

A HISTORICAL REVIEW OF THE  
MOLLUSKS OF LINNAEUS

PART 1. THE CLASSES LORICATA  
AND PELECYPODA

HENRY DODGE

BULLETIN

OF THE

AMERICAN MUSEUM OF NATURAL HISTORY

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## FOREWORD

THE TENTH EDITION of the "Systema naturae" of Linnaeus, 1758, was the first completely binomial zoological work. The book, and its date, are therefore the starting point of modern zoological nomenclature and are universally so accepted today under the Rules of Zoological Nomenclature.

In the tenth edition the Order Testacea of his Class Vermes contained the bulk of his species of what we know today as the shelled mollusks, although he included 17 other species of mollusks (most of them being shell-less or with internal shells) in other orders of Vermes—the genus *Teredo* in Vermes Intestina, the genera *Limax*, *Sepia*, and *Tethys* and the species *Doris verrucosa* and *Scyllaea pelagica* in Vermes Mollusca, that unfortunately named group, and a single species, *Monoculus telemus*, in Order Aptera (Insecta), although it is in fact a pteropod mollusk. On the other hand many species properly in other phyla were listed in Vermes Testacea along with the true mollusks. The genus *Lepas* consists entirely of cirripedes; *Anomia* contains many more brachiopods than bivalve mollusks; *Serpula* (and *Sabella* in the twelfth edition) lists many annelids.

In the "Regnum animale" of the eleventh edition, so-called, which was published in Leipzig (1760, *fide* the Catalogue of the Library of the British Museum), no species were added to or subtracted from the list. Stoeber (1792) called it a "pirated" edition and reported that it abounded in errors, but the British Museum Catalogue cites only two such errors. I have not had access to this work, but in any case there is no occasion to cite it.

The twelfth edition, and the last from the hand of Linnaeus, was published in 1767. One hundred and twelve new specific names were added to Vermes Testacea and one, *Cardium triste*, was deleted, bringing the total in that group to 814. However, many names were moved to other genera in this edition (see the Locator Index and Appendices, below), and the order of species within many of the genera was changed, so that the grouping in the twelfth edition more clearly foreshadows the generic redistribution which took place upon the breaking up of the original genera of the "Systema." Only one new

genus was added—*Maetra*—its members being drawn in part from the *Mya* and *Cardium* of the tenth edition. Although the 1758 edition is historically the most important from the point of view of priority of names, it will be necessary in these papers to discuss the species in the order in which they occur in the twelfth edition, as that represents the final and comprehensive list, with the exception of those few species mentioned in the following paragraph.

In his "Mantissa plantarum," 1771, Linnaeus added as "Sect. Regnum Animale," a further list of 33 species (four of which are not mollusks and one of the four is a mere repetition) which apparently had come to his notice since the publication of the last edition of the "Systema." These species are described with even less clarity than he used in his major work, and several must be considered as unidentified. We may cite these Mantissa species as "Linné, 1771 (Mantissa)." I have incorporated them with the "Systema" species in the Locator Index, and treat them textually in the genus to which they respectively belong, along with the original species. Hanley (1855, p. 453) says of these names: "Very few of the shells mentioned in this work appear to have been described from specimens that belonged to our author. Probably the original types were to be found in the cabinets of Ziergovell and De Geer, which (as Murray, the pupil of Linnaeus, has informed us) ranked with our author's and the Queen of Sweden's as the four principal collections in the kingdom." This fact is mainly responsible for the difficulty that has been experienced in identifying many of these names.

My plan in these papers is not to monograph the Linnaean genera, nor is it to present complete synonymies of each of the specific names, a project that would far outrun the space available and that is, moreover, quite unnecessary to accomplish my purpose. My aim is simply to give a short history of each of the species, to point out the difficulties that conchologists have encountered in identifying them, and to suggest their proper generic and subgeneric position today. I use even the word "suggest" with some diffi-

dence. The splitting of some of the Linnaean genera (notably *Venus*, *Cypraea*, *Murex*, and *Helix*, but to a lesser extent of all of the others) has resulted in a staggering and unwieldy mass of group names, and the existing conflicts in arrangement between even the most recent and careful monographers are still subjects of contention. I do not undertake to settle these conflicts here. In any case, no recent systematic arrangement of the whole Phylum Mollusca is available, with the exception of that of Thiele (1931, 1935), an elaborate and exhaustive work. This runs counter to so many accepted American views that I hesitate to use it throughout, although I cite it frequently.

In the private collection of mollusks owned by Linnaeus (which includes the types of the great majority of the "Systema" species) the specimens, when sufficiently large, were marked by Linnaeus' hand either with the name or with a number corresponding to their positions in either the tenth or twelfth edition. In most cases the tenth edition number is used. This is seldom a cause of confusion to the investigator, as of the two descriptions pertaining to the number only one will, in practically every case, agree with the characteristics of the specimen, except possibly in the case of the very low numbers in the earlier pages of the work. The great increase in the number of species in the twelfth edition brings about a considerable divergence of position in the list, so that the two numbers, if not found in different genera, will, at least, be usually placed in widely diverse "sub-generic" groups. The smaller shells are contained in tin boxes, the boxes likewise being often marked by Linnaeus with the name or number. Where the number is of the tenth edition this indicates that the specimen was a recognized and accepted type when the twelfth edition was published. Such specimens as were new species, added to the collection by Linnaeus after the last edition was printed, are almost invariably packed in separate papers or pill-boxes.

If the various methods of marking and storing the specimens presented the only difficulty, the task of investigators would have been comparatively simple, but unfortunately two more serious problems are encountered.

In the first place, the collection, after passing through the hands of Linnaeus' son, who was a competent naturalist and therefore probably a careful custodian of the cabinet, was turned over, or possibly sold, to Sir James Smith, a British botanist, who held it until its acquisition by the Linnean Society of London, where it is kept today. It is certain that the collection was mishandled during the Smith period. Specimens were added by him, some without identification, although some bear a name and number inscribed in a handwriting vastly different from the almost illegible hand of Linnaeus. There is ample evidence that not only some of these specimens, but also some of the original shells, which were either unmarked or from which the writing has been wholly or partly obliterated by wear, have been moved from one receptacle to another by Smith or by careless examiners of the collection.

In the second place, and entirely apart from the misplacing of specimens, some of the original specimens in the tin boxes, as well as the ones added by Smith, have the name or number partially or wholly obliterated or in such condition that only one or two of the digits of the number remain. When this occurs in connection with the absence of a name or number on the box itself, the problem is immeasurably more difficult. Where the obliteration is complete the investigator not only is forced to compare the specimen with the description of every species in the genus to which the specimen seems to belong, but he must also bear in mind that Linnaeus often chose strange generic positions for some of his shells, which greatly widens the field. For instance, it is now generally agreed that in his diagnosis of *Solen bullatus* he was describing *Fulvia bullata*, in Cardiidae, in spite of the obvious difference between the hinge of *Cardium* and that of *Solen*. Other instances of this are referred to later. If the question be approached from the other end, that is, an attempt to find the representative of a description rather than to identify a specimen, one must, practically speaking, examine every specimen in the collection among the gastropods or pelecypods or whatever class contained the Linnaean description. In the case of a specimen on which one or two digits of the number remain the student must fill



in the gaps with every possible digit or combination of digits, until a two- or three-digit number is arrived at which is that of a species description that agrees fully with the characteristics of the specimen in hand.

The locality assigned to a species in the "Systema" was given some weight by the investigators of the nineteenth century, but, as Hanley admits (1855, p. 5), "its importance must not be overrated." This is, if anything, an understatement. The localities of Linnaeus are notoriously inaccurate, partly owing to the lack of regard for exact documentation which was perhaps the greatest weakness of naturalists up to comparatively recent years, and partly because Linnaeus used the locality supplied by the earlier works cited in his synonymies. They should probably be accepted without reservation only in the case of species from Scandinavia with which he was familiar as a collector.<sup>1</sup> In many cases no locality was given. This troubled Hanley, but I feel that the lack of any locality is not so great a handicap as an incorrect one.

The majority of the descriptions in the "Systema" are followed by a synonymy consisting of a list of references to figures taken from the pre-Linnaean iconographies, to which, in some cases, are added the name used by the earlier author. These names were in many cases borrowed by Linnaeus and used specifically or generically in the "Systema." These lists of references contain many errors, which are most evident in the tenth edition. They are mainly errors of transcription—referring to the wrong plate or figure or, in one instance, even to the wrong author. Under many species he included figures of several quite distinct but related shells. This latter fault is probably due to the fact that Linnaeus was unable to find in his library any figure of the precise species he was discussing, and so adopted the unwise expedient of selecting that figure, in the books available to him, which was the nearest approximation to his species. In the twelfth edition, having in the meanwhile acquired a larger library, including the volumes of Lister and Seba, he deleted

<sup>1</sup> There can be added to these the localities furnished him with shells collected by his students and personal friends. These individuals are referred to in the course of the discussion of individual species.

many of these approximations and substituted correct figures. He also corrected many of his errors of transcription, and in general the twelfth edition synonymies are a great improvement over those in the earlier work.

I have recapitulated the several difficulties which the early students faced in dealing with the Linnaean species and which, of course, still exist to some extent as the principal reason why so little work, comparatively speaking, has been undertaken on the problem and why some of the species are still unrecognized.

The material available in the custody of the Linnean Society of London, apart from the collection, consists of the following documents:

1. An interleaved copy of the tenth edition which belonged to Linnaeus, the manuscript notes in which were the basis of the changes and additions in the twelfth edition. The list of tenth edition species in the author's private collection, already mentioned, is indicated by a note against each of these species in this copy, and, as the collection contains a specimen of every species described in this edition, this represents a complete list of the holotypes as of 1758.

2. Linnaeus' own interleaved copy of the twelfth edition. The manuscript notes in this volume represent the changes and additions he intended to make in his projected thirteenth edition. This is not to be confused with Gmelin's work, called by the latter the "thirteenth edition," and to emphasize the distinction I shall refer to Linnaeus' project as the "revised twelfth edition" as most other commentators have done.<sup>2</sup>

3. A copy of the twelfth edition owned by the son of Linnaeus. This volume contains a complete transcription of his father's manuscript notes mentioned in the last paragraph and is chiefly useful because the son's clear handwriting enables us to check the wording of the original notes which are often illegible.

<sup>2</sup> The manuscript notes in Linnaeus' copy of the twelfth edition were never published so far as the "Regnum animale" was concerned. The botanical part of the "Systema," however, was republished in Germany in 1774 with the manuscript notes included. The editor of this latter work was Johan Andreas Murray, a former pupil of Linnaeus, who obtained the interleaved copy from his old teacher and, after publication, sent him "a handsome sum for authorship, received by Linné with great satisfaction" (Jackson, 1923, p. 242).

It is also valuable as it contains the comments of the younger Linnaeus on certain parts of the collection at a time when the cabinets were in their original state.

4. A manuscript of the "Museum Ulricae," the greater part of which is in the hand of an amanuensis but which is provided with Linnaeus' numbers. There are usually two numbers for each species, one set of which has proved, in many cases, to agree with the numbers written by Linnaeus on the shells in his collection or on the boxes in which they were originally contained.

The work for which I use the abbreviated form "Museum Ulricae" is the catalogue of the shells in the Museum of Queen Louisa Ulrica at Drottningholm, Sweden. It appeared in 1764, in the interval between the publication dates of the tenth and twelfth editions of the "Systema." Linnaeus edited it, and it is almost certain that he supplied the names and wrote the descriptions. In the 1758 edition of the "Systema," published while this catalogue was in preparation, he frequently referred to it by placing the letters M.L.U., without any further elaboration, in the synonymy of a species. In the 1767 edition, after the Swedish catalogue had been completed, Linnaeus followed his citation of it by a definitive reference. This catalogue appears to have been drawn up entirely independently of the "Systema," as it often occurs that species having the same name in the two works are described in a way that makes it obvious that two species are involved, whereas Linnaeus never changed his ideal of a species in the two editions of his major work. Hanley repeatedly mentions the catalogue, usually to show that the "Systema" species and the M.L.U. species are different, and I also refer to it when necessary. It must be pointed out, however, that it is a very dangerous guide to follow unless the greatest care is exercised.

Philippi, Menke, and Deshayes all did excellent work in the identification of certain of the less clearly diagnosed Linnaean species, and their labors rescued many of these names from the status of *species dubius*, but it remained for Sylvanus Hanley, in his "Ipsa Linnaei Conchylia" (1855) to report on the first comprehensive examination of the entire collection, the result of several years of re-

search. He left many questions unanswered, as he apparently felt unable to take a firm position in the case of many species of whose identification we are today convinced. His style loses its effectiveness by being turgid and at times confused, and occasionally one is unable to state with any assurance just what he conceives the representative of a given Linnaean name to be. The work, however, shows evidence of a vast amount of research, the results of which are invaluable. He employed the painfully slow methods of identification outlined above, and his conclusions are as accurate as was possible at the date at which he wrote.

The only important and serious fault of Hanley's book, however, is one that cannot be attributed to him and that I hope will serve as an excuse for these papers—it is hopelessly out of date. The majority of the genera in which he placed the mollusks of Linnaeus are group names which have either been rejected as invalidly proposed or are synonyms of earlier valid names, and many of them are all but forgotten today. Then, too, the book contains no evidence that the author was aware of the value of an orderly and scientific approach to nomenclatorial problems. Even 50 years before the adoption of the Rules of Nomenclature zoologists were becoming increasingly preoccupied with a need for a stricter observance of the principles of priority, with the value of the establishment of types, and with the advisability of following the name of a genus or species with the name of its author and the date of its erection. These considerations, which Woodward, Reeve, Sowerby, and others among Hanley's contemporaries were beginning to appreciate, were seemingly of little moment to Hanley. The result is that the work, in spite of the mine of factual information it contains, is unsatisfactory as a work of reference, as too much further research is necessary in order to learn what Hanley meant by many of his comments.

The Linnean Society of London advises me (personal communication) that since Hanley's day no one has worked on the Linnaean collection sufficiently to isolate all of the types. E. A. Smith completed the isolation of the types of *Trochus* in 1879, all but five types in *Patella*, and 10 types in *Helix*.

J. W. Taylor and W. D. Roebuck similarly isolated the types of the fresh-water species about 1913 and wrote a paper on both the land and fresh-water shells which was never published. In 1938 Mrs. R. A. Rowland began an examination of the entire collection, which was never completed because of the outbreak of the war. Thus Hanley's studies represent the last comprehensive work on the Linnaean mollusks, a study completed 97 years ago.

For these reasons it is hoped that the present paper will serve a useful purpose. It will, in effect, constitute a bringing up to date of Hanley's work by using modern nomenclature, by supplying data, which Hanley lacked, bearing on the nomenclatorial history of the species, and by utilizing the knowledge that has accumulated in the years since his work was published and that now supports the accepted convictions of conchologists upon subjects as to which the investigator of 1855 could only theorize. By no means all of the Linnaean species of mollusks can be precisely identified even today, and therefore the present writer is forced, in many instances, to hazard guesses. In such cases all that any commentator can do is to present and discuss the various views that have been advanced and to choose the one that seems to him the most convincing.

In the years that have elapsed since the publication of the "Systema naturae," writers on the Linnaean specific names have been divided on the question of what is the most important factor in the identification of species not represented by a marked specimen in the collection. Some have insisted that the figures cited in the synonymy should be at least as convincing and persuasive a guide as the language of the description. Some, obviously mindful of the fact that Linnaeus was often forced to choose figures that were only approximations to the species he was describing, owing to the paucity of good figures available in his day, insist that the words of the description should control, and that if they do not point clearly to a certain known shell the name should be abandoned as representing a *species dubius*, whatever be the weight of the other accompanying evidence.

Another supplementary method of identifi-

cation is to invoke the language of the "Museum Ulricae" where a species of the same name is there described and where the description in the "Systema" is not convincing. Hanley was prone to give some weight to this method in many cases, although he occasionally advised against the retention of the original specific name even when the language of the "Museum Ulricae" cured the weaknesses of the description in the "Systema." Here the investigator must be cautioned that we know of many cases where identical names in the two works refer to demonstrably different species, and it is probable that many more such cases exist. As already said, the 1764 work is a dangerous guide. The probative value of the specimens described in that work, which comprised the collection of Queen Louisa Ulrica, are discussed below.

My own conviction, in determining what Linnaeus meant by a given diagnosis of a species, is that we must treat each species as a separate problem. For this purpose the language of the description is the most important factor. He wrote the description, in most cases, with a specimen of the shell before him, and it may be assumed that he would not have described traits that were not present, or omitted mention of conspicuous characters that were. There are a few apparent exceptions to the second part of this statement. In some species the description discloses that he did omit conspicuous features such as, to cite two examples, the sculptural ornamentation of the shell, or, in the case of bivalves, the color or texture of the interior, the latter of which he usually mentioned. It will, however, be found that in most of such cases the type specimen was too worn or too juvenile or too senile to show these characters, and, where the type is not preserved, there is often extrinsic evidence to show that such was the case. It is admitted that many of the descriptions in the "Systema" are not clear. Linnaeus used a Latin style that was sometimes involved and was usually too abbreviated, and his choice of words is often confusing. He employed more than one word for the same feature of the shell, and at times used the same word for different features. Witness his usage of the words "rima," "vulva," "nates," "mons veneris," "umbones," and "anus" in describing the dorsal area of a bivalve.

The second important element in the identification is the presence, in his collection, of a specimen which is either authenticated by the name or number of the species in either the tenth or twelfth edition, and which conforms to the description, or the presence of an unmarked specimen which uniquely, of all the shells in the collection, is in accord with the description. If the notation on the specimen or on the original tin box containing it is in the handwriting of Linnaeus, we should be safe in considering it the type of the species, but if there is any indication that it was not an original specimen, because the notation is in another hand, or because it is found in a type of receptacle not used by Linnaeus, or for any other reason, then its probative value is impugned if not destroyed. A considerable number of shells were added to the collection after Linnaeus' death, and some after it passed out of the custody of his son and into the hands of Sir James Smith. The handling of the cabinet in the latter's possession is commented upon above.

The third factor in identification is the pictorial synonymy, where present. I discuss above the lack of value of many of the figures which Linnaeus cited. Occasionally the cited figures show several identifiable species, so closely related that we may assume that the author believed that they were all varieties or forms of the same species. In such case the description can be said to cover a composite species. In other cases the figures show a shell or shells so discordant with the language of the description that we may assume that they represent errors of transcription, and we are justified in dismissing them from consideration. In some instances the figures undoubtedly represent mere approximations to the species described, deliberately chosen by Linnaeus when he could find no figures of the species in the iconographies available to him. Indeed, in one instance the author refers specifically to this difficulty. Under *Venus marica* he says: "Proxima huic est Argenv. conch. t. 24, f. B." We should not, however, consider the citation of an erroneous or unidentifiable figure as condemning the whole list of references. Those figures that effectively conform to the rest of the diagnosis and to the type in the collection, if a type is found, are certainly confirmatory of

an identification already based upon the description, and, if such a figure is unequivocally characteristic, can be used to cure minor defects or omissions in Linnaeus' language.<sup>1</sup>

Of the three aids to identification (description, type specimen, and pictorial synonymy), the last is, however, the least valuable guide. The description is based on Linnaeus' own evaluation of the species. He was transferring to paper what he could see with his own eyes. The type specimen is valuable as the physical and visible basis of such description. The cited figures, on the other hand, were only borrowed from his predecessors, and he found them where he could, with all their imperfections. He was hampered not only by the lack of existing figures but by the crude and often misleading drawings in the older works, and, it must be admitted, by his own occasional carelessness in transcription.

The fourth possible aid to identification, and one that has been given undue weight by some conchologists, is the stated locality of the species. As already stated, the localities are often so demonstrably wrong that the student is almost justified, with two exceptions, in entirely disregarding them. The exceptions are, first, the localities of the species from Scandinavian waters with which Linnaeus was undoubtedly familiar as a collector and, second, those localities that were vouched for by men who had studied under him or who had been closely associated with him. Few teachers have so commanded the admiration of their pupils as did Linnaeus, and few have produced such a group of careful and conscientious naturalists. The names of his pupils, Hasselquist, Zoega, Logie, Fagraeus, Kalm, Konig, and others, appear frequently in the "Systema," and these were men in whose scientific attainments he felt so

<sup>1</sup> The tendency among conchologists today is to over-emphasize the authority of the figures. In some cases a Linnaean species that is defined only by a single figure, the description being totally inadequate and there being no referable specimen in the collection, is cited as of Linné, 1758 or 1767. It would seem more reasonable in such cases to cite it as of the author and date of the first recognizable description after Linnaeus. The accepted theory, however, upholds the citation of the species in such cases as of Linnaeus, and while I recognize the will of the majority, I do so with some reluctance.

much confidence that we know he raised funds to send them on collecting expeditions to many countries of Europe, to the Mediterranean, the Levant, and even to America and India.<sup>1</sup>

No fixed rule-of-thumb for the determination of the Linnaean species is therefore practicable. To use such a method would be to adopt a purely legalistic approach to a problem in which arbitrary rules should play no part. The diagnosis of a species is made up of correct or incorrect data of varying degrees of importance and credibility, and each diagnosis should be judged by the over-all weight of evidence, measured by the relative values of the factors outlined above. We cannot say that any of these factors is without weight. What we are trying to do is to determine what Linnaeus meant by a given combination of data, and we are at liberty to consider all the evidence presented.

The next question to decide, and an entirely independent question, is as to the restoration or retention of the Linnaean specific name. Our conviction that we have properly identified a name, whose use has long since been abandoned, should not necessarily justify us in attempting to restore it to the nomenclature at the expense of a later validly proposed name for the same species that has been consecrated by tradition and long use. The purpose of a Code of Nomenclature should be to lessen confusion in the use of names and thus promote permanence and

stability. The restoration of a number of virtually forgotten Linnaean trivial names, even though we are convinced that we know what they mean, would only add to an already unstable nomenclatorial situation, which unfortunately is daily becoming worse. Not only is the existing Rule of Priority too strict in its language, but it has been interpreted, both by the Commission and by many zoological writers, in an increasingly legalistic manner. Fortunately the pendulum seems now to be swinging in the other direction, and it is to be hoped that the Code Revision discussed at Paris in 1948, in the form finally accepted and adopted, will give a more practicable and realistic meaning to the word "nomenclature."

Even though we should not abandon later names, which have become firmly fixed in the literature, in favor of an earlier name that was adequately defined, we should retain sufficient respect for the Rule of Priority to insist that the retention of the later name should in all cases be validated by a suspension of the rules, and the same procedure should, I suggest, be followed even where the diagnosis of the earlier might be questioned as not being completely unequivocal. Authority to suspend the rules was very wisely granted by the Monaco resolution which is now a part of the Code.

It is perhaps an act of temerity to submit to the attention of zoologists a paper which so frequently requires the consideration of imponderables in its presentation, or to introduce theory, or even guesswork, into the literature of what should be an exact science—zoological nomenclature. The nature of the task makes it certain that I shall often run counter to the dearest views of many conchologists. I am somewhat comforted, however, by recalling a comment made by Dr. Earnest A. Hooton of Harvard University in the foreword to "Men out of Asia" by Harold Sterling Gladwin: "Scientists who are always afraid of being wrong, some way or other never manage to be really right." If these papers produce controversy or, better yet, provoke a renewed inquiry into the Linnaean names, they will have been worth writing.

The molluscan genera of the "Vermes Testacea" are taken up in the order in which they occur in the twelfth edition of the "Systema

<sup>1</sup> I have not been able to identify the person whose name most often appears—E. Brander. This collector sent Linnaeus many specimens from the north coast of Africa, and his localities "in Barbaria," "in M. Mediterraneo, Africam alluente," "in Mauretania," "in Algeriam," and the like are not only always accurate but in certain instances are the deciding factors in identification because of this fact. Hanley (1855, p. 5) says that he was "the Consul at Algiers," but does not give the source of his information. There is no record of this name in the list of the pupils of Linnaeus, or in the available records of his friends or of those with whom he corresponded. The only Brander of the period who was a naturalist is a Gustavus Brander, a Swedish-born, naturalized Englishman, who became a director of the Bank of England and who, by a suggestive coincidence, was also a paleontologist who described, with the collaboration of Solander, a collection of British fossil shells in the British Museum. His identification with the E. Brander of the "Systema" seems remote, in spite of the fact that the initial "E," which Linnaeus did not always use, might be an error.

naturae," and after them are discussed the genera and single species that Linnaeus placed in other divisions of his "Vermes." Those species in "Vermes Testacea" that are not mollusks are mentioned in their regular order, but as they are not germane to the present discussion little space is devoted to them beyond an indication of their proper phylum.

I cannot close these preliminary notes without a very warm word of thanks to all those whose time I have taken, in person or by letter, in discussions of the many questions that arise to plague one in a project of this sort. The list is too long to be set out here and, by mentioning a few, I hope that I shall be taken as expressing my gratitude to all. Dr. William J. Clench of the Museum of Comparative Zoölogy and Dr. Harald A. Rehder and Mr. R. Tucker Abbott of the United States National Museum have taken much of their valuable time in considering difficult determinations of species. Dr. Ernst Mayr, Dr. John T. Zimmer, Dr. Norman D. Newell and Dr. Otto H. Haas of the American Museum of Natural History, and Dr. Harold E. Vokes of the Johns Hopkins University have all listened to my many queries in matters of nomenclature with astonishing patience and have often acted as a kindly sedative, although not always a successful one, to my occasionally rebellious attitude towards the less explicit and less popular provisions of the Code of Zoological Nomenclature. Dr. A. Myra Keen of Stanford University has been most helpful in discussing matters of classification and taxonomy, particularly in the genus *Venus*. Dr. Julia Gardner of the United States Geological Survey rendered invaluable assistance in the paleontological questions involved, and Dr. G. Arthur Cooper of the United States National Museum has supplemented my meager knowledge of the Brachiopoda by fixing the generic position of many of the species of that phylum listed under *Anomia* Linné. Finally, I gratefully acknowledge my indebtedness to Mr. John C. Armstrong of the American Museum of Natural History for his continued encouragement and help in connection with the plan and content of these papers.

In the quotation of the original descriptions, Linnaeus' subdescriptions, which often followed his references and "habitats," are

also quoted where they are factors in the identification of the species involved. In such cases they immediately follow the main descriptions, being separated from the latter by three periods (. . .).

All translations of quotations from foreign works are mine and are not further acknowledged in the text.

For reference purposes a Locator Index of all the Linnaean specific names of mollusks, showing their numbering in the tenth and twelfth editions of the "Systema naturæ" and the "Mantissa" and their generic position in those works, is included near the end of this Part 1. This Index is followed by Appendices listing the changes of specific name or genus between the tenth and twelfth editions of the "Systema."

