which contains a large proportion of Lamarck's own cabinet, does not include any specimen of *Pupa uva* that can be said to have belonged to Lamarck "either certainly or even probably."

<sup>2</sup> Deshayes apparently accepted Linnaeus' figure from Buonanni as showing *uva*.

<sup>3</sup> Note that Chemnitz' pair of figures (965), which Gmelin cited for variety  $\gamma$  of *uva*, had been referred by Chemnitz to Müller's *Helix quadridens*, whereas Deshayes treated them as close to *tridens* Draparnaud. In any case neither is a species of *Cerion*, and both probably belong in *Clausilia*.

The genus *Cerion* is confined to the tropical islands of the western Atlantic. It occurs in the Bahamas, throughout the northern West Indies, with the exception of Jamaica, and in the Dutch West Indian islands of Curaçao, Aruba, and Bonaire off the South American coast. A single species, *Cerion saccharineta* "Blanes" Pilsbry and Vanatta, 1898, is found in abundance along the lower Florida Keys. This latter species has been reported from the Florida mainland at Cape Florida, but this report lacks authority. Clench (1957, p. 121) said: "I do not know of any permanent colonies on the Florida mainland." *Cerion saccharineta* was for a long time called *Pupa incana* Binney, 1851, a *nomen nudum*. The genus is not represented on the South American coast. Küster (1841–1855, p. 92) reported his *P. antoni* from British Guiana, but Pilsbry (1885–1935, vol. 14, p. 192) admitted that this locality was erroneous. Clench (1957, p. 137) gives its locality as "Probably Great Inagua, Bahamas."

The following additional names have been used for the present genus: *Cerium* Link, 1807, type species, *Cerium uva* (Linné), by subsequent designation, Pilsbry, 1918; *Pupa* Montfort, 1810, type species, *Pupa uva* (Linné), monotypic; *Puparia* Rafinesque, 1815, a substitute name for *Pupa* Lamarck, 1801; *Cochlodonta* Férussac, 1821, type species, *Turbo uva* Linné, by subsequent designation, Clench, 1957; *Cochlodon* Sowerby, 1825, in part, type species, *Cochlodon uva* (Linné), by subsequent designation, Pilsbry, 1918; *Strophia* Albers, 1850, type species, *Pupa mumia* (Bruguière), by subsequent designation, von Martens, 1861, *non Strophia* Meigen, 1832; *Pulpa* Poey, 1858, error for *Pupa* Lamarck, type species, *Pulpa sculpta*, Poey, monotypic.

*Cerion uva* is found only on the islands of Curaçao, Aruba, and Bonaire. It has been known under several other specific names: *C. arubanum* from Aruba, *C. bonarensis* from Bonaire, and *C. diabensis* and *hatoensis* from Curaçao appear to be synonyms of *uva*; *C. vulgare* and *apiarum* Röding are also accepted as synonyms; *C. krulendijke* from Bonaire and *C. djerimensis* from Curaçao are treated as good subspecies by Baker; *C. knipensis* from Curaçao is a form close to *djerimensis*. All the above names except those of Röding

are of Baker (1924b, pp. 100–106). However, the extreme lack of stability in the characters of *uva*, in common with most of the species of *Cerion*, makes it difficult to establish the validity of many of the recent names as species or subspecies with any degree of confidence.

The present species is well figured by Schubert and Wagner (1829, pl. 235, figs. 4122, 4123<sup>1</sup>) and by Pilsbry (*tom. cit.*, pl. 33, figs. 41–45).

#### *Turbo lincina*

1758, *Systema naturae*, ed. 10, p. 765, no. 556.

1767, *Systema naturae*, ed. 12, p. 1239, no. 639.

LOCALITY: "In Jamaica. Terrestis" (1758, 1767).

"T. testa oblonga obtusa rugoso-striata, apertura limbo dilatato plano crenato."

The above description, which was identical in the tenth and twelfth editions of the "*Systema naturae*," is of little assistance in our arriving at a specific identification, as it would cover numerous other species of land operculates in the old genus *Cyclostoma* which have been discovered and distinguished from *lincina* since Linnaeus' day. While all of its details apply to the *lincina* of all authors, all that can be gained from its phraseology is that Linnaeus was describing a Jamaican cyclostomid shell.

