

A HISTORICAL REVIEW OF THE  
MOLLUSKS OF LINNAEUS

PART 2. THE CLASS CEPHALOPODA AND  
THE GENERA *CONUS* AND *CYPRAEA*  
OF THE CLASS GASTROPODA

HENRY DODGE

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## CONTENTS

FOREWORD . . . . .	7
CLASS CEPHALOPODA . . . . .	9
<i>Argonauta</i> Linné . . . . .	9
<i>Nautilus</i> Linné . . . . .	12
CLASS GASTROPODA . . . . .	16
<i>Conus</i> Linné . . . . .	16
<i>Cypraea</i> Linné . . . . .	59
BIBLIOGRAPHY . . . . .	125
CORRECTIONS FOR PART 1 (DODGE, 1952) . . . . .	133
INDEX TO SPECIES . . . . .	134

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## FOREWORD

1. THE WRITER has for some time been endeavoring to procure photographs of the specimens of mollusks collected by Linnaeus which are now in the custody of the Linnean Society of London, the majority of which were the holotypes of the species described in the "Systema naturae." The removal of the collection from London for safekeeping during the war and for some time afterward has delayed the acquisition of these photographs. Therefore, in the preparation of Part 1 of this series of papers, the writer was forced to rely on the comments and descriptions of others as to details of the types and other specimens in the collection to supplement the information given in Linnaeus' own diagnoses. Reliance has been placed principally on the comments of Sylvanus Hanley who critically examined the whole collection in the middle of the last century (1855), supplemented by Hanley's colored plates of certain of the specimens and a few other photographs of individual shells which have appeared from time to time in conchological journals. No comprehensive examination of this collection has been made since Hanley's day (Dodge, 1952, pp. 10-11).

A complete microfilm reproduction of the Linnaean collection is now available to the writer, and comments on the species represented in Part 2 and future parts of this series of papers will be based on these photographs as well as on all other external evidence.

It must be borne in mind, however, that, as mentioned in the Foreword to Part 1 (Dodge, 1952), a specimen in the London collection cannot be accepted *unequivocally* as the holotype on which the description was based unless the shell itself bears the "Systema" name or number in the handwriting of Linnaeus, although there may be other weighty internal or external evidence which seems convincing. Many of the Linnaean shells not meeting this strict test are accepted today as holotypes, and this is, in most cases, probably justified on all the evidence. Knowing, however, the history of Linnaeus' collection we must always take into account the possibility of a specimen's having been misplaced.

The obtaining of a microfilm of the collec-

tion of Queen Louisa Ulrica of Sweden, described in the "Museum Ulricae" and now housed in the University of Uppsala, has been delayed owing to difficulties of reproduction. The present Part 2 of this series of papers was completed before assurance was given that the film would be forthcoming. It will be used in the preparation of Part 3.

2. The question has been, and will frequently be, raised as to the propriety of retaining or resurrecting a Linnaean specific name which has to a greater or less degree been dropped in favor of a later name. The test commonly employed at present seems to be whether or not the later name has become so firmly fixed in the literature that its suppression would cause unwarrantable confusion in the nomenclature. Theoretically, at least, this may be a sound "rule-of-thumb," as stability in nomenclature is obviously to be desired. It is nevertheless a very vague guide. At what point may a name be said to have become fixed? And what degree of possible confusion may be said to be "unwarrantable?" Indeed the decision in a given case seems to depend on whether the individual making it takes the extreme legalistic view and deplors any modification of the Rule of Priority or is one whose conception of the proper use of the Code is based to a certain degree on reasons of convenience. I confess that my sympathies lie with the former view, but I have deferred in many doubtful cases to what seems to be the attitude of the majority of workers and what is certainly the attitude of the Commission on Zoological Nomenclature—that the convenience of zoologists, which is referred to euphemistically as "insuring stability in nomenclature," should govern.

The Commission now has under consideration a proposal that a later specific name shall be retained when it has been accepted in the literature for at least the last 50 years. It is suggested that this would not be a solution of the problem. The definition of the words "fixed" or "accepted" is still open even though the critical period is defined, and the suggested rule does not protect an earlier name which is familiarly known to all students but which is out of use merely because writers have been content to follow slavishly

those who have accepted the later name. In the last analysis, and in our eagerness to avoid the reeducation of zoological writers and museum men, we are tempted to overestimate the "confusion" which would follow the resuscitation of the earlier and validly proposed name, or to exaggerate the permanence of such confusion.

The writer's views, as said above, are not held by many taxonomists today. In recent

years there has been a decided, and to me an unfortunate, change of attitude as to the emphasis that should be given to the Rule of Priority as against the rule of convenience. It is possible that the new Rules, or the amendments to the existing Rules, which probably will be adopted at the 1953 meeting of the Congress in Copenhagen, will reflect this change of emphasis.

## CLASS CEPHALOPODA

### ARGONAUTA LINNÉ

LINNAEUS DID NOT RECOGNIZE the Cephalopoda as a separate class of mollusks and listed the few members of the group that were known to him either in the genus *Sepia* in his Vermes Mollusca (1758, pp. 658–659) for those species having no external shell, or in *Argonauta* or *Nautilus* in his Vermes Testacea for those species provided with an external shell. The two latter genera are grouped, with the majority of the gastropod genera, under the subheading “Univalvia spiralis Cochleae” in his index of the Vermes (1758, p. 645). They were therefore considered by him to belong to what we know as gastropods today. Indeed the terms by which we indicate the classes of Mollusca (Loricata, or Amphineura, Pelecypoda, Cephalopoda, Gastropoda, and Scaphopoda) were not used until many years after the publication of the “Systema naturae,” as Linnaeus and his immediate followers had but a vague and often incorrect conception of molluscan anatomy. The terms Cephalopoda and Gastropoda were coined by Cuvier (1798, pp. 377–378), who described the first group in the words (*loc. cit.*); “[The first group] has a mantle in the form of a sac, from which protrudes a head, crowned with long tentacles on which [the animal] crawls. We denominate them cephalopods.”

Linnaeus' confusion is apparent when it is seen that of the 17 species of his genus *Nautilus* only two are cephalopods, one is a gastropod, and the remaining 14 are Foraminifera, a phylum erected and described many years later, the known members of which Linnaeus placed among the univalve mollusks because of the gross or apparent shell characters alone.

The difficulties that so long delayed a proper understanding of the habits of the species of *Argonauta* and their proper classification have been due to several causes. First, a great number of specific names have been suggested based on minor differences in the sculpture of the shell or on the geographical remoteness of one form from another, most of which names can be referred to a very limited number of good species. Tryon (1879–1888, vol. 1, p. 133) divided the genus into three groups, each headed by its type species: *A. argo* Linné,

1758; *A. hians* “Solander” Humphrey, 1786, and *A. nodosa* “Solander” Humphrey, 1786 (*A. tuberculosa* Schumacher, 1817).<sup>1</sup> He lists several species in each group, but says (*loc. cit.*): “The shells of *Argonauta*, although numerous species have been described, are all separable into three groups, and may not exceed that number of species” (italics mine). Within each group the named forms have been based on the absence or presence and degree of development of the so-called “ears” or lateral extensions of the posterior edges of the lip; on small variations in the number and spacing of the ribs and their degree of undulation; on the presence or absence of bifurcate ribs; on the width and sculpture of the intercarinal space; on the proportion of the shell which is respectively tuberculate or striate; and on the degree of the compression of the shell, a character that varies the shape of the aperture. However, these characters are not all constant and often grade into one another with no demonstrable line of demarcation. There has been little discussion of *Argonauta* in the literature since Tryon's monograph, and from an examination of the shell alone I am inclined to agree that the named forms, except for the three “type species” mentioned by Tryon, have little specific or even subspecific value and that their differences are merely indicative of geographic races.

The second cause of the early confusion in classifying the argonauts is the fact that the animal lives at considerable depths, and the shell comes to the surface and is thrown on the beach only when the animal dies or is injured and is therefore deprived of its shell. Consequently Linnaeus' ignorance of the anatomy of the animal was shared by his followers up to the second quarter of the nineteenth century, when Owen, as I point out below, was supplied with adequate specimens for dissection.

A third reason for the errors that have clouded the knowledge of naturalists was the strange persistence of the legendary stories of the argonaut—that it sailed the surface of the ocean using its pair of veliform arms as sails,

<sup>1</sup> Schumacher's name has priority of five years over the *tuberculosa* of Lamarck which is sometimes cited as the earliest use of the name.

and that the animal was parasitic in the shell of some other unidentified mollusk.<sup>1</sup>

Linnaeus himself not only believed in the "sailing" theory but mentioned it in the following footnote to *Argonauta* in the "Systema": "Who would refuse to believe that the *Sepia* has entered into the little house of another organism, since it is not attached to the shell (being, as we have seen, so totally unrelated to it) in the same fashion as does the crab *Diogenes* s. *Bernhardus* [*Pagurus bernardus*], were it not for the incontrovertible testimony of so many witnesses who have seen the argonaut sailing."

It is now proved that the shell is produced by the female argonaut and is designed primarily as a receptacle for the deposition and incubation of the eggs. However, a part of the body of the mollusk also rests normally within the shell and thus protects the egg mass, although the bulk of the body, including the head and tentacles, protrudes. Inasmuch as the mollusk is not physically connected with the shell by a muscle, as are the gastropods, its hold on the shell is solely effected by the first (posterior) pair of tentacles which are broadly expanded and clasp the shell during the period of incubation of the eggs. The veliform shape of this pair of arms undoubtedly gave rise to the ancient and long-persisting theory that they were used as sails by which the animal and its shell were propelled on the surface of the ocean. The female begins the secretion of the egg case when she is not more than an inch in length, and the secretory organs are in part the mantle and in part the veliform arms themselves. Thus, to the extent that it is manufactured by the mantle, it is a true shell both in manner of production and in structure.<sup>2</sup> Gradually the egg mass increases in size, until, as seems probable, the mollusk is crowded out of her par-

<sup>1</sup> Based on the theory that the animal was parasitic, it was given the name *Ocythoë* by Leach (1817, p. 295). This name was founded on a misinterpretation of Rafinesque's 1814 description. The latter's *Ocythoë* was not intended to apply to the animal alone and therefore the name becomes an exact synonym of *Argonauta*.

<sup>2</sup> That the egg case is at least partially secreted by glands in the expanded dorsal tentacles is suggested by the fact that in *A. nodosa* "Solander" Humphrey (*A. tuberculosa* Schumacher) these tentacles are nodulous along the portion that grasps the shell, and that the nodosity of the ribs of the shell corresponds to the nodes on the arms.

tial occupancy of the shell. Then the animal, with the egg mass still attached to it, floats free until the young are hatched. During the juvenile stage of the mollusk and during the incubation of the eggs the female remains on the sea bottom, head downward, but when crowded from the shell it is possible that she floats upward with her egg mass to the surface.

The male argonaut is much smaller than the female. Its generative organ is a hectocotylied tentacle which, after being introduced into the sac of the female, breaks off and is retained in the sac or, occasionally, in some other part of the animal.

The most interesting, persistent, and vigorously argued theory was that the egg case was not in fact produced by the argonaut but that it was the borrowed shell of some other mollusk taken possession of by the female in the same manner as the pagurid crabs occupy empty mollusk shells. Blainville was the most ardent supporter of this view (1837, pp. 1-31). Lamarck, however, had already (1822, pp. 650-651) pronounced against this parasitic theory, although he did not note and apparently was unaware that the principal function of the shell was to protect the eggs. The "hermit" theory, however, was held by many later conchologists, but the question was finally settled in an oral report which Sir Richard Owen made to the Zoological Society of London in 1839 (Owen, 1839), his findings being based on a series of alcoholic specimens which Mme. Jeannette Power had collected in Messina and on a paper by Maravigna covering Mme. Power's observations on the life history of *A. argo* of the Mediterranean Sea (Maravigna, 1836). Some of his conclusions had already been confirmed by Rang (1837, pp. 12-58), but on the parasitic theory Rang was still in doubt and was seemingly influenced by the vigor with which Blainville had supported his argument.<sup>3</sup>

<sup>3</sup> Very informative discussions of the progress made in our understanding of the source and manner of secretion of the argonaut shell are found in Deshayes and Milne-Edwards (1835-1845, vol. 11, pp. 344-355), Fischer (1887, pp. 335-338), and Willey (1902, pt. 6, pp. 736-812) in addition to the papers cited above. The reader is also urged to read Owen's summation of all the evidence on both sides of the argument in the report referred to.

*Argonauta argo*

1758, *Systema naturae*, ed. 10, p. 708, no. 231.

1767, *Systema naturae*, ed. 12, p. 1161, no. 271.

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

"A. carina subdentata . . . Majorem inter et Minorem ex multis speciminibus limites non attingo. Navigat emissa aqua exonerata sentina supinus in summa aequarum, membranam mirae tenuitatis extendit, brachia duo retorquens, caeteris subremigans, velificat; demum hausta se mergens aqua. Plin. 9: 29."

The subdescription treats mostly of the mode of locomotion of the argonaut and reveals no specific characters of *A. argo*. As to the short three-word main description, even read in connection with Linnaeus' generic diagnosis: "Testa univalvis, spiralis, involuta, membranacea, unilocularis," it gives little help in identifying the species. All species of *Argonauta* are covered by Linnaeus' language, and in the author's voluminous synonymy in the "*Systema naturae*" and the shorter one in the "*Museum Ulricae*" both *A. nodosa* "Solander" Humphrey and *A. nitida* Lamarck are represented by recognizable figures, in addition to *A. argo* of authors. Based on the description and the synonymy, therefore, it is a composite species. A specimen of the Mediterranean form of the *A. argo* of authors is in the Linnaean collection and is the sole representative of the genus. It is unmarked. The presence of this specimen undoubtedly led conchologists to apply the name *argo* to that form. The accuracy of the choice is somewhat strengthened by the addition to the description in the "*Museum Ulricae*" which read: "Testa maxima, fragilissima, pellucida: anfractus compressi, transversim undulato-plicati, carinati serie duplici aculeorum brevissimorum. Apertura cordato oblonga, basi circulari excisa, variat basi obtusa et acuta." However, so far as the "*Systema naturae*" is concerned the species is composite. I cannot find that any subsequent reviser has restricted the name *argo* by sufficiently apt and categorical language, and therefore I here restrict it to the species now universally known by that name, found in the Mediterranean, the Atlantic, and eastern tropical seas, leaving for future investigation to determine whether or not certain forms close to *A. argo*,

which have been given specific names, are in fact specifically separable.<sup>1</sup>

*Argonauta argo* is a compressed shell with closely spaced, prominent, and undulating striations, some of which are bifurcate near the lip. It has a narrow intercarinal space and a moderately narrow aperture. The shell is pure white, except for the carinae, which are stained with brown. Both carinae are dentate, the teeth not being opposite. Both eared and earless forms exist.

Many figures of this beautiful and widely distributed shell exist. The earliest figure of the shell is that of Martini (1769-1777, vol. 1, pl. 17, fig. 157). This is a somewhat questionable drawing, as the striations are too regular. It apparently represents Gmelin's *argo*, variety "γ." Figure 156 (*tom. cit.*) should be examined as it illustrates the obvious sculptural differences between *argo* and *nodosa* "Solander" Humphrey. The figure was used by Gmelin for his *argo*, variety "β," and by Lamarck for *tuberculosa* Schumacher, which I believe to be a synonym of *nodosa*. The Reeve figure (1843-1878, vol. 12, *Argonauta*, pl. 2) is reasonably characteristic and represents the eared form, which was called *A. maxima* by Blainville. The most recent photographic figure of *argo* is found in Thiele (1931, 1935, vol. 2, p. 994, fig. 893). It is the earless form of the species and shows clearly the undulations of the ribs and the occasionally bifurcate ribs.

A western Atlantic form to which Dall (1889, p. 174, pl. 43, fig. 1a, b; pl. 64, fig. 142b; pl. 67, figs. 1-3) gave the name *A. argo americana* (*A. punctata* Say, 1819?) is found occasionally from New England to the West Indies and has been reported from the Florida east coast. The shell, however, has fewer and more widely spaced ribs than any of the forms of *argo* which I have seen and appears to be closer to Tryon's *A. hians* group. Its long and prominently sharp ears, however, would not necessarily take it out of the *argo* group which has eared and earless members, as said above.

*Argonauta argo* is the type of the genus, by subsequent designation, Montfort, 1810.

<sup>1</sup> *Argonauta compressa* and *maxima* Blainville, *fragilis* Parkinson, *papyria* Conrad, *gruneri* Dunbar, *nouryi* Lorois, and *expansa* and *pacifica* Dall are among the names given to forms which may be, and I think are, conspecific with *argo*.

**Argonauta cymbium**

1758, *Systema naturae*, ed. 10, p. 709, no. 232.

1767, *Systema naturae*, ed. 12, p. 1161, no. 272.

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

"A. carina rugosa mutica . . . Magnitudo vix minimae arenulae oculo armato lustranda."

This species has not been identified. The description might be said to refer to a *Carinaria*, and the figure cited from Gualtieri (pl. 12, fig. D) has the general shape of that genus. The fact, however, that the species is said by Linnaeus to be no larger than a grain of sand points away from this identification, as no *Carinaria* of that minute size is known. *A. cymbium* may belong to the Foraminifera.

The first author to mention the species after Linnaeus was Martini (1769–1777, vol. 1, pp. 238–239, pl. 18, figs. 161–162). He did not use the name *cymbium*, although he referred to Linnaeus' use of it and called it *Nautilus papyraceus minimus*. He referred also to the Gualtieri figure cited in the "Systema." His figure 161 (enlarged) is a mere copy of the Gualtieri drawing, and figure 162 purports to show the actual size of the shell, although it is pictured as considerably larger than a grain of sand.

Gmelin (1791, p. 3368) cites *A. cymbium*, copying the Linnaean main description and citing the Gualtieri figure. He adds a reference to the Martini figure 161, the enlarged drawing, and a somewhat expanded subdescription which, however, gives us no further assistance.

In 1801 Lamarck erected the genus *Carinaria* (1801, p. 98), giving as his "example" *Argonauta vitreus* Gmelin. Later he described three species of *Carinaria* (1822, pp. 673–674), one of which was *Carinaria cymbium*. For the latter species he referred to Gmelin's *cymbium*, the Gualtieri and Martini figures mentioned above, and supplied a subdescription which is to some extent a paraphrase of that of Gmelin and emphasized that "this shell, the size of a grain of sand, can only be seen in detail with the aid of a magnifying glass." His diagnosis gives us no further assistance in identifying the species.

From Lamarck onward the name *Argonauta cymbium* or *Carinaria cymbium* drops out of the literature, and I am not aware of any author who has attempted to suggest

what Linnaeus, Martini, Gmelin, and Lamarck were describing under that name. Hanley (1855, p. 154) merely says that Linnaeus did possess the species, that it may be regarded as being pictorially defined by Gualtieri, and that Lamarck referred it to *Carinaria*. Linnaeus, in his proposed "revised twelfth edition," added only a reference to the Martini figures.

**NAUTILUS LINNÉ**

In the tenth edition of the "*Systema naturae*" the genus *Nautilus* contained 17 species. In the twelfth one species was added, *N. rugosus*, but the total number remained the same, as *N. crista*, a gastropod, was moved to its proper place in *Turbo* as *T. nautilus*.

*Nautilus* is the most heterogeneous of the Linnaean genera, as it contained not only representatives of two classes of Mollusca (Cephalopoda and Gastropoda) but 14 species of Foraminifera, an order of another phylum, the Protozoa. From the external appearance of the shell and his ignorance of the nature of the animal which inhabited it, Linnaeus supposed these Foraminifera to be cephalopod mollusks, although it was probably known to him, as it was surely known to many of his immediate followers, that the chambers were connected by foramina rather than by a siphonal tube as in the multicameral cephalopods. Before the publication of the twelfth edition Linnaeus had recognized his error in the case of *N. crista*, but he still retained the Foraminifera in *Nautilus*. This misconception persisted in the works of Gmelin, Bruguière, Montfort, and Lamarck, and indeed of all the invertebrate zoologists of the eighteenth and early nineteenth centuries. In 1825 de Haan (1825, pp. 18–20) divided the shelled cephalopods into two groups: first, those that are adherent to their shell and in which the chambers are connected by a siphonal tube, which he called Siphonoïdes or true cephalopods, and, second, the microscopic shells lacking siphonal tubes which he called Asiphonoïdes. Thus de Haan had advanced a step in the understanding of the Foraminifera but still knew nothing of the nature of the animal. In the following year d'Orbigny (1826, pp. 130–131) published a new arrangement of the cephalopods consisting of three groups—the first being the naked species and the other



two being distinguished also by the presence or absence of the siphon. These latter two he called Siphonophères and Foraminifères, respectively. This was the first use of the latter word, so far as I can find, although d'Orbigny still had not perceived that the animal was not a mollusk.

It was not until nine years later that Dujardin (1835a, pp. 108-109; 1835b, pp. 312-314; 1835c, pp. 343-377) arrived at the correct conclusion that the minute multicameral tests, which his predecessors had described as the shells of cephalopods, were in fact made and inhabited by unicellular organisms. For these organisms Dujardin established a new class, Rhizopoda, in the phylum then called Zoophytes. Under modern nomenclature they are placed in Phylum Protozoa, Class Sarcodina, Subclass Rhizopoda, and Order Foraminifera.<sup>1</sup>

The generic name *Nautilus* is preserved for the true nautilids as we know them today, but was confused with *Argonauta* by the ancient writers and indeed by all naturalists up to Linnaeus. The Nautilus of Pliny was apparently *Argonauta argo* Linné. Aristotle, in the "Historia animalium," distinguished the nautilids and the argonauts, at least in his description of their respective shells, but called them both Nautilus. Impossible though it seems, he must have seen a specimen of one of the Pacific nautilids, and he, as well as Pliny, must have been familiar with the Mediterranean *Argonauta argo*. Rumphius, although he used the same name for both groups of species, described and very clearly figured "Nautilus major sive crassus" (pl. 17, figs. A,B,C),<sup>2</sup> which was an undoubted nau-

tilid although specifically undeterminable as the figures do not show the convolutions of the early whorls nor any umbilical or umbilical callus, and "Nautilus tenuis et legitimus" (*op. cit.*, pl. 18, figs. A-B and nos. 1-5), which was clearly an argonaut.<sup>3</sup>

It is strange that in the nineteenth century the first report of the finding of a living nautilus did not come until 1829. In that year a specimen was collected in the New Hebrides. It was presented to the Royal College of Surgeons and was dissected by Sir Richard Owen who wrote a full report on both the shell and the animal (Owen, 1832). This was followed by an excellent discussion by Valenciennes (1841). Since that time the anatomy of the animal has been well understood, and the species, which was once a rarity, is now found in all collections.

The few living species of *Nautilus* are the sole survivors of the great Subclass Tetrabranchiata which numbered several thousand species in the days of their predominance, which lasted from the Cambrian through the Carboniferous. The ammonites alone numbered over 2000 species. The recent species of *Nautilus* occur only in the Pacific and Indian oceans, although *N. pompilius* is found fossil in many European localities.

#### *Nautilus pompilius*

1758, *Systema naturae*, ed. 10, p. 709, no. 233.

1767, *Systema naturae*, ed. 12, p. 1161, no. 273.

LOCALITY: "In India" (1758); "in India, Africa" (1767).

"N. testae apertura cordata, anfractibus contiguis obtusis laevibus . . . Testa pulchre pictura decorticata elaborata, praeparata ad pocula aquae potatorum orientalium."

<sup>1</sup> Dujardin's discovery came at a time when the cell theory had been only partially developed. It was the discovery of sarcodes by Dujardin (1835c, p. 367) and the proof that it was living animal matter and the discovery of plant protoplasm by von Mohl in 1846 that provided the basis for the eventual rounding out of the cell theory by Cohn in 1850 and Schultze in 1861.

<sup>2</sup> Two works of Rumphius may be involved here, as in all other cases where Linnaeus cited this author—the "Amboinische Rareitetskamer" and the "Thesaurus imaginum piscium testaceorum." The first appeared in editions dated 1705, 1739, 1741, 1754 (edited by Valentyn), and 1766 (edited by Müller and Chemnitz). The second was published in 1711. It is not certain which edition or even which work Linnaeus owned, as he referred to the book in his possession merely as "Rumph. Mus." whenever he mentioned it, and the

word "Museum" does not appear on the title page of any edition of either. All plates of mollusks are identical and identically numbered and lettered in all editions of both, and thus no date can be given to any of Linnaeus' references to Rumphius except as it may be limited by the publication date of the Linnaean work involved.

<sup>3</sup> In view of this early misapprehension it is not strange that laymen have often continued to make the same error. Pope, in the "Essay on man," refers to *Argonauta argo* as follows:

"Learn of the little Nautilus to sail,

Spread the thin oar, and catch the driving gale."

And Oliver Wendell Holmes, although he wrote of "The chambered nautilus," is obviously attempting to describe an argonaut when he says:

"The venturesome bark that flings

On the sweet summer air its purpled wings."

The main description quoted above would cover every species of nautilus known today, as it does not refer to the presence or absence of the umbilicus nor to any other purely specific character. The subdescription is of no further help. There the words "pulchre pictura" refer only to the pearliness of the denticulated shell and not to the striking color pattern of the untreated *N. pompilius* of authors. The remaining language is concerned merely with one of the domestic uses to which the shell of any nautilus is put. The words in the description in the "Museum Ulricae" pertaining to an umbilicus, "latus in minoribus umbilicatum, in majoribus exoletum," indicate that Linnaeus considered that both the perforate and imperforate shells belonged to the same species. In fact the use of these words is significant in that the juvenile shell of *pompilius* shows an umbilicus which, in the adult shell, is buried under a callus. Finally the figures in the elaborate synonymy embrace both forms. In Linnaeus' manuscript notes for his proposed revision of the twelfth edition he adds a Martini figure (1769-1777, vol. 1, pl. 18, fig. 164) to the synonymy. Hanley (1855, p. 155) says that this figure represents the *N. pompilius* of authors, but the umbilical region is so crudely executed in the figure that it is not clear whether it is supposed to show an umbilicus or a callus. In any event, the proposed addition of another reference to the already equivocal synonymy does nothing to cure it.<sup>1</sup> A specimen of the *N. pompilius* of authors is found in the Linnaean collection.

In this situation conchologists were forced to make an arbitrary decision and chose the imperforate and more strikingly decorated *pompilius* of authors as the representative of the Linnaean name, basing their decision, at least in part, on the fact that the majority of references showed that shell and because it was the more common species, but principally, I feel sure, because of the existence of a speci-

<sup>1</sup> Chemnitz (1780-1795, vol. 10, p. 6, pl. 137, figs. 1274-1275) described and figured the shell later known as *N. umbilicatus* Sowerby under the name *Nautilus crassus umbilicatus*, but this volume 10 did not appear until 1788, after the death of Linnaeus, so that the latter was unaware that the species had been separated from his composite species *pompilius*. Of the pre-Linnaean writers, however, Klein (1753, p. 2) describes a shell which he called *Nautilus umbilicatus*.

men of it in the collection. As the specimen, however, was undocumented by either name or number it can carry no authority, if the criteria I have suggested in the Foreword to Part 1 of this series of papers (Dodge, 1952) for the identification of the Linnaean species are used. *N. pompilius* Linné is therefore, so far as the writings and collection of Linnaeus are concerned, a composite species. Because, as in the case of *Argonauta argo*, I find that no subsequent reviser has adequately restricted the name, I here restrict it to the *N. pompilius* of authors, the imperforate pearly nautilus of the Indo-Pacific.

It is the type of *Nautilus* Linné by subsequent designation, Montfort, 1810.

The earliest post-Linnaean figure is the Martini drawing referred to above. Martini shows also a sectioned drawing revealing the internal arrangement of the chambers and siphon (*tom. cit.*, pl. 9, fig. 165). The species is well figured by Reeve (1843-1878, vol. 12, *Nautilus*, pl. 1, figs. 1a-b), and an excellent drawing is provided by Thiele (1931, 1935, vol. 2, p. 950, fig. 869) showing not only a part of the shell dissected away to reveal the interior but the animal in the last chamber. The figure is copied from Woodward (1851-1856, frontispiece). The best and most recent color photographs of both the outer aspect of the shell and the interior are those in Platt (1949, color pl. 65).

#### *Nautilus crista*

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

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

Since this species, a gastropod, was moved by Linnaeus to *Turbo* in the twelfth edition, it will be discussed under that genus in a later part of this series of papers.

#### *Nautilus spirula*

1758, *Systema naturae*, ed. 10, p. 710, no. 239.

1767, *Systema naturae*, ed. 12, p. 1163, no. 279.

LOCALITY: "In America" (1758); "in America, Amboina, Moluccis" (1767).

"N. testa spirali, apertura orbiculari, anfractibus disjunctis cylindricis."

The word "spirali" was added to the description in the twelfth edition. There is no hint in this description that the shell is almost

entirely internal, as Linnaeus had probably never seen the animal, but the description of the shell is so clear and so characteristic that no doubt has ever arisen as to its identity. There is no planorbid gastropod or Recent planorbid cephalopod that has non-contiguous whorls and that fits the other characters mentioned. All the figures in the synonymy show, with considerable accuracy, the shell of *Spirula spirula* of authors, which was a species well known to Linnaeus' predecessors. A specimen is present in the Linnaean collection, which, although unmarked, is the only shell in the collection that conforms both to the description and to the cited figures.

The name, however, has undergone a number of changes, mostly at the hands of Lamarck. The latter created for the species a new genus, *Spirula* (1799, p. 80), apparently basing its separability from *Nautilus* on the non-contiguity of the whorls. He gave *S. spirula* (as *Nautilus spirula* Linné) as the "example" of his new genus. In 1801 (p. 102) he changed the name to *S. fragilis*, undoubtedly because of his evident dislike of tautonymic specific names. In his last work (1822, p. 601) he again changed the name, this time to *S. peronii*, because Péron, on his return from his voyage to the South Seas, had brought him a preserved specimen of the animal with its shell. Up to that time the animal had been unknown except for fragments in beach shells. Although Péron's specimen was doubtless found on the beach or in shallow water, the species is a deep-water form. Its habitat, usually below the 1000-foot level, was discovered by the Danish "Dana" expedition only in 1920-1922 (Kerr, 1929-1931, p. 6). Lamarck's change of name to *peronii* as a compliment to his colleague was, under present rules of nomenclature, just as indefensible as the earlier change to *fragilis*. Tryon (1879-1888, vol. 1, p. 206) allowed the name *peronii* to stand in spite of the priority of *spirula* Linné, as he said that otherwise confusion and uncertainty would be caused. This is good reasoning in theory, but the Linnaean name is used by the majority of

conchologists today and Tryon's fears have not been realized. The use of *spirula* is, however, not universal. Dall used *peronii* in 1889 (p. 124) and as late as 1938 Nobre used it (1938-1940, p. 25).

The shell itself, upon the death and decomposition of the animal, frequently rises to the surface and is often found on beaches in considerable numbers. Its range is almost world-wide, being found in the western Atlantic, in British waters, in the seas around Australia and New Zealand, and at the Cape of Good Hope. In the western Atlantic it is found from New England (infrequent) to Florida and the West Indies, where it is a common beach shell.

Two other names have been published for what were considered to be good species, *S. laevis* Gray and *S. vulgaris* Leach. Owen (1848, pp. 6-16) suggested that the difference between *spirula* and the other forms might be merely sexual dimorphism, but (*vide* Tryon, *loc. cit.*) it appeared that in the animal examined by Owen the terminal disk had been torn off, which vitiated Owen's reasoning. In the case of *vulgaris* Leach, the author described the animal as being "reticulated." Tryon believed this to be merely the result of mechanical irritation. In any case the shells, by whatever name the animal is called, are indistinguishable, and the consensus today is that all the forms named are conspecific with *spirula* which thus not only becomes the type of the genus, by monotypy, but is still the only species in the genus.

The first post-Linnaean figures of the shell of *spirula* were those of Martini (1769-1777, vol. 1, p. 254, vignette 11, figs. 1-3; and pl. 20, figs. 184-185), and the shell was there described (pp. 262-264) as "*Cornu Hammonis legitimum majusculum*," a name used by several of the pre-Linnaean writers. Linnaeus added a reference to Martini's figures 184 and 185 by a manuscript note in his own copy of the twelfth edition of the "Systema." The best modern figures are those of Thiele (1931, 1935, vol. 2, p. 953, fig. 870, the shell, and fig. 871, showing the animal and the position of the shell).

## CLASS GASTROPODA

### CONUS LINNÉ

THE LINNAEAN SPECIES OF *Conus* have been subjected to less change in respect to their generic position than those of any of the larger genera in the "Systema naturae." Of the 35 species described in the twelfth edition, 32 are still retained in *Conus*, *sensu lato*; the other three, *vicarius*, *minimus*, and *rusticus*, cannot be unequivocally identified. It must be emphasized, however, that the brevity and vagueness of many of the descriptions, the frequent omission of locality (in 18 of the 35 species no locality is stated), and the inaccuracy of many of the synonymies produce a situation in which it is impossible to say in many cases that a species has been adequately defined. By a strict adherence to the rules of identification suggested in the Foreword to Part 1 of this series of papers (Dodge, 1952) these species are technically *species dubiae*, and the accepted identifications that have become more or less firmly fixed in the literature are therefore "probable" only. In the great majority of such cases we may be convinced by extrinsic evidence, or by the preponderance of evidence, that the identification is correct, and in any case a denial of the Linnaean authorship would usually be as unwise as it is unnecessary.

The only names added in the twelfth edition were *vicarius*, *cedo-nulli* (as a "variety" of *ammiralis*), and *generalis*.

In spite of the extremely homogeneous character of this very compact group, it has always been so popular, sharing the popularity of *Cypraea* and *Voluta*, has been so elaborately discussed by conchologists, and presents such a wide range of color pattern within a single species that a host of specific names has been proposed, most of which prove to be synonyms. These names have been exhaustively studied and listed by Tomlin in his "Catalogue of Recent and fossil Cones" (1937). In that work the compiler lists more than 2700 good names, synonyms, and *nomina nuda*. Inasmuch as Tomlin's list is frequently referred to in the following pages, and since the names are there arranged in alphabetical order, I dispense with a page citation for each reference and refer to it merely as "Tomlin."

So far as supraspecific names are concerned, Montfort, 1810, Swainson, 1840, and Mörch, 1852, proposed several new genera, and, more recently, Iredale, 1917, 1930, and 1931, Thiele, 1929, and Cotton, 1935, have carved other generic groups out of *Conus* Linné. The great majority of conchologists have not accepted any of these names as having any systematic value. Grant and Gale (1931, p. 471) limit this to some extent by saying that *Rollus*, *Rhombus*, and *Hermes* Montfort, 1810, "are certainly distinctive and entitled to sectional or subgeneric rank." These authors do not, however, employ even these three names, although *Rhombus*, at least, was represented in the fauna covered by their paper. More recently J. P. E. Morrison of the United States National Museum has made an exhaustive systematic study of the Pacific *Cones*, based on a large amount of material from Bikini, and has rearranged the Museum's entire collection of Indo-Pacific species. He has very drastically split *Conus*, *sensu lato*, by adopting most of the earlier proposed names and giving them subgeneric or sectional value. In discussing the Linnaean species I indicate the systematic placement of each according to the Morrison arrangement, a copy of which has been supplied me (personal communication). In this arrangement sculptural differences in the shell are the basis for subgeneric separation. The additional names are for the most part based on color and are ranked as sections. It is probable that confidence in the results of Morrison's critical study and the high authority of the action of the United States National Museum will insure the increasing adoption of this latest complete arrangement, at least as to the subgeneric units.

Color differences in the *Cones*, as a guide to any systematic placement, is a criterion the value of which it is often difficult to assess. It is the most fugitive of traits, and in the case of fossils it is almost useless. The paleontologist, therefore, must identify a specimen with the earliest named species of *Conus* from the horizon involved which displays the same morphological features. To this extent, identification of fossil *Cones* is conjectural, although differences in sculpture, being

more fundamental, are a more reliable guide. The range of variations in color and color pattern in a given species of *Conus* is extremely wide, whereas sculptural differences are much less frequent and less obvious.

The type of *Conus* Linné is *C. marmoreus* Linné, by subsequent designation, Children, 1823. Swainson in 1840 later selected *C. litteratus* Linné as type. The earliest designation was that of Montfort, 1810, who selected *C. generalis* Linné, 1767, but this choice was invalid as *generalis* was not on Linnaeus' original list under that name although it was represented in the 1758 edition by varieties "γ" and "δ" of *C. capitaneus*. *Conus imperialis* Linné was designated by Montfort, 1810, as the type of the latter's *Rhombus*. I mention this designation because Thiele (1931, 1935, vol. 2, p. 373) treats *Rhombus* as an exact synonym of *Conus* Linné. Thiele's view is not accepted by Morrison.

The color pattern in *Conus* is often extremely elaborate and distinctive, even though, as said above, it varies greatly in a single species. In the colored plates of the earlier iconographers these characteristic patterns are usually badly reproduced, being either too vivid or entirely incorrect. In particular, the color plates in the Martini-Chemnitz work cannot be relied upon in most cases, and the drawings themselves are not realistically executed. This is particularly true of the 15 plates by Martini (1769-1777, vol. 2, pls. 51-65). The later plates in the Chemnitz volumes (1780-1795, vol. 10, pls. 138-144-A, and vol. 11, pls. 181-183) are somewhat better. In volume 12, the supplemental volume by Schubert and Wagner, where two of the Linnaean species are shown (varieties of *C. ammiralis* and *C. mediterraneus* Hwass, in Bruguière, 1792, which is *C. monachus* Linné), the *Conus* plates (pls. 220-222) show a still further improvement. In general, the best figures, not only in color but in drawing, are those of Chenu, Kiener, and Delessert.

The conchological collection of Baron Delessert (which includes a part of the Lamarck collection) and that of Hwass are in the custody of the Museum d'Histoire Naturelle of Geneva. The many *Cones* in these collections represent a considerable proportion of the types of *Conus* described up to the middle of the nineteenth century. Moreover a large

number of these specimens served as the models for the illustrations in the plate volumes of the "Encyclopédie méthodique" and in the works of Kiener, Delessert, and Chenu. G. Mermod of the Geneva Museum has recently completed a catalogue of the *Cones* in these collections (1947), many of which were the describer's types. Under each species the paper states the number of specimens in each collection, the dimensions of the specimens, and gives references to the figures in later works that have been based on each. It also calls attention to many errors that have crept into the literature as to the source of certain specimens, and contains many valuable historical data. I call this paper to the attention of students of the history of the genus *Conus* Linné and its nomenclature as an indispensable handbook for the field it covers.

Prior to the publication of the Mermod paper the author advised me by letter of the details of the history, ownership, and present whereabouts of the principal collections of *Cones* and furnished a preliminary and incomplete list of the types at Geneva. This letter has been published in translation (Dodge, 1946a) and is suggested as a useful corollary to a study of Mermod's catalogue.

As Lamarck's diagnoses of the Linnaean *Cones* are frequently discussed in the following pages, a difference in his treatment of references in his two important lists should be noted. They are the 1810 catalogue and the 1822 catalogue (pp. 440-530). The 1810 catalogue, when species already named and described by an earlier author are listed, refers almost exclusively to the Bruguière listing of the names and to the figures in the "Tableau encyclopédique." In a few cases a Chemnitz figure was used and less often a figure from Martini. Gmelin is mentioned but once. The important and almost unexplainable fact is that in not a single case of a Linnaean name did Lamarck mention Linnaeus or the "Systema naturae." There is a possibility that Lamarck considered this catalogue as a new presentation of Bruguière's work and in part as a tribute to his dead colleague. His introduction to the genus *Conus* lends some slight support to this view, but in the last analysis he produced a work which is defective as a nomenclatorial guidebook because of the omission of any reference to the "Systema naturae."

The list in the 1822 catalogue is almost identical with that of 1810. A very few new species were added, most of them having been "varieties" of a Bruguière species to which he gave specific rank in 1822. In this catalogue, however, he did refer to Linnaeus, as "Lin. Gmel.," for virtually all the Linnaean names. This use of the locution "Lin. Gmel." has already been referred to as raising the suspicion that Lamarck either did not possess a copy of the tenth or twelfth edition of the "Systema," or that he accepted the so-called "thirteenth edition" as an adequate substitute. The last-named would be an unfortunate choice, as many of Gmelin's names represent species different from the same name in the "Systema." Moreover, as Lamarck himself says of Gmelin's work (1810, vol. 15, p. 22): "There is in this work so much confusion in the synonymy, so many defective or insufficient specific characters which seem to have been based on figures alone, that a new determination of species, at least among the invertebrates, is much to be desired for the advancement of zoology."

Two things should be noted in using the Lamarck material: first, that the majority of the names erected by Lamarck must be cited as of 1810; second, that as an assistance in identifying the Linnaean names the 1822 list is the more useful.

The "subgeneric" headings<sup>1</sup> under which Linnaeus listed his *Cones* are less accurately chosen than is usual in the "Systema." The first three are here translated for convenience in discussion:

\*Truncate, or spire almost truncate.

\*\*Pyriform, base rounded, subcylindrical, [body whorl] one and one-half times the length of the spire.

\*\*\*Elongate, base rounded, the body whorl (cylindro) twice as long as the spire.

Under the first group were included *generalis*, *capitaneus*, and *miles*, in which the spire is sufficiently elevated to render the phrase "almost truncate" a misnomer. In the second and third groups the ratio of length of body whorl to spire is too low to apply to any

<sup>1</sup> Linnaeus' "subgeneric" headings, although they are often of assistance in explaining his concept of the relationship of species, are not accepted as of subgeneric value under the terms of Opinion 124 of the International Commission on Zoological Nomenclature.

but a few of the species included. Moreover, even if Linnaeus' ratio is accepted, certain species are placed in the wrong group, as there are shells in group 2 (\*\*\*) in which the ratio of body whorl to spire is greater than other species in group 3 (\*\*\*). In any case, this is an unrealistic method of division, not only because it has little taxonomic or phylogenetic importance but because too often there are variations in the height of the spire within a given species and between juvenile and adult and, particularly, senile individuals.

Comments on the translation and appropriateness of the fourth heading are reserved for the discussion (below, p. 56) of the species therein contained.

#### *Conus marmoreus*

1758, *Systema naturae*, ed. 10, p. 712, no. 250.

1767, *Systema naturae*, ed. 12, p. 1165, no. 290.

LOCALITY: "In Asia" (1758, 1767).

"C. testa conica fusca, maculis ovatis albis, spirae anfractibus canaliculatis . . . Testa saepe coronata, atra maculis trigono-ovatis albis."

No doubts have ever been felt as to the identity of this species. It is the *C. marmoreus* of modern authors and the type of *Conus* Linné.

A properly authenticated specimen is present in the Linnaean collection, and the description is clear and characteristic. The words "saepe coronata" call for some comment. It is a coronate species, but the degree of coronation varies greatly, not only with the age of the shell but between individual specimens. In immature shells the coronation consists of erect, triangular, and very sharp points both on the whorls of the spire and on the shoulder of the body whorl. These processes become blunted and less pronounced with age and almost disappear in senile specimens. This comparative obsolescence is especially noticeable in the forms *nigrescens* Sowerby, 1849, *croseanus* Bernardi, 1861, and *pseudomarmoreus* Crosse, 1875. The coronation in adult specimens was well described by Lamarck (1822, p. 442) as "spira tuberculis coronata." It is possible that Linnaeus had before him specimens with obvious and with practically obsolete coronation, and the individual in the Queen of Sweden's collection was certainly an adult shell, as the description in the "Museum Ulricae" uses the word "nodosa," not "coronata."

The synonymy is accurate except for the fact that the Rumphius figures (pl. 32, figs. N, I) look more like *C. bandanus* Hwass in Bruguière, 1792, than *marmoreus*.<sup>1</sup> The figures cited from Gualtieri (pl. 22, fig. D) and from Seba (vol. 3, pl. 46, figs. 1-4, and pl. 47, figs. 1-4) picture a form of the species in which the coronation appears almost obsolete.

In Morrison's arrangement *marmoreus* is placed in *Conus* Linné, 1758, and is the type, by subsequent designation, Children, 1823. (See introduction to *Conus*, above.)

In addition to the synonyms cited above, its synonymy includes, according to Tomlin, *Cucullus equestris* Röding, 1798 (p. 38, not *equestris*, *op. cit.*, p. 46), *C. proarchithalassus* Röding, 1798, *Conus maculatus* Perry, 1811 (not *maculatus* Sowerby, 1858, which, *vide* Hedley, is *anemone* Lamarck, 1810), and *Cucullus torquatus* Röding, 1798 (p. 38, not *torquatus*, *op. cit.*, p. 45).

Reeve's figure of *marmoreus* (1843-1878, vol. 1, *Conus*, pl. 14, sp. 74) is not good and was apparently modeled upon Martini's figure (1769-1777, vol. 2, pl. 62, fig. 685). The most satisfactory modern figure is the color photograph in Platt (1949, p. 53, fig. 18), erroneously labeled *marmoratus*.

#### *Conus imperialis*

1758, *Systema naturae*, ed. 10, p. 712, no. 251.

1767, *Systema naturae*, ed. 12, p. 1165, no. 291.

LOCALITY: Not given in either edition.

"C. testa albida: fasciis longitudinalibus lividis cingulisque linearibus albo fuscoque articulatis . . . Testa saepius coronata, albida maculis confluentibus caesiis."

The word "longitudinalibus" was added in the twelfth edition.

<sup>1</sup> *Conus bandanus* is very close to *marmoreus* Linné. In Morrison's arrangement it is placed in *Coronaxis* Swainson, 1840, which Morrison uses as a section of *Conus*, as the type of the section. It is smaller than *marmoreus*, and its spots are often of a rose or blue-violet color. Bruguière, in addition to his listing of *bandanus*, cited the Rumphius figures used by Linnaeus for a variety of *marmoreus* Linné. It is also called a variety of *marmoreus* by Mermod (1947, p. 191). It is possible that Martini's *marmoreus*, variety *rufus* (1769-1777, vol. 2, p. 332, pl. 62, fig. 686) was *bandanus*, although Martini's figure shows an almost flat spire. It is to be noted that Martini cited the Rumphius figure (pl. 32, fig. N) for *marmoratus* and figure I on the same plate for his variety *rufus*. The striking differences between the two shells would seem to justify their specific separation.

A marked specimen of *imperialis* is in the Linnaean collection, and this, together with the reasonably accurate description, is sufficient to identify the name with the *imperialis* of all subsequent writers except Röding, who called the species *Cucullus corona ducalis* (1798, p. 38) and on the same page *regius*; Born, 1880, who described it as *Conus fuscatus*; and Lamarck, 1810, who called it *C. viridulus*. The descriptions of all these names and the figures cited for them seem to place them all well within the range of the known variations of *imperialis* Linné.

The synonymy is correct with one exception. The letter "I" in the Rumphius reference (pl. 34, figs. H, I) was rightly erased by a later annotator, probably Linnaeus' son, as representing another species. Hanley (1855, p. 162) notes that the Regenfuss figure (pl. 3, fig. 35) "is usually cited for *C. viridulus*," and the inference is that he considered *viridulus* to be a different species. I agree with Tomlin, however, that the latter species should be thrown into the synonymy of *imperialis* Linné. I have not seen a specimen labeled *viridulus*, but the figures cited for it by Lamarck in 1822 ("Chem. Conch., 10, t. 139, f. 1280" and "Encyclop., pl. 319, f. 3") are reasonably identifiable figures of the Linnaean species.<sup>2</sup>

Under Morrison's arrangement the species is included in the sub-genus *Rhombus* Montfort, 1810, of which it is the type, by monotypy.

It is figured by Reeve (1843-1878, vol. 1, *Conus*, pl. 12, sp. 60), an extremely accurate representation of the shell, and in Kiener (1846-1850, pl. 5, all figs.)

#### *Conus litteratus*

1758, *Systema naturae*, ed. 10, p. 712, no. 252.

1767, *Systema naturae*, ed. 12, p. 1165, no. 292.

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

"C. testa conica alba, punctis fuscis . . . Testa nivea fasciis obsolete flavis, maculisque sparsis purpurascensibus."

The synonymy of this species in the "Systema" shows three different shells. The figures from Gualtieri (pl. 21, fig. O) and Regenfuss

<sup>2</sup> Mermod (1947, p. 212) lists *C. viridulus* Lamarck, 1810, as a good species, but notes that Kiener, who figures it separately from *imperialis*, (1846-1850, pl. 7, fig. 1) considered it to be only a variety of that shell.

(pl. 4, fig. 46) both represent the true *litteratus*; Regenfuss (pl. 3, fig. 29) shows a fairly good figure of *millepunctatus* Lamarck, 1822. Another reference to Gualtieri (pl. 21, fig. G) is apparently *eburneus* Hwass in Bruguière. The three species are superficially similar in color pattern, and Linnaeus undoubtedly thought that they were identical.<sup>1</sup> In the "Museum Ulricaë" seven varieties of *litteratus* are listed, and the synonymy again reveals that Linnaeus had confused these three different species. The description in the "Systema," however, clearly points to *litteratus*, and in the "Museum Ulricaë" varieties "β," "γ," or "δ," or all of them, seem to represent that species. They respectively call for "fascia gemina flava," "fasciis tribus flavescens," and "fasciis flavescens." *C. litteratus* is the only species in the black-dotted, non-coronate group that responds to the "Systema" description or the varieties mentioned.

Martini (1769-1777, vol. 2, pp. 310-316) discusses this group and supplies four figures (pl. 60, figs. 666-669), all of which he refers generally to the *litteratus* of Linnaeus. It is difficult to differentiate between the figures owing to the exaggerated colors used, but figure 668, which he calls "*Conus litteratus, Varietas fasciata*," is unquestionably the *litteratus* of the "Systema." On the same plate he figures what he calls *C. betulinus* Linné (fig. 665), another dotted cone, which he apparently conceives to belong to the same group. The shoulder of *betulinus* is distinctly rounded, whereas the *litteratus* affinity has an angled shoulder. All the figures on the plate, however, show a rounded shoulder, which explains Martini's error in so grouping them.

Lamarck (1822, pp. 461-463) separated the species of this complex, and gave the name *millepunctatus* to the shell figured by Regenfuss (pl. 3, fig. 29) in Linnaeus' synonymy of *litteratus*. Hwass had already separated the third species and called it *eburneus* (Hwass in Bruguière, 1792).

<sup>1</sup> Linnaeus also cited "Bonan. recr. 3, t. 363" in the tenth edition. There is no figure 363 in the Buonanni work, although Hanley (1855, p. 162) cited it as representing *litteratus*. In the twelfth edition, figure 132 from Buonanni was added, an unrecognizable drawing which was probably an error of transcription for figure 131 which might be taken for any member of this affinity.

Even though the synonymy in the "Systema" involves a composite species, Linnaeus clearly indicated the particular specimen he was describing, although he was apparently unaware that it was specifically separable from the other two. Moreover, a specimen of the *litteratus* of authors is found in the collection, which was, we may assume, the type specimen, although it cannot be safely accepted as such as the name was written in pencil, a medium indicating that the inscription was made by a later hand. Although it was not necessary, therefore, for any later reviser to restrict the species, Hanley (1855, p. 162) considered that it was, saying: "Naturalists have wisely selected the first of these shells, which agrees correctly with the description, because the delineations of it are not only much more numerous, but decidedly much more accurate and decipherable." This is hardly a valid reason for restricting a composite species if that had been necessary.

In general *litteratus* can be distinguished from *millepunctatus*, the species with which it is most often confused, by its consistently smaller size, by the presence of two or sometimes three pale yellow bands, the color of which is fugitive, and by the difference in size and disposition of the black spots which cover the body whorl of each. In *millepunctatus* the spots tend to be smaller and to be more often arranged in symmetrical vertical groups.

The following are synonyms: *Cucullus pardus* and *byssinus* Röding, 1798, and *Conus brevis* J. de C. Sowerby, 1840. *Cucullus leopardus* Röding,<sup>2</sup> not *Conus leopardus* Lamarck, 1807, which was the earlier name for *millepunctatus*, is (*vide* Tomlin) a variety of *litteratus*.

In Morrison's arrangement the species is placed in subgenus *Lithoconus* Mörch, 1852, of which it is the type, by subsequent designation, Kobelt, 1878.

A satisfactory figure of *litteratus* is that of Kiener (1846-1850, pl. 19, figs. 1, 1a). His figure of *millepunctatus* is less convincing.

<sup>2</sup> There is considerable disagreement as to the position of *leopardus* Röding. Tomlin, as said above, considered it to be a variety of *litteratus* Linné. Others treat it as an earlier name for *millepunctatus* Lamarck, which many writers considered to be a subspecies of *litteratus*. Dr. H. A. Rehder of the United States National Museum advises me (personal communication) that in the Museum's collection it is called a distinct species.



Reeve (1843–1878, vol. 1, *Conus*, pl. 33, sp. 183) shows *litteratus*, and (*tom. cit.*, pl. 32, sp. 178) *millepunctatus*.

#### *Conus generalis*

1758, *Systema naturae*, ed. 10, p. 713, no. 254 (as a variety of *C. capitaneus*).

1767, *Systema naturae*, ed. 12, p. 1166, no. 293.

LOCALITY: "In India orientali" (1767).

"C. testa conica nitida, spira plana muricata: anfractibus canaliculatis . . . Testa politissima ferruginea s. lutea, fasciis 3, albis, interruptis s. undatis. Spira albida, anfractibus canaliculatis, medio acuminata."

Linnaeus considered this species to be a variety of his *capitaneus* when he published the tenth edition, as all three of the figures he cited for variety "δ" and one of the figures for variety "γ" in the synonymy of *capitaneus* represent *generalis*. These figures are: for variety "δ" Rumphius (pl. 33, fig. Y), Regenfuss (pl. 6, fig. 65), and Gualtieri (pl. 20, fig. G); for variety "γ" Petiver (pl. 27, fig. 11). All these were transferred to the synonymy of the newly described *generalis* in the twelfth edition, a synonymy that is correct with one exception (Lister, pl. 276, fig. 35).<sup>1</sup>

The collection contains a specimen of the *C. generalis* of authors, which, although unmarked, alone conforms to the description which, in turn, is in agreement with the synonymy. The species can therefore be said to be adequately defined. In spite of the admirably clear description, however, Röding gave it four different names, *Cucullus cereolus*, which Tomlin calls the *monile* form of the species, and *Cucullus dux*, *locumtenens*, and *ornatus*.<sup>2</sup> Paulucci (1877, p. 274) suggested that *C. spirogloxus* Deshayes, 1863, was merely the young of *generalis*, and Tomlin treats *C. montieroi* Barros e Cunha, 1933, as related to the present species, possibly as a variety, although Tomlin's listing of *montieroi* is not clear. Link's *C. cinctus* (1807, p. 102) is

<sup>1</sup> Plate 276 of Lister contains merely the text of the arrangement of one of the author's sections and has no figures. Linnaeus erased the number in his copy of the "Systema," and his son completed the correction of the error by referring figure 35 to the proper plate, 786. This latter figure is a fair picture of *generalis*.

<sup>2</sup> This is not *Conus ornatus* Sowerby, 1883, which is probably the same as *C. cardinalis* Hwass in Bruguière, 1792, nor *ornatus* Michelotti, 1847, which Tomlin (1937, p. 206) has renamed *cosmetus*.

spoken of by Link himself as like *generalis* Linné.

*Conus generalis* was designated as the type of *Conus* Linné by Montfort in 1810, but this designation was invalid as the name was not on Linnaeus' original list in 1758.

The species varies principally in the depth of color, width, definition, and continuity of the brown bands which in some forms almost cover the body whorl. The word "muricata," which Linnaeus applied to the spire, was changed to "mucronata" by a manuscript note in his own copy of the twelfth edition. Hanley (1855, p. 163) called this the correction of a typographical error. It may have been merely such an error, but it is more logical to suppose that Linnaeus improved his choice of a word. There is no murication on the spire of *generalis*, such as tubercles or any suggestion of a coronation, but rather the pronounced exertion of the first few whorls which are produced to a sharp point. "Mucronata" is the more graphic word to describe such a feature.

The present species is figured in Reeve (1843–1878, vol. 1, *Conus*, pl. 10, sp. 48a, b, a rather crudely colored drawing) and in Kiener (1846–1850, pl. 31, figs. 2, 2a, and pl. 30, figs. 1a, b, c, a dark form; figs. 1, 1a, and 1b on pl. 31 show *Conus monile* Hwass in Bruguière, 1792, which Tomlin considers a good species, although it is very close to *generalis*).

#### *Conus virgo*

1758, *Systema naturae*, ed. 10, p. 713, no. 253.

1767, *Systema naturae*, ed. 12, p. 1166, no. 294.

LOCALITY: Not given in tenth edition; "in Africano oceano" (1767).

C. testa conica, basi caerulescente . . . Similis litteratis colore lacteo aut rubro maculata, basi semper violaceo margine acuta. Spira exquisita est."

The *Conus virgo* of all modern authors is universally accepted as the representative of *virgo* Linné. It is a symmetrically conical shell varying in color from pure white to pale cream and with the base heavily dyed with purple which also appears inside the lower edge of the aperture. The outer lip is sharp. The lower half of the shell bears a series of closely packed spiral striae which become successively more evident towards the base,

although they are always very fine and almost obsolete. In occasional specimens the spaces between these striae show almost imperceptible small granulations at the points where they cross the lightly developed growth lines of the shell. The spire is low, very slightly concave, and its whorls are symmetrical, shallowly channeled, and with a faintly salient shoulder. The only other *Conus* with which it might be confused is *C. flavidus* Lamarck (1810, vol. 15, p. 265). That shell not only has a purple base, but the entire aperture is similarly colored. It also possesses two narrow bands on the body whorl of a slightly lighter color than the tan base color of the shell. These differences do not constitute any criticism of the paucity of Linnaeus' description, as *flavidus* was not known, or at least not described, in Linnaeus' day.

The description is, however, faulty in other respects. A study of it reveals two phrases that are glaringly inconsistent with the shell now accepted as *virgo* Linné. The words "Similis litteratis" and "colore lacteo aut rubro maculata" are completely inapplicable to the *virgo* of authors. It is obvious that Linnaeus believed that *virgo* had a spotted variety. Also his failure to mention the basal striations of *virgo* is a strange omission, as he referred to this feature, when present, in many of his *Conus* descriptions.

The two species covered by the description are also found in the synonymy. The Rumphius figure in the tenth edition (pl. 31, fig. E) is the *virgo* of authors.<sup>1</sup> The Regenfuss figure (pl. 8, fig. 19) shows the shell later called *C. tessulatus* by Born in 1780.<sup>2</sup> This shell is decorated with oblong, vividly red spots and thus conforms to part of Linnaeus' description of *virgo*. It is shown by Martini (1769-1777, vol. 2, pl. 59, figs. 653-654) and by Kiener (1846-1850, pl. 17, figs. 1, 1a), and both the Regenfuss and Martini figures were cited by Gmelin for his variety "γ" of *virgo*. The Gualtieri figure (pl. 20, fig. B) added in the twelfth edition is an error. It somewhat

<sup>1</sup> The reference to Rumphius in the twelfth edition is manifestly a misprint, as there is no letter K on plate 31.

<sup>2</sup> Born's *tessulatus* was misspelled "*tessellatus*" by Bruguière (1789-1792, p. 641), and this error has been perpetuated by many subsequent writers including Lamarck (1810, vol. 15, p. 263), Hanley (1855, p. 163), and Kiener (1846-1850, p. 68). Donovan (1827, pl. 172) spelled the name "*tesselatus*."

resembles *C. quercinus* "Solander" Humphrey, 1786, in shape, a shell provided with indistinct spiral fasciae and lacking the purple base of *virgo*.

The collection contains no specimen marked for *virgo*, but two unmarked shells are undoubtedly the types of the two species covered by the description, the *virgo* of authors and *tessulatus* Born. Thus we have a composite species involved both in the description and the synonymy and an unmarked specimen of each in the collection.

Gmelin copied Linnaeus' main description, adding, in a subdescription, that the shell was "flavicante, frequentius niveae." For his variety "γ," as above mentioned, he cited both the Regenfuss and Martini figures of *tessulatus* and in the subdescription states that "γ" is "albo rubroque tessellata." For his "typical" *virgo* he cited at least one figure cited by Linnaeus (Rumphius) which represented the *virgo* of authors, and clearly included that species in his description. His inclusion of four lettered varieties, none of which bears any relation to his main species, shows that he not only blindly followed Linnaeus but complicated the question still further.

Lamarck (1822, p. 468) first adequately described *virgo*. This is an excellent and characteristic diagnosis, and both his Latin and French descriptions are worth translating in full: "[From the Latin] Shell turbinate, pale yellow, base blue-violet; fine obsolete transverse striae; spire plano-convex, obtuse. [From the French] It is of a yellow sulphur color, without bands, and when the epidermis (sa première couche) is removed, the color is milk-white. The base is always violet." Most of the specimens I have examined have a strictly angular or even slightly concave spire, and the natural color of the shell is more often cream yellow than white. With these possible objections Lamarck's description is entirely satisfactory. However, although he accepted the *virgo* of authors as the Linnaean species, he did not suggest that the latter was a composite species and did not specifically restrict it to that shell.