Where reference is made to figures cited by Linnaeus from prior works it has not seemed necessary to cite them by date, plate, and figure except in cases where such data are important, either historically or because a given figure has raised a serious question of identification. As already stated the synonyms in the "Systema naturæ" are in many cases notoriously inaccurate. Furthermore, the pre-Linnaean iconographies are so well known to conchologists that detailed references would unnecessarily encumber the text.

One of the greatest handicaps under which one labors in a study of the history of the Linnaean species is the unfortunate paucity of taxonomic data in the literature. The authors of most of the general manuals as well as the monographers of families and genera have seemed strangely uninterested in conchological history and have contented themselves with listing and describing the species, suggesting their proper placement in super-specific groups and discussing their life history, range, habitats, and habits. To this difficulty must be added a lack of interest among conchologists in the works of Linnaeus and his immediate successors. The period from 1758 to the end of the first quarter of the nineteenth century is by far the most important in a task like the present. The early descriptions of the Linnaean species, both in the "Systema naturæ" and in the works of the conchologists of the next 75 years, while often erroneous, confusing, or too brief, and the early figures, while usually crude, repre-

sent not only the first conceptions of the species but are the sources to which we must look to locate many of the errors in identification that have crept into the literature, many of which have persisted to this day. For this reason the writer spends what may seem a disproportionate amount of time on the text and figures of Martini, Chemnitz, Born, Gmelin, Poli, Bruguière, Lamarck, and their contemporaries. To cite but one example of an error that was detected many years ago but that has crystallized in the minds of authors: Linnaeus believed that his *Cypraea zebra*, 1758, and his *Cypraea exanthema*, 1767, were different species. De Roissy (Montfort and de Roissy, 1801-1805) detected that they were identical, but most authors have followed the original error, citing *exanthema* as the valid name and disregarding *zebra*. Not only did they not acknowledge the identity of the two names, but chose the later of the two. In spite of de Roissy's correct interpretation and its later confirmation by Lamarck (1810 and 1822), the name *exanthema* is still

in use by the majority of writers.

The so-called "subgeneric" headings under which Linnaeus grouped supposedly related species in many of his genera "are not to be accepted as of subgeneric value under the International Rules" under the terms of Opinion 124 of the International Commission on Zoological Nomenclature. This ruling was necessary and wise, as the relationships between species which were predicated upon these intergeneric divisions were unrealistic and taxonomically unsound in many cases, being based on superficial characteristics of the shells. As an example, the four species of *Conus* included under the heading "Laxi, ventricosi, in dorsum disjecti, super mensam tinnitantes" are placed in three widely differing subgenera of *Conus* under modern arrangements. For the purposes of this paper, however, these groupings are discussed where necessary, as, though often taxonomically indefensible, they sometimes explain Linnaeus' concept of the relationship of species and are thus of assistance in identification.

## THE "MUSEUM ULRICAE"

IN THE FOREWORD I briefly refer to the "Museum Ulricae" of 1764 and there point out not only that it was a work prepared entirely independent of the "Systema naturae," as being a catalogue of a specific collection rather than a general manual, but that it is very probable that many of the species given the same name in the two works were quite different, and that therefore it is a dangerous guide to follow blindly. However, as I refer to it frequently in the discussion of the "Systema" species, it seems wise to supplement those remarks with a further note as to the history of the work and of the collection it covers and to comment upon the limited value of both in identifying the species in the "Systema." The data here presented are drawn largely from a paper by Sven Loven published in the Proceedings of the Royal Swedish Academy of Sciences for 1887-1888, a fully documented and very complete history of both the catalogue and the collection (Loven, 1887).

In 1751, seven years before the publication of the tenth edition of the "Systema naturae," Linnaeus was commissioned to catalogue and describe the natural history collections of King Adolphus Frederick of Sweden and his Queen, Louisa Ulrica. The former collection was housed in Ulriksdal and consisted largely of vertebrates, while the Queen's collection, with which we are here concerned, was kept at her residence at Drottningholm near Stockholm and comprised specimens of the invertebrate phyla, including a large collection of shells. This latter collection, which was much more complete than the private collection of Linnaeus, was said to be the latter's principal source of information as to the exotic shells.

The writing of the catalogue was done in the years 1751 to 1754 and consisted of a file of separate leaflets or "Schedules," each covering the description of a single species, to each of which a number was assigned before publication. Owing to political reasons and other delays, the work was not published until 1764, by which date Linnaeus had completed and published the tenth edition of the "Systema" and was almost ready to announce the twelfth edition. He incorporated

into both editions of the "Systema" many of the species of the Queen's collection. It is instructive to note that, although the actual preparation of the "Museum Ulricae" took place several years before the publication of the greater work, he had already crystallized his theory of nomenclature, and the work is therefore completely binomial. We know that the schedules for the catalogue were kept currently corrected and improved up to 1758 and thus became a part of Linnaeus' research looking to the tenth edition.

Linnaeus had hoped to have the work published with plates of all species, and, in fact, 415 figures of univalves and 21 of bivalves had been prepared by Swedish artists, but not only was the pictorial part of the work never completed but he was, for some unexplained reason, never given the opportunity to approve or identify the figures either by name or number. The plates are now in the library of the Academy of Sciences in Stockholm. Two letters written by Linnaeus to his close friend Abraham Bäck in 1754 and 1755 comment on the fact that Linnaeus had requested the examination of the figures but had never received them. The "Museum Ulricae," when it finally appeared, was merely an unillustrated prodrome of a proposed work. It was not even complete. Loven says of its publication (p. 44): "Though in reality the prior work, it had, from accidental circumstances, become the later publication, and when its time arrived was still denied the final revision. It was sent forth with some haste, and not without some words implying apology."

The King died in 1771, and his collection was removed to Drottningholm in 1778 and placed with the Queen's collection. In 1789 Prof. Olaus Swartz, the botanist, was appointed curator of the two collections. The labels on the specimens today are the work of Swartz and are referred to below. In 1803 the then Swedish king, Gustavus IV Adolphus, gave the collection of Louisa Ulrica to the University of Upsala, where it was placed under the supervision of the eminent professor Thunberg and where it remains today.

In considering the probative value of the specimens in the Queen's collection as repre-



senting the Linnaean types either of the "Museum Ulricae" or of the "Systema," we are first confronted with the fact that there does not exist and never has existed a single label in the collection prepared by Linnaeus. The only clue to the identity of the specimens, independent of the descriptions, is given in Linnaeus' preface to the catalogue itself, in the words: "The short descriptions that I have drawn up for Your Majesty's Natural History collections, Insects as well as Shells, *disposed according to the order in which they were arranged*" (italics mine). In other words, the sequence of species in the catalogue followed the actual sequence of the specimens in the Queen's cabinets. No mention is made of labels. As Loven says (p. 46), "He could not have written this had he named the specimens. And, surely, if there had been labels in Linnaeus' own hand, no one would have been found presumptuous enough to reject them or exchange them for any other."

It does not appear from Loven's extremely comprehensive study whether or not the specimens of the collection and the listings in the catalogue bore the same number, but from the failure to mention this important fact it seems a justifiable assumption that the collection bore no numbers for which Linnaeus was responsible. Bäck (1779), in an oration in memory of Linnaeus delivered before the Academy of Sciences in 1778, said: ". . . both collections are now preserved at Drottningholm, and . . . they are kept in the same order in which Linnaeus arranged them, *the whole marked with his names.*" Loven (p. 46), comments on the phrase that I italicize as follows: "As the matter stands these last words cannot by any means be understood to signify: names written down by Linnaeus himself, but simply specimen-names made out from his descriptions. They had probably been done by some person employed for the purpose and through the agency of Bäck, by the orders of the Queen Dowager . . ." No trace is now left of these names, and it is not known whether they were used as labels or merely consisted of a numbered (or unnumbered) list.

Swartz, who took charge of the collections in 1789, does not allude to them, but he himself had printed sheets of labels, with names

taken from the twelfth edition of the "Systema." These labels he pasted on the specimens themselves, where they remain today. Loven (p. 47) suggests that: "Swartz, the botanist, thus avoided the risk of naming in his own handwriting objects among which he did not feel at home."

Again I quote from Loven (p. 47): "Lastly there is the testimony of Thunberg, himself a disciple of Linnaeus and intimately acquainted with the handwriting of his master, declaring that when he took charge of the Drottningholm collections after their arrival at Upsala, he had searched with the most scrupulous care for a name or anything written by Linnaeus himself, but without discovering a trace of any sort, 'except the printed labels which Professor Olaus Swartz had recently pasted on the shells.' Many years ago also Wahlenberg, who took an active part in these proceedings, affirmed to the writer of this that Linnaeus most certainly had not labeled the Queen's collection."<sup>1</sup>

It seems obvious that the absence of any authoritative labels and the ample opportunity given for the displacement of specimens or their replacement out of regular order after an examination go far to deprive them of any probative value. We are forced to rely on the descriptions alone. If a given description unequivocally and exclusively agrees with a specimen in the collection now at Upsala, it can be safely identified as the species described. If, further, this description in the "Museum Ulricae" refers specifically to a listing in the tenth edition of the "Systema," we can then be sure that the specimen is, in fact, the type of the "Systema" species. If these conditions are not met, the Upsala specimen cannot be certainly identified with the name in either the "Museum Ulricae" or the "Systema."

It may be added that we do not know the manner in which the Queen's collection was

<sup>1</sup> Trybom, in a paper on the then condition of the natural sciences in Sweden, wrote: "Meanwhile there were, and still are, some old valuable collections, as the types of Linné's 'Museum Ludovicae Ulricae,' all with his own labels" (1887, p. 410). This statement is completely at variance with the results of Loven's painstaking research and must be considered as an oversight. Loven calls attention to this error, saying that Trybom's remark "is completely groundless" (Loven, 1887, p. 47, footnote 2).

kept at Drottningholm. At present nearly all the shells are placed in square paper boxes filled with cotton to which they are glued. They are accompanied by slips of paper marked "Mus. Gust. Ad." and on the specimen itself (or in some cases on the cotton) is pasted one of the Swartz labels carrying a Linnaean name taken from the twelfth edi-

tion of the "Systema." In a few cases the printed label is loose. Both the history of the collection, therefore, and the manner of preserving and labeling it suggest that outside of an exact conformity of specimen with description, there is no certain proof that we can lay our hands upon a given Linnaean type.

## CLASS LORICATA

### CHITON LINNÉ

IN THE TENTH EDITION Linnaeus listed only four species in this genus: *hispidus*, *tuberculatus*, *aculeatus*, and *punctatus*. Of the four only one, *tuberculatus*, has been identified.

Of the five species added in the twelfth edition, *fascicularis*, *squamosus*, *ruber*, *albus*, and *cinereus*, all have been recognized and the specific names have been retained, although Hanley and his contemporaries preferred to use for *cinereus* the name *C. marginatus* Pennant, 1777.

The chitons belong to the Order Polyplacophora, the other order in the Class Loricata being the Aplacophora, which lack the plates and are practically without the foot of the Polyplacophora. They are apparently degenerate forms that have descended from a polyplacophorous ancestor. As they are all found in deep water (up to 2228 fathoms in the case of *Pachymenia abyssorum* Heath, 1911) it is not surprising that in Linnaeus' day and, indeed, up to the middle of the nineteenth century, no members of the order had been discovered.

#### *Chiton hispidus*

1758, *Systema naturae*, ed. 10, p. 667, no. 1.

1767, *Systema naturae*, ed. 12, p. 1106, no. 1.

LOCALITY: Not given in either edition.

"C. testa sexvalvi striata."

This name did not appear on the list of species owned by Linnaeus, and there is no specimen in the collection that is referable to the description. No synonymy was supplied, and this inadequate diagnosis, together with the lack of locality, led Hanley (1855, p. 11) to consider the species as unidentifiable. I have come across no helpful comment on this name since Hanley, and I am quite in accord with the opinion that the name be expunged from our lists.

#### *Chiton tuberculatus*

1758, *Systema naturae*, ed. 10, p. 667, no. 2.

1767, *Systema naturae*, ed. 12, p. 1106, no. 2.

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

"C. testa septemvalvi, corpore tuberculato. . . Corpus ovale, tectum supra tuberculis calloso-elevatis, in quincuncem positus. Testae 7, magis transversae, arcuato-striatae, vix carinatae, later-

ibus angulo distinctae; harum 1 et 7 adpersae tuberculis elevatis."

Although the description seems fairly characteristic in the twelfth edition, Hanley was unable to make a positive identification. He merely said that it was probably *C. squamosus* Born, 1780. The latter name is now conceded to be a synonym of *tuberculatus* Linné, and the Linnaean name is restored for this common *Chiton* of the West Indies and Florida.

Born (1780, p. 5, pl. 1, figs. 1-2) cited his *squamosus* as "Linné, S. N.," and adds the further erroneous reference "M.L.U. 465," which was given by Linnaeus for *squamosus*. The Born figures show two entirely different shells; one of these has eight valves and is a fair representation of *tuberculatus* Linné, and the other shows an unidentifiable seven-valved shell with practically smooth valves and an extremely wide girdle. It is easy to understand why the early writers were confused in their comments on the two Linnaean species *tuberculatus* and *squamosus*. The former was described in the "Systema" as "Testae 7" and may have been based upon an abnormal and possibly worn specimen, and it is probable that all the seven- and six-valved chitons described by the early conchologists were based on abnormal individuals or on vague or incorrectly drawn figures.

Even as late as 1878, Dall partially confused the two Linnaean species, saying of *tuberculatus* (1878, p. 300): "It has not been generally united with the *C. squamosus* of L. (S.N., ed. XII), but is not improbably a variety of it, and belongs to the same general group." The specific separability of the two is now admitted. Thus Pilsbry comments in his discussion of *tuberculatus* (1892, 1893, vol. 14, p. 154): "This species has been generally considered to be the *squamosus* of Linnaeus, but that the Linnaean name [*squamosus*] belongs to another species must be regarded as established. The references quoted by Linnaeus in the tenth edition of the Systema clearly show that this is the species which he called *tuberculatus*."

As to the eligibility of the species as the

type of *Chiton* Linné, the first claim was made in favor of its selection as "example" of the genus by Lamarck in his "Prodrome" of 1799. This is unfortunately not a good designation under the terms of Rule 30.<sup>1</sup> The first valid designation is that of Dall (1878, p. 297), "*Chiton* Cpr. Lin., not Adams. Type, *C. tuberculatus* L." It is to be noted that Dall justified his selection on three separate grounds, all of them without weight. He says (1878, p. 300): "Under the circumstances, there can be no doubt that it should be considered as the type of the genus, not only because it is the only recognizable species of those originally described, but because it was selected by Lamarck as the sole example of the genus in 1799, and served as the first species in many of the earlier works in which Chitons were enumerated or described."

<sup>1</sup> In the "Prodrome d'une nouvelle classification des coquilles," 1799, Lamarck described all the genera of mollusks, 126 in number, which were known to him at the time. Of these names 55, or almost half, were his own. After all but a few of the descriptions he listed a single species, with its author. In the case of all but 16 species the author was Linnaeus.

He did not use the word "type." Indeed no author had used that or any similar word, as the conception of types had not theretofore existed nor the value of selecting types realized. He did say, however, on page 67 of his foreword: "I confine myself . . . to the citation of a single species of each genus . . . in order to make myself better understood." In my opinion, the idea of "types" was born in this work, and I am sure that Lamarck was attempting to establish "types."

In the case of Lamarck's own genera the "examples" are valid types, by monotypy. In the case of genera there listed that had been previously erected by others, Lamarck's method runs counter to the specific language of Rule 30 as to "an illustration or example." This writer believes that Lamarck had the undoubted intention to select types in the "Prodrome" and used a satisfactory method to accomplish that end. Indeed he could have done no more, except for the failure to use a word that had not entered the vocabulary of the zoologist. I feel that the authors of Rule 30 have placed an unwarrantable and unfortunate limitation on the procedure to be followed in type designations, at least as applying to designations prior to the adoption of the Rules.

The International Commission has not ruled upon the case of the "Prodrome." In Opinion 79, it held that "rigidly construed," Lamarck's next work, the "*Système des animaux sans vertèbres*," is not acceptable as a source of type designations. In that case the facts are not "on-all-fours" with the facts in the "Prodrome" case, as the "*Système*" listed two or more species in many instances, a situation that at once raises the question of choice.

These fallacious reasons do not, of course, invalidate Dall's designation, and would undoubtedly not have been used by him after the promulgation of the 1901 Rules of Zoological Nomenclature.<sup>2</sup>

In addition to *C. squamosus* Born, 1780 (*non* Linné, 1767), *C. undatus* Spengler, 1797, and *C. bistriatus* Wood, 1815, are synonyms of *tuberculatus*.

Figured in Reeve (1843-1878, vol. 4, *Chiton*, pl. 4, sp. 23). The figure is clearly that of *tuberculatus* although entitled "*C. squamosus* Linné, var.  $\beta$ ," and in Reeve's index of the chitons is called "*striatus* Barnes."

#### *Chiton aculeatus*

1758, *Systema naturae*, ed. 10, p. 667, no. 3.

1767, *Systema naturae*, ed. 12, p. 1106, no. 3.

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

"*C. testa octovalvi striata, corpore subaculeato.*"

Linnaeus, in his own copy of the tenth edition, has indicated his possession of this species, but there is no marked specimen in the collection, and it is altogether omitted in the twelfth edition list of owned species. Certainly there is no specimen in the collection sufficiently like the description to be taken as the type of *aculeatus*. The synonymy is of no assistance as it shows several different but unrecognizable shells. Linnaeus' manuscript notes in the twelfth edition are silent on the subject of this species, although his omission of the name from the manuscript list in that edition justifies the inference that he had already questioned its existence as a good species. There is preserved in the collection a worn specimen of a *Chiton* which was probably (*vide* Hanley, 1855, p. 15) *C. picea* Gmelin, 1791 (which Hanley cites as of Wood). This specimen can be said to meet the requirements of the tenth edition description by the exercise of some clairvoyance, but it certainly does not conform to the expanded diagnosis in the "Museum Ulricae." Hanley, whose detailed discussion of the description and figures of this species

<sup>2</sup> In 1854 the Adams brothers selected *C. aculeatus* as the type of the genus. This is one of the unrecognized species. There is no specific language in the Rules which prevents such a selection, but, if accepted, it would result in such an anomalous situation that I am confident that the authors of the Rules never contemplated such a result.

should be read, found *aculeatus* "still ambiguous."

Several shells were suggested by nineteenth century conchologists as representing the Linnaean *aculeatus*. *Acanthopleura spiniger* Sowerby, 1840, was the most often cited in this connection, but Pilsbry (1892, 1893, vol. 14, p. 222), in discussing Sowerby's shell, says: "It is now impossible to prove that this is, or is not, the *Chiton aculeatus* of Linné, but anyone who will consult the original description, 'C. testa octovalvi striata corpore subaculeato,' then turn to Rumphius's figure cited as an illustration, will be prepared to acquiesce in Hanley's suggestion (*Ipsa Linn. Conch.*) that the species be dropped as unidentifiable."

A shell is figured in Reeve (1843-1878, vol. 4, *Chiton*, pl. 9, sp. 49) under the name "*aculeatus*." It is not recognizable. Reeve, however, says in the text: "There appears to be little doubt but that the *C. spiniferus* of Frembley, though published as a distinct species by M. Deshayes in his new edition of Lamarck, is the old *aculeatus* in fine condition." Frembley's shell is found in Chile. Reeve's identification is not followed today, and I have found no further helpful comments on this name, which can be dropped as unrecognized.

The *C. picea* Gmelin which Hanley mentioned above is equal to *Acanthopleura granulata* (Gmelin), a native of Florida and the West Indies. This, we may assume, would remove it too far from the range of *aculeatus* as given in the "Systema."

#### *Chiton fascicularis*

1767, *Systema naturae*, ed. 12, p. 1106, no. 4.

LOCALITY: "In Barbaria" (1767).

"C. testa octovalvi, corpore ad valvulas utrinque fasciculato. . . Corpus cinereum, laeve. Testae leviter carinatae. Fasciculi pilorum totidem, albidii, juxta testarum latera corpori insident."

This species is not in the collection, no synonymy was supplied, and the description, standing alone, is hardly adequate to identify it. Many authors believed it to be the *C. crinitus* of Pennant, 1777, but that species is probably distinct. In spite of the deficiencies in the diagnosis, the common *Acanthochiton fascicularis* of most British

authors, a native of the Mediterranean and the English Channel, is today accepted as the shell described under that specific name in the "Systema," and the locality given by Linnaeus, "in Barbaria," has been, I suspect, one of the most weighty factors in the identification.

Hanley (1855, p. 15) concluded that *C. crinitus* Pennant and Linné's *fascicularis* were identical, but Sowerby demonstrated their separability to the satisfaction of many of his other contemporaries, among them Reeve, whose remarks I quote in full (1843-1878, vol. 4, *Chiton*, pl. 10, sp. 53): "After a careful investigation of the subject I am led to conclude, with Mr. Sowerby, that the *C. fascicularis* and *crinitis* are distinct species, but I think he has erred in the identification of names. The larger species above described, inhabiting the Mediterranean and the English Channel, and in England only the south coast, appears to be the original *fascicularis* of Linnaeus 'from the coast of Barbary,' whilst the smaller, which inhabits our coasts throughout and as far north as the Shetland Islands, is the *C. crinitus* figured on an enlarged scale by Pennant. The *C. fascicularis* of Chemnitz, which Mr. Sowerby considers 'beyond doubt' identical with the Linnaean species, answers to neither of those in question; it refers rather to the *C. Zelandicus* of Quoy. . . ."

*Chiton fascicularis* Linné, 1767, the "larger species" referred to by Reeve, is the type of *Acanthochiton* Gray, 1821, by original designation.

This species was reported from "Barbaria" by E. Brander, Linnaeus' friend and the Swedish Consul at Algiers, who was the source of many species of mollusks in the "Systema." It is generally conceded that the Brander localities are almost, if not quite, as trustworthy as the Scandinavian and other north European localities of Linnaeus.

Figured in Reeve (1843-1878, vol. 4, *Chiton*, pl. 10, sp. 53).

#### *Chiton squamosus*

1767, *Systema naturae*, ed. 12, p. 1107, no. 5.

LOCALITY: "In Indiis" (1767).

"C. testa octovalvi semistriata, corpore squamuloso."

There is but one shell in the collection that

fits the description of *squamosus* in both the "Systema" and the "Museum Ulricaë." This specimen, the *Chiton fasciatus* of Hanley's day, was therefore chosen by him (1855, p. 16) as the type of *squamosus* Linné, and he recommended the restoration of the Linnaean name. This decision is inevitable and is universally followed today. Linnaeus' *squamosus*, as is noted above under *C. tuberculatus*, is not the *squamosus* of Born and of the British writers of the early nineteenth century, which was not represented in the collection.

The synonymy is extensive. It is probably equal to, among others, *C. tigris* Spengler, 1797; *C. scaber variegatus* Chemnitz, 1795; *C. fasciatus* Wood, 1815; *C. chemnitzii* Pfeiffer, 1840; *C. marmoreus* Reeve, 1847 (non Fabricius, 1780); *C. spengleri* Blainville, 1825; and *C. pictus* Blainville, 1825.

Figured in Pilsbry (1892, 1893, vol. 14, pl. 35, figs. 80-82).

#### *Chiton punctatus*

1758, Systema naturae, ed. 10, p. 667, no. 4.

1767, Systema naturae, ed. 12, p. 1107, no. 6.

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

"C. testa octovalvi laevi, corpore punctis excavatis."

The description of this species is totally inadequate, no specimen is in the collection which remotely conforms to its wording, and the figures cited in both editions apparently show four different species. It must be rejected as unrecognizable, as it is impossible even to guess at its modern genus.

The name is derived from the description of the species cited from the "Chinensia Lagerstomiana," one of the "Amoenitates" (it was cited as "Amoen. Acad. 3, p. 256" in the tenth edition). That description reads, "Chiton corpore punctato, testis octo." It is possible, as Hanley (1855, p. 16) believed, that the type, which Linnaeus may have originally seen, was an eroded specimen, from the girdle of which spines had been removed, leaving holes or pits.

#### *Chiton ruber*

1767, Systema naturae, ed. 12, p. 1107, no. 7.

LOCALITY: "In Oceano septentrionali instar Patellae affixa" (1767).

"C. testa octovalvi arcuato-substriata, corpore

rubro. . . Testa ovalis, oblongiuscula, dorso carinata, valvulis oblique subarcuato-striatis."

This was one of the few chitons owned by Linnaeus, and since the specimen found in the collection agrees, and uniquely agrees, with the description, its identification has been universally admitted.

We are probably justified in assuming that Linnaeus was entirely familiar, as a collector, with this and the two following species, to all of which he gave Scandinavian, or at least northern European, localities, and of all of which he possessed specimens. This not only strengthens the accepted identification of these shells and confirms the necessity of retaining the Linnaean specific names, but it also illustrates the fact, referred to in the Foreword, that the northern European localities of the "Systema," unlike many of the others, can be relied upon.

*Chiton ruber* Linné was for a long time included in the genus *Trachydermon* Carpenter, 1864, but with the rejection of the name *Trachydermon* (see discussion of *Chiton albus*, below) it falls into the genus *Tonicella* Carpenter, 1873, and is therefore cited as *Tonicella ruber* (Linné), 1767. *Chiton ruber* Lowe, 1825, and Carpenter, 1864, are identical with the Linnaean *ruber*. It is not *Chiton ruber* Spengler, 1797.

#### *Chiton albus*

1767, Systema naturae, ed. 12, p. 1107, no. 8.

LOCALITY: "In O. Islandico" (1767).

"C. testa octovalvi laevi; valvula prima postice emarginata. . . Testa ovalis, laevis, alba, vix dorsata, minus carinata."

This species is also represented by a specimen in the collection and, although no pictorial synonymy was given in the "Systema," it was easily recognized by the short though characteristic description. It is now considered a member of the genus *Lepidochiton* Gray, 1821.

It was long placed in *Ischnochiton* Gray, 1847, and in the subgenus *Trachydermon* Carpenter, 1864, but it seems to be settled by the researches of Dall (1918, p. 3) and Iredale (1914, p. 127) that *Trachydermon* Carpenter is preoccupied and must be superseded by *Lepidochiton* Gray. Inasmuch, however, as Dall considers that *Ischnochiton* is a synonym of *Lepidochiton*, the rejection of

*Trachydermon* Carpenter is unimportant in the taxonomic position of *albus* Linné.

Thiele (1931, 1935, vol. 1, p. 18) still uses *Ischnochiton* Gray for *C. albus*, putting it in the subgenus *Lepidopleuroides* Thiele, 1928.

The species is common along the New England coast as well as in the northern European waters to which it was restricted by Linnaeus.

It is figured by Pilsbry (1892, 1893, vol. 14, pl. 7, figs. 35-38). Reeve does not figure *C. albus* nor cite it.

#### ***Chiton cinereus***

1767, *Systema naturae*, ed. 12, p. 1107, no. 9.