The synonymy is slightly more helpful. The figure cited from Lister (1770, pl. 26, fig. 24) may be accepted as showing the *lincina* of authors. Klein's figure (1753, pl. 3, fig. 71) seems to be a copy of Lister's. The figures from Sloane (1707, 1725, vol. 2, pl. 240, figs. 12, 13) are highly conventionalized drawings of a cyclostomid shell with a moderately flaring peristome and cannot be categorically tied to *lincina* alone. All the details of Sloane's description (*tom. cit.*, p. 230) apply not only to *lincina* but to other Jamaican species of this group. Hanley (1855, p. 344) said of the Sloane figures that "they require the aid of the accompanying text to be rightly understood." I cannot gain so much information from that text as Hanley suggested. What I have said as to the Sloane

<sup>1</sup> The sculpture in the Schubert and Wagner figures is only vaguely indicated, but in other respects the figures are characteristic. The aperture is correctly drawn.

drawing applies with equal force to the figure from Browne (1789, pl. 40, fig. 5). Browne called his species "the white rugged *Licina* with a spreading rim to the aperture," and his description is also broad enough to cover more than one species. Hanley (*loc. cit.*) said of this figure that it was "characteristic and harmonized with the description in the 'Systema,'" a statement that, while correct, does not specifically identify the figure. In brief, the figures cited by Linnaeus have the same defect as is seen in all the early figures of this species and of its close congeners. In a group that has expanded so rapidly as this and in which the members are separated by such slight and in some cases almost imperceptible differences, photographic figures are necessary to show specific differentiation.

No specimen of *lincina* was found by Hanley in the Linnaean collection in London.

The breaking up of the genus *Cyclostoma* Lamarck, 1799, and the several genera carved out of it was caused by the multiplicity of new species described not only in recent years but in the nineteenth century as well, partly, at least, owing to the restricted localities of many of the cyclostomids of the West Indies.

This historical sequence of the principal treatments of *lincina* Linné and the species with which it has been confused is here briefly discussed:

The first post-Linnaean description that was seriously considered to have been based on *lincina* Linné was that of Müller's *Nerita lincina* (1773-1774, vol. 2, p. 178). His description is somewhat equivocal because of the phrases "striata apertura in puncta adnata" and "incarnata." The aperture of the *lincina* of authors is not striated except in so far as the interspaces between the transverse beading of the exterior are sometimes vaguely reflected in the aperture owing to the translucence of the shell material. This is an optical illusion rather than owing to real striations. The flare of the lip bears furrows and sharp crenulations which are developed from the spiral lines of beading of the exterior, but this feature can hardly be described as striations of the aperture. I cannot arrive at an intelligible or apt translation of the phrase "In puncto adnato" as applied to the aperture. Secondly, the word "incarnata" implies a color much darker and redder than

I have observed in this species. In spite of these misleading details and in spite of the fact that Müller's shell was stated to come from southern Europe, *N. lincina* has been included in many later synonymies of *lincina* Linné. Such an identification is, of course, somewhat strengthened by the fact that Müller referred his species to the serial number of *lincina* in the twelfth edition of the "Systema." This only means, however, that the error began with Müller himself, and I feel great hesitation in associating his shell with that of Linnaeus. A further detail that seems to repel the identification with *lincina* is his description of the umbilicus: "It has indeed an umbilicus, but it does not penetrate into the whorls." *Turbo lincina* Linné has a fairly wide umbilicus which penetrates the body whorl at least and is striated within.

Born (1780, p. 355, pl. 13, figs. 5-6) described and figured a *Turbo lincina* as from Jamaica, which was not the *lincina* of the "Systema." While his description could conceivably cover that species, except for the phrase "umbilicus impervius," his figures apparently show the shell later called *Turbo dubius* by Gmelin (1791, p. 3616).<sup>1</sup>

<sup>1</sup> Dillwyn (1817, p. 365) concluded that Born's *lincina* was *Turbo labeo* Gmelin (*Licina labeo*, error for *labeo*, Gray, 1847). The earliest use of the name *labeo*, however, is *Nerita labeo* Müller (*tom. cit.*, pp. 180-181). This was probably the species called "Turbo lincina magna" by Chemnitz in 1786 (1780-1795, vol. 9, pt. 2, p. 56, pl. 123, figs. 1061-1062). It is the type of *Licina* Gray, 1847, by monotypy. The *Cyclostoma labeo* of Lamarck (1822, vol. 6, pt. 2, p. 145), which was referred by Lamarck to the *labeo* of Müller and Gmelin, was possibly also *dubius* Gmelin. However, the figures cited by Lamarck for his *labeo* ("Tableau encyclopédique," pl. 461, figs. 4a, b) are certainly not the *labeo* of Müller and Gmelin nor the erroneously named *lincina* of Born. Bartsch (1946, p. 121) cited them for *Licina dubia* from Haiti. They appear to the present writer more closely to resemble *Cyclostoma ambigua* Lamarck (*Sallepoma ambiguum*), also a Haitian species. Lamarck gave no locality for his species, although he located *labeo* in Jamaica. Dillwyn also said, under *Turbo labeo* (*loc. cit.*): "Linnaeus considered this to be a variety of *T. lincina*, from which it principally differs in being much larger and in having the aperture more dilated." His differentiation between the two species is correct, but Linnaeus did not make the remark attributed to him. Dillwyn based his conclusion either on the word "dilato" in Linnaeus' description or on the fact that he believed that one or more of Linnaeus' cited figures showed *labeo*. I cannot associate any of these figures with *labeo*.