From Lamarck onward all authors have properly divided the Linnaean *virgo* without comment. Although Linnaeus was confused as to his species, it seems evident that

he later discovered his error. In the "Museum Ulricae" both the description and synonymy of *virgo* were purified and cover only the *virgo* of authors. The figures of *tessulatus* were not cited, and the words "rubroque maculata" were omitted. It may be said that Linnaeus himself restricted the species as his own first reviser. It is, however, unexplainable why, in the twelfth edition which was published three years later than the "Museum Ulricae," he should have reverted to the composite species. The same thing occurs in several places in the twelfth edition and can hardly be attributable to mere forgetfulness. It is also strange that Gmelin, who cited the "Museum Ulricae" as his principal reference, should also have described *virgo* as a composite species.

*Conus flavocinctus* Link, 1807, was used by Link as a new name for *virgo*, although it was an unfortunate and erroneous choice of name. *Conus emaciatius* Reeve, 1849 (1843-1878, vol. 1, *Conus*, suppl., pl. 5, sp. 248), is an exact synonym.

In Morrison's arrangement the species is included in the subgenus *Lithoconus* Mörch, 1852, section *Virgiconus* Cotton, 1945, as the type of the section, by original designation.

It is figured by Reeve (1843-1878, vol. 1, *Conus*, pl. 21, sp. 119) and by Kiener (1846-1850, pl. 36, fig. 1). *C. flavidus* Lamarck, mentioned above as a shell that may be confused with *virgo*, is also figured by Kiener (*tom. cit.*, pl. 26, fig. 4), and by Reeve (*tom. cit.*, pl. 38, sp. 207).

#### *Conus capitaneus*

1758, *Systema naturae*, ed. 10, p. 713, no. 254.

1767, *Systema naturae*, ed. 12, p. 1166, no. 295.

LOCALITY: "In Asia" (1758, 1767).

"C. testa conica glabra, basi fusca, spira convexiuscula . . . Testa caesia fasciis 2, albis fuscomaculatis. Spirae anfractus convexi."

The tenth edition used the phrase "fasciis 2 s. 3," and the last sentence was added in the twelfth edition.

The description has been deemed adequately characteristic but involves two errors, the first of which may have been a mere oversight on the part of the author. The words "basi fusca" in the tenth edition description where Linnaeus had confused this species with his *C. generalis* (see discus-

sion of that species) apply more accurately, if not uniquely, to *generalis*. The phrase is, however, retained in the twelfth edition description of *capitaneus* and omitted in that of *generalis*. The word "caesia" used for the color of the shell, is particularly inappropriate to describe the typical *capitaneus*, although occasional specimens show a greenish cast as an overtone to the light brown base color of the shell.

The synonymy needs comment. As already stated under *C. generalis*, four references in the tenth-edition synonymy of *capitaneus* were expunged and transposed to the new *generalis* in the twelfth edition. The Rumphius figure for variety "γ" (pl. 33, fig. X) was changed to figure K in the twelfth edition. The other references for variety "γ" and the sole reference for variety "β" were left unchanged, and two new references were added to "γ," including the figures from Seba. For variety "δ" the Buonanni figure for variety "ε" of the tenth edition was used, and five Seba figures were added. In the last analysis the synonymy of the twelfth edition was almost as faulty as that in the tenth, owing mainly to the indiscriminate choice and use of the eight Seba figures for varieties "γ" and "δ." Those for "γ" (pl. 42, figs. 23-25) all show *C. miles* Linné, the next species, and are used again for that species. Those for variety "δ" (pl. 42, figs. 28, 29, 30, 32, 35) show *capitaneus* in figures 28 and 29, probably *C. sumatrensis* Hwass in Bruguière, 1792, in figure 32, and *C. mustelinus* Hwass in Bruguière, 1792, in figure 35. Figure 30 is unrecognizable. "List. 780" was added to the synonymy by a manuscript note of Linnaeus in the "revised" copy of the "Systema." This figure is fairly representative of the *capitaneus* of authors.

In the "Museum Ulricae" (p. 552, no. 155) the synonymy of *capitaneus* points to the *capitaneus* of authors, while the description applies rather to *generalis*, indicating that in 1764 Linnaeus had not entirely solved his earlier confusion between the two species.

There is no authoritative type in the collection, as the single specimen present bears the name written in pencil, showing that it was done by a later hand, probably by Sir James Smith who similarly marked many of the undocumented shells.

With a synonymy that is faulty, even when mistakes of transcription are corrected, with an unfortunately broad locality, and with no authoritative type in the collection, identification of the species must rest upon the description alone, and this is equivocal in at least one particular. The whole diagnosis has been deemed by conchologists to be sufficient in spite of these defects, and probably correctly, although the confusion of mind under which Linnaeus was laboring makes it anything but a clean-cut identification.

*Conus chemnitzii* Dillwyn, 1817, is (*vide* Tomlin) identical with *capitaneus* Linné. It was based upon two Chemnitz figures (1780–1795, vol. 11, pl. 182, figs. 1764–1765) which show a predominantly brown shell with a single interrupted white band at the shoulder and with the lower half of the shell liberally sprinkled with white dots. It was called *Conus capitaneus punctatus* by Chemnitz (*tom. cit.*, p. 55), who comments upon it as follows: "Whoever wishes to read a short description of such variety has only to consult the Linnaean work *Museum Reginae Lud. Ulr.* page 552, number 155 [the listing of *capitaneus*]." I have not seen a specimen resembling the shell described by Chemnitz, or one that conforms to the descriptions in Chemnitz or any of the varieties of the "*Museum Ulricae*," but I would question the affinity of *chemnitzii* with *capitaneus* Linné.<sup>1</sup> I know of no other synonyms of *capitaneus* with the possible exception of *C. mustelinus* Hwass in Bruguière, 1792, which is apparently represented in the Seba figure 35 mentioned above, and figured in Kiener (1846–1850, pl. 20, figs. 2, 2a). It is so close to *capitaneus* in every respect that it is probably a form of that species.

In Morrison's arrangement *C. capitaneus* falls in the subgenus *Lithoconus* Mörch, 1852.

It is figured in Reeve (1843–1878, vol. 1, *Conus*, pl. 11, sp. 54) and in Kiener (1846–1850, pl. 20, fig. 1, both figures).

#### *Conus miles*

1758, *Systema naturae*, ed. 10, p. 713, no. 255.

<sup>1</sup> Lamarck (1822, p. 470) also made the two shells conspecific, as Lamarck's *capitaneus* variety "[c]" was based on the same two Chemnitz figures.

1767, *Systema naturae*, ed. 12, p. 1167, no. 296.  
LOCALITY: "In India" (1758, 1767).

*C. testa conica rudi, basi fusca, spira convexa. . . . Testa ignobilis pallidotestacea fasciis fusco-ferrugineis."*

The identification of this species with the common *C. miles* of all writers has never been questioned. We are provided with a clear description, with a synonymy consisting of five figures, four of which are in complete accord with the description, and with a properly documented specimen in the collection of Linnaeus which agrees with both. The Rumphius figure (pl. 33, fig. W) and the three Seba figures (vol. 3, pl. 42, figs. 23, 24, 25) are excellent and the figure from Argenville (1742, pl. 15, fig. L) is fairly accurate, although the shoulder seems to show a slight coronation. The latter fault is very common in the early drawings of the uncoronated species of this genus. A manuscript note in Linnaeus' "revised twelfth edition" adds "List. 786. f. 34" which also shows *miles*, and Linnaeus' son added to this copy a reference to two figures from Martini (1769–1777, vol. 2, pl. 59, figs. 663–664) which are clearly *miles* and are among the most characteristic drawings in the Martini volumes.

I know of no other name which has been given to this well-defined species.

In Morrison's arrangement it is included in the subgenus *Lithoconus* Mörch 1852.<sup>2</sup> It is well figured in Reeve (1843–1878, vol. 1, *Conus*, pl. 2, sp. 9), and in Kiener (1846–1850, pl. 38, fig. 2). The species is so constant in its color pattern and this is so unique among the *Cones* that it cannot be mistaken for any other species. Consequently the many figures of this shell are good and easily recognizable.

#### *Conus princeps*

1758, *Systema naturae*, ed. 10, p. 713, no. 256.

1767, *Systema naturae*, ed. 12, p. 1167, no. 297.

LOCALITY: Not given in either edition.

"*C. testa flava: lineis fusco-purpureis longitudinalibus ramosis. . . . Lineae latae purpureo-fuscae longitudinales subramosae."*

This description has always been deemed sufficient to identify the species with the *C.*

<sup>2</sup> Iredale, 1930, placed *C. miles* Linné in *Rhizoconus* Mörch, 1852, a group which Morrison uses as a section of *Lithoconus*, and designated *C. miles* as type. Morrison's type for *Rhizoconus* is *C. vexillum* Gmelin, 1791, an entirely different species.

*princeps* of the tropical parts of the eastern Pacific. The shell is extremely variable in the width, number, disposition, and degree of ramosity of the axial lines, and no two specimens are alike in this respect. Linnaeus did not own the species, and his description was apparently based on the specimen in the "Museum Ulricaе."

Chemnitz (1780–1795, vol. 10, pp. 17–18, pl. 138, fig. 1276) called the species *C. regius*. He supplied no references but accredited it to Linnaeus, saying (*loc. cit.*): "Whoever will read with care and attention the description which Linnaeus gave for *Conus princeps* in the twelfth edition of his *Systema Naturae*, no. 297, p. 1167, and the *Mus. Reg. Lud. Ulricaе*, no. 156, p. 552, must admit that it is conclusive as to the present shell." His figure is excellent except that it does not show that *princeps* is a coronate species.

As the tenth volume of Chemnitz is not nomenclatorially available, Bruguière's use of *regius* in 1792 validated the name as a synonym of *princeps*, and a good figure is found in the "Tableau encyclopédique" (1798, pl. 318, fig. 3). Bruguière himself admitted that *regius* was identical with *princeps*. Lamarck (1822, pp. 446–447) followed Bruguière in this identification, citing the Chemnitz and "Tableau" figures.

The name *regius*, however, was frequently used well into the nineteenth century, and indeed as late as 1884 was used by Tryon (1879–1888, vol. 6, p. 29, pl. 8, fig. 42). Tryon there called *regius* "the broad-striped form of *princeps*." It is evident that that was the form which Linnaeus described.

Deshayes and Milne-Edwards (1835–1845, vol. 11, pp. 13–14) were explicit in criticism of the use of *regius*. They said: "This is another instance of a Linnaean name uselessly changed, but this time it is Chemnitz who must be blamed. Lamarck should, in the interests of the nomenclature, have restored to the species its proper name. We believe that, contrary to the accepted view, it would be proper henceforth to call the shell *Conus princeps*."<sup>1</sup>

No synonymy was supplied in the tenth

<sup>1</sup> The *regius* of Chemnitz must not be confused with *C. regius* Gmelin, 1791, a common western Atlantic shell later called *nebulosus* Hwass in Bruguière, 1792. The latter name is discussed under the next species, *Conus ammiralis*.

edition except a reference to the "Museum Ulricaе" which was then in preparation. One figure was added in the twelfth (Buonanni, pl. 138), and this was cited with a query. It is a very badly drawn figure which both Hanley (1855, p. 165) and Deshayes and Milne-Edwards (*loc. cit.*) suggested was meant for *Conus vermiculatus* Lamarck, 1810. This suggestion is hardly plausible as *vermiculatus* is a much smaller shell, with a higher spire than *princeps*, and with its brown lines arranged in a more or less symmetrical pattern, whereas in *princeps* they are grossly asymmetrical. No locality was stated by Linnaeus. The fact that the range of the species is from Lower California southward to Peru, a region little known in Linnaeus' day, explains the inability of Linnaeus to find figures and his ignorance of the locality.

Two forms of *princeps* have been given specific names. *Conus lineolatus* Valenciennes, 1832, from Acapulco, Mexico (Humboldt and Bonpland, 1805–1837, pp. 336–337) is described as having very fine hair lines replacing the axial stripes of the typical *princeps* (see Dall, 1910, p. 207). Valenciennes's description suggests very strongly that it is in the *princeps* affinity and probably conspecific. *Conus apogrammatatus* Dall (1911, p. 224), from Panama, is a name given to a form devoid of axial lines. Tomlin recognizes it as a variety of *princeps* but lists *lineolatus* as a good species. I suggest that both are mere forms of this very variable shell.

The Linnaean shell is not *Cucullus princeps* Röding, 1798, which (*vide* Tomlin) is the *C. ammiralis summus* of Gmelin, not of Linnaeus.

Morrison places *princeps* Linné in the subgenus *Rhombus* Montfort, 1810.

In addition to the figures already cited *C. princeps* is figured by Reeve (1843–1878, vol. 1, *Conus*, pl. 7, sp. 36a–b). Figure 36a is much like Chemnitz' figure of *regius*, while 36b represents the form *lineolatus* Valenciennes. A recent color photograph is found in Platt (1949, p. 52, fig. 15). Kiener's figures are useful (1846–1850, pl. 3, fig. 2, showing the typical form, and pl. 11, fig. 4, showing the form *lineolatus* Valenciennes). He described it as *C. regius* Chemnitz.

#### *Conus ammiralis*

1758, *Systema naturae*, ed. 10, p. 713, no. 257.  
1767, *Systema naturae*, ed. 12, p. 1167, no. 298.

LOCALITY: "In O. Americae meridionalis" (1758, 1767).

"C. testa basi punctato scabra."

"*summus*. . . C. testa ferruginea maculis albis sparsis; fasciisque 4 flavis tenuissime reticulatis: tertia cingulo albo maculato.

"*ordinarius*. . . C. testa testacea maculis albis acutis: fasciis tribus albis subreticulatis, media cingulo articulato.

"*occidentalis*. . . C. testa testacea albo maculata: fasciis quatuor flavis reticulatis cingulo articulato.

"*Cedo-nulli*. . . C. testa testacea albo maculata cingulisque tribus, supremo composito, omnibus punctatis."

In the case of a species as variable in color pattern as *ammiralis*, one should approach with caution the identification of Linnaeus' named and described "varieties." The variations consist largely of the number and disposition of the encircling, reticulated yellowish bands, the frequency and size of the white maculations, and the degree with which they have invaded the bands. This writer has not been able, in the series of *ammiralis* examined, to separate specifically or subspecifically any one form from another, as the intergradation of these differences is so complete as to leave no breaks or zones of separation by which given forms could be isolated and considered worthy of infraspecific rank.

The primary description of *ammiralis* is, of course, worthless, standing alone, as a means of identification. It contains only three descriptive words, and these have no relation to any truly diagnostic features of this complex. If by "punctato" Linnaeus meant the brown or white dots arranged in spiral lines, it should be noted that these are absent in some forms, are confined to the base in others, and in some cover the entire shell. It is obvious that both the primary description and the descriptions of the "varieties" were based on the individual specimens available to Linnaeus. A careful reading of the descriptions and a comparison with any considerable series of specimens are convincing. This writer is unable to identify satisfactorily any form of *ammiralis* with any of the descriptions, as he has not seen any individual that completely conforms to a given diagnosis.

It is not known how many specimens of this species were examined by Linnaeus to enable him to describe the four "varieties."

A single specimen is at present in the Linnaean collection which, according to Hanley (1855, p. 165), "alone agrees with the combined descriptive and pictorial account of this species." It is unmarked. He felt that this specimen was most accurately defined pictorially by a pair of Chemnitz figures (1780-1795, vol. 10, pl. 141, figs. 1307-1308). Unfortunately the two figures are different and were used by Chemnitz to illustrate two different species. The first was used by Chemnitz (*tom. cit.*, p. 50) for his *Conus ammiralis* for which he referred to *C. vicarius* of Linnaeus. It shows a shell with only three bands, counting the basal band as one, with the white maculations invading all of them and apparently with the brown dots coalesced into spiral lines over the entire shell. This figure was used by Gmelin for *C. vicarius* Linné, and by Lamarck for his "variety [b]" of *ammiralis* Linné which Lamarck in the same synonymy tied to "*Ammiralis vicarius*. Brug. [var. e]." *Conus vicarius* is generally considered unidentifiable, but most writers consider it to have been some form of *ammiralis*. The second Chemnitz figure cited by Hanley was used by Chemnitz to illustrate his *Ammiralis summus*, for which he referred to Linnaeus' "variety" *summus* of *ammiralis* and to the *ammiralis summus* of the "Museum Ulricae," "varieties  $\alpha$  and  $\beta$ ," the latter of which he there called *ordinarius* which was the "variety  $\gamma$ " of the "Systema." It shows a shell very similar to that in figure 1307 in appearance, but with five yellow bands, counting the basal band, and with the white spots invading all bands. The canaliculation of the spire is much more marked than in figure 1307, and there is evidence of separated brown dots at the base. Neither figure exactly conforms to the descriptions of any of Linnaeus' "varieties."

The identification and synonymizing of the forms of the *ammiralis* complex are complicated by the inordinate number of specific and infraspecific names that have been proposed, largely by Linnaeus' immediate successors, and the manner in which subsequent authors, notably Bruguière, Gmelin, and Lamarck, have regrouped and reassigned these names. *Conus ammiralis* Linné and its four named forms were also listed by Gmelin (1791, pp. 3378-3381), who paraphrased the

original descriptions without material changes, used many of Linnaeus' references, and added seven new named "varieties" of his own, several of which were in turn subdivided into two or more unnamed forms. Lamarck (1822, pp. 473-475) listed *ammiralis* as of Linnaeus and described nine "varieties" to which he gave vernacular and not Latin names, all but one of which he credited to Bruguière either because Bruguière had named them or because they were based on figures in the "Tableau encyclopédique." He used none of Linnaeus' or Gmelin's form names except *summus*, which he cited as "*Ammiralis summus* Brug. var. a." The Linnaean form *cedo-nulli*, as *cedonulli*, was separately listed as a good species (*tom. cit.*, p. 447), but credited, as a species, to Bruguière, although Linnaeus' use of the name, as a "variety," was referred to. Of the nine named "varieties" listed by Lamarck under *cedonulli*, eight were drawn directly from Bruguière. The other, which Lamarck called "*Cedonulli verus seu principalis*" is referred to the *cedonulli* of the "Systema." Seven of the eight Bruguière names are derived from localities in the western Atlantic, *caracanus*, *curasaviensis*, *dominicanus*, *granadensis*, *martinicanus*, *surinamensis*, and *trinitarius*. The eighth species is called *mappa*.

Some early writers perpetuated Linnaeus' original error in locating all members of the *ammiralis* complex in American waters, whereas they are from the Indo-Pacific region. Moreover, the name *cedo-nulli* Linné was misused by his successors, who applied it to a western Atlantic shell. The American geographical names, proposed as manuscript names by Hwass and later published and validated by Bruguière and accepted by Lamarck as forms of his *cedonulli*, were, together with the name *Conus nebulosus* Hwass in Bruguière, 1792, actually based on a specimen of the shell called *Conus regius* by Gmelin in 1791, and do not belong in the *ammiralis* complex. Both Hwass and Lamarck recognized that this shell belonged in "les mers de l'Amerique méridionale et des Antilles." The real *cedo-nulli* of Linnaeus is an Indo-Pacific form unrelated to the western Atlantic *regius*. Lamarck also erred in listing *C. nebulosus* Bruguière as a good species distinct from his so-called "American" *cedonulli* and located

*nebulosus (regius* Gmelin) in both "the American Ocean" and the East Indies. As Clench has pointed out (1942, pp. 3-4) the long employed name *nebulosus* Hwass in Bruguière must be discarded in favor of *regius* Gmelin for the western Atlantic shell. Moreover *nebulosus* Hwass in Bruguière is a homonym of *nebulosus* Gmelin, a different species.<sup>1</sup>

I have referred to the *ammiralis* complex as involving *ammiralis* Linné and the "varieties" named by Linnaeus and his successors. Tryon (1879-1888, vol. 6, p. 29) listed none of Linnaeus' "varieties." He did treat *C. cedo-nulli* Hwass in Bruguière as a good species but pointed out that it was not *cedo-nulli* Linné but rather a synonym of *C. nebulosus*. An examination of the figures and descriptions involved in the various names and of the specimens available to me labeled with any of the names used convinces me that they should be dropped, with the possible exception of *cedo-nulli*. Saying that the various "varietal" names cannot be identified merely means that the forms are not sufficiently separable to justify being named at all. Undoubtedly individuals may be found that will conform to the descriptions of each of the suggested names, but if we named any of these forms we would almost be compelled to name each specimen, so great is the variability of the species and so constant their intergradation.

*Conus ammiralis* Linné is placed in the subgenus *Lithoconus* Mörch, 1852, in Morrison's arrangement.

According to Tomlin, the species is identical with *C. admiralis* Berge, 1847. He also suggests that *Cucullus granulatus* Röding, 1798, is "apparently *ammiralis* Linné" and that *Cucullus imperialis* Röding is a variety. Kiener (1846-1850, p. 135) calls *C. blainvilli* Vignaud, 1829, a form of *ammiralis*.

For some of the early figures of this species see Martini (1769-1777, vol. 2, pl. 57, fig. 634),

<sup>1</sup> The Hwass name *Conus regius* is not the *regius* of Gmelin but (*fide* Bruguière himself) is equal to *C. princeps* Linné. The *Cucullus regius* of Röding is *C. imperialis* Linné. A young specimen of *C. regius* Gmelin was probably (*fide* Clench and Turner, 1950, p. 258), the shell called *C. armillatus* by C. B. Adams (1850, p. 59), although Tomlin associates Adams' *armillatus* with *C. proteus* Hwass in Bruguière (*C. spurius* Gmelin).

a figure that Martini referred both to Linnaeus' *ammiralis summus* and *vicarius*, and (*tom. cit.*, fig. 635) a figure that he referred to Linnaeus' *ammiralis occidentalis*. Figure 635a of the same plate was referred to *ammiralis larvatus* by Gmelin and to *Ammiralis personatus* Hwass in Bruguière by Lamarck. See also Chemnitz (*tom. cit.*, pl. 141, fig. 1306), a figure called *ammiralis cedo nulli* by Gmelin. See also Reeve (1843-1878, vol. 1, *Conus*, pl. 3, sp. 1a-1e) and Kiener (1846-1850, pl. 21, fig. 1-1d).

#### *Conus vicarius*

1767, *Systema naturae*, ed. 12, p. 1167, no. 299.

LOCALITY: Not given.

"C. testa testacea albo maculata, fasciis 4 flavis immaculatis: secunda angulo divisa."

This species has not been identified, except that it was apparently a member of the large group of shells which have been rather loosely referred to *ammiralis* Linné. From its description it was one of the white spotted forms with four spiral bands which were not invaded by the white spots. The phrase "secunda angulo divisa" conveys no meaning to this writer. We are not told to what part of the shell it referred. Linnaeus did not own a specimen of *vicarius*, and nothing is present in his collection that is close enough to the brief description to be accepted as the type specimen. The single figure cited (Argenville, 1742, pl. 15, fig. H), which Argenville called the "Vice Admiral," was probably intended to represent some form of *ammiralis*. Argenville thus describes his figure: "This is the famous Vice Admiral shell whose bands, marbled with white spots, on a yellow base, are a very beautiful feature (forment un très belle compartiment) . . . The spire is thickly spotted and very high for a Cone." The statement that the bands were marbled with white spots is in direct contrast to the "immaculata" of Linnaeus' description. Thus we are not assisted by anything in the Linnaean diagnosis. The "Museum Ulricaë" did not mention a *Conus vicarius*.

The use of the name *vicarius* by the immediate successors of Linnaeus, although of little assistance in the identification of the species, is here taken up in chronological order to show the confusion of mind of the

early conchologists in regard to it. Its constant association with the puzzling *ammiralis* group is a sufficient excuse for the vagueness of their opinions.

Martini (1769-1777, vol. 2, pp. 284-285, pl. 57, figs. 638-639) described and figured a shell which he called *Conus clavicula pyramidalis* and *Proarchitalassus Indiarum orientarium*, from "America, East Indies and Africa." He used the vernacular name "Vice Admiral" and based it in part on a Rumphius figure (pl. 34, fig. F) and an Argenville figure which he cites as "D'Argenv. App., pl. 1. K.L.V., p. 385." I am not able to locate such a work by Argenville or figures so designated. The reference is not the Argenville figure cited by Linnaeus for *vicarius*. Martini quotes "Argenville" as calling the shell "Vice Admiral." It is described as white, with dark reticulations, and "fasciatus." Both figures show the reticulations very clearly, and longitudinal, irregular brown streaks somewhat as in *C. varius* or *generalis* Linné. It has no spiral decoration. Note that all Linnaeus' "varieties" of *ammiralis* are apparently described as having spiral bands. I cannot recognize this form. Martini did not refer to Linnaeus as source, and his figures are referred to here merely because Röding later used them to illustrate his own *vicarius*. They do not conform in any particular to Linnaeus' description or to the Argenville figure he cited. In spite of the irreconcilable differences between Martini's figures and Argenville's (pl. 15, fig. H), both authors called it "Vice Admiral."

Chemnitz (1780-1795, vol. 10, p. 50, pl. 141, fig. 1307) described and figured a *Conus ammiralis* which he specifically refers to *vicarius* Linné and quotes Linnaeus' description in full. His figure shows a shell that is clearly allied to the *ammiralis* group. It has a brown background color rather thickly spotted with white spots and with three well-defined spiral yellow bands partially invaded by the white spots. The bands are finely reticulated, and the shell is encircled with numerous fine, thread-like lines of dark brown. It conforms to Linnaeus' description of *vicarius* except for the detail "immaculata," relating to the bands and the fact that there are three bands instead of four. It conforms almost perfectly with the Argenville figure cited by Lin-



naeus (pl. 15, fig. H).<sup>1</sup> This Chemnitz figure was cited by Lamarck for his *C. ammiralis*, variety "[b]."

The *vicarius* of Hwass is listed in Bruguière's "Histoire naturelle des vers" (1789, 1792, p. 659) and figured in the "Tableau encyclopédique" (1798, pl. 328, fig. 2). It was called by Bruguière *Ammiralis vicarius*, variety "e," one of his seven varieties of *ammiralis*. The figure indicates some member of the *ammiralis* complex and is much like Chemnitz' figure 1307, which the latter referred to *vicarius* Linné.

Röding's *C. vicarius* (1798, p. 45, no. 567) is also referred to as the "Vice Admiral." He cited the two Martini figures referred to above and Gmelin's *C. ammiralis americanus*. Tomlin suggests that the first of these Martini figures (fig. 638) is the real *vicarius* Röding.<sup>2</sup>

Lamarck described a *Conus vicarius* (1810, vol. 15, p. 274) as a new species and cited no references. Later he repeated the description (1822, p. 482), citing only his original listing of 1810. The description conforms in some measure to Linnaeus' description. The comment on the species in French says, in part, ". . . resembles the Admiral Cone by its size and shape and is colored like the textiles (draps d'or). . . . The appearance of this cone is that of an Admiral with very white bands which are irregular and without reticulations." It seems to be the accepted opinion that Lamarck's *vicarius* is a different species from the *vicarius* of Linnaeus. The few details of Linnaeus' description are certainly comprised in that of Lamarck, and it cannot be categorically stated that they are separable. Lamarck mentions that a specimen of his *vicarius* is in the Museum in Paris, but Lamarck's own collection, now in the Geneva Museum, does not contain a specimen. Kiener (1846-1850, p.

<sup>1</sup> Chemnitz cited the Argenville figure as "plate 12, figure H." This is the same figure cited by Linnaeus. In the 1757 edition of Argenville, which was used by Chemnitz, plate 12 is identical with plate 15 of the 1742 edition, which was used by Linnaeus.

Linnaeus cited a Rumphius figure (pl. 34, fig. D) for his *ammiralis occidentalis*. This same figure was cited by Gmelin for *vicarius* and by Chemnitz (*loc. cit.*) for his *ammiralis*—the "Vice Admiral."

<sup>2</sup> Tomlin also suggested that the second Martini figure (fig. 639) was meant to represent *C. varius* Linné, but the figure is too crude to admit of such an identification. *C. varius* is a heavily granulated shell and is not reticulated as this figure shows.

136, pl. 37, fig. 3) describes and figures *vicarius*, which he attributes to Lamarck, paraphrasing Lamarck's language by saying: "This Cone has the appearance of *ammiralis* with very white areas, almost without reticulations." His figure does show faint reticulations and contrasts with Lamarck's language "sans réseau." Kiener adds: "Linnaeus, in the Systema, listed under the name *vicarius* a variety of *Conus ammiralis*, which Dillwyn listed in his catalogue and transferred to its proper place. We think the same, that Lamarck's *vicarius* is only a variety of *ammiralis*. All the features of *ammiralis* are found in the specimen portrayed." A reading of Kiener's entire description and comment makes one confident that he believed the two *vicarius* were either identical or two very close forms of the same shell, *ammiralis* Linné.

Melville (1900, p. 306) may have been impressed by Lamarck's statement that his *vicarius* was colored like *C. textile*, as he makes *vicarius* Lamarck one of his eight varieties of *textile*, saying: "Form more pyramidal, pattern coarser and larger in detail, with greater preponderance of the white triangular patches." He evidently did not identify *vicarius* Lamarck with the Linnaean species, and I would hesitate to associate either with any form of *textile*.

It is not easy to ally *vicarius* Linné with either the Hwass or Röding *vicarius*. Neither the descriptions nor the figures cited in their support can reasonably be tied to Linnaeus' description. Indeed, Tomlin cites all three of them and the *vicarius* of Lamarck as good species, and identifies only *vicarius* Hwass (*in* Bruguière) with *ammiralis*.

In summary, if one can summarize such a confused body of opinion, I am not able to identify *vicarius* Linné. It may well have been one of the many forms of *ammiralis*. Both the Hwass and the Lamarck representatives of the name may have been associated with *ammiralis*. Röding's *vicarius* is even more dubious. It will be recalled that he cited Martini's figure 638, which Tomlin said represented Röding's shell, on what basis I do not know. Certainly the figure shows a form with which I am not familiar. I know of no serious attempt in modern times to identify *vicarius* Linné, and it is universally abandoned, as a *species dubia*.

**Conus senator**

1758, *Systema naturae*, ed. 10, p. 714, no. 258.

1757, *Systema naturae*, ed. 12, p. 1168, no. 300.

LOCALITY: Not given in either edition.

"C. testa conica laevi glabra, spirae anfractibus obtusis scriptis . . . Testa flava, albo maculata striis transversis, numerosissimis, albo fuscoque articulatis."

The entire subdescription was added in the twelfth edition.

The diagnosis of *C. senator* is not sufficiently precise and ample to permit of an identification with any known species, and I incline strongly to the view that it must be abandoned as a *species dubia*. Many authorities, however, have insisted that it is but one of the many forms of *C. planorbis* Born, 1780.

Linnaeus presumably did not possess the shell, as it does not appear on either of the lists of his collection, and, with the exception of *C. clavus* (discussed below), it is the only shell in the genus which lacks both a locality and a synonymy. There is no specimen in the collection which uniquely agrees with it, and it is not described in the "Museum Ulricae." We must, therefore, rely on the "Systema" description alone in any attempt to identify it. Hanley (1855, p. 160) was unable to recognize the species, saying of it, "its meager description, unfortunately, being equally applicable to more than one species," although he suggested that "a spotted variety of the *Conus planorbis* of Born . . . agrees extremely well with the few features that have been specified by our author."

*Conus senator* has been repeatedly associated with *planorbis* Born both in the literature and on museum labels either as a synonym or as a good species close to *planorbis*. It is well to set out here, in translation for convenience, the description of the latter species (Born, 1780, p. 164, pl. 7, figs. 13, 14): "Conical ventricose, base with transverse granular striations (basi transversim striato-punctata), spire low and canaliculated . . . [Subdescription] Elevated granulose scabrous striations, spire low with canaliculated whorls, shoulder acute. Color of body whorl fulvous; spire white with fulvous maculations. Aperture pale violet." I have not seen a specimen of *planorbis*, even unworn, in which the interior can be said to be "amethystina," which was Born's word. In a few individuals

the basal part of the aperture shows a milky violet tinge which might easily escape observation. It may be that this color is extremely fugitive, as any shade of purple usually is.

Like Born's description, Linnaeus' description of *senator* is of a specimen rather than of a species, and we cannot even be sure that he was not basing it on memory or on data furnished to him by a colleague or a collector.

Born's figure 13, to which he referred for *planorbis*, conforms only partially with his description. It shows the low, canaliculated spire, the sharp shoulder, and the dark brown maculations or flammules on each whorl. It has a body whorl of a medium brown color, but also shows two white spiral bands, one just below the shoulder and the other around the middle of the whorl, the latter narrow and very distinct. These are not mentioned in the description. The spiral lines look like a series of black dots and cover the entire body whorl instead of merely the base of the shell as the description requires, and they are represented as colored dots rather than the "transverse granular striations" of the description (transversim striato-punctata).<sup>1</sup> In the figure the upper white band is invaded at intervals by brown "fingers" or flammules which extend upward from the upper brown zone. *C. planorbis* is an extremely variable species both in color pattern and in the disposition and sculpture of the spiral lines, and it seems obvious that Born's description was based on a different specimen than the one he used for figure 13.

Born's figure 14 is an obvious error. It shows a round-shouldered shell with a color pattern that identifies it with some member of the *C. textile* group and is probably intended to represent *C. pennaceus*, which Born describes on the following page.<sup>2</sup>

The variations in the species indiscriminately called *senator* or *planorbis* in collections may be recapitulated as follows:

<sup>1</sup> This is misuse of a Latin word of which Linnaeus was frequently guilty. "Punctatus" means "with little holes," from "pungo" to pierce or punch, rather than "with raised points or granules" or "with painted dots."

<sup>2</sup> The description of *pennaceus* refers to "figure 15," but there is no figure numbered 15 and Born evidently transferred figure 14 (*pennaceus*) to the description of *planorbis* in error.

1. The brown zones of the body whorl vary in color from a deep brown to a pale yellow and may cover the greater portion of the shell or be restricted in width depending on the number and width of the white zones or bands.

2. The height of the spire varies greatly, although it is always canaliculate and always exhibits the brown flammules on each whorl. The sharp shoulder is also a constant feature.

3. The shell may have merely a median white band, in which case it is usually narrow, or a median band and a band of varying width just below the shoulder. In dark-colored specimens the latter is invaded at intervals by the brown of the upper brown zone. In occasional specimens this band is replaced by a series of moderately large white spots, a form which probably represents the specimen described by Linnaeus in the words "albo maculata."

4. The spiral lines may cover the entire body whorl or may be restricted to the lower half or even to a small area near the base, and are in any case more evident in that area. They may be lines of dark brown or black or interrupted lines of dots or dashes. In about half of the specimens examined they are granulose at the base, and often the granulations appear over the whole body whorl. Infrequently these lines are lighter than the base color on which they appear, and in such cases the granulations, where present, often take the pale color of the lines.

If the shell which Linnaeus described was a form of *planorbis* it was obviously one of the pale color forms (cf. "flava") with the spotted spire of the species, having numerous interrupted spiral lines which apparently covered the shell. The white bands are not mentioned, and we may therefore assume that the median band, at least, was lacking, the words "albo maculata" referring to the displacement of the shoulder band by a few white spots. The shell was probably not granulose, as we may assume that Linnaeus would have mentioned that feature as he did in the case of the other granulose species, *C. varius* and *granulatus*. The shell labeled *senator* in some collections is usually a pale form in which the white and darker zones are only faintly delimited. In such specimens the spiral lines are almost, if not quite, obsolete, and the shell shows no

white spots and no granulations. Those labeled *planorbis* tend to be darker, with the spiral lines more distinct, and are frequently granulose.

The respective descriptions of Linnaeus and of Born show striking differences and, although we know that *planorbis* is a variable shell, it is difficult to convince oneself that they refer to a common species. Any attempt to tie the Linnaean description, with its meager details and apparent inconsistencies, to *planorbis* involves too many assumptions. If it had been more ample and had been supported by any confirmatory evidence, it might have been possible to assert with some degree of confidence that it represented a form of Born's species, and in that case the prior name of *senator* could be retained. I suggest, however, that the description is too equivocal to be accepted as a good definition of a species and that it be dropped from the nomenclature, leaving *planorbis* Born as the valid name of this variable species.

The weight of evidence in the literature favors this view, although the treatment of the name *senator* by some of Linnaeus' followers discloses frequent doubts.

Born himself described *C. senator* as of Linnaeus, in addition to his own *planorbis* (1780, p. 155), but did not figure it. His description is interesting: "Testa ovata, nebulosa, laevi, transversim articulato-striata . . . [Subdescription] Testa ovata, laevis, striata, striis elevatis transversis. Spira acutiuscula; Anfractuum sutura excavato-striata: Basis submarginata; Color griseus, fasciis longitudinalibus latis, transversim albo fuscoque articulatis lineatis." The words "griseus" and "fasciis longitudinalibus latis" are not understood. If they were well chosen Born was surely not describing the same shell as Linnaeus, and they are most inapt as applied to any form of *planorbis*. This is shown by the figures he cited. He supplied two references. A figure from Seba (1758, vol. 3, pl. 43, fig. 36) is too vague to be identified, but the ornamentation consists of white blotches loosely arranged longitudinally and brown blotches which partially resolve themselves into transverse bands. The figure shows articulated lines over the entire body whorl. He also cited three figures from Martini (1769-1777, vol. 2, pl. 55, figs. 609-611). Of these,

figures 609 and 611 show the dotted spiral lines and the canaliculated spire of Linnaeus' *senator*, but exhibit in addition brown nebulosities arranged in wide longitudinal stripes as mentioned in Born's description, a feature which is significantly lacking in the description of *senator* Linné. Figure 610 is too crude to be useful.

Gmelin's *senator* (1791, p. 3381) is demonstrably identical with that of Linnaeus, as the description is the same with the addition of the word "notata," which is not understood. He supplied three references. He wisely placed a question mark after those from Lister and Valentyn, as these figures are unrecognizable. The figure from Martini (*tom cit.*, pl. 59, fig. 659) is the same figure that Martini used for his listing of *senator* Linné. It is a stylized but fairly accurate picture of a form of *planorbis* with interrupted spiral lines and with only a median white band. Thus both Gmelin and Martini had no doubts as to the identification of *senator*.

Bruguière described a *C. vulpinus* (1789, 1792, p. 648; 1798, pl. 326, fig. 6) which he admitted was a new name for *C. planorbis* Born and which has always been accepted as a synonym of that name.

Lamarck did not cite either *planorbis* or *senator* as good species, but put them both in the synonymy of *vulpinus* (1822, p. 467), the first under his "typical" *vulpinus* and the second under his variety "[c]" for which he cited the Martini figure (fig. 659) cited by Gmelin, a figure given a great deal of weight by Hanley (*loc. cit.*) in his reluctant attempt to identify *senator* with *planorbis*, as that figure had been added to the Linnaean synonymy by Linnaeus' son.

Deshayes and Milne-Edwards commented on *senator* in their treatment of *C. vulpinus* (1835-1845, vol. 11, pp. 44-45, note). These authors took the view advocated here, that while *senator* was possibly a form of *planorbis*, it was too ill defined a name to be retained. They say: "I think that this *Conus senator* is too little understood to make it possible to refer it to any species. After reading the short description of Linné with the greatest attention, and weighing each word, one soon perceives that this description could apply to several species, among which it is impossible to choose, since Linné did not add any syno-

nymic citations which might guide us in the determination of the species. As is shown in Lamarck's synonymy, this Cone had already been given a name by Born long before Bruguière had given it another [*vulpinus*]. We must allocate to this species its first name of *Conus planorbis*."

Kiener adopted a contrary view as he believed that *senator* was identical with *planorbis*. He said (1846-1850, vol. 2, p. 105, pl. 27, figs. 1, 1a): "This cone, called *vulpinus* by Bruguière, is variable in color and in the more or less dark transverse lines. One variety which we figure [fig. 1a] is especially remarkable for a widely spaced spiral series of raised granulations over all the convexity of the shell." In the figure cited the granulations seem to replace the spiral lines entirely, as is the case in several specimens examined by me.

Tryon (1879-1888, vol. 6, p. 50, pl. 14, fig. 81) described and figured *Conus planorbis* Born, and, like several of his predecessors, was unwilling to identify *senator* Linné. He said: "This species is called *C. senator* by Reeve and others, but the description in the *Systema naturae* shows that the identification is wrong. Hanley was not able to identify *C. senator* in the Linnean collection." Tryon's figures show the spiral brown lines described by Linnaeus as "articulatis" and shown in Martini's figure of *senator* and Born's figure of *planorbis*. Tryon also asserted that Kiener's *senator* was not the *senator* of Linnaeus but was the *planorbis* of Born, a conclusion with which I entirely agree.

Under Morrison's arrangement, *C. senator* Linné, which he adopts as a good species, belongs in the genus *Dendroconus* Swainson, 1840. He does not refer to the generic position of *planorbis*, but it may be assumed that he would consider it congeneric with his *senator*.

The opinion as to the non-determinability of *senator* Linné which is expressed in this paper is not that held by Tomlin, nor, as noted above, by the United States National Museum (Morrison, personal communication). The writer disagrees with these authorities with the greatest reluctance, and it is hoped that such disagreement may bring further expressions of opinion on this admittedly vexing question, with the possibility of set-

tling the confusion which is apparent in our museum labels.

#### *Conus nobilis*

1758, *Systema naturae*, ed. 10, p. 714, no. 259.

1767, *Systema naturae*, ed. 12, p. 1166, no. 301.

LOCALITY: Not given in either edition.

"*C. testa conica laevi glabra . . . Testa nitidissima flava punctis obscurioribus striata maculisque albis sparsis.*"

As in the case of *C. senator*, the entire subdescription was added in the twelfth edition. It would have been impossible to identify the species from the tenth edition description alone, and even as it stands in the later edition the language is barely sufficient. The description in the "Museum Ulricae," however, is clear, and it is obvious that it was decisive in the identification of *nobilis* Linné with the *nobilis* of all modern authors. An unmarked specimen of the shell in the Linnaean collection conforms accurately with the expanded diagnosis and with the single reference cited in the "Systema" (Argenville, 1742, pl. 15, fig. M).

It is not *C. nobilis* Schröter, 1783, which was cited by Dillwyn (1817, vol. 1, p. 413) as a synonym of the latter's *C. festivus* (*C. pertusus* Hwass in Bruguière, 1792). The latter shell was originally described and figured, as *festivus*, by Chemnitz (1780-1795, vol. 11, p. 57, pl. 182, figs. 1770-1771) as a predominantly pink shell with white blotches arranged loosely in two spiral bands, and Chemnitz there called attention to Schröter's misidentification, saying (*loc. cit.*): "The Herr Superintendent Schröder [*sic*] . . . is of the opinion that this splendid shell is the *Conus nobilis* of Linnaeus. Herr Gmelin also seems to be of the same opinion, as in the latest edition of Linnaeus' *Systema Naturae*, Tom. 1, P. 6, pag. 3381, no. 13 he admits Schröter's citation as sound. The real *Conus nobilis* of Linnaeus, which was called the Yellow Tyger Cone<sup>1</sup> in the instructive catalogue of the Portland Museum, no. 184, 1478, 3496, is excellently figured in this Syst. Conchylienwerke, figure 1312 and is described by me in detail." Chemnitz' figure 1312 is a recognizable, although somewhat stylized, picture of the *C. nobilis* of authors, as is the Martini figure

(1769-1777, vol. 2, pl. 62, fig. 689). Both figures were cited by Lamarck (1822, p. 504) for this species.<sup>2</sup>

Tomlin treats *C. victor* Broderip, 1842, as a variety of *nobilis* Linné.

In Morrison's arrangement the species is included in subgenus *Leptoconus* Swainson, 1840.

In addition to the Martini and Chemnitz figures referred to above, *nobilis* is figured in the "Tableau encyclopédique" (1798, pl. 339, figs. 7-8<sup>3</sup>; Chenu (1859, 1862, vol. 1, fig. 1479); Kiener (1846-1850, pl. 49, figs. 1a, b, c); Reeve (1843-1878, vol. 1, *Conus*, pl. 1, sp. 2c); and Delessert (1841, pl. 40, fig. 10).

#### *Conus genuanus*

1758, *Systema naturae*, ed. 10, p. 714, no. 260.

1767, *Systema naturae*, ed. 12, p. 1168, no. 302.

LOCALITY: Not given in either edition.

"*C. testa cingulis linearibus albo fuscoque articulatis.*"

Although a specimen of the *Conus genuanus* of all authors is found in the Linnaean collection, it is devoid of authority as the type, as Linnaeus' lists show that he did not own the species, and Hanley (1855, p. 167) reports that it was added to the collection by Lord Valentia. The description, brief as it is, gives us the details of the characteristic color pattern and, when assisted by the best of the references, is sufficient for identification.

The figure from Rumphius (pl. 34, fig. G), from whom Linnaeus borrowed the specific name, is one of the few good figures in that work. Three of the Seba drawings (vol. 3, pl. 48, figs. 1-3) are obviously intended for this species. The others (*tom. cit.*, pl. 44, figs. 1-5) are all drawings of either *C. betulinus* Linné or *C. papilionaceus* Hwass in Bruguière, 1792. All the Seba figures, together with a very doubtful figure from Argenville (pl. 15, fig. V), were added in the

<sup>2</sup> Lamarck cited figure 1312 for his typical *nobilis*. For his *nobilis*, variety "β," described as "var. fulvo castanea, bizonata," he cited the two following figures in Chemnitz (figs. 1313 and 1314) which show a shell resembling *nobilis* except that the obscure, interrupted bands of color are more evident and are concentrated in three bands dividing the body whorl into several fairly delimited zones. I am not familiar with this form.

<sup>3</sup> Lamarck (*loc. cit.*) also cited these two figures from the "Tableau encyclopédique," figure 8 for his typical *nobilis* and figure 7 for the variety "β."

<sup>1</sup> Argenville called it *Tigris lutea*.

twelfth edition, where the variety *papilio* appeared for the first time. They are placed after the listing of *papilio*, and Hanley (*loc. cit.*) believed this position to be the result of a typographical error. Insofar as *papilio* may be considered a recognizable subspecies or form of *genuanus*, Seba's figures on plate 48, at least, seem to be correctly placed, as they do show a form of *genuanus* which departs somewhat from the typical and might be held to conform to the phrase "Varietas  $\beta$  fasciis connexis ocellis pupillatis" which follows *papilio*.

Two supplementary references entirely support the accepted identification. One from Lister (pl. 769) was added by Linnaeus in his "revised twelfth edition" and two good figures from Martini (1769-1777, vol. 2, pl. 56, figs. 623, 625) were added in the copy owned by the younger Linnaeus. Martini's figure 623 probably represents *papilio* and was so called by Martini. It was cited by Lamarck (1822, p. 475) for his variety "[b]", although Lamarck's variety, from its description, does not seem to be the *papilio* of Linnaeus. Martini's figure 624 (not cited) is also of the typical *genuanus* and shows the apertural aspect.

The diagnosis of this species in the "Museum Ulricae" (1764, p. 554, no. 158) does not suggest any form of *genuanus* and was probably based on another species.

The species, under Morrison's arrangement, is placed in *Leptoconus* Swainson, 1840. *Cucullus sphinx* Röding, 1798, and *Conus alternatus* Link, 1807, are synonyms.

The shell of *genuanus* is pale flesh pink encircled by numerous interrupted bands made up of brownish oblong spots, four to seven of which are considerably wider than the rest. The spire is evenly and obtusely pyramidal in all specimens that I have seen, although several of the figures show it as slightly concave. The species is much like *C. aurisiacus* Linné in appearance, except for the two light brown bands which encircle the body whorl of the latter and are fairly well defined in unworn specimens.

*Conus genuanus* is figured in Reeve (1843-1878, vol. 1, *Conus*, pl. 15, sp. 81) and in Kiener (1846-1850, pl. 18, fig. 2) in addition to the figures referred to above.

### *Conus glaucus*

1758, *Systema naturae*, ed. 10, p. 714, no. 261.  
1767, *Systema naturae*, ed. 12, p. 1168, no. 303.

LOCALITY: "In Asia (1758, 1767)."

"C. testa basi emarginata striata, spira inermis anfractibus contiguus."

Linnaeus did not own this species, and it was identified by the full and characteristic description in the "Museum Ulricae" rather than by the brief diagnosis in the "Systema" which tells us only the color of the shell by the use of the name *glaucus*, the fact that it was not coronate, that it had a striated base, which is true of many other cones, and that the whorls of the spire were "contiguus." The latter word is not used for any of the other Linnaean cones and, unless it was a typographical error for "convexis," which is highly descriptive of the species, it has no discernible meaning. The description in the "Museum Ulricae," on the other hand, is detailed and correctly describes the *glaucus* of all authors. It is to be noted that the doubtful word "contiguus" was there changed to "convexis."

The sole figure in the synonymy (Rumphius, pl. 33, fig. G.G.) is a fair representation of the species. Both Martini (1769-1777, vol. 1, pp. 316-318, pl. 61, figs. 670-674) and Chemnitz (1780-1795, vol. 10, pp. 19-21, pl. 138, figs. 1277-1278) supply recognizable descriptions of the *glaucus* of authors which they both attribute to Linnaeus and, indeed, there has been very little question of the identification of the species. The figures from Chemnitz are good. Those in Martini are almost too crude to recognize.

In Morrison's arrangement the species is placed in *Chelyconus* Mörch, 1852. It is identical with *Cucullus fraxinus* Röding, 1798. It is not *glaucus* Gmelin, 1791, which seems to be a composite species, Tomlin stating that it "seems to be a mixture of *eburneus* Brug. and others." It is not *glaucus* Röding, 1798, which, *vide* Tomlin, equals *minimus* Gmelin.<sup>1</sup>

In addition to the figures mentioned above *C. glaucus* is figured in Reeve (1843-1878, vol. 1, *Conus*, pl. 2, sp. 10) and in Kiener

<sup>1</sup> Tomlin seems to differentiate *minimus* Gmelin from *minimus* Linné. They seem to be demonstrably identical.

(1846–1850, pl. 25, fig. 2, two figures).

*Conus glaucus* is one of the most distinctive *Cones* in appearance and once seen it cannot be mistaken. It is shining and almost glassy. Its shape is typically pyriform, and with its evenly rounded shoulder and smooth spire, its pointed base and low ratio of length to breadth it has almost exactly the outline of a child's top. Indeed, Lamarck (1822, p. 478) uses the word "turbinata" in his description of the species. None of these features are brought out in the description in the "Systema," but many of them are referred to in the "Museum Ulricaë," and it is on the diagnosis in the latter work that the identification must be based. The color pattern, which was not mentioned in the "Systema," is very simple and characteristic. On a dirty-white or "glaucus" base color it exhibits only a closely packed series of interrupted lines consisting of blackish brown dashes of varying lengths. The spire is more colorful, showing large flammules of a somewhat brighter brown, which, on the penultimate whorl, are curved in the direction of growth.

#### *Conus monachus*

1758, *Systema naturae*, ed. 10, p. 714, no. 262.

1767, *Systema naturae*, ed. 12, p. 1168, no. 304.

LOCALITY: Not given in either edition.

"C. testa gibba fusco-caerulescente nebulata acuta, basi striata."

*Conus monachus* has always been a source of trouble to the students of the genus *Conus*, and many names have been given to it and its various forms. A tray in the Linnaean collection marked *monachus* contains a worn specimen of a shell which Hanley (1855, p. 169) correctly identified as *C. mediterraneus* Hwass in Bruguière, 1792. As the shell itself was not marked, its authority as the type specimen is open to some question.

The synonymy contained the same three figures in both editions of the "Systema" and shows that *monachus*, so far as the references are concerned, was a composite species. The Rumphius figure (pl. 33, fig. CC) shows the *mediterraneus* of authors, which I consider as identical with the Linnaean *monachus*. Both the figure from *Buonanni* (fig. 126) and that from Regenfuss (pl. 12, fig. 68), the latter a particularly clear and well-executed drawing, show an entirely different shell, undescribed

up to that time. Gmelin, as first reviser, separated the two, calling the shell represented in the two latter figures *Conus nebulosus*,<sup>1</sup> and citing the same two figures.<sup>2</sup> It may be added that while the Regenfuss figure is unquestionably *nebulosus* Gmelin, the figure from *Buonanni* is so poor that I would hesitate to give it a name. Deshayes and Milne-Edwards said (1835–1845, vol. 11, p. 60, note): "If we rely on the synonymy, *Conus monachus* Linné in the tenth edition of the *Systema naturae* is not the same as the *monachus* of Bruguière and Lamarck; but following the description in the *Museum Ulricaë*, it must be presumed that the synonymy alone must be rejected." The description in the latter work, with its details of the spire and its expanded account of the nebulous ornamentation of the shell, leans rather towards *nebulosus* than *monachus*. The rejection of the "Systema" synonymy by these authors, based on the description in the "Museum Ulricaë," is therefore somewhat of a *non sequitur*.

In spite of Gmelin's action in separating the two species covered by the "Systema" synonymy, Dillwyn (1817, vol. 1, p. 384) treated *nebulosus* as a synonym of *monachus*. Lamarck (1822, p. 449) apparently did not recognize *nebulosus* Gmelin, his own *nebulosus* being *nebulosus* Hwass in Bruguière (the *C. regius* of Gmelin) which he credited to Solander. He listed *monachus* Linné from the "Ocean Asiatique" (*tom. cit.*, p. 478) but did not refer to any of the figures cited in the "Systema."

Hanley (*loc. cit.*), although he recognized that the partially authenticated specimen in

<sup>1</sup> This is not *nebulosus* Hwass (*in* Bruguière, 1792), which is the same as *C. regius* Gmelin, 1791, and the later *C. corona-civica* Röding, 1798.

<sup>2</sup> The shell which Gmelin called *monachus* has a rather equivocal diagnosis. First, for his "typical" *monachus* he referred not to the "Systema" but to the "Museum Ulricaë," as was his invariable custom in cases where the same name occurred in both works, whereas, as I suggest below, the shell described in the latter was probably, in this case, a different species. Second, for his "variety  $\beta$ ," he referred only to two Chemnitz figures (1780–1795, pl. 142, figs. 1319–1320) which Chemnitz called *Monachus franciscanus*. These figures bear little resemblance to *monachus* Linné and may possibly be intended to represent *Conus catus* Hwass (*in* Bruguière, 1792) or the "Minime" of several pre-Linnaean writers, a name which is further referred to under *Conus minimus* Linné, the next species discussed.

the collection was *C. mediterraneus* and that that shell had been adequately described in the "Systema" and was the species undoubtedly meant by Linnaeus, nevertheless rejected it as the representative of *monachus* Linné for reasons which were entirely fallacious and inconsistent. He said: "Nevertheless, since that shell [*mediterraneus*] is not hinted at in the synonymy, and the description is utterly inadequate, it can have no claim to the Linnaean appellation: it has not the striated spire of the *monachus* of the 'Museum Ulricae.' "

Based both on the description in the "Systema" and the figure from Rumphius, it seems clear to this writer that Linnaeus was describing the shell later called *mediterraneus* by Hwass. *Conus monachus* is, therefore, the technically correct name for the species. The shell described in the "Museum Ulricae" was apparently another species, if we are to believe that the words "spira . . . striata" correctly described the shell there examined. Inasmuch as the name *mediterraneus* has become fixed in the literature and is almost universally employed, and as the Linnaean diagnosis of *monachus* is considered by most conchologists to be not entirely free from doubt, it would be unwise and confusing to suggest the restoration of the Linnaean specific name.

Tomlin does not associate the two names and apparently considers them both as good species.

Under the Morrison arrangement, *C. mediterraneus* falls in the genus *Chelyconus* Mörch, 1852, subgenus *Lautoconus* Monterosato, 1923, as the subgenotype.

It is figured in Reeve (1843-1878, vol. 1, *Conus*, pl. 16, sp. 89, as *mediterraneus*; and in pl. 22, sp. 122-122c, as *monachus*), and in Kiener (1846-1850, *Conus*, pl. 56, figs. 1-1f, as *mediterraneus*; and in pl. 50, figs. 1-1d, as *monachus*).

#### *Conus minimus*

1758, *Systema naturae*, ed. 10, p. 714, no. 263.

1767, *Systema naturae*, ed. 12, p. 1168, no. 305.

LOCALITY: Not given in either edition.

"C. testa cinerascente punctis oblongis cincta."

This is a debatable species and, to the writer, unidentifiable. The brief description in the "Systema," its lack of concordance

with the single figure referred to, the fact that the longer description in the "Museum Ulricae" adds little that is helpful and may not have been designed to cover the same species, the lack of a locality, and the fact that no type specimen is found in the collection of Linnaeus leave us with too little evidence on which to base a satisfactory identification.

The description in the "Systema" tells us nothing except that it is an ash-colored shell banded with oblong spots, and even these few words contain an inconsistency. The word "punctum" means a hole or, as often used by Linnaeus, a point or dot, and "oblonga" is therefore a misnomer. It is a singularly unrevealing description, as it might apply to several cones. The figure from Argenville (1742, pl. 15, fig. A) has been popularly held to represent *Conus figulinus* Linné, and it is so much like that shell that a specimen of *figulinus* may have been the model for the figure. Its color is that of *figulinus*, and its body whorl seems to be encircled with closely packed lines or threads, which is one of the diagnostic features of the latter shell. The figure is, however, so completely unresponsive to the description that it is almost impossible to believe that Linnaeus was not guilty of an error of transcription. It has already been suggested in the Foreword to Part 1 (Dodge, 1952) that a description, if intelligible, is a more weighty factor in the identification of a species than a cited figure. This is based on what appears to the writer to be the unanswerable argument that Linnaeus' descriptions are his own interpretation of the objects before him, while most of the figures available to him were crude, and his choice of a figure often represents the nearest approximation to the specimen which he could find in the works at his disposal. More important still, the citation of a figure always involves the danger of an error of transcription, of which many examples are found in his works. The description of *minimus* is intelligible, even if we cannot tie it to a single known species, and it would stretch the limits of my credulity to believe that Linnaeus could have wittingly chosen this figure of Argenville to represent the species covered by the description.

The definition in the "Museum Ulricae" adds two details which point still farther



away from *figulinus*. There the color of *minimus* is described as "glaucosordidoque nubilata" which does not fit the rich tan and cinnamon color of *figulinus* and its lack of any nebulous color pattern. Secondly, the spire is said to be "albida" and to exhibit "maculis fuscis, magnis, transversis." These expressions cannot be applied to *figulinus*. In the face of these glaring inconsistencies, Tomlin categorically identified *minimus* with *figulinus*, as many of his predecessors had done. Such an identification was obviously based on the cited figure, and the plain language of the description was disregarded.

Neither Martini nor Chemnitz described a *Conus minimus*, although *C. figulinus* is clearly described and well figured by the former (1769-1777, vol. 2, pp. 299-301, pl. 59, fig. 656) and referred to the *figulinus* of Linnaeus.

Born (1780, p. 156) described, but did not figure, a *C. minimus* which he believed to be that of Linnaeus and so listed it, and this identification was accepted by many of his successors. Born's description reads: "Testa ovata-oblonga, glaucosordidoque nebuloza, lineis fuscis interruptis cincta . . . Spira variat corona." With the exception of the last phrase, this description parallels, to some extent, the description in the "Museum Ulricaë." That phrase, however, is definitely a departure from either of the Linnaean descriptions. While Linnaeus did not give the weight to the presence of a coronation that is given to this feature by modern conchologists, he always mentioned it when present, and there is no reference to it in either the "Systema" or the "Museum Ulricaë" descriptions of *minimus*. Born's *minimus* is a coronate species, and his reluctance to accept this as a constant feature may have been due to the fact that worn specimens were among the lot examined by him or to the fact that his lot contained two different species. Coronate species of *Conus* are constantly coronate and never show aberrant individuals lacking coronation, at least when unworn.

Gmelin (1791, p. 3382) described *C. minimus* and referred to the *minimus* of the "Museum Ulricaë" and to a figure from Martini (*tom. cit.*, pl. 55, fig. 613). That figure shows an ovate rather than a conic shell, thus conforming, to this extent, with the description

in the "Museum Ulricaë" and with a color pattern of dark longitudinal streaks almost concealing the ground color of bluish gray. The figure bears little resemblance either to Linnaeus' description or to the Argenville figure he cited. The coloring, both of the body whorl and of the spire, is not too unlike that given for *minimus* in the "Museum Ulricaë," but the spiral lines required by that work and the "Systema" are not shown. I am unable to give a name to the figure. Martini himself called it *Textile sericum* and referred to it *Conus monachus* Linné, with a question mark, and adds the very significant and emphatic query, "Vix credo." Martini's scepticism is understandable. Gmelin also referred to two figures from Knorr (pt. 5, pl. 25, fig. 5; pt. 6, pl. 1, fig. 5), which had already been added to the synonymy of *minimus* by Linnaeus' son. The two figures are of two entirely different shells and their only similarity to Linnaeus' descriptions is the presence of the series of spiral dotted lines in both. Deshayes and Milne-Edwards (1835-1845, vol. 11, p. 62) were the first to adopt the view that Gmelin's *minimus* was not the *minimus* of Linnaeus, but was equal to *C. achatinus* Hwass in Bruguière, 1792. Their opinion was obviously not based on Gmelin's description, which was identical with that in the "Systema" and with the main description in the "Museum Ulricaë," but on the Martini figure.