LOCALITY: "In O. Norvegico" (1767).

"C. testa octovalvi ovata . . . Testa vix Cimice major, planiuscula, cinerea, ovata s. postice paulo latior, parum carinata, non glabra."

This shell is also found in the Linnaean collection and, by the same process as with the last two species, was easily recognized. Hanley (1855, p. 17) called it the *Chiton marginatus* of Pennant, 1777, and all British writers up to Hanley's time, and did not expressly suggest the restoration of the Lin-

naean specific name. The *marginatus* is now definitely recognized as a mere synonym of *cinereus* Linné, and the latter name is always used. It is the type of *Lepidochiton* Gray, 1821, by subsequent designation, Iredale, 1914.

*Chiton cinereus* is a common British shell. Binney's edition of Gould (1870, p. 260) reports a specimen of this shell from Massachusetts. As it was living when found, the theory that it was introduced in ballast, as so many species are that are collected in the vicinity of shipyards, would seem to be repelled. It is deposited in the collection of the Academy of Natural Sciences of Philadelphia. As far as I am aware, no further specimens have been found on this side of the Atlantic.

In addition to being equal to *C. marginatus* Pennant, and of many authors following him, it is Reeve's *Chiton circumvallatus*, 1847.

It is not *Lepidopleurus cinereus* Sars, 1878, nor *Chiton cinereus* Poli, 1791, and Montagu, 1803.

It is figured in Reeve (1843-1878, vol. 4, *Chiton*, pl. 28, sp. 191).

[PHYLUM ARTHROPODA, CLASS CRUSTACEA,  
SUBCLASS CIRRIPIEDIA]

[LEPAS LINNÉ]

THE 10 SPECIES of *Lepas* described by Linnaeus are all demonstrably barnacles, members of the Phylum Arthropoda, Class Crustacea, and Subclass Cirripedia, and therefore need not be individually discussed in this paper. Linnaeus placed them in Vermes Testacea under the misapprehension, which was shared by his predecessors and immediate successors, that they were multivalve mollusks, as they live in a calcareous shell which they se-

crete, and therefore their position in the "Systema," immediately after *Chiton* and before *Pholas*, was entirely consistent. The specimens in the collection are in bad condition and bear no identifying names or numbers. The synonymies are for the most part distinctly bad. In spite of this, most of the species have been satisfactorily identified. In connection with the incorrect allocation of this group, it is to be noted that Linnaeus took the name *Lepas* from the earlier naturalists who had applied it to the limpets.



## CLASS PELECYPODA

### PHOLAS LINNÉ

*Pholas* IS THE LATIN (AND GREEK) word used by the ancients for all of the burrowing mollusks, both those now in the family Pholadidae and those members of Mytilidae that have burrowing habits. The name comes from the Greek verb *pholeo*, to bore, or lurk in a hole. It is a feminine noun in the original Greek, though used as masculine in Latin, at least by Linnaeus, and this use has persisted.

All of the six specific names that Linnaeus listed in the twelfth edition have been satisfactorily identified. One remains in *Pholas*; two have been placed in *Barnea* Risso, 1825; one is now in *Martesia* Blainville, 1824; one in *Zirfaea* Gray, 1842; and the sixth, *pusillus*, is found to be a mere synonym of *Martesia striata* Linné, so that the net number of good species is reduced to five. In the tenth edition Linnaeus listed only five specific names in the genus, *crispata*, which he moved to *Pholas* in the twelfth edition, having been included in *Mya* in the tenth.

The type of the genus is *Pholas dactylus*, by subsequent designation, Children, 1822.

The family Pholadidae is an extremely homogeneous group whose characteristics are for the most part constant and not duplicated in any other family. All species have an edentulous hinge, with the ligament and resilium either absent or obsolete. The shells, because of the lack of these features, are provided with one or more accessory plates, which are usually shelly but sometimes membranaceous, to protect the margins of the valves. These plates are often missing in specimens in collections and are very infrequently found with fossil shells. The most striking and unique feature is the pair of styloid apophyses, prominent spoon-shaped processes projecting into the cavity of the shell from under the umbones.

Because of the presence of these accessory elements, the pholads, along with certain non-molluscan groups, were lumped by the early conchologists in a so-called "class" which they labeled "Multivalvia." Lamarck, for instance, in 1799, included under this heading the molluscan genera *Pholas*, *Chiton*, and *Teredo* Linné, *Gioenia* Bruguière, 1789,

and *Fistulana* Forskål, 1775, and the two genera of Cirripedia known to him, *Balanus* Da Costa, 1778, and *Anatifa* Bruguière, 1789. Linnaeus himself used the heading "Multivalvia" for *Chiton* and *Lepas* in his list of genera in the Vermes Testacea (1758, p. 645).

### *Pholas dactylus*

1758, Systema naturae, ed. 10, p. 669, no. 10.

1767, Systema naturae, ed. 12, p. 1110, no. 20.

LOCALITY: "Intra Europae australioris scopulos" (1758); "intra Europae scopulos, per-terebratis saxis, noctu lucens" (1767).

"Ph. testa oblonga hinc reticulato striata."

A specimen of the common European *Pholas dactylus* is in the Linnaean collection. This shell agrees so well with the great majority of the figures in the elaborate synonymy (15 figures from nine pre-Linnaean iconographies are cited) that its identification with the species of the "Systema" has never been questioned, in spite of the very brief and unenlightening description. It is still retained in the original genus, although it has been placed, from time to time, in *Hypogaeoderma* Poli, 1795, *Thovana* (Leach MS) Gray, 1847, *Dactylina* Gray, 1847, and *Pragmapholas* Fischer, 1887. It is still often cited as *Dactylina dactylus*.

Children designated it as the type of *Pholas* Linné in 1822, and Lamarck, in 1799, used the species as the single illustrative "example" of the genus.

Figured in Donovan (1799-1803, vol. 4, pl. 118), and in Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, atlas, pl. 87, figs. 1-5, the typical form, and figs. 6-7, the variety *callosa*).

### *Pholas costatus*

1758, Systema naturae, ed. 10, p. 669, no. 11.

1767, Systema naturae, ed. 12, p. 1111, no. 21.

LOCALITY: "Intra scopulos Europae australis" (1758, 1767).

"Ph. testa ovata costis elevatis striata."

It was the excellent figure from Gualtieri that determined the identification of this species, rather than the description, which, in common with most of the diagnoses in this genus, leaves something to be desired. This

figure was supplemented by a distinctive drawing from Lister in the "revised twelfth edition." The locality was erroneous, as the species is an American one, the common "angel-wing" of our Atlantic coast. It is now included in the genus *Barnea* Risso, 1826.

It is the type of the genus *Scobina* Bayle, 1880 (a new name for the "*Pholas* Linné" of H. and A. Adams). As *Scobina* had been used for a group of insects many years prior to 1880, Grant and Gale (1931, p. 431) proposed the name *Scobinopholas* as a substitute, making it a section of *Barnea* Risso and designating *Pholas costatus* as type. This group is the *Pholas* of Lamarck, 1801, "example" *Pholas costatus*, but not of Lamarck, 1799, "example" *Pholas dactylus*, which is the Linnaean genus.

The range of the species is from Cape Cod to the West Indies, becoming much more common at the subtropical end of its area.

Figured in Reeve (1843-1878, vol. 18, *Pholas*, pl. 1, sp. 2).

#### *Pholas striatus*

1758, *Systema naturae*, ed. 10, p. 669, no. 12.

1767, *Systema naturae*, ed. 12, p. 1111, no. 22.

LOCALITY: "Intra scopulos maritimos Europae australis" (1758, 1767).

"Ph. testa ovata multifariam striata."

The description of this species is as brief as that of *costatus*. One could not choose two *Pholas* so widely differing in appearance as *costatus* and *striatus*, yet the only difference in the two descriptions is "costis elevatis striata" for *costatus* and "multifariam striata" for *striata*. No hint is given of the great difference in size, or of the peculiar appearance of *striata* apart from the sculpture. Without the synonymy it would have been impossible to determine these two species. Fortunately, as in the previous case, a figure cited from Gualtieri proved conclusive. A specimen of the *striatus* of authors was in the collection, but the writing on the box containing it is not in Linnaeus' handwriting, which deprives it of any authority. It is certain that Linnaeus did not possess the shell, as it does not appear on his list. The stated locality was erroneous, as it is an American species, the European records, if correct, having possibly been based on individuals found in ship's timbers. In the last analysis we are left with a figure from

Gualtieri as our only proof of the identity of either of these species. We know what Linnaeus was describing, but I feel that it is only the traditional usage that justifies us in retaining the specific names of the "Systema" in such a situation.

Sowerby, in the "Thesaurus," points out the resemblance of *striata* to *P. cuneiformis* Say, 1822, but notes that the striae on the anterior portion of *cuneiformis* are curved, rather than angular as in *striatus*. The two species are not identical.

The present species is now placed in the genus *Martesia* Blainville, 1825. It is often stated to be the type of that genus, which, however, was monotypic, with *Pholas clavator* Lamarck (*P. cuneiformis* Say) as a single species. It has never, so far as I have been able to find, been placed in any other genus than *Martesia*, although it has a very large synonymy owing to a surprisingly large number of other specific names, based either on careless research or on the giving of specific value to slight differences in sculpture or form. It is identical with *Pholas pusillus* Linné (below), for which Linnaeus gave the locality "in America." This was correct, but the author believed that two separate species existed, one on each side of the Atlantic.

Figured in Reeve (1843-1878, vol. 18, *Pholas*, pl. 8, sp. 32, a, b, c).

#### *Pholas candidus*

1758, *Systema naturae*, ed. 10, p. 699, no. 13.

1767, *Systema naturae*, ed. 12, p. 1111, no. 23.

LOCALITY: "In Europae et Americae scopulis marinis" (1758, 1767).

"Ph. testa oblonga undique striis decussatis muricata."

The description is more characteristic in this instance, although the figure from Lister was something more than a mere corroboration of the identification. A properly marked specimen of the *Pholas candidus* of authors is in the collection, which confirms this determination. It falls today in the genus *Barnea* Risso, 1826, of which it is the type, by monotypy. Risso called it *Barnea spinosa*, but the Linnaean specific name has been restored. As the type of *Barnea* it is to be cited as *Barnea spinosa* Risso, equals *Pholas costatus* Linné, by monotypy. It is a European species, as Linnaeus correctly stated, being common in

Great Britain, burrowing in chalk.

Figured in Donovan (1799-1803, vol. 4, pl. 132).

#### *Pholas pusillus*

1758, *Systema naturae*, ed. 10, p. 670, no. 14.

1767, *Systema naturae*, ed. 12, p. 1111, no. 24.

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

"Ph. testa oblonga rotundata arcuato-striata. . . . Valvulae accessoriae a tergo testae singulares; an distincti generis?"

This name is mentioned above in connection with *Pholas striatus* (*Martesia striata*), with which it is identical.<sup>1</sup>

The Linnaean collection does not contain any specimen marked *pusillus* by either name or number, nor is there any further reference to it in the various manuscripts of the author. It is to be inferred that he did not possess it, and possibly he had never even seen the shell on which the name was based.

The only reference given was to Browne's work on the mollusks of Jamaica.

The description is interesting. Although the generic diagnosis of *Pholas* in the "Systema" refers to the accessory plates ("cum minoribus saepe accessoriis," 1758, and "cum minoribus accessoriis difformibus, ad cardinem," 1767), it is to be noted that, of the specific descriptions, only that of *pusillus* refers to these features. There the subdescription reads, "Valvulae accessoriae a tergo testae singulares." The word "singulares" here must obviously be given its secondary meaning of "odd" or "extraordinary" rather than the primary meaning of "single." The final words of the description, "an distincti generis?", show that Linnaeus was impressed by the distinctive characteristics of the species, which, strangely enough, did not occur to him in the case of *striatus*.

Linnaeus correctly placed *pusillus* as a native of "America," following Browne's work, and therefore decided that it was different from his *striatus*, which he had unwittingly placed in Europe.

<sup>1</sup> Up to the middle of the last century the identity of *P. pusillus* with *P. striatus* was not clearly established, most commentators regarding *pusillus* as a variety of the other shell. Hanley (1855, p. 26) did tentatively recognize their common identity, but "with a note of interrogation." Since that time, however, all revisers of the genus *Pholas*, who have admitted that the two names refer to one species, have selected *striatus* as the name to be retained, with *pusillus* in its synonymy.

#### *Pholas crispata*

1758, *Systema naturae*, ed. 10, p. 670, no. 15 (*Mya crispata*).

1767, *Systema naturae*, ed. 12, p. 1111, no. 25 (*Pholas crispata*).

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

"Ph. testa ovali hinc obtusiore crispato-striata, cardinis dente curvo. . . . Testa tertia exigua ad cardinem."

A specimen of the *Pholas crispata* of all nineteenth century authors is in the collection in its original marked box and is the only shell in the cabinet that meets the requirements of the description, which is considerably more enlightening than usual. Certainly no other *Pholas* could be described as "obtusiore crispato-striata." The Lister figure is corroborative of this view as are also the two figures added by Linnaeus in his manuscript notes, another from Lister and one from Petiver. The author added a long additional description in manuscript in his copy of the twelfth edition, which dispels any doubt as to the shell he had before him: "Habet dentem vacuum porrectum ut *Mya*, sed margo posticus recurvatus ut *Pholas*. Striae testarum hinc scabrae, inde laeves. Differt a reliquis dente intus recurvato vacuo. Testa multum hians connectit cum sequente." As *crispatus* is the last species in *Pholas*, it is not clear what Linnaeus meant by the words "cum sequente," unless he referred to *Mya truncata* which is the next species in the "Systema." That shell is "widely gaping," but it would seem unnecessary to use this comparison, inasmuch as several of his species of *Pholas* are equally gaping.

The species is now a member of the genus *Zirfaea* Gray, 1842, and is the type, by subsequent designation, Gray, 1847. The genus is often attributed to Leach, 1852, by those who deny the validity of Gray's 1840 and 1842 listings of the name. Grant and Gale (1931, p. 432) accept Gray's 1842 work as validly proposing *Zirfaea* (Gray, 1842, p. 76).<sup>2</sup>

<sup>2</sup> The 1840 and 1842 uses of the name by Gray occur in editions 42 and 44, respectively, of Gray's "Synopsis of the contents of the British Museum." These two editions were not available to this writer, but Neave (1939-1940, vol. 4, p. 702) considers the 1840 use a *nomen nudum* and accepts the 1852 use as valid. He does not list the 1842 use.

The species is known on both sides of the Atlantic. There are numerous reports in the literature of its occurrence on the Pacific coast of the United States, but there is some controversy as to whether or not these reports are authentic. I have not seen the specimens on which they were based.

Figured in Donovan (1799-1803, vol. 2, pl. 62, an excellent figure showing both the inside and outside of the valve).

#### MYA LINNÉ

The generic name *Mya* is thought to be derived from Myax, the Latin name for a mussel found on the north shore of the Bosphorus. If this is correct we can only guess as to whether Linnaeus realized that he was using the name for a group of species which, while related to the mussels and which he partially confused with them in the "Systema," are not in fact mussels, or the lexicographers were content to use the name mussel as a general term for any bivalve.

Eight species of *Mya* are listed in the tenth edition. Of these eight, *M. crispata* was moved to *Pholas* in the twelfth edition and *M. lustraria* to his newly created genus *Mactra* and are discussed under those genera. One new name was added in the twelfth edition, *M. arctica*, thus bringing the total number down to seven.

It appears from the manuscript notes for the projected "revised twelfth edition" that the author planned a further breakdown of his *Mya*. He proposed to erect another new genus, *Unedo*, for the reception of *M. margaritifera* and *M. pictorum* and to transfer *M. perna* to a new genus, *Perna*. The history and synonymy of *Perna*, the majority of the species of which he planned to take from *Ostrea*, are reserved for the discussion of the latter genus.

The type of *Mya* Linné is *Mya truncata* Linné, 1758, by subsequent designation, Children, 1822.

#### *Mya truncata*

1758, Systema naturae, ed. 10, p. 670, no. 16.

1767, Systema naturae, ed. 12, p. 1112, no. 26.

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

"M. testa ovata postice truncata, cardinis dente antrorsum porrecto obtusissimo."

This easily identified species was recog-

nized not only by the characteristic description and an adequate synonymy but by the existence, in a properly marked box in the collection, of a specimen of the shell which has always been known under the Linnaean name.

Linnaeus limited its range to European waters. It is, however, circumpolar in Arctic waters and very common in New England.

*Mya truncata* can probably look to *M. arenaria* Linné as its ancestral form, from which it has sufficiently diverged today to justify its specific separability. There are, however, several Recent intermediate forms connecting the two to which it is difficult to give either name. The best known of these are the Pacific forms *japonica* Jay, 1857, and *profundior* Grant and Gale, 1931, which were both described as varieties of *M. arenaria*. A detailed and very helpful discussion of these and other varieties is given by Grant and Gale (1931, pp. 411-414).

The most interesting variety of *truncata* is *M. truncata uddevalensis*, described by Forbes (1846, p. 407) from a fossil specimen found in southern Norway. It has since been found in Pleistocene beds on the Gulf of St. Lawrence and in various places in Europe, and living in the western Atlantic from Greenland to the St. Lawrence. This shell is apparently a true divergent from *truncata* rather than an intermediate between *truncata* and *arenaria*, as the divergence takes the form of a very pronounced truncation of the posterior margin which has an exaggerated slant anteriorly. This form intergrades with the typical *truncata*, which is, at best, a very variable species.

*Mya truncata* is figured by Foster (1946, pl. 17, pl. 18, figs. 1-4).<sup>1</sup>

#### *Mya arenaria*

1758, Systema naturae, ed. 10, p. 670, no. 17.

1767, Systema naturae, ed. 12, p. 1112, no. 27.

LOCALITY: "In O. Europae septentrionalis sub arena, foraminibus duobus detegenda" (1758, 1767).

"M. testa ovata postice rotundata, cardinis dente antrorsum porrecto rotundato denticuloque laterali . . . Cardinis dens in altera tantum

<sup>1</sup> Foster's paper, cited above, contains additional information on the characteristics and range of the form *uddevalensis*.

testa prominens cum denticulo parallelo versus vulvam."

As in the case of the preceding species all the details of the diagnosis in the "Systema" are clear and unequivocal, and there is a specimen of the shell, properly marked, in the collection. It is the *arenaria* of all authors since the middle of the last century, although prior to that time a number of other specific names were given to it, many of them being based on forms that are now considered varietal.

As with *M. truncata*, Linnaeus ignored the American range of the species. It is the soft-shelled clam of New England, so common as to be an important article of commerce. It is not, however, circumpolar, as its native congener in the Pacific is a different species, the true *arenaria* that is now taken on the West Coast from northern California to Puget Sound being the result of artificial introduction at San Francisco of stock from New England.

*Mya arenaria* is the type of the genus *Arenomya* Winckworth, 1930, a name whose generic value has not been widely accepted in the United States. Winckworth (1930, p. 15) says: "The marked conchological differences between adult *Arenomya* and *Mya* (type *truncata* L.) seem sufficient reason for giving this name."

Figured by Foster (1946, pl. 20, figs. 1-3; pl. 21, figs. 1-2).

#### *Mya pictorum*

1758, *Systema naturae*, ed. 10, p. 671, no. 19.

1767, *Systema naturae*, ed. 12, p. 1112, no. 28.

LOCALITY: "In Europae fluviis" (1758, 1767).

"*M. testa ovata, cardinis dente primario crenulato, laterali longitudinali: alterius duplicato.*"

The diagnosis of this species is not so conclusive as are the diagnoses of the preceding two. The description might fit more than one *Unio*, and the synonymy shows both *Unio pictorum*, the common fresh-water mussel of Europe, and an indeterminate species, which some writers have thought to be *Unio tumidus* Retzius, 1788.

Taken as a whole, the weight of probability is in favor of the shell that now universally bears the name *pictorum* and that was shown in the figure cited from Lister. There are several *Unio* in the collection. None of them

bears a "Systema" number, but a specimen of our *Unio pictorum* has written upon it references to two other Lister figures, both of which are sufficiently like the figure cited in the "Systema" to be accepted. In any case, our *pictorum* is the recognized identification. It is now placed in the genus *Unio* Retzius, 1788.

*Unio* was first described as a genus containing species with, and species without, lateral teeth. No type was named at this early date. In 1815 Oken divided the group, calling the species with lateral teeth *Lymnium* and the remainder *Unio*, and selected *U. margaritifera* (Linné) as the type of the latter. Schumacher in 1817 reversed this grouping, retaining *Unio* for the species with teeth and proposing the name *Margaritana* for the rest and selecting *margaritifera* as the type of the new genus. Thus the same species has been selected for two different groups so far as dentition of the hinge is concerned. In this situation there developed considerable doubt as to the author of *Unio*, as to its type, and even as to the genus in which many of its species should be placed. A. E. Ortmann (1911b, pp. 88-91) states the case for all these points of view and (1911a, p. 21) states that *M. pictorum* is the type of *Unio* Retzius. I agree with most of Ortmann's conclusions, but unfortunately he says (1911b, p. 89) that Bruguière described *Unio* in 1792 and adds, "Consequently Bruguière has the priority." Bruguière never described *Unio* in 1792 or at any other date. The only volume of the "Encyclopédie méthodique" that he wrote (appearing in 1789-1792) was alphabetically arranged and contained the genera only up to *Conus*. The attribution of the genus to him rests upon a plate of figures headed "*Unio*" in plate volume 2 of the "Encyclopédie" published in 1797. Although the International Commission has now ruled, in an opinion as yet unpublished, that these plate headings are sufficient to validate a genus, I cannot agree with Ortmann that Bruguière's *Unio* "has the priority" over Retzius' *Unio* which was nine years earlier.<sup>1</sup>

<sup>1</sup> It has been the accepted, and to me the sound, view that those generic names of Bruguière that were based on mere plate headings in the "Tableau" of the "Histoire naturelle des vers" were not good genera in that they did not conform to the requirements of Article

As the great majority of American writers credit Retzius as the author of *Unio*, I am adhering to that opinion, with which I fully concur. *Mya pictorum* Linné, 1758, is the type, as designated by Ortmann in 1911 (*loc. cit.*).

The most characteristic figure of *pictorum* is, I suggest, to be found in Donovan (1799–1803, vol. 5, pl. 174).

#### *Mya margaritifera*

1758, *Systema naturae*, ed. 10, p. 671, no. 20.

1767, *Systema naturae*, ed. 12, p. 1112, no. 29.

LOCALITY: "In totius orbis arctici cataractis" (1758, 1767).

"M. testa ovata antice coarctata, cardinis dente primario conico, natibus decorticatis."

A correctly numbered specimen of the shell, which has always been known as *margaritifera*, is present in the Linnaean collection. It agrees with the description, which is unusually enlightening, and with the figures cited by Linnaeus. It is generally placed in the genus *Margaritana* Schumacher, 1817, and is the type of the genus by original designation.

There has been a great deal of controversy as to the proper genus to receive this species. It is concerned largely with the dentition of the hinge,<sup>1</sup> on the several contradictory divi-

25 of the Rules and of Opinion 1. Bruguière never wrote any description of these genera. Lamarck (1799, p. 66) admitted that his predecessor had written nothing as to their characteristics and said that he had merely "planned" their erection ("conçu l'établissement"). The species which the plates in question depicted were not identified by specific names for many years after Bruguière's death, many of them being named for the first time by Deshayes in the later volumes of the "Histoire naturelle des vers" (1830–1832, vol. 2; 1832, vol. 3). It is even possible that Bruguière did not supervise or even see the plates, which appeared at intervals from 1792 until 1816, as he left France sometime in 1792 on a voyage from which he never returned. Such a situation does not appear to constitute a basis for validity under the Rule of Priority.

A recent Opinion of the International Commission on Zoological Nomenclature (as yet unpublished at this writing) holds that these "plate-heading" genera are considered valid Bruguière names as of the date of the publication of the respective plates, and I am constrained to follow this ruling in these papers. I have set forth my own views in more detail elsewhere (1947b).

<sup>1</sup> Woodward (1851–1856, p. 274) calls attention to the fact that the posterior teeth of *margaritifera* become obsolete with age which might prove confusing unless a growth series of the shell is studied.

sions of *Unio* based on the hinge, and the arguable failure of Oken in 1815 to select, for *Unio*, a type that was a normal member of the genus. These questions are referred to under the previous species and are too complex to be further discussed in this paper.

An excellent figure of the species is found in Reeve (1843–1878, vol. 16, *Unio*, pl. 64, sp. 325).

#### *Mya perna*

1758, *Systema naturae*, ed. 10, p. 671, no. 21.

1767, *Systema naturae*, ed. 12, p. 1113, no. 30.

LOCALITY: "In Freto Magellanico" (1758, 1767).

"M. testa oblonga dilatata basi angustiore compressa. . . Forte Mytili species."

The Linnaean collection contains a specimen of the *Mytilus perna* of post-Linnaean authors marked with the number of *perna* in the "Systema," and this specimen so perfectly conforms to the description and to the single figure from Argenville cited that it has always been accepted as the type of the Linnaean species.

The addition to the description in the twelfth edition, "Forte Mytili species," suggests that Linnaeus more than suspected a relationship that his successors confirmed, and a manuscript note in his copy of the twelfth edition indicates that he intended to transfer the species to the new genus *Perna* in the "revised twelfth edition," a genus of which the restricted *Mytilus* of Lamarck is equivalent. It is, in fact, a true mytilid, with the elongated shape and terminal umbones of *Mytilus*.

Thiele puts *M. perna* in the subgenus *Chloromya* Mörch, 1853, as the subgenotype, citing it as "*Mytilus* (*Chloromya*) *perna* (Linné) 1758."

Figured in Reeve (1843–1878, vol. 10, *Mytilus*, p. 6, sp. 23).

#### *Mya vulsellia*

1758, *Systema naturae*, ed. 10, p. 671, no. 22.

1767, *Systema naturae*, ed. 12, p. 1113, no. 31.

LOCALITY: "In Indiis."

"M. testa linguiformi, cardine terminali depresso semiorbiculato."

The collection contains no specimen of this shell, and the description, apart from the fact that it indicates a mytilid-like species, is not of much help. It is necessary to refer to

the description in the "Museum Ulricae" for the identification. This is considerably more illuminating, and conchologists have agreed that Linnaeus had before him a specimen of *Vulsella lingulata* Lamarck, 1801.

*Vulsella* Röding, 1798, contained only two species, *V. major* and *V. minor*. These were apparently both based upon *Mya vulsella* Linné, although the figures cited in the synonymy in the Bolten Catalogue (from Chemnitz) indicate that Röding may have thought that they were in fact different shells. The genus was later expanded by Lamarck who renamed the Linnaean species *Vulsella lingulata*. It is so cited today and credited to Lamarck, 1801. In the "Prodrome" of 1799, Lamarck used *Mya vulsella* as the type of the genus *Vulsella*. It is probably wise to use the Lamarckian name instead of restoring the *vulsella* of the "Systema," as there is so little in the diagnosis of 1758 that is of real probative value, and the name *lingulata* has become fixed in the literature.