Chemnitz (1780–1795, vol. 9, pt. 2, pp. 54–55, pl. 123, figs. 1060a–c) described and figured a “*Turbo lincina* Linnaei,” but none of his three figures can be reasonably tied to *lincina* Linnaeus. They all show only spiral striations, with no hint of the symmetrical beading of the Linnaean species. The sculpture of *lincina* is decussate in appearance, as it is formed by extremely fine tubercles arranged strictly in both axial and spiral series, the spiral series being strikingly dominant, the axial series not being evident in most specimens. The color of Chemnitz’ figure 1060a is pure white and shows a shell much too large for *lincina*. Figures 1060b and c are dorsal and apertural views of a shell somewhat resembling *lincina* in contour but showing no beading. Their color is dark brown. All three figures have a color quite different from the pale fawn tint of *lincina*.

Schröter (1783–1786, vol. 2, p. 43) described *Turbo lincina* Linnaeus as a “red striped shell,” a misleading description. The only suggestion of a “stripe” of color in the species is the existence of a narrow area of brown stain in its deeply depressed suture. This was not referred to by earlier writers but had already been mentioned by Schröter (1779, p. 365). In the later work Schröter admitted that he did not himself know the species, saying: “I cannot boast of having seen this shell, of which Herr Justizrath Müller, on which conscientious man I can rely, gave the following description.” After quoting Müller’s description of *Nerita lincina*, Schröter continued: “Lister and Linnaeus place this species among the land shells and both locate it in Jamaica. Gronow asserts that it is found in the Antilles. Thus it is still unknown whether it is a land, fluviatile or marine shell.” Schröter did not figure it.

Gmelin (1791, p. 3605) copied Linnaeus’ description and added these further details, “Habitat in Jamaicam et insulis vicinis” and “dura, pellucida, umbilicata, anfractus 5,” which are only partly accurate. The species is found only in Jamaica and is thin and fragile rather than “dura.” Gmelin listed all the figures, good and bad, cited by his predecessors, except that, following Chemnitz, he omitted the Browne figure. His omission of this figure and his addition of a figure from Petiver (pl. 118, fig. 11) constitute some in-

dication that he had a specimen before him when he wrote, but his two questionable added descriptive phrases must be considered an indication of almost equal cogency that he had confused *lincina* with some other species.

Neither Bruguière, Röding, nor Link listed *lincina*.

Dillwyn (1817, p. 864) was the first to describe *lincina* as having decussate sculpture. He also correctly described the umbilicus as “rather large, deep and striated.” A perforating umbilicus is not a constant feature in the genus *Choanapoma*, in which I am placing *lincina* Linnaeus. Most species show it, but some have only a non-perforating umbilical depression. The perforation of the apex of the shell is, however, seen in all specimens of *lincina* examined by the writer, when the nuclear whorl is sufficiently damaged to show an apical cavity. Dillwyn added a variety: “Smooth, and transversely striped,” which he referred to the Chemnitz figure 1060a. I am not familiar with a smooth form of the *lincina* of authors. In any case the Chemnitz figure mentioned does not show a smooth shell. It does show the sutural stain noted above, which was probably the feature described by Dillwyn as “transversely striped.”

Schumacher (1817, p. 196) erected the genus *Annularia*. Of his two species, *A. aurantia* and *fimbriata*, the latter, while it is referred to *Turbo lincina* Linnaeus, is also referred to the Chemnitz figure 1060a which, as said above, is shown as a pure white shell larger than the *lincina* of authors and apparently only spirally striated. Some writers have placed *lincina* in *Annularia*, as type species. The extremely equivocal character of the Chemnitz figure, however, cited by Schumacher for *fimbriata*, a figure that does not represent *lincina*, certainly militates against the possibility of associating *lincina* with Schumacher’s genus. Baker’s diligent research into these groups of terrestrial operculates led him to this conclusion (1924a, p. 91), and I am following him in placing *lincina* Linnaeus in the genus *Choanopoma* Pfeiffer, 1847, for reasons fully stated by him.<sup>1</sup>

<sup>1</sup> I quote in full Baker’s rejection of *Annularia* Schumacher, in favor of *Choanopoma* Pfeiffer as the vehicle to contain *Turbo lincina* Linnaeus:

Lamarck did not include *lincina* in his *Cyclostoma*, at least under that name. He listed a *C. lincinella* (1822, vol. 6, pt. 2, p. 148) which he located in Jamaica and referred it to the Lister figure (pl. 26, fig. 24) which Linnaeus had cited for *lincina*. I can find little in his description of *lincinella* that does not conform to the characters of the *lincina* of Linné and of all authors.<sup>1</sup> Moreover, his only other reference was to a pair of figures in the "Tableau encyclopédique" (pl. 461, figs. 2a, b). These figures are as close to *lincina* in detail as any that had appeared. Their only defect is that the axial lines of beads is emphasized at the expense of the spiral series. It should be noted that in the "Explanation of plates"<sup>2</sup> these two figures are referred to as "*Cyclostoma lincina*. *C. lincinella*. Lamk. 6. pars 2. 148." This is an indication that the reference was based on a