Lamarck (1822, p. 450) listed a *C. minimus*, crediting it to "Lin. Gmel." Its color was described as "glaucina, fulvo-maculata," and in his appended French description he said, "with reddish brown spots, and ornamented with articulated spiral lines, on a background of pinkish white or violet." It will be noted that all these latter descriptions of what was supposed to be Linnaeus' *minimus* show a similarity in color pattern which is strongly suggestive of the *C. coronatus* of Gmelin, and both the *minimus* of Born and that of Lamarck are described as being coronate. Tomlin, indeed, definitely unites *minimus* Born and *coronatus* Gmelin, an opinion which seems entirely reasonable, and the *minimus* of Lamarck is, I suggest, the same shell. Mermod (1947, p. 193) reports that of the six specimens of "*minimus*" known to have been owned by Lamarck three are now in the

Lamarck collection in the natural history museum in Geneva, one of which was the model for a Chenu figure (Chenu, 1859, 1862, vol. 1, p. 244, fig. 1460) of *C. minimus*. This figure is a black and white line drawing and is not particularly detailed but does show an obvious coronation. It is a short, plump shell, with encircling spiral lines of dots and no further ornamentation save a few amoeba-like dark blotches. It is, however, much like Gmelin's *coronatus*. The other three specimens are not at Geneva, but, *vide* Mermod, were the models for Kiener's figures of *minimus*. These are colored figures resembling very closely the sketchy figure of Chenu but with a more elaborate color pattern of asymmetrically arranged dark blotches and are visibly coronate (Kiener, 1846-1850, p. 44, pl. 14, figs. 1a, b, c).

Lamarck, for his *minimus*, referred to three Martini figures (1769-1777, vol. 2, pl. 63, figs. 703-705), all of which show a small conic shell with fulvous blotches and suggestions of interrupted spiral lines. Two of the figures are coronate. They all correspond reasonably well to Lamarck's description but are not sufficiently characteristic to be identified. Except for the coronation they might represent *monachus* Linné (*Mediterraneus* Hwass in Bruguière, 1792), but were probably based on specimens of *coronatus* Gmelin. The only reference in Lamarck's synonymy which points away from *coronatus* is the reference to Bruguière's *minimus* (1792, p. 618; 1798, pl. 322, fig. 2). This figure is very clearly not coronate. It shows an ovate shell, with very convex spire whorls with deep sutures and a round shoulder. The series of spiral dotted lines cover the entire body whorl. The color pattern consists of light and dark blotches arranged so asymmetrically that it is not possible to read into them any longitudinal or transverse tendency. It is not a good figure and does not recall any species known to the writer.

Hanley (1855, p. 169) admitted that the Argenville figure (pl. 15, fig. A) cited by Linnaeus for *minimus* was "manifestly" *C. figulinus* Linné, but he confessed himself unable to identify *minimus*. He also held that the *minimus* of Born and others was a different species. As to the *minimus* of Hwass in Bruguière he said (*loc. cit.*): "In modern

works we find a *Conus minimus* (Reeve, Conch. Icon. vol. 1. Con. f. 143) supposed by Hwass to be identical, but upon what grounds I cannot understand."

Tryon (1879-1888, vol. 6, p. 22) identified Linnaeus' *minimus* with the group of *C. miliaris* Hwass in Bruguière, 1792. As *miliaris* is a synonym of the coronate *C. coronatus* Gmelin and *Cucullus coronalis* Röding, which are merely new names for *C. minimus* Born, Tryon perpetuated the original error of Born who identified his *minimus* with that of Linnaeus.

Tomlin's view has already been referred to.

The most recent opinion is that of Morrison (personal communication). He recognizes that the *minimus* of Linnaeus and of Born are specifically separable and confesses his inability to identify the Linnaean species. After examination of the figures, descriptions, and references of those who have listed a "*Conus minimus* Linné," and especially the two Linnaean diagnoses, I am unable to form any opinion as to its identity and am constrained to leave it as a *species dubia*.

I have referred above to the possibility that the *minimus* of the "Museum Ulricae" was a different species from that described in the "Systema" and the seeming certainty that Gmelin's *minimus* was not the "Systema" species.<sup>1</sup> In this connection the remarks of Deshayes and Milne-Edwards (1835-1845, vol. 11, p. 19, footnote) are here quoted in full, not only to show the scepticism of these authors as to the position of Gmelin's *minimus*, but to illustrate the confusion in the minds of the nineteenth century conchologists as to the identity and the synonymies of the several species involved in this question. They said: "If Linnaeus had not given a short description of this species in the Museum of the princess Ulrica, it would have been impossible to recognize it from the much too short details of the 10th and 12th editions of the *Systema Naturae*. It is obvious that the

<sup>1</sup> Gmelin referred his *minimus* to the *minimus* of the "Museum Ulricae." It should be pointed out that Gmelin, in citing Linnaean species, never referred to the "Systema" and, in the case of such species as were also described in the "Museum Ulricae," always listed the latter work as a reference. Such a reference, therefore, does not necessarily mean that the latter work covered a different shell, or that Gmelin thought so.

species of Bruguières and Lamarck is indeed the same as that of Linnaeus. Lamarck erroneously referred to the *Conus minimus* of Gmelin in his synonymy. Indeed, under the characteristic phrase which he borrowed from Linnaeus, Gmelin used a part of the synonymy of *Conus achatinus*, while in the synonymy of *Conus coronatus* he cited a figure of the true *minimus*. . . . Dillwyn considered the *Conus minimus* of Linnaeus to be a variety of *Figulinus*, and, adopting the *Conus coronatus* of Gmelin, he rejected its entire synonymy and substituted for it that of the *minimus* of Linnaeus. According to Mr. Reeve, the *Conus tiaratus* of Mr. Broderip is only a variety of *Minimus*.<sup>1</sup> We are placing it in our synonymy, relying on the authority of Mr. Reeve, because the variety in question is not before us."

A study of the diagnoses of Gmelin's *minimus*, *achatinus*, and *coronatus* does not disclose the "characteristic phrase" which he borrowed from Linnaeus, nor can I select, from the 14 figures cited in the synonymy of *coronatus*, the one which was said to be "a figure of the true *minimus*."

The origin of the name *minimus* has not been appreciated by many workers, and this may have contributed to the confused manner in which the name has been discussed. It does not mean, as might be supposed, that the shell was small, although some of the shells that have been suggested as its representative are, in fact, small. The name was intended to be a Latinized version of "Le Minime," meaning "the monk," an appellation used by Gersaint (1736, p. 112, no. 266), Argenville (1742, p. 234, pl. 12, fig. A), and Davila (1767, vol. 1, p. 242, no. 477). The Argenville figure was the one cited by Linnaeus for his *C. minimus*, and from which he borrowed his specific name. In this connection, Martini (1769-1777, vol. 2, pp. 299-301, pl. 59, figs. 656-657) described and figured a shell which he called *Lignum Quercinum* and referred to *C. figulinus* Linné. The figures clearly represent *figulinus*, but he was apparently deceived into thinking that his species was the "Minime" of the pre-Linnaean authors, as he cited the "Minime" of Gersaint

<sup>1</sup> Reeve did not so express it. He made *tiaratus* Broderip, 1833, equal to *coronatus* Gmelin, which is not *minimus* Linné.

and Argenville, using the name. He also cited a figure from Regenfuss (pl. 10, fig. 47) which that author called *Cuculla minimorum franciscanorum*. Both Regenfuss' and Argenville's figures of "Minime" resemble *figulinus* superficially, but Regenfuss' shell, at least, was apparently quite a different species. It was probably the *Monachus franciscanus* of Chemnitz (1780-1795, vol. 10, p. 68, pl. 142, figs. 1319-1320)<sup>2</sup> and Lamarck's variety "[c]" of *Conus achatinus* Hwass in Bruguière, 1792,<sup>3</sup> a dark brown shell with sparse white blotches. It has the spiral lines of *figulinus*, but its spire is more elevated, and it has a more ovate and less conic outline. In any case its ornamentation of white spots distinguishes it from any form of *figulinus*. While Linnaeus borrowed the name *minimus* from Argenville, he was either guilty of an error of transcription of plate or number, or was deceived as to its characteristics, as his description conforms in no respect to the "Minime" of his predecessors.

In brief, all three authors, Argenville, Martini, and Linnaeus, were deceived in their conception of "Le Minime." Argenville erroneously gave the name to his figure A, a name that belonged to another species, the "Minime" of Gersaint and the other authors mentioned. Martini was deceived into thinking that his *Lignum Quercinum* (*figulinus* Linné) was also the "Minime" of the earlier authors. Linnaeus, probably through an error of transcription, used the name *minimus* because it was appended to a figure which he never intended to cite. In other words, I suggest that he originally chose a different figure, but when he actually put pen to paper he unwittingly substituted another figure and automatically used the name which Argenville used for it. It may well be that he would have chosen another name for his species had it not been for such an error. For those who are accustomed to the punctiliousness of modern authors in regard to references such an argument may seem fanciful, but the more one studies the works of Linnaeus the more

<sup>2</sup> Abbott (personal communication) suggests the possibility that the Chemnitz figures 1319 and 1320 were intended to represent *Conus catus* Hwass in Bruguière, 1792.

<sup>3</sup> Tomlin could not separate *achatinus* from *monachus* Linné.

one suspects his synonymies, and endeavors to discover the reason for his errors. Of one thing we may be sure. Linnaeus never intended to cite this particular figure from Argenville.

#### *Conus rusticus*

1758, *Systema naturae*, ed. 10, p. 714, no. 264.

1767, *Systema naturae*, ed. 12, p. 1168, no. 306.

LOCALITY: "In Africa" (1758, 1767).

"C. testa ovata, basi rugoso muricatoque scabra spira conico-convexa . . . testa livida, fascia albedo nebulosa."

This species has not been satisfactorily identified, although several writers have suggested possible identifications, which are referred to below. The description in the "Systema," while fairly detailed, cannot be tied to a particular species, especially when read in connection with the very diverse synonymy. The language in the "Museum Ulricae" contains additional data, particularly the phrase "longitudinaliter nebulosa flavo et glauco" which clarify to some extent the description of the color pattern in the "Systema."

The synonymy is a classic example of Linnaeus' search for figures among the iconographies available to him, the majority of the drawings in which are extremely crude. The references embrace three different species as nearly as can be determined. The Rumphius figure (pl. 32, fig. R) possibly represents *Conus cinereus* Hwass in Bruguière, 1792, and has been usually accepted as such. That shell is, however, not "ovata," and its base is not "rugoso muricatoque scabra," as the description of *rusticus* requires. The reference to Gualtieri (pl. 25, fig. R) is a drawing of an apparently much worn shell which cannot be identified with certainty but which Hanley (1855, p. 170) suggested "has somewhat the aspect of *magus* or *achatinus*."<sup>1</sup> The figure is not particularly characteristic of either species and shows few features which correspond to the description of *rusticus*. The third figure cited (Argenville, 1742, pl. 15, fig. D) represents what is seemingly a smooth and polished conic shell, which is opposed to the "ovata" of the description and to the language re-

<sup>1</sup> *Conus achatinus* Hwass in Bruguière, 1792, is a synonym of *C. monachus* Linné, *vide* Tomlin.

lating to the basal sculpture. This figure has been referred by some writers to *C. classarius* Hwass in Bruguière, 1792. The reference was marked "bene" in Linnaeus' copy of the "Systema," which may be explained by the fact that the box marked for *rusticus* in the Linnaean collection contains a highly polished specimen of *classarius*. The use of the collection as a guide, however, is complicated by the finding, in the same box, of specimens of *C. flavidus* Lamarck, 1810, and *C. lividus* Hwass in Bruguière, 1792. Hanley (*loc. cit.*) suggested that Linnaeus probably believed the polished specimen to be the uncoated state of one of the other two shells. As *classarius*, which Hanley recognized as the polished shell, is unlike either *flavidus* or *lividus*, the suggestion would seem to have no weight. It may seem strange that Linnaeus should have united the latter two species in the same box, as *lividus* is a coronate shell while *flavidus* is non-coronate, although they have a superficial resemblance. This is explained by the footnote which follows the diagnosis of *rusticus* in the "Systema": "The shells which are called coronate are those in which the upper part of the whorls are either tuberculate or mucronate; there is no specific difference between the coronate and non-coronate (calvas) shells." This conception, that coronation is a mere varietal rather than a specific difference, is, of course, completely erroneous. No species of *Conus* has coronate and non-coronate forms. The "Museum Ulricae" diagnosis of *rusticus* mentions a coronate form ("Varietas coronata major"), and it is probable that this was based on a specimen of *lividus* in the Queen's collection.

We are thus presented with a description which is inadequate, a synonymy that appears to show three different species, and with a mixture of three species marked for *rusticus* in the collection. *C. rusticus* must be left as unidentified, although it is possible that Linnaeus based it on the combined features of *lividus* and *flavidus*.

Martini (1769-1777, vol. 2, pp. 229-230, pl. 52, fig. 578) was the first to suggest a possible identification. He there listed a *Conus teres* for which he cited, among other references, the same Rumphius figure that Linnaeus used for *rusticus* and referred to the *rusticus* of the "Systema," although he placed

a query after the reference.<sup>1</sup> His figure 578 shows a predominantly blue shell with interrupted brown spiral lines covering the entire body whorl and with a distinct white band just below the middle of the shell. The spire is shown as concave, mucronate, and with deep sutures. I hesitate to give a name to this figure.

Chiaje (1826, p. xxxviii, pl. 45, figs. 4-6) cites a *Conus rusticus* "L." The Chiaje work was not available to me, but Tomlin reports that the figures are those of *C. mediterraneus* Hwass in Bruguière, 1792.

Reeve (*tom. cit.*, pl. 41, sp. 220) identified *rusticus* Linné with both *C. cinereus* Hwass in Bruguière, 1792, and *C. caerulescens* Lamarck, 1810, possibly basing the first identification on the Rumphius figure cited by Linnaeus and which was called *Voluta cinerea* by Rumphius.

The confusion that existed in the minds of Linnaeus' immediate successors is well illustrated by Gmelin's treatment of *rusticus*. He lists the species as from the "Museum Ulricae" copies the "Systema" description, and assigns to it three varieties. For variety "α" he cited the Rumphius figure which that author called *Voluta cinerea* and which Linnaeus cited for *rusticus*. It is generally accepted as representing the *cinereus* of Hwass. For variety "β" he cited two other figures from Martini (*tom. cit.*, pp. 339-340, pl. 63, figs. 694-695), which the latter referred specifically to *Conus rusticus* Linné. His figure 694 is an unmistakable likeness of *C. lividus* Hwass. The figure 695 is unrecognizable. For variety "γ" he referred to two Chemnitz figures (1780-1795, vol. 10, p. 90, pl. 144A, figs. e and f). Both of these figures, which he cited with a query, look like *C. spectrum* Linné, and the figure f was cited for that species by Gmelin a few pages later, with several other Chemnitz figures, all of which show color forms of *spectrum*. Thus Gmelin adopted two of the species which Linnaeus had united in *rusticus* and added a third of his own.

Deshayes and Milne-Edwards (1835-1845, vol. 11, pp. 62-63), in their discussion of

<sup>1</sup> *Conus teres* Martini is cited by Reeve (1843-1878, vol. 1, *Conus*, pl. 36, sp. 194) as a synonym of *clavus* Linné, but later (*tom. cit.*, pl. 40, sp. 217) he said it was equal to *spectrum* Linné. (See discussion of *C. clavus*, below.)

*Conus cinereus*, sum up in a footnote the conclusion which conchologists have been forced to adopt as to this species: "After having studied the *Conus rusticus* of Linnaeus, one is constrained to regard this species as too doubtful to justify its retention in the catalogues; the description is too short even in the *Museum Ulricae*, and the synonymy, composed of three citations, includes figures of three distinct species. That of Rumphius alone can remain in the synonymy of *Conus cinereus* of Bruguière. The preceding justifies those conchologists who retain for the species the name of *Conus cinereus*. Gmelin continued the confusion in Linnaeus' synonymy and added errors of his own. It is thus that he added *Conus lividus* as a variety."

#### *Conus mercator*

1758, *Systema naturae*, ed. 10, p. 715, no. 265.

1767, *Systema naturae*, ed. 12, p. 1169, no. 307.

LOCALITY: Not given in either edition.

"C. testa ovata alba, fasciis reticulatis flavis."

The description in the "Systema" can confidently be referred to the shell which we know as *mercator* Linné. It is accurate in all details, and the phrase "fasciis reticulatis flavis" can be applied to no other Linnaean cone that conforms to the remaining language. The "Museum Ulricae" adds the important details that it is the size of a beech nut and that there are two spiral reticulated bands, one at the shoulder ("juxta verticem") and the other at the middle of the body whorl.

The figures in the synonymy are unusually accurate and characteristic, with the exception of one of the Lister figures (pl. 758, fig. 3), which bears no resemblance to *mercator* and was properly crossed out in the copy of the "Systema" which Linnaeus used as the manuscript of his proposed "revised twelfth edition." In the "Museum Ulricae" the only one of the "Systema" figures used was that from Argenville (pl. 15, fig. P).

A specimen of the species conforming entirely to the description and the synonymy is in the Linnaean collection, wrapped in a paper bearing the name. It is not the type specimen, however, as the name *mercator* is not found on any of Linnaeus' lists of owned shells, and it was undoubtedly added by a later hand.

Two Martini figures (1769-1777, vol. 2, pl.

56, figs. 619–620) were added by Linnaeus' son. Figure 620 is unmistakably intended for *mercator*, although the bands contain white dots instead of reticulations. Martini recognized the identity of his shell with *mercator* Linné but called it *Conus reticulatus*. Tomlin lists *Conus reticulatus* Born, 1780, as a variety, with a query, basing the suggestion on a further Martini figure (*tom. cit.*, pl. 56, fig. 621). This figure was also used by Martini to illustrate the same shell as in figures 619–620. It is radically dissimilar, as the whole body whorl is covered with gross reticulations not concentrated into bands. All these figures, however, show forms of *mercator*, which is a very variable species in respect to the number of bands and their position on the shell, in the fineness or coarseness of the reticulations, and in the substitution of white spots for reticulations. The typical, or most common, form, which is probably the *mercator* of the "Systema" and certainly the form described in the "Museum Ulricae," has two reticulated bands, one at the shoulder and a narrower band on the lower third of the body whorl. Another form has white dots instead of reticulations (Martini, *tom. cit.*, pl. 56, figs. 619–620). The collection of the American Museum of Natural History contains specimens with only the lower band present, a form with two very narrow bands sown with white dots (Kiener, 1846–1850, pl. 54, fig. 3d), others with three reticulated or spotted bands (Martini, *tom. cit.*, pl. 56, fig. 619), and others showing no bands and with the reticulations covering the entire shell (Martini, *tom. cit.*, pl. 56, fig. 621). In addition to the color pattern, the species is characterized by its graceful shape, symmetrically rounded shoulder, and slightly concave and mucronate spire.

*Cucullus aurelius* Röding, 1798, is a synonym of *mercator* Linné.

In Morrison's arrangement the species is included in the subgenus *Chelyconus* Mörch, 1852.

In addition to the figures cited above it is figured in Reeve (1843–1878, vol. 1, *Conus*, pl. 16, fig. 83b) and in Kiener (*tom. cit.*, pl. 54, figs. 3a, b, c).

#### *Conus betulinus*

1758, *Systema naturae*, ed. 10, p. 715, no. 266.  
1767, *Systema naturae*, ed. 12, p. 1169, no. 308.

LOCALITY: Not given in either edition.

"C. testa basi submarginata rugosa, spiraplaniuscula mucronata."

*Conus betulinus* is a large, coarse shell with a base color of cream or light tan, the body whorl encircled with numerous interrupted spiral lines consisting of dark brown round or oblong spots. It is variable in the number, size, and shape of these spots, some specimens having very few. The shoulder is well rounded and the spire low, slightly concave, and mucronate. The description in the "Systema," which treats only of the basal rugae and the details of the spire, could not have identified the species. The description in the "Museum Ulricae" adds the necessary details as to the color pattern and its variations and the size and shape of the shell ("turbinata . . . magnitudine pyri") and must be used as the definitive description of the species. In color pattern the shell superficially resembles the members of the *litteratus* group of cones but is easily distinguished by its rounded shoulder, higher and more mucronate spire, and usually smaller spots on the body whorl. In shape it is similar to the following species, *Conus figulinus*, but is distinguished by its much paler coloration and the much smaller number of its spiral lines.

The synonymy of *betulinus* is partially correct. The Gualtieri figure (pl. 21, fig. B) and that from Rumphius (pl. 31, fig. C) are sufficiently characteristic of *betulinus*. Seba's drawings are not useful. Of these one (vol. 3, pl. 45, fig. 1) is certainly intended for one of the *litteratus* group, probably *millepunctatus* Lamarck, and the rest are not recognizable. The figure from Olearius is too crude to permit of a positive identification, although it is somewhat like *betulinus*.

The identification is confirmed by the presence of a marked specimen of *betulinus* in the Linnaean collection, which entirely agrees with the description in the "Museum Ulricae" and with the decipherable portion of the synonymy.

The species is identical with *Cucullus lacteus* Röding, 1798, not *Conus lacteus* Lamarck, 1810, nor Reeve, 1844. *C. immaculata* Dautzenberg, 1906, is considered by its author to be a variety of *betulinus*.

In Morrison's arrangement it is placed in the subgenus *Chelyconus* Mörch, 1852.

Linnaeus' son added to the synonymy a figure from Martini (1769–1777, vol. 2, p. 308, pl. 60, fig. 665). This figure was later used by Gmelin and Lamarck as illustrating *betulinus*. Martini referred the figure to Linnaeus' *betulinus*, calling it *Meta butyri flava*, a name copied from Rumphius' *Meta batyri flava*, and cited the Rumphius and Gualtieri figures used by Linnaeus, but it is difficult to accept it as being *betulinus*, as it seems to combine characteristics both of that shell and the *litteratus* group. Another Martini figure (*tom. cit.*, pl. 61, fig. 675) pictures a shell of the exact conformation of *betulinus* but with a series of blackish streaks arranged in three spiral bands around the body whorl. Martini (*tom. cit.*, p. 318) did not associate it with *betulinus* and called it *Voluta Caput Medusae*, a name which he himself erected, but this name and its figure were later used by Gmelin for his *Conus betulinus*, subspecies "β," *Medusa* (1791, pp. 3383–3384, no. 20), which the latter describes as "alba seriebus tribus characterum violaceorum." I am not familiar with this form, if, indeed, it exists and can be referred to *betulinus* Linné. Lamarck did not refer to it, nor did Deshayes and Milne-Edwards. Tomlin treats *C. betulinus medusa* Gmelin as being equal to *Cucullus tigris* Röding, 1798, and *Cucullus medusae* Röding. Chemnitz (1780–1795, vol. 10, p. 69, pl. 142, fig. 1321) describes and figures *Meta butyri*, which he refers to as a variety of *Conus betulinus* and cites Martini's figure 665, a figure from da Costa (1776, pl. 5, fig. 3), Born (1780, p. 158), and Favanne's Argenville (1780, vol. 2, p. 455, pl. 16, fig. L 2). The Chemnitz figure certainly shows the form of *betulinus* Linné where the dark round or rounded spots are replaced by blotches in the form of broad transverse dashes. This figure was used by Gmelin for his variety "γ" and by Lamarck for his variety "δ" of *betulinus* Linné, and represents a fairly common form. Da Costa's figure is good. Born's description clearly points to *betulinus* Linné. The figure from Favanne's Argenville looks nothing like *betulinus*.

#### *Conus figulinus*

1758, *Systema naturae*, ed. 10, p. 715, no. 267.  
 1767, *Systema naturae*, ed. 12, p. 1169, no. 309.  
 LOCALITY: Not given in either edition.

"C. testa basi emarginata rugosa, spira acuminata: anfractibus planiusculis."

The color of *Conus figulinus* Linné, a cinnamon-yellow shell as Lamarck described it, its numerous, closely spaced, dark brown, spiral lines, its distinctive conical shape, its gracefully rounded shoulder and low convex spire with sharply acuminate early whorls make it one of the easiest of the cones to recognize. It could not, however, have been identified from the description in the "Systema," which omits any reference to its unique color and color pattern. Of the two figures supplied the Rumphius drawing (pl. 31, fig. V) is not helpful, being obviously meant for the shell later described by Hwass in Bruguière (1792, vol. 1, p. 681; 1798, pl. 332, figs. 5–6) as *C. quercinus*. The Linnaean description might conceivably be applied to that shell. The figure from Regenfuss shows a very light-colored specimen of *figulinus*. A specimen much resembling this figure is present in the Linnaean collection. The synonymy is therefore half correct.

The language of the "Museum Ulricaë," however, clears away all doubts. It is adequately characteristic and particularly notes the pattern as "pallidus, cinctus lineis testaceis" and mentions the rounded shoulder of the body whorl and the spire as "ferruginea, convexa . . . sensim mucronata, anfractibus 11 seu 12." More graphic language could scarcely have been chosen to point to *figulinus*. This is therefore another case where the entire diagnosis in the "Systema" is insufficient to identify the species with assurance, and the description in the "Museum Ulricaë" must be invoked.

*Cucullus buxeus* Röding, 1798 (not *buxeus* Reeve, 1844), *Conus loroisii* Kiener, 1847,<sup>1</sup>

<sup>1</sup> Kiener's *C. loroisii* is listed by him as a good species (1846–1850, pl. 65, fig. 1), and not even its similarity to *figulinus* Linné is mentioned. The shell, with the exception of color and a slight deepening of the basal striations, is identical with *figulinus*. Its base color is a pale cream. The closely packed brown spiral lines of the latter are here somewhat wider and more widely spaced and are obsolete in some specimens. There are also vague, longitudinal brown lines coincident with the growth lines of the shell which are probably formed just prior to, or at the time of, the successive cessations of growth. The edge of the outer lip shows no deepening of color in any individuals I have examined. The whole shell is pale and the markings are faint. I am inclined, however, to agree with Tomlin that it is a form of *figulinus*.

and *Voluta fagina* Martyn, 1792, are identical with *figulinus*. Tomlin considered *C. chytreus* Tryon, 1883, to be a variety of *figulinus* Linné and apparently treats *C. violascens* Barros e Cunha, 1833, as a subspecies. Tomlin also considered the present species an exact synonym of *C. minimus* Linné, and in this he is joined by many conchologists. This identification is discussed under the latter species, above. The *figulinus* of Linnaeus is not *figulinus* Grateloup, 1847, a Tertiary fossil, which is the *subfigulinus* of d'Orbigny, 1852.

In Morrison's arrangement *figulinus* belongs in *Chelyconus* Mörch, 1852, section *Cleobula* Iredale, 1930, as the type of the section, by original designation.

The first post-Linnaean figures are those of Martini (1769–1777, vol. 2, figs. 656–657) and are reasonably accurate. The species is well figured in the "Tableau encyclopédique" (1798, pl. 332, fig. 1) and in Kiener (1846–1850, pl. 28, fig. 1, both figures). These are the best figures of the species available.

#### *Conus ebraeus*

1758, *Systema naturae*, ed. 10, p. 715, no. 268.

1767, *Systema naturae*, ed. 12, p. 1169, no. 310.

LOCALITY: "In India" (1758, 1767).

"C. testa ovata alba: fasciis nigris ex maculis transversis."

The elaborate and correct synonymy supplied for this species in the "Systema" rather than the accurate although brief description insured its early identification. The description in the "Museum Ulricaë" added significant and conclusive details as to its size, basal sculpture, and spire, and specimens of the *C. ebraeus* of all authors are present in the Linnaean collection which are in complete accord with the description and the figures cited for it.

The name *ebraeus* was emended by Martini (1769–1777, vol. 2, pp. 259–261) to *hebraeus*. Although this was unjustifiable, the latter name has persisted in the literature and is almost universally used today. It probably was based on the fact that some of the pre-Linnaean authors called the shell "l'Hebraïque."

*Conus quadratus* Perry, 1811 (not *Cucullus quadratus* Röding, 1798, which is the same as *C. spurius* Gmelin, 1791) is a synonym.

In Morrison's arrangement *C. ebraeus* is

included in the subgenus *Rhombus* Montfort, 1810, section *Virroconus* Iredale, 1930, as the type of the section, by original designation.

The earliest post-Linnaean figure is that of Martini (1769–1777, vol. 2, pl. 56, fig. 617), a clear and easily identifiable drawing. See also Chemnitz (1780–1795, vol. 10, pl. 144A, figs. g and r), which are among the most characteristic figures available; "Tableau encyclopédique" (1798, pl. 321, figs. 2 and 9); and Kiener (1846–1850, pl. 4, fig. 2).

The "varietas maculis ramosis gaudens" of the "Museum Ulricaë" is the *Cucullus chaldaeus* Röding, 1798, for which the later name *Conus vermiculatus* Lamarck, 1810, is commonly used. Linnaeus' references to Lister (pl. 779, fig. 26) and Gualtieri (pl. 25, figs. T and Q) represent this form. Martini (*tom. cit.*, pp. 343–345, pl. 63, figs. 699–700) has very characteristic figures of *chaldaeus*, but refers them, fortunately with a query, to *C. princeps* Linné, a much larger, more slender, and more brightly colored species. Born (1780, p. 153) was guilty of the same error.

*Conus chaldaeus* (Röding) is usually given specific rank today, although there is still a difference of opinion as to its possible relationship to *ebraeus*. Based on shell characters alone it seems to be conspecific with *ebraeus* and of only varietal rank. In the middle of the last century Reeve (1843–1878, vol. 1, *Conus*, pl. 19, sp. 104a) adopted the latter view. Deshayes and Milne-Edwards (1835–1845, vol. 11, pp. 20–21, footnote 2) rather tepidly disagreed, saying: "M. Reeve... proposes to attach *vermiculatus* to *hebraeus* as a variety; we would be tempted to follow his example, but despite all our efforts we have never encountered intermediate varieties, although we have searched with much care." I suggest above that, based on shell characters alone, the two seem to be identical save, of course, in the matter of the color pattern. In this connection Deshayes and Milne-Edwards (*loc. cit.*) quoted Quoy and Gaimard as reporting that "the animal of this cone is absolutely identical with that of the following, *Conus vermiculatus*." The most recent comment on the subject is that of Abbott (1950, p. 85). He says, in his discussion of *chaldaeus*, "It may possibly be a form of *ebraeus* Linné."



In addition to the early figures mentioned above, *chaldaeus* is figured in the "Tableau encyclopédique" (1798, pl. 321, figs. 1 and 8); Chenu (1895, 1862, vol. 1, fig. 1457); and Kiener (1846–1850, pl. 8, fig. 3a).

#### *Conus stercus-muscarum*

1758, *Systema naturae*, ed. 10, p. 175, no. 269.

1767, *Systema naturae*, ed. 12, p. 1169, no. 311.

LOCALITY: "In Asia" (1758, 1767).

"C. testa basi emarginata striata, spirae anfractibus canaliculatis."

As there are several cones with a striated base and with the whorls of the spire canaliculate it would have been difficult if not impossible to have identified this species from the Linnaean description alone. The characteristic dotted color pattern which gave the species its name is not mentioned. Moreover the locality is too broad for the description to be tied to any one species. The rather elaborate synonymy contains figures of both the *stercus-muscarum* of authors and of *C. arenatus* Hwass in Bruguière in almost equal numbers.<sup>1</sup> The tray marked for the present species in the collection of Linnaeus contains specimens of both. The two much resemble each other and are in fact almost identical in color and color pattern. *C. arenatus*, however, is a coronate cone, whereas *stercus-muscarum* is non-coronate and has, moreover, a spire which is deeply canaliculate, which is less true of *arenatus*.<sup>2</sup> I suspect that Linnaeus believed the two shells to be conspecific, and we must therefore admit that the accepted identification is based on tradition. It is to be noted, parenthetically, that the "sub-generic" headings in *Conus* Linné are based largely on the relative lengths of the body whorl and the spire and that the coronate and non-coronate species are not distinguished.

<sup>1</sup> Hanley (1855, p. 173), in discussing this synonymy, incorrectly called the Hwass species *arenarius* and repeated this error in a later paper (1860, p. 62).

<sup>2</sup> In the majority of individuals the blackish brown dots of *arenatus* are smaller, more numerous, and therefore more thickly distributed. They tend to concentrate and arrange themselves in spiral lines at the base of the shell, and often form zigzag vertical lines on the body whorl, whereas in *stercus-muscarum* the concentrations are less symmetrical and more blotchy. However, these distinctions are not absolutely diagnostic, as specimens of the two species can be found which show an identical color pattern, leaving the details of the spire the only sure guide to identification.

Born and Schröter perpetuated the confusion between the two species.

*Cucullus arenatus* Röding, 1798 (not Hwass in Bruguière, 1792, which latter species is *Cucullus arenosus* Röding, 1798), and *Cucullus sabella* Röding, 1798, are synonyms.

In Morrison's arrangement the present species is included in the subgenus *Textilia* Swainson, 1840, and *C. arenatus*, which Linnaeus confused with it, is the type of the subgenus *Puncticulus* Swainson, 1840.

Good early figures of *stercus-muscarum* are found in Martini (1769–1777, vol. 2, pl. 64, figs. 711–712). Martini (*tom. cit.* pp. 349–351) properly referred them to the *stercus-muscarum* of the "Systema," although he called the species *Voluta arenata*. They do not represent the species later called *arenatus* by Hwass. The present species is also well figured by Reeve (1843–1878, vol. 1, *Conus*, pl. 17, sp. 90), and by Kiener (1846–1850, pl. 58, fig. 3). Kiener also shows good figures of *arenatus* (*tom. cit.*, pl. 10, figs. 1, 1a, 1b).

#### *Conus varius*

1758, *Systema naturae*, ed. 10, p. 715, no. 270.

1767, *Systema naturae*, ed. 12, p. 1170, no. 312.

LOCALITY: Not given in either edition.

"C. testa elongata muricata, spira coronata acuta."

In spite of the absence of any reference to color or color pattern and the failure to give any locality, a common fault in the diagnoses of many Linnaean cones, this species was readily identified by the characteristic figure from Argenville (pl. 15, fig. R), the only figure cited, and the more ample language of the "Museum Ulricae," which graphically describes the decoration of the shell and emphasizes the granulated spiral lines over the entire surface of the body whorl. The latter feature gave to the shell its popular name of "Peau de Chagrin," first used before Linnaeus by Davila and Argenville and later adopted by Martini (1769–1777, vol. 2, pp. 324–325) and Lamarck (1822, p. 454). A specimen of the *Conus varius* of all modern authors is found in the Linnaean collection, but, not having been included by Linnaeus in his lists of owned species, must be assumed to have been added by a later hand and is therefore without authority.

Martini (*loc. cit.*, and pl. 61, fig. 679) described what was clearly *C. varius* and referred to the *varius* of both editions of the "Systema" and the "Museum Ulricaë." His figure is poor and is not referable to this species. Chemnitz, however (1780-1795, vol. 10, p. 26, pl. 138, fig. 1284), while he supplied a figure which is fully as accurate and characteristic as the recent figures of the shell, does not use the name *varius* but calls the species *Papyrus marmorata*, followed by a detailed and graphic description of the *varius* of Linnaeus, and uses the popular name "Peau de Chagrin." In the text, however, he recognizes the Linnaean origin of the shell saying (*loc. cit.*): "Linnaeus properly called this shell *Conus varius* as it has many variable characteristics running through a wide range (es gar viele sehr weit von einander abweichende Abänderungen giebt)." He states the locality to be both the East and West Indies, whereas it is confined to the Indo-Pacific region.

Gmelin divided the species, basing his typical *varius* on the Martini figure cited above, which is not *varius* Linné, and his undescribed variety " $\beta$ " on the Chemnitz figure, which is *varius* Linné. In the case of such a variable species the naming or figuring of varieties is confusing and useless. Lamarck (*loc. cit.*) also listed a variety "[b]" based on a specimen with the granulations confined to the base of the shell, leaving the upper half smooth and citing a figure from the "Tableau encyclopédique" (1798, pl. 321, fig. 3). I am not familiar with this form, and there is no indication that it was the "variety" of Gmelin. Mermod (1947, p. 210) states that Lamarck possessed two specimens of *varius* but that neither is found in the Lamarck collection in the Natural History Museum in Geneva.

Synonyms of *varius* are: *Cucullus granulatus* Röding, 1798 (not Sowerby, 1834, which is, *vide* Tomlin, a variety of *Conus tendinius* Hwass in Bruguière, 1792; *Cucullus radula* Röding, *vide* Röding himself; and *Conus interruptus* Wood, 1828 (not Broderip and Sowerby, 1829). The shell called *Cucullus vicarius* Röding, 1798, is based on two figures of Martini (*tom. cit.*, pl. 57, figs. 638-639). Tomlin suggests that the first figure is *vicarius* Röding and the second *Conus varius*

Linné. The reticulated surface of both figures and the absence of any granulations would seem to point away from any form of *C. varius* with which I am familiar. Martini called his shell *Proarchitalassus Indiarum orientarium* and his description (*tom. cit.*, pp. 284-285) does not assist us in identifying either figure with *varius* Linné.<sup>1</sup>

Under Morrison's arrangement *Conus varius* Linné is placed in the subgenus *Rhombus* Montfort, 1810.

In addition to the satisfactory figure of Chemnitz cited above, the species is figured by Reeve (1843-1878, vol. 1, *Conus*, pl. 12, sp. 58), in the "Tableau encyclopédique" (1798, pl. 321, figs. 3-4), and by Kiener (1846-1850, pl. 7, figs. 3, 3a). Kiener also (*tom. cit.*, pl. 13, fig. 4) shows a shell that he referred (pl. 21) to the variety "[b]" of Lamarck mentioned above.

#### **Conus clavus**

1758, *Systema naturae*, ed. 10, p. 716, no. 272.

1767, *Systema naturae*, ed. 12, p. 1170, no. 313.

LOCALITY: Not given in either edition.

"C. testa striis convexis laevibus, basi caerulescente . . . Testa flava, maculis albis reticulata: fasciis duabus saturatoribus, maculis albis majoribus: striae obsoletae sunt."

The subdescription was added in the twelfth edition. No references nor locality was supplied in either edition, the shell was not owned by Linnaeus as it does not appear on his lists, and there is no specimen in his collection conforming to the description in the "Systema."

Linnaeus' immediate followers were not in agreement as to its identification. Martini (1769-1777, vol. 2, p. 223, pl. 52, fig. 570), in describing a *Cochlea volutata larga*, referred it to *Conus clavus* Linné of the tenth and twelfth editions and supplied a figure which might be taken for the white-spotted *clavus* of many authors (which is referred to below). Martini called his shell "Das goldene Netz" and "Drap d'Orange. Reseau d'or," both names being graphically descriptive of the reticulated, spotted shell. His colleague and suc-

<sup>1</sup> Reeve (1843-1878, vol. 1, *Conus*, pl. 41, sp. 224) treated *C. interruptus* Wood, 1828, as a variety of *C. varius*. Deshayes and Milne-Edwards (1835-1845, vol. 11, p. 25, note) agreed that the two were conspecific. Tomlin's list merely cites Wood's *interruptus* as being equal to *varius*, *vide* Reeve.

cessor Chemnitz was unwilling to refer this shell to *clavus* Linné. He listed it (1780-1795, vol. 10, pp. 78-79, pl. 143, fig. 1327) as "Die kleine bandirte Netzrolle" which he described in part as *Conus parvus reticulatis fasciata*, the remainder of his description clearly suggesting the spotted *clavus* of authors and his figure being an excellent representation of that shell. He said, however (*loc. cit.*): "... Martini considered that in this 'Netzrolle' he had found *Conus clavus* Linné. To be sure the shell has 'testam elongatam flavescens, fascias binas saturatioribus, maculas albas reticulatas,' but not 'maculas albas majores' but rather 'minores.' Also I find in it no such 'Cylindrum' which should be 'twice, thrice or four times longer than the spire.' Then, too, one of the important features which Linnaeus called for in his Cone and which is responsible for the name *clavus* is lacking.<sup>1</sup> Still it is undeniable that it must be, of course, a near relative of that shell."

Bruguière (1789-1792, vol. 1, p. 742) described *Conus auricomus* and referred to *C. clavus* Linné, 1767. Lamarck (1822, p. 517) was seemingly not troubled by any difficulty of identification, citing for *clavus* not only "Lin. Gmel." but both the Martini and Chemnitz figures mentioned above. Reeve (1843-1878, vol. 1, *Conus*, pl. 36, sp. 94) and Mermod (1947, pl. 176) identify Bruguière's *auricomus* with *clavus* Linné. Tomlin does not, apparently, accept this identification unreservedly but qualifies it by saying "fide Reeve."

The confusion in the identification of *clavus* can be resolved if we realize that, in amplifying the description in the twelfth edition, Linnaeus unwittingly described two species. The twelfth edition language adds to the original description details which apply to *C. auricomus* Hwass in Bruguière, 1792, which became the *clavus* of Reeve and of Hanley (1855, p. 174), which is not *clavus* Linné. Indeed, the diagnosis of *auricomus* in the

<sup>1</sup> Chemnitz did not clearly state what this "important feature" was. It must have been, however, the two dark bands ("fasciis duabus saturatioribus") which Linnaeus described. This is the only reason for the name *clavus*. The primary meaning of *clavus* is a "nail," but there is a little-used secondary meaning of a "stripe," used for the stripe of purple on the tunics of senators and knights in Roman times. Only in this way can Linnaeus' specific name be explained.

Bruguière work refers only to Linnaeus' twelfth edition, suggesting that only that edition was available to him. The *clavus* of the tenth edition is the species later called *C. terebra* Born, 1780, Hwass in Bruguière, 1792, and Lamarck, 1810 and 1822, and *C. terebellum* Gmelin, 1791, and Reeve, 1843. This is a long and narrow, pure-white shell finely striated spirally and with a high, slightly convex spire. Its only color consists of two pale yellow spiral bands, the color of which is extremely fugitive.

The identification of *clavus* Linné is therefore not as clean-cut as one could wish owing to the fact that one description is brief and the other describes two shells. I restrict the name *clavus* Linné to the unspotted, banded shell later named *terebra* by Born, and figured by Martini (1769-1777, vol. 2, pl. 52, fig. 577). The Linnaean name should be restored.

In Morrison's arrangement the species is placed in the subgenus *Hermes* Montfort, 1810.

In addition to the Martini figure mentioned above, accurate figures of *C. clavus* Linné, 1758, are found in Kiener (1846-1850, pl. 34, fig. 2, both figures).

#### *Conus nussatella*

1758, *Systema naturae*, ed. 10, p. 716, no. 273.

1767, *Systema naturae*, ed. 12, p. 1170, no. 314.

LOCALITY: "Ad Nussatello insulam Asiae" (1758, 1767).

"C. testa subcylindrica rubra inermi striis tuberculatis scabra... Testa pallida, reliquis longior, striis punctis fulvis scabris."

A specimen of the *Conus nussatella* of all modern authors is present in the collection of Linnaeus and adequately agrees with the description in the "Systema" and with all of the figures cited. The only author who appears to have questioned this identification was Chemnitz. His predecessor Martini (1769-1777, vol. 2, p. 189, pl. 51, fig. 567) supplied a figure of *nussatella* which is accurate except as to color, the blotches on the body whorl being reproduced as olive-green instead of reddish brown. He called it *Terebellum granulatatum* but referred it to the "*Nussatellana*" (*sic*) of the "Systema." Chemnitz (1780-1795, vol. 10, p. 81, pl. 143, fig. 1329) described what is obviously the same shell, used a barely recognizable figure which

is wholly inaccurate as to color pattern and shape, and called it *Conus terebra*.<sup>1</sup> He did not refer to the "Systema" or to any of Linnaeus' references and said (*loc. cit.*): "This black-dotted rare cone must not be confused with the golden-flecked, rough and granulated shell which Martini described and figured in this Systematische Conchylien-cabinet, vol. 2, fig. 567 and, with others, thought was *Conus nussatella* of Linnaeus." In other words, Chemnitz did not admit that either Martini's figure or his own was *nussatella* Linné.

Virtually all specimens of *nussatella* bear granulations of a greater or less degree of development. As might be expected, the condition of the specimen governs the persistence and prominence of the granules, and therefore worn specimens usually exhibit none at all. It is also true, however, that practically fresh specimens are occasionally observed which are smooth except for the fine spiral ridges that encircle the body whorl. Further, a type of granulation exists which consists merely of low nodosities caused by the crossing of the spiral threads by the growth lines. At their greatest development the true granulations become elevated, and the surface is scabrous to the touch even in fairly worn individuals. Both Linnaeus and Gmelin used the word "scabra" in their descriptions of *nussatella*, and it seems certain that they conceived of it as a constantly granulate species, and that the smooth form had not come to their attention. Rumphius called the species by the significant name *Terebellum granulatum*.

Lamarck (1822, p. 515) adopted the view that the typical *nussatella* was the non-granulate form. His Latin description does not speak of granulations. For his typical shell he refers not to Linnaeus but to the *Conus terebra* of Chemnitz. He then erects a variety "[b]" which he calls "*var. granulosa*" and refers it to the "Systema" and the Martini figure mentioned above. Thus he admitted that Linnaeus' type was the granulate form but infers that was not the typical one.<sup>2</sup>

<sup>1</sup> This is not the *C. terebra* of Born, 1780, which was a later name for the *C. clavus* Linné of the tenth edition. See discussion of the latter species above.

<sup>2</sup> Mermod (1947, p. 197) reports that the Lamarck collection in Geneva contains two specimens of Lamarck's "typical" *nussatella*, the smooth form, and one

It is curious that Lamarck, after erecting a granulate and a supposedly smooth form, should have supplied a French description, covering the two forms, which refers to the "rangées transverses de points bruns qui le rendent élégamment piqueté." Lamarck's conception of the species was completely erroneous in that he used the name *granulosa* for a form which he supposed was a mere variety, whereas it is the typical form.

*Conus nussatellata* Brazier, 1877, is an error for *nussatella* Linné.

In Morrison's arrangement *nussatella* is the type of the subgenus *Hermes* Montfort, 1810, by monotypy. It is also the type of *Theliconus* Swainson, 1840, which Morrison uses as a section of *Hermes*. Thiele (1931, 1935, vol. 1, p. 374) treats *Theliconus* Swainson as a synonym of the typical subgenus of *Hermes*, thus giving generic rank to Montfort's name.

In addition to the Martini figure mentioned above, a good figure is found in Reeve (1843-1878, vol. 1, *Conus*, pl. 11, sp. 56). The best figure is the color photograph in Platt (1949, vol. 96, p. 53, fig. 7).

#### *Conus granulatus*

1758, Systema naturae, ed. 10, p. 716, no. 274.  
1767, Systema naturae, ed. 12, p. 1170, no. 315.  
LOCALITY: "In O. Africano" (1758, 1767).

"C. testa scabra inermi: striis sulcatis laevibus . . . Testa magis rubra magisque falcata quam in reliquis; fasciae albae una alterave et puncta purpurea ad strias."

The inappropriate word "falcata" in the twelfth edition description was apparently a misprint for the "sulcata" of the tenth. Gmelin restored "sulcata." "Fasciis albae" was "fascia alba" in the tenth.

Without the words "magis rubra magisque sulcata quam in reliquis" it would have been difficult to recognize the species from the Linnaean description. However, a specimen of the rare *granulatus* of the Antilles is found in a properly marked box in the collection,

specimen of the variety "[b]," *granulosa*. After a re-examination of these specimens, the author advises me (personal communication) that all three are undoubtedly granulated, which is fully borne out by photographs he supplies. He adds that, of the 17 specimens of *nussatella* in the Geneva museum, from all sources, five are grossly granulate and all the others show granulations of a lesser degree of prominence.

which insured the identification. Neither of the two figures in the synonymy (Rumphius, pl. 32, fig. T; Gualtieri, pl. 25, fig. H) correctly portrays the species, as both fail to show the deep spiral grooves which are its most notable characteristic. Otherwise the figures are suggestive.

Linnaeus' locality is incorrect, as it is a western Atlantic species.

The species is comparatively rare. Clench (1942, p. 18), in his monograph on the genus *Conus* in the western Atlantic, was able to examine only three specimens. These came from Watlings Island in the Bahamas and from Jamaica. Weinkauff (1875, pp. 89, 167, pl. 15, figs. 9-10) reported it from Antigua, Surinam, and Brazil. Clench (*loc. cit.*) mentions the record of a single specimen dredged off Fort Lauderdale, Florida. The American Museum of Natural History collection contains 14 specimens, in five lots, four labeled "West Indies" and the other "Antigua." The supposed reason for the specific name *granulatus* was not apparent in the specimens examined by Clench, which showed only the strong spiral sculpture on the body whorl and three or four spiral threads on the whorls of the spire. The shells seen by the writer in the American Museum of Natural History, on the contrary, all showed definite granulations on the body whorl but lacked the threads on the spire in all but three specimens, which could not be attributable to wear as the shells were fresh. The 11 specimens in the United States National Museum are of both forms, and we must conclude that the species is very variable in its sculpture. Mr. R. Tucker Abbott of the United States National Museum reports (personal communication) that "about 50 or more specimens are known."

Tryon (1879-1888, vol. 6, p. 82) makes it synonymous with *C. verulosus* Hwass in Bruguière, 1792, saying that a specimen before him labeled *verulosus* was "only a worn *granulatus* devoid of color." It is also identical with *C. roseus* G. Fischer, 1807 (not Lamarck, 1810, nor Sowerby, 1834, nor Kiener, 1849). It is not *C. granulatus* Röding, 1798, nor Sowerby, 1834, nor Borson, 1830.

In Morrison's arrangement it is placed in the subgenus *Floraconus* Iredale, 1930.

It is well illustrated in a photographic figure by Clench (1942, pl. 9, fig. 3). Kiener's

figure (1846-1850, pl. 68, fig. 5) shows the spiral threads on the spire whorls, and the granulations are faintly indicated. Martini's figures (1769-1777, vol. 2, pl. 52, figs. 574-575) were probably based on a specimen of *granulatus*, although Martini did not refer to Linnaeus' species and called the shell *Terebra rubra, fasciata*. Figure 575 should be examined and compared with Clench's photograph, which it much resembles.

#### *Conus aurisiacus*

1758, *Systema naturae*, ed. 10, p. 716, no. 275.

1767, *Systema naturae*, ed. 12, p. 1170, no. 316.

LOCALITY: Not given in either edition.

"C. testa incarnata laevi fasciis albidis, anfractuum summis canaliculatis . . . Testa aurantia fasciis 3 albidis, striisque albo nigroque variis. Spira canaliculata, aurantia margine maculis oblongis albis fuscisque."

The above language is much more detailed than in most of Linnaeus' *Conus* descriptions and is equivocal in only one respect. In one part of the description the shell is said to be "incarnata" and later is described, as to both the body whorl and the spire, as "aurantia." The ground color of the species is a pale pink without any suggestion of yellow. Lamarck well describes it (1822, p. 505, French description) as "flesh-colored and almost rose." Many of the pre-Linnaean writers, among them Petiver, Klein, Argenville, and Seba, either called the species the "Orange Admiral" or used the descriptive word "aurantia." Davila, on the other hand, said it was "rose-colored." The early vernacular name of the shell may have confused Linnaeus, but his use of both colors in the same description is puzzling. In the tenth edition the subdescription read "Ammiralis hic s. Cedo nulli differt testa magna laevi, anfractibus supra canaliculatis."

The synonymy is one of the few in *Conus* Linné which is correct in its entirety, and these figures, combined with a fairly graphic description, are sufficient to define the species, in spite of the fact that Linnaeus did not possess a specimen. There is no *aurisiacus* in the collection, and the name does not appear on his lists of owned shells. It is possible that he had never seen a specimen and based his diagnosis on data in pre-Linnaean works, as the "Museum Ulri-

cae," which he catalogued, did not mention it. This may have partially explained his vagueness as to the color of the shell.

Linnaeus' son added to the synonymy two figures from Martini (1769-1777, vol. 2, p. 282, pl. 57, figs. 636-637). These figures, although somewhat stylized and exaggerated in color, are easily recognizable as *aurisiacus*. Martini called the species "*Admiralis Arausiacanus*" and referred it to *Conus arausiacus*<sup>1</sup> (*sic*) of the "Systema."

Gmelin listed a variety " $\beta$ " of his "*arausiacus*," which was undescribed but for which he referred to an unrecognizable figure from Chemnitz (1780-1795, vol. 10, p. 92, pl. 144A, fig. 1 or [I]). There is no figure 1 on this plate, which contained only species identified by lower-case letters. A figure lettered l shows a shell which is utterly dissimilar from *aurisiacus* and is unrecognizable. Chemnitz called it, however, *Conus Arausiacus sive Arausionensis* but supplied no references. His description cannot be tied to *aurisiacus* Linné, as it not only omits any reference to the color of the shell but does not mention the spiral bands of white.

In Morrison's arrangement the species is included in the subgenus *Dendroconus* Swainson, 1840.

It is figured in Reeve (1843-1878, vol. 1, *Conus*, pl. 5, sp. 29), in Kiener (1846-1850, pl. 49, figs. 2, 2a), and in Delessert (1841, pl. 40, fig. 12).

#### *Conus magus*

1758, *Systema naturae*, ed. 10, p. 716, no. 276.

1767, *Systema naturae*, ed. 12, p. 1171, no. 317.

LOCALITY: Not given in either edition.

"C. testa subcylindrica: fasciis longitudinalibus albo-punctatis."

*Conus magus* was one of the most troublesome of the Linnaean cones to the early writers, because of the great variation in its color pattern and the inadequacy of its description and synonymy. The description is so brief that it cannot be referred to any single species. The description in the "Museum Ulricae" is much more elaborate but hardly more informative, as it adds some confusing details. In

<sup>1</sup> This form of the name, which was also used by Gmelin (1791, p. 3392, no. 56) was based on the *arausiacus* of Rumphius, which was emended by Martini to *Arausiacanus*.

particular, it says that care must be taken to distinguish it from a variety of *C. striatus* and adds, "but the spire of the latter always has loosely coiled and rounded whorls which are not strictly canaliculate as in the present species." The description of the spire is exact, but any danger of confusing the two species would seem to be remote, as the differences in the color pattern of the two easily separate them.

The synonymy is wholly inaccurate, as Linnaeus, apparently not finding good figures of his species in his library, was obliged to choose what seemed to him to be the closest approximations. The Rumphius figure (pl. 32, fig. Q) looks like *C. augur* "Solander" Humphrey, 1786. That taken from Gualtieri (pl. 20, fig. F), which Linnaeus cited with a query, shows a coronated shell which might represent *C. aurantius* Hwass in Bruguière, 1792. Seba's figure (vol. 3, pl. 44, fig. 27) is unidentifiable, but was possibly an error of transcription for figure 30, which adjoins it on the same plate and is a recognizable figure of the *magus* of authors. This figure was omitted in the "Museum Ulricae," where the Rumphius reference was altered to plate 34, figure A, which shows *C. aurisiacus* Linné, and a new reference added (Argenville, pl. 15, fig. H) which had already been cited for *C. vicarius*. Out of this tissue of confusion the only figure of *magus* is the Seba drawing which Linnaeus did not cite, possibly in error.

Martini (1769-1777, vol. 2, pp. 288-289, pl. 58, fig. 641) described and figured a shell which he referred to *Conus magus* Linné and called *Conus teres basi acuminata*. It has the color pattern of one form of *magus*, but it is too strictly conical and basally acuminate to fit the Linnaean requirement of "oblonga." It resembles *Conus augur* and the Rumphius figure cited by Linnaeus in the "Systema," although it was later used by Gmelin for *magus*. Martini figures another shell (*tom. cit.*, pl. 52, figs. 579-580), which he also called *Conus teres*, and which is a very fair picture of the *magus* of authors. Lamarck (1822, p. 509) later used it to illustrate his "typical" *C. magus* Linné.

Chemnitz (1780-1795, vol. 10, pp. 36-37, pl. 140, fig. 1295) figured and described *Conus indicus*, the figure which Chenu (see below) later identified with *magus* Linné, and which Weinkauff (1874, p. 265) believed to repre-

sent a variety of *magus*. In 1795 Chemnitz (*op. cit.*, vol. 11, pp. 61–63, pl. 183, figs. 1778–1779) in his discussion of *Conus circae*, went into great detail as to the identity of Linnaeus' *magus* and came to the conclusion that the real *magus* was shown in his figure 1295 in the tenth volume. His comment is here quoted: "The real *Conus magus* of Linnaeus seems to be unknown to many. One perceives this immediately from the basically erroneous references which are cited by some writers as being vouched for by Linnaeus . . . Most [students], as I see by consulting the references, consider the pretty cone which is figured in the second volume of this [work] as figure 641, which is best shown in Knorr's 'Vergnügen der Augen,' vol. 6. pl. 13. fig. 6, and which Solander called *Conus augur*, Angl. dotted Cone, to be the true *Conus magus*. One must not be misled by trifles. [Chemnitz here points out several significant differences between *magus* and *augur* and continues] . . . by its 'forma oblonga' it must have been a close relative of the *Conus striatus* which immediately followed it in the 'Systema.' Moreover, what must one think of the inexcusable carelessness of those who neither notice or give weight to such a characteristic description as that in 'Mus. Reg. Lud. Ulr.,' as Linnaeus himself says . . . Whoever wishes to determine the real *Conus magus* of Linnaeus need only examine the shell which I have shown in the tenth volume of this [work], as figure 1295. . . . It bears a striking resemblance to the *Conus striatus* of Linnaeus and thus we may all the more quickly explain and understand why Linnaeus warned us in 'Mus. Reg. Lud. Ulr.' not to mistake *Conus magus* for *striatus*. . . . The shell which I here describe [*Conus circae*] is likewise, and more frequently, confused with the cone which is called *magus* by Linnaeus."

The superficial similarity between Chemnitz' figure 1295 and any form of *magus* is more fancied than real. It is based on color pattern rather than color, although the shape of the two shells is similar. I cannot share Chemnitz' conviction that he had figured *magus*, although he is entirely correct, as Linnaeus was, in disassociating it from *striatus*.

Lamarck (1822, p. 509) listed a "typical" *magus* and three "varieties." His "typical" species is based on the Martini figures 579 and 580 which I consider to be the closest to

the *magus* of authors of any of the early figures. Variety "[b]" was based on Chemnitz' *Conus indicus* (fig. 1295); variety "[c]" on *Conus clandestinus* (Chemnitz' fig. 1296) a figure resembling *magus* in shape, but with a predominantly red base color with a single band of white blotches. I cannot refer it to any form of the *magus* of authors; and variety "[d]," on Chemnitz' *Conus circae* (figs. 1778–1779). To justify his subdivision of the species he says (*loc. cit.*): "No species shows more variation in color than this."

The equivocal character of the description, the confusion in the synonymy, the lack of any locality, and the absence of a type specimen in the collection force me to the conclusion that the species is too badly defined for identification, and that the acceptance of the shell we know as *Conus magus*, as the representative of the Linnaean species, must be based upon tradition. I am aware that most conchologists, who read into the language of the "Museum Ulricae" a satisfactory description of the *magus* of authors, will take issue with this view, but I confess that I do not know what Linnaeus was describing.

The *Conus magus* of authors is figured in Reeve (1843–1878, vol. 1, *Conus*, pl. 35, sp. 190d); "Tableau encyclopédique" (1798, pl. 341, figs. 4 and 8); and Kiener (1846–1850, pl. 67, fig. 1).<sup>1</sup>

In Morrison's arrangement *C. magus* of authors is placed in the subgenus *Dendroconus* Swainson, 1840, section *Pionoconus* Mörch, 1853, as the type of the section, by subsequent designation, Iredale, 1930. The related species *striatus* Linné is the type of the subgenus *Dendroconus*.

A complete synonymy of *magus* Linné is found in E. A. Smith (1876, p. 535).

#### *Conus striatus*

1758, *Systema naturae*, ed. 10, p. 716, no. 277.

1767, *Systema naturae*, ed. 12, p. 1171, no. 318.

LOCALITY: "Versus littora Hitoe" (1758);

"Versus littora Hitoe, inque O. Africano" (1767).

"C. testa ovata-oblonga gibba nebulosa: striis tenuissimis parallelis fuscis."

The Linnaean description is clear and graphic as far as it goes, although the word

<sup>1</sup> Plate 67 of Kiener shows two different shells numbered 1. I follow Mermod (1947, p. 190, footnote) in designating the left-hand figure as *magus*.

"nebulosa" might well have been amplified to show that the nebulosities are loosely concentrated in two wide spiral bands. The description is further impaired by the omission of a reference to the deeply canaliculate spire, a feature that is usually referred to by Linnaeus where present. However, the description is aided by a perfectly correct synonymy in the tenth edition and by the presence of a marked specimen of the *striatus* of all authors in the collection, and thus the species is accepted as being properly defined. The additions which Linnaeus made to the synonymy in the twelfth edition may be disregarded. The figures from Lister and Adanson represent another species. Of the Seba figures added (1758, vol. 3, pl. 42, figs. 5-10) only figures 8 and 9 accurately picture *striatus*.