Swainson's *Rentiella* is probably a synonym of *Vulsella* Röding, and Gray points out that Swainson undoubtedly based his genus on a distorted specimen of a *Vulsella*. *Volsella* Scopoli, 1777, for a group of mytilids, is not a homonym. It is unfortunate that two names so similar should be used for groups so closely related.

*Vulsella lingulata* is a native of the Indo-Pacific region. It is difficult to find characteristic figures of the species. Plate 16, figure 21, in Woodward (1851-1856) is fairly illustrative, but the best figure is in Sowerby (1820, 1825, 1834, vol. 1, pl. 123, upper figures).

#### *Mya arctica*

1767, Systema naturae, ed. 12, p. 1113, no. 32.

LOCALITY: "In Oceano Norvegico" (1767).

"M. testa striata: valvulis carinis duabus spinulosis; cardine edentulo. . . Testa magnitudinae Fabae, rudis, facie Arcae noae, pallida. Antice retuso-planiuscula, parte anteriore obtusissima, posteriore brevior, acutiuscula; pars anterior a natibus excurrit angulis duobus remotis antrorsum subaculeatis. Cavitas interna lactea est. Cardo vix ullus."

In spite of the lack of any synonymy, *arctica* was readily identified by the fairly satisfactory description in the "Systema" and the presence in the collection of a speci-

men of the common and widely distributed *Saxicava arctica*, which was obviously the shell from which Linnaeus drew his data.

In 1802 Fleuriau de Bellevue erected the genus *Saxicava*, a genus with a single species, *Saxicava striata*. This shell is demonstrably identical with *Mya arctica* Linné, and the type of *Saxicava* is therefore to be cited as *Saxicava striata* Fleuriau de Bellevue, 1802, equals *Mya arctica* Linné, 1767, by monotypy. In 1823 Children selected as type "*Mytilus rugosus* Linné 1767." The latter species has been declared by many writers to be identical with *Mya arctica*, but their separability has been very strongly urged, as is noted below. If *rugosus* is in fact distinct, then, as it did not appear on the original list, Children's designation and an identical designation by Gray in 1847 are invalid.

Linnaeus' *arctica* is, however, identical with *Solen minutus* Linné, 1767. This was admitted by Linnaeus himself in a note opposite the name of the latter species in his own copy of the twelfth edition, "idem cum Mya Arctica." Thus the author described the same species twice, and in two different genera in the same work. Another manuscript note indicates that he intended to transfer *arctica* to *Solen* in the "revised twelfth edition."

There are two weaknesses in the description of *arctica* which have given rise to some controversy. In the first place, the words "cardine edentulo" are incorrect. It is true that Linnaeus changed the phrase to "cardine subedentulo" in a note to the species, and thus indicated a proposed change in the next edition, but the change is hardly emphatic enough to describe the obvious teeth in the hinge. Again, "valvulis carinis duabus spinulosis" is misleading to one who has only a limited series of specimens to examine. Some figures show definite spines along the two radial carinae, but in the majority of specimens the spines are absent, and this is always true of young or worn individuals. This feature is clearly shown in the illustrations in Reeve (1843-1878, vol. 20, *Saxicava*, pl. 1, figs. 1a, b, c, d).

My comments on *Mya arctica* should be read in connection with the following paragraphs on *Mytilus rugosus* and *pholadis* Linné, which are inserted here instead of in

their regular place in order to complete the discussion of *arctica*.

*Mytilus rugosus*: This name appeared for the first time in the twelfth edition (p. 1156, no. 249). The references to size, shape, texture, color, sculpture, and hinge in the description point unquestionably to a *Saxicava* and not to a *Mytilus*. I would be tempted to say that Linnaeus, who had deliberately described the shell as a *Mytilus*, was unconsciously swayed by its resemblance to his *Mya arctica* in choosing the language of his diagnosis. It is apparent, at least, that he was dissatisfied with the description, as we find it almost erased in his annotated copy, the inference being that he had become convinced that the shell was similar to, if not identical with, *arctica*.

Pennant (1777) and Dillwyn (1817) left the species in *Mytilus*. Fleuriau de Bellevue did not mention it when he erected his *Saxicava* in 1802, nor did Lamarck in 1799 or 1801. As nearly as I can determine, Lamarck, in the 1818 volume of the "Histoire naturelle des animaux sans vertèbres," was the first to list it as a *Saxicava*, and it has remained in that genus ever since. The great majority of writers have considered it specifically distinct from *arctica*. Hanley, however (1855, p. 139), believed the two to be identical, basing his contention on the fact that "the *Saxicava rugosa* of authors" is not found in the collection, while in a box marked with the name *rugosa* are "worn, full-aged specimens of *Saxicava arctica*" which agreed with the description of *M. rugosus*. Inasmuch as the two shells, if distinct, are so close, and inasmuch as almost any *Saxicava* might agree with the description of *rugosus*, Hanley's reasoning seems to be based on very little evidence. A few other writers have from time to time followed Hanley in suggesting that *rugosus* is a mere synonym of *arctica*. Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, pp. 589-597) discussed fully the relationship between the two and came to the considered conclusion that they are specifically distinct. Their researches indicated that *arctica* lives in deeper water than *rugosus* and is attached by a byssus, whereas *rugosus* has no byssus and lives in holes which it has bored in soft rocks. Grant and Gale (1931, p. 428), the most recent commentators on

this complex, refer to the above conclusions with approval and cite both names as good species, together with *S. pholadis*, the next species discussed.

The figures cited for *M. rugosus* by Linnaeus add little to the identification. The Gualtieri drawing is that of a *Unio*, and the "?" which Linnaeus evidently intended to put after it was inadvertently, I believe, shifted to the other figure, from Lister. That figure shows something like a *Saxicava*, but is otherwise uninformative.

*Mytilus pholadis*: This name was not in either edition of the "Systema" but appears on the list of mollusks appended to the "Mantissa plantarum," 1771, four years after the publication of the twelfth edition. The description, like that of *rugosus*, is more fitting to a *Saxicava* than a *Mytilus* and is a fair definition of the shell we know as *Saxicava pholadis*.

This species, too, has been the subject of controversy. Hanley (1855, p. 455) noted that it had generally been identified with *S. rugosa*, although the description could equally apply to *S. arctica*. Others, in discussing the species, call attention to its similarity to both *arctica* and *rugosa*, but by far the greatest number of commentators give it specific rank. Grant and Gale (1931, p. 428) say: "This species has been confused with *rugosa* and possibly in some cases with *arctica*. It is edentulous, strongly concentrically wrinkled, and spineless. It is generally much less quadrate than *arctica* and differs from the latter in its edentulous hinge. Sars figures well the hinge characters of these two species."

In brief, the practice today is to treat all three forms as good species. They differ in the following particulars:

*Saxicava arctica*: One tooth in the right valve and two in the left. Roughly quadrate in form and longer in proportion to width than *rugosa*. Spines on young or unworn specimens.

*Saxicava rugosa*: Practically edentulous, showing the vestiges of one lateral tooth in unworn specimens. Oval rather than quadrate. Spineless.

*Saxicava pholadis*: A completely edentulous form. The concentric sculpture is weaker than in either of the others. Less



quadrate than *archica*. Spineless. More evenly rounded at the ends than the other two.

I am willing, tentatively, to recognize all three as distinct. They are, however, so close that it is very possible that this complex may be a single species and that the variations are purely ecological, arising from differences in their burrowing habits. In connection with the statement of Bucquoy and his co-authors, cited above, may it not be that the specimens of the form *archica* that they examined were immature shells, and that this group, like the *pectens*, spins a byssus when young and becomes free-swimming only in the adult stage?

The figures of all three forms cannot be blindly relied upon. Drawings of each seem to have been interchanged by some writers. For what they are worth I refer to the following figures of each.

For *archica*, in addition to the Reeve figures already cited, see Forbes and Hanley (1853, vol. 4, pl. 6, figs. 4-6). For *rugosa*, see Reeve (1843-1878, vol. 20, *Saxicava*, pl. 1, sp. 3) and Sowerby (1847-1887, vol. 5, pl. 471, fig. 3). For *pholadis*, see Reeve (1843-1878, vol. 20, *Saxicava*, pl. 1, sp. 5) and Sars (1878, pt. 1, pl. 20, fig. 7a-b). The Sars figures are the best and correctly represent *pholadis*.

A very instructive plate of figures, illustrating many forms of this complex from England, the French Atlantic coast, and the Mediterranean, is found in Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, atlas, pl. 86).

Before closing the discussion of *Mya archica* I should call attention to the fact that *Saxicava* is not the earliest name for the genus in which it is placed.

The date of *Saxicava* Fleuriau de Bellevue is fixed by the date 1802 on the title pages of the respective volumes of the serials in which the name was first proposed, volume 54 of the *Journal de Physique*, and Bulletin number 62 of the *Société Philomathique de Paris*.

The date of the name *Hiatella*, which covers the same group, has been stated variously as 1802, 1801, or, generally, one or the other of these dates preceded by a question mark. The doubt is due to the fact that the work in which *Hiatella* was proposed, the "Histoire naturelle des coquilles," a five-volume work by L. A. G. Bosc, bears, on the

title page of each volume, only the date according to the French Republican calendar, "an 10," which year began on September 23, 1801, and ended on September 22, 1802. Thus there is no internal evidence of the date according to the Gregorian calendar.

Fortunately, the question is settled beyond dispute by a review of Bosc's work in annual volume 4 of the *Journal général de la littérature de France*, a contemporary bibliographical periodical. The date of volume 4 (1801) appears on the title page, and the notice of Bosc's work is found on page 291 of the volume, in the monthly fascicule headed "Vendémiaire, an 10 de la République française."<sup>1</sup> This Republican "month" covered the period of September 23 to October 23, 1801. Thus it is incontestible that the work appeared at least prior to October 23, 1801. Under the Rules, therefore, *Hiatella* has priority over *Saxicava*.<sup>2</sup>

*Hiatella* was, as to Daudin, a manuscript name. Bosc says (1801, p. 120): "Ce genre a été fait par Daudin, qui a bien voulu permettre qu'on fît usage, pour cette ouvrage, de ces inintéressans manuscrits" (italics mine). The genus should therefore be cited as *Hiatella* Daudin in Bosc, 1801.

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

TENTH EDITION	TWELFTH EDITION
<i>Mya crispata</i> , no. 15	<i>Pholas crispata</i> , no. 25
<i>Mya lutraria</i> , no. 18	<i>Mactra lutraria</i> , no. 101

#### SOLENN LINNÉ

Of the 12 species of *Solen* in the "Systema" and the "Mantissa," only the first two (*vagina* and *siliqua*) still remain in the genus, and one (*strigulatus*) has even been moved to a different family. The generic placement of all of them is fairly well agreed upon today, although the profusion of generic names that have been suggested has been

<sup>1</sup>For the reference to the *Journal général de la littérature de France*, I am indebted to Mr. C. P. Castell of the Department of Geology of the British Museum (Natural History) (personal communication). He has found in Sherborn's manuscript notes, now in the custody of the British Museum, a reference to the French journal in a note covering the Bosc work.

<sup>2</sup>The evidence bearing on the priority of *Hiatella* over *Saxicava* has been discussed by the present writer in somewhat more detail elsewhere (1950a).

the cause of considerable controversy which has not entirely died down.

#### *Solen vagina*

1758, *Systema naturae*, ed. 10, p. 672, no. 23.

1767, *Systema naturae*, ed. 12, p. 1113, no. 33.

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

"S. testa lineari recta: extremitate altera marginata, cardinibus unidentatis."

The common British razor clam, the *Solen vagina* of all authors, was not represented in the collection but does conform closely to the "Systema" description. It is universally accepted as Linnaeus' *S. vagina* and was designated as the type of *Solen* by Children in 1823. *Solen marginatus* Pulteney, 1799, is sometimes cited as the type and is so used by Thiele, but that name is synonymous with *vagina*.

Hanley (1855, p. 29) emphatically disagreed with this identification. He referred first to the fact that *vagina* was missing from the collection, but that a specimen of *Solen brevis* Gray, 1842, which is present, adequately fitted the description. As to this argument we must remember that the absence of a specimen has no significance whatever. He continued by calling attention to the fact that, of the four references listed, three (Rumphius, Argenville, and Klein) refer to an East Indian shell, and only one (Gualtieri) to a European. But we have learned not to give undue weight to Linnaeus' synonymies, and the fact that this one was discordant should not have troubled any one as familiar as Hanley was with the "Systema" and with the scarcity of available figures in 1758. He added (*loc. cit.*), "... authors have seemed obstinately bent upon reserving the name for the latter [the European shell] in despite of the language of the 'Museum Ulricae,' 'Extremitas postica crassior, oblique extrorsum truncata, antice vero rotundata,'" and continues, "Hence there can be no reasonable doubt that it [the Indian shell] was the type of the species." It would be difficult to find language more characteristic of the British *S. vagina*. It is admitted that it applies equally well to *Solen brevis*, which has its two ends truncated and rounded, respectively, and thus it is impossible to determine which species was in-

tended by Linnaeus in spite of the fact that *brevis* is much shorter. It is unwise, however, to disturb the accepted identification of the British shell. Hanley called the words above quoted (*loc. cit.*) "so inapplicable to the *Solen vagina* of British writers." It is not easy to understand how such a careful observer as he could have made this statement.

Figured in Reeve (1843-1878, vol. 19, *Solen*, pl. 1, sp. 2).

#### *Solen siliqua*

1758, *Systema naturae*, ed. 10, p. 672, no. 34.

1767, *Systema naturae*, ed. 12, p. 1113, no. 34.

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

"S. testa lineari recta, cardine altero bidentato. . . . Haec, praecedens et sequens nimis affinis sunt."

A specimen of the common *Solen siliqua* of European waters is in the collection marked with the correct number. Its agreement with the brief, though characteristic, description insured its identification with the Linnaean species. The synonymy contained for the most part very bad figures, although the figure from Lister is unmistakable.

The shell called *Solen siliqua* by Chickering in 1855 is a different species and is probably a synonym of the "*Ensis americana* Beck" of the Adams brothers. The latter is a manuscript name (*vide* Dall, 1900, p. 107).

Thiele, who uses *Solen marginata* Pulteney, 1799, as the type of *Solen* Linné, has a figure of the type which is designated as "*S. siliqua* L." Pulteney's *marginata* is a synonym of *vagina* Linné, not *siliqua* Linné.

The most characteristic figure of *Solen siliqua* is in Donovan (1799-1803, vol. 2, pl. 46). See also Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, atlas, pl. 74, figs. 1-3, the Atlantic form, and figs. 4-5, the Mediterranean variety).

#### *Solen ensis*

1758, *Systema naturae*, ed. 10, p. 672, no. 25.

1767, *Systema naturae*, ed. 12, p. 1114, no. 35.

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

"S. testa lineari subarcuata, cardine altero bidentato. . . . Testa utraque extremitate rotundata est et praecedente minor ac magis arcuata."

This species was called *Solen ensis* by all the early British authors, and Hanley (1855,

pp. 29–30) so cited it as the representative of the Linnaean name. A specimen is in the collection and, while it bears no identification, conforms to the description and to the recognizable part of the synonymy. It is now placed in the genus *Ensis* Schumacher, 1817, of which it is the type by absolute tautonymy.

Even the earlier American authors expressed doubts as to whether the American race of this species was identical. It is larger than the British shell and not so slender proportionally. The western Atlantic form was named *Ensis directus* by Conrad as early as 1843. Its separability is now generally conceded and Conrad's name universally used. In Binney's edition of Gould (1870, p. 42) the editor suggested that it be called "variety *americana*," being apparently unaware of Conrad's prior name. It is interesting to note that Spengler (1790–1810, vol. 3, pt. 2, pp. 91–92) reported a form of *Solen ensis* Linné which he collected on his American tour "in New York and Rhode Island," and which he called "var. b." This was undoubtedly Conrad's *directus* and Binney's "var. *americana*."<sup>1</sup> The British *Ensis ensis* is figured in Donovan (1799–1803, vol. 2, pl. 50) and the American *Ensis directus* in Maxwell Smith (1941, pl. 24, fig. 8). Further excellent figures of the European shell are to be found in Bucquoy, Dautzenberg, and Dollfus (1882–1898, vol. 2, atlas, pl. 73, figs. 1–5, which include figures of the Mediterranean variety, *minor*).

#### *Solen legumen*

1758, *Systema naturae*, ed. 10, p. 672, no. 26.

1767, *Systema naturae*, ed. 12, p. 1114, no. 36.

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

"S. testa lineari-ovali recta, cardinibus bidentatis: alterius bifido. . . Praecedentibus brevior et cardine versus medium testae, nec ad extremitatem, ut in praecedentibus."

This is the "vegetable pod" of the British, the *Solen legumen* of all authors up to the 1840's. After being included in various other genera from time to time it is now placed in *Pharus* (Leach) T. Brown, 1844, as the type of the genus. The description is clearly that

<sup>1</sup> Binney's *E. ensis* var. *americana* must not be confused with the *Ensis americana* Beck of H. and A. Adams mentioned above in connection with *Solen siliqua* Linné.

of this shell and the synonymy, with one exception, excellent.

In the manuscript notes in the twelfth edition the following words occur: "Costa rudimentaris in medio testae, nec ad anum propinquum ut in *38 radiatus*." This language is misleading. In *legumen* a narrow, faintly brown stripe extends across the outside of the valves, running from the umbones to the ventral margin. It is in no sense a rib, is not raised, and does not appear on the interior of the shell. To compare it with the prominent internal strengthening rib of *S. radiatus* Linné (*q.v.*, below) suggests that Linnaeus must have intended the note to apply to some other species. However, *S. radiatus* is the only shell listed in *Solen* Linné that bears this internal rib, and therefore I can give no reasonable explanation of the quoted language.<sup>2</sup> *Polia* d'Orbigny, 1843 (*non* Ochsenhausen, 1816), *Ceratisolen* Forbes and Hanley, 1848, and *Artusius* Leach, 1852, are synonyms of *Pharus* T. Brown.

Figured in Reeve (1843–1878, vol. 19, *Pharus*, pl. 1, sp. 1a–b). See also Bucquoy, Dautzenberg, and Dollfus (1882–1898, vol. 2, atlas, pl. 75, figs. 1–4).

#### *Solen cultellus*

1758, *Systema naturae*, ed. 10, p. 673, no. 27.

1767, *Systema naturae*, ed. 12, p. 1114, no. 37.

LOCALITY: "In Amboinae littoribus arenosis" (1758, 1767).

"S. testa ovali-oblonga subarcuata. . . Cardinis dentes ut in primis tribus, sed callus marginalis ut in specie prima."

The description in the "Systema" does not give one much help in the determination of this species. The synonymy and the description in the "Museum Ulricae," however, clearly point to the shell that has always borne this specific name. It is now in the genus *Cultellus* Schumacher, 1817. Schumacher apparently chose *Cultellus* as the name of his genus because its meaning, "a little knife," well describes the shape and general appearance of its members, rather than because the Linnaean species *S. cultellus* belonged to it. In designating a type he

<sup>2</sup> *Tagelus* Gray, 1847, in Sanguinolariidae, contains some species that show an internal ray of color or opacity which is believed by some authorities to indicate that these species, or their ancestral forms, once possessed such a rib.

passed over *culiellus* Linné and selected *S. lacteus* Spengler, a synonym of *S. maximus* Gmelin.

It is figured in Reeve (1843-1878, vol. 19, *Culiellus*, pl. 6, sp. 23a-b).

#### *Solen radiatus*

1758, *Systema naturae*, ed. 10, p. 673, no. 28.

1767, *Systema naturae*, ed. 12, p. 1114, no. 38.

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

"S. testa ovali recta laevi, costa transversali adnata depressa. . . Testa violacea radiis quatuor albis."

There are a number of specimens of this species in the Linnaean collection, which, although unmarked, agree so perfectly with the description and with the cited figures that identification becomes simple. It is placed in the genus *Siliqua* Megerle von Mühlfeld, 1811. According to Thiele, Gray, Herrmannsen, Dall, and others, it is the type of the genus.

The genus *Siliqua* is distinguished from all other groups in Solenidae by the presence of a prominent internal rib beginning at the dorsal margin of the shell, from which it is developed, and extending nearly to the ventral margin. This rib is usually white and becomes flatter and wider as it nears the margin. It is strongly developed in *S. radiata* and is the most characteristic feature of the American *Siliqua costata* Say, 1822. It is obviously designed to strengthen the shell, which, in this genus, is very fragile.

*Siliqua radiata* Linné is not *Solecurtoides radiatus* (Ravenel), 1834, which is a synonym of *Siliqua costata* Say, 1822.

*Siliqua* is equivalent to *Leguminaria* Schumacher, 1817, and *Machaera* Gould, 1841. *Solecurtus* Blainville, 1824, is frequently given as a synonym, but Iredale has shown that it is, rather, equal to *Psammosolen* Risso, 1826.

Linnaeus' *radiata* is figured in Reeve (1843-1878, vol. 19, pl. 4, sp. 13).

#### *Solen strigilatus*

1758, *Systema naturae*, ed. 10, p. 673, no. 29.

1767, *Systema naturae*, ed. 12, p. 1115, no. 39.

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

"S. testa ovali oblique striata. . . Testa incarnata radiis duobus albis. Dens cardinis re-

curvatus exsertus; margoque cardinis prominulus."

The modern name of the representative of the Linnaean *strigilatus* is *Tagelus strigilatus*, the species having been transferred from the family Solenidae into *Tagelus* Gray, 1847, a group in Sanguinolariidae, although many writers consider *Tagelus* to be identical with *Solecurtus* Blainville, 1824. Deshayes, in 1829, designated this species as the type of *Solecurtus*.<sup>1</sup>

It is a fairly common shell in the Mediterranean and was readily identified by the specimen in the Linnaean collection, which conformed both to the description and to the figures cited in the synonymy.

It is figured in Reeve (1843-1878, vol. 19, *Solecurtus*, pl. 1, sp. 4) and in Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, atlas, pl. 76, figs. 1-5).

#### *Solen anatinus*

1758, *Systema naturae*, ed. 10, p. 673, no. 30.

1767, *Systema naturae*, ed. 12, p. 1115, no. 40.

LOCALITY: "In O. Asiatici fundo arenoso" (1758, 1767).

"S. testa ovata membranacea inflata pilosa, cardinis costa falcata. . . Testa pellucida alba et fere membranacea."

Although this species is not found in the collection, it was identified at an early date as *Anatina subrostrata* Lamarck, 1818, by means of the fairly clear description and the passably good figure from Rumphius, with the aid of the fuller description in the "Museum Ulricaë." The *Anatina* of Lamarck, 1818,<sup>2</sup> which should not be confused with *Anatina* Schumacher, 1817, a quite different group of species, and which is therefore a homonym, now takes the much earlier name of *Later-nula* Röding, 1798, a group which is generally placed in Periplomatidae. Some con-

<sup>1</sup> Blainville selected no type in 1824, 1825, or 1827. Deshayes' selection (1829, p. 482) is the earliest. Des Moulins (1832, p. 88) later chose the same type. Dall (1890-1903, vol. 3, pt. 5, p. 950) reached a different result, as he used *Psammosolen* Risso, 1826, for the *strigilatus* group and designated *Solen legumen* Linné as the type of *Solecurtus*.

<sup>2</sup> Lamarck used this generic name first in 1809, and again in 1812, but in both cases it was employed in the vernacular, as "Anatine." He validly proposed the name for the first time in the "Histoire naturelle des animaux sans vertèbres," in 1818 (vol. 5, p. 462).

chologists, including Thiele, the most recent systematist covering the whole Phylum Mollusca, have restored the original specific name *anatinus*. Some question might be raised as to the wisdom of this step, as the Linnaean description is not unequivocal. The most striking feature of *Laternula* is the presence of a very prominent chondrophore in the hinge. The only suggestion of this in the description is the phrase "cardinis costa falcata," which is hardly sufficiently descriptive of the spoon-shaped chondrophore present in all members of the genus. I prefer to cite the species as *Laternula subrostrata* (Lamarck), 1818. It is the type of the genus, by subsequent designation, Gray, 1847. *Auriscalpium* Megerle von Mühlfeld, 1811, is a later name for the same group as *Laternula*.

Figured in Reeve (1843-1878, vol. 14, *Anatina*, pl. 1, sp. 6).

#### *Solen bullatus*

1758, *Systema naturae*, ed. 10, p. 673, no. 31.

1767, *Systema naturae*, ed. 12, p. 1115, no. 41.

LOCALITY: Not given in either edition.

"S. testa subrotunda inflata substriata antice crenato-hiante. . . Dens cardinis unicus; marginalis remoti compressi."

I comment upon this name with somewhat more detail than I have given to the other *Solen* because of what I am convinced is an erroneous identification by many of our museums. It is said to be *Fulvia bullata*. *Fulvia* was erected by Gray in 1853 and was long used as a subgenus of *Papyridea* Swainson, 1840, a genus in *Cardiidae*, although it is now given full generic rank by many conchologists.

Linnaeus' type of *bullatus* is not in the collection, no specimen is present that can be said to agree with the description, and no locality was given. The manuscript notes add nothing to this meager data. The *Cardium bullatus* of many authors was for a long time thought to be the Linnaean species, but this shell is now conceded to be identical with *Papyridea hiatus* (Meuschen), 1787, a quite different shell (Clench and Smith, 1944, p. 17). Hanley (1855, pp. 31-32) mentions this identification with *Cardium bullatus* of authors and also refers to another nineteenth century theory that Linnaeus' *bullatus* was

*Cardium apertum* Bruguière, 1789, a name that was based on a figure from Chemnitz (1780-1795, vol. 6, pl. 18, fig. 181). This figure is undoubtedly a *Cardium*, roughly trigonal in shape, slightly inequilateral, and definitely ribbed. The most recent comment on *bullatus* is by Lillian C. Smith (1945, pp. 1-2), who identifies Linnaeus' *bullatus* with *Fulvia bullata* and rests her opinion squarely upon the fact that Linnaeus' species was based on the figure from Rumphius (pl. 44, fig. N),<sup>1</sup> discussed below.