"*Annularia* Schumacher (1817, Essai Nouv. Syst. Hab. Vers. Test., pp. 60, 196) contains two species, *A. aurantiaca* and *A. fimbriata*, both of Schumacher. Each is founded on figures in Chemnitz, and the first is apparently close to *Cyclophorus volvulus* (Müller). The second is described by the citation: 'Turbo lyncina Lin. Chemn. 9, sect. 2, pag. 54, Tab. 123, fig. 1060, Littr. a.' This cannot be construed as a quotation of *Turbo lincina* Lin. (1758, Syst. X, 765) and *A. fimbriata* Schumacher must be restricted to the figure in Chemnitz, which certainly does not represent the Linnaean species. In fact, this figure totally defies recognition, although Pfeiffer (1852, Mon. Pneum. Viv., 159) identified it, with doubt, as *Cyclostoma fimbriatulum* Sowerby. As a result, Dall's (1905, Proc. Malac. Soc. London, VI, 208) choice of *Turbo lincina* Lin. as the type of *Annularia* is impossible; the only identifiable species of the genus, *Annularia aurantiaca*, is now chosen as its type; and *Annularia* passes into the synonymy of *Cyclophorus* Montfort (1810, Conch. Syst. II, 290).

"For these reasons the Jamaican group which has temporarily been known as *Annularia* must revert to its classical generic title, *Choanapoma* Pfr. (1847, Zeit. Mal., 47), type *Turbo lincina* Lin. (1758)."

<sup>1</sup> Lamarck's description reads: "C. testa orbiculato-conica, umbilicata, tenui, longitudinaliter subtilissime striata, cinerea; spira brevi, acuta; labro margine reflexo, lato, patente." The only equivocal details are the words "cinerea" applied to the shell and "acuta" as applied to the spire. The latter may have meant that Lamarck had before him either a young shell or an individual that had suffered no damage to the nuclear whorl. As said above, all specimens examined by the writer were damaged in this respect and showed an apical cavity. Lamarck added a subdescription (in French): "Lives in Jamaica. My collection. It is related by its aperture to *C. labeo* but is quite distinct."

<sup>2</sup> The "Explanation of plates" should not be confused with Lamarck's "Liste" published in 1816.

conviction that the two names referred to the same species.<sup>3</sup> On all the evidence, I am satisfied that Lamarck's shell was indeed some life stage of the *lincina* of Linnaeus, even though he did not cite the "Systema" or even "Lin. Gmel." for it. His specimen of *lincinella* is unfortunately not found today in the collection of Lamarckian types in the Geneva Museum, on the authority of M. Binder, the Curator of Mollusks in that museum (personal communication, 1957).

Deshayes (*in* Deshayes and Milne-Edwards, 1838, p. 359) disagreed with what I have since concluded as to the common identity of *lincina* and *lincinella*. He said, in a footnote: "We first believed that the species of Lamarck was the same as the *Turbo lincina* of Linné but we think that the two species should be retained; it is, in fact, sufficient, in order to make any confusion impossible, to expunge the Lister figure from Lamarck's synonymy and restore it to the Linnaean species." Deshayes here seems to be supporting his theory by the mere suppression of unpalatable evidence. He listed *lincina* separately (*tom. cit.*, p. 368) and referred it to the *lincina* of the twelfth edition of the "Systema naturae" and to all the figures and descriptions of his predecessors, including the Lister figure and the white Chemnitz figure (1060a). In his French subdescription he commented on the early history of the name *lincina*: "Many species have been described under the name which should be reserved for this one. Chemnitz confused it with the *Nerita lincina* of Müller, a species from the southern parts of Europe to which Draparnaud had given the name *Cyclostoma sulcatum*."<sup>4</sup> He added: "The *Cyclostoma lincina* is distinguished from other species not only by

<sup>3</sup> The date of publication of the section of the "Explanation of plates" containing plate 461 is not definitely known, but the evidence seems to show that it was 1816. It is also not definitely known whether Lamarck himself had approved and supervised the preparation of all plates beyond the number 189, but we know that it was either he or Bory de St. Vincent (see Dodge, 1947b, p. 486). In any case, Lamarck must have seen the reference to *lincina* in the pertinent section of the "Explanation."

<sup>4</sup> Draparnaud's *C. sulcatum* was also listed by Deshayes (*tom. cit.*, p. 370) and was referred to the Chemnitz figures 1060b and c. These are figures of the dark brown, spirally striated shell mentioned above in the discussion of Chemnitz' "Turbo lincina Linnaei."

the thin fringed and furrowed lip of the aperture, but by its fine transverse striae and its narrow and shallow umbilicus. Müller said that this shell is of a reddish-fawn color, not very dark [peu foncé] either within or without. The specimens we have seen were white." Deshayes' reliance on the very equivocal Chemnitz figure (1060a) and his description of the umbilicus of *lincina* convince me that his conception of *lincina* Linné is almost devoid of authority. Either he had before him some species other than *lincina* or he had not carefully examined the umbilicus which, in *lincina*, traverses the entire shell to the perforation at the apex and is not "narrow and shallow."