Only one other specific name has ever been given to this species.<sup>1</sup> Sowerby, when he described his *Conus floridus* (1847-1887, vol. 3, p. 47, frontispiece, fig. 558), compared it to *C. striatus* Linné, and E. A. Smith (1884, p. 488) definitely identified *floridus* as only "a slight variety" of *striatus*.

Lamarck (1822, p. 506) divided the species into four "varieties" based on three figures in the "Tableau encyclopédique" (1798, pl. 340, figs. 1-3). For one "variety" no figure was cited. These were all forms varying in color or color pattern according to Lamarck's descriptions. They are in no sense subspecies and were not cited by any of Lamarck's successors.

In Morrison's arrangement *Conus striatus* falls in the subgenus *Dendroconus* Swainson, 1840, as subgenotype.

It is figured in Reeve (1843-1878, vol. 1, *Conus*, pl. 32, sp. 179a, b) and in Kiener (1846-1850, pl. 47, figs. 1, 1a).

<sup>1</sup> Tomlin states that "*Cucullus doreyanus* Blainville" (1830, vol. 60) from New Guinea, was "perhaps" *C. striatus* Linné, and was "probably" an emendation of *C. dorensis* Péron, 1807. Tomlin's opinion was based on the fact that *striatus* was the only cone reported from Port Dorey, New Guinea, by Quoy and Gaimard (1834, p. 89). A check of the Blainville reference reveals that the *Cucullus* there described was not a mollusk but a coelenterate. The name "*doreyanus*" should therefore be dropped from Tomlin's list. Moreover, *C. dorensis* Péron, which Tomlin said was the original spelling of "*doreyanus*," is a coronate shell belonging to the subgenus *Rhombus* Montfort, 1810, whereas *striatus* Linné, to which Tomlin referred it with a query, is a non-coronate species.

### *Conus textile*

1758, *Systema naturae*, ed. 10, p. 717, no. 278.

1767, *Systema naturae*, ed. 12, p. 1171, no. 319.

LOCALITY: "Ad Bandam Asiae" (1758, 1767).

"C. testa venis reticulatis luteis, maculis luteis fuscisque."

The above description is insufficient to identify the species as well as being somewhat equivocal. It covers color pattern alone and is patently the description of a specimen rather than of a species. *Conus textile* is an extremely variable shell in respect to color, in the disposition, predominance, and shape of the longitudinal wavy or zigzag lines which Lamarck characterized as "onduleuses et tremblantes," and in the number and size of the white trigonal spots or "tents." The early writers described and named many forms of the species, and it is an almost impossible, and certainly an unproductive, task to synonymize these forms from the various inconclusive descriptions and often crude figures of the *textile* complex in the works of the early writers. It is apparent, from the description in the "Museum Ulricae," which must be resorted to for a confirmation of the language of the "Systema," that the Linnaean type was the form described by Lamarck (1822, p. 524) as his "typical" *textile*, the form with the yellowish base color which was called the "cloth-of-gold," *Textile aureum*, *Rete aureum*, or *Pannus aureus* by Linnaeus' predecessors and some of his immediate followers. This form is figured by Reeve (1843-1878, vol. 1, *Conus*, pl. 38, fig. 209). Two specimens of this form are found in Linnaeus' collection and, though unmarked, are probably the type specimens.

The use of the phrase "reticulatis luteis" in the description is somewhat equivocal in two respects. Certain forms of *textile* show true reticulations, that is, a network of brown lines on the lighter background. Other forms do not exhibit any reticulation, and therefore it is incorrect to characterize the species as "reticulate." Many specimens of the species show what might loosely be called reticulations, in that the wavy longitudinal brown lines become so ramose that they cross each other, or the brown edges of the white "tents" form a simulated network because of the overlapping of the "tents." These are not



true reticulations such as are found in the "reticulate" forms of *textile* and in the species *C. mercator* and many forms of *C. ammiralis*, and it must be admitted that Linnaeus here used the word very loosely. Moreover, the reticulations, where present, are not "luteus" as stated in the "Systema," nor does the shell have "striae reticulatae flavescens" as the "Museum Ulricae" has it. It is the base color which is of varying shades of yellow. The reticulations and the longitudinal wavy lines are deep brown.

The synonymy includes several types of *textile* and several errors. One of the Gualtieri figures (pl. 25, fig. X) is apparently *C. aulicus* Linné, the succeeding species in the "Systema," and was transferred by Linnaeus in error from the synonymy of that species. A transposition is also evident in the Seba figures (vol. 3, pl. 47, figs. 10, 11, 16, 17). Figures 10 and 11 show *aulicus* and were erroneously chosen instead of numbers 14 and 15 which are clearly *textile* but which were placed in the synonymy of *aulicus*. Figures 16 and 17 seem to represent *textile*, as does the remaining Gualtieri figure (pl. 25, fig. AA). Regenfuss (pl. 6, fig. 62) shows a loosely reticulated form which is possibly the shell called *C. verriculum* by Reeve in 1843 (1843-1878, vol. 1, *Conus*, pl. 38, sp. 209). The crude Buonanni figure (pl. 135), one Rumphius figure (pl. 32, fig. P), and one Argenville figure (pl. 16, fig. I) may also represent the form *verriculum*. The other Rumphius figure (pl. 32, fig. O) is certainly not the typical *textile* and may be the shell designated in the "Museum Ulricae" as the "varietas parva" of *textile*. The synonymy in the "Museum Ulricae" shows what is apparently an attempt at purification, but the only important change is that all of the Seba figures are omitted.

The above paragraph is a partial paraphrase and an amended statement of the conclusions reached by Hanley (1855, pp. 176-177). A careful examination of Linnaeus' references confirms Hanley's opinion, in so far as one can be said to have an opinion on the identity of some of the very dubious drawings cited for *textile*. It is certain, however, that the synonymy covered two species at least, *textile* and *aulicus*, and therefore does not entirely conform either to the description, with its mention of reticulations, or to the

specimens in the collection, as *aulicus* is a non-reticulate cone. The identification of the Linnean name *textile* with the *textile* of authors is therefore predicated primarily on the existence of specimens in the collection, and to a lesser degree on the description in the "Museum Ulricae."

Among the names that have been given to *textile* or its various forms are: *Cucullus auriger* Röding, 1798; *C. gloria-maris* Röding, 1798; and possibly *Conus gloria-maris* Perry, 1818 (not Hwass in Bruguière, 1792); *C. rete-aureum* Perry, 1811; *C. undulatus* "Solander" Humphrey, 1786 (not Sowerby, 1857-1858); *C. sulcata* Sowerby, 1834; *C. scriptus* Sowerby, 1857-1858; *C. euetrios* Sowerby, 1882; and *C. ponderosa* Dautzenberg, 1932.

It is not *C. textile* Bellardi and Michelotti, 1840, which is *C. subtextile* d'Orbigny, 1852, a new name.

In Morrison's arrangement the species is placed in the subgenus *Cylinder* Montfort, 1810, of which it is the subgenotype, by original designation.

In addition to the figure cited from Reeve, above, a good figure is found in Kiener (1846-1850, pl. 102, fig. 4).

#### **Conus aulicus**

1758, *Systema naturae*, ed. 10, p. 717, no. 279.

1767, *Systema naturae*, ed. 12, p. 1171, no. 320.

LOCALITY: "In Asia" (1758, 1767).

"C. testa venis reticulatis fasciisque longitudinalibus fuscis interruptis . . . Varietas forte praecedentis."

The *Conus aulicus* of authors is accepted as the representative of Linnaeus' *aulicus* in spite of the brief description in the "Systema" which, like that of *textile*, covers only the color pattern, and in spite of the words "venis reticulatis." This misuse of the term "reticulate" is even more obvious than in *textile*, as *aulicus* never shows true reticulations. Even the description of the color pattern is misleading. The brown portions of the shell are not in any sense "fasciis longitudinalibus." The fasciae, if they can be so called, are the groups of white "tents" which are loosely arranged longitudinally. There is no mention of the fine and closely spaced spiral threads which cover the entire body whorl, and, surprisingly, the white "tents," which are the

most characteristic feature of the shell, are not mentioned, as they were in *textile*. Linnaeus' statement that *aulicus* is possibly a variety of *textile* is puzzling. The two species have nothing in common, so far as decoration is concerned, except the white spots, which the author forebore to mention in *aulicus*. Thus the description does not make a single accurate statement and omits the really characteristic features of the shell. Even in a work which abounds in uninformative descriptions it is outstanding for inaccuracy.

The synonymy, as Hanley (1855, p. 177) described it, is a "tissue of confusion." Its 12 figures from five authors show four different species, *aulicus* Linné; *episcopus* Hwass in Bruguière, 1792; *pennaceus* Born, 1780; and *omaria* Hwass in Bruguière.<sup>1</sup> Hanley reported that a further species was involved, *C. auratus* Hwass in Bruguière, 1792, but that name is now conceded to be a synonym of *aulicus* Linné. Two of the Seba figures, as was mentioned under *C. textile*, the preceding species, show *textile* and were probably included under *aulicus* by mistake. Six of the 12 figures are clearly *aulicus*, and it may be that this fact determined the identification with the *aulicus* of authors. It is difficult to find anything else either in the "Systema" or the "Museum Ulricae" which can be taken as evidence of this identification. There is no specimen of *aulicus* in the collection. The identification of the Linnaean species with the *aulicus* of authors is possibly correct but is based on the most tenuous evidence.

The only synonyms of the *aulicus* of authors are *C. auratus*, referred to in the last paragraph, and *Cucullus aureus* Röding, 1798, *vide* Röding himself. Sowerby, in 1834 ([1832-] 1841, pl. 55, fig. 71), described a *C. roseus*, which he was inclined to think was a variety of *aulicus* Linné. There is a pinkish form of *aulicus* which is probably this variety.

In Morrison's arrangement *aulicus*, as *C. auratus* Hwass in Bruguière, is placed in the subgenus *Cylinder* Montfort, 1810, section *Regiconus* Iredale, 1930, of which it is the subgenotype, by original designation.

It is figured by Reeve (1843-1878, vol. 1, *Conus*, pl. 24, sp. 134) and by Kiener (1846-

<sup>1</sup> Reeve (1843-1878, vol. 1, *Conus*, pl. 32, sp. 177) treated *omaria* as a synonym of *pennaceus* Born. The two shells seem to this writer to be separable.

1850, pl. 53, fig. 1). An excellent color photograph is found in Platt (1949, vol. 96, pl. 53, fig. 17).

#### *Conus spectrum*

1758, *Systema naturae*, ed. 10, p. 717, no. 280.

1767, *Systema naturae*, ed. 12, p. 1171, no. 321.

LOCALITY: "In Asia" (1758, 1767).

"C. testa caerulescente flavo-nebulosa, punctis striisque albo-luteis."

Hanley (1855, p. 178) was doubtful whether the *Conus spectrum* of authors could be referred to the *spectrum* of Linnaeus. The collection supplies no evidence, as it contains no specimen marked for the name and none that conforms to the description. For this reason, and because of the defects in the synonymy, Hanley recommended "a note of interrogation when referring to the works of Linnaeus for the traditional *spectrum*."

The synonymy is indeed imperfect. The Gualtieri figure (pl. 25, fig. S) shows a shell which Hanley (*loc. cit.*) identified as *C. janus* Hwass in Bruguière, 1792, and which Deshayes and Milne-Edwards (1835-1845, vol. 11, p. 105) referred to *C. amadis* Gmelin. The two opinions are very far apart, and I would hesitate to guess what Gualtieri's figure represented. The reference to Rumphius (pl. 32, fig. S) has been widely cited for *spectrum* of authors. However, neither of these drawings conforms to the requirements of the description in the "Systema." The Regenfuss figure (pl. 2, fig. 20), cited only in the twelfth edition, is likewise opposed to the "flavo-nebulosa" in Linnaeus' description, and, moreover, this same figure served double duty, as it was later used by Linnaeus for his *C. tulipa*, although it was omitted from the synonymy of *spectrum* in the "Museum Ulricae."

The description in the latter work is much more ample, adding many details omitted in the "Systema." The shell is described as oblong, gibbous, with yellow cloudy blotches arranged longitudinally, and with numerous striae of yellow and white. The columella is said to be posteriorly striate and folded back. The interior of the shell is said to be faintly blue ("subcaerulescens"), the spire elevated, mucronate, and granulated. Hanley (*loc. cit.*) objected even more strenuously to this description, saying: "The details mentioned . . .

are so ample, that it is incomprehensible to me how the *Conus spectrum* of authors (Lamarck, Reeves, &c.) could so long have retained its appellation unquestioned. . . . The description reminds one, in some respects, of *C. achatinus*: it would be hazardous, however, to conjecture what the shell in the Royal Museum actually was; the striated pillar might, indeed, almost induce the belief of its not having been a *Cone* at all."

Hanley's objection to the mention of a "striated pillar" ("*Columella postice striata et replicata*") is not understood. If Linnaeus meant by this phrase the rugosities and coarseness of the base of the columella, these are almost a constant feature of all cones. As to the rest of the "Museum Ulricae" description, while it is far from perfect and somewhat inconsistent, it is close enough to the *spectrum* of authors, as is the brief language of the "Systema," to permit us to accept it rather than to disturb the traditional identification.

The early post-Linnaean figures are not characteristic. The earliest were those of Martini (1769-1777, vol. 2, pp. 231-233, pl. 52, fig. 581, and pl. 53, figs. 582-583). He called the species *Voluta spectrorum* and had no hesitation in referring it to the *spectrum* of the "Systema." He also referred to the Rumphius and Gualtieri figures cited by Linnaeus but omitted the figure of Regenfuss. The three Martini figures are not particularly useful. They do not show the elevated spiral threads which are characteristic of the species. Two of them (figs. 582-583) were, however, cited for *spectrum* by Lamarck (1822, p. 510), as was the Rumphius figure. Chemnitz' figures hardly advance our knowledge of the species. He first described and figured a *Conus spectrum album* (1780-1795, vol. 10, p. 45, pl. 140, fig. 1304), the figure showing a pure white, round-shouldered shell with apparently deep spiral striae covering the lower half of the body whorl, and with a mucronate spire showing deep sutures. This figure was cited by Gmelin for his variety " $\beta$ " of *spectrum*. Chemnitz' shell was probably *Conus lacteus* Lamarck, 1810, the description of which fits figure 1304 exactly. As to the spiral striae Lamarck says they cover the shell, instead of merely the lower half as Chemnitz showed, but he qualified this by

saying that they were obsolete over the upper part, and in his French description says (1810, vol. 15, p. 274): "It bears widely spaced spiral grooves over its whole length; nevertheless those of the lower half are more apparent than the others." Lamarck's *lacteus* is unquestionably the shell figured by Chemnitz, although he cited the Chemnitz figure with a query.<sup>1</sup> It is sometimes cited today as *Conus spectrum lacteus* Lamarck. The shell is pure white and sometimes so shining that Chemnitz said (*loc. cit.*): "Some of these Cones are as shining-white as the whitest porcelain. . . ."

Four other figures of Chemnitz have been used in connection with *spectrum*. In the same volume (*op. cit.*, p. 91, pl. 144A, figs. g and h, and p. 94, pl. 144A, figs. o and p) he described and figured two species which he called, respectively, *Conus spectrum sumatrae* and *Spectrum variegatum*. These latter four figures show a brown and white mottled shell, whose asymmetrical pattern is impossible to describe. The last figure (fig. p) shows the shell girdled with two lighter brown bands. I do not believe that this group of figures was intended to illustrate any form of *spectrum*. They are mentioned solely because they were cited by Gmelin for his varieties " $\gamma$ " (figs. g and h) and " $\delta$ " (figs. o and p) of *spectrum*.

Lamarck, as said above, cited for the species the Rumphius and Martini figures but significantly forebore to refer to those from Chemnitz. He described the species as "white with longitudinal, flexuous red or chestnut streaks (flammes). It is spirally striated over its lower half, and is characterized by a patulous aperture." This is a good description of the *spectrum* of authors, and Lamarck had no hesitancy in attributing it to the *spectrum* of Linnaeus. In spite of the somewhat equivocal character of the Linnaean diagnosis the

<sup>1</sup> Reeve (1843-1878, vol. 1, *Conus*, pl. 40, sp. 217) listed a *C. martinianus* (which he admitted was identical with *C. radiatus* Gmelin) and accused Lamarck of having treated it as a variety of the latter's *lacteus*. This is error. Lamarck did not establish any varieties of *lacteus* and did not cite for it the Martini figure (*tom. cit.*) which Gmelin used for *radiatus*.

In listing *Conus parvus* Reeve, 1844 (*tom. cit.*, pl. 43, sp. 235), Deshayes and Milne-Edwards, who gave it the popular name of "cône albâtre," cite as a synonym the *Conus spectrum album* of Chemnitz, already mentioned above.

identification, so far as I have been able to find, has not since been questioned except for Hanley's extreme reticence to adopt it.

In Morrison's arrangement the species is placed in the subgenus *Phasmoconus* Mörch, 1852, of which the type is *C. radiatus* Gmelin.

The species is figured by Reeve (1843-1878, vol. 1, *Conus*, pl. 15, sp. 80) and by Kiener (1846-1850, pl. 44, figs. 5, 5a).

It is identical with *Cucullus carota* Röding, 1798, *vide* Röding himself. Other synonyms are: *Conus conspersus* Reeve, 1844, *vide* E. A. Smith, and *C. broderipii* Reeve, 1844, *vide* Tomlin, who said that it is an immature specimen of *spectrum*. There is a *C. spectrum* "Solander" Humphrey, 1786, which is possibly a *nomen nudum* and may be identical with *spectrum* Linné. Link, in describing his *C. felinus*, said that it was "near to *spectrum* L. but differs by its flat spire." Thus even as early as 1807 Link apparently had no difficulty in identifying the present species.

*Conus spectrum* and the three following species, *bullatus*, *tulipa*, and *geographus*, the four last names in *Conus* Linné, were placed by Linnaeus under the "subgeneric" heading "Laxi, ventricosi, in dorsum disjecti, super mensam tinnitantes." The somewhat swollen, *Bulla*-like outline of the four species and their patulous outer lip are accurately described by the phrase "Laxi, ventricosi," although the lip of *spectrum*, at least, is hardly more expanded, if at all, than the lip of *striatus*, *textile*, and *aulicus* which immediately precede it and are included in another "subgeneric" heading. The second phrase, "in dorsum disjecti," conveys no meaning to this writer. "Dorsum" is a word which was used by Linnaeus for no other cone. He used it appropriately in describing certain species of *Chiton*, *Cypraea*, and *Patella*, and it is in general use today in the descriptions of cypraeids, but it is peculiarly inappropriate for *Conus* or for most other gastropod genera. The last phrase, "super mensam tinnitantes," is possibly a use of a fanciful and somewhat unscientific locution. Three of the four species, *bullatus*, *tulipa*, and *geographus*, are so light in structure in comparison with the other Linnaean cones that they do "ring" with a tinkling sound when dropped. To accept this sense of the phrase, however, we must condone Linnaeus' erroneous use of the

preposition "super" as meaning "on."

*Conus spectrum* is questionably placed in being joined with the three other species. It is sensibly heavier and coarser in structure and has a less patulous outer lip, and would have been better placed in the preceding group.

The relationship of the three other patulous species and their specific differences are discussed below.

#### *Conus bullatus*

1758, *Systema naturae*, ed. 10, p. 717, no. 281.

1767, *Systema naturae*, ed. 12, p. 1172, no. 322.

LOCALITY: Not given in either edition.

"*C. testa flava albo-nebulosa.*"

Only an extremely credulous reader would assert that this species was either pictorially or descriptively defined in either the "Systema" or the "Museum Ulricae." Linnaeus possibly intended to describe the *Conus bullatus* of modern authors, but this identification can be based only on the fact of the position of the species with the three structurally light, patulous-lipped shells which conclude the genus *Conus* in the "Systema," and on the external evidence, for what it is worth, afforded by the addition of a pictorial reference to the synonymy made by the younger Linnaeus.

The descriptions of 1758 and 1767 are certainly inadequate, as they cover only the color pattern of the shell, and there are several of the Linnaean cones which could be so described. In fact, even the few words of this description are suspect, as they do not strictly conform to the arrangement of color in the *bullatus* of authors, which is a white shell decorated with blotches ranging from pale yellow to deep brown or red rather than the reverse, as the wording of Linnaeus has it. All other important diagnostic details are omitted. There is no mention of the extremely light structure of *bullatus* of authors, of the darker reddish brown dots on its body whorl, of the wideness of its aperture, or of the canaliculated spire, a feature to which Linnaeus consistently referred where present. The description in the "Museum Ulricae" repeats the equivocal language of the "Systema" as to color and adds little else that is helpful. There the shell is said to be "*oblonga, convexa, flava, nebulosa,*" characters which point to the *bullatus* of authors, and the spire

is described as canaliculate. On the other hand, the spire is said to be "vix tuberculata." Even this mild expression is untrue of our *bullatus*, which has a smooth spire. Linnaeus distinguished it from *Bulla pallida* and *Bulla livida* in that the latter are "solida." They are in fact heavier shells than *bullatus* but are otherwise so different that one wonders why Linnaeus should have used them as a comparison. The further detail is added that "the interior of the lip at the base has a reflected margin." This feature, if the phrase is understood as meaning the twist of the columella at the base, is found in many of the Linnaean cones, including *geographus*, where it is not mentioned but where it is much more marked than in the *bullatus* of authors. Finally there is no reference to the very characteristic diagnostic details which were also omitted in the "Systema." In the last analysis there is little in the "Museum Ulricae" description which merits its being referred to our *bullatus* except the words relating to its shape, color, and the canaliculated spire.

The sole figure cited in both works (Gualtieri, pl. 26, fig. C) was adopted by some later writers as representing *bullatus*, but it bears little resemblance to the shell we know by that name. Four excellent figures of the *bullatus* of authors are found in two works which we know were in Linnaeus' library and to which he constantly referred. They are Argenville (1742, pl. 16, fig. H) and Seba (vol. 3, pl. 42, fig. 14; and pl. 43, figs. 15-16). The fact that he neglected to refer to any of these figures and used only that from Gualtieri is weighty, although not conclusive, evidence that he was describing another shell. In the copy of the "Systema" owned by the younger Linnaeus there is a manuscript note referring to a figure from Knorr (pt. 5, pl. 11, fig. 4). This figure is a recognizable picture of our *bullatus*, but, being no part of Linnaeus' diagnosis, is without authority.

Linnaeus did not own a specimen of the shell he described, as the name does not appear on any of his lists, and the *bullatus* of authors is not present in his collection. The combination of all these facts must lead us to the conclusion that the species is too imperfectly defined to be identified and is technically therefore a *species dubia*. Neverthe-

less the accepted identification is so firmly established in the literature that it should not be disturbed. It is realized that most conchologists accept the description in the "Museum Ulricae" as an adequate definition of the species, but the inconsistencies in that description lead me to a contrary view.

The identification with the *bullatus* of authors was accepted by all the early writers without considering its weakness. Chemnitz (1780-1795, vol. 10, pp. 64-66, pl. 142, figs. 1315-1316) paraphrased much of the "Museum Ulricae" language but brought it into line with our *bullatus* by the addition of two important features: "apertura effusa dehiscente" and "fauce aurantia." He also cited the Argenville figure omitted by Linnaeus and the plate 43 figures from Seba, all of which show our *bullatus*, and his own figures are unmistakable drawings of that shell. He continued, however, to cite the questionable figure from Gualtieri used by Linnaeus. It is apparent, however, that he based his identification mainly upon the position of *bullatus* in the "Systema," saying (*loc. cit.*): "This cone belongs in the last group into which Linnaeus divided his genus *Conus*, in which he placed the more expanded and swollen species, whose whorls are more loosely wound. The members of this subordinate group have *testam laxe convolutam ventricosiorum et aperturam dihescentem*. I was not the first to venture to adopt in full the evidence that this shell is really the *Conus bullatus* of Linnaeus, since it lacks none of the descriptive details and distinctive marks which Linnaeus specified for *Conus bullatus* and conforms to the position in the series which Linnaeus allotted to it between the cone which he called *spectrum* and that known as *tulipa*." Chemnitz' first conclusion, that the *bullatus* which he figured lacks none of the details of *bullatus* Linné, is a begging of the question. The descriptions, both in the "Systema" and the "Museum Ulricae," are less significant for what they contain than for the details they omit. Thus far, therefore, Chemnitz' opinion is based on a false premise, and we are left only with his second reason, that the species is identifiable because of its position in the "Systema." He later said (*loc. cit.*): "The base has a remarkable twist (Ausschweifung)." This detail, as already noted above, is much

more evident in *geographus*, yet neither Chemnitz nor Martini mentioned it in connection with the latter species.

One further comment on the species should be noted. Lamarck (1822, p. 510) mentions the color of *bullatus*, in his French description, as "blotches of white and flame color on a base the color of red-lead (minium)." The *bullatus* of authors has a white background with spots of various shades of brown and yellow, some of which are so dark as to be called "red-lead." Although he described the other details of *bullatus* with great clarity and cited the appropriate figures of the *bullatus* of authors, this confusion as to base color is unexplainable and serves only to emphasize the equivocal character of the accepted identification of the species.

*Fide* Dillwyn (1817, vol. 1, p. 432) *Conus nubecula* Gmelin is identical with *bullatus*. The figures Gmelin cited for his *nubecula* do not bear this out. *Cucullus laganum* Röding, 1798, was based on the figure from Knorr which was added to the synonymy of *bullatus* by Linnaeus' son, and therefore, *fide* Tomlin, is a synonym of *bullatus* "Linné." The *bullatus* of authors is not the "*bullatus* var." of Sowerby, 1833 ([1832-] 1841, pl. 29, fig. 24), which, according to Tomlin, equals *C. cervus* Lamarck (1822, p. 510), a species that follows immediately after *bullatus* in the "Histoire naturelle" and that Lamarck recognized as being very close to *bullatus* "Linné," although distinguishable.

In Morrison's arrangement the *bullatus* of authors is the type of the subgenus *Textilia* Swainson, 1840.

It is figured in Reeve (1843-1878, vol. 1, *Conus*, pl. 17, sp. 93a, b) and in Kiener (1846-1850, pl. 58, fig. 2).

#### *Conus tulipa*

1758, *Systema naturae*, ed. 10, p. 717, no. 282.

1767, *Systema naturae*, ed. 12, p. 1172, no. 323.

LOCALITY: Not given in either edition.

"*C. testa oblonga gibba laevi, apertura dehiscente . . . Simillima Geographo, sed minime coronatus; caeterum testa laxa convoluta.*"

Although the few details of the seven-word main description of this species apply to the *tulipa* of authors, they are insufficient to allow of an unequivocal identification, as the preceding and the following species may be

similarly described. In the subdescription, however, the comparison with *geographus* is accurate and adequately distinguishes the two. This is a group where the identification of three species, *bullatus*, *tulipa*, and *geographus*, must be based largely, if not entirely, on a comparative study of the three descriptions. The three shells have a markedly patulous lip ("apertura dehiscente"), somewhat more expanded than any other of the Linnaean cones, with the possible exception of *spectrum*, and the degree of patulousness increases successively from *bullatus* to *geographus*. Apparently Linnaeus considered the wide aperture in *bullatus* unworthy of mention, although he placed the species in the same group as the other two. The word "coronata" is used for the last two species but was correctly omitted for *bullatus*, and the degree of coronation between the last two is correctly stated.

The synonymy of *tulipa* represents a mixture of species. *Conus monachus* is pictured in one of the Rumphius figures (pl. 34, fig. L).<sup>1</sup> Hanley took the Argenville figure (1742, pl. 16, fig. B) for *monachus*, but it is too vague to be identified, although Argenville called it "La Tulipe." Linnaeus borrowed the name from him but tied it to a shell which cannot with justice be tied to the figure. *C. testudinarius* Hwass in Bruguière, 1792, was apparently the model for figure K on the same plate of Rumphius and was also cited by Linnaeus. The figure by Seba (vol. 3, pl. 42, fig. 16) and that of Regenfuss (pl. 2, fig. 20) are reasonably recognizable figures of the *tulipa* of authors. The presence in the collection of a specimen of that shell and the absence of *testudinarius* partially confirm the identification, although the specimen is not marked or otherwise documented. The accepted interpretation of Linnaeus' diagnosis of *tulipa* is undoubtedly correct but is a conclusion based on somewhat equivocal evidence. With a specimen which is unmarked and therefore of imperfect probative value, with no locality and with a composite synonymy, a description should have been more informative than that of *tulipa* to be

<sup>1</sup> Hanley (1855, p. 179) referred this Rumphius figure to *C. achatinus* Hwass in Bruguière, 1792, but that shell cannot be separated from *monachus*.

used as a basis for an unquestioned identification.

*Cucullus purpureus* Röding, 1798, is an exact synonym of *tulipa*.

In Morrison's arrangement *tulipa* of authors is placed in the subgenus *Rollus* Montfort, 1810, as the type of the section *Tuliparia* Swainson, 1840.

It is figured in Reeve (1843-1878, vol. 1, *Conus*, pl. 23, sp. 128) and in Kiener (1846-1850, pl. 12, figs 2, 2a).

#### *Conus geographus*

1758, *Systema naturae*, ed. 10, p. 718, no. 283.

1767, *Systema naturae*, ed. 12, p. 1172, no. 324.

LOCALITY: "In Indiis" (1758, 1767).

"C. testa oblonga gibba coronata, apertura dehiscente."

This species can be distinguished from the preceding by the use of the word "coronata" in its description and the mention, in the description of *tulipa*, that the latter is less coronate than *geographus*. It can be distinguished from *bullatus*, on the questionable assumption that in the latter species Linnaeus described the *bullatus* of authors, by the fact that there is no mention of coronation in the description of the latter species. The effect of all three descriptions, however, would have been improved if the author had noted that *bullatus* had an "apertura dehiscente."

While the description of *bullatus* is highly unsatisfactory, that of *geographus* is entirely adequate, in itself, to have identified the species, except that it is still necessary to go to *tulipa* for assistance in the interpretation of the word "coronata." This identification is fully confirmed by the presence of a marked specimen of the *geographus* of all authors in the collection.

The synonymy shows satisfactory figures of that shell with the exception of the references to Buonanni (3, fig. 319) and Adanson (pl. 6, fig. 8).<sup>1</sup>

<sup>1</sup> Both the Buonanni and Adanson references were properly discarded by the manuscript notes of Linnaeus' son, who also added a figure from Martini (1769-1777, vol. 2, pl. 64, fig. 517). I have not had access to the notes made by the younger Linnaeus. Hanley (1855, p. 180) reports the note as reading "f. 517." This was an error either of Hanley or the annotator, as figure 517 is found on plate 48 and shows a small *Oliva*. The proper figure of *geographus* is figure 717 on plate 64. This latter figure was cited by Lamarck (1822, p. 455) for *geographus*.

*Conus rosea* Sowerby, 1833, is held by Tomlin to be a variety of *geographus*. *Cucullus geographicus* Röding, 1798, is an error for *geographus*.

In Morrison's arrangement the species is placed in the subgenus *Rollus* Montfort, 1810, of which it is the type, by original designation.

In addition to the Martini figure cited above, the species is figured in Reeve (1843-1878, vol. 1, *Conus*, pl. 23, sp. 130) and in Kiener (1846-1850, pl. 12, fig. 1, both figures).

The following species, placed in *Conus* in the tenth edition, were moved, in the twelfth edition, to the genera indicated:

TENTH EDITION	TWELFTH EDITION
<i>Conus spinosus</i> , no. 271	<i>Strombus spinosus</i> , no. 510
<i>Conus terebellum</i> , no. 284	<i>Bulla terebellum</i> , no. 388

#### CYPRAEA LINNÉ

The genus *Cypraea* has had a considerable nomenclatorial history, as the popular interest in these beautiful and unusual shells has stimulated a vast amount of research, particularly in the last 75 years. For a century after the publication of the twelfth edition of the "Systema naturae" very few alterations in Linnaeus' nomenclature were made, but Troschel in 1863 and Jousseaume in 1884 erected many new supraspecific names for the reception of most of the Linnaean species, and Iredale and the Schilders in the 1920's and 1930's added others.

One of the earlier Schilder papers (F. A. Schilder, 1925) monographed the families Triviidae, Pedicularidae, Cypraeovulidae, Amphiperasidae, and Cypraeidae in the superfamily Cypraeacea. The 1925 arrangement, as modified in part by later papers (F. A. Schilder, 1932a, 1933a) has been accepted by most conchologists except as to the Cypraeidae, the arrangement of which has been supplanted by F. A. and M. Schilder's "Prodrome of a monograph on living Cypraeidae" (1938, 1939). The new classification was made necessary, in part at least, by Iredale's later partial classification cover-

The Lister reference ("4.s. 10. c. 7. t. 3. f. 2"), which refers to the 1685-1692 edition, was corrected by a manuscript note of Linnaeus to conform to the style of the Huddesford edition (1770) when that became available.

ing the Queensland species (1929, 1930), and in part by the Schilders' further studies, both of which factors considerably modified the original arrangement. This latest classification is now accepted by many workers as probably representing the limits to which the division of this family can be carried, unless progress in the paleontology of the group should require new generic or subgeneric units to receive new fossil species. It is used in the following pages.

The type of *Cypraea* Linné is *C. tigris* Linné, by subsequent designation, Montfort, 1810. The Schilders, who retained *C. mappa* Linné in *Cypraea* in their earlier works, used it as the type of the genus, but this failure to recognize the earlier designation of *tigris* was cured when *mappa* was transferred to *Mauritia*, subgenus *Leporicyprea* Iredale, 1930.

An important feature of the nomenclature used in the Schilders' "Prodrome" should be mentioned. For most of the species of Cypraeidae they list two or more "geographical races" based on variations in the shell occurring in areas which may be widely separated, or in some cases overlapping, but each of which "usually has its own center of distribution where it is relatively more frequent than at the periphery." These geographical race names are admitted by the Schilders to be subspecies within the meaning of the International Rules of Zoological Nomenclature; that is to say, they are coordinate with the specific names with regard to the laws of priority and homonymy. When it becomes necessary in this paper to refer to such a "race" of a Linnaean species, it is expressed as a subspecies, e.g., *Erronea (Adusta) onyx adusta* (Lamarck), 1810. It follows from this taxonomic concept that no "variety" which is not a geographical race is entitled to a name. This excludes ecological "varieties," and the authors recommend that the term "variety" is in any case a taxonomic unit too ambiguous and unrealistic to be retained in use, and that an ecological variation be called "forma," abbreviated to "f." and followed by a descriptive word such as "oblonga," "suffusa," "rostrata," and the like. Thus expressed, the "varietal" description cannot be mistaken for a subspecific name. This procedure has been suggested several times in an effort to clarify and simplify nomenclature in

zoology but never with the emphasis that has been given to it by the Schilders. The present writer heartily agrees.

Details of the generic features of the cypraeid shell and the terms used to express them are found in the "Prodrome" on page 125 (1938). The reader is referred to this page as an excellent glossary of the morphological characters of the genus.

The number, shape, and length of the columellar and labial teeth of the cypraeids, the denticles in the columellar fossula, and the color of the teeth and interspaces are today used as most important diagnostic factors in specific differentiation. The Schilders' "Prodrome" provides us with a complicated but useful dental formula for each species. Linnaeus did not appreciate the value of the teeth as a specific determinant, relying almost entirely on the structure of the shell and its color pattern and in fact described the teeth in only five of the 46 species in his genus.

We do not know how fully Linnaeus appreciated the vast difference in the structure, shape, and color of cypraeids during their various life stages. The young shell shows a well-developed and salient spire, a *Bulla*-like outline with a more or less expanded lip, and a structure that is thin and fragile. Between the embryonic stage and the fully developed adult the shell becomes progressively more solid, the columella and lip are more involute, and the spire tends to disappear under the growth of callus at the posterior extremity of the shell. The teeth are rather late in appearing, becoming evident immediately after what has been called the "*Bulla*" stage. Names have been suggested for the several stages of growth, but any arbitrary divisions of a slow and progressive structural change such as is seen in *Cypraea* seem unrealistic. Perhaps the most striking change is in color. The young shell generally gives no hint of the color or color pattern that will appear when the final layer of porcelaneous material has been deposited. Linnaeus gave different names, in several cases, to the juvenile and the adult shell, and these descriptions, most of which describe the two stages very graphically, do not suggest that he realized his error, except in one instance. In the case of *Cypraea spurca* the description contains one



sentence whose meaning is unclear and confusing but it is possible that by 1767 Linnaeus suspected that certain individuals before him were the juvenile form of the shell. This is confirmed by his comments on *Bulla cypraea*. The language of the two descriptions is discussed in detail below under the pertinent species.

The Linnaean collection is of somewhat less assistance in proving the identity of the *Cypraea* species than in the case of most of the other genera. Of the 46 specific names in the "Systema" and the "Mantissa" only 18 are represented by a documented type in the Linnaean cabinet. The shell itself is marked in 12 of the 18 cases, most of these being large shells, and in the remaining six the name appears only on the tray containing the shell. This latter method of labeling is obviously a much less authoritative one, as specimens may have been, and undoubtedly were, misplaced during the several changes of ownership of the collection before it was acquired by the Linnean Society of London. Thus there are only 12 unquestioned types in the collection. Of the remaining 28 species the collection contains specimens of 18, but, as these are not labeled or documented in any way, their authority as types is impugned except to the extent that their appearance on one of Linnaeus' lists of owned shells may be considered evidence. It is impossible to say how many of these may have been originally marked by Linnaeus, as the porcelaneous surface of most *Cypraea* makes them difficult to mark permanently. As to 10 names, no specimens are known to be in the collection; that is to say, no shell present uniquely conforms to the description.

No locality is stated for 19 species, and for nine no references are supplied except to the "Museum Ulricae," in case of those names that appear in that work.

In spite of the paucity of evidence in the collection, however, the identity of all of the Linnaean cypraeids has, with two exceptions, been satisfactorily determined. These determinations are based largely on the general average of excellence of the descriptions from the point of view of clarity of language, but also, in no small measure, on the striking differences between the several species in the details of structure, sculpture, and color and

the accuracy with which these differences are covered by the descriptions. For this reason the comments that follow are brief in the case of those species of which the identity has never been seriously questioned.

The "subgeneric" headings of Linnaeus, which are mentioned above in connection with the genus *Conus*, are also very loosely used in his *Cypraea*.

The first group is called "Mucronatae," which refers, we must assume, to sharp projection, in the adult of some species and in all juvenile shells, of the early whorls of the spire which have not been completely covered by callus. The designation is too inclusive. In certain species in the group, *carneola* and *talpa* for example, not only is the spire completely covered, but often this callus is so developed that the shell is umbilicated at the posterior end. Also Linnaeus used the words "subturbinata" and "turbinata" instead of "mucronata" in his descriptions. but his choice between the two is not always understood in the case of young shells, four of which are described in this first group.

The second heading, "Obtusae, absque spire manifesta," is also equivocal in that it covers all but a few of the members of the genus in the adult state, even those that are definitely umbilicate. The third heading, "Umbilicatae," is essentially correct, as is the fourth, "Marginatae," although the vague boundary between the dorsum and the base of *circercula* and *globulus* can hardly be described as a margin, in the sense in which that word is employed in the rest of the group.

#### *Cypraea zebra*

1758, *Systema naturae*, ed. 10, p. 719, no. 291.

1767, *Systema naturae*, ed. 12, p. 1174, no. 332.

LOCALITY: Not given in either edition.

"C. testa turbinata cinerea fasciis fuscis . . . Statura Carneolae sed duplo major, spira majore evidentiore quam in reliquis. Denticuli aperturae fusi. Venter ocellis obsoletis."

The last three words were added in 1767.

#### *Cypraea exanthema*

1767, *Systema naturae*, ed. 12, p. 1172, no. 325.

LOCALITY: Not given.

"C. testa subturbinata ferruginea maculis pallidis rotundis aspersa, linea longitudinali subramosa . . . Similis C. Mappae, sed color atro s.

rufo ferrugineus; linea longitudinalis recta uno alterove ramo; caeterum adspersa punctis latis pallidis. Spira mucrone prominens. Subtus pallida, immaculata."

These two names are here discussed together, because it is certain that they describe the same species, *zebra* being based on an immature shell and *exanthema* on a specimen which had almost reached its final adult stage. The name *exanthema* must be supplanted by *zebra*, as the latter was described in 1758, whereas *exanthema* did not appear until 1767. Not only do the descriptions reflect the details of the two growth stages, but specimens of each, properly documented, are present in Linnaeus' collection. The description of *zebra* and indeed its name accurately fit the young shell. The words "turbinata," "cinerea," "ocellis obsoletis," and "fasciis fuscis" all show the young shell, whereas "subturbinata" and "maculis pallidis rotundis aspersa" describe a stage in which the spots have developed, the bands of color have disappeared, and the spire has not yet been entirely covered by the adult callus. The phrase "linea longitudinali subramosa" is normally characteristic of the adult or nearly adult shell as Linnaeus used it, although it is often already apparent in individuals that still retain evidence of the dark transverse bands of the juvenile *zebra*. The progressive change of color pattern of the species from the young to the fully grown shell sometimes takes a different course in different individuals, so that a given feature may appear in one specimen at an earlier stage than in another. The word "subramosa" is overdrawn. The line, although generally curved and often very wide, is in no sense ramose.

Linnaeus compared his *exanthema* to the next species, *C. mappa*, a grossly misleading comparison. They are unlike in color, in color pattern, in outline, in the markedly more cavernous fossula of *exanthema*, and in the more hump-backed dorsum of *mappa*. The median dorsal line of the latter is expanded into large blotches of white at irregular intervals and is truly ramose in having numerous side branches. The extremities of *mappa* are more produced and more callous. The two species belong in different genera.

In the description of *zebra* occurs the phrase "statura Carneolae, sed duplo major." The

word "statura" must have been used in the sense of shape rather than of size, as otherwise the language is meaningless. *C. carneola* has, nevertheless, the same general shape as *zebra-exanthema* and bears the transverse bands of the young *zebra*, although they are of a different color. It is otherwise essentially different, and the two cannot be confused. The fact that there is no mention of the dark color of the apertural teeth in the diagnosis of *exanthema*, whereas it is noted in describing the young shell, *zebra*, is also unexplainable.

Thus while we know from a study of a complete growth series of this species and from the specimens in the collection that Linnaeus' two types were merely the adult and immature shells of *zebra*, it is doubtful whether this conclusion could have been arrived at from a study of the descriptions alone. The figures referred to in the synonymies are mostly unsatisfactory, although in some of them the adult shell is recognizable. The Petiver drawing cited for *exanthema* (pl. 96, fig. 6) is actually a picture of *C. mappa* and was also used under that species by Linnaeus.

It is certain that Linnaeus, to the day of his death, conceived of the two names as belonging to two different species. His immediate successors Born and Gmelin listed both as good species. Both Martini and Chemnitz failed to mention *zebra*. Bruguière's conception of the two names is not known, as he died before reaching a discussion of "Porcelaine" in his "Histoire naturelle des vers." Volume 1, his sole contribution to the work, in which the genera were treated in alphabetical order, ended with *Conus*. The first writer to recognize that the two names were conspecific was Felix de Roissy. In his continuation of the manual commenced by Denys de Montfort (1801-1805, vol. 5, p. 415), after listing *exanthema*, he gives as a synonym "Cypraea *exanthema* et *C. zebra* (Lin.)" and adds: "Bruguière proved that the shell to which Linnaeus gave the name of *Cypraea zebra*, treating it as a good species, was none other than a young individual of this species [*exanthema*], not yet covered by its second coat of testaceous material." De Roissy was in error in attributing this discovery to Bruguière, as the latter had never discussed the two species, as above noted. He apparently based his opinion on

the figures in the "Tableau encyclopédique," the pertinent plates of which appeared after Bruguière's death (1798, pl. 349, figs. A-E), and which it is almost certain that Bruguière never saw (see Dodge, 1947b). Of these figures, figures D and E represent a completely adult specimen; figure C shows a shell adult in shape and structure but still possessing the transverse bands and lack of basal and lateral spots characteristic of the last pre-adult stage; figures A and B show a very young shell. It is probable that de Roissy wrongly considered that the juxtaposition of these figures on the same plate was tantamount to Bruguière's acceptance of the two names as synonyms. In any event de Roissy was the first to call attention to the common identity of *exanthema* and *zebra*. Lamarck recognized this fact (1810, vol. 15, p. 447; 1822, p. 375). From this time on all writers accepted the identification, but have continued to use *exanthema* as the valid name of the species, in spite of the nine years' priority of *zebra*. Hanley comments on both names but seemingly confers validity on *exanthema*, as he says of *zebra* (1855, p. 183): "A not perfectly mature example of the *Cyp. exanthema* . . . is marked for this species in the Linnaean cabinet." In the modern literature the name *zebra* has all but dropped out of the nomenclature. It is possible that the early writers' unwillingness to base a specific name on a growth stage of a shell rather than on an adult specimen was responsible for the universal use of *exanthema* even after the identity of the two was established. Yet even after the adoption of Article 27b of the Rules, holding that the oldest available name is retained, "When any stage in the life history is named before the animal itself," the use of *exanthema* has persisted. Even Thiele (1931, 1935, vol. 1, p. 276) used it. Schilder and Schilder (1938, p. 179), in the most recent and most exhaustive work on the classification of the living Cypraeidae, are among the few who reduce *exanthema* to the status of a synonym of *zebra*. Certainly the correction of an obvious error of Linnaeus, which was moreover detected more than a century ago and published in a work of such importance and widespread use as Lamarck's "Histoire naturelle" should outweigh the principle that stability in the nomenclature should be safe-

guarded. The name *zebra* for the spotted cowry of the western Atlantic should be restored.

The species is the type of the subgenus *Macrocypraea* Schilder, 1930, of *Trona* Jousseaume, 1884, by original designation, as *Cypraea exanthema* Linné.<sup>1</sup>

It is figured in Martini (1769-1777, vol. 1, pl. 28, fig. 289; pl. 29, figs. 298-299) and in Reeve (1843-1878, vol. 3, *Cypraea*, pl. 5, sp. 16). *Cypraea cervus* Linné, 1771 ("Mantissa"), a closely related species that is often confounded with *C. zebra* and has a roughly similar range, is figured by Chemnitz (1780-1795, vol. 10, pl. 145, fig. 1343). This is a very characteristic drawing both as to color and shape and shows the lack of ocellation of the white spots and the frequency of the spots, which are two of the distinguishing features of the species. (See discussion of *C. cervus*, p. 121, below.)

A southern form of *zebra*, which is common from São Paulo to Pernambuco, Brazil, was called *C. dissimilis* by Schilder in 1924, but was later relegated to the status of a geographical race (Schilder and Schilder, 1939, p. 179). It differs from the northern race "by the darker red brown color, which extends dorsally above the extremities, being more accentuated, by the lateral spots not ocellated though large, and by the less numerous teeth."

Tryon (1879-1888, vol. 7, p. 164) lists *Cypraea cervinetta* Kiener, 1843, as "a small variety" of *zebra* occurring on the West Coast of the United States, but it seems to be readily separable from *zebra*.

#### *Cypraea mappa*

1758, *Systema naturae*, ed. 10, p. 718, no. 285.

1767, *Systema naturae*, ed. 12, p. 1173, no. 326.

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

"C. testa subturbinata characteribus inscripta, linea longitudinali ramosa . . . Differt a sequenti lateribus laevibus pallidis immaculatis."

A specimen of the *C. mappa* of authors is marked for this species in Linnaeus' collec-

<sup>1</sup> When Schilder erected the subgenus *Macrocypraea* in 1930 (1930, p. 55) he designated the type as *Cypraea exanthema* Linné, apparently under the misapprehension that that was the valid name of the species. Schilder and Schilder (1939) later recognized that the name *zebra* had priority, and placed *exanthema* in its synonymy.

tion and agrees with the brief main description, although the phrase "linea longitudinali ramosa" is a most inadequate way of describing the meandering, amoeba-like white pattern that takes the place of the usual median line on the dorsum of most of the *Cypraea* species. The subdescription is inaccurate in one particular. It speaks of the pale-colored, unspotted sides of *mappa* and compares them to the sides of the following species, *arabica*, which are described as having dark spots. *C. mappa* also has lateral spots, although they are paler and much less numerous than the dark, blackish brown spots of *arabica*.<sup>1</sup>

The figures from Rumphius and Argenville, cited in the synonymy, are recognizably *mappa*. The Petiver figures are extremely bad and cannot be reasonably tied to that shell. They were omitted by Linnaeus in the "Museum Ulricae," although Lamarck (1822, p. 378) restored them to the synonymy. Two further figures from Martini (1769-1777, vol. 1, pl. 25, figs. 245-246) were added in the notes for Linnaeus' "revised twelfth edition." These are characteristic of the species in color and shape and are the first post-Linnaean figures, being published only two years after the appearance of the twelfth edition of the "Systema."

Schilder retained *mappa* in the genus *Cypraea* Linné in his earlier works on the genus, stating it to be the type. Later (1939, p. 181) the Schilder brothers transferred the species to *Mauritia* Troschel, 1863, subgenus *Leporicyprea* Iredale, 1930, of which it is the subgenotype, by original designation.<sup>2</sup> Schilder's original use of *mappa* as the type of *Cypraea* was possibly based on Lamarck's use of it as the "example" of *Cypraea* (1799, p. 69), which, under the Rules, is an invalid "designation."

*Cypraea mappa* is a native of the Indo-

<sup>1</sup> There is a pink-based form of *mappa* found both in Madagascar and the Philippines, which is a mere ecological variation. This form is devoid of lateral or basal spots except in rare instances.

<sup>2</sup> Iredale's *Leporicyprea* was not a monotypic genus, strictly speaking, as, although it was erected only for *mappa* Linné, he "tentatively" placed in it the species *C. valentia* Perry, 1911, a rare species from Torres Strait. Thus *valentia* was actually listed as a member of the genus and was later definitely placed in *Leporicyprea* by the Schilders (1938, p. 180).

Pacific region, ranging from Japan and Australia westward to the east African coast. Of the four races into which the Schilders divided it, the specimen described by Linnaeus was the form called *alga* by Perry, 1811.

In addition to the Martini figures mentioned above the species is well figured in Reeve (1843-1878, vol. 3, *Cypraea*, pl. 6, sp. 18) and in Thiele (1931, 1935, vol. 1, p. 276, figs 293). Kiener (1843-1847, two pls. numbered 20, figs. 1, 2) also shows fair figures of the typical *mappa* and the so-called "varieties."

#### *Cypraea arabica*

1758, *Systema naturae*, ed. 10, p. 718, no. 286.

1767, *Systema naturae*, ed. 12, p. 1173, no. 327.

LOCALITY: "In India orientali, ad Fretam Sunda" (1758, 1767).

*C. testa subturbinata characteribus inscripta, macula longitudinali simplici . . . Differt a praecedenti lateribus incrassatis fusco maculatis. Intus violacea est."*

The description and synonymy are identical in both editions except for the addition of a figure from Seba in the twelfth.

This very distinctive shell is identified by its equally characteristic main description in the "Systema," and the identification is confirmed by the presence of a marked specimen of the *arabica* of all authors in the Linnaean cabinet.

The synonymy is correct except for the reference to Seba (vol. 3, pl. 76, fig. 3), which shows what must have been intended for *C. mappa* Linné. The subdescription of *arabica* and that of *mappa* contain one peculiar error. The two shells are contrasted by the reference to the brown spots on the sides of the first and to the fact that the sides of *mappa* are "immaculatis." *Cypraea mappa* normally has the brown spots on the sides, and it seems evident that Linnaeus either overlooked this detail or that the specimen he was examining was actually devoid of lateral spots. A specimen in the writer's collection is such an individual and, as the specimen is adult and unworn, it is impossible that the lack was the result of erosion.

The present species is placed in the genus *Mauritia* Troschel, 1863, subgenus *Arabica* Jousseaume, 1884, as the subgenotype, by

original designation.<sup>1</sup> There are three non-Linnaean species, all congeners of *arabica*, which are occasionally confused with it. *Mauritia* (A.) *maculifera* Schilder, 1932 (*reticulata* Martyn, 1798), is distinguished by a constant, dark blotch on the base to the left of the aperture, by the fact that the white maculations on the dorsum are brighter, more numerous, and more distinct than in *arabica* and are dominant over the "characters," which are sometimes obsolete. In *Mauritia* (A.) *depressa* Gray, 1824, the shell is smaller and, as the name implies, has a more depressed dorsum than *arabica* and a more heavily and callously margined base. In *Mauritia* (A.) *histrion* Gmelin, 1791, the dorsum is more sloping towards the anterior end, the base and sides are pure white rather than yellowish white as in *arabica*, and only sparsely spotted with brown, and the margins tend to bend up, in which it resembles *maculifera* rather than *arabica*. The dorsal spots are polygonal and crowded.

The species is figured in Reeve (1843-1878, vol. 3, *Cypraea*, pl. 1, sp. 2) and in Kiener (1843-1847, pl. 17, figs. numbered 1, dorsal and apertural aspects; the figures numbered 2 are called *arabica* var., but show *histrion* Gmelin).

The young shell of *arabica* was described by Linnaeus under the name of *C. fragilis* (see discussion of that name, below).

<sup>1</sup> *Cypraea arabica* Linné was designated as the type of *Arabica* by Jousseume in the issue of the Bulletin of the Zoological Society (France) for 1884 which was numbered "Parts 1 and 2" on its cover. The issue was not dated other than by its year, but was probably published in the early part of 1884 as that year's volume consisted of five parts.

The genus *Arabica* was also listed, but not described, by Jousseume in Number 51 of *Le Naturaliste* of Paris on February 15, 1884, the date being printed on the cover. No type was designated for any of the Jousseume genera there listed. It is idle to speculate on the exact date of the publication of *Arabica* in the Bulletin of the Zoological Society as the use of the name in *Le Naturaliste* was, in any case, a *nomen nudum*, and the publication in the Bulletin was therefore the first valid use of the name. The type there selected, *Cypraea arabica* Linné, was a type by original designation.

The same is true of all the Jousseume genera of cypraeids referred to in the present paper, as they all appeared in the same manner in both publications mentioned.

### *Cypraea argus*

1758, *Systema naturae*, ed. 10, p. 719, no. 287.

1767, *Systema naturae*, ed. 12, p. 1173, no. 328.

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

"C. testa subturbinata subcylindrica adpersa ocellis, subtus maculis quatuor fuscis . . . Subtus maculae utrinque duae magnae fuscae."

The description, synonymy, and locality of this species are identical in the two editions. Its identification has never been questioned, as the description could be applied to this species alone, the synonymy is unusually accurate, as might be expected in the case of a shell so distinctive in appearance, and a specimen of the *C. argus* of authors is present in the collection, which, although undocumented, uniquely agrees with both. The irregularly scattered light brown "eyes" of varying sizes on the flesh-colored surface of the shell and the pair of roughly quadrangular, deep brown spots on either side of the aperture distinguish it from any other *Cypraea*. Indeed, its specific name, which was borrowed from Rumphius' "Argus," is almost a definition in itself.

Lamarck (1822, p. 376) reports that many of the larger dorsal spots are not rings or "eyes" but are solid spots. This writer has not observed such a specimen or any figure showing this feature.

The species is placed in the genus *Talparia* Troschel, 1863, subgenus *Arestorides* Iredale, 1930, and is the subgenotype, by monotypy. Schilder and Schilder (1938, p. 180) mention three subspecies, *argus argus* Linné from the western Pacific, *argus ventricosus* Gray, 1824 (*concatenata* Dautzenberg, 1903), from Polynesia, and *argus contrastriata* Perry, 1811, from the east African region. But based on the figures cited it is difficult to assign to them any subspecific rank,<sup>2</sup> and their original descriptions do not suggest taking them out of the synonymy of *argus*.

The earliest post-Linnaean figures are those of Martini (1769-1777, vol. 1, pl. 28,

<sup>2</sup> The Perry figure for his *contrastriata* (1811, pl. 20, fig. 3) shows a shell approximately one-half of the size of his figure of *argus*, attenuated anteriorly and exhibiting only faint ocellations. It is described as a white shell transversely banded in orange, and these bands are brilliantly colored in the figure, unlike the obsolescent banding of the adult *argus*. It seems obvious that Perry based his species on an immature shell.

figs. 285–286). They are badly executed drawings, but *argus* is such a distinctive species that they are easily identifiable. Chemnitz (1780–1795, vol. 10, pl. 145, figs. 1344–1345) gives figures which are similar to Martini's.<sup>1</sup> It is also figured in Reeve (1843–1878, vol. 3, *Cypraea*, pl. 3, sp. 8) and in Kiener (1843–1847, pls. 37, 38, figs. 1 and 2 on both pls.). The Kiener figures are very characteristic.

#### *Cypraea testudinaria*

1758, *Systema naturae*, ed. 10, p. 719, no. 288.

1767, *Systema naturae*, ed. 12, p. 1173, no. 329.

LOCALITY: Not given in tenth edition; "in Sinu Persico" (1767).

"C. testa obtusa subcylindrica, extremitatibus depressis . . . Haec in suo genere maxima et reliquis longior; variat cum et absque spira antice manifesta."

The identity of this species, which shares with *C. cervus* Linné the honor of being the largest of the cypraeids,<sup>2</sup> has never been questioned. The combination of the nebulous brown and dirty-white dorsum, the cloudy dark spots on the sides, and the whiteness of the teeth and aperture, particularly on the columellar side, distinguish it from all other species. The description in the "Systema," however, except for the reference to the size of the shell, is not sufficiently characteristic and the identification can be more satisfactorily based on the language of the

<sup>1</sup> The figures of Martini and Chemnitz, respectively, purport to show two different species. Those from Martini, which he called *argus* and referred to Linnaeus' shell, show both aspects of a shell thickly covered with "eyes." The Chemnitz figures, which were called *Cypraea argus simplex*, referred only to a work which I am not able to identify, "Favanne, Catal. rais. p. 71. tab. 2. no. 308." It does not appear in the catalogues of the Library of Congress, the British Museum (Natural History), or the American Museum of Natural History. Chemnitz' figures are of a slightly larger shell on which the "eyes" are less numerous, and in some instances larger, than in the typical *argus*, and the larger are surrounded by a thicker line. Chemnitz located it in the Nicobar Islands in the Bay of Bengal. The slight variation in the size and distribution of the "eyes" has been properly disregarded by subsequent writers. The subspecies of the Schilders are based on the differences in the length of the apertural teeth and the degree to which the extremities are produced and take no account of variations in the color pattern.

<sup>2</sup> As *C. cervus* (Linné, 1771, p. 548) had not been described at the date of publication of the last edition of the "Systema," the expression "maxima et reliquis longior" was justified as of 1767.

"Museum Ulricaë," where the color pattern is accurately described, and on the figures cited from Rumphius (pl. 38, fig. C) and Petiver (pl. 97, fig. 6). A later unpublished reference in a manuscript note of Linnaeus (Martini, 1769–1777, vol. 1, p. 353, pl. 27, figs. 271–272, which are recognizable figures of *testudinaria*) and the manuscript addition of the words "aspersa atomis albis" are confirmatory.

The remainder of the synonymy in the "Systema" consisting of two references to Lister are faulty. In the first (1678, 4, s, 9, c, 5, pl. 6) the figure 6 is a misprint for 9, and in the second (*op. cit.*, 4, s, 10, c, 8, pl. 1), which Linnaeus designated as "β" and said "Larva est." the two figures on the plate show juvenile shells of two different species, one of which is sometimes cited for the young of *C. tigris* Linné. The other is unrecognizable.

*Cypraea testudinosa* Perry, 1811, is a synonym which probably represents merely Perry's unfortunate habit of changing spellings even where he did not radically change the name of a species. Schilder and Schilder (1938, p. 178) use it for the subspecific or race name of the form of *testudinaria* found in Melanesia and Polynesia, supplying the new name *ingens* for the Lemurian race and reserving *testudinaria testudinaria* for the western Pacific form in spite of the locality, Persian Gulf, which Linnaeus gave for his species.

The species is placed in the genus *Callistocypraea* Schilder, 1927, subgenus *Chelycypraea* Schilder, 1927, and is the subgenotype, by monotypy.

The Schilders base their races on the following figures: *C. testudinaria, sensu stricto*, on two figures from Kiener (1843–1847, pl. 15, fig. 1, dorsal aspect; pl. 16, fig. 1, apertural aspect). These figures tend to show the typical form as differentiated in the Schilders' comments. The form *testudinosa*, with a query, is based on a figure from Sowerby (1847–1887, vol. 4, *Cypraea*, pl. 83, fig. 4) and on a Perry figure (1811, pl. 20, fig. 1), neither of which shows sufficient detail to illustrate slight differences; the Lemurian form *ingens*, on one of the same Lister figures used by Linnaeus (pl. 689, fig. 36).<sup>3</sup> This latter figure

<sup>3</sup> This citation involves the correction of Linnaeus' misprint and also revises the complicated manner of

suffers, as do most of the Lister drawings, from the lack of careful draughtsmanship which makes it almost useless. Reeve (1843-1878, vol. 3, *Cypraea*, pl. 3, sp. 9b) figures the adult *testudinaria*, and in figure 9a of the same plate shows a pre-adult stage of the shell.