The description of the hinge of *S. bullatus* in the "Systema" is clear and definite, "dens cardinis unicus," and in the generic description of *Solen* the hinge is described as "Cardo: dens subulatus, reflexus, saepe duplex, non insertus testae oppositae." Both the specific and generic descriptions are utterly inapplicable to the strikingly dissimilar *Cardium* hinge, and although we recognize that Linnaeus was often inaccurate in conforming his descriptions to the specimen he was describing even when he had the specimen at hand, which is at least questionable in this case, it is to me incredible that he could have chosen, as a member of his clearly limited *Solen*, a shell that is demonstrably a *Cardium*. In this connection Hanley (*loc. cit.*) cites a comment by Schumacher which is worth quoting in full. In speaking of *Cardium soleniforme* Bruguière, 1789 (*C. hiatus* Meuschen, 1787), and of *Solen bullatus* Spengler, 1794, Schumacher says (1817, p. 159): "These two savants believe that they see in this shell the *Solen bullatus* Linné. But how could our great master have placed a shell in a genus whose characteristics it lacks, except that it is gaping at both ends as almost all species of the genus *Solen* are? And why is

<sup>1</sup> Two works of Rumphius may be involved here, as in all cases where Linnaeus cited this author, the "Amboinische Rariteitskammer" and the "Thesaurus imaginum piscium Testaceorum." The first appeared in editions dated 1705, 1741, and 1766 (the last edition by Müller and Chemnitz) and the second in 1739 and 1741. It is not certain which work or edition Linnaeus owned, as he referred to the book in his possession as "Rumph. Mus.," whenever he mentioned it, and the word "Museum" does not appear on the title page of any edition of either work. All plates of mollusks are identical and identically numbered in all editions of both, and thus no date can be given for any of his references to Rumphius.

it that authorities on shells who desire to make such changes as will render the systematics of Mollusca more complete have left the old name to a shell which they must know differs from it in generic traits? There is no doubt that the hinge of the shell of which I speak here does not resemble the hinge of *Cardium*, but still less the hinge of *Solen*. Mr. Bosc follows the example of MM. Chemnitz and Spengler in good faith; he clearly described the *Solen bullatus* . . . solely after the figure of Chemnitz, for if he had read the description of *Solen bullatus* by Linnaeus and even that of Chemnitz, he would have soon seen that this shell should not be placed among the *Solen*. . . ."

The sole figure cited by Linnaeus in his synonymy in both editions was Rumphius' (pl. 44, fig. N) already referred to. This figure is somewhat like a *Cardium*, a heavy, obliquely inequivalved but roughly quadrate shell with numerous, apparently flat ribs. Rumphius called it "*Pecten bullatus*." The synonymies in the "Systema" are notoriously undependable, but it is inconceivable that Linnaeus could have knowingly chosen this figure for a *Solen*. I feel sure that it was either a *lapsus calami* on his part or a printer's error, of both of which the work is often guilty. The figure, although very poor, may, by the exercise of some imagination, be said to show an *Arca*, as Dall (1890-1903, pt. 5, p. 1107) suggested.

Gmelin was obviously loath to follow the lead of Linnaeus as he cites the Rumphius figure with an interrogation mark but introduces a further error himself, an error that persisted for some time, by citing four additional figures which with more or less accuracy show the shell which we know as *Papyridea hiatus* (Meuschen). Two of them (from Chemnitz and Gualtieri) are clearly *P. hiatus*. The Lister figure might be taken for *hiatus*. The drawing from Knorr is, as usual, almost unrecognizable but has the shape of *hiatus*. In any event none of them can be mistaken for a *Fulvia*.

No one will now claim that *P. hiatus* is the representative of Linnaeus' *bullatus*, and we are therefore left with the Rumphius figure cited in the "Systema" as the sole argument that the author was describing a *Cardium* and that the modern *Fulvia bullata* is the

shell he intended to list. *Solen* Linné is a small and very characteristically described group, with definite attributes, and there is nothing in the brief diagnosis of *bullatus* that differentiates it from its congeners to the degree that would be necessary if Rumphius' figure were to be accepted as authoritative. I have been able to find no further comments in the literature which are helpful, and therefore feel that the species must be rejected as unrecognizable.

#### *Solen minutus*

1767, Systema naturae, ed. 12, p. 1115, no. 42.  
LOCALITY: "In O. Norvegico" (1767).

"S. testa ovali: valvularum angulis utrisque serratis. . . . Testa ovalis, magnitudine seminis Cucumeris, longitudinaliter striata, apice truncata. Carinae a cardine versus apicem divergentes, acutae, serrato-dentatae."

This name was expunged from the genus *Solen* by Linnaeus himself. A manuscript note opposite the species in his copy of the twelfth edition reads, "idem cum *Mya arctica*." It must therefore be thrown into the synonymy of *Hiatella arctica* (Linné), 1767. It further appears that Linnaeus intended to transfer *Mya arctica* to *Solen* in his "revised twelfth edition."

#### *Solen virens*

1767, Systema naturae, ed. 12, p. 1115, no. 43.  
LOCALITY: "In Java" (1767).

"S. testa ovato-oblonga, umbonibus tumidis. . . . Testa inaequalvalvis ovato-oblonga, umbonibus gibba, alba, extus virens, fragilissima, diaphana, forma *Myae pictorum*, apice et basi vix clausa. Cardo alterius dentibus duobus approximatis absque antagonistis; praeterea callus in utraque testa, quasi dens obsoletus testae."

It appears from Linnaeus' list of the shells in the collection that he owned this species, and as only one specimen in the collection conforms to the elaborate and characteristic description no doubt has ever been felt as to its identification. That shell is the *Glaucomya virens*, a brackish-water species found in the rivers of southeast Asia and the East Indies.

*Glaucanome* was a genus erected by Gray in 1828 with a single species, *G. sinensis*, as type, by monotypy. It is not *Glaucanome* Goldfuss, 1826. The name was emended to *Glaucomya* by Bronn in 1838, and further emended to *Glaucomya* by Woodward in

1854. It is possible that Bronn's spelling was an error rather than an emendation, and this view is apparently taken by Thiele who cites *Glaucomya* as of Bronn 1838. In any event, *Glaucomya* is in universal use today.

Figured in Reeve (1843-1878, vol. 2, *Glauconome*, pl. 1, sp. 9).

#### Solen diphos

1771, *Mantissa plantarum, regni animalis appendix*, p. 544.

LOCALITY: "In India" (1771).

"Testa ovali recta laevi, nymphis prominentibus. . . Testa simillima *S. radiato*, violacea radiis albis tantum duobus, nec quatuor. Margo montis veneris obtusus, retusus, nec exsertus. Cardo interius nulla. Nymphae prominentes, nec retusae. Cardo unidentatus."

The "Mantissa" species have been generally more difficult to determine than those of the "Systema," as most of them were described from specimens that did not belong to the author, and in some cases the descriptions were possibly derived from correspondence with Linnaeus' colleagues. He does not mention *diphos* in his list of shells, and there is nothing in the collection that can be said to fit the description. Lamarck believed it to be identical with his *Solen violaceus*, possibly relying on the color mentioned in the description, but that shell is much shorter and more quadrate than the shell which has come to be accepted as the Linnaean *diphos*. That is *Soletellina diphos* (Linné), 1771. *Soletellina* is of Blainville, 1824, and is very close to *Sanguinolaria* Lamarck, 1799. Thiele makes it a section of the latter genus, with *S. diphos* Gmelin [sic] as type of the section.<sup>1</sup>

Figured in Reeve (1843-1878, vol. 10, *Soletellina*, pl. 2, sp. 8).

<sup>1</sup> Dall (1890-1903, pt. 5, p. 9) and Thiele (1931, 1935, vol. 2, p. 909) both attribute *S. diphos* to Gmelin, but Gmelin's *diphos* seems to be identical with that of Linnaeus. He copied the main description from the "Mantissa" and referred to that work. He paraphrased the subdescription but made only one important change: for "Cardo unidentatus" he said "alterius valvae cardine unidentato, alterius bidentato," a distinction that might well have escaped Linnaeus' attention if the specimen he examined was worn. Finally, Gmelin cited for his *diphos* two figures of Chemnitz (1780-1795, vol. 6, pl. 7, figs. 53-54) which Chemnitz called *Solen diphos Linnaei* and which are excellent pictures of that species.

*Solen inaequivalvis* (no. 32 in the tenth edition) was moved to *Tellina (inaequivalvis)*, no. 56) in the twelfth edition.

#### TELLINA LINNÉ

Linnaeus listed 25 species of *Tellina* in the tenth edition and added but four more in the twelfth. Three of these latter are new species and one, *inaequivalvis*, was moved to *Tellina* from its tenth edition position in *Solen*.<sup>2</sup>

Most of the early post-Linnaean descriptions of the genus *Tellina* are too limited and fail to take account of the great variation in the sculpture and shape of the shell and the dentition of the hinge which is found among the species listed in the "Systema." For instance, most of these diagnoses emphasize the fold near the posterior end of the right valve which is absent in some species and only faintly indicated in others. Many, if not most, of the older descriptions also mention that there are two lateral teeth in each valve, whereas in many instances one or both of the laterals in the left valve may be absent or obsolete, and in some cases not only are the left laterals absent but the posterior right lateral is obsolete. The broad genus also contains shells that are highly and sharply sculptured, as in *virgata* and *lingua felis*, and others that have a shining or procrescent exterior and only faint sculpture, as in *radiata*.

The classic example of this restricted description is that of Lamarck (1799, p. 84): "Oblique or orbicular, with a fold at the anterior [sic] end; one or two cardinal teeth, two lateral teeth widely separated." *Tellina virgata*, a shell with a prominent fold and strong laterals in the right valve and somewhat less developed laterals in the left, is

<sup>2</sup> In both editions he subdivided the genus into three groups of species by the subheadings: "Ovatae crassiusculae," "Ovate compressae," and "Suborbiculatae." As this is the first genus taken up here in which he so used these subheadings it might be well to refer to Opinion 124 of the International Commission on Zoological Nomenclature which held: "The various subdivisions of genera published by Linnaeus 1758 are not accepted as of this date as of subgeneric value under the International Rules." This conclusion seems inescapable but was made necessary by the fact that some of these subheadings have been utilized to create group names as of Linné, 1758.

given as his "example." It is obvious that Lamarck was describing a subgeneric group, often called "*Tellina* Lamarck," which is equal to, or close to and possibly broader than, the subgenus *Tellinella* (Gray) Mörch, 1853, type *T. virgata* Linné.<sup>1</sup>

Dall (1890-1903, pt. 5, pp. 1009-1016) divided the *Tellina* of Linnaeus into three groups based on the number, strength, and degree of obsolescence of the teeth and the details of the sockets and resilium. Although Dall's grouping is to a large degree accepted today, he adopted Lamarck's *Tellina* as the typical subgenus, with the type *Tellina virgata* Linné, which is not the modern arrangement. In brief, we consider today that *Tellina*, *sensu stricto*, contains those species without a pronounced posterior fold in the right valve and with a shallow depression, more marked in the right valve, extending from the posterior margin towards the umbo, and with the lateral teeth either absent or obsolescent. The sculpture is low and not scabrous and the texture of the shell smooth and frequently shining. The type is *Tellina radiata* Linné, by subsequent designation, Schmidt, 1818. Subgenus *Tellinella* covers the species with a definite fold in the right valve and a corresponding furrow in the left. It has strong, triangular laterals in the right valve, those in the left being low and to some extent fused with the margin. The sculpture is often stronger and the surface frequently scabrous.

The species in the "Systema" other than those remaining in the two subgenera of *Tellina*, *sensu lato*, have all been transferred to other groups of the Tellinidae, the majority of which are now accorded full generic rank by most modern writers. The attribution of these species to the respective genera is discussed below under the species involved.

It will be useful to call attention at this point to one of Linnaeus' common errors which is graphically illustrated in his descriptions in *Tellina*. He often used the words

<sup>1</sup> The name *Tellinarius* Froriep, 1806, has been used for the group included in the subgenus *Tellinella*, but, as is pointed out by Dall, Bartsch, and Rehder (1938, p. 187) Froriep's name is preoccupied by *Tellinarius* Duméril, 1806, which is actually an absolute synonym of the typical subgenus *Tellina*, *sensu stricto*, which has as type *T. radiata* Linné.

"antice" and "postice" and their derivatives in a sense exactly opposite to their actual meaning, and in *Tellina* he was consistently guilty of this error. His confusion is to be explained by his almost complete ignorance of the anatomy of the mollusk and his consequent inability to understand the orientation of the shell. The same error is found in some of his species of *Venus* and indeed occurs occasionally throughout his descriptions of the Pelecypoda, although sometimes he uses the correct word, possibly by oversight. In *Tellina* a characteristic feature of the shell is the distinctive sculpture and shape of the posterior end, which may be rostrate, folded, keeled, or twisted, in contrast to the anterior end which is usually more or less evenly rounded. In this genus the mistake is readily detected, but the student should read all pelecypod descriptions carefully.

#### *Tellina gargadia*

1758, *Systema naturae*, ed. 10, p. 674, no. 33.

1767, *Systema naturae*, ed. 12, p. 1116, no. 44.

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

"T. testa subrotunda compressa antice rugosa, rima dentata."

This species gives us another instance of an identification that cannot be unequivocally based upon the "Systema." Not only was the type absent from the collection but the description is not sufficiently elaborate to point to *gargadia* rather than to one of the other scabrous species in the genus. The two figures cited are both erroneously transcribed and, although drawings of the shell we know as *gargadia* are found on other plates of the iconographies cited, Linnaeus' error in transcription detracts from any certain identification.

The description in the "Museum Ulricae," however, is convincing, and the identification of the species as the modern *gargadia* is apparently based on that work. The fact that Linnaeus derived the name *gargadia* from the figure, which he probably intended to cite from Rumphius, is to some extent corroborative of the accepted view.

The species is now a member of the genus *Quadrans* Bertin, 1878, and is the type of the genus.

It is figured in Reeve (1843-1878, vol. 17 *Tellina*, pl. 17, sp. 84).



**Tellina lingua-felis**

1758, *Systema naturae*, ed. 10, p. 674, no. 34.

1767, *Systema naturae*, ed. 12, p. 1116, no. 45.

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

"T. testa subovata scabra: squamulis lunatis quincuncialibus. . . Differt a T. scobinata, quod sesquialior quam longa."

A specimen of the well-known *T. lingua-felis* of all authors is among the shells in the Linnaean cabinet, and, though it is unmarked, it alone agrees with the expanded description in the "Museum Ulricae." Hanley (1855, p. 33) intimates that it is necessary to invoke the later diagnosis in order to identify the type, but the description in the "Systema" seems fairly clear. The only other species it could cover would be *T. scobinata* (see below), and that shell is expressly differentiated in the description itself: "Differt a T. scobinata, quod sesquialior quam longa." The figure cited from Rumphius, from which the name *lingua-felis* is derived, is sufficiently accurate, although the Gualtieri drawing is probably intended to represent another species.

Whatever the inadequacies of the description, the Linnaean specific name has been universally, and, in my opinion justly, retained. The species is now placed in the genus *Scutarcopagia* Pilsbry, 1918, the type of which is *T. scobinata* Linné, mentioned in the preceding paragraph.

Figured in Reeve (1843-1878, vol. 17, *Tellina*, pl. 13, sp. 61) and Sowerby (1847-1887, vol. 1, pl. 64, fig. 236).

**Tellina virgata**

1758, *Systema naturae*, ed. 10, p. 674, no. 35.

1767, *Systema naturae*, ed. 10, p. 1116, no. 46.

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

"T. testa ovali striis transversis recurvatis antice angulata, dentibus lateralibus prominulis. . . Dens lateralis ante vulvam poneque anum triangulus."

The *Tellina virgata* of authors is present in the Linnaean collection and no doubt has ever been entertained as to its identification with the species described by that name. It is the type of the subgenus *Tellinella* (Gray) Mörch, 1853, by subsequent designation. Stoliczka, 1871. Thiele (1931, 1935, vol. 2, p. 920) divides *Tellina*, *sensu lato*, into two sec-

tions: *Tellina*, *sensu stricto*, for which he still retains *T. virgata* as type, and *Liottellina* P. Fischer, 1887, with *T. radiata* as type. This is an arrangement which is not generally followed by American conchologists as it makes the *virgata* group the typical subgenus.

Figured in Reeve (1843-1878, vol. 17, *Tellina*, pl. 13, sp. 59a-b).

**Tellina angulata**

1767, *Systema naturae*, ed. 12, p. 1116, no. 47.

LOCALITY: "In Java" (1767).

"T. testa subovata striis transversis recurvatis, antice angulata, dentibus lateralibus nullis. . . Affinis T. virgatae, sed minus oblonga, alba, immaculata nec radiata; angulo antico magis extrorsum sito et imprimis defectu dentium laterali-um. Anus ovalis, nec solis marginibus inflexis."

This name appeared for the first time in the 1767 edition. Although it appears on the list of shells owned by Linnaeus at that date, there is no specimen marked for it in the collection. Linnaeus cited no figures, and Gmelin, who copied the description in the twelfth edition, cited three references to figures which could by no stretch of the imagination be said to conform to the language of the description. The figures cited by Gmelin should be consulted (Lister, 1770, pl. 388, fig. 235, pl. 406, fig. 252; Chemnitz, 1780-1795, vol. 6, pl. 9, figs. 74-75; Schröter, 1783-1786, vol. 2, pl. 7, fig. 8). The Chemnitz figures show a shell lacking any pronounced concentric sculpture, with a posterior fold that is only faintly indicated, with little or no angulation of the posterior end and with an outline that suggests an *Apolymetis* and does not in any respect conform to the words "Affinis T. virgatae" of Linnaeus. These figures were generally accepted as representing *T. angulata* Linné up to the middle of the last century. Sowerby was the first to call attention to their inaccuracy. He reproduced one of them (1847-1887, vol. 1, pl. 60, fig. 250) and said of it (p. 324), "This is not the *T. angulata* of Linnaeus, which I believed to be a *Psammobia*." It seems inescapable, from the description of *angulata* alone, that Sowerby was correct, although he was certainly in error in thinking that the Linnaean shell was a *Psammobia*. The other figures are equally unconvincing.

A few years later Hanley (1855, p. 34)

called attention to the fact that a specimen of Bruguière's *Tellina plicata* was in the collection and was the only one present which agreed in all points with the description of *angulata* with the exception of the words "dentibus lateralibus nullis." As a matter of fact, the lateral teeth in all specimens of *T. plicata* that I have seen are not prominent and, in a worn specimen, would have been easy to overlook. Laminate teeth, such as are found in this species as in so many of the tellens, wear down to mere vestiges which are difficult to distinguish from an irregularity of the margin.

As we know that the type of *angulata* was represented in the collection, this identification is, I submit, satisfactorily proved. Hanley selected *plicata* as the representative of *angulata*, "with a note of interrogation appended," but his preoccupation with the matter of the lateral teeth was the admitted cause of his hesitancy. As the description is otherwise so accurate I restore the Linnaean name.

Some commentators have placed *Tellina plicata* in *Apolymetis* Salisbury, 1929. It differs from the members of that genus in important particulars. It has well-defined concentric sculpture. Its general outline, particularly its produced posterior end and pronounced angulation, is quite different from the fairly regular shape of *Apolymetis*. It has lateral teeth, which are wanting in the latter genus. It is in truth very much like *T. virgata* in appearance as Linnaeus pointed out. It is difficult to place it generically, as it has characteristics both of *Tellina*, *sensu stricto*, and of *Tellinella*, but I shall tentatively consider it a *Tellinella*.

Figured in Reeve (1843-1878, vol. 17, *Tellina*, pl. 20, sp. 142) as *Tellina plicata*. The *T. angulata* of Chemnitz is figured as sp. 141 on the same plate. The examination of these juxtaposed figures and a reading of the description of *angulata* in the "Systema" are convincing.

#### *Tellina gari*

1758, *Systema naturae*, ed. 10, p. 674, no. 36.

1767, *Systema naturae*, ed. 12, p. 1117, no. 48.

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

"T. testa ovali: striis transversis recurvatis, dentibus lateralibus obsoletis."

The diagnosis in the "Systema" alone does not enable us to identify this species with any certainty, and although the opinions and figures of Linnaeus' successors are possibly sufficiently convincing to allow us to determine the shell that he had in mind, this method of identification does not justify the retention of the name *gari*. The name was taken from Rumphius' "*Tellina gari*," although the figure Rumphius cited shows an unsculptured shell quite at variance with the words "striis transversis recurvatis" in the "Systema" description. The figure cited from Argenville is equally unenlightening. Hanley (1855, pp. 34-35) had recourse to the rather more ample description in the "Museum Ulricae" which seemed to him to indicate *Psammobia ferroensis* (Chemnitz), 1782, and he somewhat doubtfully accepted that shell as the type of Linnaeus' *gari*.<sup>1</sup>

<sup>1</sup> As the species here called *ferroensis* is referred to several times under *Tellina*, a comment upon its orthography is necessary. The correct spelling of the name, based upon the orthography used in the locality from which it is drawn, the Faeroe Islands, is *färöensis*. In English orthography, with the diacritical marks converted, it would read *faeroensis*.

Chemnitz used the name first, in 1782, as "*Tellina ferröensis*." Under Article 19 of the Rules the original orthography of a name must be preserved unless (a) an error of transcription, or (b) a *lapsus calami*, or (c) a typographical error is evident. While Chemnitz' spelling seems to have been intended and merely based on ignorance, rather than an example of any of the types of error mentioned in Article 19, nevertheless his name cannot be retained, as the volume of Chemnitz in which it occurs is not consistently binomial and is not, therefore, accepted. It is a nude name for all purposes. The first valid use of the name is that of Gmelin (1791, p. 3235). Here there is an obvious typographical error (or *lapsus calami*), as the word is spelled *fervensis*. In such a case Article 19 comes into effect. Gmelin's "original orthography" cannot be preserved, and we are required to use the correct form *färöensis*.

Article 20 of the Rules provides that in forming names derived from languages using the Latin alphabet, the exact original spelling, including diacritical marks, is to be retained, and one of the examples given is *färöensis*. In other words, Gmelin, if he had lived today, should have used the later and correct form. He did not, but, as the Rules were not then in effect, Article 20 cannot invalidate his orthography. In other words, it was not designed to cover this case. Article 19, however, as to following "original orthography," is not a law whose application has any connection with the date of the adoption of the Rules, and is the one which governs the present case. I am sure that the framers of the Rules did not contemplate any conflict between the two Articles, as, indeed, there is none.

This theory has not been followed. Chemnitz (1780–1795, vol. 6, p. 100, pl. 10, figs. 92, 93) described and figured two shells, one of which (fig. 92) he specifically states to be *Tellina gari* Linné, from the Spengler collection. Schumacher, in 1817, erected the genus *Gari* with two species in his original list. The first was *Gari vulgaris*, a new name, as he states (1817, p. 131), for "*Tellina gari* Lin. Spengler," and he cites Spengler's listing of the shell (1790–1810, vol. 4, pt. 2, p. 70, no. 1) and also the Chemnitz figures above referred to.<sup>1</sup>

It seems apparent from all the evidence that Schumacher's *vulgaris* is, in fact, the *gari* of Linnaeus. Grant and Gale (1931, pp. 381–382) comment on this identification: "Dall assumed that the *T. gari* Linnaeus of Schumacher was not the *T. gari* of Linnaeus 1758 but of Linnaeus 1762 [*sic*]. Fortunately Schumacher's reference to Chemnitz settled the uncertainty, for although the latter figures two different species (pl. 10, figs. 92, 93) he states that figure 92 represents the *Tellina gari* Linnaeus which unquestionably was the one which Schumacher had in mind when he referred to Spengler."

The species may be cited as *Gari vulgaris* Schumacher, 1817 (= *Tellina gari* Linné, Spengler). Based upon the presence in the synonymy of the specific name *gari*, the species may be used as the type of Schumacher's *Gari*, by absolute tautonymy. *Psammobia caerulea* Lamarck, 1818, at least in part, is a synonym. The genus *Gari* has a year's priority over *Psammobia* Lamarck, so the latter falls into its synonymy. *T. gari* Linné is not *T. gari* Poli, 1791.

Thiele (1931, 1935, vol. 2, p. 909) casts what seems to be a very unfounded doubt on the validity of Schumacher's genus, "The generic name *Gari* Schumacher, 1817, for *Tellina gari* Linné, can hardly be used [kaum brauchbar], since this '*gari*' is the genitive of 'garum,' which was a spicy root-vegetable

In Lamarck (1818, 1819, vol. 5, p. 512), where the species is placed in his *Psammobia*, it reads *feroenis*, and this style has been the most consistently used. Sherborn's Index gives the correct Anglicized version, *faeroeensis*.

The species should therefore be cited as *Psammobia färöensis* (Gmelin), 1791.

<sup>1</sup> Schumacher's second species was *Gari papyracea*, a *Tellina*, and one that need not be considered in this connection.

[scharfe Speisewürtze] of the Romans, which was probably unknown to Schumacher." A grammatical error, if that be Thiele's objection, is hardly a reason for the rejection of the name.

*Gari vulgaris* is figured in Reeve (1843–1878, vol. 10, *Psammobia*, pl. 8, sp. 60, as *Psammobia caerulea* Lamarck).

#### *Tellina fragilis*

1758, *Systema naturae*, ed. 10, p. 674, no. 37.

1767, *Systema naturae*, ed. 12, p. 1117, no. 49.

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

"T. testa ovata alba gibba: striis transversis recurvatis, natibus flavescens. . . Testa magnitudine extimi pollicis, gibba, striis subscabris."

The collection contains a specimen of *Gastrana fragilis* (Linné) which is marked for *Tellina fragilis* and is unquestionably the Linnaean type. Although no synonymy was supplied by Linnaeus, the specimen agrees so well with the description that there can be no doubt as to its identification.

Although Fabricius included this species in *Venus*, the majority of the German and British writers immediately following Linnaeus retained it in *Tellina*. It lacks many features even of *Tellina*. Lamarck, who restricted *Tellina* to the *virgata* group in 1799, was of the opinion that *fragilis* might be in his *Petricola*. Turton included it in *Psammobia*. Deshayes, in 1846, erected a new genus, *Diodonta*, for its reception, and Agassiz in the same year also used the same name, but Agassiz' name was a mere emendation of *Didonta* Schumacher, 1817, a different group, and it is probable that he was not aware of Deshayes' proposal. *Fragilia* Deshayes, 1846, next received the species, but this name was not generally used, and the shell was usually referred to as *Diodonta fragilis* until it was realized, in comparatively recent times, that all the names cited above were synonyms of *Gastrana* Schumacher, 1817. Linné's *fragilis* is the type of *Gastrana*, as well as of *Diodonta* and *Fragilia* Deshayes.

Figured in Reeve (1843–1878, vol. 17, *Tellina*, pl. 29, sp. 158a-b) and in Bucquoy, Dautzenberg, and Dollfus (1882–1898, vol. 2, atlas, pl. 93, figs. 6–10).

#### *Tellina albida*

1758, *Systema naturae*, ed. 10, p. 675, no. 38.

1767, *Systema naturae*, ed. 12, p. 1117, no. 50.

LOCALITY: "In Oceano Europaeo" (1758, 1767).  
 "T. testa ovali laevi, nymphis prominentibus.  
 . . . Cardo absque dentibus marginalibus. Sutura  
 ante et post cardinem notata lineis transversis  
 rufis."