Linnaeus did not own a specimen of *lincina*, as the serial number of the species is not underlined in his working copy of either the tenth or twelfth edition of the "Systema," a notation indicating his possession of a shell. Hanley (1855, p. 344) was therefore unable to find the type in the Linnaean collection in London. He appears, however, to have been certain of its identity and cited for it the *Cyclostoma lincina* of Sowerby (1847-1887, vol. 1, pl. 28, figs. 148-149). These are excellent figures of the species except that, as in so many of the earlier figures, the shell is shown as much too dark in color. Hanley based his identification squarely on the figures cited by Linnaeus, saying: "All the four cited figures have been ascribed to the same *Cyclostoma* which has justly been selected by Sowerby, in his late Monograph of that genus, as the representative of the Linnaean species." I comment above (p. 241) on his very credulous acceptance of the Sloane and Browne figures in Linnaeus' synonymy.

It is difficult to understand this sudden and categorical identification of *lincina* by Sowerby and Hanley, as the previous history of the species had been so equivocal. Based on Linnaeus' whole diagnosis, they had very little real evidence to support them. Sowerby said (*tom. cit.*, p. 140): "This is undoubtedly Linné's *Turbo lincina* with which Lamarck's *Cycl. lincinella* and his *Cycl. interruptis* have been both confounded. Neither of which, however, agrees with the character Linné gives of his *T. lincina*." Whether we agree or disagree with the conclusions of Sowerby and

Hanley, there seems to have been little doubt, from Hanley onward, that the well-known *lincina* of authors is the Linnaean species. This is a possible and even reasonable identification, but it is not at all a certain one.

There is a curious dearth of figures of the *lincina* of authors in recent literature. Except for the Sowerby figures, I have not been able to find a figure that can be surely tied to *lincina*.

The species was not described in the "Museum Ulricae."

#### *Turbo auriscalpium*

1758, *Systema naturae*, ed. 10, p. 767, no. 569.

1767, *Systema naturae*, ed. 12, p. 1240, no. 652.

LOCALITY: "In M. Mediterraneo" (1758, 1767).

"T. testa turrita alba laevissima, apertura labio porrecto planiusculo concavo obtuso . . . Testa subulata, lactea, glaberrima 7 s. 8 spirarum. Apertura dilatata auriscalpium referens; Labro porrecto, obtuso, concavo, marginato."

The entire diagnosis is identical in the tenth and twelfth editions of the "Systema," except for the addition of the word "labio" in the main description in the twelfth and the consequent necessity of giving the following four adjectives a masculine ending. In its combination of striking diagnostic characters it is as nearly a perfect guide to identification as any description in the molluscan portion of the "Systema" and leaves no doubt that Linnaeus had before him a specimen of the *auriscalpium* of authors.

Two minor omissions may be noted: first, that the pronounced angulation at the junction of the posterior ends of the columella and outer lip is not mentioned; second, that the word "laevissima" is misleading. The anterior half of the body whorl is seen, under a lens, to be finely spirally striated, and the upper half of this whorl and of the three anterior whorls of the spire bear a few widely spaced rugae, which descend from the suture and become obsolete anteriorly. The remaining spire whorls are devoid of sculpture. This inconsistency in the description is explained by Hanley, who noted, in his report on the Linnaean collection in London (1855, pp. 352-353), that the specimen of *auriscalpium* in the collection was beach-worn and therefore differed from the fresh shell which was,

in his words, "not inelegantly sculptured." He added that "when two or three of the very small species succeed on another in the arrangement of the 'Systema' they are generally found in the cabinet of our author wrapt up in the same paper, or enclosed in the same little box." As an illustration of this practice, Hanley found, mixed with specimens of *Turbo perversus* (*Balea perversa*), a specimen that, alone of the contents of the collection, agreed with the description of *auriscalpium*. He assumed, probably correctly, that it was the specimen on which Linnaeus' description was based, although, following the formula for the identification of holotypes adopted in these papers, it cannot be accepted as Linnaeus' type specimen except on a "probable" basis. Linnaeus' Mediterranean locality is correct and was vouched for by Logie, one of his pupils, who had supplied him with the specimen. The specific name, "an ear-pick," is graphically descriptive.

The single figure in the synonymy (Argenville, 1742, pl. 32, fig. 19) is not satisfactory and was, indeed, queried by Linnaeus in both editions. Although it shows the characteristic form of the spire and, somewhat vaguely, of the aperture, it is shown as a sinistral shell, and the sculpture appears to consist of close axial ribbing on all whorls. Argenville (p. 385) compared it in size to an oat grain, a fair comparison, but incorrectly referred to it as a land shell. Hanley concluded that it was based on a species of *Clausilia*. The figure appears to the present writer to be closer to *Balea*. Linnaeus failed to mention the size of his species, a fault of which he was often guilty (see p. 212, above) in the case of the minute species.