#### *Cypraea stercoraria*

1758, *Systema naturae*, ed. 10, p. 719, no. 289.

1767, *Systema naturae*, ed. 12, p. 1174, no. 330.

LOCALITY: Not given in either edition.

"*C. testa subturbinata gibba livido testaceoque maculata, utrinque marginata, subtus plana . . . Testa subovata gibba subturbinata undato-glauca maculis griseis fuscisque temere adpersa; antice juxta spiram macula fusca; postice depresso-marginata deflexa; subtus plana: labro interiore postice valde retuso; apertura antice valde gibba.*"

When this ample and detailed description has been corrected to eliminate Linnaeus' common error in reversing the application of the words "antice" and "postice,"<sup>1</sup> it becomes one of the most graphic and illuminating descriptions in the "Systema," covering the several distinctive features which, combined, set *stercoraria* apart from all other Linnaean cypraeids. It is amply sufficient to identify the species, even without recourse to the properly marked specimen in the collection.

The synonymy, as both Hanley (1855, p. 182) and Deshayes and Milne-Edwards (1835-1845, vol. 10, p. 499, note) have pointed out, is very faulty. One of the figures from Gualtieri (pl. 15, fig. S) and one of those from Petiver (pl. 96, fig. 8) appear to represent *C. mauritiana* Linné, and indeed the latter figure was again cited by Linnaeus for that species. Barrelier's two figures (pl. 1321, fig. 23; pl. 1322, fig. 4) are possibly an error for plates 1325 and 1326, as no shells are found on the plates cited and figures 23 and

referring to figures in the 1678 edition to conform to the Huddesford edition of 1770.

<sup>1</sup> Linnaeus at times used the words correctly and at other times incorrectly. The error may be excused by the fact that he was in almost complete ignorance of the anatomy and habits of the animal within the shell and that he did not appreciate the necessity of being consistent. The same error is observable in the description of the preceding species, where it is said "variat absque et cum spira antice manifesta." If the reader is not careful to detect this error, many descriptions, which should be clear, appear not to apply to the species intended.

24 of the other two plates show a *Cypraea* which might be *C. tigris* Linné. The other reference to Gualtieri (pl. 15, fig. T), those from Columna (pl. 69, figs. 1, 2), and the Adanson figure (vol. 1, pl. 5, fig. 1) may possibly be retained as representing the species under discussion. The last figure is said by Adanson himself to be a dwarf individual.

Lamarck (1810, vol. 15, p. 451) described a shell to which he gave the name *Cypraea rattus*. He cited for it Gualtieri's figure T (which was given by Linnaeus for *stercoraria* and is probably that species) and the other Petiver figure cited by Linnaeus (pl. 96, fig. 7). This figure escaped the attention of Hanley when he discussed the synonymy of *stercoraria* and seemingly has been passed over by subsequent writers. Its absence from later synonymies is excusable as it tells us little more than that it is a *Cypraea* with a spotted dorsum. Petiver called it merely "The Great Leopard." Lamarck says of his *rattus*: "This shell should not be confused with *C. stercoraria*; for it attains a greater size, and although it is swollen (bombée) it is not humpbacked (bosue). Moreover its convex portion is covered with irregular, more or less confluent spots, red-brown or chestnut in color, on a whitish and livid background. A large brown spot is seen near the spire." This is a perfect description of *stercoraria* Linné with the exception of the fact that the gibbosity of the shell is minimized by the comparison of the extreme humped dorsum of *stercoraria* and the less elevated dorsum attributed to *rattus*. It was probably merely a form of the Linnaean species in which the gibbosity of the dorsum was less highly developed. Deshayes and Milne-Edwards (1835-1845, vol. 10, p. 498, footnote) agree that Lamarck was in error in giving specific rank to *C. rattus*, saying: "It is to be presumed that Lamarck separated this species from the following (*stercoraria*) because he had only a small number of specimens; today, when the collections contain a great number, it is easy to assure oneself that *Cypraea rattus* is only a variety of *stercoraria*." Schilder and Schilder (1938, p. 178) treat *rattus* as a synonym of *stercoraria* and also identify it with *C. conspurcata* Gmelin, 1791.

The latter species is described so briefly that it is impossible to identify it with any

assurance, although Gmelin said that it is "stercorariae affinis." The word "turbinata" is used, which would point away from *stercoraria*, the spire of which, almost involved in callus, is scarcely visible. The term "caerulescente" is employed in a way which makes it difficult to say whether Gmelin referred to the dorsum or some other part of the shell. The basal callus of *stercoraria* is indeed bluish. I cannot place the Gmelin species except to suggest that it was a form of *stercoraria*, a name which he separately described, showing some variation from the typical. Schilder and Schilder (*loc. cit.*) take a very positive view, saying: "The oblong *conspurcata* (= *rattus*) and the humpbacked *stercoraria* are ecological varieties of only one species . . . as they pass into each other, and as they have been found both in the whole area inhabited by the species, though rarely occurring at the same locality."

The only other synonyms of this species are *C. olivacea* Gmelin, 1791 (not Lamarck, 1810, which is *C. ovum* Gmelin), and probably *C. cauteriata* and *fasciata* Chemnitz, 1788, which are, respectively, an adult and a juvenile stage of the same shell.

*Cypraea stercoraria* Linné belongs to the typical subgenus of *Trona* Jousseaume, 1884, and is the type, by original designation. It is very close to *C. zebra* and *cervus* Linné and *C. cervinetta* Kiener, 1843, which belong in *Macrocypraea* Schilder, 1930, the other subgenus of *Trona*, and is like those species in its cavernous fossula and widely excavated anterior end.

It is figured in Reeve (1843-1878, vol. 3, *Cypraea*, pl. 5, sp. 15) and in Kiener (1843-1847, pl. 11, figs. numbered 1, adult, and 2, juvenile, as *C. rattus*; and pl. 12, figs. numbered 1, as *C. stercoraria*). Early but characteristic figures are those of Chemnitz (1780-1795, vol. 11, pl. 180, figs. 1739-1740).

#### *Cypraea carneola*

1758, *Systema naturae*, ed. 10, p. 719, no. 290.

1767, *Systema naturae*, ed. 12, p. 1174, no. 331.

LOCALITY: "In Asia" (1758, 1767).

"C. testa subturbinata pallida fasciis incarnatis, ore violaceo . . . Testa tenuis oblonga, apertura saepe violacea."

This species may be said to be unequivocally identified with the *carneola* of authors

by the unmistakably clear description and the figure from Rumphius cited in the synonymy (pl. 38, fig. K). The collection contained no type specimen of the shell, and Linnaeus' lists show that he did not own this species. The unmarked specimens present were therefore added by a later hand. The description in the "Museum Ulricaë" is more detailed and amply confirms the identification, although it is confusing in speaking of the pink bands as the background color and the lighter zones as the decoration in the phrase "fasciis albidis in corpore subincarnato."

Two other criticisms of both descriptions might be made. First, they do not mention the fairly heavy cream-colored and extended callus forming the sides of the adult shell, a feature that might well have led Linnaeus to place the species in his fourth "subgeneric" group "Marginatae." Secondly, the shell of *carneola* is never "subturbinata," as its spire has completely disappeared under the adult callus and in some specimens is replaced by a depression, characteristics that conform more nearly to the description of his later groups, "absque spira manifesta" or "Umbilicatae." It seems obvious that the shell on which Linnaeus based his species was not an adult.

The only other figure cited in the synonymy (Petiver, pl. 80, fig. 7) can only be described as a young *Cypraea* with transverse bands over the dorsum and is so inconclusive that Linnaeus omitted it in the "Museum Ulricaë," although he restored it to the synonymy in the twelfth edition, a practice of which he was often guilty.

The species shows a growth feature which is rare in the genus *Cypraea*, in that the dorsal color pattern, at least in all individuals that I have examined, is observable in all life stages. The violet color of the aperture, however, and the cream-colored callus of the sides appear only at maturity.

The range of *C. carneola* is much more extensive than is indicated by Linnaeus' locality "In Asia." It is common from the south central Pacific to the Red Sea and east Africa and from Australia to Japan, being particularly common in the Lemurian region.

The following names have been given to forms of *carneola*: *crassa* Gmelin, 1791; *pro-*



*pinqua* Garrett, 1879; *sowerbyi* Anton, 1839; and *loebbeckeana* Weinkauff, 1881; all of which are used by Schilder and Schilder (1939, p. 188) to denominate geographical races of the species. The Linnaean name is given to that form found in the central part of the range and is based by these authors on the Rumphius figure cited by Linnaeus. The species is not *C. carneola* Martyn, 1789 (*achatina* Perry, 1811), nor *ventriculus* Lamarck, 1810, a species closely related to *carneola* Linné.

It is placed in the genus *Cypraea* Linné, subgenus *Lyncina* Troschel, 1863.

The earliest post-Linnaean figures are those of Martini (1769-1777, vol. 1, pl. 28, figs. 287-288). They are crudely executed but adequately show the oblong outline of the shell, the color pattern, and the violet aperture. More modern and accurate figures are found in Reeve (1843-1878, vol. 3, *Cypraea*, pl. 6, sp. 19) and in Kiener (1843-1847, pl. 37, two figs. numbered 3, which seem to show the Pacific form of the species named *propinqua* by Garrett).

#### *Cypraea zebra*

1758, *Systema naturae*, ed. 10, p. 719, no. 291.

1767, *Systema naturae*, ed. 12, p. 1174, no. 332.

LOCALITY: Not given in either edition.

"*C. testa turbinata cinerea fasciis fuscis* . . . *Statura Carneolae, sed duplo major, spira majore evidentiore quam in reliquis. Denticuli aperturæ fuscæ. Venter ocellis obsoletis.*"

This name has already been identified and partially discussed under *C. exanthema*, above.

That it was based on a young shell is suggested by the phrase "*spira majore evidentiore quam in reliquis*" and the use of the word "*turbinata*." Under the subheading "*Mucronatae*" Linnaeus used "*subturbinata*" for all the species except *zebra* and *fragilis*,<sup>1</sup>

<sup>1</sup> For the species *vanelli* and *lota* Linnaeus used "*subturbinata*," although these two names were certainly based on pre-adult specimens of species whose adult forms he described separately under other names. Linnaeus was apparently inconsistent in his use of the two terms, although it is possible that the young specimens were in varying stages of growth that were consistent with the term used. It is impossible to say just how far he erred, as some of the types are missing. It is also possible that certain specimens had grown abnormally and that the callus around the spire had not developed as rapidly as the rest of the shell.

both of which were based on young shells and therefore merited the expression "*turbinata*," as in the young stages the spire is more prominent than later. Linnaeus did not realize, however, that the more turbinated shells were, in fact, only juvenile individuals and supposed that they were smaller species.

The synonymy of *zebra* offers a further partial confirmation of its identity. The figure from Seba (vol. 3, pl. 76, fig. 5) and that from Buonanni (fig. 266) adequately show the young *zebra*. Argenville's figure (1742, pl. 21, fig. G) is not convincing.

#### *Cypraea talpa*

1758, *Systema naturae*, ed. 10, p. 720, no. 292.

1767, *Systema naturae*, ed. 12, p. 1174, no. 333.

LOCALITY: "In Asia" (1758, 1767).

"*C. testa subturbinata subcylindrica testacea fasciis pallidis, subtus incrassata fusca.*"

*Cypraea talpa* was known to all of the pre-Linnaean conchologists either under the name "*Talpa*" (Rumphius, Klein, Knorr, Lesser) or its French equivalent "*Taupe*" (Argenville, Davila). The description in the "*Systema*" as well as the figures cited in most of the references clearly ties Linnaeus' name both to the "*Talpa*" of his predecessors and to the *C. talpa* of modern writers. If any criticism may be made of the Linnaean description it is that the overworked word "*fusca*," which the author applied to almost any shade of brown, is hardly apt in describing the almost black base and sides of *talpa*.

The synonymy is accurate except for the figure cited from Borellier (pl. 1325, fig. 19), which is a picture of *C. arabica* Linné, and the erroneous figure from Lister, which was erased by Linnaeus in his copy of the "*Systema*" in preparation for his proposed "revised twelfth edition."

The species ranges from the central and south Pacific to the east African coast.

What little variation is found within the species is confined largely to the degree of flattening of the base, the thickening and up-bending of the right side of the base in certain forms, the degree of the anterior dilation or curving of the aperture, and the degree of concavity of the fossula. Schilder and Schilder (1938, p. 180) attribute separate portions of the range of the species to three of these forms, which they treat as subspecies, giving

the name *talpa*, *sensu stricto*, to the Malayan race, *saturata* Dautzenberg, 1903, to the Pacific race, and *imperialis*, a *nomen nudum* of Dautzenberg, to the form found in the western Indian Ocean. The *Cypraea exusta* of Sowerby, 1832, is very close to *talpa* but is regarded by some authors as a good species because of its smaller and more numerous apertural teeth and its unribbed fossula, a distinction that most conchologists will regard as of no more than subspecific value. It is found in the region of the Gulf of Aden.

*Cypraea talpa* belongs in the typical subgenus of *Talparia* Troschel, 1863, and is the type of the genus, by virtual tautonymy.

It is figured in Kiener (1843-1847, pl. 12, two figs. numbered 2) and in Reeve (1843-1878, vol. 3, *Cypraea*, pl. 2, sp. 5). An excellent black and white drawing is to be found in Crouch (1827, pl. 19, figs. 18, 18a), and a color photograph in Platt (1949, pl. 68, fig. 13).

#### *Cypraea amethystea*

1758, *Systema naturae*, ed. 10, p. 720, no. 293.

1767, *Systema naturae*, ed. 12, p. 1174, no. 334.

LOCALITY: "In Madagascar" (1758, 1767).

"C. testa subtrubinata: lateribus gibbis corticatis, dorso violaceo."

Attempts have been made to identify the shell covered by this very brief and puzzling description, but it is now generally agreed that the name should be dropped. The Linnaean collection contains a specimen marked for this species, but as the entire dorsal surface is either worn away from natural causes or has been artificially treated it is impossible to refer it to any one species, except that it is probably a member of the subgenus *Mauritia* (*Arabica*), a group that contains the *arabica* of Linnaeus, *histrion* Gmelin, 1791, *maculifera* Schilder, 1932, and *depressa* Gray, 1824—species that are much alike and are often confused.

The short description is not enlightening, except that the mention of the gibbosity of the sides of the shell indicates that the model was an adult individual. The word "corticatis" applied to the sides is superfluous, as it means "having a bark or outer layer" and undoubtedly refers to the callus on the sides, which had already been adequately described by the word "gibbis."<sup>1</sup> The violet color of the

dorsum mentioned in the description is a feature that is seen in worn specimens of several *Cypraeae*, and only in worn specimens, with the exception of a few very small species and certain of the Triviidae. There are numerous well-worn *Cypraeae* in the author's collection showing a purple dorsum, but worn representatives of species of the subgenus *Arabica* show no such color. While an examination of a much larger series might produce worn *Arabica* species showing a violet dorsum, it is not an unreasonable inference that Linnaeus himself may have been guilty of the error.

Reeve in 1845, in discussing *C. arabica* Linné (1843-1878, vol. 3, *Cypraea*, pl. 1, sp. 6), suggested that *amethystea* Linné was the young shell of that species, saying, "The young of this species appears to have been described by Linnaeus in different states under the names of *Cypraea fragilis* and *amethystea*." I am constrained to agree as to *fragilis* (see the discussion of that name, p. 75 below), but neither the description of *amethystea* nor its type specimen involves an immature shell.

Hanley (1855, p. 184), after a critical examination of the Linnaean collection, stated categorically that the specimen marked for *amethystea* was "an example of the *Cypraea reticulata* (Knorr, Del. Yeux, pt. 3, pl. 2, f. 2), the *C. histrion* of authors, having the outer coating of the dorsal surface artificially removed." In commenting on this opinion I wish to point out that *C. reticulata*, a Martyn species, was renamed *maculifera* by Schilder in 1932, following the now accepted view that the Martyn names are not nomenclatorially available, and is not a synonym of *C. histrion* Gmelin, 1791. They are both good species, quite different in the color pattern of the dorsum as well as in other details. Another objection to referring the species to *maculifera* is that Linnaeus stated the locality of his species to be "Madagascar," whereas *maculifera* is known only from Polynesia. In view of

<sup>1</sup> As the specimen of *amethystea* in the collection is either a worn or artificially decorticated shell, the suggestion has been made that Linnaeus used the word "corticatis" in error for "decorticatis." While the substitution of the latter word would clarify the description, it seems hardly possible that Linnaeus could have been guilty of such a glaring error.

Linnaeus' frequent errors in locality, this objection is less cogent than it appears to be.

Lamarck (1822, p. 379) treated *amethystea* as a synonym of *histrion*, and his successors and editors, Deshayes and Milne-Edwards (1835-1845, vol. 10, p. 497), made it synonymous not only with *histrion* but with *arabica* Linné and *reticulata* Martyn (*maculifera* Schilder) as well. These various comments on the name well illustrate the grave confusion of the early writers as to this group of species.

In view of the equivocal value of the name *amethystea*, being based on an imperfect specimen, and because of the brevity and lack of specific details in the description, it has long since been dropped from the nomenclature. The Schilders, in their latest work on the Cypraeidae (1939, pp. 181-184), do not include the name in any of the synonymies in the subgenus *Arabica*, although F. A. Schilder mentions it, with a query, in the synonymy of *histrion* in an earlier paper (1932b, p. 138).

The synonymy supplied by Linnaeus is of little assistance. The figure from Petiver (pl. 32, fig. 10) is a picture of a plant. The Rumphius figure (pl. 39, fig. Q) is too uninformative and badly drawn to be of use. It shows a margined shell with a vaguely blotched black and a suggestion of obsolete transverse bands and lacks any informative detail.

#### *Cypraea lurida*

1758, *Systema naturae*, ed. 10, p. 720, no. 294.

1767, *Systema naturae*, ed. 12, p. 1175, no. 335.

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

"C. testa subturbinata lurida subfasciata, extremitatibus luteis nigro-bimaculatis."

The description of this species in the "Systema," although accurate so far as it goes, does not cover enough of the diagnostic characters of the *lurida* of authors to insure its identification with that shell. The combination of the mouse-gray or fawn-colored dorsum with its darker but indistinct transverse bands and the pairs of deep brown spots at the two extremities is also characteristic of another *Cypraea*, *C. pulchra* Gray, 1824. The latter species is very similar in appearance except that the terminal spots are often confluent and the apertural teeth are brown, instead of white as in *livida*. It is also slightly longer in proportion to its width and more

nearly cylindrical. These details are not included in the description of *lurida*, which might cover either species. Some confirmation of the accepted identification is provided by the presence of specimens of the *lurida* of authors in the Linnaean collection, where *pulchra* is absent, but as these are undocumented in any way they have no authority as type specimens. Specimens of *C. isabella* Linné are also present, but the peculiar color pattern of the dorsum of that shell, consisting of black dashes on a variably colored ground, is not in accord with the phrase "lurida subfasciata" of the description of *lurida*, although the two are superficially similar.

Four figures are cited in the synonymy (Gualtieri, pl. 13, fig. I; Buonanni, pt. 3, pl. 251; Argenville, pl. 21, fig. C; and Adanson, pl. 5, fig. D). All of these except the figure from Argenville are fair representations of *lurida*, although they lack sufficient detail to show the fine distinctions between *lurida* and *pulchra*. The Gualtieri figure shows the brown spots at one extremity only, which led Hanley (1855, p. 184) to conclude that the model must have been a young shell.

The Argenville figure shows the pairs of black terminal spots of *lurida*, but the color appears to be a solid black, only modified by an unshaded highlight in the drawing. The shape is not cylindrical but, rather, ovate, and in this respect resembles the shape of *C. mus* Linné. These details are mentioned because Argenville called the shell "Souris" (mouse) which suggests that he may have meant it for *C. mus* Linné.<sup>1</sup>

One detail of the diagnosis, and perhaps the most important one from the point of view of identification, is the Mediterranean locality. Even though Linnaeus' localities are often suspect, *lurida* is one of the few *Cypraeae* living in the Mediterranean, and it may fairly be assumed that he was more familiar with its fauna than with the shells of the Gulfs of Suez and of Aden, the home of *C. pulchra*.

The identification of this species with the *lurida* of authors is therefore not entirely satisfactory. Although it is extremely prob-

<sup>1</sup> Linnaeus did not, however, cite this figure for *mus*, but used another Argenville figure on the same plate (fig. E), with a query. The latter figure is undecipherable.

able that Linnaeus was describing the modern *lurida*, the defects both in the synonymy and the description should prevent us from treating it as a species that was unequivocally defined. It has, nevertheless, been accepted by all writers and is certainly firmly fixed in the literature. Dunker, in 1853, gave the name *minima* to a small form of what was certainly *lurida* from the Cape Verde Islands and the neighboring west African coast. The Schilders (1938, p. 175) adopted the subspecific name *oceanica* for the race occurring in the Atlantic islands of Ascension and St. Helena.

*Cypraea lurida* is the type, by original designation, of the genus *Luria* Jousseaume, 1884.<sup>1</sup>

It is figured in Reeve (1843-1878, vol. 3, *Cypraea*, pl. 9, sp. 32) and in Kiener (1843-1847, pl. 23, figs. 1,1). Crouch (1827, pl. 19, figs. 18, 18a) has an accurate and finely executed black and white drawing.

#### *Cypraea vanelli*

1758, *Systema naturae*, ed. 10, p. 720, no. 295.

1767, *Systema naturae*, ed. 12, p. 1175, no. 336.

LOCALITY: Not given in either edition.

"C. testa subturbinata maculata punctis lutescentibus, extremitatibus fusco-maculatis, fauce rufa . . . Apertura inter dentes rufa."

The description supplied for this name is a very fair description of an immature *Cypraea lynx* Linné, and, with the substitution of "fuscis" for "lutescentibus" and the elimination of "subturbinata," might well be used as a description of the adult of that species. In the adult shell (see p. 80, below) the spire has completely disappeared under a callus and the maculation consists of numerous pale brown spots with a few larger and much darker ones. Hanley (1855, p. 184), who made the first critical examination of the Linnaean collection, found that the specimen marked for *vanelli* was in fact a young individual of *lynx*. Deshayes and Milne-Edwards (1835-1845, vol. 10, p. 513, footnote) had already arrived at this conclusion from the language used for *vanelli* in the "Museum Ulricae" which added details not included in the "Systema" and even more clearly described

the young *lynx*. Since that time *vanelli* has never been listed as a good species. Lamarck did not even mention it and Reeve (1843-1878, vol. 3, *Cypraea*, pl. 9, sp. 33) and Tryon (1879-1888, vol. 7, *Cypraea*, p. 227) both recognized that it represented the immature shell of *lynx*. Kiener does not use the name even as a synonym, although he supplies a good figure of the young *lynx* (1843-1847, pl. 38, figs. 2, 2, dorsal and basal aspects). The Schilders (1939, p. 186) resurrected it but only as a subspecific name for the race of *lynx* which ranges from Japan on the east to Ceylon on the west and south to New Guinea, reserving the name *lynx lynx* for the subspecies found in the western islands of the Indian Ocean and on the African coast.

Gmelin, who spelled the name "*venelli*" (1791, p. 3402), copied the main description of Linnaeus together with the single figure cited (Petiver, pl. 95, fig. 13), but later (*op. cit.*, p. 3420) described a *Cypraea squalina*, which many authors have synonymized with *lynx* and *vanelli* (Reeve, *loc. cit.*; Sowerby, 1847-1887, vol. 4, *Cypraea*, Index, p. 57; Deshayes and Milne-Edwards, *loc. cit.*)

Article 28 of the Rules of Zoological Nomenclature, in so far as it relates to "page precedence," is unclear, as the exact meaning of the phrase "other things being equal" is not explained. With this reservation, a case might be made for the use of the name *vanelli* for the species and the suppression of the name *lynx*, because its description, supported by a figure, precedes that of *lynx* in the "Systema." However, the action of Deshayes and Milne-Edwards in noting the common identity of the two names and their listing of *lynx* as a good species could probably be considered a "selection" by a first reviser, although this writer feels that such a selection should be made by more categorical language than those authors employed. In any case, the substitution of the earlier name would unnecessarily confuse the nomenclature, and this, under present practice, is a sufficient argument against it.

The best figure of the immature *lynx* is found in Sowerby (1847-1887, vol. 4, pl. 305, fig. 85). This figure, and figure 88 on the same plate showing the adult shell, were cited by the Schilders (*loc. cit.*) for the "race" *vanelli*. Kiener (1843-1847, pl. 38, figs. 2, 2, dorsal and apertural aspects) also shows the young shell.

<sup>1</sup> Thiele (1931, 1935, vol. 1, p. 274) reduced *Luria* Jousseaume to the status of a subgenus of *Talparia* Troschel, 1863.

*Cypraea lota*

1758, *Systema naturae*, ed. 10, p. 720, no. 296.

1767, *Systema naturae*, ed. 12, p. 1175, no. 337.

LOCALITY: Not given in either edition.

"*C. testa subturbinata alba, denticulis subulatis.*"

Linnaeus' *Cypraea lota* has been one of the most puzzling of all his *Cypraea* species. The description in the "Systema," standing alone, is utterly inadequate to identify it. No figure is referred to. The description in the "Museum Ulricae," while more detailed, adds little to our knowledge of the species and repeats the use of the word "alba," the most unrevealing feature of the diagnosis. Linnaeus did not originally own the model on which *lota* was based, for the name does not appear in either of his lists, and the presence in the collection of a specimen marked with the proper number 337 does not necessarily prove it to be the type, as it cannot be established when it was added to the collection or whether it was introduced by Linnaeus or added by a later hand. The number on the specimen, which is apparently a young *C. spurca* Linné, may therefore merely represent the opinion of some later custodian of the collection. The attempts to identify *lota* are further complicated by the fact that neither the *lota* of Gmelin nor that of Lamarck can be said with any certainty to be the same as the *lota* of Linnaeus. A number of authors, relying on the specimen in the collection, have identified *lota* with *spurca*, but it seems hardly reasonable to suppose that Linnaeus would have described that species as "alba" without any mention of its other color details unless he was describing an individual so worn that all color had vanished. This is difficult to believe, as the dorsum of the young *spurca* is an even yellowish brown color, sometimes with vaguely defined darker bands, and the shell is so delicate in structure that it would be destroyed long before wearing could bleach it white, and the deep brown color of the pitted spots on the prominent marginal callus of the adult shell is peculiarly resistant to erosion. All the early descriptions of *lota* call it a white shell, and the early figures all show it as colorless. It is impossible to associate either figures or description with any individual of *spurca*, immature or adult, fresh or bleached, that I have ever seen.

Some of the references to the name *lota* are here noted:

Gmelin (1791, p. 3402) preserved the Linnaean description intact, gave a locality, "in mari Siculo," which is correct for the eastern fulvous-based races of *spurca*, but added in a subdescription the words "testa lactea nitidissima" which do not fit *spurca*. He also said "translucente inter dentes sinistre labii rubore." The word "translucente" might apply to a very young stage, but the use of "inter dentes" shows that he was dealing with a fairly mature shell which had already acquired teeth. The Mediterranean race of *spurca* does have a fulvous base, as distinguished from the shining white base of the western Atlantic form, but the word "rubore" connotes a red too dark for any form of *spurca*. Among the figures he cited were a drawing from Martini (1769-1777, vol. 1, pl. 30, fig. 322), a dorsal view of a colorless shell unlike *spurca* in both shape and decoration, and two Born figures (1780, pl. 8, (figs. 4, 5), also showing a pure white shell both dorsally and ventrally, which, however, exhibits a circle of brown dots on the margin and a small salient spire. It might well be a young *spurca* except for the color. A figure from Buonanni (1684, fig. 245) shows so little detail that it can hardly be said to represent a mollusk shell. The Gualtieri figure (pl. 15, fig. C), which Gmelin cited for his undescribed variety "β," is almost equally undecipherable, being merely a margined shell devoid of color. Gmelin may have been describing a Mediterranean *spurca* bleached to whiteness, but the conflict between his main description and the subdescription, the vagueness and inapplicability of his various figures, and the fact that the figures do not conform to either make it impossible to identify his species.

Lamarck does not mention *spurca*, but lists a *C. lota* as of "Lin. Gmel. p. 3402." His Latin description, as did that of Linnaeus and Gmelin, used the word "alba," but adds "marginē exteriore supra crenulato," words that suggest a species of the *spurca* group. The French description characterized the shell as "white, laterally margined, especially on the right side, and whose basal callus is provided with pitted spots (points enfoncés)." The only two references given were the Born and Martini figures cited by Gmelin.

I am equally in the dark as to the identity of this *lota*, largely because of his locality "Asiatic Ocean" and his persistent use of the word "white." It is too great a coincidence that Linnaeus, Gmelin, Born, and Lamarck could all have had in their collections, or at least described, a completely bleached *spurca*, and that Lamarck, who was known to have a large collection of shells, should have omitted *spurca* entirely. What this white shell was I hesitate to suggest, but it is probable that Lamarck's specimen, as well as Born's, was in fact some form of adult shell in the *spurca* group which had lost its color except for the marginal spots, and that he merely borrowed the name *lota* in ignorance from his predecessors.

Deshayes and Milne-Edwards (1835-1845, vol. 10, p. 531) repeated Lamarck's description, referred the name *lota* to "Lin. Gmel." and again placed the species in the "Asiatic Ocean." They add, however, the following significant footnote: "In spite of the description which Linné gave for this species in the 'Museum Ulricae,' it is today very difficult to recognize it. I have never seen in the collection a shell which conformed to the requirements of the *lota* of Linné. We have seen specimens which were beach-rolled or faded by the sun, which had almost the features of *Cypraea lota*, which makes us think that this species should have long since been placed among the dubious species. As for the *lota* of Lamarck, M. Gray believes it to be a faded individual of *Cypraea flaveola*." This is the first expression of doubt in the literature as to the identity of *lota* Linné. The name *flaveola* referred to in the above quotation was used by the early writers for at least two different shells. One, the *flaveola* Linné of the twelfth edition, is the same as *acicularis* Gmelin, which is the western Atlantic race of *spurca* Linné (see discussion of *flaveola* Linné, p. 101, below). Deshayes and Milne-Edwards were probably in error, however, in saying that Gray referred *lota* to any *flaveola*. In the Gray paper to which they undoubtedly referred (1828a, p. 572) Gray said of *lota* Lamarck: "I have an apparently washed shell of this division which agrees well with Lamarck's characters above quoted. The figures represented in Born. t. 8. f. 4. 5. and Martini 1. t. 30. f. 322 and referred by

Lamarck are certainly those of worn, or young shells, of the denticulated division, probably of *C. spurca*." Gray did not mention *flaveola*.

Neither Reeve nor Kiener refers to the name *lota*. Sowerby's "Thesaurus" does not list a *lota*, but in the index to volume 4 occurs the notation "*lota* Lamk., *spurca*?"

Hanley (1855, p. 185), who first reported the presence of a young *Cypraea* in the Linnaean collection, marked with the number 337, agreed that it was impossible to identify *lota* Linné from either the description in the "Systema" or that in the "Museum Ulricae." He did admit that the marked specimen "seems merely a young *spurca*."

Krebs (see Clench, Aguayo, and Turner, 1947, p. 72), in reporting *spurca* Linné from various localities in the West Indies, cited as synonyms "*C. flaveola* Reeve; *C. lota* Born." The *lota* of Born seems to be, as already mentioned, a worn shell of some species of the *spurca* group.

The name *lota* has almost dropped out of the nomenclature in modern times, but Schilder (1932b, p. 164) puts *lota* Linné, with a question mark, in the synonymy of *Erosaria* (*Erosaria*) *acicularis* Gmelin and uses *lota* Gmelin, without a query, in the synonymy of *Erosaria* (*Erosaria*) *spurca spurca* Linné.<sup>1</sup> In the "Prodrome," however (1938, p. 133), Schilder and Schilder do not refer to *lota*, but it should be noted that the synonymies in that work are much condensed.

Thus, ever since Linnaeus' time, the name *lota* has been frequently associated with some form of one of the species in the *spurca* group by those who have attempted to identify it, but there seems only a very equivocal basis for such an identification. The persistence of the word "alba," the necessity of basing a determination on worn specimens, and the strange lack of any mention of the name *spurca* by Lamarck are largely the basis of this writer's doubts. No one today refers to *lota* Linné except with a query, and there have been no recent attempts to identify it

<sup>1</sup> In the "Prodrome" (1938, p. 133) Schilder and Schilder abandon the name *acicularis* as a good species and treat it as a subspecies of *spurca*, identical with *C. flaveola* Linné (the *flaveola* of the twelfth edition, in the opinion of the present writer), and make it the race name of the American *spurca*.

nor any discussion of the species. It must remain one of the dubious species.

#### *Cypraea fragilis*

1758, *Systema naturae*, ed. 10, p. 720, no. 297.

1767, *Systema naturae*, ed. 12, p. 1175, no. 338.

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

"C. testa turbinata ovata glauca testaceo-undata subfasciata . . . Testa structura C. arabicae, sed picta undis longitudinalibus griseis et fasciis pallidis cincta, caeterum reliquis magis tenuis est."

A more graphic picture of the immature *arabica* could hardly be drawn than the above description. While several of the older works also describe the young *arabica* with great accuracy, it was not until 1844 that Deshayes and Milne-Edwards categorically stated that the Linnaean name *C. fragilis* was based on such a juvenile individual (1835-1845, vol.10, p. 492, footnote, and p. 495, footnote). These authors based their opinion on the description of *fragilis* in the "Museum Ulricae" and on the single figure in the synonymy (Gualtieri, pl. 16, fig. Q), but, though the language in the "Museum" is more ample, it is merely confirmatory of an identification that could have been arrived at from a study of the description in the "Systema." A few years after Deshayes and Milne-Edwards, Hanley, who made the first extensive study of the mollusks in the Linnaean collection in London, confirmed their opinion by reporting the presence of a specimen of a young *arabica*. The specimen was not marked, but as we know that the species was owned by Linnaeus and the specimen was the only one present which fulfilled the requirements of the description, it is regarded as the type of *fragilis*.<sup>1</sup>

The Gualtieri figure cited by Linnaeus (pl. 16, fig. Q) is a fair picture of the young *arabica*. I have found no good modern figures.

Schilder (1932b, p. 138) uses the name *fragilis* Linné in the synonymy of *Mauritia (Arabica) arabica arabica*. It is not the "C.

*fragilis* Linné" of Born (1780, p. 179, pl. 8, fig. 6). Born's description is that of *fragilis* Linné, but his figure clearly shows a young shell of *C. mauritiana* Linné.

#### *Cypraea caput-serpentis*

1758, *Systema naturae*, ed. 10, p. 720, no. 298.

1767, *Systema naturae*, ed. 12, p. 1175, no. 339.

LOCALITY: "In Mauritio" (1758, 1767).

"C. testa obtusa triquetro-gibba, postice obtusiuscula."

Based on the description in the "Systema" alone, which refers solely to the shape of the shell, it would have been impossible to identify this species. The same description would cover, for instance, any of the species in the genus *Monetaria*. The description in the "Museum Ulricae," which contains details as to the size, color, color pattern, aperture, and teeth, adequately defines the species, especially when read in connection with the correct portions of the synonymy. Complete confirmation is found in the marked specimen of the *caput-serpentis* of authors in the Linnaean collection.

Of the figures cited in the "Systema" several show errors of transcription or other defects. The reference to Petiver's "Amboina" (pl. 12, fig. 7) should have read "plate 16, figure 7"; the reference to the Adanson figure should be "plate 5, figure G"; Gualtieri's figure is a poor drawing and probably could not have been meant for this species. The remainder of the synonymy is reasonably accurate.

The species has a very wide range, being found from the African coast to Hawaii. As might be expected from such a distribution, the species shows a great variation in color, although the color pattern itself is fairly constant. The color of the marginal callus, which is remarkable for the length of its extension up the side of the shell, thus restricting the area of the dorsum proper, varies from a pale coffee color to a deep chocolate-brown. The fulvous, gray, or fawn of the base sometimes blends into white as it approaches the aperture and sometimes persists so that the color involves the aperture itself. The interspaces between the apertural teeth, which are white or a very pale tan in the African race, become stained with dark brown in the eastern races. This is particularly noticeable in the Hawaiian shell, to

<sup>1</sup> In the description of *arabica* in the "Museum Ulricae" (p. 566, no. 180) there is at least a partial confirmation of the identification of *fragilis* with *arabica*. Linnaeus there describes a variety as follows: "Varietas cinerea grisea-undulata fasciis 2 s. 3 glaucis, obsoletis." This accurately describes one stage of the young *arabica* and paraphrases the description of *fragilis* in both the "Systema" and the "Museum Ulricae."

which the Schilders give the subspecific name *caputophidii* Schilder, 1927. In the latter race the basal color tends to be bluish and the pale blotches above the two outlets are bluish white instead of brownish white. The median dorsal line is not always in evidence, and, where present, its position is very variable. There is less variation in the shape of the shell, except that it is sometimes more ovate than deltoidal.

The constant features are the unspotted sides and base, the extension of the marginal callus into the dorsum, and the fact that the dorsum and margins form either a straight declivity or a slight concavity when seen in section, and never form an angle with each other as in many of the margined Cypraeidae.

The juvenile shell, in its earlier stages, is ashy-brown, with longitudinal brownish streaks and one well-developed and distinct brown band. In a later pre-adult stage the dorsum becomes brown and is liberally sprinkled with minute specks of brilliant white, especially at the sides and ends of the shell. Some of these white specks occasionally persist into the adult stage.

*Cypraea caput-serpentis* is now placed in the genus *Erosaria* Troschel, 1863, subgenus *Ravitrona* Iredale, 1930, of which it is the subgenotype, by original designation.

Its best-known races are *C. reticulum* Gmelin, 1791; *caputanguis* Philippi, 1849; *caputophidii* Schilder, 1927; and *argentata* Dautzenberg and Bouge, 1933; all of these, together with *mikado* and *kenyonae*, new names erected by the Schilders (1938, pp. 135-136), are made subspecific names attached to the several Indo-Pacific races of *caput-serpentis*.

It is figured in Martini (1769-1777, vol. 1, pl. 30, fig. 316), Reeve (1843-1878, vol. 3, *Cypraea*, pl. 11, fig. 44), and Kiener (1843-1847, pl. 49, fig. 1, the adult shell, figs. 1a and 1b, two of the juvenile stages). The type specimen of Linnaeus belonged to the African race, which was chosen by Schilder and Schilder (*loc cit.*) as the typical subspecies. It is figured in the Kiener figures above cited.

#### *Cypraea mauritiana*

1758, *Systema naturae*, ed. 10, p. 712, no. 299.

1767, *Systema naturae*, ed. 12, p. 1176, no. 340.

LOCALITY: "In Mauritio" (1758); "in Mauritio, Java" (1767).

"C. testa obtusa triquetro-gibba, postice depresso-acuta; subtus nigra . . . Haec magna subtus fusca; praecedens parva subtus albida. Haec disco maculis rotundis pallidis sparsis medio gibboso."

The last sentence of the description was added in the twelfth edition.

The diagnosis of this species, both in the "Systema" and the "Museum Ulricaë," is too characteristic to leave any doubt as to its identity. Not only is it accurately described, but the comparison of the color of its base with that of *caput-serpentis*, which immediately precedes it in both works, is helpful. The species is represented in the collection by a marked specimen of the *mauritiana* of authors, and the synonymy is correct with one exception. The Lister reference should have been to plate 13 and not plate 8, which shows *C. exanthema* Linné.

In spite of Linnaeus' treatment of this species as an apparent relative of *caput-serpentis* and notwithstanding its superficial resemblance to that species except for its far greater size, *mauritiana* is congeneric with *arabica* rather than with *caput-serpentis*. It belongs in the typical subgenus of *Mauritia* Troschel, 1863, of which it is the type, by virtual tautonymy. It is also the type of *Mauxiena* Jousseaume, 1884, a generic name which is not used by the Schilders or by any other modern nomenclaturist.

Three races are listed by Schilder and Schilder (1939, p. 184) from the Indo-Pacific region, to which these writers give the subspecific names of *mauritiana* Linné for the African race, *regina* Gmelin, 1791, for the Malaysian race, and *calxequina* Melvill and Standen, 1899, for the form found in a wide range extending from Australia and Japan eastward to the Hawaiian Islands. Tryon (1879-1888, vol. 7, p. 215) gives *C. fragilis* Born, 1780, as a synonym. Born's shell was based on an immature *mauritiana* as already explained under *Cypraea fragilis* Linné (p. 75, above). Chemnitz (1780-1795, vol. 10, pp. 101-102, pl. 144, figs. 1335-1336) describes and figures a shell which he called "Regina Cypraeorum"—the "Queen of the Cypraeae." His description is unquestionably that of an almost adult *mauritiana*, and his two figures show the same shell. They are apparently copied from the Born figures of



"*C. fragilis* Linné," and he cited the Born reference in his synonymy. This "Regina Cypraeorum" is the *C. regina* of Gmelin, 1791, which the Schilders used as the sub-specific name of the Malaysian race of *mauritianiana*.

The variations between the geographical races of this species are not particularly marked, consisting largely of slight differences in the teeth and the aperture and in the degree of attenuation of the anterior extremity. It should be noted here that Linnaeus, in the descriptions of the species in both the "Systema" and the "Museum Ulricae," committed his frequent error in the orientation of the shell, saying "postice depressa" instead of "antice depressa," although he made the correct distinction in both diagnoses of *caput-serpentis* ("postice obtusiuscula").

*Cypraea mauritianiana* is figured in Reeve (1843-1878, vol. 3, *Cypraea*, pl. 1, sp. 1) and in Kiener (1843-1847, pl. 39, fig. 1, dorsal aspect, pl. 40, fig. 1, apertural aspect, and pl. 47, figs. 1, 1, both aspects, of an immature shell). The most recent color photograph of the species is found in Platt (1949, vol. 96, p. 69, fig. 8).

#### *Cypraea vitellus*

1758, *Systema naturae*, ed. 10, p. 721, no. 300.

1767, *Systema naturae*, ed. 12, p. 1176, no. 341.

LOCALITY: Not given in tenth edition; "ad Sundam Asiae" (1767).

"C. testa obtusa livida maculis albis."

Although the description in the "Systema" is brief, it is sufficient to distinguish this species from all other Linnaean *Cypraeae*. There is no other member of his genus that conforms to the words "livida maculis albis." It is not necessary, however, to rely on this description. The amplified language of the "Museum Ulricae" completely confirms the identification by the addition of data on the size of the shell, the appearance of the white spots, and the details of the aperture and teeth. Moreover, a marked specimen of the *vitellus* of authors is found in the collection and can be accepted as Linnaeus' type. The synonymy is only partly accurate. The Petiver and Buonanni figures, poor as they are, are recognizably *vitellus*, and the Rumphius figure was probably meant for that species.

The reference to Lister was erased by Linnaeus in his "revised twelfth edition."

*Cypraea vitellus* belongs in the genus *Cypraea* Linné, and in the subgenus *Lyncina* Troschel, 1863. In 1930 Iredale designated it as the type of his new subgenus *Mystaponda*, in the genus *Lyncina*. Schilder and Schilder however (1939, p. 186), moved the species to *Lyncina* as a subgenus of *Cypraea* and did not recognize Iredale's *Mystaponda*.

The most characteristic feature of the color pattern of the present species is the series of parallel, hair-like, brown lines which can be seen on the right side of the shell and which extend so far up onto the dorsum that they restrict the pale fawn-colored area. These lines are also occasionally visible on the left side, but there they are much less obvious and are usually concentrated in separated "bundles" which lie at various angles to each other. They are what the Schilders call "the lateral sand-like striae." One peculiarity of these lines or groups of lines has never, I believe, been reported. In the course of the deposit of the last layer of enamel either the rate of deposition has been different on different parts of the sides or the crystals of the deposit have been laid down at varying angles. The result is that by varying slightly the angle at which the shell is viewed the lines can be made to disappear, and reappear as the shell is moved, or reappear at a different angle. A possible contributory cause of this phenomenon may be that the lines are laid down in the layer immediately before the final one, which is translucent, so that they are viewed as through a distorting mirror.

The lines are most highly developed in the east Australian subspecies to which the Schilders gave the name *vitellus orcina* Iredale, 1931, and in that form they extend farther up on the dorsum and are so well defined that the optical phenomenon just described is much less evident. In the subspecies *vitellus polynesiae* Schilder and Schilder, 1939, they are almost completely obsolete. In the latter race, also, the white spots of the dorsum are more numerous, much whiter, and less nebulous.

The species is figured in Reeve (1843-1878, vol. 3, *Cypraea*, pl. 5, sp. 14) and in Kiener (1843-1847, pl. 19, figs. i, l). The latter figures show a dorsum which is somewhat too

dark, although a fulvous color, darker than the typical fawn, is occasionally encountered.

#### *Cypraea mus*

1758, *Systema naturae*, ed. 10, p. 721, no. 301.

1767, *Systema naturae*, ed. 12, p. 1176, no. 342.

LOCALITY: "Ad Carthagenam" (1758, 1767).

"C. testa obtusa retusa gibba cinerea: fascia longitudinali fusca, denticulis nigricantibus."

The *Cypraea mus* of authors is one of the most distinctive and unmistakable members of the genus, but the description in the "Systema" is hardly adequate to define it. Not only does it omit important details, but the word "cinerea" does not describe the variegated tan background of either the dorsum or the base, and the word "fascia" is most inapt for the median line. The shell is almost deltoidal in shape, its dorsum is markedly gibbous, and it has no marginal shelf. In color pattern it shows a more or less well-marked, whitish median line, stained interruptedly with blackish brown, on a pale tan background almost entirely covered by a series of coffee-colored transverse wavy lines which are often interrupted, especially as they approach the sides. The teeth are reddish brown and only slightly developed, being often obsolete in the central portion of the columella. This brown color extends back from the aperture on the columellar side, forming a blotch of greater or less extent. The variations in the species consist largely of the disposition and prominence of the wavy brown lines of the dorsum, which at times resolve themselves into spots, and of the extent and arrangement of the dark stains on, and on either side of, the median line. There is usually a larger blotch near the posterior end of the shell immediately over the outlet and a chain of smaller spots running the entire length of the median line but often concentrated near the anterior end.

The form *bicornis* Sowerby, 1870, shows two prominent tubercles or "horns," one on either side of the median line near the posterior end of the shell, that on the left having the appearance of a vestigial spire entirely covered by callus. Schilder and Schilder (1938, p. 174) treat this as an ecological variety only, possibly because its range parallels the comparatively restricted range of the typical *mus*, but there would seem good grounds for

considering such a radical and distinctive structural difference as worthy of subspecific separation. In addition to the dorsal tubercles this form has normally a much more highly developed callosity.

While the description in the "Systema" is too brief to identify *C. mus*, that in the "Museum Ulricae" gives additional details covering the color pattern of the dorsum, particularly of the central zone, the depression of the anterior end of the shell, and the slight development of the apertural teeth, and is quite adequate to define the species. The synonymy is only partially correct. The Rumphius figure (pl. 39, fig. S) is a good representation of *mus*. The Argenville figure (1742, pl. 21, fig. E), which Linnaeus cited with a query, seemed to Hanley (1855, p. 187) to represent *C. onyx* Linné. To this writer it looks more like *C. mappa* Linné, at least in color pattern. The Lister figure ("4. s. 9. c. 1. t. 2") obviously shows *onyx*. The figures from the third volume of Seba (pl. 76, figs. 33-34) may be taken for *mus*.

The range of the species is from the northern coast of South America to Curaçao and Barbados. Linnaeus' locality, "ad Carthagenam," to be correct must be assumed to mean Cartagena, Colombia, which is within the range of *mus*. "Carthagenam" is an obsolete spelling of both the Cartagena in Colombia and that in Spain.

The only species that might be confused with *mus* is *Cypraea leucostoma* Gaskoin (1843, p. 25).<sup>1</sup> It is superficially similar in appearance to the present species but is distinguished by its white or very pale tan base and by the fact that the columellar lip is devoid of teeth and the outer lip is only faintly denticulate. The sides are more heavily and darkly spotted and more callous. The dorsal line is more distinctly branched, and the brown staining of the center of the dorsum in *mus* is replaced by one large central blotch. Schilder and Schilder (*loc. cit.*) do not compare *leucostoma* with *C. mus* as Gaskoin and Reeve did, but used the name as a synonym of *C. teulerei* Cazenavette, 1845 (pp. 117-118), a species from the Persian Gulf, which they place in the genus *Bernaya* Jousseaume, 1884. Cazenavette says of his *teulerei* (*ibid.*, p.

<sup>1</sup> *Cypraea leucostoma* Gaskoin is a preoccupied homonym of *C. leucostoma* Gmelin (1791, p. 3413).

117): "At first sight this shell might be taken for *Cypraea mus*. It differs essentially in all details, which seems to me very remarkable." He then supplies a long description, which covers all the differences mentioned above.

*Cypraea mus* belongs in the genus *Siphocypraea* Heilprin, 1887. It is often incorrectly cited as the type of that genus, possibly because it is the only living representative. Heilprin founded the genus on a Pliocene fossil from Florida. As *Cypraea mus* Linné was not on Heilprin's original list, his sole species, *S. problematica*, becomes the type, by monotypy.

The species is figured by Reeve (1843-1878, vol. 3, *Cypraea*, pl. 7, sp. 24). The colors in this figure are exaggerated. Kiener (1843-1847, pl. 25, figs. 1, 1a) has accurate figures of the species.

#### *Cypraea tigris*

1758, *Systema naturae*, ed. 10, p. 721, no. 302.

1767, *Systema naturae*, ed. 12, p. 1176, no. 343.

LOCALITY: "In Madagascar" (1758); "in Madagascar, Java" (1767).

"C. testa obtusa ovata, postice obtusa, antice rotundata, linea longitudinali testacea . . . Testa albida s. purpurascens maculis obsoletis, fuscis, confluentibus; antice posticeque cinerascens; subtus nivea."

In spite of the comparative wealth of detail in the description of *Cypraea tigris* it is not, when dissected, particularly enlightening, and again Linnaeus has used the wrong words for the two ends of the shell. The language of the "Museum Ulricae" is hardly more helpful. The synonymy is only partially correct, as in it Linnaeus confuses *tigris* with *pantherina* "Solander" Humphrey, 1786. We must therefore rely on the marked specimen of the *tigris* of all modern authors that is present in the Linnaean collection as a complete confirmation of the accepted identification.

The synonymy is defective in that the Gualtieri figure (pl. 14, fig. H), one of Barrelet's figures (pl. 1325, fig. 23), and the Lister figure 681 (this number in the 1770 edition of Lister corresponds to the circuitous reference cited by Linnaeus from the edition of 1685-1692) all show *pantherina*. In the Petiver figure (pl. 96, fig. 17) the reference should have been to figure 7 which was probably in-

tended for *C. tigris*. The drawing cited from Rumphius (pl. 38, fig. D) accurately depicts *tigris*, and another figure on the same plate of Gualtieri (pl. 14, fig. I), which Linnaeus possibly intended to cite, is also *tigris*.

*Cypraea tigris* Linné, in spite of its being a common shell, and notwithstanding its distinctive appearance, was not clearly understood by the early followers of Linnaeus. In addition to the unfortunate, if pardonable, confusion with *pantherina*, there are three other names which must be mentioned in any discussion of *tigris*:

Martini (1769-1777, vol. 1, p. 333) lists what he supposed to be a form of *tigris* Linné, *Tigris femina*, which he describes only as "levi subspirali." For this name he cited Gualtieri (pl. 16, fig. 5, an apparent misprint for figure S), Seba (vol. 3, pl. 16, fig. 8), and Davila (1767, p. 267, no. 562, no fig.). The last-mentioned shell was called "Femelle de Peau de Tigre" by Davila. Martini also referred to two figures of his own which were described under his section on *Bulla* (p. 22, figs. 207-208). I know of no pre-adult stage of either *tigris* or *pantherina* which conforms either to these figures or to Martini's description of them on page 295. Gmelin (1791, p. 3409) and Lamarck (1822, p. 382) each describe a *Cypraea feminea*, which, based on the figures they cite, including the references given by Martini, was apparently the same as the latter's *femina* and Davila's "femelle." Deshayes (1830, 1832, vol. 3, p. 817) and Dillwyn (1817, vol. 1, p. 449) state categorically that *feminea* is a young *tigris*, and Deshayes and Milne-Edwards, in the second edition of Lamarck (1835-1845, vol. 10, p. 503) add nothing to Lamarck's opinion. Since that time the name *feminea* has not been profitably discussed. Based on all the figures and descriptions it is not possible to be more definite than to say that it represented the young of a *Cypraea* closely allied to *tigris*. Gmelin, indeed, called it "tigridi affinis."

*Cypraea tigrina* Gmelin (1791, p. 3404) is a name that must be suppressed, as it is a synonym of *tigris* Linné, being based on a young shell of that species. This is suggested by Gmelin's subdescription, "C. tigridi affinis, at spira manifesta guttisque longe rarioribus distincta." *C. tigrina* Lamarck (1822, p. 383) is a different species, being a new name for *C.*

*guttata* Lamarck, 1810, erected by Lamarck in order to avoid confusion with *C. guttata* Gmelin (1791, p. 3402).<sup>1</sup> Unfortunately, Lamarck did not realize that his *guttata*, 1810, was not only a homonym of *guttata* Gmelin, but was identical with *paniherina* "Solander" Humphrey, and therefore both his *guttata* and his *tigrina* have been dropped from the nomenclature. Deshayes and Milne-Edwards (1835-1845, vol. 10, p. 504, footnote) recognized the identity of *tigrina* Lamarck with *paniherina* and suggested the substitution of the latter name.

*Cypraea tigris* is the type of *Cypraea*, by subsequent designation, Montfort, 1810. It is also the type, by absolute tautonymy, of the genus *Tigris* Troschel, 1863, a group name which has been abandoned by most writers.

Schilder and Schilder (1939, p. 185) divide *tigris* into three subspecies based on geographical forms: *tigris tigris* for the race from east Africa and the Indian peninsula; *tigris pardalis* Shaw, 1795, for the race ranging from Melanesia to Japan and Australia; and *tigris lyncichroa* Melvill, 1888, for the eastern and central Pacific race. It is a moderately frequent to common species throughout its range.

The variations in the species clearly separate the three subspecies. In the typical *tigris* the sides are more evenly rounded, even in calloused shells, the fossula is shallow, and the aperture wider than in the other races. It is more inflated and the dorsal spots tend to be smaller than in *pardalis*, at least. In *lyncichroa* the fossula is distinctly concave, with prominent ribbing, and the sides of the shell are less rounded, sometimes becoming almost angular. The race *pardalis* is intermediate between the two others with respect to the conformation of the sides and the depth of the fossula. Its dorsal spots tend to be larger than in the other races. The above variations are among those noted in Schilder

<sup>1</sup> *Cypraea guttata* Gmelin is very far removed from the *tigris* complex. Its most outstanding characteristic is the length of the reddish brown apertural teeth, which are so long that they not only cross the entire width of the base but are visible dorsally at the two ends of the shell. This feature is well illustrated by Kiener (1843-1847, pl. 43, figs. 1, 1). It is a rare shell from Melanesia. It is placed in the typical subgenus of *Erosaria* Troschel, 1863.

and Schilder's extensive discussion and compare very accurately with the series of the species examined by the writer. Among the Indian Ocean specimens examined in the collection of the American Museum of Natural History are several individuals in which the entire dorsum has a brick-red background, contrasting very sharply with the usual white or yellowish color. This red color does not give the appearance of having been the result of staining from an external source. I have not seen this variation mentioned. Hidalgo (1906-1907, p. 542), in his list of "varieties" of *tigris*, described one as "testa dorso intense fulvo" and cites a figure from Weinkauff (1881, pl. 30, fig. 1). This figure is of a *tigris* with the central part of the dorsum a rosy pink quite unlike the saturate brick-red of the specimens mentioned. Sowerby (1847-1887, vol. 4, pl. 312, fig. 175) shows a form with the color covering a larger area of the dorsum but again pink instead of brick-red.

*Cypraea tigris* is figured in Reeve (1843-1878, vol. 3, *Cypraea*, pl. 4, sp. 12). Schilder and Schilder (*loc. cit.*) refer Reeve's figure 12b to the race *pardalis* Shaw, with a query, and indeed the figure is not sufficiently detailed to show the necessary variations. The Kiener figures (1843-1847, pl. 45, fig. 1; pl. 46, figs. 1, 1, dorsal and apertural aspects) apparently show *pardalis* because of the darker and larger dorsal spots, as the Schilders state. Sowerby's figures (1847-1887, vol. 4, pl. 312, figs. 173-174) are referred by the Schilders to *lyncichroa*, and figures 172 and 175 (the latter with a query) to *tigris tigris*. I should hesitate to base a subspecific name on the details of the last two figures mentioned.

The young *tigris*, in its early stages, gives more of an impression of whiteness than the adult shell, as the brown spots are lighter in color, smaller, and less numerous. In a later pre-adult stage the dorsum bears yellow-brown wavy or zigzag longitudinal lines instead of spots. A specimen between these two stages was apparently the one described by Gmelin (1791, p. 3408) as *C. flammea*. He said his shell was "tigridi proxime affinis" and described the ornamentation of the dorsum as "maculis flavis undatis varia."

#### *Cypraea lynx*

1758, *Systema naturae*, ed. 10, p. 721, no. 303.

1767, *Systema naturae*, ed. 12, p. 1176, no. 344.

LOCALITY: "Ad Madagascar" (1758, 1767).

"C. testa oblongo-ovata punctis fuscis lineaque flavescente, postice acutiuscula, ore rufa... Praecedenti similis nitidaque, sed parva."

The description of *Cypraea lynx* in the "Systema" adequately distinguishes it from *C. tigris*, which it immediately follows, and is sufficient to define the species. The orange-red color of the apertural teeth and the shining appearance of the shell are mentioned, as well as its smaller size. The omission of the word "confluentibus," as applied to the dark spots of the dorsum in *tigris*, is significantly accurate. It should be pointed out that here again Linnaeus confused the application of "postice" and "antice" in the phrase "postice acutiuscula."

Of the three references given, only that of Gualtieri (pl. 14, fig. 2, C, D) is of any value. The Petiver figure (pl. 97, fig. 17) had already been used for *tigris* in error for figure 7, and neither figure is characteristic of *lynx*. The Lister figure is undecipherable. In Linnaeus' annotated copy of the twelfth edition it was changed to "f. 684," which was the number in the 1770 edition corresponding to the complicated reference in the earlier edition. It may possibly have been based on an immature *lynx*.

The identification of the species with the *C. lynx* of authors is, however, completely confirmed by the presence in the collection of a properly marked specimen of that shell.

The species belongs in the genus *Cypraea*, subgenus *Lyncina* Troschel, 1863, of which it is the subgenotype, by virtual tautonymy.<sup>1</sup>

<sup>1</sup> Of the seven Linnaean species that are the types of the cypraeid genera erected by Troschel in 1863, one, *tigris* for the genus *Tigris*, is the type by absolute tautonymy, and five may be considered types by virtual tautonymy under the rather unexplicit language of Article 30 of the Rules. *Vide C. moneta* for *Monetaria* and *C. erosa* for *Erosaria*. In one case, *Lyncina*, there might be a question raised as to whether the specific name *lynx* is "virtually" the same as the generic name, as it is somewhat farther removed in orthography than in the other cases. I consider the terms of the Article broad enough to cover this case as well, and therefore treat *lynx* as type by virtual tautonymy. This case is mentioned because Schilder (1932b) was apparently convinced that the orthographic differences between the two names were too marked and did not refer the date of the fixation of type to Troschel's 1863 paper, as he did in the case of the latter's other genera.

*Cypraea lynx* is represented in the Indo-Pacific region by four distinct races, the ranges of which do not apparently overlap and which the Schilders treat as subspecies. Using the Schilder race names, the race *lynx lynx* is found from Mauritius and Madagascar to the adjacent African coast; the race *lynx williamsi* Melville, 1888, is a Red Sea subspecies; the race *lynx vanelli* Linné (see discussion of *C. vanelli*, p. 72, above) ranges from south Malaysia west to Ceylon and the Indian Peninsula, east to the western part of New Guinea and north to Japan; the race *lynx caledonica* Crosse, 1869, is found from Melanesia north to the Marianas, east to Hawaii, and south to New South Wales.

The variations that the species exhibits seem to be largely ecological rather than geographical. The Schilders' race descriptions show no marked differences, and this is borne out by examination of series from the various areas mentioned. On the other hand, shells differing markedly in shape and color are found throughout the whole range of the species. Some of the larger individuals are long and cylindrical, in contrast to the usual rounded-ovate shape. In some the white background, with its nebulous decoration of pale brown, overlain with a few larger and darker spots, becomes bluish gray with a partial suppression of the brown pattern, and in these individuals the dorsum exhibits an aluminum-like glaze of greater or less extent. Specimens are found with a large central dorsal blotch and with few of the smaller dorsal spots. The distinguishing and constant features, however, are the deep orange-red color of the interspaces of the apertural teeth and the prominent angle or ridge between the left side and the markedly flat base on the columellar side. On the right side the lateral callus rounds evenly into the base.