No specimen of this shell was found in the collection, no synonymy was supplied by Linnaeus, and no assistance is given by his manuscript notes. We are left to the wording of the description, which is not sufficiently characteristic to justify any definite identification. Dillywn suggested that it might be intended for *Psammobia vespertina* Lamarck, 1818 (*Solen vespertinus* Gmelin, 1791, *vide* Lamarck's synonymy). Hanley (1855, p. 36) discussed the claims of *Psammobia tellinella* Lamarck, 1818, and *Sanguinolaria occidens* Lamarck, 1818 (*Solen occidens* Gmelin, 1791), but found sufficient differences to prevent him from selecting either. In fact, none of these shells conforms closely enough to the description to be adopted as the representative of *albida*. There are no helpful comments on this species in the later literature, and while it is possible to read into Linnaeus' language a description of a *Psammobia*, it is certainly not possible to fix upon a particular shell. Indeed, we cannot be certain that he was describing a *Psammobia*. The name *albida* should be dropped as undetermined.

#### *Tellina foliacea*

1758, *Systema naturae*, ed. 10, p. 675, no. 39.  
 1767, *Systema naturae*, ed. 12, p. 1117, no. 51.  
 LOCALITY: "In O. Indico" (1758, 1767).  
 "T. testa ovali, pube scabra, rima serrata."

As with the last species, the Linnaean collection contained no specimen of this shell. The synonymy, however, together with the expanded description in the "Museum Ulricaee," served to identify it without question. It is the *foliacea* of all authors, from the Indo-Pacific region, which has now been placed in the genus *Phylloda* Schumacher, 1817.

It is figured in Reeve (1843-1878, vol. 17, *Tellina*, pl. 3, sp. 11).

#### *Tellina planata*

1758, *Systema naturae*, ed. 10, p. 675, no. 40.  
 1767, *Systema naturae*, ed. 12, p. 1117, no. 52.  
 LOCALITY: "In O. Europaeo, Mediterraneo" (1758, 1767).

"T. testa ovata compressa, transversim substriata laevi: marginibus acutis, pube subtomentosa.

. . . Testa maxime plana, pellucida, incarnata, minus flexa, margine acutissimo."

The only two figures cited in the pictorial synonymy show the white form of *Tellina radiata* Linné (*T. radiata unimaculata* Lamarck, 1818), which does not conform to the description of *planata* in either color or shape. *Radiata* is neither "ovata" nor "incarnata." The acceptance of these figures by Linnaeus' followers was undoubtedly responsible for the delay in the recognition of the species. While Chemnitz followed the figures and called it *radiata*, Spengler was inclined to believe it was the white *T. hyalina* of "Chemnitz."<sup>1</sup> Born, in 1780, was the first to identify it with the *T. planata* of authors of his day. A recourse to the "Museum Ulricaee" where the description is more ample and characteristic, together with the discovery of a properly marked specimen of *planata* in the Linnaean cabinet, when it was first examined by Hanley, insured the identification.

Most collections include Linnaeus' *planata* in the genus *Peronaea* Stoliczka, 1871. Thiele does not recognize this genus in his arrangement of Tellinidae, and, as he does not cite *planata* Linné, it is not possible to determine where he would place it.

Figured in Reeve (1843-1878, vol. 17, *Tellina*, pl. 8, sp. 30) and in Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, atlas, pl. 94, figs. 1-5).

#### *Tellina laevigata*

1758, *Systema naturae*, ed. 10, p. 675, no. 41.  
 1767, *Systema naturae*, ed. 12, p. 1117, no. 33.  
 LOCALITY: "In O. Europaeo et Indico" (1758, 1767).

"T. testa ovata laevigata, dentibus lateralibus marginatis, pube striato-scabra, nymphis inflexis."

No question has ever been raised as to the identification of this common species. The collection contains specimens of both color

<sup>1</sup> The shell referred to by Spengler was cited and figured by Chemnitz (1780-1795, vol. 6, pl. 11, fig. 99) and was called by him "*Tellina complanata pellucida*," although it was in fact *Tellina hyalina* Gmelin, 1791, *vide* Wood (1856, p. 24).

Deshayes (1836, p. 93, pl. 18, ser. 3, figs. 12, 13, 14) also describes and figures a *Tellina hyalina*, but his figures are not sufficiently characteristic to be identified. They show no indication of a posterior angulation and their size is not indicated. No sculpture is indicated except what appears to be concentric growth lines.

forms—the rayed shell and the white form ordinarily found with an orange-red border. The sole figure cited by Linnaeus, from Rumphius, was possibly the best available figure in 1758 but certainly does not fit the words of the description, “pube striato-scabra,” nor that part of the “Museum Ulricae” diagnosis which refers to its size as “magnitudine ovi vel major.” However, the description in both works points definitely to the shell that has always been known as *T. laevigata*.

It remains in the typical subgenus of *Tellina* Linné and is therefore cited as *Tellina* (*Tellina*) *laevigata* Linné, 1758. Linnaeus' locality was incorrect, as the species is native to the West Indies and Florida.

Figured in Reeve (1843–1878, vol. 17, *Tellina*, pl. 7, sp. 28).

#### *Tellina radiata*

1758, *Systema naturae*, ed. 10, p. 675, no. 42.

1767, *Systema naturae*, ed. 12, p. 1117, no. 54.

LOCALITY: “In Oceano Europaeo” (1758, 1767).

“T. testa oblonga longitudinaliter subtilissime substriata nitida, sutura anali canaliculata. . . Testa alba radiis incarnatis, obsolete striata. Rima Nymphis hiantibus nec prominulis.”

This well-known species, found almost everywhere in the tropical and subtropical waters of the western Atlantic, was given an incorrect locality by Linnaeus, although he corrected his mistake by adding “Jamaica” in a manuscript note in his copy of the twelfth edition. He likewise added references to three figures, the diagnosis in the “Systema” having lacked any synonymy save references to the “Museum Ulricae” and the “Fauna Suecica.” Two of these figures are sufficiently accurate. The third, from Argenville, is inconclusive and had, in any case, been already cited by him for *Tellina virgata*. Hanley (1855, p. 38) suggests that the error in locality might have arisen from confusion with the shell referred to in the “Fauna Suecica,” a different species, or from the examination of specimens that were adventitious as possibly coming from the ballast of a vessel.

In any event there is no question as to the identification of the species. A specimen of the American *T. radiata* is properly marked in the collection, and the description is unequivocal. It is the type of *Tellina* Linné and

of the typical subgenus as well and is to be cited as *Tellina* (*Tellina*) *radiata* Linné, 1758. Some authorities, notably Thiele, place it in section *Liotellina* P. Fischer, 1887, of *Tellina*, *sensu lato*, as the type of the section, and make the *virgata* group the typical section of the genus, as mentioned in the introduction to *Tellina* (above).

Lamarck (1818, 1819, vol. 5, p. 521) described a form of this shell which is devoid of rays of color and named it “*unimaculata*.” As the two forms are found together and are almost equally common there is no ecological or other basis for their separability, and it would seem best to deny to *unimaculata* even a subspecific validity.

The typical *T. radiata* is figured in Reeve (1843–1878, vol. 17, *Tellina*, pl. 3, sp. 8).

#### *Tellina rostrata*

1758, *Systema naturae*, ed. 10, p. 675, no. 43.

1767, *Systema naturae*, ed. 12, p. 1118, no. 55.

LOCALITY: “In O. Europaeo & Indico” (1758); “in O. Indico: Java” (1767).

“T. testa oblonga: antice angulato-rostrata, angulis subdentatis.”

The description of this species in the tenth edition: “T. testa oblonga: antice angulato-rostrata” is not particularly helpful as it might apply equally to other members of the genus. No figure of the species was available in 1758, and the figures cited for it are, as is so often the case in the “Systema,” the nearest approximations that Linnaeus could find. In the twelfth edition the description was improved by the addition of the words “angulis subdentatis,” which narrow the choice to two species: *Tellina foliacea*, which is described as “rima serrata” but which has been definitely isolated as another and quite different species, and the shell that is now conceded to be the type of Linnaeus' *rostrata* and has retained that specific name. The addition of a good figure of our *rostrata* from Lister was added in a manuscript note and the description in the “Museum Ulricae,” with its more ample language, seems to confirm the identification.

I point out the details of the descriptions because, strangely enough, both Schumacher and Hanley were dissatisfied with the identification with our *rostrata* or at least were unwilling to perpetuate the Linnaean specific

name. They both chose *Tellina spengleri* Chemnitz, 1782, as the type of *T. rostrata*, and in fact Hanley (1855, p. 38) calls attention to the presence in the collection of a properly marked specimen of that shell. The Chemnitz shell I believe to be identical with *rostrata* Linné, and there seems to be no reason against the restoration of the name Linnaeus gave to it. It is not *Tellina spengleri* Gmelin, 1791.

Other eighteenth century writers, who apparently based their views on the tenth edition alone, selected *Tellina vulsella* Chemnitz. This shell is almost identical with *rostrata*, except in color and in the complete absence of denticulations on the dorsal margin.

The position of this species is in the typical subgenus of *Tellina*, and it should therefore be cited as *Tellina (Tellina) rostrata* Linné, 1758.

Figured in Reeve (1843-1878, vol. 17, *Tellina*, pl. 17, sp. 83).

#### *Tellina inaequivalvis*

1758, *Systema naturae*, ed. 10, p. 673, no. 32 (*Solen*).

1767, *Systema naturae*, ed. 12, p. 1118, no. 56 (*Tellina*).

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

"T. testa oblonga-rostrata: valvula altera plana . . . Testa longitudine pollicis transversa, lactea, laevis, pellucida. Sutura dorsalis recta excurrans in rostrum obtusum patulum. A natibus ad rostri inferiora angulus obliquus ut in Tellinis. Valvula altera plana; altera leviter convexa. Cardio dentibus duobus absque lateralibus."

This species was on Linnaeus' list of owned shells, and the specimen in the collection, although unmarked, is the only one present that agrees with the extremely long and characteristic description. Although no figures are cited it is impossible to mistake Linnaeus' species for anything else than the *Pandora inaequivalvis* of all modern writers.

In the tenth edition Linnaeus listed *inaequivalvis* as a *Solen*, but, aside from some similarity in shape, its characteristics are quite unlike those of that genus. It is identical with the *Pandora rostrata* of Lamarck, 1818, a name that was used by many nineteenth century conchologists, Hanley saying (1855, p. 39) that the type in the collection was a "produced form" of Lamarck's *rostrata*.

In the "Prodrome" of 1799 Lamarck used *T. inaequivalvis* as the "example" of the genus *Pandora*, and it is not clear why he decided to abandon the Linnaean name in favor of *rostrata* in the later work. It is the type of *Pandora*, by subsequent designation, Children, 1823.

The authorship of *Pandora* is somewhat complicated. It was first used, but not published, by Hwass. The date of this use is not known, but we do know that he communicated it, possibly by letter, to Chemnitz who mentions the group as follows: "The Herr Justitzrath Hwass has erected a new genus, which he calls *Pandora*, out of such of the Tellens as have a flat valve above and a deep, saucer-shaped valve below, like *Tellina inaequivalvis*, *Tellina crystallina* and others" (1780-1795, vol. 11, p. 211). This statement occurs at the end of the description of *Tellina crystallina* and is the only mention of *Pandora* in the Martini-Chemnitz work. The next appearance of the name was as the heading of a plate of figures which was published in 1797 as a part of the "Tableau" of the "Histoire naturelle des vers" by Bruguière. Bruguière, whose writings, so far as generic descriptions are concerned, are confined solely to the first volume of that work, in which he treated the genera in alphabetical order only as far as *Conus*, never described *Pandora*. However, under the recent Opinion of the Commission referred to in the footnote on page 29, these plate headings are held to be valid proposals of genera as of the date of the plates in question. Thus *Pandora* can be cited as of Bruguière, 1797.

For those who believe that the reference in Chemnitz is a valid proposal of *Pandora*, and take Opinion 184 of the Commission as a tentative rather than a definitive opinion on the nomenclatural availability of the Chemnitz names, the genus may be cited as *Pandora* Hwass in Chemnitz, 1795. For those who do not accept the Chemnitz proposal for any reason, it may be cited as *Pandora* Bruguière, 1797, under the authority of the recent unpublished opinion above mentioned. In my opinion the ruling on the Bruguière plate headings is not only unwise but does violence to the authority and permanent effectiveness of the Rule of Priority.

Dating it as of Bruguière, 1797, would not

change its application, as its type would be *Pandora margaritacea* Lamarck, which (*vide* Stewart, 1930, p. 303) is a variety of *T. inequivalvis* Linné.

Figured in Sowerby (1820, 1825, 1834, vol. 1, *Pandora*, figs. 1-3, as *P. rostrata*) and Hanley (1855, pl. 1, fig. 6).

#### *Tellina trifasciata*

1758, *Systema naturae*, ed. 10, p. 675, no. 44.

1767, *Systema naturae*, ed. 12, p. 1118, no. 57.

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

"T. testa ovata laeviuscula sanguineo-triradiata, pube rugosa. . . . Testa magnitudine unguis, pallida; radiis 3 sanguineis a cardine ortis, antice magis obtusa; vulva ovata."

Hanley (1855, p. 39) identified this species with a specimen of *Donax vittata* Lamarck, 1818, in the collection. The specimen is in a tray labeled with this name, but as the writing is not that of Linnaeus it has little probative value, and Hanley was thus forced to resort to the expedient of comparing the description of *trifasciata* with every pelecypod in the collection. He concluded that Linnaeus' specimen of Lamarck's *Donax vittata*, as the only one that conformed, was the type of *trifasciata* Linné. The Lister figure cited must be rejected. In the first place it clearly represents *Psammobia färöensis*, a quite different species, and second, it was repeated in the synonymy of *Tellina incarnata*, the succeeding species in the "Systema."

Although Hanley (1855, pl. 1, fig. 5) figures "*Donax vittata* Lamarck" as a *Tellina*-like shell with three red rays diverging from the umbo, it is not clear what the figure represents. Lamarck published the name in 1818. Delessert (1841, pl. 6, figs. 12a-b, and text page opposite plate) lists the name and uses a description copied verbatim from Lamarck, and his figure shows a shell which might be taken as the one Hanley figured, although the rays of color appear only faintly. The *Donax vittata* of Da Costa, 1778, described as *Cuneus vittatus*, does not agree with either of the above-mentioned figures. Donovan (1799-1803, vol. 2, pl. 60) figures a *Tellina trifasciata*, as of Gmelin, but the figure is again something quite different, a pinkish, strongly angulated *Tellina* with many reddish rays, in pairs, radiating from the umbones. Among the synonyms cited by Donovan is the Lister

figure which Linnaeus erroneously used for *trifasciata*. Donovan's figure is much like *Psammobia färöensis*.

In my opinion, Linnaeus' *trifasciata* is a *Donax* and is quite possibly *D. vittata* Lamarck. In that genus the variation in number, alignment, and color of the rays is extremely great, and in many species we find rayed and unrayed individuals. Therefore Linnaeus' statement that his species possessed three red rays does not necessarily exclude any one of several members of the genus. The specimen before him merely presented one color variety.

Hanley, as above mentioned, unequivocally adopted *D. vittata* Lamarck as the representative of *trifasciata*, but a study of his comments makes me suspect that he based his identification on the fact that the specimen of that shell in the collection was the only one that *did not disagree* with the description. Hanley was very prone to cut corners in this fashion when he was confronted with a marked specimen whose origin was questionable, but it is surprising to find him doing so when he admits, at the same time, that the name *trifasciata* was written in a hand other than that of Linnaeus, and that the tray on which it was written was not one of the original tin boxes in which Linnaeus stored his specimens.

In brief, the species may have been *Donax vittata* Lamarck, but this is impossible to prove, and I can only consider it as a *species dubius*. It is not *Donax vittatus* Da Costa.

#### *Tellina incarnata*

1758, *Systema naturae*, ed. 10, p. 675, no. 45.

1767, *Systema naturae*, ed. 12, p. 1118, no. 58.

LOCALITY: "In O. Europaeo, Mediterraneo" (1758-1767).

"T. testa ovata antice productiore compresso-planiuscula, natibus submucronatis. . . . Testa magnitudine extimi pollicis, simillima *T. planatae*, sed incarnata radio uno alterove pallido. Nates acutiusculae."

Two figures were cited for this species. The one from Lister (1678, pl. 1, fig. 8) is obviously meant for *Psammobia färöensis*. The Gualtieri figure (1742, pl. 88, fig. M), although a very poor drawing, shows the shell that has been most often called *Tellina squalida* Pulteney, 1799, or *T. depressa* Gmelin, 1791. Not only does this last draw-

ing agree with the description, but a specimen of *T. squalida* is in the collection, marked for *incarnata*. The clarity of the description and the existence of an authenticated and conforming specimen have convinced most commentators that Linnaeus was describing *T. squalida*, in spite of the discordance of the synonymy.

The *T. incarnata* of the "Fauna Suecica" was undoubtedly a different shell. There the description is quite different, although its first phrases are the same, and the whole very accurately describes *Psammobia färöensis*. It may also be significant that only the Lister figure was cited in the "Fauna Suecica," the figure that represents *Psammobia färöensis*, but I think it possible that Linnaeus was unaware of the separate identities of the *incarnata* of the two works. Both Loven and Bucquoy, Dautzenberg, and Dollfus agree that he was describing the two different shells.

The *incarnata* of the "Systema," under modern arrangements, is placed in the genus *Angulus* Megerle von Mühlfeld, 1811, and I see no reason, based upon the entire diagnosis both in 1758 and 1767, why the Linnaean specific name should not be retained and *T. squalida* and *T. depressa* thrown into its synonymy.

Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, pp. 482-483, 658-659) discuss the identity of *T. incarnata*, *T. trifasciata*, and *Psammobia färöensis* in the two works and reach the above conclusions. They comment on the wording of the descriptions, on the identity of the cited figures, and on the opinions of other commentators in great detail, and their comments should be read.

Good figures of the *incarnata* of the "Systema" are difficult to find. That in Reeve (1843-1878, vol. 17, *Tellina*, pl. 8, sp. 31a-b) is fair. Recent photographic figures are in Nobré (1938-1940, pl. 76, fig. 3, pl. 77, figs. 1-2). Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, atlas, pl. 91) show a number of varieties of *incarnata*. *Tellina squalida* Pulteney, which those authors treat as a good variety of *incarnata*, is shown in figures 6 and 7 of plate 91.

#### *Tellina donacina*

1758, *Systema naturae*, ed. 10, p. 676, no. 46.

1767, *Systema naturae*, ed. 12, p. 1118, no. 59. LOCALITY: "In M. Mediterraneo" (1758, 1767).

"T. testa ovata compresso-planiscula laeviuscula: antice obtusissima. . . . Testa simillima *T. incaranatae*, sed minor, purpurescens radiis plurimis rubris. Regio vulvae obtusissima et fere truncata, ut in *Donace*."

No question has ever been raised as to the identity of this species with the *T. donacina* of authors. A specimen of that shell showing the characteristic coloring noted in the description ("purpurascens radiis plurimis rubris") is among the other specimens of *donacina* found in a properly marked container in the collection. It agrees with the description in the other necessary respects.<sup>1</sup> The synonymy can be disregarded, as the single figure cited (from Gualtieri) shows a true *Donax*. It is now included in the genus *Moerella* P. Fischer, 1887, of which it is the type, by monotypy. This genus is very close to *Tellina*, *sensu stricto*, from which it differs in having a weaker left lateral tooth and a less marked rostration. Thiele makes *Moerella* a subgenus of *Angulus* Megerle von Mühlfeld, 1811.

Figured in Reeve (1843-1878, vol. 17, *Tellina*, pl. 10, sp. 43).

#### *Tellina truncata*

1767, *Systema naturae*, ed. 12, p. 1118, no. 60. LOCALITY: "In Java" (1767).

"T. testa ovali compressa substriata, parte antica truncata suturae distincta. . . . Testa similis *T. incarnatae*, sed violacea, magis fragilis, apice anteriore fere truncato. Regionem anteriorem distinguit linea elevata: Dentes omnes emarginati."

This species, which appeared for the first time in the twelfth edition, was not provided with any synonymy. A specimen of *Psammobia pulchella* Lamarck, 1818, in the collection of Linnaeus, conforms adequately to the description of *truncata*, and, *vide* Hanley

<sup>1</sup>Lamarck, in the synonymy appended to the name *Psammobia tellinella* (1818-1819, vol. 5, p. 515) noted, "It is not the *Tellina donacina* of Linné," a comment that seems entirely superfluous. Hanley (1855, p. 36) referred to the possibility that *P. tellinella* was identical with *T. albida* Linné but rejected the identification on grounds that he did not make clear. Except for the above-mentioned statement of Lamarck, it has never been suggested that there was any question of identifying it with *T. donacina*. The two species seem to be distinct.



(1855, p. 40), is the only one that does so agree, particularly in respect to the striking feature noted in the description ("Regionem anteriorem distinguit linea elevata.") However, Hanley qualified the identification by saying, "There is every probability that it was the actual type of the species."

Linnaeus added to the description the words "similis *T. incarnatae*, sed violacea." As the *T. incarnata* of the "Systema" can hardly be compared with *T. truncata* because of the striking sculptural division between the anterior and posterior parts of the shell in the latter, it is probable that he was speaking of the *T. incarnata* of the "Fauna Suecica," and that Loven was correct in his surmise mentioned under *T. incarnata* (above).

In view of the excellence and unmistakably characteristic language of the description of *truncata* it would seem that Hanley's qualification was not necessary. The identification, in fact, seems so perfect that there should be no hesitancy in restoring the name *truncata*.

The species is undoubtedly a *Psammobia*, but owing to the fact that *Gari* Schumacher, 1817, covering the same group, has a priority of one year over Lamarck's genus, it is proper to cite it as *Gari truncata* (Linné), 1758.

Figured in Reeve (1843-1878, vol. 10, *Psammobia*, pl. 4, sp. 23, as *Psammobia pulchella*).

#### *Tellina balaustina*

1758, *Systema naturae*, ed. 10, p. 676, no. 47.

1767, *Systema naturae*, ed. 12, p. 1119, no. 61.

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

"T. testa dilatato-orbiculata laeviuscula, valvula altera dentibus lateralibus. . . . Testa magnitudine seminis Lupini albi, fere orbicularis, sed paulo magis dilatata, albida radiis obsolete rufis."

There is no specimen in the collection marked with either the name or number of *balaustina*, and no figures are cited. The type was isolated by Hanley (1855, p. 40) by the slow process of comparing every bivalve present with the description. The shell called *balaustina* by all post-Linnaean authors was the only one that conformed perfectly. The stated locality corroborates this identification, as its accuracy is confirmed by the name of the collector, Fagraeus.

Conchologists now place *balaustina* in the

typical subgenus of *Arcopagia* (Leach) T. Brown, 1827, of which it is the type, and cite it as *Arcopagia (Arcopagia) balaustina* (Linné), 1758.

*Arcopagia* (Leach) Brown, 1827, of which *T. balaustina* is the type, is not *Arcopagia* d'Orbigny, 1853, which is a synonym of *Heterodonax* Mörch, 1853.

Figured in Reeve (1843-1878, vol. 17, *Tellina*, p. 10, sp. 46).

#### *Tellina remies*

1758, *Systema naturae*, ed. 10, p. 676, no. 48.

1767, *Systema naturae*, ed. 12, p. 1119, no. 62.

LOCALITY: "In O. Europaeo et Indico" (1758, 1767).

"T. testa suborbiculata compressa rugosa."

It is not necessary to use the tedious process of comparison and exclusion in order to determine the type of *remies*, as a specimen of the *Tellina remies* of most authors still remains in a box so marked in the collection. This specimen agrees with the description. Linnaeus borrowed the specific name from Rumphius, as is stated in the "Systema," and, although the reference is erroneously transcribed (pl. 43 instead of pl. 42), the error is corrected by Linnaeus in a manuscript note. The figure from Gualtieri is unrecognizable.

The species has been placed in various genera from time to time, but I am following Dall's arrangement (1890-1903, pt. 5, p. 1012) and including it in *Cyclotellina* Cossmann, 1886. It is not *Tellina remies* Born, 1780.

Figured in Reeve (1843-1878, vol. 17, *Tellina*, p. 6, sp. 23). Born's *remies* is figured in the same volume and section of Reeve (pl. 1, sp. 1).

#### *Tellina reticulata*

1767, *Systema naturae*, ed. 12, p. 1119, no. 63.

LOCALITY: "In India" (1767).

"T. testa lentiformi compressa reticulata. . . .

Testa alba: Striis longitudinalibus crispis striisque transversis elevatis lynceo tantum videndis reticulata. Anus cordatus, impressus, brevis-simus."

Chemnitz (1780-1795, vol. 6, pl. 12, fig. 118) published a figure, as "*Tellina reticulata Linnaei*," which apparently shows the West Indian shell which Spengler, Schumacher, Wood, Crouch, and other early writers called

by the Linnaean specific name, and which Sowerby, 1822, included in the genus *Amphidesma* Lamarck, 1818. These authors all adopted it as the representative of Linnaeus' *T. reticulata*. In Chemnitz' text (*tom. cit.*, pp. 124-125) he specifically states the locality to be "the West Indian sugar islands," after quoting Linnaeus' description and Linnaeus' locality "In India." A specimen of the West Indian shell is in the Linnaean collection, but as it is unmarked and the name does not figure in the list of species owned by Linnaeus, its presence proves nothing as it may have been added later. Hanley (1855, p. 41) felt that this specimen "coincides so very fairly" with the description in the "Systema" that he was inclined to accept it "with a note of interrogation attached." The words "lynceo tantum videndis" as applied to both the radial and concentric sculpture, the inapplicability of the Rumphius figure (for which Linnaeus again wrote "t. 43" for "t. 42") which shows a very coarsely reticulate shell, to both the specimen in the collection and to the description, the absence of an authoritative type, and the fact that Linnaeus' locality was vouched for by Tesdorff, make Hanley's "note of interrogation" an obvious understatement. We must consider the Linnaean *reticulata* to be an oriental shell and to be unidentifiable.

The first name to be given to the West Indian species was *Tellina proficua* Pulteney, 1799, a specific appellation which has several years' priority over the *reticulata* of authors, which was, moreover, based upon an erroneous identification with the Linnaean species. It is now in *Semele* Schumacher, 1817, which has one year's priority over *Amphidesma* Lamarck, 1818, as *Semele proficua* (Pulteney). This species, as *Semele reticulata*, was the type, by monotypy, of Schumacher's genus. Schumacher's comment on his type is pertinent (1817, p. 166): "I do not dare to assert that this shell is the *Tellina reticulata* of Linné, but I am certain that it is the shell of Spengler mentioned above, as I have compared my three specimens or individuals with those in the collection of Mr. Spengler, and have found them in every way identical."

#### *Tellina scobinata*

1758, *Systema naturae*, ed. 10, p. 676, no. 49.