This species belongs in the genus *Rissoa* (Fréminville) Desmarest, 1814, and is placed by some systematists in section *Zippora* Leach, 1852, of the typical subgenus. *Loxostoma* Bivona, 1838, *Anatasia* and *Apanthausa* Gistel, 1848, and *Goniostoma* "Megerle von Mühlfeld" Villa, 1841, not of Swainson, 1840, are listed as synonyms by Thiele.

In spite of Linnaeus' clear description, the fact that he had not referred to the minuteness of the species, together with the equivocal figure from Argenville, may have been the cause of the delayed identification of *auriscalpium*. It was not mentioned by Martini, Chemnitz, Born, or Lamarck and was

apparently lacking in the collections described by Röding and Link. Schröter (1783–1786, vol. 2, pp. 59–60) merely paraphrased what Linnaeus had said, although he cited Müller's vernacular name, "Das Öhrlöf-felschen."

Gmelin (1791, p. 3611) merely copied Linnaeus' diagnosis and was apparently not familiar with the species. Dillwyn (1817, pp. 880–881) cited for it only the references to Linnaeus, Schröter, and Gmelin, and his comments make it clear that he had never seen a specimen.

Even after further specimens of *auriscalpium* had appeared in collections, their identity with the Linnaean species was not generally appreciated. Desmarest (1814, p. 8, pl. 1, fig. 4) described and figured *Rissoa acuta*, which is almost certainly Linnaeus' shell. Payraudeau (1826, p. 110) and Deshayes (*in* Deshayes and Milne-Edwards, 1838, p. 470) followed Desmarest in listing *R. acuta* with no reference to the Linnaean *auriscalpium*. Deshayes' description is particularly convincing and seems to point unquestionably to Linnaeus' shell. Philippi (1836–1844, vol. 2, p. 125) was the first writer after Müller to associate *acuta* with *auriscalpium* Linné.

Synonyms of the species *auriscalpium* that may be accepted with assurance are: *Rissoa acuta* Desmarest, 1814,<sup>1</sup> *R. acicula* Risso, 1826, and *R. drummondi* Leach, 1847. Bucquoy, Dautzenberg, and Dollfus (1882–1898) recognized a variety which they named *expansilabro*.

*Turbo auriscalpium* was not described in the "Museum Ulricae," as the Queen's collection contained virtually none of the smaller species.

The species is figured by Reeve (1843–1878, vol. 20, pl. 2, fig. 11) and by Bucquoy, Dautzenberg, and Dollfus (1882–1898, vol. 1, pl. 34, figs. 6–9). An early figure, showing both shell and animal, is found in Philippi (1836, 1844, vol. 2, pl. 23, fig. 2).

#### *Turbo nautilus*

1758, *Systema naturae*, ed. 10, p. 709, no. 234 (as *Nautilus crista*).

<sup>1</sup> James de C. Sowerby (1812–1829–[1846]) described a fossil *Rissoa* from the oölite of Ancliffe, England, as *Rissoa acuta*. As this name was a homonym Deshayes (*in* Deshayes and Milne-Edwards, 1838, p. 485) re-named it *R. sowerbyi*.

1767, *Systema naturae*, ed. 12, p. 1241, no. 654 (as *Turbo nautilus*).

LOCALITY: "In Germaniae paludibus; minutus" (1758). "In Ceratophyllo<sup>1</sup> Germaniae, Helvetiae; minutus" (1767).

"T. testae apertura orbiculata, anfractibus contiguus, articulis annulatis dorso spinosis.†"<sup>2</sup>

"T. testa planiuscula anfractibus annulatis dorso cristatis.†"

This species was considered by Linnaeus, in 1758, to belong to his genus *Nautilus*. Of the 17 species in the *Nautilus* of the tenth edition, 14 are in the protozoan order Foraminifera, the other three being mollusks. Of the latter, two (*pompilius* and *spirula*) are cephalopods, and one (*crista*) is a gastropod. Apparently Linnaeus believed that the 14 Foraminifera were minute cephalopod mollusks, owing to the external appearance of the test and his own ignorance of the unicellular nature of the animal, although it is seen from his generic description of *Nautilus* that he was aware that the test was multicameral and that there existed a foramen between the chambers: "Testa univalvis, isthmiis perforatis concamerata, polythalamia."<sup>3</sup>

By the time that the twelfth edition of the "Systema" was being prepared in the years preceding 1767, Linnaeus had recognized his error in the case of *crista*, although he still retained *Nautilus* in the Foraminifera. The species *N. crista* was transferred to his genus *Turbo*, with a change of its specific name to *nautilus*. His recognition that the two were identical is shown by his reference to "Syst. nat. 10. p. 709. n. 234" in his synonymy of *T. nautilus* and the repetition of the single figure ("Roes. insect. 3. p. 599. t. 97. fig. 21, 22") cited for it in the tenth edition. The priority of the specific name *crista* is now recognized, and the species is placed by Thiele (1931, p. 48) in the family Planorbidae, genus

*Anisus* Studer, 1820, and section *Armiger* Hartmann, 1840.<sup>4</sup>

Linnaeus, as said above, made changes and additions in the description in the twelfth edition, although there is nothing conflicting in the two versions. The most useful addition is the word "planiuscula." The reasons for the changes in language do not seem to have been motivated by his altered conception of the systematic position of the species, but that in the twelfth edition is the more characteristic and may be accepted, with reservation, as defining the species.