With the exception of the subspecific names mentioned above, given to shells from the widely separated areas of its distribution, and the name *michaelis* Melville, 1905, which is a synonym of the race *vanelli*, this well-known and distinctive shell has had little nomenclatorial history.

The best figures are those of Reeve (1843-1878, vol. 3, *Cypraea*, pl. 9, sp. 33) which seem to show the typical subspecies from the western Indian Ocean, and those from Kiener

(1843-1847, pl. 25, figs. 2, 2) which have been cited by the Schilders for the Red Sea subspecies *williamsi* Melvill. The immature *lynx*, on which Linnaeus based his *C. vanelli*, is also figured by Kiener (pl. 38, figs. 2, 2).

#### *Cypraea isabella*

1758, *Systema naturae*, ed. 10, p. 722, no. 304.

1767, *Systema naturae*, ed. 12, p. 1177, no. 345.

LOCALITY: "In Mauritio, Madagascæ" (1758, 1767).

"C. testa obtusa subcylindrica, extremitatibus luteis."

The very brief description in the "Systema" points to the *Cypraea isabella* of authors so far as concerns the few characteristics it covers. All that it tells us is the shape of the shell and its yellow extremities, but as these are possibly the two most important features, in combination, it is possible to say that the species had been well defined by the language in 1758 and 1767. It is not necessary to rely upon it, however, as the description in the "Museum Ulricæ" supplies more details and is entirely adequate. It gives us the coloration "pallida s. glauca, adpersa lineis lineis longitudinalibus s. punctis fuscis"; it mentions the white base and the obsolescence of the teeth at the posterior end of the aperture; and it refers to the bluntness of that end of the shell. Specimens of the *isabella* of authors are found in Linnaeus' collection, although they are not identified in any way. The synonymy is entirely correct, with one exception. The Lister reference was to a figure which is certainly not *isabella* and was changed by Linnaeus to "List. Conch. 660" in his "revised" copy of the "Systema."

*Cypraea isabella* offers considerable variation. One of its constant features is the pair of spots at each end of the shell, but the character of these spots changes as one progresses from the western to the eastern limits of its range. In the Indian Ocean races the spots are bright orange-red, but even here there is an ecological variation in that the spots in certain individuals tend to coalesce and cover the entire end of the shell. As the species progresses eastward these are supplemented by a pair of small brown spots immediately behind them. The latter become increasingly larger and darker, until at the extreme eastern limit of the species in the

Hawaiian Islands they are almost black and tend to obscure or invade the orange spots. The black dots and dashes of the dorsum are also very variable in their frequency and in their concentration on different areas. The ground color of the dorsum varies from an ashy gray to a pinkish gray, the latter shade being more common at the eastern end of the range. All specimens show vague transverse bands of a slightly deeper color than that of the background, but the degree to which these are visible varies greatly throughout the range of the species. The degree of concavity of the fossula is a radical variation, the fossula being shallower in the western races and more cavernous and with a projecting inner margin in the Pacific.

*Cypraea controversa* Gray, 1824, from the Hawaiian Islands and the western coast of Central America, was for many years considered a variety of *isabella* but has now been separated as a good species by the Schilders (1938, p. 176), although as late as 1933 F. A. Schilder had treated it as a form of *isabella* (1933b, p. 13). It is found with *isabella* in the Hawaiian Islands and is much more common than the latter. It is easily distinguishable. It resembles *isabella* in shape and in the presence of terminal spots. The latter are, however, larger and darker than in even the eastern *isabella*. The shell reaches a greater size than that species, and the dorsum is usually of an even pale to chocolate-brown, on which light and dark zones are easily visible. The shell is heavier and more callous and the dorsum is slightly more elevated.

Names that have been referred to as forms of *isabella* are *limpida* Melvill, 1888; *fulva* Rous, 1905; and *lekalekana* Ladd, 1934. Rous (1905, p. 77) gave no locality for his "*isabella* var. *fulva*," but there is nothing in his description which does not indicate a worn specimen of *controversa*. The Schilders (*loc. cit.*) use the Ladd name for the central and western Pacific race, and publish two new names, *atriceps* for the race of east Polynesia including Hawaii, and *rumphii* for the south Malaysian and Japanese race, reserving the name *isabella isabella* for the race found in the Lemurian province.

The species is now placed in the genus *Luria* Jousseaume, 1884, subgenus *Basiltrona* Iredale, 1930, of which it is the subgenotype,

by original designation. The type specimen described by Linnaeus in the "Systema" was an example of the typical subspecies from the Lemurian province, Madagascar, Mauritius, and the island groups of the western Indian Ocean.

*Cypraea isabella* is figured in Kiener (1843–1847, pl. 48, fig. 3). In Kiener's figure 3a the appearance of the terminal spots suggests the subspecies *atriceps*. Reeve's figure is also good (1843–1878, vol. 3, *Cypraea*, pl. 12, sp. 51).

#### *Cypraea onyx*

1758, *Systema naturae*, ed. 10, p. 722, no. 305.

1767, *Systema naturae*, ed. 12, p. 1177, no. 346.

LOCALITY: "In Asia" (1758, 1767).

"C. testa umbilicata, subtus fusca, supra albida . . . Testa magnitudine pollicis, subtus atrata; supra lutea, albido-flava, similis caeterum Capiti-Serpentis; an mutata?"

The description of *onyx* in the "Systema" adequately defines the species, although the language describing the dorsum is not particularly graphic. This is understandable, as the back of the typical *onyx* is too complicated in its ornamentation to be described in a few words. The words "caerulescens fasciis duabus, flavescens, obsoletis" of the "Museum Ulricaе" are more characteristic, and the whole description in that work adds other confirmatory details as to the size of the shell and the dentition of the aperture. Linnaeus' comparison of *onyx* with *caput-serpentis* in both editions of the "Systema" and his query that *onyx* might be a form of that shell are not understood. The two shells are utterly dissimilar in every feature except the dark base and the lighter dorsum. This portion of the description did not appear in the "Museum Ulricaе" and was erased in Linnaeus' own "revised" copy of the "Systema." It was retained by Gmelin, however, which strengthens the opinion of many writers that Gmelin did little more than copy the diagnoses in the "Systema" or paraphrase them by improving the grammar, and add new species of his own, many of which prove to be identical with other Linnaean names.

The synonymy is partly defective. Gualtieri's figure (pl. 15, fig. N) was probably meant for *onyx*. That taken from Rumphius (pl. 39, fig. G) is less characteristic, and all

that Hanley would say (1855, p. 188) was that it was "not so unlike" it. The figure from Buonanni (pl. 255) is, like most of the figures in that work, too poor to be identified.

Linnaeus' description in both works was obviously based on the typical *onyx* with the black base and the iridescent, varicolored dorsum. No specimen of that shell is present in the collection, but an undocumented specimen of the *C. adusta* Lamarck, 1810, is found, the form with the dark, unicolored dorsum and the base that is considerably lighter than that of the typical *onyx*. This specimen cannot be regarded as the type of *onyx* as it does not conform to the phrase "subtus atrata" or the words "supra lutea, albido-flava." Hanley (*loc. cit.*) was inclined to accept it as the type specimen, saying that it was the only shell in the collection that conformed to "subtus atrata," with the exception of the marked specimen of *C. talpa*, thus failing to appreciate the very limited meaning of the word "atrata."

Synonyms of the name *onyx* are: *C. pulla* Gmelin, 1791 (based on a late stage of the juvenile *onyx*), *C. prunus* Röding, 1798, and *C. castanea* Mueschen, 1778 (both apparently based on the *adusta* form), and *C. nymphae* Jay, 1850, and *C. carnicolor* Mörch, 1852 (both based on an unusual form of the species, a white or pinkish white shell with vague, pale fulvous bands and a base and margins either shining white or occasionally pale yellow, especially on the right side).

None of the Linnaean *Cypraeaе* exhibit such a wide range of color variation as this species. Typical *onyx*, the dark *adusta*, and the pale *nymphae* form a trio so totally different in appearance that they would be clearly separable by anyone who based their identity on color alone. The juvenile form is that called *C. succincta* by Linnaeus. Examination of a considerable series of immature *onyx* leads me to believe that all the forms mentioned look alike in the early pre-adult stages, at least, and that it is not possible to refer any immature shell in the *Bulla* stage to any one adult form. Further investigation is necessary on this question. *C. succincta* is further discussed on page 87, below.

The immediate followers of Linnaeus were confused in their conception of Linnaeus' *onyx*. The reference in the "Systema" to the

possible affinity of *onyx* with *caput-serpentis* seems to have impressed Martini. He described a shell (1769-1777, vol. 1, pp. 386-388, pl. 30, fig. 316) which he referred to *C. caput-serpentis* Linné, and his figure unquestionably shows that species. At the end of his synonymy he adds a further synonymy headed "Huc pertinet" in which he cites the Rumphius figure given by Linnaeus for *onyx* and quoted Rumphius as having called it "Caput serpentis coeruleum," whereas in fact Rumphius' name was "Porcellana caerulea." He also cited the Gaultieri figures used by Linnaeus for *onyx*, and the synonymy ends with a definite reference to the *onyx* of the "Systema" and the "Museum Ulricae." It is possible that both Linnaeus and Martini were unduly impressed by the dark base and sides which are common to both species. The problem of Martini's conception of *onyx* Linné is not simplified by the fact that he described and figured two other species which may possibly be referred to it (*tom. cit.*, p. 352, pl. 26, figs. 267-268; and pl. 26, figs. 269-270). The first of these he described as "Porcellana pyriformis . . . dorso subflavo maculato et fasciato . . . ventre saturate croceo" and the second as "Porcellana pyriformis . . . dorso dilute bruno vel badio . . . fasciis transversalibus distincto, ventre et lateribus atrofuscis." The two pairs of figures, each showing the dorsal and apertural aspects, accurately reflect the above descriptions and show, respectively, a shell with a yellowish brown dorsum banded in lighter yellow and with a paler yellow margin and base, and a shell with a dorsum somewhat similar to that of the first pair but with the almost black base of the typical *onyx*. He did not use the name *onyx* anywhere in these descriptions, but the two pairs of figures are very suggestive of pre-adult form of *adusta* and *onyx*, respectively, having developed beyond the *succincta* stage but not yet having developed the dorsum of the adult form of either.

Chemnitz (1780-1795, vol. 10, p. 106, pl. 145, fig. 1341) described *Cypraea adusta* for the first time and his figures, both numbered 1341, are excellent dorsal and apertural views of that form. He was still puzzled, however, by the *caput-serpentis* analogy, and while his German is as usual difficult to put

into English, a translation of his comments upon that subject is given. He said (*loc. cit.*): "We have here a rare *Cypraea* which is not readily available to my conchological associates. Some good conchologists have attempted to persuade me that it is *Cypraea Onix Linnaei*. One does indeed find in it the features which Linnaeus attributed to his *Cypraea onyx* no. 346 in the *Systema naturae*. It has *testam umbilicatum subtus fuscam et atratam, supra albido flavam seu luteum, magnitudinem pollicis &c.* However, when I hear Linnaeus himself unexpectedly ask, in a comparison of this species with that which is called *caput serpentis*, whether or not *Cypraea Onix* may not have originated by a mere change [Veränderung = ?evolutionary change] of that common species; and when I further consult his citations from Bonanni, Rumph and Gaultieri; and finally refer to the *Mus. Reg. Lud. Ulr.*, and see that there he ascribed to it a pair of yellow bands, and *testa coeruleascens* and *supra cinerascens*, instead of the formerly cited *testa lutea et albido flava*, then I candidly admit that I do not recognize the species from the whole diagnosis of Linnaeus, and I would very much like to learn from someone else how we could find our way out of this labyrinth."

Gmelin's acceptance of Linnaeus' curious misconception as to the relation of *onyx* to *caput-serpentis* has already been referred to. He was the first, however, to evaluate the position of *adusta* correctly, although he did not use that name. He cited *onyx* as a good species, and both his description and his references, the latter lifted bodily from the "Systema," point clearly to the typical *onyx* with the black base and sides and the varicolored dorsum. His variety "β," on the other hand, is obviously the *adusta* described by Chemnitz and later validated by Lamarck in 1810, as the principal figure cited for it is the Chemnitz figure 1341. Gmelin's *Cypraea pulla* (p. 3412) described a young stage of *onyx*, and the figures he cited for it are the two figures from Martini (figs. 269-270) which show the shell with the dorsum of the young *succincta* and the black base of the adult *onyx*.

Lamarck was apparently not familiar with the Linnaean *onyx*. His *C. adusta*, both in 1810 and 1822, was based solely on the *adusta*



of Chemnitz. In his French description, however, he uses language which suggests that he had seen specimens of *onyx*. He there said (1822, p. 389) that the shell of *adusta* "in an advanced stage of life becomes entirely brown. Its sides and base, very black, make it appear as roasted." This statement is true of *adusta* with the exception of the reference to the "very black" base, which is seen only in the typical *onyx*. In the second edition of Lamarck, Deshayes and Milne-Edwards recognize the affinity of the two species, but not the marked subspecific difference between them. They said (1835-1845, vol. 10, pp. 514-515, footnote): "We are certain that this species [*C. adusta*] of Lamarck was known to Linnaeus, who designated it, in the 10th. edition of *Systema Naturae*, under the name of *Cypraea onyx*. The description which he gave in the *Museum Ulricae* leaves no doubt on this subject. It is necessary, therefore, to substitute the Linnaean name for that of Lamarck." This is, of course, a very equivocal statement. Linnaeus did not describe the form *adusta* in either work. His descriptions can be referred only to the typical form of *onyx*. I doubt whether he had ever seen a specimen of *adusta* in the adult state and suspect that the specimen of that form in the collection was added after his death. We know that several specimens which are now in the Linnaean cabinet in London were later accessions. Lamarck's editors very properly said that the name *adusta* should be abandoned as that of a good species, but they might well have pointed out its subspecific value.

Hanley (1855, p. 188) referred to the above comments of Deshayes and Milne-Edwards with approval but still did not recognize the extreme variability of the species, referring, as already said, to the "black" base of *adusta* and nowhere pointing out that it was in any way different from *onyx*, *sensu stricto*. Later writers have generally associated *adusta* with *onyx* as a synonym without emphasizing this variability. It is only recently that adequate subspecific descriptions have been used, culminating in the excellent racial diagnoses of Schilder and Schilder (1938, pp. 149-150).

*Cypraea onyx* belongs in the genus *Erosaria* Troschel, 1863, subgenus *Adusta* Jousseaume, 1884, of which it is the subgenotype, by absolute tautonymy.

Of the six geographical races into which the Schilders (*loc. cit.*) divided the species, three are the forms described under the same subspecific names by their authors, the southeast African *adusta* being in fact the dark shell of Lamarck, the south Lemurian form being the pale *nymphae* of Jay, and the Malaysian form being the typical *onyx* of Linnaeus with the black base and the suffused dorsum. The name *succincta*, which was based upon the immature shell, is given without much reason to the race from the Indian peninsula. To the races from the Persian Gulf and New Britain the Schilders allot two new names, *persica*, 1938, and *melanesiae*, 1937, respectively.

The species is figured in Reeve (1843-1878, vol. 3, *Cypraea*, pl. 10, sp. 39a, b, c) and in Kiener (1843-1847, pl. 44, figs. 1-1d). The full plate of figures of Kiener's *onyx* shows *adusta*, *nymphae*, and the immature shell, but no figures of *onyx onyx*.

#### *Cypraea clandestina*

1767, *Systema naturae*, ed. 12, p. 1177, no. 347.

LOCALITY: Not given.

"C. testa umbilicata, lineis transversis subtilissimis flavescens passim concurrentibus . . . Testa laevis livida, magnitudine C. Aselli, fascia una alterave pallida obsoleta. Notae propriae sunt striae pictae, luteae, transversim passim concurrentes, vix nisi oculo armato manifestae. Subtus testa alba immaculata est."

The species, which appeared for the first time in the twelfth edition, was therefore not included in the "*Museum Ulricae*" and one must rely solely on the description in the "*Systema*," as no synonymy or locality was supplied by Linnaeus. Fortunately the description is ample and extremely graphic. In fact the species can be said to be adequately defined by the last two sentences alone, as the fine and barely visible converging hairlines of the dorsum constitute a feature that distinguishes *clandestina* from all other species in Linnaeus' *Cypraea* and that undoubtedly gave it its name. A specimen of the form called *moniliaris* by Lamarck, a name discussed below, is in the Linnaean collection and though unmarked may have been the shell on which Linnaeus based his name.

In spite of the fact that the presence of the pale hairlines is the decisive diagnostic characteristic of the species, *clandestina* was not

well understood by many of the early conchologists and partially deceived writers as recent as Hidalgo, possibly because they did not give due weight to the words "vix nisi oculo armato manifesta" in the description, but largely, I suspect, because these lines are very fugitive and usually disappear after any considerable wearing of the shell. This fact has given to *clandestina* a somewhat troubled nomenclatorial history and has resulted in several names now known to be synonyms. These are noted below.

Neither Martini nor Chemnitz refers to the species by name and none of their descriptions or figures can be referred to it. Gmelin merely paraphrased Linnaeus' diagnosis without further comment, adding merely that its locality was "In India." Dillwyn (1817, vol. 1, p. 453) cited the species under the Linnaean name, but later (p. 456) treated it as a variety of *C. asellus* Linné.

Lamarck did not mention *clandestina* by that name either in 1810 or in 1822, but described a *C. moniliaris* (1810, vol. 16, p. 98) which he believed to be a new species but which was in fact one of the forms of *clandestina*. He distinguished it from *C. asellus*, the preceding species in his list, by saying that its dorsal zones were always very pale. This was correct, but he might well have added that the bands of *asellus* are not only darker but tend to be straight and well defined, whereas in all forms of *clandestina* they are slightly sinuous and only vaguely delimited. He cited for his species a figure from Petiver (pl. 97, fig. 10), which clearly shows *clandestina* and was, in fact, added to the synonymy by Linnaeus in a manuscript note in his own copy of the twelfth edition of the "Systema." Lamarck's specific name is not appropriate. The name "moniliaris" or "monile" is traditionally given to a shell which bears spots or tubercles in the form of an encircling "necklace," which is the primary meaning of "monile." A secondary meaning is "collar," but the light brown spots of *clandestina*, which are almost as wide as they are long and extend around only a limited arc of the dorsum, can hardly be termed a "collar." Lamarck repeated this meaning in his vernacular name "Porcelaine à collier."

Gray was the first to identify *moniliaris*

with *clandestina* (1824, p. 374). Deshayes and Milne-Edwards (1835-1845, vol. 10, p. 529) agreed and definitely placed it in the synonymy of the latter.

Pease (1865, p. 515; and 1868, p. 95, pl. 11, fig. 12) described and figured a *Cypraea candida*, an almost white form of *clandestina*. The brown hairlines are so obsolescent in this form that as late as the present century Hidalgo said of it (1906-1907, p. 315): "The *Cypraea candida* of Pease is only a *Cypraea clandestina* which lacks the angular transverse lines." It should be remembered that these transverse lines are characteristic of every form of the species.

*Cypraea aberrans* Ancey (1882, p. 55) is a form of *clandestina* with abnormally rostrate extremities. It is figured by Dautzenberg (1902, pl. 7, figs. 1, 2).

*Cypraea passerina* Melvill (1888, p. 220) is an unusual form with orange extremities, dorsal spots which are lilac gray and more saturate, and a more pyriform shape than the other forms. It is figured by Sowerby (1847-1887, vol. 4, pl. 328, fig. 534). Sowerby called this figure "*clandestina* with *hirundo*-like markings." The markings do not, in fact, resemble those of *hirundo* Linné, as they are well defined, while the markings of *hirundo* are very irregular and almost zigzag blue zones.

*Cypraea artuffeli* Jousseaume (1876, p. 81) is a Japanese shell which Sowerby (*tom. cit.*, pl. 321, fig. 327) treated as a variety of *C. asellus* Linné and which both Tryon (1879-1888, vol. 7, p. 188, pl. 16, fig. 61) and Melvill and Standen (1895, p. 111) placed among the "varieties" of *clandestina*, although Tryon (*loc. cit.*) said: "Further investigation may prove this to be a distinct species." It is now conceded to be a good species. It resembles *asellus* more than *clandestina*, as its dorsum bears three well-defined parallel zones instead of the vague sinuous bands of the latter and it entirely lacks the transverse hairlines.

Linnaeus' *clandestina* belongs in the typical subgenus of *Palmadusta* Iredale, 1930, of which it is the type, by original designation.

In addition to the figures cited above the species is figured by Reeve (1843-1878, vol. 3, *Cypraea*, pl. 19, sp. 106).

*Cypraea succincta*

1758, *Systema naturae*, ed. 10, p. 722, no. 306.

1767, *Systema naturae*, ed. 12, p. 1177, no. 348.

LOCALITY: Not given in either edition.

"C. testa umbilicata, labio interiore utraque extremitate rotundato."

As already stated under *Cypraea onyx* (p. 83, above) *C. succincta* is not a good species, being merely the young of *onyx*. There is, however, little in the Linnaean diagnosis to support this conclusion. The last phrase of the description in the "Systema" somewhat suggests a young *Cypraea*. The word "umbilicata" is not helpful, as there is a considerable number of adult members of the genus which show a depression at the site of the spire. The description in the "Museum Ulricae," with its combination of "fragilis" and "Rima utrinque dentata, sed obsolete" and the expanded description of the two lips of the shell, almost certainly describes a young *Cypraea*. Moreover, the words "ovata, testacea, fasciis duabus, linearibus, albis" point to the young *onyx*. The identity of *succincta* is, moreover, proved by an examination of the type in the Queen's collection in Sweden, as the shell described in the "Museum Ulricae" is manifestly the same as that of the "Systema." It is an individual of *onyx* in the so-called *Bulla* stage, showing the pale brown background, the two white bands encircling it, the juvenile teeth appearing only at the base of the columellar lip, and the marked expansion of the aperture at that point. Hanley (1855, p. 189) had already reached this conclusion. He reproduced (*op. cit.*, pl. 5, figs. 1, 2) two colored engravings of the dorsal and apertural aspects of this specimen, saying, as to their source: "Thanks to Mr. Gaskoin, that diligent investigator of the Cypraeadae [*sic*], the mystery has been solved by the examination of the original type still preserved in the Dronningen Museum near Upsala. The figures here engraved are copied by Mr. Gaskoin's permission from some beautiful paintings of the Royal specimens. . . ." The "paintings" referred to may mean the series of 436 contemporary figures prepared for the "Museum Ulricae" by Swedish artists, but never used, which have already been mentioned in Part 1 (Dodge, 1952), but it seems hardly possible that Gaskoin's permission would have been necessary for the copy-

ing of such figures. They were more likely to have been a private collection, which I have been unable to trace.

The conchological writers up to Hanley's day were either ignorant of the identity of *succincta* or, if they expressed an opinion, they were not in agreement. To quote again from Hanley (*loc. cit.*): "Solander fancied it was *C. Humphreysii*; Bruguière opined that it was a young *C. mus*; Mörch the *cinerea* of Gmelin; and I myself had imagined, from the description, that it might have been an almost mature example of *C. pyrum*."

Chemnitz (1780-1795, vol. 11, p. 38, pl. 180, figs. 1741-1742) describes *Cypraea succincta Linnaei* and refers it to the proper "Systema" and "Museum Ulricae" locations. His description parallels fairly closely that in the "Museum Ulricae," but his two figures 1741 and 1742 are completely inapplicable either to the description or to the appearance of the true *succincta*. They show a young *Cypraea* asymmetrically decorated with spots and dashes of all shapes and with transverse rows of square brown spots which might be called interrupted bands. Chemnitz referred to no other species except to say that *succincta* must not be confused with his own *C. zonata*. The latter species is figured and described in an earlier volume (*op. cit.*, vol. 10, p. 107, pl. 145, fig. 1342). The figure referred to shows, indeed, a young, brown-banded *Cypraea*, but the background is a vivid blue flecked with brown, and the bands themselves are variegated in shades of brown. There is no similarity between this figure and the figures he supplied for *succincta*, and one wonders why he should have thought it necessary to warn his readers not to confuse the two.

Gmelin (1791, p. 3410) merely copied Linnaeus' description of *succincta*. Neither Lamarck nor Deshayes and Milne-Edwards referred to the name and in fact did not mention *onyx* itself except as a synonym of *C. adusta* Lamarck. Mörch (1852, 1853, vol. 1, p. 115), decided that it was *C. cinerea*, which he attributed to Martyn. In the Kierulf catalogue of 1850, however, Mörch's *succincta* is, *vide* Hidalgo (1906-1907, p. 164), the *C. fragiloides* of Meuschen, 1778, which was, again according to Hidalgo (*op. cit.*, p. 356), an earlier name for *C. cinerea* Gmelin. Meuschen's own *succincta* was probably *C.*

*caurica* Linné. Hidalgo (*op. cit.*, p. 164) refers Chemnitz' *succincta* to the juvenile *C. erroneus* Linné, a determination probably based on the fancied similarity between the young *erroneus* and Chemnitz' figures 1741 and 1742 which the latter cited for his *succincta*, as above noted. The most recent writer to assign his "*succincta*" to Linnaeus was the little-known author Krebs. (See Clench, Aguayo, and Turner, 1947, p. 72.) He reported *C. succincta* Linné from various locations in the West Indies and gave as synonyms *C. cinerea* Martyn (1784) and *C. sordida* Lamarck (1810). The latter species was found by Deshayes and Milne-Edwards (1835-1845, vol. 10, p. 509) to be identical with *C. cinerea* Gmelin, and Krebs' *succincta* was undoubtedly that shell.

Schilder assigns the name *succincta* Linné to the subspecies of *onyx* inhabiting the southern end of the Indian peninsula, probably because that race has a brown dorsum with the lighter dorsal zones often showing through, so that it approaches the coloration of the immature shell.

#### *Cypraea ziczac*

1758, *Systema naturae*, ed. 10, p. 722, no. 307.

1767, *Systema naturae*, ed. 12, p. 1177, no. 349.

LOCALITY: Not given in either edition.

"*C. testa umbilicata, subtus lutea punctis fuscis, extremitatibus maculis duabus fuscis.*"

If the description in the "Systema" is to be accepted as a definition of the species we must first reckon with a striking inconsistency. All forms of *ziczac*, however much they may vary in the color pattern of the dorsum, have one constant feature, a half-circle of minute brown spots which completely or partially encircle the two extremities of the shell, those on the posterior end surrounding the umbilicus and those on the anterior placed just behind the somewhat prominent and recurved border of the outlet. Yet the description of these spots reads: "*extremitatibus maculis duabus fuscis.*" The description in the "Museum Ulricaë" does nothing to clear up this inconsistency, as it repeats the wording in the "Systema" and adds "*postice prominens latere utroque fuscis,*" which implies a brown spot on each side of the outlet. I have not seen a specimen with a pair of posterior terminal spots. *C.*

*diluculum* Reeve, 1845, with which *ziczac* has been often confused, has a single brown terminal spot posteriorly, and at the anterior end a brown band completely or partially bordering the outlet. Specimens of both *ziczac* and *diluculum* are present in the Linnaean collection, although neither is marked. It is possible that Linnaeus thought them conspecific, as their ornamentation is superficially similar. Such an error, however, would not explain away the inconsistency as to the terminal spots, and in any case neither species has the ornamentation required by the description in the "Museum Ulricaë."

The history of the name *ziczac* has been confusing, not only because of the several synonyms employed by Linnaeus' successors but because of a homonym which resulted from a misconception of the species and by the identification of the shell later called *diluculum* with the Linnaean name.

Martini (1769-1777, vol. 1, pp. 325-327, pl. 23, figs. 224-227) described and figured a shell which he referred to *ziczac* Linné and cited two of the references used by Linnaeus (Petiver and Seba). Of the four Martini figures, two (figs. 224-225) clearly represent *ziczac* and show the circles of terminal spots, and the other two probably represent *diluculum*, although they show features of both species. This seems to indicate that Martini had confused the two.

Lamarck (1810, vol. 16, p. 9) described a *C. undata* and also (p. 96) a "*C. zigzag* Linné." The first was in fact the real *ziczac* of Linnaeus, while the second was the species later called *diluculum* by Reeve in 1845. Lamarck later rectified his error (1822, pp. 393-394) by changing his *undata* of 1810 to "*zigzag*" and changing his "*zigzag*" of 1810 to *undata*, the latter thus becoming a preoccupied homonym. Reeve, in his turn, erected a new name, *diluculum*, for Lamarck's 1822 *undata*, thus creating a confusion of names which misled conchologists for many years. Summing up the results of these changes: Reeve's *diluculum* is a good species, as both its earlier names, *zigzag* Lamarck, 1810, and *undata* Lamarck, 1822, were preoccupied homonyms. Neither of Lamarck's *undata* is a good name. The first is a synonym of *ziczac* Linné and the second a homonym of the *undata* of 1810.

The yellow base of *ziczac* Linné, thickly sown with vivid brownish red spots, and the circle of smaller dots around the extremities are constant features. The color pattern of the dorsum, however, exhibits considerable variation. In most cases the base color is a clear tan or a grayish tan. Some forms have two, some three, indistinctly delimited whitish bands which are decorated with a transverse series of crescents or tents the color of which ranges from pale to deep brown. In some specimens the brown tents are so narrow that the white spaces between them seem to be the dominant ornamentation of the bands and appear like white crescents or tents. Another quite different form has a white to ashen base color with brown, longitudinal wavy or zigzag dorsal lines. The "Systema" description does not cover any detail of the color pattern of the dorsum, and based on that description it would have been impossible to have identified the species. The "Museum Ulricae," however, supplies these data, both in the words "supra albida lineis pallidis undatis" and in the appended descriptions of three separate types of dorsal pattern, two of which are referred to above. It is apparent that Linnaeus in this work considered the form with longitudinal zigzags to be the typical or most common one, as he uses for it the word "vulgaris." Hidalgo (1906-1907, p. 568) also treated that form as typical, as did Tryon (1879-1888, vol. 7, p. 187). The third form noted by Linnaeus is described as entirely white, unspotted, and without a yellow base. I am not familiar with this form, and Schilder and Schilder (1938, p. 159) do not refer to it in the descriptions of any of their subspecies.

In addition to *C. undata* Lamarck, 1810, the following names have been used for the species: *C. musculus* Meuschen, 1778; *misella* Perry, 1811; *undulata* Wood, 1818; *vittata* Deshayes, 1831<sup>1</sup>; and *decolorata* Dautzenberg, 1902.

It is not the *C. ziczac* of Röding, 1798, of Lamarck, 1810, or of Wood, 1818.

The species is now placed in the typical

<sup>1</sup> Mörch (1852, 1853, vol. 1, p. 117) referred *C. vittata* Deshayes to *C. diluculum* Reeve, but the Schilders (*loc. cit.*) use it as a subspecific or race name for the form of *ziczac* that ranges from Palau Island through Melanesia to New South Wales.

subgenus of *Palmadusta* Iredale, 1930.

*Cypraea ziczac* is figured in Kiener (1846-1850, pl. 31, figs. 2, 2a). Kiener also figures (pl. 30, figs. 3, 3a) the *diluculum* of Reeve as *undata* Lamarck. Reeve also figures *C. ziczac* (1843-1878, vol. 3, *Cypraea*, pl. 18, sp. 97). The latter's *diluculum* is shown in the same volume (pl. 14, sp. 65). See also for *ziczac*: Sowerby (1847-1887, vol. 4, pl. 310, figs. 135-138) and Tryon (1879-1888, vol. 7, pl. 16, fig. 33).

#### *Cypraea hirundo*

1758, *Systema naturae*, ed. 10, p. 722, no. 308.

1767, *Systema naturae*, ed. 12, p. 1178, no. 350.

LOCALITY: Not given in either edition.

"C. testa umbilicata, supra caerulescente, extremitatibus maculis duabus fuscis."

The two constant features of *C. hirundo* Linné are, first, the pairs of blackish brown spots at each end of the shell flanking the outlets and, second, the sinuosity and lack of sharpness of the dorsal bands. The latter feature distinguishes it from *assellus* Linné which has straight and sharply defined bands. In addition to these constant features the dorsum is usually of a blue or bluish green ground color.

Although Linnaeus' description of *hirundo* in the "Systema" omits any reference to the banding of the dorsum or the brown dots on the sides and base of the shell, its blue color is noted, as well as the terminal spots, and the combination of these two features serves to distinguish it from any of the other small umbilicated members of the genus.

The only reference is a single figure from Petiver (pl. 30, fig. 3). This is not a characteristic drawing. Its defects are unimportant, however, as the Linnaean collection contains a specimen of the *hirundo* of almost all later writers, which, although unidentified by any name or number either on the shell or on its container, uniquely agrees with the details of the description.

The description in the "Museum Ulricae" is much more ample and includes most of the characteristic details of the species, except the frequent appearance of the dark blotches on the dorsum, often combined with a large central blotch. It is certain that the shell there described is the *hirundo* of the "Systema."

The smaller umbilicated *Cypraea* species

have been the cause of some confusion in the minds of conchologists ever since Linnaeus' day, and this confusion is apparent in the literature. Four different but closely allied species have been confounded under the name *hirundo* by later authors: the true *hirundo* of Linnaeus, which is *neglecta* Sowerby, 1837; *kieneri* Hidalgo, 1906, which is the renamed *hirundo* of Sowerby, 1837; *oweni* Sowerby, 1837, which is equal to *menkeana* Deshayes, 1863, and *modesta* Sowerby, 1870; and *ursellus* Gmelin, 1791, which is *coffea* Sowerby, 1837. All four species possess the two terminal pairs of dark spots, and they are all now placed in the genus *Blasicrura* Iredale, 1930, subgenus *Derstolida* Iredale, 1935, all the species of which show black-brown or red-brown terminal spots. The varying color patterns of these species are well figured in an interesting paper by F. A. Schilder (1933c, pp. 355-357, pl. 8).

The first post-Linnaean use of the name *hirundo* to be considered here is that of Martini (1769-1777, vol. 1, p. 361, pl. 28, fig. 282). This figure was added to the synonymy of *hirundo* by a manuscript note of Linnaeus in his own copy of the twelfth edition. It is a poor drawing, as the blue of the dorsum is too brilliant, but it shows the two white bands of the dorsum and the terminal spots, which suggest that Martini had properly identified *hirundo*.<sup>1</sup> The irregular amoeba-like blotch in the center of the dorsum indicates, however, that it was based either on a specimen of *hirundo* or of *ursellus* Gmelin. The subpyriform outline of the figure, however, points to the latter, as *hirundo* is usually ovate to cylindrical.

Born's figure of *hirundo* (1780, pl. 8, fig. 11) is not accurately characteristic. The blue of the dorsum is too deep, the bands are yellow instead of white, and are too straight-edged to represent the vague, sinuous bands of *hirundo*. It is a bad figure, although probably meant for the present species.

Gmelin described *hirundo* (1791, p. 3411)

<sup>1</sup> In any reference to the two bands of *hirundo* as "white," it must be understood that the width of the white and blue zones of the dorsum is variable, sometimes making the pattern appear to be blue with white bands, sometimes white with blue bands. In reference to the dorsal bands of *asellus*, the next species, this question does not arise, because there the bands always appear as brown on a milk-white shell.

and referred to the *hirundo* of the "Museum Ulricae" and the Petiver figure cited by Linnaeus as well as the Martini reference later added to the "Systema." The subdescription is graphic and complete and refers to the frequent dorsal spots and their variability in size in the words "supra saepius fusco punctata, aut maculata." The phrase "testa angusta elongata" distinguishes it from his new species *ursellus* which is described on the same page and tends to be subpyriform, as stated above. He uses the unfortunate words "c. asello affinis," whereas *hirundo* is much closer to his *ursellus* than to *asellus* Linné. In describing *ursellus* he categorically limits the terminal spots to the posterior end of the shell in the words "punctus ad umbilicum duobus fuscis." This is a definite error, as *ursellus* is one of the group of four allied species which always show the terminal spots at both ends. If we are to accept Gmelin's description as validly defining the *ursellus* of authors, we must attribute this error to carelessness or to the examination of partially worn specimens.

Lamarck (1810, vol. 16, p. 95; 1822, p. 393) described *hirundo* with all the necessary diagnostic details. His variety "[b]," described as "var. testa ovata-oblonga" is referred to *C. felina* Gmelin (1791, p. 3412) which is a distinct species and in no sense a form of *hirundo*. He cited for such variety two figures from Martini (*tom. cit.*, pl. 28, figs. 283-284). Figure 283 shows a shell much more truncate and expanded at both outlets than *hirundo*, and with an unbanded, bluish dorsum with numerous dots and larger spots of brown. The dorsal and lateral spots are so casually arranged that it is difficult to say whether or not Martini intended to show terminal spots. I hesitate to identify the figure. It may have been intended for *C. felina*. For Lamarck's variety "[c]," which is described as having a large dorsal spot and an elongated shape, he refers to two additional Martini figures (*tom. cit.*, pl. 28, figs. 294-295). These are in accord with his description of the variety, but again show no terminal spots or any banding. They do not belong in the synonymy of *hirundo* or any of its allies. It must be emphasized that in a group of species so variable and so difficult to separate as the small *Cypraea* in the

genera *Palmadusta*, *Blasicrura*, and *Cribraria*, crude figures, such as the majority of the drawings of Martini, are of very little assistance, and the presence or absence of a given detail should not be given too much weight.

Lamarck's *ursellus* (1810, vol. 16, p. 98; 1822, p. 395) is fairly graphically described. It corrects Gmelin's error as to the terminal spots by referring to the "brown spots which are found at the extremities." The Martini figure he cited (*tom. cit.*, pl. 24, fig. 241) is too crudely drawn to be even guessed at. Lamarck himself called it "Mala." He also referred to a figure from the "Tableau encyclopédique" (1798, pl. 356, fig. 6) which he had already cited for *C. hirundo*. This robs the reference of any value whatever, for either species, and indicates Lamarck's vagueness as to their identity and relationship.

Gray, in his monograph on the Cypraeidae (1824, p. 378) was also deceived as to the identity of *hirundo*. He believed that only Lamarck's *hirundo*, variety "[c]," represented *hirundo* Linné, and that Linnaeus' shell was identical with the *ursellus* of Gmelin. On the latter point he said (*loc. cit.*): "This species [*hirundo* Linné] sometimes loses the spots at one or both extremities, when it is the *C. ursellus* of Gmelin." Gmelin's description of *ursellus*, which limited the terminal spots to the posterior end, was partly responsible for the error of Gray, who, like Gmelin, probably examined only worn specimens.<sup>1</sup>

<sup>1</sup> Gray also described another species which he called *C. pulchella* (*tom. cit.*, p. 379), but in a later paper (1829, p. 78) he treats it as a variety of *hirundo* Linné. It has been abandoned as a synonym or variety of that species for two reasons. In the first place, it is preoccupied by *C. pulchella* Swainson, 1823, and Gray recognized that it was a homonym, saying (1824, p. 380): "Mr. Swainson having described this species a few months before the publication of the species which I have called *pulchella*, it is necessary that the name of the latter be changed. I propose therefore, to call it in future *Cypraea Pulchra*, the Beautiful Cowry." In the second place, the renamed *pulchra* is not related to *hirundo*, being placed in the genus *Luria* Jousseaume, subgenus *Basiltrona* Iredale, 1930, and is thus a congener of *C. isabella* Linné. Gray had more than suspected that it was a distinct species. In 1829, in his supplement to the monograph on the Cypraeidae, he reported (p. 78) that he had been impressed with its possible specific value, and only retained it in *hirundo* because of some specimens which, it seemed to him, "completely united it with the type."

It is now well established that *Cypraea neglecta* Sowerby, 1837, is a synonym of *hirundo*, yet the name persisted in use as a valid species until comparatively recent times. Reeve, Weinkauff, and Tryon so used it. Dautzenberg (1902, p. 310) considered it to be a good species identical with *hirundo* Kiener, not Linné. The Schilders (1938, p. 167) treat it as a race of *hirundo* Linné, a term, as used by them, equivalent to subspecies.

Even as recently as the present century the specific separability of *hirundo* and *ursellus* was not accepted by some writers. Hidalgo, in his usually accurate monograph on the genus *Cypraea*, unites the two species. He said (1906-1907, p. 382): "The *Cypraea Ursellus* of Gmelin has also been misunderstood. The shell given this name is very close to the *Cypraea felina* of Gmelin, but has its own characteristics and is easily distinguishable from the latter. Gmelin's species was based on worn specimens of the *Cypraea Hirundo*, and cannot be retained notwithstanding the fact that the following authors have described and figured it under that name." He then lists the authorities as follows: Gmelin (1791, p. 3411); "Tableau encyclopédique" (1798, pl. 356, fig. 6); Lamarck (1810, vol. 16, p. 95); Dillwyn (1817, vol. 1, p. 455); Wood (1818, pl. 17, fig. 35); Deshayes and Milne-Edwards (1835-1845, vol. 10, p. 528); and continues: "In order to avoid all confusion in the future I have given to the *Cypraea Ursellus* of authors, not of Gmelin, the name *Cypraea Melvilli* Hidalgo. . ." The Schilders, in the most recent arrangement of the living Cypraeidae, who accept *ursellus* as a good species, place *melvilli* Hidalgo not in their diagnosis of either *hirundo* or *ursellus* but as a race or subspecies of *C. felina* Gmelin. It is not clear whether these authors merely chose *melvilli* as a conveniently available name or whether they considered it to be identical with *felina*.

With the above exception Hidalgo's treatment of *hirundo* is accurate. He recognized (*op. cit.*, p. 381) that the *hirundo* of Reeve, Weinkauff, Tryon, and others was not the Linnaean species (which was, in fact, the shell described by those authors as *C. neglecta* Sowerby), and that the form *neglecta* was probably the type specimen of Linnaeus.

That the latter opinion is correct is strongly indicated by the concordance of the description of *hirundo* in the "Museum Ulricae" with one of the characteristics of *neglecta*. The teeth of *neglecta* on the left side of the aperture are much prolonged over the base of the shell, and this detail conforms to the phrase in the "Museum Ulricae," "Labium interius dentibus transversis, extensis rugis per basin exteriorem." He also gave a new name to the *hirundo* of authors, not Linné: "The *Cypraea neglecta* is therefore used in this monograph under the name *Cypraea Hirundo* Linné, and the *Cypraea Hirundo*, not of Linné, is described as *Cypraea Kieneri* Hidalgo."<sup>1</sup>

*Cypraea hirundo* is figured in Sowerby (1847-1887, vol. 4, pl. 323, figs. 374-378), in Reeve (1843-1878, vol. 3, *Cypraea*, pl. 19, sp. 100), and in Tryon (1879-1888, vol. 7, pl. 4, figs. 60-62).

#### *Cypraea asellus*

1758, *Systema naturae*, ed. 10, p. 722, no. 309.

1767, *Systema naturae*, ed. 12, p. 1178, no. 351.

LOCALITY: "In Maldivis" (1758, 1767).

"C. testa umbilicata alba: fasciis tribus fuscis."

*Cypraea asellus* lends itself to an accurate description more readily than any other Linnaean cypraeid. Its color pattern is so striking and uncomplicated that it cannot be confused

<sup>1</sup> Shaw (1909, p. 298) disagreed with this view. He admitted that the *hirundo* of the "Museum Ulricae" was *neglecta* Sowerby, but said that the *hirundo* of the "Systema" was a different shell. He said: "I maintain that if the *hirundo*, Linn., is the *neglecta*, Sow., Hanley would have mentioned the fact, considering that both these species are on the same plate in Reeve's *Conch. Icon.*, and I therefore do not see how the species of the *Mus. Ulricae* can be taken as the type, ignoring that of the *Syst. Nat.*, which was described six years earlier, and quite a different shell, and I hold the typical *hirundo* Linn. to be the one quoted in the *Syst. Nat.*, while the species of the *Mus. Ulricae* equals the *neglecta* Sow., which is now generally admitted to be a variety of *hirundo*. *C. kieneri*, Hidalgo, therefore becomes a synonym of *C. hirundo* Linn." Shaw's preoccupation with the idea that the *hirundo* of the "Systema" and that of the "Museum Ulricae" are different shells is the basis of his disagreement with Hidalgo. I can find nothing in the "Museum Ulricae" description which would justify considering that it described a different species. Hanley's failure to mention the position of *neglecta*, to which Shaw gave so much weight, does not impress one as being a very cogent piece of evidence.

with any other species, and therefore the description in the "Systema" is necessarily graphic enough to identify it without question. In color the species varies only in the broadness and deepness of the brown dorsal zones. In shape it is fairly constant except for the African race of the species, called the typical *asellus* by Schilder and Schilder (1938, p. 157), where the shell is more elongate and the extremities produced and restricted. This race also shows narrower dorsal bands of a lighter brown than the shells from the more eastern areas. There are other slight variations in the teeth and fossula but they do not involve any form which should be accorded subspecific rank. The Schilders describe and name four geographical races of *asellus*, and, while they state (1938, p. 120) that the races which they describe in their arrangement of the Cypraeidae "undoubtedly are subspecies in the sense of the International Rules of Zoological Nomenclature," it would seem that, in this case at least, the presently accepted concept of speciation has been considerably modified, if not violated.<sup>2</sup>

The description of *asellus* in the "Museum Ulricae" elaborates on the few necessary details of that in the "Systema" and adds other details which are merely confirmatory, such as the difference between the labial and columellar teeth and the apparent brevity of the dark bands of the dorsum and their reappearance in the left side of the aperture after having been almost obliterated by the deposition of the marginal callus ("latere interiore maculis tribus ferrugineus").

Owing to Linnaeus' use of the word "maculis" there may be some question as to whether he realized that the appearance of the brown color in the left side of the aperture represented, in fact, the terminations of the dorsal bands, although in most specimens examined by me the callus on the left side of the shell was not sufficiently dense to obliterate them completely. The right, or labial, side produces a heavier callus and is more distinctly margined than the left, but the bands on the

<sup>2</sup> The creation of subspecies out of forms which vary too slightly to justify such action is seen in the case of other species in the Schilder work, although in many other cases their selections seem reasonable. The argument of these authors should be studied. In theory, at least, it appears perfectly logical.



right terminate where the callus begins and do not extend under it. The additional phrase at the end of the "Museum Ulricae" description, "ad latera non extensis," may refer to the right side only. The question may be settled by examination of the juvenile shell before the marginal callus has been deposited, where it can be seen that the bands do not extend beyond the dorsum on the right side. Even in adult shells this is clearly indicated by the presence of a border of orange-brown around the bands. This appears at their ends on the right side, but not on the left where the deep brown is abruptly cut off by the callus. Lamarck (1822, p. 396) uses an equivocal phrase, saying that the bands "cross the dorsum but are interrupted near the margin." It is uncertain whether he used the word "interrupted" as meaning a temporary or permanent termination. The French word "interrompre" is used in both senses. Reeve (1843-1878, vol. 3, *Cypraea*, text for sp. 98) said that in the young shell the bands extend to the columella, but he made no distinction between them. Kiener's description (1846-1850, p. 93) was the first to describe this feature accurately, saying that the bands "stop (s'arrêtent) at some distance from the right margin; on the opposite side they are covered by the callosity which forms the margin." He did not mention the "spots" in the aperture. Hidalgo (1906-1907, p. 274) supplies an equivocal statement: "The three dorsal zones continue over the base up to the interior of the aperture, being more or less visible under the white callosity of the left margin." This seems to indicate that he supposed the bands were originally visible on the margin and base of the shell on both sides.

*Cypraea asellus* is figured in Kiener (*op. cit.*, pl. 31, fig. 3) and Reeve (*tom. cit.*, pl. 18, sp. 98). The Kiener figure is extremely characteristic and shows the orange border continuing around the ends of the bands on the right side.

It belongs in the typical subgenus of *Palmadusta* Iredale, 1930.

The synonymy in the "Systema" is correct except for the figure from Lister, which was deleted in the notes for the "revised twelfth edition." Linnaeus later used it correctly for *C. cribraria* (below).

### *Cypraea erronea*

1758, *Systema naturae*, ed. 10, p. 723, no. 310.

1767, *Systema naturae*, ed. 12, p. 1178, no. 352.

LOCALITY: Not given in either edition.

"C. testa umbilicata: macula testacea aequali . . . Differt a C. stolidata macula una, nec pluribus."

In a tray in the Linnaean collection marked for *erronea* there is a specimen which was held by Hanley (1855, p. 191) to be the shell called by Lamarck *C. olivacea*, variety "[c]," a shell with a central cloudy agglomeration of brown spots arranged roughly in quadrilateral form (Lamarck's "macula dorsali rufo-fusca") and a cream yellow, unspotted base. The description in the "Systema" is practically valueless as pointing to any one species, for it tells us no more than that the shell is umbilicate and showed a spot, presumably on the dorsum, although the phrase "macula testacea aequali" cannot be intelligibly translated. The word "testacea" is commonly used by Linnaeus to mean "shell-colored," an incorrect meaning in this case, and the word "aequali" is meaningless unless we read it as "symmetrical" or "equilateral," meanings which are also unresponsive to the dorsal maculation found in most forms of the complex with which this name is associated. There is no synonymy nor any locality in the diagnosis. The only additional hint that we are given is the subdescription: "Differt a C. stolidata macula una, nec pluribus." Inasmuch as the color pattern of the *erronea* of authors is so variable, and of *stolidata* even more so, the mention of a distinction between the two is doubtfully helpful. It is true that *stolidata* generally has a number of vaguely angular dark blotches, irregularly disposed over the entire dorsum, while *erronea* (in those forms which possess such a feature) usually has only one. There are, however, forms of *stolidata* devoid of blotches and forms of *erronea* with two or more roughly quadrate spots arranged in the form of a transverse band. The existence of a dorsal spot or spots in most forms of both species is, however, their only point of resemblance.

The description of *erronea* in the "Museum Ulricae," while it is as usual more ample, is not unequivocally diagnostic. It ties the name *erronea* to a complex of species (discussed below) but does not sufficiently differentiate

between them. It refers to the nebulous pattern of the dorsum and to a central spot ("macula dorsali flavescence-testacea"). The dorsal spot in this group of species is always darker than the nebulous background and cannot be called "flavescence" in any of the spotted forms.

The list of names given to this affinity is long. The *C. spurca* of Born (1780, p. 190), not Linné, was probably the *errones* of authors. Gmelin (1791, p. 3412) described a *C. ovum* which was long associated with *errones* but which is now considered to be a good species. Gmelin's *oblonga* (p. 3416) and *cruentia* (p. 3420) are probably identical with his *ovum*, and the *olivacea* of Lamarck (1810, vol. 16, p. 95), to which Hanley referred the specimen marked for *errones* in the Linnaean collection, was merely a new name for *ovum*.

The *C. succincta* of Chemnitz, 1795 (1780-1795, vol. 11, p. 38, pl. 180, figs. 1741-1742), was (*fide* Hidalgo, 1906-1907, p. 340) the juvenile *errones*, although Chemnitz referred it to the *succincta* of Linnaeus.

Kiener, who did not list *errones*, described and figured (1846-1850, p. 56, pl. 29, figs. 4-4a) a shell that he called "*Cypraea ovum* Lin.," apparently considering that the so-called "thirteenth edition" of the "Systema" by Gmelin should be credited to Linnaeus, although the majority of its species, including *ovum*, were Gmelin's own names. Both Kiener's description and his figures refer to an unspotted form of the *errones* of authors. His figure 4a is referred by the Schilders (1938, p. 153), with a query, to that form of the *errones* of authors which Schröter, 1804, called *coerulescens*.

Hidalgo's discussion (1906-1907, pp. 340-343) of *errones* Linné is complete and supplies a long synonymy, but even at this comparatively late date we find a monographer of the Cypraeidae treating *ovum* Gmelin and its synonyms as being equal to Linnaeus' *errones*.

While *ovum* Gmelin (*olivacea* Lamarck) is now accepted as a good species, it is very close to the *errones* of authors. As both species are so variable and the variations in the one parallel so closely the variations in the other, it is always difficult to allocate a given individual to either. I have thus far spoken of *errones* as the *errones* of authors, because, based on the contemporary evidence, I cannot be con-

vinced that the Linnaean species was adequately defined. Moreover, the presence of a specimen of *ovum* Gmelin in Linnaeus' collection is persuasive evidence that he was describing that shell, although the evidence would be much more conclusive if the name had been written on the specimen itself instead of on the container. The name *errones*, however, is so firmly fixed in the literature as standing for a good species as of Linnaeus, 1758, that it would be unwise and confusing to drop it as a *species dubia*. I shall, although with reluctance, conform to the accepted view.

In addition to the Born, Gmelin, Chemnitz, and Lamarck names, which have been mentioned above as synonyms of *ovum*, the following are among the names which have been given to forms of this complex, although I would hesitate to assign some of them to the proper species: *C. errones* Reeve, 1845, *non* Linné, *C. sophiae* Brazier, 1876, and its varieties *albida* and *compressa* Dautzenberg, 1902, and *C. chrysostoma* Schilder, 1927, are all probably *ovum*. *C. coerulescens* Schröter, 1804, *C. bimaculata* Gray, 1824, *C. ovum* Kiener, 1843, *not* Linné, *C. coxi* Brazier, 1872, *C. chrysophaea* Melvill, 1888, and *C. nimisserans* Iredale, 1935, seem to be *errones*, and were in fact adopted by the Schilders (*loc. cit.*) as race and subspecific names for forms of that species. I am doubtful of the position of *C. sophiae* Tryon, 1885 (? *not* Brazier), *C. olivacea* Quoy and Gaimard, 1834 (? *not* Lamarck), *C. ferruginosa* Combes, 1824, *C. virescens* Humphrey, 1824, *C. pallidior* Dautzenberg, 1902, and *C. subflava* Wood, 1818.<sup>1</sup>

I here paraphrase the list of details by which, according to the Schilders (*loc. cit.*), *C. ovum* can be distinguished from *errones*: The fossula is broader and the inner denticles are more distinct; it shows a yellow color between the apertural teeth; there is no trace of the terminal spots which are sometimes seen at the anterior extremity of *errones*; it is less cylindrical and has more attenuated extremities; its base is more convex, its aperture less dilated, and its teeth less distant. It is to be noted that these authors do not refer to any differences in the color pattern, except for the

<sup>1</sup> *Cypraea olivacea* Gmelin (p. 3408) is *not olivacea* Lamarck and (*fide* Tryon, 1879-1888, vol. 7, index to *Cypraea*, p. 221), equals *C. stercoraria* Linné.

yellow tinge between the teeth.

I have endeavored to separate the specimens of *errones* and *ovum* in the collection of the American Museum of Natural History on the basis of the above distinctions and find that it is almost impossible to isolate any considerable series of either species by using the Schilders' list. The variations are so numerous and there is so much intergrading that one is tempted to assert that all the shells belong to one species.

*Cypraea errones* is placed in the typical subgenus of *Erronea* Troschel, 1863, and is the type, by virtual tautonymy.

#### *Cypraea cribraria*

1758, *Systema naturae*, ed. 10, p. 723, no. 310.

1767, *Systema naturae*, ed. 12, p. 1178, no. 353.

LOCALITY: Not given in either edition.

"*C. testa umbilicata marginata lutea: punctis rotundata albis.*"

The position of *cribraria* in the "Systema" was moved from the "subgeneric" heading "Umbilicatae" in the tenth edition to stand as the first species under the heading "Marginatae" in the twelfth. The reason for the change is not apparent, as the species is both umbilicate and margined.

The description of the species has been held adequate to identify it with the *cribraria* of authors. The synonymy is, with the exception of one figure, correct. The figure from Argenville (pl. 12, fig. 7), which shows the form with marginal spots, and that from Lister (correlated to pl. 695, fig. 42, of the 1770 edition) are characteristic. The reference to Petiver ("t. 80. f. K; an t. 8. f. 3?") must be disregarded, as there is no plate 80 in Petiver and the queried reference is a figure of a *Cardium* species.<sup>1</sup> A Martini figure (1769–1777, vol. 1, p. 403, pl. 31, fig. 366) was added to the synonymy in the "revised twelfth edition" by a manuscript note of Linnaeus, but the figure is poor and shows the comparatively rare form of the species with marginal spots. Martini referred it to *cribraria* Linné. The description in the "Museum Ulricae" is more

<sup>1</sup> Hanley, in commenting on this error (1855, p. 192) committed a further blunder himself, as he said: "and 't. 80, f. K' [there is no such figure] has been erased from the reference to Gualtier." Moreover there is no figure of *C. cribraria* in Petiver. Thus it is impossible to identify what Linnaeus intended to cite.

elaborate but adds no significant new details except a description of the apertural teeth.

The color pattern of the shell has been often described as a brown dorsum covered with large, round white spots. This does not reflect the manner in which the successive layers of shell material are laid down. The background of the dorsum is white, as is the rest of the shell, the brown color having been deposited with the final layer of enamel in the form of a screen or perforated coating, through the lacunae of which the white background is seen. The specific name is derived from this perforated appearance ("cribrum," a sieve). I find no reference to the fact that the brown pattern is the last addition to the shell until it was noted by Reeve in 1845 (1843–1878, vol. 3, *Cypraea*, text for pl. 16, sp. 81), the description of Lamarck, "decorated with a multitude of milk-white, round spots," being illustrative of the previous descriptions. The young shell, prior to the deposition of the final layer of material, shows broad bands of cream-yellow or flesh color across the dorsum, and in the African race of the species (south-east Africa to Madagascar and Zanzibar) the flesh color of these dorsal bands is still visible through the lacunae. This form, which was the *C. comma* of Perry, 1811, also exhibits considerable variation from the typical in the details of the teeth and aperture. The Schilders (1938, p. 172) use the name *comma* for the race in question. It is figured in Sowerby (1841, fig. 63), and possibly was the model for another Sowerby figure (1847–1887, vol. 4, pl. 311, fig. 162) if we admit that the lateral spots were added in error by Sowerby's artist, as these spots are lacking in *comma*.

The lateral spots are sometimes found in the more eastern races of *cribraria*. The Schilders conclude (*loc. cit.*) that they "seem to occur" only in the shells from the northern areas of the Indian Ocean, and they give to this race the name *cribraria cribraria* Linné. They are shown in the Martini figure cited above.

The only species that could ever be seriously confused with *C. cribraria* is *C. eson-tropia* Duclos, 1833, a shell from Mauritius. It was long held to be a synonym of the present species as it resembles it closely except for its marginal spots, which are too numerous for the spotted form of *cribraria*.

Duclos' figure (1833, pl. 26) is instructive. Aside from the number of marginal spots, it varies from all forms of *cribraria* in the following respects: It is more gibbous than *cribraria*, which tends to be depressed. Its outline is deltoidal rather than ovate. Its marginal spots are not confined to the sides but extend over a considerable area of the base. The dorsum shows vague grayish zones.<sup>1</sup>

In addition to *C. comma* Perry and the Linnaean name *cribraria cribraria*, the Schilders use the following synonyms as race names: *C. melwardi* Iredale, 1930, for the Melanesian and Pacific race, and *C. fallax* Smith, 1881 (*exmouthisensis* Melvill, 1888), for the Australian race, although they indicate that the characters of *fallax* need further research. *C. esontropia* Weinkauff, 1881, which is questionably different from Duclos' *esontropia*, may be a further synonym. Dautzenberg (1902, p. 361) described *C. rostrata*, a melanitic and deformed *cribraria* with produced extremities, and used *exmouthisensis* Melvill as a "variety" of *cribraria*.

The present species is placed in the typical subgenus of *Cribraria* Jousseume, 1884, as the type by absolute tautonymy.

In addition to the Reeve figure cited above, *C. cribraria* is figured by Kiener (1843-1847, pl. 29, fig. 1). This figure shows the scattered marginal spots, which, *fide* the Schilders, indicates the typical race. Figure 2 on the same plate shows *C. esontropia*. This latter figure well illustrates the peculiarly long anterior columellar teeth which distinguish the species from *cribraria*.

#### *Cypraea moneta*

1758, *Systema naturae*, ed. 10, p. 723, no. 312.

1767, *Systema naturae*, ed. 12, p. 1178, no. 354.

LOCALITY: "Ad Africam, in M. Mediterraneo (1757); "ad Africam, in M. Mediterraneo; Alexandria; imprimis in Maldivis" (1767).

"C. testa marginato-nodosa albida."