1767, *Systema naturae*, ed. 12, p. 1119, no. 64.

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

"T. testa lenticulari scabra: squamis lunatis quincuncialibus. . . Ani fossula oblonga, nec labia canaliculata."

The Pacific species which has always been called *T. scobinata* is represented in the collection and, as it exclusively and accurately agrees with the Linnaean description, is accepted without question as the shell which Linnaeus described under that name.

In the most recent arrangement (Dall, Bartsch, and Rehder, 1938, p. 183), it is placed in *Scutarcopagia* Pilsbry, 1918, to which these revisers give full generic rank. I am adopting this view and therefore cite the species as *Scutarcopagia scobinata* (Linné), 1758. It is the type of *Scutarcopagia* Pilsbry, by original designation.

Figured in Sowerby (1820, 1825, 1834, vol. 1, pl. 56, fig. 2).

#### *Tellina lactea*

1758, *Systema naturae*, ed. 10, p. 676, no. 50.

1767, *Systema naturae*, ed. 10, p. 1119, no. 65.

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

"T. testa lentiformi gibba alba pellucida laevi. . . Testa semine Lupini albi major, parum transversim obsolete striata."

The difficulties of identification in this case arose from the very imperfect description and the meagerness of the synonymy. The single figure cited, from Gualtieri, shows a shell which, while probably a lucinid, does not conform to the description. For many years it was identified with the *Lucina lactea* of authors. Hanley (1855, p. 42) treated the identification of the species in some detail, the substance of his argument being as follows: Philippi, noting the word "gibba" in the description which did not apply to the *lactea* of authors, decided to transfer the Linnaean name to the shell which he had formerly called *Lucina fragilis*. Philippi, however, overlooked the words "semine Lupini albi major" [larger than the seed of the white lupine], in the definition of Linnaeus' *lactea*. Inasmuch as both *balaustina* and *carnaria* are described as being "as large as" the white lupine seed, *lactea* must be a larger shell than either, which is not true of *fragilis*. Hanley (1855, pp. 42-43) also called attention to the fact that *Lucina fragilis* is an edentulous

species and that this would hardly have been passed over by Linnaeus if his *lactea* had been devoid of teeth.

There is, however, in the collection a specimen of *Lucina globosa* Chemnitz, 1784, that is so like the description of *lactea* that Hanley (*loc. cit.*) unhesitatingly chose it as the type of the Linnaean species. This specimen also bore the remains of a number (the digit 5) and, by the method noted in the Foreword to the present paper, Hanley determined to his own satisfaction that no other species in the "Systema" whose number contained the digit 5 could be identified with *globosa*. The numbers of *lactea* in the two editions are, respectively, 50 and 65.

In spite of Hanley's conclusions conchologists have returned to the views of the early writers and are virtually unanimous in identifying Linnaeus' *lactea* with the *lactea* of authors, a shell common in the Mediterranean. The species is placed generally in *Loripes* Poli, 1791. The most recent pronouncement on *lactea* is that of Nobre (1938-1940, p. 731) who cites it as "*Lucina (Loripes) lacteus* Linné (*Tellina lactea* L. Syst. Nat. 10, p. 676)." Bucquoy, Dautzenberg, and Dollfus also cite the species as being *lactea* Linné. It may be noted that even Hanley's contemporary, Woodward, did not adopt Hanley's theory.

This shell should not be confused with the *Tellina lactea* of Poli, which is a synonym of *Amphidesma lucinalis* Lamarck and, under that name, is the type of *Loripes* Cuvier, 1817. As *Lucina fragilis* Philippi it is also the type of *Loripinus* Monterosato, 1884.

The Linnaean *lactea* is figured in Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, atlas, pl. 89, figs. 1-9) and in Nobre (1938-1940, pl. 70, fig. 4).

#### *Tellina carnaria*

1758, Systema naturae, ed. 10, p. 676, no. 51.

1767, Systema naturae, ed. 12, p. 1119, no. 66.

LOCALITY: "In Oceani brevibus" (1758, 1767).

"T. testa suborbiculata laevi utrinque incarnata oblique striata: striis hinc reflexis. . . Testa magnitudine seminis Lupini albi, nonnihil compressa."

This species was easily identified as the *Strigilla carnaria* of the western Atlantic. A specimen of that shell is in the collection and conforms perfectly with the unusually

characteristic description. The identification is facilitated by the fact that there is no other *Tellina* present for which it could be mistaken. The synonymy can be disregarded, as it figures two quite dissimilar *Tellina*.

It is the type of *Strigilla* Turton, 1822.

Figured in Reeve (1843-1878, vol. 17, *Tellina*, p. 9, sp. 37a, b).

#### *Tellina bimaculata*

1758, Systema naturae, ed. 10, p. 677, no. 52.

1767, Systema naturae, ed. 12, p. 1120, no. 67.

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

"T. testa triangulo-subrotunda latiore laevi albidia: intus maculis duabus sanguineis oblongis. . . Testa vix extimi pollicis magnitudine, extus alba, sed maculae interiores parum pellucunt; laevis nisi striis aliquot obsoletis circumdata esset. Flexura testae in hac non manifesta."

This species is also in the collection, and the fact that the specimen is marked with the number of *bimaculata* and is in perfect accord with the description makes it readily identifiable. It has been put in the genus *Heterodomax* Mörch, 1853, and is the type of that genus. The locality assigned to it by Linnaeus is incorrect, as it is a native of the Antilles, of Florida, and of the Pacific coast of the United States. It is the *Psammobia affinis* of C. B. Adams, 1843.

Figured in Reeve (1843-1878, vol. 17, *Tellina*, pl. 18, sp. 94a, b, c) and in Sowerby (1847-1887, vol. 1, *Tellina*, pl. 56, figs. 16, 20-22).

#### *Tellina balthica*

1758, Systema naturae, ed. 10, p. 677, no. 53.

1767, Systema naturae, ed. 12, p. 1120, no. 68.

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

"T. testa subrotunda laevi extus incarnata. . . Testa seminis Lupini albi magnitudine; moliuscula, fragilissima; intus alba, extus incarnata; e triangulo rotundata."

The type of *T. balthica* is found in its properly marked box in the collection and conforms to the description in both the "Systema" and the "Fauna Suecica." The synonymy, which is accurate, is confined to the reference to the latter work and to the account of Linnaeus' travels in the Baltic Islands (Linné, 1745, p. 43). It has been moved to *Macoma* Leach, 1819.

The species occurs in the western Atlantic as well as in the Baltic Sea. Dall (1921a, p.

47) lists it from the Pacific coast of the United States, but later writers have called the Pacific form a subspecies of *balthica* to which they have given the name *inconspicua*. It seems to be generally agreed today by West Coast conchologists that *inconspicua* is of specific value, having characteristics which separate it from the specimens from the western Atlantic at least.

Figured in Maxwell Smith (1941, pl. 23, fig. 8).

#### *Tellina pisiformis*

1758, *Systema naturae*, ed. 10, p. 677, no. 54.

1767, *Systema naturae*, ed. 12, p. 1120, no. 69.

LOCALITY: "Ad Europaei ostia fluviorum" (1758, 1767).

"T. testa subglobosa laevi, intus incarnata, oblique substriata: striis antice angulo acuto reflexis. . . . Testa magnitudine Pisi, alba, fundo purpureo, striata. Striis vix oculo nudo manifestis, obliquis, sed anterieus reflexis ad angulum acutum. Cardinus dens unicus praeter laterales prominulos. Rarius tota alba reperitur."

The description alone is sufficient to identify this species, as it is one of the clearest and most elaborate in the entire "Systema." The locality is incorrect; there are no authentic specimens in the collection and the figure from Gualtieri is of no value. It represents, very crudely, what is apparently one of the fluviatile viviparous cyclades. Moreover, in the twelfth edition Linnaeus cited the wrong figure, having copied the wrong letter from the Gualtieri plate.

The representative of Linnaeus' shell is our *Strigilla pisiformis* of the West Indies. The collection does contain specimens of that shell, but a paper found with them indicates that they were added after the collection passed out of the custody of Linnaeus' son, which leaves them without any probative value.

The white variety mentioned in the "Systema" has been thought by some writers to be *Strigilla flexuosa* (Say), 1822.

Linnaeus' *pisiformis* is figured in Reeve (1843-1878, vol. 17, *Tellina*, pl. 42, sp. 250).

#### *Tellina divaricata*

1758, *Systema naturae*, ed. 10, p. 677, no. 55.

1767, *Systema naturae*, ed. 12, p. 1120, no. 70.

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

"T. testa subglobosa alba bifariam oblique striata. . . . Testa magnitudine Pisi, subcom-

presso-globosa, gibba. Striae tenuissime, bifariam ad utrumque latus ductae."

This species is the small shell so well known in the Mediterranean as *Divaricella divaricata*. At one time Philippi called it *Lucina commutata* but later recognized it as the Linnaean *divaricata* leaving it, however, in *Lucina*. It was separated from *Lucina* by von Martens who placed it in his genus *Divaricella*, 1880, along with the two American species *D. dentata* Wood, 1815, and *D. quadrisulcata* d'Orbigny, 1846.

There has been a great deal of confusion in synonymizing the three species of *Divaricella* mentioned above. Gould (1841, p. 70) apparently saw no difference between *divaricata* Linné and the American *dentata* of Wood. Forbes and Hanley (1853, vol. 1, p. 52) demonstrated that they were separable, and Binney (1870, p. 100) adopted this view and differentiated *divaricata* Lamarck (which he identified with *dentata* Wood) from the Linnaean *divaricata*. He said of *dentata* (*loc. cit.*): "There can be no doubt that this shell is not the *Tellina divaricata* of Linnaeus as was supposed in the first edition; that name referring, as shown by Forbes and Hanley, to a smaller European species."

The Linnaean species is the Mediterranean shell and is so much smaller than either of its American congeners ("magnitudine Pisi") that confusion between the two would seem to be impossible, although it undoubtedly arose from the use of the name *divaricata* by Lamarck for a shell which was probably the American *dentata*. Finally the western Atlantic *quadrisulcata* is entirely distinct from either. Yet as late as 1894, Cockerell (p. 114) made *divaricata* Linné equal to *dentata* Wood, and in 1919 C. W. Johnson (p. 5) identified *dentata* Wood with *quadrisulcata*, although this error was later rectified by him (1934, p. 42).

*Divaricella divaricata* (Linné) is the type of *Divaricella* von Martens, 1880. It is figured by Reeve (1843-1878, vol. 6, *Lucina*, pl. 8, sp. 47a-b).<sup>1</sup>

<sup>1</sup>As the result of further investigation since the above comments on *Tellina divaricata* were written, the writer must correct his statement as to the type of *Divaricella* von Martens, 1880. The frequent reference to *Divaricella divaricata* (Linné) as the type of the genus has apparently been based on the erroneous grounds

**Tellina digitaria**

1758, *Systema naturae*, ed. 10, p. 677, no. 56.

1767, *Systema naturae*, ed. 12, p. 1120, no. 71.

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

"T. testa subglobosa pallida cincta striis obliquis uniformibus. . . Testa magnitudine Pisi, albida, interdum maculis undatis rufis. Striae transversae, sed pulchre obliquae, sensim desinentes ad marginem exteriorem, uti striae in apice digitorum, unde apparet spiraliter striata."

The description of this shell in the "Systema" is so clear and describes the striking sculpture so meticulously that its identification was readily made. It is the *Lucina digitaria* which is referred to by all of the writers on the shells of the Mediterranean. The locality, being vouched for by the observer Logie, corroborates the identification and, in fact, the specimen of that shell in the collection is the only one that can be completely tied to the description.

In 1853 S. Wood erected the genus *Digitaria* for the reception of this species. Thiele (1931, 1935, vol. 2, p. 845) places it in *Astarte* J. Sowerby, 1816, and uses *Digitaria* Wood as a section, citing the species as *Astarte (Digitaria) digitaria* (Linné), 1758. It is the type of *Digitaria* by absolute tautonymy.

Figured in Philippi (1836, 1844, vol. 1, pl. 3, fig. 19), and in Thiele (*tom. cit.*, fig. 812). The latter figure well shows the peculiar oblique sculpture of the shell.

**Tellina cornea**

1758, *Systema naturae*, ed. 10, p. 678, no. 57.

1767, *Systema naturae*, ed. 12, p. 1120, no. 72.

that von Martens' sole species, *D. angulifera*, was identical with *Tellina divaricata* Linné. Von Martens said (1880, p. 321) that his species was "probably the same as Dufo's *L. divaricata* 218 . . . and Reeve's *divaricata* Fig. 476." He did not state that the two *divaricata* mentioned were identical with Linnaeus' *divaricata*, and an examination of the evidence makes it certain that they were not. Dall (1890-1903, pt. 6, p. 1387) introduced a new complication by stating that von Martens' *angulifera*, the type, by monotypy, of *Divaricella*, was equal to *Lucina ornata* Reeve, 1850, but an examination of Reeve's figure shows that it does not resemble either *angulifera* or *divaricata*. Dall, however, stated the type of *Divaricella*, *sensu stricto*, to be *ornata*. Thiele (1931, 1935, vol. 2, p. 867) makes *angulifera* von Martens equal to *quadrisulcata* d'Orbigny, but this is highly improbable as the first is found in Mauritius and the second is a western Atlantic species. In any event it is certain that the type of *Divaricella* is *D. angulifera* von Martens, by monotypy; and that the latter is not *divaricata* Linné.

LOCALITY: "In Europae paludibus, stagnis" (1758, 1767).

"T. globosa glabra cornei coloris: sulco transversali . . . Testa magnitudine Pisi, rudis, cornu coloris; at in Islandia quadruplo major."

It was the clear and characteristic figure cited from Lister (1685, appendix, p. 22, pl. 1, fig. 5), rather than the description, which was responsible for the early identification of this species, although the language of the description in the "Systema," coupled with the somewhat better diagnosis in the "Fauna Suecica," seems entirely adequate. It is the *Cyclas cornea* of the early nineteenth century authors. The genus *Cyclas* (*fide* Lamarck, 1799, p. 66) was proposed in certain manuscript notes of Bruguière before he left France in 1792, on a voyage from which he never returned, but it has now been validated as of Bruguière, 1797, by an unpublished Opinion of the International Commission on Zoological Nomenclature covering certain plate headings in the "Tableau encyclopédique et méthodique." I refer to this Opinion in the discussion of *Mya pictorum* Linné (above). *T. cornea* Linné was used by Lamarck, 1799, as the "example" of *Cyclas*.

It is now placed in the genus *Sphaerium* Scopoli, 1777, of which it is the type, by monotypy. It is figured by Forbes and Hanley (1853, vol. 2, pl. 37, figs. 3-6) and by Reeve (1843-1878, vol. 20, *Sphaerium*, pl. 2, sp. 17a, b, c).

**CARDIUM LINNÉ**

The genus *Cardium*, as conceived by Linnaeus, has often been said to be a very broad group, even when compared to his other genera. If this criticism applies only to the *Cardium* of the tenth edition, it is probably justified. Linnaeus, however, made useful changes in the twelfth edition and in his manuscript annotations. Three species (*corallinum*, *solidum*, and *stultorum*) were moved to *Mactra*, a new genus, and *humanum* was transferred to *Chama*. Significant changes were also made in the generic definition.

The genus as it left the hands of Linnaeus in the annotated 1767 edition, the last one published by him, seems to be a very compact and homogeneous group of species. The gross details of the hinge are sufficiently constant. The prominent and recurved um-

bones are present in all the Linnaean species, although the amount of curvature of the umbones, as well as their degree of separation or approximation, varies between wide extremes. The presence of radial sculpture and the absence of concentric sculpture are constant except in the case of *laevigatum* and *serratum*. In these two species the radial ribs are extremely light or obsolescent, and are visible only on the interior of the valves and on portions of the exterior, while concentric sculpture is usually present as well. Both species, however, have the typical *Cardium* hinge. The improvement of the generic description illustrates the widening of Linnaeus' conception of the genus and more accurately covers the species themselves. In the twelfth edition the words "dentibus mediis binis alternatis" were substituted for the words "dentibus duobus," in the description of the cardinal teeth, and in Linnaeus' manuscript notes he changed "alternatis" to "recurvis" and added the phrase "Nymphae eminentis retrorsum pressae."

It can fairly be said that the genus in its final state was a narrow and homogeneous group, and it cannot even be claimed that *laevigatum* and *serratum* were out of place. They are, of course, farther from the typical *Cardium* than the others, but the difference is one of degree and not one of kind. A definitely atypical species is *C. costatum*, and this shell is commented on below.

It is true that *Cardium, sensu lato*, has been split up into new genera to such a degree that the typical subgenus, *Cardium, sensu stricto*, contains only one of Linnaeus' species, *costatum*. However, this splitting has been carried out with almost the same completeness in most of his other genera and does not in the least militate against the view that *Cardium* should not be singled out as a heterogeneous group. The new genera that have been carved out of all of the "Systema" genera are simply the result of research far beyond the reach of Linnaeus and his contemporaries and are based on data not possessed by them and on a multiplicity of species not dreamed of in his day. In any event the new genera of Cardiidae into which his species have fallen are often marked by very slight differences, and many of them are con-

troversial even today. There is certainly no unanimity of opinion as to the proper arrangement of the family.

#### *Cardium costatum*

1758, *Systema naturae*, ed 10, p. 678, no. 58.

1767, *Systema naturae*, ed. 12, p. 1121, no. 73.

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

"C. testa gibba aequivalvi: costis elevatis carinatis concavis membranaceis."

This species was accurately described and was supplied with an ample and correct synonymy, and this, together with the presence of a correctly marked specimen in the collection, made its identification simple. It is placed by most modern authors in the genus *Cardium, sensu stricto*, as the type species.

It is a peculiar form, with few but very sharp and high ridges representing the radial sculpture, the rest of the shell being smooth. It is unlike any of the other Linnaean species and, indeed, unlike any other species in the genus. It was designated as the type of *Cardium* by Children in 1823, and this is generally accepted as the earliest valid designation. However, Lamarck (1799) used *C. aculeatum* Linné as his "example" of the genus. One of the unfortunate results of the provision of Rule 30, that the mention of an "illustration or example" is not a valid type selection, arises in the case of *Cardium*, as it is not only confusing but taxonomically inartistic (and, according to some zoologists, improper) to designate as a typical subgenus a group the members of which are not typical of the genus. *C. costatum* is admittedly not typical, as it differs from all other members of *Cardium* not only in sculpture but in other respects. If we could accept Lamarck's designation of *C. aculeatum* as type, then the group embraced within *Acanthocardia* Gray, 1851, which also has *aculeatum* as type, would become the typical subgenus. This is a much more normal arrangement, although it has been suggested that *aculeatum* is also atypical. However, the departure from normal in this case is based upon much less obvious and important differences than in the case of *costatum*, and I would not feel that violence to good nomenclatorial practice had been done in considering the *aculeatum* group as

the typical subgenus.<sup>1</sup>

*Tropidocardium* Römer, 1868, is a toponym of *Cardium*, *sensu stricto*, as its type is *C. costatum* Linné, by subsequent designation, Tryon, 1869. Authors who accept Lamarck's selection of *C. aculeatum* as the "example" of *Cardium* Linné as a valid type designation cite *Tropidocardium* as a subgenus.

Figured in Reeve (1843-1878, vol. 2, *Cardium*, pl. 2, sp. 11).

#### *Cardium cardissa*

1758, *Systema naturae*, ed. 10, p. 678, no. 59.

1767, *Systema naturae*, ed. 12, p. 1121, no. 74.

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

"C. testa cordata: valvulis compressis dentato-carinatis, natibus approximatis. . . Variat testa lateribus utrinque planis aut altera concava."

The same factors contribute to the ready identification of this species as in the last case. The cited figures agree with the description, and the specimen found in the collection is not only marked for *cardissa* but agrees in every respect with all the details of the diagnosis. It is now placed in *Corculum* Röding, 1798, as the type of that genus, by subsequent designation, von Martens, 1870. *Corculum* Röding, once a very limited group, has been expanded in recent years, particularly by the German conchologists, to embrace as subgenera *Fragum* Röding, 1798, *Hemicardia* (Klein) Mörch, 1853, *Lunulicardia* Gray, 1853, *Trigonicardia* Dall, 1900, and other less important groups. It thus comprises, in its broadest use, all of the species having a roughly trigonal shape, strong ribs, and a sharply or moderately descending posterior slope, as well as the extremely inequilateral species *retusum* and *hemicardium* and the extraordinary species *cardissa*, which is the type of the "typical" subgenus *Corculum*, *sensu stricto*. If it is necessary that the subgenus which bears the name of the genus must be typical of the genus, then a more absurd result than this can hardly be imagined. It is not only not a normal member of the genus; it is a freak member. It is distorted to the

<sup>1</sup> It is suggested that zoologists might find it difficult to explain why one group of species is to be considered "typical" of a genus rather than another. I confess I dislike to have to use the term. There is certainly no "rule-of-thumb" on which the choice of the "typical subgenus" should be based.

point that its "breadth," as that term is ordinarily used, has disappeared and its place is taken by an edge or sharp angle, and its "thickness," in the plane of the umbones, has become the greatest dimension of the shell. The American conchologists have not unanimously accepted the above arrangement, whose principal protagonist is Thiele.

*Corculum* Röding takes precedence over *Cardissa* Megerle von Mühlfeld, 1811, *Hemicardium* (Cuvier) Schweigger, 1820, and *Cardissa* Swainson, 1840.

Linnaeus' *Cardium cardissa* is not the *C. cardissa* of Born, 1780, which is apparently *Cardium impressum* of the Portland Catalogue (Solander, 1786).

The *Cardium humanum* of Chemnitz (1780-1795, vol. 6, p. 153, pl. 14, figs. 145-146), *non* Linné, is a form of *C. cardissa* Linné. The *Cardium cardissa* of the "Museum Ulricae" was certainly the same as the species of that name in the "Systema naturae" but was provided with two varieties: (a) "colore rufo" and (b) "carina valvarum acuta, integerrimo." These varieties were referred to by Chemnitz, who erected three separate species for the *cardissa* complex. It will be useful for the student to examine the Chemnitz figures and discussion on this complex, i.e., (a) "*Cardium humanum* (*cardissa* Lin.) maculis sanguineis adpersum . . ." (p. 153, pl. 14, figs. 145-146); (b) "*Cardium cardissa* Linnaei . . ." (p. 150, pl. 14, figs. 143-144); and (c) "*Cardium roseum* . . ." (p. 154, pl. 14, figs. 147-148). Lamarck (1818, 1819, vol. 6, pp. 16-17) lists *C. cardissa* Linné and *C. junoniae*, the latter being Chemnitz' *roseum* and carrying Chemnitz' figures 147-148 as a reference, but does not cite the figures for Chemnitz' *humanum*. The above division of *cardissa* by Chemnitz and Lamarck is not longer followed, and all of the color forms mentioned should be included under one species and have no specific significance. The Reeve figures cited in the next paragraph show all the various color forms.

*Corculum cardissa* (Linné) is figured by Reeve (1843-1878, vol. 2, *Cardium*, pl. 3, sp. 15) and by Sowerby (1820, 1825, 1834, vol. 1, pl. 75, fig. 5). A good photographic figure is shown in Thiele (1931, 1935, vol. 2, p. 881, fig. 833).

**Cardium retusum**

1767, *Systema naturae*, ed. 12, p. 1121, no. 75.

LOCALITY: "In India" (1767).

"C. testa cordata: valvulis striatis crenulatis subcarinatis, ano lunato cordiformi intruso. . . . Testa inter Hemicardium et Fragum media, lactea. Valvulae angulo subcarinatae, striatae et transversim crenulatae. Anus profunde intrusus sinu lunari. Margo plicato-dentatus."

The entire diagnosis in the "Systema" was in accord with the marked specimen of *retusum* in the collection. Linnaeus himself called attention to the relationship of the species with *hemicardium* and *medium* by the words "Testa inter Hemicardium et Fragum media" in the description. It is generally placed in the genus *Lunulicardia* Gray, 1853, as the type of the genus, by monotypy, although it seems closer to *Fragum* Röding, 1798.

The only possible confusion in the identification of this species arises from the fact that several specimens of *Cardium subretusum* Sowerby, 1841, are found in the same marked box in Linnaeus' collection. As the latter shell is a mere form of *retusum* the Linnaean name is reserved for the typical form.

Figured in Reeve (1843-1878, vol. 2, *Cardium*, pl. 19, sp. 103).

**Cardium hemicardium**

1758, *Systema naturae*, ed. 10, p. 678, no. 60.

1767, *Systema naturae*, ed. 12, p. 1121, no. 76.

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

"C. testa cordata subquadrilatera: valvulis carinatis, natibus distantibus."

No specimen of the *hemicardium* of authors is found in the collection. The cited figures, however, clearly show that shell, and this identification is confirmed by the description in the "Museum Ulricaë," to which it is necessary to refer. The description in the "Systema" is hardly sufficient to determine the species with certainty. It is now cited as *Hemicardia hemicardium* (Linné), 1758, and is the type, by virtual tautonymy, of *Hemicardia* Spengler, 1799.<sup>1</sup>

<sup>1</sup> The first proposal of the name *Hemicardia* was by Klein in 1753 (pre-Linnaean). Bruguière's use of the name in 1789 is not valid under Opinion 5, as he merely copied the pre-Linnaean name without adopting it as his own. Stewart in 1930 accepts Spengler's *Hemicardia* as a valid proposal, although this is a debatable choice, as many of Spengler's nomenclatural units seem to

Figured in Reeve (1843-1878, vol. 2, *Cardium*, pl. 7, sp. 38).

**Cardium medium**

1758, *Systema naturae*, ed. 10, p. 678, no. 61.

1767, *Systema naturae*, ed. 12, p. 1122, no. 77.

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

"C. testa subcordata subangulata: valvulis angulatis sulcatis laevibus. . . . Testa simillimi priori, sed exalbido-purpurascense varia, sulcis laevibus absque aculeis, angulisque obsoletis."

The *Cardium medium* of the western Atlantic was identified with the Linnaean species by the presence of a specimen of that shell in the collection which bears the appropriate number. No question has ever been raised as to the shell that Linnaeus described. Hanley (1855, p. 47) refers to the fact that the listing of *C. medium* in the "Museum Ulricaë" compares it to *C. cardissa*, but it seems obvious that this merely suggests that the *medium* of the latter work was an entirely different shell, possibly, indeed, a form of *cardissa* or a distorted specimen of the latter, although it would be difficult to conceive of a distortion of a shell already so asymmetrical as *cardissa*.

The present position of *C. medium* is in *Trigonicardia* Dall, 1900, in the subgenus *Americardia* Stewart, 1930, of which it is the subgenotype, by original designation. Thiele does not accord generic rank to *Trigonicardia* Dall, which he uses as a subgenus of *Corculum* Röding, and does not recognize *Americardia* Stewart, his pelecypod volume having been published only a year after the publication of Stewart's name. The best practice is to cite the species as *Trigonicardia (Americardia) medium* (Linné), 1758.