The figure from Rosel's "Insectbelustigung" (vol. 3, pl. 97, fig. 7) and the figures from the "Acta Helvetica" (vol. 4, p. 212, pl. 9, figs. 21–22) were not seen by the writer as these works were not available.

Inasmuch as Linnaeus had completely altered his conception of this species in the twelfth edition, his repeated use of the dagger sign in that edition (see Dodge, 1955, p. 9) raises an interesting question. It would seem impossible that he could have corrected his original error without having a specimen before him, unless his transference of the species to a gastropod genus had been based on some further contact with a colleague who had arrived at that conclusion by the examination of a specimen of the shell. It is also curious that he should have placed this distinctly planorbid species in the group of *Turbo* headed: "Turriti proprie dicti."

In 1774 O. F. Müller adopted the genus *Planorbis* (1773–1774, vol. 2, p. 152) and included the present species as *P. imbricatus*. Draparnaud (1801, p. 46) continued the use of the latter name. In a later work (1805, p. 44, pl. 2, figs. 1–3, pl. 1, figs. 49–51) Draparnaud listed and figured both *P. imbricatus* and *P. cristatus*, but both specific names are now considered to refer to forms of the Linnaean *crista* which are not even subspecifically separable. Both *imbricatus* and *cristatus* were used indiscriminately for many years before their identity with *crista* or its other Linnaean synonym *nautilus* was generally recognized, although Chemnitz, Montagu, Maton, Rackett, and a few others listed a

<sup>1</sup> "Ceratophyllo" refers to some European species of the genus *Ceratophyllum* Linné, 1753, a genus of submerged aquatic plants.

<sup>2</sup> After the description in both editions appears the symbol of a cross, or dagger, which signifies that Linnaeus had not seen the species alive or in any museum. (See Dodge, 1955, p. 9.)

<sup>3</sup> This misconception persisted in the conchological works of Gmelin, Bruguière, Montfort, Lamarck, and, indeed, of all the invertebrate zoologists of the eighteenth and early nineteenth centuries, until the real position of these minute organisms was established by the researches of Hahn, d'Orbigny, and Dujardin.

<sup>4</sup> Kennard and Woodward (1926, p. 79) place *crista* in the genus *Planorbis* Geoffroy, 1767, and in the subgenus *Gyraulus* Charpentier, 1837. Many conchologists raise *Armiger* to generic status, disregarding *Planorbis* and *Anisus* for this species.

*Turbo nautilus*, most of them referring it to *T. nautilus* of the twelfth edition of the "Systema."

The earliest post-Linnaean figure of the species is found in Chemnitz (1780–1795, vol. 9, pt. 2, p. 63, pl. 123, fig. 1077), who called it "*Turbo nautilus* Linnaei," the Müller name *P. imbricatus* appearing only in his synonymy. The figure is much enlarged and is characteristic. A companion figure, 1077a, shows the natural size of the shell. Schröter (1783–1786, vol. 2, pp. 60–61) also listed the species correctly and did not cite either of the Müller names, but called the species "Die Nautilusschnecke Müll." It is questionable whether Schröter had seen a specimen. His comments on its localities and habitat should be read, as he gives several European records.

Both Lamarck (1822, vol. 6, pt. 2, p. 155) and Deshayes (*in* Deshayes and Milne-Edwards, 1838, p. 389) listed the species as *P. imbricatus* Müller, but the latter, in a footnote, recognized its real identity, saying: "There is no doubt of the common identity of the *Turbo nautilus* of Linné and the *Planorbis imbricatus* of Müller; as the Müller name appeared after that of Linnaeus, it is proper to return the Linnaean name to the species and to enter it in conchological works under the name *Planorbis nautilus*." There is no indication in Deshayes' treatment of the species that he was aware of the earlier name *crista* from the tenth edition. Indeed I find no mention of *crista* until Reeve used it in 1863 (p. 141), in *Planorbis*.

Hanley did not mention *Nautilus crista* in his comments on the *Nautilus* species (1855, pp. 154–161) but deferred discussion of the species to his section on *Turbo* Linné (*op. cit.*, p. 354). He found a specimen of *Turbo nautilus* in the Linnaean collection in London, "enclosed in a small paper envelope, on which the name is written at full length." He referred to it as the *P. imbricatus* of Müller and cited for it figure 94 in Gray (1840). The figure is characteristic. Hanley did not say whether or not the legend on the envelope was in Linnaeus' handwriting, but, as we know that Linnaeus did not own a specimen of the shell in either 1758 or 1767, we must conclude that the specimen was documented and added to the collection by someone else, or, if the inscription is in Linnaeus' hand, that it was added to the collection by Lin-

naeus later. In any case it is not available as his type, as it cannot have been the specimen on which his description was based. Hanley referred to Deshayes' statement as to the restitution of the Linnaean name, but without comment and without mentioning the earlier name *crista*.