The five-word description in the "Systema" is not sufficient to identify the species, as it can be read to mean *C. erosa* or even any of

<sup>1</sup> *Cypraea esontropia* is very close to *C. gaskoini* Reeve, 1846, from the Hawaiian Islands (*peasei* Sowerby, 1870, and *fischeri* Vayssièrè, 1910), and has been confounded with that species, from which it differs, however, by variations in the teeth and fossula and by the absence of the dorsal line.

the *spurca* group. Even the word "albida" is not sufficiently exclusive and is a description of a specimen rather than a species, as it could apply only to the comparatively rare form in which the dorsum shows no color. It could not apply to the juvenile shell, of which the dorsum shows bands of color, nor to the worn specimens which show the blue under layer from the previous life stage.<sup>2</sup>

A manuscript note in the copy of the twelfth edition belonging to Linnaeus adds the words "saepe annulo flavo circumdata ut [sequens]" which adds a detail which, with the original description, unequivocally points to the *moneta* of authors. The yellow ring seen in almost all specimens of the species is not so striking a feature as in *annulus*, the succeeding species, as it is paler, broader, and tends to blend in with the usual yellow or greenish color of the dorsum. In the great majority of specimens, however, it, or a portion of it, can be seen, and thus it becomes a diagnostic feature that distinguishes *moneta* from all other *Cypraea* species except *annulus*. Although this handwritten note is no part of the published description, the yellow ring is mentioned in the "Museum Ulricae." The wording there indicates that Linnaeus in 1764 had not seen so extensive a series of the shell as he must have later examined when he wrote the manuscript note referred to, as he used the word "rarius" instead of "saepe," saying: "Rarius occurrit annulo flavo uti sequens, qui indicat summam affinitatem cum sequenti, quamvis illa non nodosa sit." Taking account of the entire diagnoses in both works, we may accept the species as being adequately defined, and the identification is confirmed by the presence of a properly marked tray in the collection containing a specimen of the *moneta* of all authors. The synonymy in the "Systema" is uniformly good.

The species exhibits great variation in shape, color pattern, and sculpture throughout its extensive range, which reaches from the east African coast to the Hawaiian Islands, and it is surprising that so few specific names have been suggested for it. The color

<sup>2</sup> A lengthy subdescription was supplied as a continuation of the "habitat" of *moneta*, but as it covers only the collecting of the shell and its commercial and ornamental value and does not assist in its identification, it is not quoted here.

ranges from milk-white shells to those with a cream-yellow base and a greenish yellow dorsum. Dark bands traversing the dorsum are visible in whole or in part in the great majority of specimens, ranging from vague darkening of the ground color to deep olive-green stripes. The greatest variation is seen in the outline of the shell, which ranges from ovate with a simple margin to very nodose deltoidal or pentagonal forms. In addition to the nodosity of the margin, usually noted at the greatest diameter of the shell, there are often a pair of pronounced nodes at the posterior end of the dorsum just behind the outlet. There is also some variation in the anterior dilation of the aperture, the length and strength of the teeth, and the truncation or production of the anterior end.

The Schilders divide the species into three geographical races: *moneta* Linné, for which they cite as synonyms *mercatoria* and *ethnographica* Rochebrune, 1884, *barthelémyi* Bernardi, 1861, which equals *tuberculosa* Quoy and Gaimard, 1834, and *rhomboides* Schilder and Schilder, 1933. In addition to the above, *atava*, *pleuronectes*, *plumaria*, and *vestimenti* Rochebrune, 1884, *numisma* Röding, 1798, and *icterina* Lamarck, 1810, have been proposed for forms of *moneta*. Kiener (1846–1850, pl. 34, fig. 3) figures and describes *icterina* as a good species, but in his comment in French at the end of the description (*tom. cit.*, p. 123) he concludes that "it is only a variety of *moneta*, and that the two species should be reunited." The great majority of writers preceding Kiener had preserved *icterina* as a good species, as it is considered today. It is the only shell that could be mistaken for *moneta*, but may be distinguished by its narrower and more ovate form, its simple outline and absence of dorsal nodosities, and much less extensive marginal callus. A further very noticeable distinction is that the anterior columellar teeth are shortened at their apertural end so that they appear to recede to permit the terminal ridge to project into the aperture, which is more dilated at this point than in *moneta*.

With the exception of the desire of some conchologists to name geographical and ecological forms of this variable shell, it has had an uneventful nomenclatorial history. There has never been any doubt as to its identity,

which is not surprising in the case of such a strikingly unusual species.

It is now placed in the typical subgenus of *Monetaria* Troschel, 1863, of which it is the type, by virtual tautonymy.

It is figured in Kiener (*tom. cit.*, pl. 34, fig. 1, showing the race *barthelémyi* Bernardi), in Reeve (1843–1878, vol. 3, *Cypraea*, pl. 15, sp. 74, the same race), and in Sowerby (1847–1887, vol. 4, pl. 317, figs. 244–251, showing several forms of the species).<sup>1</sup>

#### *Cypraea annulus*

1758, *Systema naturae*, ed. 10, p. 723, no. 314.  
1767, *Systema naturae*, ed. 12, p. 1179, no. 355.  
LOCALITY: "Ad Amboinam frequens" (1758);  
"ad Amboinam frequens; Alexandriae" (1767).  
"C. testa marginata, dorso annulo flavo circumdato."

The emphasis in the "Systema" on the yellow ring surrounding the dorsum of this species and the failure to mention this feature in the description of *C. moneta* are probably sufficient to identify it and to distinguish it from its congener, although, as mentioned above, many specimens of *moneta* show such a ring. The ring in *moneta* is of two types. There is, first, a yellowish band surrounding the dorsum, which is broad and vaguely defined and, though of a somewhat darker yellow than the dorsum itself, tends to blend into the lighter yellow both of the dorsum and the marginal callus. It is often obsolescent and difficult to detect and is sometimes wanting. There is also occasionally seen a narrow, sharply defined, bright yellow line similar to that in *annulus*. Where present this is usually seen only on one side, though in some specimens it is visible on both. There is no apparent distinction in respect to these features between shells from different regions. The ring

<sup>1</sup> Philippi (1836, 1844, vol. 1, p. 235) reports the finding of six specimens of *Cypraea moneta* and one specimen of the following species, *Cypraea annulus*, in Sicilian waters. It is possible that eggs or larvae of these species could have been mechanically transported on the hull of a vessel. Again, I have seen pale yellow specimens of *C. helvola* from Micronesia, which look suspiciously like *moneta* at first glance. They have no dorsal color pattern, and the marginal callus and base are almost white, with the margin somewhat nodose as in *moneta*. It may be that worn specimens of the Mediterranean form of *C. spurca*, a species closely allied to *helvola*, may have confused Philippi. This latter theory would not, however, explain the Sicilian specimen of *annulus*.

in *annulus* is always narrow, sharply defined, and of a brilliant orange-yellow, standing out in sharp relief to the color of the shell. It is quite possible that Linnaeus failed to perceive either type of yellow ornamentation in the specimens of *moneta* he examined.

The distinction between the two is very imperfectly expressed in the descriptions in the "Museum Ulricae." I have already called attention to the wording covering *moneta*. For *annulus* a very equivocal expression is used: "annulo lineari flavescente obsoleto." While "lineari" is highly descriptive it is difficult to understand why Linnaeus should have described the sharply drawn, orange-yellow ring as "obsoleto," as it appears clearly even in worn specimens. At the end of the description, however, we find the statement "Noscitur alba annulo oblongo flavo," which can possibly be said to cure the ambiguity of the earlier wording. In any case the difference in the descriptions in the "Systema" is sufficiently marked to distinguish the two species, even considering the statement in the "Museum Ulricae" that in *moneta* a ring was "rarely present."

*Cypraca annulus* had been known for many years before Linnaeus described it, and the identification of the description with the *annulus* of all authors has never been questioned. We are assisted by a synonymy which is largely correct, and by the discovery by Hanley (1855, p. 192) of a documented specimen of the species in the Linnaean collection.

The comment was made under *moneta* that the species is so variable that it is surprising that so few synonyms have been used. It might be said of *annulus* that it is so comparatively constant in its characteristics that it is equally surprising that any other names have been suggested. *C. nouméensis* Marie, 1869, is *annulus*, as are *C. harmandiana* and *camelorum* Rochebrune, 1884, and *C. soso-keana* Ladd, 1934. The Schilders (1938, p. 141) used *nouméensis* and *camelorum* as sub-specific names for geographical races of the species, along with a new name of their own, *scutellum* Schilder and Schilder, 1937. *C. annularis* and *caerulea* Perry, 1811, are also synonyms.

The only good species that could be confounded with *annulus* is *C. obvelata* Lamarck, 1810, which differs from *annulus* principally in

the fact that a trough is interposed between the margin and the raised central area of the dorsum, the yellow line lying in this trough, and in the greater thickness of the marginal callus which forms a torus around the dorsal trough. The dorsum is never tinged with flesh color, as is sometimes the case in *annulus*, and the apertural teeth are less numerous. *C. obvelata* is identical with *C. perrieri* Rochebrune, 1884. Excellent figures are found in Kiener (1846-1850, pl. 34, fig. 4, dorsal and ventral aspects.) It is a comparatively rare species even in its restricted range in eastern and northern Polynesia, from the Cook Islands to the Marquesas and, *fide* the Schilders, north to Johnson Island.

*Cypraea annulus* is placed in the genus *Monetaria* Troschel, 1863. The Schilders have erected a new subgenus, *Ornamentaria*, 1936, to contain *annulus* and *obvelata*, of which *annulus* is the subgenotype.

It is figured in Kiener (*tom. cit.*, pl. 34, fig. 2, dorsal and ventral aspects), and in Reeve (1843-1878, vol. 3, *Cypraea*, pl. 15, sp. 71).

#### *Cypraea caurica*

1758, *Systema naturae*, ed. 10, p. 723, no. 313.

1767, *Systema naturae*, ed. 12, p. 1179, no. 356.

LOCALITY: Not given in tenth edition; "in Oceano Indico" (1767).

"C. testa margine gibbo inaequali albido fuscopunctato, dorso nebulato-testaceo."

It was fortunate for the early followers of Linnaeus that the synonymy of this species in the "Systema," after an error of transcription had been corrected, showed two recognizable figures of the shell which had been so inadequately defined. The description is insufficient, as there are several species of *Cypraea* with spotted right and left margins of an unequal degree of callosity and a dorsum which is "nebulato-testaceo." It omits any reference to the violet interior of the shell, a feature to which Linnaeus usually referred, when present, and does not mention the incomplete, though obvious, blue-white bands of the dorsum. It also omits any mention of the striking dentition of the aperture, which is an important diagnostic feature of the shell. The addition of any one of these features would, by a process of exclusion, have identified the species. The aperture is very wide and anteriorly much dilated. The

labial teeth are white, strong, rounded, and distant, and their interspaces are strongly tinged with a deeper shade of the pinkish tawny color of the margins. The white columellar teeth, 12 to 14 in number, are divided into two groups. On the posterior half of the columella they are long, slender, and close together, extending inward across the almost obsolete columellar sulcus and outwardly reaching one-third to one-half of the way across the base, diminishing in length anteriorly and posteriorly. On the anterior half of the columella the teeth are short, thick, and more distant, and bear a pair of tubercles where they are interrupted by the fossula. The last two approach the terminal ridge in obliquity. The teeth on this side also have tawny interspaces. The above description of the aperture and base is based upon a specimen of the race *longior* Iredale, 1935, from Queensland, but will fit the more eastern and western races with slight modifications.

The species also varies in shape from elongate and rounded shells with thinly caloused margins to shorter and more depressed forms with much thickened sides. In some races, notably those from the Pacific islands, the color of the interspaces between the teeth is often orange. *Fide* Tryon (1879–1888, vol. 7, p. 171), the dorsum frequently bears a reddish brown spot. I am not familiar with this form, but according to the figure supplied by Born for his *Cypraea dracaena* (1780, p. 188, pl. 8, fig. 12) and the synonymy cited by Born for that species, it shows a central irregular blotch. Schilder and Schilder (1938, p. 154) use *dracaena* Born as the race name for a form of *caurica* from east Africa.

Of the two references cited in the "Systema" that from Rumphius (pl. 38, fig. P) is the most characteristic. The Gualtieri figure (pl. 15, fig. AA, as corrected<sup>1</sup>) is at least recognizable as *caurica* and has been often cited for it. Based on the synonymy alone Linnaeus' successors found no difficulty in identifying the species.

Within two years of the appearance of the twelfth edition of the "Systema," Mar-

tini (1769–1777, vol. 1, pp. 374–375) published a much more adequate description, in which he mentioned, among other features, the anterior dilation of the aperture and the strong teeth, though he failed to note the difference between the anterior and posterior columellar teeth. His figures, however (*tom. cit.*, figs. 301–302), show the characteristic dentition with reasonable accuracy. He also cited both of Linnaeus' references in his elaborate synonymy. The identification was fully confirmed by the discovery by Hanley (1855, p. 192) of a documented specimen of the *C. caurica* of all prior authors in the Linnaean collection.

The species is now placed in the typical subgenus of *Erronea* Troschel, 1863.

It is figured in Reeve (1843–1878, vol. 3, *Cypraea*, pl. 11, fig. 46) and in Kiener (1843–1847, pl. 10, fig. 2, dorsal and ventral aspects). This latter figure is said by the Schilders (*loc. cit.*) to represent the race *dracaena* Born, mentioned above. The brown spot in the dorsum referred to by Tryon is, however, not clearly shown. Instead, the figure exhibits merely the three brown zones and the two interposed whitish bands characteristic of all forms of the species. Moreover, the apertural teeth are not accurately shown. The two figures numbered 3 on the same plate are much more accurate. They show the form *elongata* Perry, 1811, from east Africa, which the Schilders also use as a race name.

The following are probably exact synonyms of forms of the present species: *Cypraea dracaena* Born, 1778; *corrosa* Gronovius, 1781; *derosa* Gmelin, 1791; *quinquefasciata* Röding, 1798; *elongata* Perry, 1811; *obscura* Rossiter, 1882; *oblongata* Melvill, 1888; *cairniana* Melvill and Standen, 1904; and *longior* Iredale, 1935.

*Cypraea variolaria* Lamarck, 1810 (? *chinesis* Gmelin, 1791), has been confounded with this species but seems to be readily separable. Hidalgo (1906–1907, p. 299) described a "variety" of *caurica*, to which he gave no name, as "brevior, ovata . . . subdepressa," but referred to several names that had been given to the form, namely: *variolaria* Kiener, var., 1843–1847; *cruenta* Gmelin, 1791, var. *coloba* Melvill, 1888; and *gregori* Ford, 1893. He properly concluded, however, that the shell which had been given these names was

<sup>1</sup> Linnaeus cited this figure as "t. 15. f. X." Figure X has little resemblance to *caurica* and was probably an error of transcription or misprint for figure "AA" on the same plate. Figure X was probably meant for *C. helwola* Linné.

not the form he himself had described. His language is very vague and it is not clear what he was describing in his "variety."

#### *Cypraea erosa*

1758, *Systema naturae*, ed. 10, p. 723, no. 315.

1767, *Systema naturae*, ed. 12, p. 1179, no. 357.

LOCALITY: "In Mauritio et insula Adcensionis" (1758, 1767).

"C. testa deroso-marginata flava albo-punctata, lateribus macula subfusca . . . Labium exterius transverse profunde sulcatum, macula ferruginea in utroque latere."

With an adequately characteristic description in the "Systema" and a synonymy containing two characteristic figures, and with the type specimen in the properly marked tray in the Linnaean collection, the identification of *Cypraea erosa* has presented no difficulties. The several names that have been given to it have been for the most part based on geographical races. The description in the "Systema" supplies all the important diagnostic features of the *erosa* of authors, the erose, brown-streaked margin, the white-spotted fulvous dorsum with its large lateral spots, and the deeply cut labial teeth. The description in the "Museum Ulricae" is highly confirmatory as it describes all of these features in greater detail. This latter description suggests that form of the species which is described and figured in Sowerby (1847-1887, vol. 4, pl. 309, figs. 111-112). This form has been accepted by most conchologists as the typical *erosa*, as it is the form represented in the Linnaean collection and shown in Lister's figure 692 (Linnaeus' Lister reference, conformed to the numbering of the 1770 edition), and, based on Linnaeus' locality and the legend on Lister's plate, comes from Mauritius. Schilder and Schilder (1938, p. 137) allot to this form the subspecific name *erosa erosa*.

Of Linnaeus' other references, the Rumphius figure (pl. 39, fig. A) is unmistakably *erosa*. The figure from Petiver (pl. 97, fig. 19) is recognizable, but that from Gualtieri (pl. 15, fig. 4) is useless as a guide. It merely shows a depressed dorsum and a callous margin and leaves out any distinguishing details.

*Cypraea erosa* is confined to the Indo-Pacific region. The inclusion in Linnaeus' locality of the southeastern Atlantic island of Ascension is an error, possibly caused by the

author's having confused with *erosa* the race of *C. spurca* from Ascension and St. Helena to which F. A. Schilder gave the name *sanctaehelenae* in 1930.

The variations seen in the species are largely regional. They concern principally the deepness or paleness of the color of the dorsum, the presence or absence of ocellated spots thereon, the position of the large, square lateral spots and the degree to which they invade the dorsum, the degree to which the extensions of the labial teeth cross the marginal callus, and the presence or absence of coloration on the marginal ridges. None of these variations, however, are sufficiently marked to obscure the identification of the species or lead to confusion with any other *Cypraea*.

The following names have been given to geographical races of *erosa*: *C. similis* Gmelin, 1791; *phagedaina* and *chlorizans* Melvill, 1888; *purissima* Vredenburg, 1919; and *lactescens* Dautzenberg and Bouge, 1933. *Cypraea nebrites* was suggested in 1888 by Melvill as the name for an Indian Ocean form in which the square lateral spots appear only on the dorsum and do not invade the marginal callus. Hidalgo (1906-1907, p. 338) retained it as a "variety" of *erosa*, but it is now given specific rank by the Schilders (*loc. cit.*) because of the position of the lateral spots and other distinctions which appear to these writers sufficient to justify its separation from *erosa*.

*Cypraea erosa* is placed in the typical subgenus of *Erosaria* Troschel, 1863, as the type by virtual tautonymy. Thiele (1931, 1935, vol. 1, p. 273) does not recognize *Erosaria* as a good genus but uses it as a subgenus of *Pustularia* Swainson, 1840.

The species is figured in Reeve (1843-1878, vol. 3, *Cypraea*, pl. 11, sp. 43). This figure suggests the Polynesian race of *erosa* to which the Schilders (*loc. cit.*) allot the subspecific name *lactescens* Dautzenberg and Bouge, 1933, although they note (p. 137) that that race needs further study. It is distinguished by the fact that the lateral blotches invade the dorsum to a greater degree than in any other form except *nebrites*, and at the same time are visible on the marginal callus.<sup>1</sup> Kiener's figure (1843-1847, pl. 9, fig. 2) appears to illustrate

<sup>1</sup> The Schilders, however (*loc. cit.*), refer the Reeve figure to the typical race, *erosa erosa*.



the same race, although Kiener's description is not clear. Kiener's figure 3 on the same plate shows a shell said by that author to come from the Red Sea. The only race of *erosa* occurring through the Red Sea is *nebrites*, a shell in which the lateral blotches are on the dorsum only, whereas the figure shows a complete absence of either blotch. *C. erosa similis* Gmelin, however, is reported by Vayssière to have been found at the extreme southern tip of the Red Sea, and in that race the left dorsal blotch is obsolete or very small. Figure 3 of Kiener is undoubtedly *similis*, and the absence of both blotches is attributable to the fact that it was based on a young specimen. The Schilders refer the figure to *similis*.

#### *Cypraea flaveola*

1758, *Systema naturae*, ed. 10, p. 724, no. 320.

1767, *Systema naturae*, ed. 12, p. 1179, no. 358.

LOCALITY: Not given in either edition.

"C. testa deroso-marginata flavescente albo punctato: lateribus punctis fuscis obsoletis subsparsis."

Only the first clause of the above description was used in the tenth edition, the word "deroso-marginata" read "eroso-marginata," and "fulvo" was used instead of "flavescente." No references were supplied in either edition.

The early writers were confused by this name, partly because they did not suspect that the *flaveola* described in the two editions of the "Systema" might be different species and partly because they had not clearly differentiated between the Mediterranean and western Atlantic races of *Cypraea spurca* Linné. In fact, during the first hundred years after Linnaeus' day, the relationship between the races of *spurca* and the several forms of *C. helvola* Linné were not understood. Even Hanley (1855), in his discussions of *spurca*, *flaveola*, and *helvola*, does not appear to have fully grasped these distinctions, although it is difficult to arrive at his views as his comments on *flaveola*, at least, are not clearly expressed.

It is now generally conceded that the *flaveola* of the twelfth edition is the shell called *acicularis* by Gmelin, the western Atlantic race of *spurca*. Schilder and Schilder (1938, p. 133) use the name *acicularis* Gmelin as a subspecific name for the American race

of *spurca*, giving *flaveola* Linné, 1767, as a synonym. This race of *spurca* differs from the European races by its shining white instead of fulvous base, its shorter fossula, and its more deltoidal shape. The *flaveola* of the "Museum Ulricae" was, in my opinion, *helvola* Linné. The language of the description in that work, "noscitur colore supra et subtus flavo," does not conform to the American *spurca*, and the failure to mention the marginal brown spots points away from any race of *spurca* but does apply to *helvola*. The entire "Museum Ulricae" description gives, in fact, a recognizable picture of that shell.

The *flaveola* of the tenth edition of the "Systema" is, I suggest, also *helvola* Linné. As in the "Museum Ulricae," the failure to mention the marginal spots, which are so distinctive a feature of all forms of *spurca*, is significant, as it could hardly have been an oversight.

It should be noted that Linnaeus supplied no localities for *flaveola* or *helvola*, although he located *spurca* in the Mediterranean. Four specimens of shells belonging to this group are in the Linnaean collection, but none is marked in any way, and it is not possible to tell when any of them were introduced. None of them can, therefore, be regarded as an authoritative type specimen. Two are examples of the American *spurca*; one is the European *spurca*; and one is *helvola*. Linnaeus' lists of owned species contains all three names, *flaveola*, *spurca*, and *helvola*, and thus it is certain that he owned specimens of each at some time. In spite of the absence of any documentation for these specimens, a careful reading of Linnaeus' descriptions for the three names in the several works mentioned makes it abundantly clear that he correctly differentiated between the various forms involved, his only error being in the use of the redundant name *flaveola* for the American *spurca* and his failure to see that the *flaveola* of the "Museum Ulricae" was the same shell that he described as *helvola* on the next page of the "Systema."<sup>1</sup>

<sup>1</sup> Since the above comments on the name *flaveola* were written I have examined the remarks of Hidalgo (1906-1907, p. 175) on the subject and find that he reached the same conclusions, at least in so far as concerns the Linnaean uses of the name. As his comments involve the use of the name by several of Linnaeus' followers, the passage is here quoted: "The original name, that in the

The differences between the various forms or races of *spurca* and *helvola* as well as the references to figures are reserved for the discussion of these species (below).

#### *Cypraea spurca*

1758, *Systema naturae*, ed. 10, p. 724, no. 317.

1767, *Systema naturae*, ed. 12, p. 1179, no. 359.

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

"C. testa submarginata lutescente, luteo irro-

10th edition of the *Syst. Naturae*, along with the good description of Linnaeus in the *Mus. Ludov. Ulricae*, was given to a color-variety of the *Cypraea helvola* (of which I have a beautiful specimen in my collection, which completely conforms to the original description). The *C. flaveola* of the 12th edition of the *Syst. Naturae* is the *C. acicularis* Gmel. or *flaveola* Deshayes, 2nd edition of Lamarck, from the Antilles; the *flaveola* of other authors is the *spurca* Linné of the Mediterranean; the *flaveola* of Reeve is a var. of the *gangrenosa* [sic] of the Indo-Pacific province; the *flaveola* of Born is the *Cypraea Pyrum* Gmel. of the Mediterranean and it is probable that the *C. flaveola* of others is the *C. cernica* Sow. from Mauritius."

The species *gangrenosa* mentioned by Hidalgo is of Dillwyn, 1817. It is a congener of *C. spurca* Linné, falling in *Erosaria* (*Ravitrona*) and is very close to the *spurca-helvola* group. *C. cernica* Sowerby, 1870, also mentioned, is in the same subgenus, but can be distinguished from its congeners by the absence of the terminal spots. *C. pyrum* Gmelin, 1791, is a quite different species, belonging in the typical subgenus of *Zonaria* Jousseau, 1884. It is native to the Mediterranean Sea, the eastern Atlantic Islands, and the adjacent African coast. It is certainly the shell called *Cypraea rufa* by Lamarck in 1810 but is only doubtfully identical with *flaveola* Born, 1780. Hidalgo did not specifically mention *flaveola* Gray, 1825, which is a synonym of *C. labrolineata* Gaskoin, 1848, another member of *Erosaria* (*Ravitrona*).

Shaw (1909, p. 295) again disagreed with Hidalgo and with the view expressed in this paper on this point, and notes that E. A. Smith also disagreed. He said in part: "In the first place I do not admit that the *flaveola* of the tenth edition and of the *Mus. Ulricae* is a color variety of *C. helvola*. . . . It is more than probable that the shell described in the *Mus. Ulricae* was different from that of the tenth and twelfth editions of the *Systema*, yet it is evident that the author supposed them to be the same, since in the twelfth edition we have a reference to the *Mus. Ulricae*, in which he again refers to the tenth edition. . . ." This argument, if it be understood, seems specious. The references in the "*Museum Ulricae*" to the tenth edition and in the twelfth edition back to the "*Museum Ulricae*" carry little weight as this was Linnaeus' invariable custom, and yet we know that the shells described under the same name in the three works often involved more than one species. Although it is manifestly impossible to be certain what was in Linnaeus' mind and the whole question of the identity of the several *flaveola* is not susceptible of absolute proof, Shaw's argument is not logically expressed and is partially contradictory.

rata, lateribus fusco-punctatis . . . Testa ovata, laevis, lutescens, punctis pallidioribus aut saturatoribus confertim adspersa; margo supra crenulatus colore fusco; labium interius postice reflexo apice, quod huic proprium. Testa interdum occurrit livida immaculata diaphana, nondum dentes adepta, sed tamen magnitudine justa, unde apparat has senectam exuere. n. 389."

The discussion of this species should be read in connection with that of the preceding name, *C. flaveola*, and of *C. helvola*, below, as these three names form an affinity which was not understood by conchologists for over a hundred years after Linnaeus. Although the species are widely separated geographically, they are biologically close relatives.

*Cypraea spurca* represents one of the few instances of a tropical or subtropical shell which is found in great numbers on both sides of the Atlantic, although there are several boreal species of which this is true. The *spurca* of the western Atlantic and of the Mediterranean and eastern Atlantic are now treated as forms of the same species, although the differences between them are so obvious that, as Schilder and Schilder said (1938, p. 133), they "could almost be separated specifically."

The description in the "*Systema*," the longest and most detailed that Linnaeus supplied for any of his cypraeids, is so characteristic that it unequivocally defines the species. It cannot be stated categorically which of the two widely separated races Linnaeus was describing nor even whether he knew that the American race existed. The two most important differences between them are: first, the base of the American shell is always pure white, while the other has a fulvous base, although the shade varies greatly; second, the brown spots on the sides and sometimes on the base of the European shells are numerous and well defined, whereas in the American race they are fewer in number and paler and less conspicuous than the dark brown lateral pittings. In Linnaeus' diagnosis, while he gave the Mediterranean as the locality of the species, he failed to describe the color of the base. On the other hand, he spoke of the lateral spots as "pallidioribus aut saturatoribus," which suggests, that he had at least, seen the American shell.

No synonymy was supplied for *spurca* in

the "Systema" and it was not described in the "Museum Ulricaë."

The distinction between the two races mentioned was unwittingly disclosed by Gmelin, although he described them under two different names and was not aware of their common identity. He first described *spurca* (1791, p. 3416) in practically the same words as did Linnaeus, and while he did not note the color of the base or mention the lateral spots he located the shell in the Mediterranean. He then (*op. cit.*, p. 3421) described a *C. acicularis* in words which clearly point to *spurca*. He gave no locality but specifically said "subtus lactea" which, with the phrase "punctis ad marginem impressis," ties his shell to the American race of the species. His only reference was to a Martini figure (1769-1777, vol. 1, p. 402, pl. 31, fig. 335). This figure is equivocal. Martini himself did not cite any references and confessed that he did not know the origin of his single specimen, as it had been given him by a traveler who had found it in the "Spanish Sea," which at that epoch could mean either the eastern or western Atlantic. The shell is described as having a white base, "ventre et lateribus lactea." The figure shows the white margins (but not the base) and the impressed brown dots around the ends and right side of the shell. We must conclude that both Gmelin's *acicularis* and Martini's shell represented the American form of *spurca*.

It is well to summarize here the conclusions reached in the discussion of *C. flaveola*, above:

A. That the *flaveola* of the tenth edition of the "Systema" was *C. helvola* Linné (base and margins fulvous and marginal spots lacking).

B. That the *flaveola* of the twelfth edition was the western race of *C. spurca* Linné, which Gmelin called *acicularis* (base and margins white; marginal spots pale and less conspicuous than in the eastern race).

C. That the *flaveola* of the "Museum Ulricaë" was also *C. helvola* Linné.

D. These conclusions are based solely on the four Linnaean descriptions involved.

The confusion between the two principal races of *spurca*, and between *spurca* and *helvola*, for which the inclusion of the unnecessary name *flaveola* was partly responsible, was not resolved for over a century. References to a few of the comments on this group

are here noted in order to illustrate how Linnaeus' names puzzled his successors.

Dillwyn (1817, vol. 1, p. 462) cited *spurca* Linné with *spurca* Gmelin, *acicularis* Gmelin, and *flaveola* Lamarck, 1810, as synonyms. The locality is stated to be the Mediterranean Sea, though Dillwyn based his species on a specimen with a white base. He said: "Gmelin's *C. acicularis* answers so well to the description of this species in the Systema Naturae that I have no doubt of its being the same." He also cited *flaveola* (*loc. cit.*) as of Linnaeus and Gmelin and commented: "Born supposed *C. Pyrum* to be this species, but it does not correspond with the Linnean characters, and other authors have with greater probability stated their opinion, that the shell described by Linnaeus was a variety of *C. erosa*."

Lamarck did not list *C. spurca* by that name, but his *C. flaveola* (1822, p. 394), for which he referred to *C. acicularis* Gmelin, is certainly the American *spurca*, although he did not supply any locality for his species. In his Latin description he spoke of its "subtus alba, lateribus albidis, fusco punctata," and in the French description he said: "Under the same name Linné mentions a *Cypraea* which is not known to me and for which he gave no synonym. The shell here listed is slightly gibbous, with a yellow dorsum, obscurely spotted with brown, with swollen sides, *which, as well as the base, are white* and adorned with reddish brown dots, among which those near the margin are pitted" (*italics mine*). This is a perfect description of the American *spurca*. Strangely enough, he did not mention the member of this affinity from European waters. The editors of Lamarck's second edition, Deshayes and Milne Edwards (1835-1845, vol. 10, p. 525), list both *Cypraea flaveola* Lamarck, the American *spurca*, copying Lamarck's description word for word, and also *C. flaveola* Linné (*tom. cit.*, p. 558). For the first they omit any reference to locality, as did Lamarck, and add a footnote which is here quoted in full: "Under the name of *Cypraea flaveola*, Linné, both in the *Museum Ulricaë* and in the 12th edition of the *Systema naturae*, established a species for which he furnished no synonymy; but in the first of these works he gives a description which proves that the shell allied to that of

Lamarck differs from it in several particulars. Lamarck seems to recognize it, but nevertheless he was in error in applying the Linnean name to another species than that of the great naturalist." Thus these authors seem to recognize that in the "Museum Ulricae" Linnaeus described a different species from the *flaveola* of the twelfth edition, but the circumlocutions they employ make it difficult to understand or translate their language. They continued by saying: "We must leave to the species of Linné its name and it is necessary to give another name to the species of Lamarck. As a matter of fact, as Dillwyn and later Gray recognized, the *Cypraea spurca* of Linné is the same species as the *flaveola* of Lamarck." This statement is correct only if these authors referred to the *spurca* of the twelfth edition of the "Systema," the American shell. A few pages later, in listing the *flaveola* of Linnaeus (*tom. cit.*, p. 559), they described it in somewhat different terms but still referred to the white base and gave "the Antilles" as its locality. The remarks of Lamarck and his editors are full of contradictions and erroneous conclusions, but the most important thing to note is that, after Gmelin, no conchologist has realized that *spurca* was found on both sides of the Atlantic and that both Lamarck and his editors did not even refer to the European shell.

Gray (1825, p. 501) described *spurca* as a shell with a white base, sometimes with scattered brown spots near the edge, thus pointing to the American form, although he locates it in the Mediterranean. He gave as synonyms: the *spurca* of Gmelin and Dillwyn and *flaveola* Lamarck as well as the *acicularis* of Gmelin, and correctly says (*op. cit.*, p. 502): "This shell differs considerably from the *C. flaveola* of Linnaeus, with which Lamarck has confounded it." He also listed *flaveola* Linné as having a white base but with the margin crowded with brown spots, rounded and unequal in size, and said: "I have seen only one perfect specimen of this shell, which is apparently distinct from the former. It agrees well with the character of Linnaeus, except that the brown spots on the margin are not obscure. I have therefore added the Linnean name" (*italics mine*). He gave no locality. I suspect that his "one perfect specimen" was the Mediterranean shell which occasionally

shows an almost white base.

Philippi (1836, 1844, vol. 1, p. 235) gives a fair description of *C. spurca* but does not mention the color of the base. He is, of course, referring to the Mediterranean shell, as his locality is Syracuse and his work covers only species from Sicily. His comments are mentioned only because he lists the Indo-Pacific species *C. helvola*, one specimen of which he claimed to have found at Syracuse. This doubtful record presents the same problem discussed under *C. moneta*, above. It is possible, although extremely unlikely, that eggs or larval shells could have been mechanically transported to Sicilian waters.

Reeve (1843-1878, vol. 3, *Cypraea*, pl. 14, sp. 68) came no closer to an understanding of this affinity than his predecessors. He cited *spurca* Linné from the Mediterranean, referring it both to *spurca* Gmelin and *acicularis* Gmelin and mentioning its white base, thus doubly confusing the American and European races. His figures can be taken for either. He also lists a *flaveola* as of "Linnaeus Syst. Nat. p. 1179" (the twelfth edition *flaveola*), "not of Born or Lamarck," thus referring to the American race of *spurca*, though he gives no locality. He said of his *flaveola*: "Care must be taken not to confound this shell with the *C. flaveola* of Lamarck, which is the *C. spurca*." Thus he did not appreciate the identity of the twelfth-edition *flaveola*, which is, in fact, a race of *spurca*.

Sowerby (1847-1887, vol. 4, p. 38, pl. 309, figs. 118-122) describes *spurca* as "lateribus punctatis . . . maculis prope extremitates nullis, nec termine fuscis." No mention is made of the color of the base and no locality is given. The mention of the fact that there are no spots near the extremities definitely points away from the American race of *spurca*. The figures show shells with both white and fulvous bases. In the explanation of the plate he makes *spurca* equal to "*acicularis* Gmelin and Lamarck, not Lin.," which may have been an oversight or a misprint, as Linnaeus described no *acicularis*. Figure 121 is said to represent *C. flaveola* (no author stated) from "Cape Verde, Mediterranean, Indian and Pacific Oceans," thus including *C. helvola*. The Sowerby treatment is a most unsatisfactory guide to an understanding of this group.

Weinkauff (1881, p. 102) was the first to recognize that *spurca* Linné is found on both sides of the Atlantic, as his list of localities embraces the European and African coasts, the south Atlantic islands, and the Antilles. He still, however, describes it as "subtus convexa alba, aut cum marginibus fulva." He referred neither to the name *acicularis* Gmelin nor to the fulvous base of the European shell.

Tryon (1879-1888, vol. 7, p. 195) did not even mention the fact that the American *spurca* exists. He described the species as having a base "white to pale yellowish brown" which could describe both races, but neither accurately, as the American *spurca* has always a white base, and the European shell often shows a base darker than "yellowish brown." He listed *acicularis* only in his index of species, and there only as a synonym of *spurca*. His figures (*tom. cit.*, pl. 19, figs. 16-17) show a dorsal view which might be a shell from either side of the Atlantic, and a ventral view of a shell with a pale tan base, which is probably the European shell. He also cited *C. flaveola* (*loc. cit.*) as of Linné, 1767, and gives it margins stained and spotted with blackish brown and a white base. The figures (*tom. cit.*, pl. 19, figs. 20-22) follow the description. His treatment is complicated by the fact that he locates the species in Japan and Australia, which are the northern and southern limits of *helvola* Linné. The *flaveola* of the tenth edition of the "Systema" may be *helvola*, but that of the twelfth edition is certainly the *spurca* of the western Atlantic. Therefore Tryon's combination of a white base and a Pacific locality is highly contradictory.

Dall (1889, p. 136) cited *C. spurca* from Cedar Keys, Florida, and a shell which he called "*spurca* var. *flaveola* Lam." from Key West. Lamarck's *flaveola* is certainly the American *spurca*, but I have seen no specimens of *spurca* from American waters which varied sufficiently to be singled out as a "variety."

Hidalgo (1906-1907) recognized that the shell which he called *C. acicularis* Gmelin (*op. cit.*, p. 245) and the *C. spurca* of Linnaeus (*op. cit.*, p. 515) were closely related, but was emphatic in saying that they were not conspecific. He located his *acicularis* from Brazil to Florida and throughout the Carib-

bean and said (p. 182): "This species has been reported from these localities under the name of *Cypraea spurca*, which is a related species but very distinct." He speaks of it (p. 246) as "A species very close to the *Cypraea spurca* of Linné, but may be distinguished by its shorter form, its gibbous dorsum, its lateral margins angulated and not compressed above and the very white color of the base of the shell. If one weighs its similarity against all its other features it is distinguishable from the other at the first glance. I do not adopt the name of *Cypraea flaveola* which Linné gave it in the 12th edition of the *Systema naturae*, because it is not the same shell as that previously described under the same name by that naturalist in the 10th edition, which, according to the excellent description in the *Museum Ludovicae Ulricaе*, is only a color variety of his *Cypraea helvola*. I must therefore retain the name of *Cypraea acicularis* established by Gmelin in the 13th edition of the *Systema naturae* . . . The *Cypraea flaveola* of Lamarck is the *Cypraea acicularis* Gmelin and not the *Cypraea spurca* Linné, as other authors have supposed, since the terms employed by Lamarck in his description conform more closely to Gmelin's species. . . ."

I have set out Hidalgo's comments almost in full as he was the first student of *Cypraea* to grasp fully the meaning of the various *flaveola* of Linnaeus. In fact his only divergence from the modern view of this complex is that he did not recognize that the *acicularis* of the western Atlantic and the *spurca* of European waters were forms of the same species that should be called *spurca*, although he admitted that they were close relatives.

The specific identity of the eastern and western forms of *spurca* has been acknowledged by the great majority of American authors of the present century, but the detailed allocation of the several names that have been given to the species was not clearly explained until the publication of the Schilders' "Pro-drome" on the Cypraeidae (1938, p. 133). They there divide the species into four geographical races, or subspecies. They describe two eastern races: *C. spurca spurca* Linné, the Mediterranean form, which is figured in Kiener (1843-1847, pl. 30, fig. 1a) and which had already been called *lunata* by Fischer in 1807, and *C. spurca atlantica* Monterosato, 1897,

an oceanic form ranging from Portugal to Angola and Madeira and figured in Sowerby (1847-1887, vol. 4, pl. 327, fig. 516). This form was called *verdensium* by Melvill in 1888. To the western Atlantic race, *C. spurca acicularis* Gmelin, they added a further race to which they gave the name *C. spurca sanctaehelenae* F. A. Schilder, 1930, a race restricted to the South Atlantic islands of St. Helena and Ascension,<sup>1</sup> and which is figured in Sowerby (*tom. cit.*, pl. 309, figs. 120, 122). In this race the dorsum is brown instead of yellow, and the lateral spots are deeper in color and more distinct than in the Antillean *spurca acicularis*.

*Cypraea spurca* is now placed in the genus *Erosaria* Tröschel, 1863, subgenus *Ravitrona* Iredale, 1930.

There has been a widely held belief that *Bulla cypraea* Linné, which will be discussed in a later part in this series of papers, is in reality merely a name given to the juvenile shell of *Cypraea spurca* and that Linnaeus was aware of this fact and expressed this awareness in the diagnoses of the two names. The question is so complicated, principally by Linnaeus' peculiar Latin and by his unexplained manner of listing the two names, that a complete discussion of the problem is reserved until *Bulla cypraea* is considered, in order that the reader may have the entire diagnoses of both species before him.

#### *Cypraea stolidia*

1758, *Systema naturae*, ed. 10, p. 724, no. 318.  
1767, *Systema naturae*, ed. 12, p. 1180, no. 360.

LOCALITY: Not given in either edition.

"*C. testa marginata cinerea, testaceo quadrato variegata.*"

The description of this species in the "*Systema*," when supplemented by the somewhat more detailed description in the "*Museum Ulricae*" and by the synonymy, is barely sufficient to identify it with the *stolidia* of authors. The latter is not "*cinerea*" except rarely; the meaning of Linnaeus' word "*testaceo*" is not clear; and the word "*quadrato*" as applied to the central dorsal blotch is not accurate except in a scant minority of specimens. The blotch is usually more amoeba-like, and in

<sup>1</sup> The Schilders speak of the latter two as the western races, although the island locality is more properly in the southeastern than in the southwestern part of the Atlantic.

some specimens this appearance is intensified by the "feelers" that connect it with the smaller blotches in the corners of the dorsum. Fortunately, the Linnaean collection contains a specimen of the *stolidia* of authors, which is the only shell in the collection that agrees with the descriptions, although it cannot be accepted as the type specimen as it is not marked in any way.

The synonymy is half correct. The Argenville figure (pl. 21, fig. Y) is recognizable and harmonizes with the description. The Petiver figure (p. 97, fig. 19) is either a misprint or an error of Linnaeus' as it shows *C. erosa* Linné and had already been used for that species on the preceding page of the "*Systema*." Linnaeus corrected the error in a manuscript note in his copy of the twelfth edition, changing it to "figure 18." The latter figure is unmistakably *stolidia*.

Linnaeus' son added to the synonymy, by manuscript note, two further references. The first was a Martini figure (1769-1777, vol. 1, p. 377, pl. 29, fig. 305) which is a good picture of *stolidia*. Martini, however, had not realized its identity, as he did not refer it to Linnaeus' species and, indeed, gave no synonymy. The second figure added by the younger Linnaeus was a Born drawing (1780, p. 191, pl. 8, fig. 15).<sup>2</sup> This is recognizable as *stolidia*. Neither of these latter references nor the corrective manuscript note of Linnaeus is authoritative as defining the species as of Linné, 1758, as they did not appear in the original diagnosis. The species, therefore, must be based on the descriptions, such as they are, and the Argenville figure.

*Cypraea stolidia* has had a rather uneventful nomenclatorial history, although it was not immediately recognized. Gmelin (1791, pp. 3416-3417) copied Linnaeus' description word for word, with the sole omission of the word "*marginata*," which may mean that he had examined a subadult specimen, and added the locality "ad Amboinam." He cited many figures, among which Linnaeus' two references were not included. It seems to be very doubtful whether he had properly identified the species. This doubt was well expressed by Chem-

<sup>2</sup> The actual reference was to "Born, p. 177," which refers to the 1778 work of that author which contained no figures (see Bibliography). The same description appears in the 1780 work, and the species is there figured as above.

nitz (1780–1795, vol. 11, p. 41, pl. 180, figs. 1743–1744): “The real *Cypraea stolidia Linnaei* seems to be quite unknown to most conchologists. One of the most recent commentators who discusses Linnaeus, and to whom one should attribute the highest reliability, has cited for this species 17 figures from conchological writings, all of which are incorrect. Only one is accurate, that which was cited from Born’s Testac. Caes. tab. 8., fig. 15, and the accuracy of this one is not unequivocal since a question-mark is put after it. Most of these writers consider a very common *Cypraea*, which was called *caurica* by Linnaeus, to be *C. stolidia* Linné, provided the customary brown spot on the dorsum takes on an unusual shape, and one may therefore with the assistance of a vivid imagination, make out the shape of a dragon or a similar object in its place . . . My dear Martini, in the first volume of the Syst. Conchyl. Werkes, figures 292–293, also committed this error and figured an odd spotted *caurica* for *stolidia* Linné.”

From the time of Chemnitz onward I am not aware of any doubts in the minds of conchologists as to the identification of this species, save for a comment by Lamarck (1822, p. 392) to the effect that: “Some [writers] have confounded this species with individuals of the Var [c] of *C. hirundo*, which approach it in form, but which have two brown or black spots at their extremities, which are not found in this species.” He did not further identify the writers referred to, and it would seem difficult to confuse *stolidia* with any form of *hirundo*. Lamarck’s variety [c] is described as “Testa elongata, fulvo-subpunctata, macula dorsali rufescente lata signata.”

The *C. stolidia* of Gmelin, which Chemnitz tentatively identified with *caurica* Linné, is said by Deshayes and Milne-Edwards (1835–1845, vol. 10, pp. 516–517, footnote) to be identical with *C. dracaena* Born, which, as said above under *C. caurica* Linné, is a form of that species. Deshayes and Milne-Edwards say of *caurica* (*loc. cit.*): “It is here that we should place the *Cypraea stolidia* of Gmelin which is not the same species as that of Linné but which represents, under another name, the *Dracaena* of Born, and is consequently a variety of *Caurica*.”

Schilder and Schilder (1938, pp. 167–168) recognize four subspecies of *stolidia*, which

they use as geographical races: the typical *stolidia*, from the western Pacific; *stolidia crossei* Marie, 1869, from Micronesia south to New Caledonia; *stolidia diauges* Melvill, 1888, from east Africa; and *stolidia brevidentata* Sowerby, 1870, which ranges from Torres Strait to northwestern Australia. The variations in this shell consist largely in the color pattern of the dorsum. The base color runs from grayish blue to a sky-blue and in some specimens a highly polished yellow. The dorsal ornamentation ranges from a few brown specks to an isolated, central blotch. There are often supplementary spots in the four corners of the dorsum, and these are often connected with the central blotch by irregular connecting lines of brown. The shape of the shell is from ovate to pyriform. There are also differences in the color of the teeth which may be white or ferruginous, by the fact that the columella sulcus is ribbed instead of denticulate, and in the degree of concavity of the fossula. An extreme and unusual color form is seen in the Australian race, *brevidentata*, where the corner spots are lacking and the central blotch is small or even obsolete.

The species is now placed in genus *Blasicrura* Iredale, 1930, subgenus *Derstolidia* Iredale, 1935.

The four Schilder races are figured in the following works: for *stolidia stolidia*, see Kiener (1843–1847, pl. 31, fig. 1); for *crossei*, see Marie (1869, pl. 1, fig. 3); for *diauges*, see Melvill (1888, pl. 1, fig. 5); and for *brevidentata*, see Kiener (*tom. cit.*, pl. 31, fig. 1a).

#### *Cypraea helvola*

1758, Systema naturae, ed. 10, p. 724, no. 316.

1767, Systema naturae, ed. 12, p. 1180, no. 361.

LOCALITY: Not given in either edition.

“C. testa marginata triquetro-gibba albo-punctata, postice erosa, subtus flavo immaculata.”

In spite of the complications that plagued the early conchologists in the separation of *spurca* and *helvola* and their several forms by the injection of the unnecessary name *flaveola*, the two species are easily distinguishable. While the marginal callus and base of *spurca* are white or, in the European race, fuscous, in *helvola* they are always yellow or brown, in shades ranging from pale tan to orange or chestnut, the deepest color being usually seen at the aperture. While the pits at the left margin and extremities of *spurca* are

impressed with brown, they are usually colorless in *helvola* and less numerous. The marginal callus is usually angulated where it joins the dorsum on the right side, and at times on the left side as well, a feature which is much less evident in *spurca*, and a wide brown or orange band lies between the margins and the dorsum, the upper edge of which is ill defined and which in most specimens lightens in color as it invades the dorsum. The extremities, which are white in *spurca*, usually show a violet tinge in *helvola*, at least in fresh shells. There is a considerable area of gray on the dorsum of *helvola*, which is never seen in *spurca*.

The description of *helvola* in the "Systema" is probably sufficient to identify the species, although, as in so many of Linnaeus' descriptions in *Cypraea*, it defines a specimen rather than a species. The words "triquetro-gibba" suggest a pyriform or subpyriform shell, which is seen in only one of the several distinctive forms of the species. The phrase "albo-punctata" is likewise too broad. The light portion of the dorsum, in many forms, is composed of a multitude of white spots surrounded by grayish rings. In some forms the spots do not appear to be ringed, but rather to be set on a grayish background. Shells from some areas have a series of independent and more brilliant white spots, particularly on the sides of the dorsum, and when this pattern appears there are no grayish rings or background, the white spots being imposed on a brown base color. Sometimes there are brown spots scattered indiscriminately over a predominantly grayish ground color, and the various races are distinguished largely by the degree to which the brown areas predominate over the gray or white, or vice versa. In other words, it would be as accurate to describe the species as "fusco-punctata" as "albo-punctata." Neither phrase is consistently descriptive of this variable species. There are specimens in the writer's collection in which the dorsum is almost entirely made up of groups of confluent brown spots.

The words "subtus flava immaculata" in the "Systema" represent the most important clue in distinguishing *helvola*, and the "subtus saturate lutea" of the "Museum Ulricae," where the whole description is longer and somewhat clearer, is even more characteristic.

A specimen of the *helvola* of authors is present in the Linnaean collection, and, though unmarked in any way, agrees fairly and uniquely with the description. It is apparently an individual of the form of *helvola* from the western Indian Ocean, which Melvill, 1888, called *mascarena*, the *chalcedonia* of Perry, 1811.

In the identification of the races of this species, based on differences of color and color pattern, one must take into consideration its noticeable tendency to fade, not only on exposure, but even when housed in collections. The violet color of the extremities, which is particularly a feature of the Pacific races, will fade from a deep purple to white and the orange or brown of the lateral bands, both of which are ordinarily resistant colors, is apparently almost as fugitive. This tendency may confuse the worker who has before him a series of long-collected shells, and has often resulted in contradictory descriptions of shells from the same locality.

The Schilders divide the species into seven geographical races or subspecies as follows: the typical *helvola*, which they allot to the race found from north Malaysia to the Sea of Japan, and which is figured by Tryon (1879-1888, vol. 7, pl. 19, figs. 8-9); *helvola citrinicolor* Iredale, 1935, an Australian form which they admit is doubtfully distinct; *helvola callista* Shaw, 1909, a Micronesian and Polynesian form figured by Vayssière (1910, pl. 13, fig. 4); *helvola mascarena* Melvill, 1888, a northwestern Indian Ocean form figured in Reeve (1843-1878, vol. 3, *Cypraea*, pl. 15, sp. 72); *helvola hawaiiensis* Melvill, 1888, a form restricted to the Hawaiian Islands and figured by Ostergaard (1920, pl. 2); *helvola argella* Melvill, 1888, a form ranging from Natal, East Africa, to Aden and figured by Maxwell Smith (1912, pl. 4, fig. 8); and *helvola meridionalis* Schilder and Schilder, 1938, a form restricted to the southeast corner of Africa, of which the only figure is to be found in Wein-kauff (1881, pl. 35, figs. 2-3).

The race *hawaiiensis* was for some time considered a good species and was called *C. pacifica* by Ostergaard, 1920. In 1921 Dall (p. 50) called attention to the fact that the name *pacifica* was preoccupied by Gray (1832, p. 185), and suggested "that this interesting



form whether variety or good species be named *ostergaardi* after its discoverer." He also said (*loc. cit.*): "I have had the opportunity of comparing a specimen with the varieties of *C. helvola* from the dump at Honolulu, to which it bears a suspicious resemblance, though apparently very distinct, but the bleaching of the specimens from this dredged material plays strange tricks with the *Cypraeas*." Although Dall did not decide the question of whether *hawaiiensis* was in fact a mere form of *helvola*, it has been so considered by all recent writers. It has features that distinguish it from all the other forms. The margins are suffused with a pinkish flesh color varying to a pinkish tan to straw color, unlike the reddish brown of the other Pacific and Indian Ocean forms. The latter color is confined to portions of the aperture, if it is seen at all. The extremities are a bluish rather than a pinkish violet. The base is, like the margins, of a pale flesh color, and the lateral bands are apt to take on the same tinge, being pinkish brown rather than the orange-brown of the other races.

*Cypraea helvola* belongs in the genus *Erosaria* Troschel, 1863, subgenus *Ravitrona* Iredale, 1930.

#### *Cypraea ocellata*

1758, *Systema naturae*, ed. 10, p. 724, no. 319.

1767, *Systema naturae*, ed. 12, p. 1180, no. 362.

LOCALITY: Not given in either edition.

"C. testa submarginata lutea: ocellis nigris."

This species is now placed in the typical subgenus of *Erosaria* Troschel, 1863, along with *C. erosa* (above) and *C. poraria* (below).

Its dorsum is pale brown, covered with a multitude of white spots, simulating to this extent the dorsum of *C. cribraria*. A varying number of these spots are ocellated with deep brown or black dots, although the ocellated spots are usually in the minority. In appearance it much resembles its congener *C. nebrites* Melvill, 1888, the principal characteristics which distinguish it from that species being the ocellations and the absence of the two dark quadrate spots on the sides of the dorsum in *nebrites*.<sup>1</sup>

<sup>1</sup> *Cypraea nebrites* is mentioned above under *C. erosa* as being a possible form of that shell, although the Schilders consider it a good species.

It is confined to the Indian Ocean, being found on the west coast of Java and ranging around the coast line of Asia as far as the Gulf of Aden. It has also been found in Mauritius. It is very constant in its characters throughout its range, the only departure from the typical being the much smaller size of the specimens from Java.

It is difficult to accept the description in the "Systema" as unequivocally defining the species. Several other *Cypraeae* bear dorsal ocellae and have moderately developed margins. The synonymy is almost worthless. The Buonanni figure (1684, fig. 247) is crudely drawn and shows no ocellae, the black dots being independent of the white spots. The figure from Petiver (pl. 9, fig. 7) has the same fault. Neither can be taken for *ocellata* with any degree of confidence. Linnaeus, in his "revised" copy of the "Systema," added a further reference by a manuscript note (Martini, 1769-1777, vol. 1, pl. 31, figs. 333-334) which could not have assisted in the identification. The ventral view is fairly characteristic but the dorsal aspect shows a brick red instead of a light brown color and no ocellations. The identification of the species must again rest on the description in the "Museum Ulricae" which is extremely characteristic of the shell known by all conchologists as *C. ocellata*.

A further distinction between *ocellata* and *nebrites*, or indeed any of the forms or close relatives of *C. erosa*, is seen in the margins. They are less callous and less extended than in those shells and are not ridged by the extensions of the labial teeth, although they are slightly crenulate at both ends. The upper sides of the margins, however, are deeply pitted as in *erosa*, and the whole callus is sown with brown dots, often streaky, which extend over a portion of the white base on each side.

The *Cypraea lota* of Lamarck, 1810, is stated by Kiener (1843-1847, p. 67) to be a synonym of *ocellata* Linné. Kiener said: "We refer to it the specimen in the Lamarck collection which bears the name of *C. lota*. It is a beach-rolled and white specimen of *C. ocellata*. As for the description which Linné supplied for this species, it can be applied as well to Lamarck's shell as to many other *Cypraea* allied to *C. ocellata*." Hidalgo (1906-1907, p.

140) also referred to *lota* Lamarck as a synonym. Lamarck's shell is discussed above (p. 73) in connection with *C. lota* Linné. It was there suggested that *lota* Linné, together with the *lota* of Born, Gmelin, and Lamarck, which appears to be identical, must be left as a *species dubia*, but that Linnaeus' shell was probably a worn and bleached individual of one of the *C. spurca* group.

Other than the suggestion of Kiener and Hidalgo I know of no writer who has referred *ocellata* to *lota*, nor has any other name been given to the present species, although Melvill, 1888, named three so-called "varieties," *pelidna*, *palatha*, and *pretiosa*. It is not *ocellata* Meuschen, 1787, which is *C. spurca* Linné, nor Röding, 1798, which is *C. gaskoini* Reeve, 1846.

It is figured in Kiener (*tom. cit.*, pl. 49, fig. 3), in Reeve (1843-1878, vol. 3, *Cypraea*, pl. 15, sp. 73), and in the "Tableau encyclopédique" (1798, pl. 355, fig. 7)

#### *Cypraea poraria*

1758, *Systema naturae*, ed. 10, p. 724, no. 321.

1767, *Systema naturae*, ed. 12, p. 1180, no. 363.

LOCALITY: Not given in either edition.

"*C. testa marginata subviolacea albo punctata.*"

The description of *C. poraria* in the "Systema" is short but sufficiently characteristic to define the species adequately, as it states the three most important diagnostic features of the shell, which occur in combination in no other species of *Cypraea*. The "Museum Ulricaë" description adds details as to its shape ("ovata"), mentions the pitting of the anterior end of the margins ("versus basin supra crenato"), and the extreme concavity of the fossula ("tantum exculpti"), but the identification may be based on the "Systema" alone, in spite of the absence of any synonymy or locality. There are two races of the species, according to Schilder and Schilder (1938, p. 136). The Pacific form, which they name *scarabaeus* Bory, 1827, is subdeltoidal, with a narrow and straight aperture and a markedly cavernous fossula, and is more deeply tinged with purple. The Indian Ocean form, to which they refer the typical *poraria*, is ovate, with a wider and more sinuous aperture and shallower fossula. Its coloring is less brilliant, and the purple of the base fades to whitish as it nears the aperture. From the "ovata"

of the "Museum Ulricaë" it might be deduced that the shell described in that collection was from the Indian Ocean. A partially marked specimen of *poraria*, from which some of the digits of the number have disappeared, is found in the Linnaean collection. It is subdeltoidal rather than ovate, which would refer it to the Pacific race. The specimen, however, cannot be categorically stated to be the Linnaean type owing to the partial obliteration of its marking, and in any case the difference in the shape of the shell in the two races is not striking and Linnaeus might have used "ovata" for either.

The young shell of *poraria* has a clear purple dorsum with no spots, and the purple of the right margin blends into white, which is continued over the base on that side. The left side of the base is purple. The visible spire is tipped with reddish brown.

In addition to *C. scarabaeus* Bory, which was adopted by the Schilders as the name for the Pacific race, the names *caeca* Röding, 1798, *vibex* Kenyon, 1902, and *insignis* Dautzenberg, 1902, have been used as synonyms or varietal names for *poraria* Linné. Hidalgo (1906-1907, p. 161) said that *C. poraria* Martini (1769-1777, vol. 1, p. 394, pl. 30, figs. 324-325) was not *poraria* Linné but was equal to *C. gangranosa* Dillwyn, 1817. Martini's figures are too crude for definite reference to any one species of the group to which *poraria* Linné belongs, and there is nothing in Martini's diagnosis to tie it to *gangranosa* except for the phrase "Purpura alba gangraenosa," which may have been the basis of Hidalgo's opinion. Kiener (1843-1847, p. 51) says, after his description of *gangranosa*: "This beautiful species is close to the *C. poraria* and the *C. albuginosa*; it is wider and longer than the first; its dorsal side is more convex, the base flatter and whitish instead of being violet, its ocellations are less numerous and ringed with a black circle. Its truncated base and narrower shape also distinguish it from the *C. albuginosa*."

The student is constantly faced in the literature with the warning not to confuse the present species with *C. albuginosa* Gray, 1825. The two species have much in common but are easily distinguishable. In addition to the details noted by Kiener, *albuginosa* has a much more humped dorsum and the aperture

is more dilated anteriorly. It has a flatter base, the color of the dorsum is darker and the dorsal ocellae are larger and more numerous, though more distant, the inner edges of the margins are not pitted as are those of *poraria*, and its base is almost white.

*Cypraea poraria* belongs in the typical subgenus of *Erosaria* Troschel, 1863.

It is figured in Kiener (*tom. cit.*, pl. 49, fig. 2, dorsal and ventral aspects) and in Tryon (1879-1888, vol. 7, pl. 18, figs. 2-3).

#### *Cypraea pediculus*

1758, *Systema naturae*, ed. 10, p. 724, no. 522 (error for 322).

1767, *Systema naturae*, ed. 12, p. 1180, no. 364.

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

"*C. testa marginata transversim sulcata* . . . Haec maculas gerit dorsales 3 fuscas. Indica dorso exarato sulco longitudinali; Europaea eo sulco destituta; Anglica tota absque maculis alba."

The word "marginata" in the main description and the entire subdescription were added in the twelfth edition.

The description shows clearly that this is a composite species. It covers the common *Pusula pediculus* of the western Atlantic and the spotted and unspotted forms of *Trivia arctica* Pulteney, 1799, from the eastern Atlantic and the Mediterranean. It refers to the dorsal sulcus seen in *pediculus*, the shell which Linnaeus designated as "Indica,"<sup>1</sup> which is found in the Antilles, the Caribbean Sea, and the tropical and subtropical coasts of North and South America, and also the absence of the sulcus which distinguishes the eastern *arctica*, which Linnaeus called "Europaea" and which occurs along the coasts of Europe and Africa from the North Cape to the Rio de Oro, in the Cape Verde Islands, the Azores and Madiera, and the Mediterranean. The white, unspotted form of the eastern species is described under the word "Anglica," although its range is nearly that of the spotted shell.