The species was first described from Europe and early records are available: from the River Bièvre in Paris by Geoffroy (1767), from Denmark by Müller (1773–1774), from Mühlhausen in Alsace in the "Acta Helvetica," and from Britain by Boys and Walker (1784).

There are no very early American records for this species, the first occurrence having been noted in 1878, and since then the shell has been only sparingly collected on this continent. The 1878 report was by De Tarr and Beechey from the Huron River, Ann Arbor, Michigan, in a privately printed, one-page leaflet, under the name "*Planorbis costatus* De Tarr and Beecher. Subgenus *Menetus*."<sup>1</sup> From this first discovery until 1900 several American records have been published in volumes 10–14 of the *Nautilus*.<sup>2</sup> Since the latter date I

<sup>1</sup> Dr. Henry van der Schalie (personal communication, 1958) advises the writer that the copy of this leaflet consulted by him was printed in "Albany, Oct. 25th, 1878." The habitat is there given as "Found in rather deep water on weeds and fragments of wood. Date 1874." The leaflet contains about 10 lines of description and concludes: "The species is readily distinguished from any allied form, by the possession of very marked transverse costae or ribs."

<sup>2</sup> From Eaton, New York (purported locality), reported by Bryant Walker in 1897, as having been found by an unknown collector "several years ago" and called *Planorbis nautilus*.

From Barren Brook, Aroostook County, Maine, by O. A. Nylander reported by Bryant Walker (1897).

From Hamilton, Ontario, as reported by George W. Taylor (1897) on two specimens received from A. W. Hanham "about eight years ago."

From southern Alberta, Canada, by Whealan in 1894, as also reported by Taylor (1897).

From Barren Brook, Maine, by Nylander (1899) in 1897, as *Planorbis crista* var. *cristata* Draparnaud, and in 1899 as a fossil in the marl deposit of Lovely Brook, Fort Fairfield, Maine (*loc. cit.*).

In 1901 (p. 102) Nylander reported the find of a shell in the marl of Barren Brook bog, which he listed as "*Planorbis* (?)," adding that it was "related to *P. crista* L., probably a new species." This was probably not Draparnaud's *cristata*, as Nylander had already listed and accepted that "variety," nor can it have been a young *exacutus* Say, with which he was undoubtedly familiar

can find no further American records until 1917, when Dall (p. 12) found a specimen among a lot of fresh-water shells from Fort Yukon, Alaska, submitted by a collector. This, incidentally, was the first report from the American continent in which the Linnaean name *crista* had been used without designating it as "var. *cristata* Draparnaud."

Bryant Walker (1897, p. 117), in commenting on the present species, suggested a plausible reason for its late discovery and the paucity of records: "It is possible that the small size of the shell and its superficial resemblance to a very young *Planorbis exacutus* Say, has caused it to be overlooked by collectors, and that it will be found to have substantially the same range over the northern part of this continent as other circumpolar species."

Two recent American records are those of Mozley (1926, p. 55), reported from Jasper

Park, Alberta, Canada, and of Nylander (1928, p. 85), who reported another Maine occurrence (Nadeau Lake, Aroostook County). Apparently the minute size of the species is still responsible for the paucity of records. It has been, however, the subject of considerable study in recent years, a study largely based on the habits and habitat of the European form.

Synonyms are *Nautilus crista* Linné, 1758, *Planorbis imbricatus* Müller, 1774, *Helix carinata* and *spinosa* Jacob, 1798, *Helix nautilus* Montagu, 1803, *Planorbis cristatus* Draparnaud, 1805, and *Planorbis costatus* De Tarr and Beecher, 1878.

In addition to the Chemnitz and Draparnaud figures cited above, the species is figured by Reeve (1863, fig. on p. 141) and by Gray (1840, fig. 94). Figures of this species, sufficiently enlarged to be identifiable, are scarce.

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- The plates in brackets are based on external evidence. Plates 1-95 were published before Bruguière's departure from France in late 1782 and were probably supervised by him. He may have been responsible for plates 96-189 [1792]. The remaining plates were to have been approved by Lamarck, and the majority probably were, although Bory de Saint-Vincent, who succeeded to Lamarck's task, and possibly others, were responsible for many of them. The name of Bruguière appears alone on the title page of the livraison containing the 1791-[1792] plates; the 1797 plates were anonymous so far as the title page is concerned; Lamarck's name appears alone of the title pages of the livraisons containing the remaining plates.
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## CORRECTIONS FOR PART 6 (DODGE, 1958)

Page 158, column 1, line 25: For "copysit" read  
"copyist."

Page 180, column 1, line 9 from bottom: For "or"  
read "of."

Page 181, column 2, line 18 from bottom: For  
"cinera" read "cinerea."

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