The synonymy refers to 11 figures from seven pre-Linnaean authors. These figures, excluding those that are unrecognizable or involve a demonstrable error, can be tentatively almost equally divided between the

<sup>1</sup> This is one of the instances, already referred to, where Linnaeus used the word "Indica" or a derivative as meaning the West Indies.

two species. In general, however, the figures exhibit such a vagueness of detail and such a contradictory combination of features that it is impossible to allot many of them to a given species with any degree of accuracy. Hanley (1855, p. 197) grouped them as follows: for *C. pediculus*, which he cites as *pediculus* Lamarck, Argenville (pl. 21, fig. L), Lister (1685-1692, pl. 706, fig. 56, as correlated to the 1770 edition), and Gualtieri (pl. 15, fig. P); for *arctica*, Gualtieri (pl. 15, fig. R), Lister (1678, pl. 3, fig. 17), Ginanni (vol. 2, pl. 13, fig. 109), and Barrelier (pl. 1326, fig. 28). He also included in the second list the figure from Adanson (pl. 5, fig. 3), of which he said that it "looks so like the latter [*arctica*], that one would naturally refer it there, but it was probably designed for *Napolina*, a very closely allied Senegal shell, which of late has been separated from it."<sup>2</sup> Hanley's lists are incomplete, as he confessed himself unable to identify the rest of the figures and did not include any applicable to the white form of *arctica*. A critical examination of the whole synonymy, however, makes one reluctant to accept even the partial list with any assurance.

The description in the "Museum Ulricaë" also includes two species. The description of the dorsal groove here reads "sutura longitudinali saepe exarata," which again covers both the American and European species and reflects Linnaeus' opinion, as he conceived of the two as conspecific. The color is said to be "incarnata s. albida," which fits both species, and in all other respects the description very clearly unites the two shells.

*Cypraea arctica* Pulteney (1799, p. 39) is the earliest name for the eastern Atlantic shell. The description is unmistakably that of the European species. He supplied no figure in the original edition, but in a later edition by Rackett (1813)<sup>3</sup> a series of plates were supplied, most of which were lifted bodily

<sup>2</sup> *Cypraea napolina* Duclos, 1845, differs from the spotted form of *arctica* by its smaller number of dorsal ribs, which are more sinuous, and by its color, which is gray to yellowish. It has been given specific rank by most modern authors including Hidalgo (1906-1907, p. 438). Kiener's figures (1843-1847, pl. 53, fig. 5), however, resemble *arctica* very closely. I have not seen a specimen of *C. napolina*.

<sup>3</sup> *Fide* "Catalogue of the library of the British Museum."

from da Costa's 1778 work. The writer has not been able to examine these figures, as Rackett's edition is not available.

Montagu (1803, 1808) redescribed *C. pediculus* Linné (vol. 1, p. 200) and *C. arctica* Pulteney (p. 201) and also described two new forms as *C. bullata* and *diaphana* (pp. 202 and 225, respectively). In the supplement to Montagu's second volume (1808) he chose a new name for Pulteney's spotted *arctica*, calling it *C. europaea*, and retained the name *arctica* for the unspotted form. He said (1803, 1808, vol. 2, suppl., p. 88): "In the former part of this work we had expressed a doubt whether the shell commonly known under the denomination of *Cypraea pediculus*, in the cabinets of the collectors of *British Testacea*, was the true *pediculus*, since it differs so essentially in several particulars, especially that of being destitute of the dorsal sulcus. . . . The *Cypraea europaea* with spots, and that without spots, termed *arctica*, may be considered as perfectly formed varieties; the smooth kind, originally entitled *bullata*, is the same species in the adult state; and *Bulla diaphana* the first and most imperfectly formed shell."

I have quoted Montagu's remarks, as they seem to be the first correct revision and restriction of Linnaeus' *pediculus*. In the 1808 volume he dropped the name *pediculus* as applied to the European shell, although he unnecessarily erected a new name for a mere form of that shell. His *C. europea* was, however, used for both its spotted and unspotted forms for almost a century, except for the use by the continental writers of the Lamarckian name *coccinella*, as appears below.

Although Montagu correctly separated the two species from the two sides of the Atlantic and expunged the name *pediculus* from the eastern fauna, his views were apparently lost sight of by some of the later writers, because the original error unfortunately persisted.

It will be useful to refer to the interpretations of the most important of Montagu's predecessors and successors:

Martini (1769-1777, vol. 1, p. 379, pl. 29, fig. 309) listed a *C. pediculus* which he referred to the *pediculus* of the "Systema," but his figure shows a shell with no dorsal groove and no spots. While it is a bad figure it cer-

tainly represents the unspotted form of *arctica* Pulteney. He also listed a "*Porcellana minor*" (*tom. cit.*, p. 381, pl. 29, figs. 310-311) which, as appears from his unmistakable figures, was the American *pediculus*. Both of Martini's shells were located in both the western and eastern Atlantic, the first in Jamaica and the Orkney Islands, and the second in Barbados and on the French coast. For the second he cited two of Linnaeus' references (Lister, pl. 706, fig. 56, correlated to the 1770 edition; and Gualtieri, pl. 15, fig. P), both of which were probably based on the American species. At the end of his synonymy of "*Porcellana minor*" he referred to Linnaeus as follows: "Lin. loc. alleg." As he had not mentioned Linnaeus for this species, the meaning of the abbreviated phrase is not clear. As "allego" means "to choose," he may have wished to say: "This species was described by Linnaeus, but just where I leave to the reader to choose."

Gmelin (1791, p. 3418) copied Linnaeus' main description with the unfortunate omission of the word "marginata," expanded the locality to "Oceano Europae septentrionali, americano, indico, mari mediterraneo," and substituted for Linnaeus' subdescription a lengthy passage covering all color combinations and the presence or absence of the spots and the dorsal groove, with a completeness which further emphasized the mixture of species, but without giving them geographical names as did Linnaeus. His synonymy is equally inclusive. He also listed, but did not describe, a variety "β" for which he cited a further trio of Martini figures (*tom. cit.*, pl. 29, figs. 306-308). These figures somewhat resemble *Trivia solandri* Gray, in Sowerby, 1832, a heavily ribbed, unspotted form with a pronounced dorsal groove. It is probable that they were, however, based on the American *pediculus*, as the locality of *solandri*, the west coast of Mexico and California, was little known to conchologists in Martini's day. They are badly drawn, and it is difficult to determine whether the apparent groove in the dorsum may not have been intended to represent the aperture.

Dillwyn (1817, vol. 1, p. 466) described *Cypraea sulcata*, a new name for "*C. pediculus* Linné, 1767," which he placed in its synonymy. His description covers the American

*pediculus* as it mentions the combination of dorsal groove and dark spots. His variety "B" is described as "white, ventricose, rounded at the base and margins." He refers this to *C. oryza* Lamarck, 1810, which is an Indo-Pacific species, far removed from *pediculus* in range and distinguishable by its color, shape, and the character of its ribs. He also referred, for his "variety," to the figures from Rumphius (pl. 39, fig. P) and Gualtieri (pl. 14, fig. P), which had been cited by Linnaeus for *pediculus* but which do not show the American shell, because, while they show the dorsal groove, they appear to be unspotted. They might well represent *oryza*. Hanley (1855, p. 197) has this to say as to Dillwyn's *sulcata*: "Had not the *C. sulcata* of Dillwyn included several other distinct species (*carnea*, *pulex*, *oryza*) one might have preferred bestowing that appellation upon the former variety [the American shell], since, assuredly, two most essentially different *Cowries* have been irremediably confused by Linnaeus. Since, however, that form ('Indica') takes precedence of the rest in the specification of both varieties and localities, it is perhaps expedient to follow Reeve in ascribing the name *pediculus* to it, rather than fabricate a new appellation for that abundant shell." This comment is quoted not only to show the care with which the student must read, or rather interpret, the often vague and indefinite language of Hanley, but to illustrate the fact that the conchologist of his day believed that a reviser should follow some fixed rule in the restriction of a composite species, or at least give reasons for the choice of one of its components.

Lamarck separated the two species, although we cannot be certain that he realized that he was doing so. He defined the American *pediculus* (1810, vol. 16, p. 103) in unmistakable terms, both in his Latin and French descriptions, although he did not refer it to *pediculus* Linné, and cited an excellent choice of figures, including the two good Martini figures mentioned above (figs. 310-311). He located the species both in American and European waters and the Mediterranean, thus nullifying the idea that he was restricting the composite species. On the following page he described *Cypraea coccinella* in terms that clearly point to the European *artica* and

pointed out the features distinguishing it from *pediculus*. As said above, *coccinella* displaced both *artica* and *europaea* in the works of the continental workers for many years, and Lamarck did not even put them in his synonymy of *coccinella*. The most puzzling feature of Lamarck's diagnosis is the fact that he professed himself to be ignorant of the locality of his species, as he left a blank after "Habite. . . ." It is indeed strange that he could have described such a common European species and referred to specimens in his own collection without knowing its locality. His synonymies are repeated word for word in 1822 (pp. 403 and 404), with some additions in the case of *pediculus*, and his 1822 treatment of *coccinella* again makes no mention of the earlier names of the species. The locality is again left blank, and the locality of *pediculus* is altered to "Ocean of the Antilles etc.," which is equivocal. Thus, although he accurately described two distinct species, he certainly did nothing to restrict Linnaeus' *pediculus* to either.

The editors of the second edition of Lamarck's work, Deshayes and Milne-Edwards (1835-1845, vol. 10, p. 544), copy the original description and synonymy of *coccinella*, adding numerous references of their own, and also omit the locality. They added to *pediculus*, however, the following footnote (*tom. cit.*, p. 541), which deserves to be quoted: "The figures which Linné cited in his synonymy are not all equally good. Nevertheless we recognize two species under the common name, that of Rumphius, which is the *Oryza* of Lamarck, and the species of Adanson which Lamarck referred to *Oryza* but which seems to us to be quite distinct from the other two. Born repeated the synonymic confusion of Linné, as did Schröter, Gmelin and even Dillwyn, although the latter took pains to add to the synonymy such varieties as constituted distinct species. Lamarck restricted the synonymy within too narrow limits. His whole synonymy covers but a single species; but should this species retain the Linnaean name? In order to reply to this question we must study the species in the 'Museum Ulricae' where it is briefly described. As this description can be applied to many species, the synonymy itself comprising all the sulcate species known in Linné's day, our reply may

be expected to be based on the principle which we have followed, and it is our view that this species is among those which it is necessary to abandon. We also think that Dillwyn's example should be followed, and another name should be chosen, since that of *sulcata* proposed by the English author would be a homonym of the *sulcata* of Gmelin, which is another species. Many conchologists confuse with *Cypraea pediculus* a species from European waters which resembles it, but which is quite distinct, the *Cypraea europea* of Montagu, *Cypraea coccinella* Lamarck."

The last sentence of the above quotation, standing alone, is entirely correct, and thus, based solely on this sentence, these authors might be said to have properly broken down Linnaeus' composite species. The rest of their remarks, however, particularly when read in connection with a further quotation below, is not only contradictory but is in part erroneous and certainly confusing. Why should it be necessary to abandon the name *pediculus*, which is validly proposed, at least in part, in Linnaeus' description? Further, Dillwyn's *sulcata* is not a homonym, as Gmelin, contrary to these authors' statement, never described a *Cypraea sulcata*. To increase the confusion, Deshayes and Milne-Edwards in the same footnote discuss the fossil "*Cypraea pediculus*" of Lamarck, which is found in several French horizons, and on pages 578 and 579 they change the name of this fossil species to *C. pedicularis*, and say: "Lamarck confused this rare and curious species with the *Cypraea pediculus* which is a common shell living in European waters" (italics mine). Thus as late as 1844, they believed that the American *pediculus* lived side by side with the European *artica*, and this error throws considerable doubt on their previous apparent restriction of the Linnaean species.

Almost contemporaneously with the publication of Deshayes and Milne-Edwards' tenth volume Kiener (1843-1847, pp. 132, 139) published excellent descriptions of both *pediculus* and *coccinella* but committed the persistent error of his time in locating *pediculus* not only in the Antilles but in the "Seas of Europe." His figures for *pediculus* (tom. cit., pl. 40, fig. 2) and for *coccinella* Lamarck (pl. 52, figs. 2, 2a), both showing dorsal and ventral aspects, can hardly be improved upon.

Tryon (1879-1887, vol. 7, p. 201) correctly evaluated the two species. He gave no European or African localities for *pediculus*.

Hidalgo (1906-1907, p. 215), in his comments on the distribution of *pediculus*, cited the erroneous reports of an eastern Atlantic *pediculus* and said: "Various authors have mentioned the European Ocean and the Mediterranean, and these citations are inexact, because they either refer to shells fortuitously brought in or are cases where individuals of *C. arctica* have been classified under this name." This is the first instance of an author's specifically dismissing the possibility of a European locality for *pediculus*. Hidalgo is less categorical in his views of the frequently cited African localities. He lists reports of *pediculus* from the Azores and several west African points, and says: "This species is evidently American and doubtless has been propagated in the Azores and on the coast of Africa." The meaning of this statement is not clear.

The American *pediculus* is now placed in the genus *Pusula* Jousseaume, 1884, and subgenus *Niveria* Jousseaume, 1884. The eastern Atlantic *artica* is in *Trivia* Broderip, 1837,<sup>1</sup> and is the type of the genus, by subsequent designation, Gray, 1847, as *Cypraea europaea* Montagu.

Synonyms of *C. pediculus* in its various forms include: *C. sulcata* Dillwyn, 1817; *labiosa* Gaskoin, 1835; and *cimex* Owen, 1870. It is not *Trivia pediculus* Tuomey and Holmes, 1857, which is *Trivia suffusa* Gray, in Sowerby, 1832.

*Cypraea arctica* Pulteney, 1799, is identical with *C. umbilicalis* da Costa, 1829 (juvenile), *norvegica* Sars, 1835, *candida* MacGill, 1843, and *jousseaumei* Locard, 1886, as well as with *europaea* Montagu, 1808, and *coccinella* Lamarck, 1810, already mentioned, and is the *C. pediculus* of many authors, not Linné.

<sup>1</sup> The genus *Trivia* has been traditionally cited as of Gray, 1832, as having been first described in Gray's "Descriptive catalogue of shells." Based on the researches of Shaw (1909, p. 288) and Iredale (1916, pp. 34-35), which disclosed that Gray's catalogue, usually cited as having been published in 1832, was never published but existed only in proof, I am tentatively accepting the view of Iredale that Broderip, the next writer who used the name (1837, Penny Cyclopaedia, vol. 8, p. 256), must be accepted as the author of the genus. This view is adopted by F. A. Schilder (1925, pp. 62-63).

In addition to the figures cited above, *pediculus* is figured in the "Tableau encyclopédique" (1798, pl. 356, fig. 1a) and by Reeve (1843-1878, vol. 3, *Cypraea*, pl. 23, sp. 131). *C. arctica* is figured in the "Tableau encyclopédique" (pl. 356, fig. 1b). The two Bruguière figures in the "Tableau" are shown side by side. They are excellent figures and clearly illustrate the striking difference between the two species. Linnaeus admitted this difference in his description of *pediculus*, a description that was based on specimens of both shells in his collection, and it is surprising not only that he could have united the two shells, but that so many of his followers failed to separate them and allot them to their respective ranges.

#### *Cypraea nucleus*

1758, *Systema naturae*, ed. 10, p. 724, no. 323.

1767, *Systema naturae*, ed. 12, p. 1181, no. 365.

LOCALITY: "In O. Indiae orientalis" (1758, 1767).

"C. testa utrinque marginata subrostrata rugosa: supra punctata tuberculis."

The description of this species in the "Systema" is so clear and characteristic that it is hardly necessary to refer to the ampler language of the "Museum Ulricae" where additional details covering the dorsal sulcus, the extremities, and the apertural teeth are given. A correct, if restricted, locality is supplied.

The synonymy is only partly correct. The Rumphius figure (pl. 39, fig. I), as reported in the tenth edition and the "Museum Ulricae," is, though crude, intended to represent *nucleus*, and Linnaeus gave the Rumphius name for it, "Nux avellana granulata," after his citation of the figure. Plate 36 of Rumphius, as the reference stands in the twelfth edition, is either a misprint or an error of transcription. The Lister figure (pl. 610, fig. 61, as correlated to the 1770 edition of Lister by Linnaeus in his "revised twelfth edition") was said by Hanley (1855, p. 197) to represent *C. madagascariensis*, "an allied shell, which suits not the 'subrostrata' of the description." Two comments may be made as to this reference: First, the original reference in the "Systema" to the 1685-1692 edition of Lister reads "4. s. 9. c. 8. t. 2. f. 3." The plate 2 referred to shows *Cypraea annulus* Linné, so that Linnaeus committed an error in his citation in the

"Systema." Second, Hanley did not state whether he meant *C. madagascariensis* Gmelin, 1791, which is a synonym of *nucleus* Linné, or *madagascariensis* Sowerby, 1823, which is the same shell as *C. granulata* Pease, 1862, a distinct but closely related species endemic in the Hawaiian Islands.<sup>1</sup> The Lister figure referred to in the "revised" edition of the "Systema" is not sufficiently clear to settle the point, as the two shells of the same name have so many features in common that an accurate figure would be required to distinguish them. The reference to Seba (vol. 3, pl. 55, fig. 22) is not helpful. The group of 16 shells over the number 22 shows several *Cypraea*, none of which can be positively identified as *nucleus*. Of the remainder of the figures, Gualtieri (pl. 14, fig. S), Argenville (pl. 21, fig. V), and Petiver's "Amboina" (pl. 16, fig. 11) all show *nucleus* with more or less accuracy. The figure from Petiver's "Gazophylacium" (pl. 97, fig. 12), however, seems to be clearly *C. asellus* Linné and was probably an error of transcription for the adjoining figure 11, which could be taken for *nucleus*.

The specimen of the *C. nucleus* of authors now present in the Linnaean collection had been originally marked by someone, but the marking is partially obliterated so that only "32" remains. Hanley supplied the missing digit by the process of exclusion referred to in the Foreword to Part 1 (Dodge, 1952), the number 323 being the number of *nucleus* in the tenth edition, and the specimen being the only shell in the collection that conformed to its description.

The accuracy of the description and the discovery of the ostensible type have given to the species an uncomplicated nomenclatorial history, only three synonyms being

<sup>1</sup> Lamarck (1822, p. 400) did not cite *madagascariensis* Gmelin either as a good species or as a synonym of *nucleus*. Deshayes and Milne-Edwards (1835-1845, vol. 10, p. 565), however, make *madagascariensis* Gmelin a good species, but unfortunately confuse it with *madagascariensis* Sowerby, as they cite in the synonymy the figures of the latter species from both James Sowerby's "Genera of shells" (1820, 1825, 1834, pl. 62, fig. 6) and G. B. Sowerby's "The conchological illustrations" ([1832-] 1841, pl. 113, fig. 116). It is probable that much of the confusion as to this name and the two different species to which it was given stemmed from this synonymy.

noted: *C. variolosa* Röding, 1798, *C. gemmosa* Perry, 1811, and *C. cerea* Paetel, 1887. Only two other species could be confused with it. The first is *C. granulata* Pease, 1862. This was described as *C. madagascariensis* by Sowerby in 1823 and as *C. honoluluensis* by Melvill in 1888. It is distinguished from *nucleus* by its much larger size, the bluntness of its extremities, and the more sparse and distant dorsal tubercles. Its margins are less developed than those of *nucleus*, it is more dilated laterally and has a more depressed dorsum, and fresh specimens show a pink tinge caused by fine red-brown lines bordering the ribs both above and below. The most distinctive diagnostic character, however, lies in the nature and disposition of the ribs. These are stronger, more distant, and less numerous than in *nucleus* and usually show six to eight narrower ribs intercalated on the left side of the base and margin. These subordinate ribs not only cross the entire base but even traverse the columellar sulcus and, in connection with the major ribs, extend past the margin and become the dorsal ridges on which the tubercles are strung. *C. nucleus* also possesses these intercalated ribs, but they are much less numerous and never reach the aperture, with the occasional exception of a single rib. *C. granulata* is endemic in the Hawaiian Islands, where *C. nucleus* is not found. The second species that has been confused with *nucleus* is *C. limacina* Lamarck, 1810. This shell, in most regions where it is found, shows dorsal tubercles similar to those of *nucleus*, but they are markedly less elevated and not connected by wavy ridges. The basal ridges, unlike the ridges of *nucleus* and *granulata*, all terminate before they reach the margin.

Schilder and Schilder (1938, pp. 130-131) divided *nucleus* into four subspecies. They applied the name *nucleus nucleus* to the western Pacific form; the east African race was given the name *nucleus madagascariensis* Gmelin, 1791; that from the central Pacific was *nucleus sturanyi*. They noted, however, that *madagascariensis* and *sturanyi* need further study, so that their nomenclature is, to this extent, tentative. The racial distinctions noted by these authors are not entirely borne out by examination of reliably documented specimens from these regions, and the granting of subspecific validity to the races

would seem to be questionable.

*Cypraea nucleus* is placed in the genus *Staphylaea* Jousseaume, 1884, subgenus *Nuclearia* Jousseaume, 1884, and is the subgenotype, by original designation.

It is figured in Reeve (1843-1878, vol. 3, *Cypraea*, pl. 15, sp. 70), a figure that shows the "typical" race, and conforms to the specimen in the Linnaean collection, and in Kienner (1843-1847, pl. 2, figs. 3, 4).

#### *Cypraea staphylaea*

1758, *Systema naturae*, ed. 10, p. 725, no. 324.

1767, *Systema naturae*, ed. 12, p. 1181, no. 366.

LOCALITY: Not given in either edition.

"*C. testa subrostrata, punctis elevatis sine striis, extremitatibus luteis.*"

While the description of *C. staphylaea* in the "Systema" is characteristic of many forms of the species and indeed is so generalized that it can be read to cover all forms and while it is amplified and confirmed by the description in the "Museum Ulricae," the great variation it displays and its similarity to two other allied shells have resulted in some confusion in the identification and proper placement of all the members of this complex. It should be noted that while the description properly distinguishes it from *nucleus* by the phrases "sine striis" and "extremitatibus luteis," it gives no hint as to the features that separate it from some of its congeners or distinguish its own varieties. No locality is given and, after leaving it without a synonymy in the tenth edition, Linnaeus was able to muster only a single figure in the twelfth, a very crude drawing from Argenville (pl. 21, fig. S) which might even be taken for either *C. cicercula* or *C. globulus*, discussed below. In the "revised twelfth edition" "List. Conch. 708," "Mart. Syst. t. 29. f. 313-314," and "Pet. Gaz. 97, f. 15" were supplied. The Martini figures are reasonably accurate, as they show the orange-brown extremities of *staphylaea*, but it is not possible to determine whether the ornamentation consists of white spots or raised granules, a distinction not mentioned by Martini. The authority of the figures is somewhat weakened by the fact that his figure for *nucleus* (*tom. cit.*, pl. 29, fig. 312) is equally deficient in this respect. The Lister figure is recognizable. The figure from Petiver is most uncharacteristic.



A specimen of the *staphylaea* of authors is present in the collection, which, although unmarked, uniquely agrees with the description and shows granules.

In many collections lots labeled *staphylaea* often have smooth dorsums and at times display white dots or larger white spots in place of the granules described by Linnaeus as "punctis elevatis," evidencing a widespread and persistent theory that the species was variable in this respect. It arose from the fact that *staphylaea* had been confused with *C. limacina* Lamarck, 1810. The latter species is even more variable than *staphylaea*. While the typical *limacina* of the Pacific Ocean and Australia always shows dorsal tubercles, which are often white, in the *limacina* of the Indian Ocean from South Africa to Ceylon the tubercles are replaced by white dots. The latter form is the *C. interstincta* Wood, 1828, which has been often improperly associated with *staphylaea* rather than with *limacina*. *C. limacina* varies also in the length of its apertural teeth. *C. staphylaea*, though it varies in many of its features, has one constant character in that it is always granulose, although the granules may be large and numerous or small and distant. One form, called *laevigata* by Dautzenberg (1932), from the east African coast around the Indian Ocean to Ceylon (thus paralleling the range of the western form of *limacina* noted above) may serve as some excuse for the confounding of the two species, as its granulations are much less developed than in all other forms of *staphylaea* and in some individuals are obsolete.

This confusion persisted for many years. Sowerby (1847-1887, vol. 4, p. 40, pl. 316, figs. 223-229; pl. 328, fig. 518) described and figured several forms of both *limacina* and *staphylaea* under the latter name, and said: "No species is so widely variable as this. In f. 228, 229 it is a rounded, beaked shell, granulated all over at the back, and with the dental ridges completely crossing the base. In f. 223, 224 and 227, the *interstincta* of Wood, and the *limacina* of Lamarck, the middle teeth of the columellar lip stop suddenly before reaching halfway over. The pale, thin, sharp variety is from the Sandwich Islands. All these varieties, differing extremely in some specimens, yet pass imperceptibly into each other, so that it is impossible to separate

them." Sowerby properly united *interstincta* with *limacina* but erred in associating either with *staphylaea* Linné. His shell from the "Sandwich Islands" is doubtful. The only member of this group, *Staphylaea* (*Staphylaea*), from the Hawaiian Islands is *S. (S.) semiplota* Mighels, 1845, a very common shell in the main islands, and that species cannot be said to be "pale," the color of its dorsum ranging from a chocolate to a blackish brown (reddish brown in worn specimens), with numerous small white dots. One form of *semiplota*, which was called *polita* by Roberts, 1869, is lighter in color and somewhat pellucid, and this form might suggest Sowerby's "thin" shell. What he meant by "sharp" is unexplained.

Briefly, *limacina* is distinguished from *staphylaea* by its larger size, its more distant dorsal tubercles or spots, and its markedly shorter apertural teeth. Its base is white, blending into orange around the aperture, whereas in *staphylaea* the entire base appears to be fulvous on account of the brown lines bordering the teeth. In *staphylaea* the tubercles are closer and more numerous and the teeth extend across the entire base to the margin of the shell.

Reeve (1843-1878, vol. 3, *Cypraea*, pl. 16, sp. 82a, b) made the same error. He supplied two figures for *staphylaea*, the first of which he called *staphylaea* "var.  $\beta$ ," referred it to *interstincta* Wood, and said that it has white spots instead of nodules, thus confounding a form of *limacina* with the present species. His figure 82b was apparently considered by him to show the typical *staphylaea* and is thus properly reproduced as it not only shows the granulated surface of that species, but agrees in other respects. Reeve also cited a "varietas *intermedia*," a name I cannot identify (if indeed he intended to refer to a form previously so named), which he referred to *limacina* but did not figure. His comments are quoted in full: "This I consider, without exception, the most variable species of the genus, so much so that I can only particularize the two extremes through which all variations range. The typical variety (Fig. b) is small and granulous, the opposite variety (Fig. a) is smooth, the grains being replaced by spots, and larger, confirming with peculiar accuracy an observation in my Monograph of the Cones to the

effect that all those varieties of shells in which the surface is raised in granules are proportionately diminutive in size. One of the most constant character[s] throughout the varieties of this species is the yellowish-brown colouring of the teeth and extremities, indeed it is hard to distinguish some of the white varieties from the *C. nucleus* except by this peculiarity." Note that it is only in *staphylaea* that the "yellowish-brown colouring of the teeth" is present. Also I suggest that his theory of the relation of size to the presence of raised granules cannot be supported.

Kiener (1843-1847, pl. 36, figs. 2, 2a) properly figures *staphylaea*, although on another plate (pl. 22, fig. 2) he shows *interstincta* Wood under the name of a variety of that shell. He separately figures *limacina* and two of its forms (pl. 35, figs. 1, 1a, 1b). One of these latter figures (fig. 1b) is also clearly *interstincta*, and is therefore properly, though unwittingly, placed.

Even as late as Tryon's "Manual" (1879-1888, vol. 7, p. 196) the same confusion is apparent. In commenting on *staphylaea* Tryon said that *interstincta* (pl. 20, figs. 42-44) "is a whitish or brownish variety with larger and less numerous pustules, which are sometimes partially obsolete, the teeth are coarser, darker in color, and do not always extend entirely across the base."

Hidalgo (1906-1907) distinguishes *staphylaea* (p. 518) from *limacina* (p. 398) and in his work Wood's *interstincta* is finally placed as a form of the latter species. His treatment of this complex represents the modern conception of the group,<sup>1</sup> except for the fact that he

<sup>1</sup> This view of the separate identity of *staphylaea* and *limacina* is not, however, universally accepted. Shaw (1909, pp. 303-304) did not agree with Hidalgo that *limacina* was a good species. He said: "*C. limacina* is considered by Hidalgo (pp. 400, 519) as a good species and distinct from *C. staphylaea*. I do not, however, agree with this opinion, but consider Lamarck's species merely a large and smooth variety of *C. staphylaea*, in which the teeth do not extend more than half-way over the base, while the granulation on the dorsal surface is replaced in some cases by large white spots, which are sometimes slightly raised, or by a few scattered and distant nodules, whilst in others the dorsal surface is of a smooth, shining brown, entirely destitute of granulations, with a few white spots on the margins. With a series of specimens it is possible to link up the two extremes, thus clearly proving that *C. limacina* is only a variety." He also comments on *C. interstincta* Wood (p. 304): "With re-

considered *semiplota* Mighels as a small variety of *limacina*. It is given specific rank today.

*Cypraea staphylaea* is identical with *C. consobrina* Garrett, 1879, *laevigata* Dautzenberg, 1932, and *descripta* Iredale, 1935, all of which Schilder and Schilder use as race names for forms of the species and consider them subspecies.

*Cypraea limacina* includes the forms *minuta* Gmelin, 1791; *jenningsia* Perry, 1811; *interstincta* Wood, 1828; *nucleus* Quoy and Gaimard, 1834, not Linné; and (*vide* Schilder and Schilder, 1938) *farCIFer* Iredale, 1935. *Cypraea interstincta* and *farCIFer* are used by Schilder and Schilder as race names or subspecies.

The name *granulata* Humphrey, not Pease, 1862, is (*vide* Gray, 1828b, p. 86) a synonym of *staphylaea* Linné.<sup>2</sup>

*Cypraea staphylaea* Linné is the type of the genus *Staphylaea* Jousseume, 1884, by absolute tautonymy.

#### *Cypraea cicercula*

1758, Systema naturae, ed. 10, p. 725, no. 325.

1767, Systema naturae, ed. 12, p. 1181, no. 367.

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

"C. testa utrinque rostrata, adpersa punctis elevatis."

#### *Cypraea globulus*

1758, Systema naturae, ed. 10, p. 725, no. 326.

1767, Systema naturae, ed. 12, p. 1181, no. 368.

LOCALITY: "In Asia" (1758, 1767).

"C. testa utrinque rostrata laevi."

These two species are considered together, because they have been confounded by many

respect to the *C. interstincta* Wood, which Melvill considers as a variety and distinct from *limacina* (both of which he regards as varieties of *staphylaea*), after examining Wood's figure, which is unaccompanied by a description, I have been unable to see where it differs from *limacina*, and maintain that it is simply another name for the same shell."

Shaw was quite correct in his conception of the position of *interstincta*, but the radical differences in size, shape, and ornamentation between the "typical" or extreme forms of *staphylaea* and *limacina* seem too great to permit uniting them under one species, as I have not been able to detect the perfect intergrading of the two, upon which Shaw insists, even after the examination of a very considerable series of specimens of both from widely separated localities.

<sup>2</sup> The name *granulata* was listed in the "Museum Calonnianum," a catalogue published by Humphrey in 1797, which, under the terms of Opinion 51, is not to be used as a basis for any nomenclatorial work.

conchologists and are still wrongly labeled in some collections. The descriptions are very unsatisfactory. They tell us merely that the two species are rostrate, and distinguish the two by the presence or absence of granulations. The latter is not an obvious character and is also extremely fugitive, and even in fresh specimens it is often necessary to test the shell with the finger before the presence of granulations can be established. The gross and noticeable features of the shells, their usually golden color, their extreme gibbosity, and their lightness of structure are not mentioned. It would have been difficult to identify either from the descriptions alone.

The principal differences between the two species may be summarized as follows:

*Cypraea cicercula*

1. Exhibits a centrally placed, short brown groove at the posterior end of the dorsum, immediately behind the outlet and at the anterior end of a somewhat callous ridge. This is often reduced to a mere brown dot in a depression.
2. Color yellowish white, punctate with brown, occasionally white.
3. No dorsal or basal blotches.
4. Dorsum more "humped" than in *globulus*, i.e., the gibbosity is less symmetrical.
5. Extremities more rostrate than in *globulus*.
6. Faintly granulose on sides and anterior extremity. The words "adpersa punctis elevatis" in the description are much too strong, as in the great majority of cases the granulations are almost obsolete, and in the eastern race of the species (Melanesia, Guam, and the Hawaiian Islands) are completely lacking.
7. A dorsal sulcus is visible, but is often seen only near the extremities.<sup>1</sup>

*Cypraea globulus*

1. Lacks the brown groove or depressed brown spot at the posterior extremity, and the callous ridge of *cicercula* is here usually compressed into a noticeable, wart-like callus.
2. Color ochraceous or golden, sometimes whitish, usually more heavily punctate with brown than *cicercula*.
3. Base often four-spotted.

<sup>1</sup> Schilder and Schilder (1938, p. 126) say that in the most eastern race, which they have named *C. cicercula margarita* Dillwyn, 1817, the dorsal sulcus is lacking. In all specimens of this race collected by the writer in the Hawaiian Islands the sulcus is faintly but unmistakably visible near both extremities.

4. Dorsum more symmetrically globular than in *cicercula*.
5. Extremities less attenuate and less rostrate than in *cicercula*.
6. Granulations lacking in all races.
7. Dorsal sulcus and dorsal blotches lacking.

Thus, in so far as the "Systema" description is concerned, the words "adpersa punctis elevatis" must be held to mean the granulated shell described above, even though the granulations are confined to a small area of the shell and are often obsolescent or wanting. The word "laevi" in the description can mean only the smooth shell described above, in which the absence of granulations is a constant feature. As to the eastern race of *cicercula*, which is common as a beach shell in Hawaii, where *globulus* is not found, the Schilders suggest that it "could be regarded as a separate species for geographical reasons" (although its range overlaps that of the typical *cicercula*) because of the "total absence of dorsal granules and of any sulcus." I am sympathetic to the suggestion that it be given specific rank with the re-adoption of the name *margarita* Dillwyn, 1817, in spite of the fact that the Schilders appear to have been in error as to the "total absence" of the sulcus. Jousseau, 1884, treated it as a good species under the name *C. tricornis*.

*Cypraea cicercula* was not described in the "Museum Ulricae," but the description of *globulus* in that work confirms many of the above distinctions. It uses the terms "glabra," "alba s. flavescens," and "subrostrata." The rest of the description can be criticized for a lack of accuracy, but it must be remembered that seeming inconsistencies and the use of inclusive statements may be attributed to the fact that Linnaeus was describing specimens and not species, and therefore his wording takes little account of specific variability.

*Cypraea bistrinotata* Schilder and Schilder, 1937, which was separated from this group by those authors, is, generally speaking, a darker shell than either *cicercula* or *globulus*. It is consistently granulose laterally, and usually dorsally as well, making it the most granulose of the three species. It is almost as rostrate as *cicercula*. Its dorsal sulcus is prominent, at least near the extremities, and bounded by three pairs of parallel brown streaks,

the central pair being often wanting. Although this species is easily distinguishable because of the dorsal ornamentation, it was almost always called *cicercula* before its separate identity was established.

Specimens of both *cicercula* and *globulus* are in the Linnaean collection but are not identified in any way. Hanley (1855, pp. 198–199) referred to these specimens by saying, of each, that “alone of the contents of the collection it agrees with the description.” This gives us no help in solving the problem of which shell Linnaeus meant by either description. The question must be resolved by a reading of the description alone. The synonymy of both species is very poor, as might be expected in a group in which slight and almost imperceptible variations have specific value. For *cicercula* Linnaeus cited only two figures. The Gualtieri figure (pl. 14, fig. T) has more the appearance of *staphylaea* than *cicercula*. The reference to Rumphius (pl. 39, fig. 9) shows a species of the genus *Oliva*. It is probable that the “9” was a transcription for figure “K,” which may have been intended for *cicercula* and has been frequently cited for it. For *globulus* he cited several figures, none of which are sufficiently characteristic to be useful.

The locality of *cicercula* is incorrect. It is an Indo-Pacific species, as is *globulus*.

A few of the most important of the references to these two species are here inserted for their historical importance:

Martini (1769–1777, vol. 1, p. 338, pl. 24, fig. 242) referred his *globulus* to the *globulus* of the “Systema” and (*tom. cit.*, p. 339, pl. 24, figs. 243–244) also listed *cicercula* as a Linnaean species. As with all of the early figures of these species, his figures are too crude to be instructive. *C. globulus* is shown as a pure white shell with no suggestion of ornamentation and with distorted extremities, and *cicercula* as a faintly yellow shell covered with small circles which may have been intended to represent granulations. As already suggested, the reproduction of the difference between spots and tubercles or granulations was seemingly beyond the powers of the artists used by the early iconographers. The amount of rostration in the several figures is not discernibly different. Martini cited some of Linnaeus’ references for *globulus*, but none for

*cicercula*, and the great diversification in the synonymies shows that he had not understood either species.

Gmelin described both *cicercula* and *globulus* (1791, p. 3419) by merely copying Linnaeus’ descriptions and synonymies and adding several references of his own. He also listed a *Cypraea affinis* (p. 3420) which he described as “oblonga subrostrata laevi flava: anterius utrinque ocellata” and “c. globulo affinis, aut magis oblonga.” This may have been based on an unusually long and laterally compressed specimen of *globulus*, a species which is quite constant in shape in all individuals seen by this writer. The word “ocellata” may refer to the brown dots which are often seen at one or both extremities of *globulus* but can hardly be referred to as ocellations. I have not seen any form of that species which would justify the apparent variation suggested by Gmelin’s two descriptions, although the Schilders (*loc. cit.*) list *affinis* as an exact synonym of the typical race of *globulus*.

Chemnitz (1780–1795, vol. 10, p. 104, pl. 145, figs. 1339–1340) describes *globulus* as of Linnaeus, and his figures show all the necessary diagnostic characters of the species, the evenly rounded gibbosity of the dorsum, which contrasts with the asymmetrical, posteriorly placed “hump” of *cicercula*, the smooth surface, punctate with scattered brown dots, and the yellow ground color of most forms of that shell. He did not list *cicercula*.

Lamarck (1810, vol. 16, p. 89) gives us a confusing diagnosis of *cicercula*. He describes the aperture as “perangusta,” which suggests that he had before him a specimen of *bistrinotata*. His specimens came from the East Indies, where both *cicercula* and *bistrinotata* occur. In his French description in 1822 (p. 397) he calls attention to the length of the apertural teeth: “Its base is transversely striated by the prolongation of the teeth of the aperture.” This is more characteristic of *bistrinotata*. His reference to granulations might apply to either. He also describes a “[b] var. laeviuscula, postice non rostrata, lactea,” which strongly suggests *globulus*, the word “lactea” indicating a pale form or a worn specimen. For *cicercula* (main species) he referred to neither of Linnaeus’ two refer-

ences. On the next page (1822, p. 398) he described *globulus* as "Lin. Gmel.," and the descriptions, in both Latin and French, are entirely accurate. He adequately distinguished it from *cicercula* "principally because it is almost smooth . . . and lacks the dorsal line." He cited three of Linnaeus' references in his synonymy and refers to the Chemnitz figure, noted above, as "Optima." Lamarck's diagnoses are discussed here to illustrate the fact that, before the separation of *bistrinotata* by the Schilders, that species was always associated with *cicercula* rather than with *globulus* and to point out Lamarck's puzzling adoption of what seems to be *globulus* as a "variety" of *cicercula*, in spite of his very accurate description of *globulus* on the next page.

Kiener (1843-1847, p. 156) listed *C. cicercula* as of Gmelin and copied Lamarck's description almost word for word, merely substituting "flava aut luteo-fulva" for "alba aut pallide fulva." His figures (*tom. cit.*, pl. 50, fig. 3, dorsal and ventral aspects) are almost certainly drawn from a specimen of *bistrinotata* and are cited for a form of that species by the Schilders (*loc. cit.*). His confusion in respect to this complex is shown by the fact that he did not list *globulus* as a good species, saying, in a note appended to his description of *cicercula*: "The granulations are not constant, so perhaps we should unite to this *Cypraea* the *Cypraea globulus* of Linné and of Lamarck where this feature is lacking." His figure (*tom. cit.*, pl. 50, fig. 4), which he called "*Cypraea cicercula* var.," is almost certainly *globulus*. This tendency to unite *globulus* with *cicercula* did not entirely die out until recently. Indeed, F. A. Schilder (1932b, p. 157) uses it as a subspecies of *cicercula* as *C. cicercula globulus*, although Schilder and Schilder (1938, p. 126) acknowledge that it is a good species and call attention to the details of color, shape, and sculpture which separate it from both *cicercula* and *bistrinotata*. Dautzenberg (1902, pp. 377-378) cites the *cicercula* of Reeve and Kiener in his synonymy of *cicercula* Linné, thus uniting it with *bistrinotata* as did all his predecessors, and lists *globulus* Linné as a mere "variety." Hidalgo (1906-1907, pp. 310-313 for *cicercula*, and pp. 370-372 for *globulus*) gives as adequate a diagnosis of

the two species as could be expected before the separation of *bistrinotata* had been published and accepted. His description of *cicercula* included that species, and his "varieties" involved at least one of its forms. He separated *cicercula* from *globulus* by parallel lists of their distinguishing characteristics, one of which he stated to be: for *cicercula*, "dentibus aperturae satis elongatis," and for *globulus*, "dentibus aperturae minus elongatis." He undoubtedly based his mention of longer teeth for *cicercula* on a specimen of *bistrinotata*, as I can detect no difference in the length of the teeth in the two Linnaean species, whereas in *bistrinotata* the teeth are noticeably longer than in either of the others.

All three species are now placed in the typical subgenus of *Pustularia* Swainson, 1840, of which the type is *C. cicercula* Linné, by original designation.

*Cypraea cicercula* is figured in Tryon (1879-1888, vol. 7, pl. 20, figs. 57-58). Neither of Kiener's figures (*tom. cit.*, pl. 50, figs. 3, 4) show *cicercula*, figure 3, as above noted, being *bistrinotata*, and figure 4, which he called *cicercula*, var., showing *globulus*. *C. globulus* is also figured in Reeve (*tom. cit.*, pl. 21, fig. 118), Reeve's *cicercula*, which is figure 116 on the same plate, being *bistrinotata*.

#### *Cypraea cervus*

1771, Mantissa plantarum, regni animalis appendix, p. 548.

LOCALITY: Not given.

"*Cypraea cervus* testa subtrubinata testacea, maculis pallidis rotundis sparsis, linea pallida simplici longitudinali . . . Testa ovato-oblonga, testacea, adpersa punctis majoribus, confertis, albidis. Linea pallida, longitudinalis, sublateralis, indivisa. Cauda s. postice depressa in marginem acutum. Dentes fusci. Spirae mucro quasi testae substantia oblitus."

This species is very close to *C. zebra* Linné (*C. exanthema* Linné) above, and their ranges are roughly similar. Both are found on the Atlantic and Gulf coasts of Florida from southern Georgia around the peninsula to Cedar Keys and throughout the West Indies and the Caribbean. The range of *zebra*, however, continues up the Atlantic coast as far as Hatteras and throughout most of the Gulf of Mexico, while *cervus* is not found north of Savannah or west of Cedar Keys. For many

years conchological writers were divided as to whether *cervus* was a good species or a subspecies of *zebra*. Many American authors treated it as a subspecies until recently, but its many marked and constant differences of shape, structure, and ornamentation separate it from *zebra* and entitle it to specific rank. It varies little throughout its range, although the Schilders (1938, p. 179) have tentatively made a subspecies of the form inhabiting the Bermuda Islands, with the name *cervus peilei* (1932). This race is distinguished only by a slightly narrower aperture, the lengthening of the central columellar teeth, and a certain lack of definition of the columellar sulcus. The Schilders examined only one living specimen from Bermuda, though it is found there as a Pleistocene fossil. While they were inclined to believe that the differences mentioned were racial rather than ecological, they emphasized that the matter needed further study.

*Cypraea cervus* is readily distinguished from *C. zebra* by its generally larger size, lighter structure, and less elongate shape, by the greater inflation of the dorsum and the much wider aperture, and by the fact that the white spots are smaller and more numerous than those of *zebra*, and those near the margin are never ocellated with black spots. The most constant and distinctive feature of the species is, however, the fossula. That of *zebra* is wide and cavernous, with its inner margin projecting into the aperture like a shelf. The fossula of *cervus* is narrower and shallower and lacks the shelf.

There is nothing in the "Mantissa" description that serves to distinguish the species there described from *C. zebra* with the possible exception of the words covering the dorsal line, "linea pallida simplici longitudinali." This feature in Linnaeus' description of *exanthema*, the adult *zebra*, in the "Systema," reads "subramosa" instead of "simplici." It is strange that, with so many significant differences between the two species, Linnaeus should have pointed out this very minor detail and one that is neither particularly obvious nor constant. No locality is given. One of the two figures cited (Regenfuss, pl. 10, fig. 38) had already been cited by Linnaeus for *C. exanthema* and is in any case not sufficiently characteristic to be taken for

*cervus*. Although no ocellated spots are shown the shell is not sufficiently inflated. The Buonanni figure (fig. 267) is somewhat better, though it is also a crude drawing.

I confess a certain sympathy with the early writers who could not identify *C. cervus*, or at least could not separate it from *exanthema-zebra*, as their only basis of comparison was an unilluminating description and two figures which did not show any of the distinguishing features of *cervus*. Martini (1769-1777, vol. 1, p. 368, pl. 28, fig. 289; pl. 29, figs. 298-300) described and figured both the juvenile and adult form of *zebra*, under the name *exanthema* Linné. He also described and figured (*tom. cit.*, p. 348, pl. 26, figs. 257-258) a shell which he called *Argus indiae occidentalis fuscus* but for which he did not refer to any of Linnaeus' works. The two figures, distorted and highly colored as they are, can be referred only to *C. cervus*. They show the wider aperture of that species and the absence of ocellated spots, both of which are in strong contrast to his figures used for *exanthema*. Chemnitz also omitted the name *cervus*, but described and figured (1780-1795, vol. 10, p. 108, pl. 145, fig. 1343) what he called *Cypraeorum maxima*, "A rare variety of the species which is called *Exanthema* in the *Systema* of Linnaeus." It is abundantly clear, both from the description and the figure of this shell, that it was based on a specimen of the *cervus* of the "Mantissa."

Born did not list *cervus*. Gmelin (1791, p. 3403) described *C. oculata*, and while he placed the *cervus* of the "Mantissa" in its synonymy did so only with a query. He located it in the "American Ocean" and cited the two Martini figures which the latter used for *Argus indiae occidentalis fuscus*.

Lamarck (1810, vol. 15, p. 447) was the first to use the name *cervus* as a good species. He did not, however, refer it to the *cervus* of Linnaeus, but apparently treated it as a new name. He cited two figures from Martini (*tom. cit.*, pl. 26, figs. 267-268), but these were cited in error for figures 257-258, as they do not resemble any of the group to which *cervus* belongs and probably represent *C. rufa* Lamarck, 1810, and were later cited for that species (1810, vol. 16, p. 92). Dillwyn (1817, vol. 1, p. 437), although he referred *cervus* to Linnaeus' "Mantissa," used it

only as a synonym of *exanthema*, saying, "some of the spots are frequently ocellated and others plain in the same specimen." In 1822 Lamarck changed the specific name to *cervina* (1822, p. 375), and this name was in use for many years. It was unquestionably the *cervus* of Linnaeus, as clearly appears both from Lamarck's references and his description, although he still refrained from mentioning Linnaeus. He cited, among other references, the *oculata* of Gmelin and the good Martini and Chemnitz figures mentioned above. Both Gray (1824, p. 140) and Deshayes (1830, 1832, vol. 3, p. 812) used the name *cervina*. Deshayes and Milne-Edwards were the first unequivocally to refer the name *cervus* to *cervus* Linné. Although they repeat Lamarck's description of the species as *cervina*, they said (1835-1845, vol. 10, p. 488, footnote): "It cannot be doubted that the *Cypraea cervus* of Linné is indeed this species. It is remarkable that Lamarck, after having adopted the Linnaean name in the *Annales du Museum*, rejected it here and changed it to *cervina*. Many authors, notably Gmelin and Dillwyn, have confounded it with the following species [*exanthema*]."

Kiener (1843-1847, p. 72), while he used the name *cervina*, said in a footnote: "It is probable that the *C. cervus* of Linné belongs to this species, to which we should restore the name of *cervus*."

Reeve, in 1845, listed both *exanthema* (1843-1878, vol. 3, *Cypraea*, pl. 5, sp. 16) and *cervus* (*tom. cit.*, pl. 2, sp. 6) and used them as good species. Since his day the two names have been universally used, although, as already said, opinion has been divided on the question of whether *cervus* was distinct from *exanthema* (*zebra*) or a mere subspecies.

Other than *oculata* Gmelin and *cervina* Lamarck, *C. cervus* Linné has had no synonyms, with the possible exception of *C. meleagris* Röding, 1798, which may be *cervus*, in part. Hidalgo (1906-1907, p. 137) identifies *cervus* with *C. bifasciata* Gmelin. That species was said by Gmelin to be *C. zebra*, and it was certainly based on a juvenile specimen of either *zebra* or *cervus*. Gmelin referred to a figure from Born (1780, pl. 8, fig. 3), which is too brilliantly and incorrectly colored to represent any member of the *zebra* group, although it has the general outline

and the suggestion of the juvenile bands of the young *zebra*. It is not sufficiently clear to be identified. *C. cerina* Wyatt, 1838, is a typographical error for *cervina*.

*Cypraea cervus* belongs, with *zebra* and *cervinetta*, a western American species, in the genus *Trona* Jousseume, 1884, subgenus *Macrocypraea* Schilder, 1930, of which the subgenotype is *C. zebra* Linné, by original designation.

The best figures of the species are those of Kiener (*tom. cit.*, pl. 2, fig. 1, dorsal and ventral aspect) described as *C. cervina* Lamarck.

#### *Cypraea punctata*

1771, *Mantissa plantarum, regni animalis appendix*, p. 548.

LOCALITY: Not given.

"*Cypraea punctata* testa umbilicata alba punctis testaceis . . . Testa magnitudine *C. ziczac*, vix marginata, retuso-umbilicata, ovata, alba, adpersa punctis testaceis, vagis, subaequalibus, distantibus. Margo vix marginatus, notatus ordine punctorum similium minimorum. Os album."

The description of this species, even without the assistance of any synonymy, is sufficient to identify it and distinguish it from any other member of the genus. The only criticism is the use of the equivocal word "testaceis" to describe the color of the dorsal spots. This is a word frequently employed by Linnaeus to describe a great range of colors and is virtually always inapplicable. The spots in *punctata* range in color from scarlet to a brownish red. It was not identified with the Linnaean species for many years, however, and received several other names.

Martini (1769-1777, vol. 1, p. 371, pl. 28, figs. 290-291) described a shell as "*Porcellana oblonga parva, lactea, punctis rubiginosis sparsis, elatis Stercori Muscarum similibus*,"<sup>1</sup> which he called "Die kleine punktirte Porcellane." This was undoubtedly the same shell which Linnaeus described in the "*Mantissa*" two years later as *C. punctata*. Martini's figures, although not well executed, may be safely referred to *punctata*.

Born (1780) did not list a *punctata* or de-

<sup>1</sup> I have not been able to identify *Stercori Muscarum*. Martini did not use that name for any of his *Cypraea* species. The first use of this combination was the *C. stercus muscarum* of Lamarck (1810, vol. 16, p. 98), which is demonstrably *punctata* Linné.

scribe or figure any species that can be referred to it. Schröter (1783–1786, vol. 1, p. 140) listed a shell for which he gave no Latin name but for which he referred to the Martini figures and called it by the German name used by the latter. He said: "It belongs to Linnaeus' third class," which undoubtedly means the third "subgeneric" heading in *Cypraea* Linné, "Umbilicatae," the heading that contains the small umbilicated species *clandestina*, *ziczac*, *hirundo*, and *asellus*.

Gmelin (1791, p. 3412) described what is unquestionably the same species, as *C. atomaria*, citing the Martini figures as sole reference. His description reads: "C. testa oblonga nivea fusco punctato ad utrumque finem obscuro biguttato . . . testa  $\frac{1}{2}$  circiter pollicem longa." This description cannot be improved upon for brevity and clarity. There was no reference to the *punctata* of the "Mantissa," and I feel sure that, like Martini and Born, he had never even seen that work or at least did not realize that it contained descriptions of mollusks. Röding, 1798, did not list any *Cypraea* that can be referred to *punctata*.

Lamarck (1810, vol. 16, p. 98) described the same species under the name *C. stercus muscarum*. He, too, omitted any reference to Linnaeus as author, and cited only the Martini figures and *atomaria* Gmelin. The description is, however, characteristic.

Dillwyn (1817, vol. 1, p. 458) was the first author to cite the species as the *punctata* of Linnaeus and placed in synonymy both *atomaria* Gmelin and the "Kleine punktirte Porcellane" of Martini and Schröter. In spite of this correct identification Lamarck, five years later, still called the species *stercus muscarum* (1822, p. 396) with no mention of the Linnaean authorship, and in this he was followed by Deshayes (1830–1832, vol. 3, p. 834). In 1844, however, Deshayes admitted the identity of Lamarck's shell with *cervus* Linné (Deshayes and Milne-Edwards, 1835–1845, vol. 10, p. 530). Though these authors repeated Lamarck's description under Lamarck's name, as was their custom, they added the following in a footnote: "It is certain that this species of Lamarck is specifically the same as the *Cypraea punctata* of Linnaeus: that name should therefore be restored."

Reeve (1843–1878, vol. 3, *Cypraea*, pl.

19, sp. 101), whose figure is characteristic, added the following useful comment on the species: "There appears to be two very distinct states of this species, one in which the teeth are yellow and extend partially across the base, as represented in the accompanying figure: the other in which the teeth are very fine, short and colorless." The form lacking the yellow teeth is the shell called *C. trizonata* by Sowerby in 1870 (1847–1887, vol. 4, p. 29, pl. 323, figs. 361–362), a Polynesian shell which seems to be identical with the *C. stercus muscarum* listed by Sowerby (*tom. cit.*, p. 29, pl. 323, figs. 363–365), which he credited to Lamarck but which appears to be a distinct form. Sowerby also figured and described *C. punctata* Linné as a distinct species (*tom. cit.*, p. 28, pl. 319, figs. 278–281). Sowerby's various figures are reasonably characteristic of the forms they are designed to represent, but his use of the various names as good species and his confounding of Lamarck's *stercus muscarum* and his own shell of that name were reflected in the confusion of some of the later writers on this affinity. Hidalgo (1906–1907), for instance, although he identified *punctata* Linné with both *atomaria* Gmelin and *stercus muscarum* Lamarck and properly distinguished the latter from the shell of the same name described by Sowerby, cited *trizonata* Sowerby as a good species. The best opinion today, in the view of this writer, is that all the names mentioned above are forms of a single species, *C. punctata* Linné. The Schilders (1838, p. 156) adopt this view and use *atomaria* and *trizonata* as geographical races of *punctata*, although, as they treat these races as subspecies, they place a limitation on it to that extent. They describe two other races or subspecies, the typical *punctata punctata* Linné and a new subspecies, *iredalei* Schilder and Schilder, 1938. They treat *stercus muscarum* Lamarck as an exact synonym of the typical subspecies, which they place in east African waters.

*Cypraea punctata* is in the typical subgenus of *Palmadusta* Iredale, 1930.

In addition to the figures mentioned above, the species is figured in Kiener (1843–1847, pl. 39, fig. 2, dorsal and ventral aspects) as *C. atomaria* Gmelin. These figures are of the Polynesian form *trizonata* Sowerby.



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 The dates in brackets are based on external evidence. Plates 1-95 were published before Bruguière's departure from France in late 1792 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 on the title page of the livraisons containing the [1798] and 1816 plates. (See Sherborn and Woodward, 1893, 1899, and 1906.)
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## CORRECTIONS FOR PART 1 (DODGE, 1952)

- Page 34, column 2, line 22 from bottom: For "*marginata*" read "*marginatus*."
- Page 61, column 1, line 13 from bottom: For "Sowerby" read "J. de C. Sowerby."
- Page 61, column 1, line 10 from bottom: For "he" read "G. B. Sowerby."
- Page 67, column 1, line 12 from bottom: For "values" read "valves."
- Page 68, column 1, lines 14 and 15 from bottom: "For "Brugière" read "Bruguière."
- Page 102, column 1, line 8 from bottom (in footnote): For "*Cythera*" read "*Cytherea*."
- Page 113, column 1, lines 20 and 21 are to read: "paratively recent times have so considered them. Bucquoy, Dautzenberg, and Doll."
- Page 126, column 2, line 20: For "1827" read "1823."
- Page 135, column 2, line 6 from bottom (last line of text): For "*arcinella*" read "*Arcinella*."
- Page 136, column 2, line 24 from bottom: For "*semiorbicularis*" read "*semiorbiculata*."
- Page 145, column 2, line 3 from bottom (in footnote): For "*modiola*" read "*modiolus*."
- Page 146, column 2, lines 5 and 9: For "*Vulsella*" read "*Volsella*."
- Page 153, column 1, line 2: For "1921" read "1912."
- Page 153, column 2, line 24: For "volva" read "vulva."
- Page 188, column 2, line 5: For "1781" read "1788."
- Page 216, column 2, line 5 from bottom (in footnote): For "*Modilus*" read "*Modiolus*."
- Page 231, column 1, line 6: For "1845" read "1848."
- Page 231, column 1, line 22: For "Concylien" read "Conchylien."
- Page 231, column 1, line 30: For "éclaircie" read "éclaircie."
- Page 236, column 2, line 1: For "Avidulidae" read "Aviculidae."
- Page 243, column 1, line 13: For "c" read "o."
- Page 245, column 2, line 2 (beneath the headings): For "*Paiella*" read "*Patella*."

## INDEX TO SPECIES

The generic name, in parentheses, which follows each species, refers to the genus in which the species is placed in the twelfth edition of the "Systema naturae" (1767) or the "Mantissa" (1771).

- amethystea (Cypraea), 70  
ammiralis (Conus), 25  
annulus (Cypraea), 97  
arabica (Cypraea), 64  
argo (Argonauta), 11  
argus (Cypraea), 65  
asellus (Cypraea), 92  
aulicus (Conus), 53  
aurisiacus (Conus), 49  
betulinus (Conus), 42  
bullatus (Conus), 56  
capitaneus (Conus), 23  
caput-serpentis (Cypraea), 75  
carneola (Cypraea), 68  
caurica (Cypraea), 98  
cedo-nulli (Conus), 26  
cervus (Conus), 121  
cicercula (Cypraea), 118  
clandestina (Cypraea), 85  
clavus (Conus), 46  
cribraria (Cypraea), 95  
crista (Nautilus), 14  
cymbium (Argonauta), 12  
ebraeus (Conus), 44  
erosa (Cypraea), 100  
errones (Cypraea), 93  
exanthema (Cypraea), 61  
figulinus (Conus), 43  
flaveola (Cypraea), 101  
fragilis (Cypraea), 75  
generalis (Conus), 21  
genuanus (Conus), 33  
geographus (Conus), 59  
glaucus (Conus), 34  
globulus (Cypraea), 118  
granulatus (Conus), 48  
helvola (Cypraea), 107  
hirundo (Cypraea), 89  
imperialis (Conus), 19  
isabella (Cypraea), 82  
litteratus (Conus), 19  
lota (Cypraea), 73  
lurida (Cypraea), 71  
lynx (Cypraea), 80  
magus (Conus), 50  
mappa (Cypraea), 63  
marmoreus (Conus), 18  
mauritiana (Cypraea), 76  
mercator (Conus), 41  
miles (Conus), 24  
minimus (Conus), 36  
monachus (Conus), 35  
moneta (Cypraea), 96  
mus (Cypraea), 78  
nobilis (Conus), 33  
nucleus (Cypraea), 115  
nussatella (Conus), 47  
occidentalis (Conus), 26  
ocellata (Cypraea), 109  
onyx (Cypraea), 83  
ordinarius (Conus), 26  
papilio (Conus), 34  
pediculus (Cypraea), 111  
pompilius (Nautilus), 13  
poraria (Cypraea), 110  
princeps (Conus), 24  
punctata (Cypraea), 123  
rusticus (Conus), 40  
senator (Conus), 30  
spectrum (Conus), 54  
spirula (Nautilus), 14  
spurca (Cypraea), 102  
staphylaea (Cypraea), 116  
stercoraria (Cypraea), 67  
stercus-muscarum (Conus), 45  
stolida (Cypraea), 106  
striatus (Conus), 51  
succincta (Cypraea), 87  
summus (Conus), 26  
talpa (Cypraea), 69  
testudinaria (Cypraea), 66  
textile (Conus), 52  
tigris (Cypraea), 79  
tulipa (Conus), 58  
vanelli (Cypraea), 72  
varius (Conus), 45  
vicarius (Conus), 28  
virgo (Conus), 21  
vitellus (Cypraea), 77  
zebra (Cypraea), 61, 69  
ziczac (Cypraea), 88