The erroneous locality stated by Linnaeus was changed by Gmelin to "American Ocean."

Figured in Clench and Smith (1944, pl. 11, figs. 1-2).

**Cardium aculeatum**

1758, *Systema naturae*, ed. 10, p. 679, no. 62.

1767, *Systema naturae*, ed. 12, p. 1122, no. 78.

have been "groups" names written in the plural. I am following Keen's suggestion (1937, p. 21) in tentatively accepting Spengler's *Hemicardia* as valid, until such time as the International Commission on Zoological Nomenclature shall have passed upon it.



LOCALITY: "In O. Europaeo australi" (1758, 1767).

"C. testa subcordata: sulcis convexis linea exaratis: exterius aculeato-ciliatis. . . . Maxime affinis sequente et forte varietas."

This species was erroneously listed in the tenth edition of the "Systema" as *C. muricatum*, an obvious *lapsus* as Linnaeus listed the true *muricatum* on the following page. The error was corrected in the "Emmendanda" of the tenth edition, and does not appear in the twelfth. Through another oversight the mistake persisted in the "Museum Ulricaе" which was published between the last two editions of the "Systema."

This was not one of the shells owned by Linnaeus and does not appear on his list. The description is, however, conclusive of its identity. That the author had some doubts as to the validity of the species is shown by the words of the description: "Maxime affinis sequenti et forte varietas." The following species referred to is *C. echinatum*, and while the two descriptions are somewhat similar, the figures cited under each are sufficient, with the description, to differentiate the two shells. Certainly it would be difficult to confuse them when one has the two side by side, and it is a fair assumption that Linnaeus had never seen a specimen of *C. aculeatum*. The latter is a Mediterranean species, whereas *echinatum* is a shell that ranges into the colder waters of northern Europe and must have been familiar to Linnaeus, as is indicated by its inclusion in his "Fauna Suecica."

*Cardium aculeatum* is the type of *Acanthocardia* Gray, 1851, by subsequent designation, Stoliczka, 1870. (See comments on *Cardium costatum*, above.)

Figured in Reeve (1843-1878, vol. 2, *Cardium*, pl. 7, sp. 17). Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, atlas, pl. 40, all figs.) figure both the adult and juvenile stages of this species. (See discussion of *Cardium ciliare* Linné, below.)

#### *Cardium echinatum*

1758, *Systema naturae*, ed. 10, p. 679, no. 63.

1767, *Systema naturae*, ed. 12, p. 1122, no. 79.

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

"C. testa subcordata: sulcis exaratis linea ciliata aculeis inflexis plurimus."

This common northern European shell is

represented in the Linnaean collection by a marked specimen which closely conforms to the diagnosis of *echinatum* and to the figures cited. The locality is correct, as the species ranges from Iceland to Morocco and the Atlantic islands. It is not found in the Mediterranean, although Bucquoy, Dautzenberg, and Dollfus treat *C. mucronatum* Poli, 1791, which occurs throughout that sea, as a variety of *echinatum*. Pallary (1938, p. 52) reports a shell from Syria under the name of *C. echinatum*. This is so far from the ordinary range of the typical form, at least, that one suspects that he was referring to *mucronatum* Poli, to which he has attributed the name of the typical *echinatum*.

The species is now a member of the genus *Acanthocardia* Gray, 1851, and is thought to have been the *Cardium spinosum* of the Portland Catalogue (Solander, 1786).

Figured in Reeve (1843-1878, vol. 2, *Cardium*, pl. 6, sp. 34) and Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, pl. 42).

#### *Cardium ciliare*

1758, *Systema naturae*, ed. 10, p. 679, no. 64.

1767, *Systema naturae*, ed. 12, p. 1122, no. 80.

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

"C. testa subcordata: sulcis elevatis triquetris: extimis aculeato-ciliatis. . . . Simillima duobus praecedentibus, sed minor et nivea. Sulci triquetri, latere scilicet altero adnato."

The early nineteenth century conchologists were seemingly unable to identify this species, although it is a fairly common Mediterranean shell. They were probably confused by Linnaeus' language in the description, "Simillima duobus praecedentibus," referring to *C. aculeatum* and *echinatum*. They therefore referred the name either to the young of one or the other of those species, or to *C. paucicostatum* Sowerby, 1841. The latter suggestion is repelled by the words "aculeato-ciliatis" in the description of *ciliare*, as *paucicostatum* has papillae on the ribs rather than spines. The comparison with *aculeatum* and *echinatum* was more reasonable, but took no account of the fact that *ciliare* has but 16 ribs, whereas the other two have ribs much more closely set, about 23 in number. Unfortunately the box marked *ciliare* in the Linnaean collection contains, in addition to an adult specimen of

*ciliare*, also properly marked, a young specimen of *echinatum* bearing the name "*ciliare*." This led Hanley (1855, p. 48) to conclude that the two were identical and that Linnaeus himself must have come to the same conclusion at some period after the publication of the twelfth edition, a supposition which is not entirely improbable. His manuscript notes give us no further information.<sup>1</sup>

The description, although it does not mention the number of ribs, is sufficiently clear to indicate the shell which is universally called *ciliare* today. It is a member of the genus *Acanthocardia* Gray, 1851.

It should be pointed out that, in the language describing the ribs, the author used the word "sulcus" instead of "costa," a complete reversal of meaning, and was guilty of this error in the case of most of the other species of his *Cardium*. Indeed, he used "costa" only in the single case of *C. costatum*. The description in general, although it accurately defines the peculiar shape of the ribs, cannot be accurately translated owing to Linnaeus' peculiar Latin. We can only guess at the meaning of the words "latere scilicet altero adnato."

Reeve's figure of *ciliare* (1843-1878, vol. 2, *Cardium*, pl. 7, sp. 35) is the best I have been able to find. He also figures the immature *aculeatum* (1843-1878, vol. 2, *Cardium*, pl. 4, sp. 17).

#### *Cardium tuberculatum*

1758, *Systema naturae*, ed. 10, p. 679, no. 65.

1767, *Systema naturae*, ed. 12, p. 1122, no. 81.

LOCALITY: Not given in either edition.

"C. testa subcordata: sulcis obtusis nodosis transversim striatis."

This name is accepted as being the common *Cardium tuberculatum* of all authors, long known from European waters, and it is surprising that Linnaeus seemed ignorant of its locality. He did not own a specimen of the shell, and his manuscript notes supply no

<sup>1</sup> Even as late as 1892 Bucquoy, Dautzenberg, and Dollfus were not willing to accept *ciliare* as a valid name because of their hesitation in the face of the confusion among the specimens in the collection of Linnaeus. They cite the fact that Turton believed that *ciliare* was only the young of *echinatum*, and conclude: "It seems preferable to us to eliminate it from the nomenclature" (Bucquoy, Dautzenberg, and Dollfus, 1882-1898, vol. 2, p. 266).

further data. The description, which is the same in the two editions, is not only short but incomplete, as it might apply to more than one *Cardium*. Linnaeus cited but two figures; "Rumph. Mus. t. 48. f. 11" and "Argenv. Conch. t. 26. f. L."<sup>2</sup> The two drawings, which are much alike, are apparently taken from the same original. They show a lateral view of a shell which might be meant for *C. tuberculatum*, but which is somewhat too inflated and with an apparent sinuosity of margin lacking in that species. Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, p. 259) were of the opinion that the Rumphius figure "shows incontestably the Mediterranean shell [*tuberculatum*]," but that the figure from Argenville is that of a *Hemicardium*. The two figures are so much alike that it is difficult to understand why these writers should have so distinguished them. Hanley (1855, p. 48) had the same opinion. He said: "The two synonyms decidedly pertain to two distinct species. . . ."

The identification of the Linnaean species with our *C. tuberculatum* is far from being perfect but has been universally accepted. Hanley (*loc. cit.*) accepted it, but, as he often said, "with a note of interrogation appended." In truth, the description in the "*Systema*" is not quite good enough, and it is necessary to go to the "*Museum Ulricae*" for an unequivocal diagnosis. Thus while we accept Linnaeus as the author of the species as of 1758 we are basing our opinion on a later work.

Hanley points out (*loc. cit.*) what has been long realized, that this species is identical with *Cardium rusticum* Linné (discussed below), the latter having been based on young and worn specimens.

As do *C. aculeatum*, *echinatum*, and *ciliare*, *tuberculatum* falls into the genus *Acanthocardia* Gray, 1851, and is now usually placed in the subgenus *Rudicardium* Monterosato, 1917, of which it is the type. Thiele (1931, 1935, vol. 2, p. 880), whose rather radical arrangement of the Cardiidae is referred to above, recognizes *Rudicardium* but uses it, as he does *Acanthocardia*, as sections of *Cerastio-*

<sup>2</sup> This figure is on plate 26 in the first edition of Argenville's work (1742), but on plate 23 in the second edition (1757). It does not appear in the third (Favanne's) edition (1780).

*drema* Mörch, 1853, which he makes a sub-genus under *Cardium* Linné.

Figured in Donovan (1799–1803, vol. 3, pl. 107, fig. 2) and in Sowerby (1820, 1825, 1834, vol. 1, pl. 75, fig. 3). Bucquoy, Dautzenberg, and Dollfus (1882–1898, vol. 2, atlas, pl. 41, figs. 1–7) figure both the adult and juvenile stages of this species, as well as two named varieties. These photographic figures are the clearest and best that I have found.

#### *Cardium isocardia*

1758, *Systema naturae*, ed. 10, p. 679, no. 66.

1767, *Systema naturae*, ed. 12, p. 1122, no. 82.

LOCALITY: Not given in either edition.

"C. testa cordata: sulcis squamis fornicatis imbricatis."

The collection contains a specimen of the *Cardium isocardia* of all subsequent authors, bearing the proper "Systema" number. The description is sufficiently characteristic to differentiate the species from *C. unedo* and *C. muricatum* (below), the only two shells of which the diagnosis could possibly be confused with that of *isocardia*, although the differentiation from *muricatum* is negatively rather than positively expressed. In *muricatum* the absence or obsolescence of scales over the central portion of the shell is conveyed by the words "lateribus muricata," while in *isocardia* the words "squamis fornicatis imbricatis" must be read to mean "scales over the whole area of the shell," as we must assume that Linnaeus, who had both species before him, perceived the difference between the two.

The species is common in the West Indies, and up to a few years ago was believed to be identical with the Florida shell which has for so long borne the same name. Clench and Smith (1944, p. 5) have shown, however, that the Florida form, although very close to *isocardia*, presents definite and very constant differences. It therefore must take the name *egmontianum* which was given to it by Shuttleworth in 1856 and which had apparently been lost sight of. As the Florida form is such a familiar shell to American collectors it is well to mention the differences pointed out by Clench and Smith. It possesses smaller imbricated scales than *isocardia* and therefore appears less spinose. The scales cover little more than half of the rib, whereas the

scales in *isocardia* extend across the entire rib. It has 27 to 31 ribs, while *isocardia* has 31 to 37. The color of the interior is more diffused and extends to the posterior margin, leaving only the anterior side white. It generally does not reach the size of *isocardia*.

The two species are placed in the genus *Trachycardium* Mörch, 1853. The type is *C. isocardia* Linné, by subsequent designation, von Martens, 1870.

Some authors have included *isocardia* in *Acanthocardia* Gray, 1851. Thiele leaves it in *Trachycardium* Mörch, but uses that group as a subgenus of his very comprehensive genus *Laevicardium* Swainson, 1840, which is discussed below under the species *C. laevigatum* and *serratum*.

Figured in Clench and Smith (1944, pl. 2; pl. 3 is *egmontianum*).

#### *Cardium fragum*

1758, *Systema naturae*, ed. 10, p. 679, no. 67.

1767, *Systema naturae*, ed. 12, p. 1123, no. 83.

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

"C. testa subcordata subangulata: sulcis notatis lunulis elevatis."

A specimen of the *Cardium fragum* of the nineteenth century writers is in the collection, and, although unmarked, its close agreement with the description in the "Systema" is sufficient to identify it, in spite of the completely erroneous pictorial synonymy. Indeed, based upon the description of *fragum* alone, the only possible confusion would be with the succeeding species (*unedo*), but a glance at the ample and characteristic diagnosis of the latter is enough to resolve any confusion. Linnaeus derived the specific name from the name given to the Rumphius' figure (*Fragum album*), although that drawing itself is too crude to identify and probably represents another species. The American locality is, of course, erroneous.

The species is the type of the genus *Fragum* Röding, 1798. Even though it is not on Röding's original list in the "Museum Boltenianum" as a valid species, it is a synonym of the *Fragum flavum* of that list, and therefore is eligible to be the type by absolute tautonymy, under section 1-d of Rule 30. *Fragum unedo*, a closely related species, is on the original list and is commonly cited as the type, possibly

because of the failure to recognize that *fragum* is a synonym of *flavum*. The generic names *Isocardia* Oken, 1815 (in part, not Lamarck, 1799), *Hemicardium* Swainson, 1840, *Loxocardium* Cossmann, 1887, and *Americardia* Stewart, 1930, have all been used for this group, but, until the vexing question of the availability of the generic names in the "Museum Boltenianum" shall have been finally settled by the International Commission on Zoological Nomenclature, the wisest course would seem to be to use the earlier Röding name. The "Museum Boltenianum" has always been, and still is, a very rare work, and probably was not known to, or at least not accepted by, the earlier authors.<sup>1</sup>

Figured in Reeve (1843-1878, vol. 2, *Cardium*, pl. 4, sp. 23).

#### *Cardium unedo*

1758, *Systema naturae*, ed. 10, p. 680, no. 68.

1767, *Systema naturae*, ed. 12, p. 1123, no. 84.

LOCALITY: Not given in either edition.

"C. testa subcordata: sulcis lunulis coloratis. . . Vulvae labium alterum alteri incumbit, quod vix in praecedenti, cui maxime affinis, sed saepe decuplo major."

The difference between this species and its very close congener, *fragum*, is clearly pointed out in the description of *unedo*. Not only is the word "subangulata" omitted here, but the scales on the ribs are specified to be "coloratis." The sub-description, also, recognizes the larger size of *unedo*, although the

<sup>1</sup> Opinion 96 merely declared the "Museum Boltenianum" to be validly published, rather than being a sales catalogue. The Summary of Opinion, however, said that its names were "nomenclatorially available." There has been a widespread tendency to construe these words as giving a blanket validity to all the names in the work. I feel sure that the Commission had no such intention and will one day wish to clarify the Opinion. In the last analysis, I feel that the only new genera listed in the work which are valid are those which are monotypic or have tautonymic types. Whatever the Commission does to clarify the present situation (based on a misconstruction of Opinion 96), it would be helpful if it should officially promulgate a list of valid and invalid names. It would be even more helpful to provide for a suspension of the Rules for those invalid names that are in common use today. Otherwise much confusion would result. For the present it seems the safer course to follow the majority opinion and treat the Röding names as all valid, and I shall follow this course in these papers.

description of the prosogyrous beaks is not convincing, in its attempt to differentiate the two species in this respect. Otherwise, the cleanly worded diagnosis points unequivocally to the *Cardium unedo* of all subsequent authors. The synonymy is entirely correct, so that the lack of any locality is not serious. The shell is a native of the western Pacific. A marked specimen is in the collection.

It is placed in *Fragum* Röding, 1798, and, as stated in the discussion of the preceding species, is often cited as the genotype.<sup>2</sup>

Figured in Reeve (1843-1878, vol. 2, *Cardium*, pl. 2, sp. 13).

#### *Cardium muricatum*

1758, *Systema naturae*, ed. 10, p. 680, no. 69.

1767, *Systema naturae*, ed. 12, p. 1123, no. 85.

LOCALITY: "Ad sinum Campechiensem" (1758, 1767).

"C. testa subcordata sulcata lateribus muricata. . . Testa praecedentibus similis, margine undique serrata, extus flavescens; intus umbonibus purpurascens."

The collection contains a specimen of the common *Cardium muricatum* of the western Atlantic in a box which is marked with the name. Hanley (1855, p. 49) calls attention to the fact that it fits the description "fairly enough (yet not perfectly)." It must be borne in mind that *muricatum* is a variable shell in two particulars: the denticulations on the ribs usually cover the entire shell but in the middle of the disc are frequently lacking, and the color patch under the umbones, which Linnaeus described as "intus umbonibus purpurascens," is often not a solid patch but a wash of yellow bordered by two red streaks. Linnaeus' statement that *muricatum* is similar to *unedo* should not be taken too seriously. They are unlike both in shape and in the striking red color of the rib scales of *unedo*.

The locality given by Linnaeus is much too restricted. The shell is found not only in the Gulf of Mexico but along the American coast

<sup>2</sup> *Cardium unedo* Linné is also the type, by subsequent designation, Gray, 1847, of *Hemicardium* Swainson, 1840. The latter name, which is an exact synonym of *Fragum* Röding, 1798, is invalid as being a homonym of *Hemicardium* Schweigger, 1820 (*ex* Cuvier, 1817, vernacular use), which is, in turn, a typonym of *Corculum* Röding, 1798, having the same type—*Cardium cardissa* Linné.

from Hatteras to Argentina, and is common in some of the West Indies.

It has long been placed in *Trachycardium* Mörch, 1853, and falls now in the subgenus *Dalloccardia* Stewart, 1930, a group that differs from the typical *Trachycardium* only in the shape and position of the hinge plate and the cardinal teeth. It is identical with the *Cardium campechiense* of the "Museum Bolteni-  
anum." It is figured in Clench and Smith (1944, pl. 5).

#### *Cardium magnum*

1758, *Systema naturae*, ed. 10, p. 680, no. 70.

1767, *Systema naturae*, ed. 12, p. 1123, no. 86.

LOCALITY: "Ad Jamaicam" (1758, 1767).

"C. testa oblonga: sulcis angulatis latere serratis."

This species remained unidentified for many years. The description is inadequate, the synonymy is confined merely to a reference to its listing in the "Museum Ulricae," and we know that Linnaeus did not possess the shell. Certainly there is nothing in the collection that can be said to be the type specimen of *C. magnum*. The only thing in the description which would exclude the possibility of its being *C. muricatum* Linné is the word "oblonga."

The shell we know as *Cardium magnum* Linné today was known to the early writers, who gave it various names but did not conceive it to be the *magnum* of Linnaeus. Born called it *C. leucostomum* in 1780 (pl. 3, fig. 6), his own *C. magnum* being probably *C. robustum* Solander<sup>1</sup> Humphrey, 1786.<sup>1</sup> Lamarck in 1819 named it *C. marmoreum*, which is probably the shell that Gmelin listed as variety "β" of *C. magnum* Linné. Even as late as 1831 Sowerby (1820, 1825, 1834, vol. 1, pl. 74, fig. 1) was unaware of its identity with the Linnaean *magnum* and gave it the name of *C. elongatum*, which he changed to *subelongatum* in 1840 (1840, vol. 8, p. 108). Incidentally both Linnaeus' description of the shell as "oblonga," and Sowerby's 1831 specific name emphasize a characteristic that is not particularly marked. Sowerby's emen-

ation of 1840 is therefore the more descriptive.

The early attempts to identify *magnum* Linné were equally unsuccessful. Born believed it to be *C. ventricosum* Lamarck, 1819. That shell, however, could certainly not be described as "oblonga." Chemnitz described it as of Linnaeus, 1758 and 1767, but his figure (1780-1795, vol. 6, pl. 19, fig. 191) shows a shell that is generally accepted as representing the species later known as *C. rugosum* Lamarck, 1819. The latter is now conceded to be a synonym of *C. flavum* Linné, the next species here discussed. Spengler cited for *magnum* a figure from Seba which was probably intended for *Cardium elongatum* Bruguière, 1789 (non Sowerby 1831), and Hanley (1855, p. 50) was "inclined to assent" to this identification. Bruguière himself identified his *elongatum* with *magnum* Linné, but with a query. The two shells are very much alike and possibly identical, although Bruguière's was probably based upon an East Indian specimen, according to Clench and Smith (1944, p. 7). The principal difference to be reconciled is that the Bruguière shell is described as having 39 to 40 ribs, whereas *magnum* Linné usually has 32 to 35. However, Clench and Smith (*loc. cit.*) report specimens of *magnum* with as many as 40 ribs and call attention to the great variability of the species in this respect, to which fact they attribute most of the confusion that has existed. Hanley (*loc. cit.*) and his contemporaries believed that the conflict arose because of what they felt was a typographical error in reporting the number of ribs in the "Museum Ulricae." Dillywn (1817, pp. 120-121) refused to commit himself on the subject of the identity of *magnum* Linné, and Hanley says, in introducing his remarks on the species (*loc. cit.*), "the name *magnum* must disappear from our catalogues, for so inadequately has Linnaeus described it that even his own son was unable to recognize it."

It is admitted that the species cannot be defined from the description alone. But fortunately (whatever may be eventually decided as to its identity with *C. elongatum* Bruguière) the locality, Jamaica, given by Linnaeus offers unimpeachable, although circumstantial, evidence that it was the *magnum* of the West Indies. That island yields only

<sup>1</sup> Born's figure of his *magnum* (1780, pl. 3, fig. 5) leaves something to be desired, but Reeve's figure of *C. magnum* Born (1843-1878, vol. 2, *Cardium*, pl. 4, sp. 20) is unquestionably Solander's *robustum*.

two other species of *Cardium* large enough to merit the name *magnum*, and both of these, *C. isocardia* and *C. muricatum*, were described by Linnaeus.

This species, as is the preceding, is a member of the genus *Trachycardium* Mörch, 1853, and is placed in the subgenus *Acrosterigma* Dall, 1900. The latter group is very close to *Trachycardium*, except that the scales on the ribs are confined to the extreme lateral areas of the shell.

Figured in Clench and Smith (1944, pl. 4, figs. 1-2).

#### *Cardium flavum*

1758, *Systema naturae*, ed. 10, p. 680, no. 70.

1767, *Systema naturae*, ed. 12, p. 1123, no. 87.

LOCALITY: Not given in either edition.

"*C. testa subovata sulcata: latere anteriore scabro, posteriore dentato. . . Testa subovata, flava, latere anteriore alba. Sulci crenati nodulis in latere posteriore; margo non rubens.*"

This name was also absent from Linnaeus' lists, and no specimen in the collection can be said to conform to the description. There is no synonymy, other than a reference to the "Museum Ulricae" in the twelfth edition, no locality is supplied, and there is no further reference to the species in the manuscripts of Linnaeus. Even the more ample diagnosis in the "Museum Ulricae" fails to identify the species. Thus there is no internal evidence of its identity. Two suggestions were made by the early writers. Hanley (1855, p. 51) says: "Born, regardless of the 'nodulis crenatis,' considered it to be the Mediterranean *oblongum* (*Cardium sulcatum* of Lamarck). Chemnitz, with much hesitation, has delineated the *Cardium muricatum* as this species." A glance at Born's treatment of *flavum* and at the figures of Born and Chemnitz do not substantiate Hanley's statement. Chemnitz (1780-1795, vol. 6, p. 186, pl. 17, fig. 178) listed and figured a variety of *C. muricatum* Linné, which he called "muricatum flavescens costis muricatis," and suggested its identity with *flavum* Linné. Born (1780, p. 47, pl. 3, fig. 7) lists a *C. flavum* which he attributes to Linnaeus. Chemnitz' *oblongum* (*tom. cit.*, pl. 19, fig. 190) is shown as a shell clearly distinguishable from his *muricatum* variety and from Born's *flavum*, and there is no hint in Born's treatment of his *flavum* that he con-

sidered it identifiable with *oblongum* Chemnitz,<sup>1</sup> which, indeed, was not named and published until two years later. Certainly the words "nodulis crenatis" in the Linnaean description of *flavum* point away from Born's *flavum* or either of the Chemnitz species mentioned.

Schröter (1783-1786, vol. 3, p. 43, pl. 7, figs. 11a-b) figures as *flavum* Linné a shell that is very close to *rugosum* Lamarck, 1819, and this view, which was accepted by most of the later writers, is the accepted identification today. The Linnaean specific name has been generally retained and Lamarck's *rugosum* thrown into its synonymy. It is not *Fragum flavum* (Gmelin), 1791, and Röding, 1798, which is *Fragum fragum* (Linné).

The species belongs in the genus *Trachycardium* Mörch, 1853, and seems to fall properly into the subgenus *Acrosterigma* Dall, 1900.

The identification with *C. rugosum* Lamarck, which Lamarck himself suggested only with a query (1818-1819, vol. 6, p. 10), is not so convincing and clean-cut as one could wish. Although we may be convinced that Linnaeus was, in fact, describing *rugosum*, I feel that those who have doubted the wisdom of restoring the Linnaean name are justified.

Figured by Reeve (1843-1878, vol. 2, *Cardium*, pl. 14, sp. 68), as *C. rugosum* Lamarck.

#### *Cardium laevigatum*

1758, *Systema naturae*, ed. 10, p. 680, no. 72.

1767, *Systema naturae*, ed. 12, p. 1123, no. 88.

LOCALITY: Not given in either edition.

#### *Cardium serratum*

1758, *Systema naturae*, ed. 10, p. 680, no. 73.

1767, *Systema naturae*, ed. 12, p. 1123, no. 89.

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

Because of the confusion that has existed between these two species, they are here considered together.

Each is provided with identical descriptions in the two editions:

<sup>1</sup> Chemnitz, in opening his discussion of *C. oblongum* (*tom. cit.*, p. 195) said: "Born believed that in this *Cardium* he had found the *Cardium flavum* of Linnaeus." Hanley evidently drew his remark upon Born's opinion from this same source. There is certainly nothing in Born's work which suggests it.

"*C. laevigatum*: *C. testa obovata: striis obsoletis longitudinalibus. Testa simillima praecedenti [C. flavum], sed striae loco sulcorum.*"

"*C. serratum*: *C. testa obovata laevi: striis obsoletis, margine interiore serrato. Testa flava, versus cardinem gibba, margine exteriori crenulato, anteriore serrato. Nates regulares.*"

No figures were cited for either name. No locality was given for *laevigatum*, but *serratum* was stated to be from the Mediterranean Sea.

Chemnitz (1780–1795, vol. 6) treated this affinity as follows: He first listed a *Cardium citrinum serratum* (p. 193) as of Linnaeus and referred specifically to *serratum* in both editions of the "Systema" and in the "Museum Ulricae." His figure (pl. 18, fig. 189) shows a shell that might well be taken for the West Indian shell that is commonly, and probably correctly, known as *C. laevigatum* today. It is perhaps not sufficiently elongated, the color is lemon yellow, and the serration of the inner margin is clearly visible. He cited also *C. laevigatum* Born (1778, p. 35) and Gronovius (1781, p. 266, sp. 1128). His locality is given as "American Ocean at Barbados and Indian Ocean at Ceylon."

He then listed a *C. laevigatum* (*tom. cit.*, p. 191) for which he also refers to both editions of the "Systema," and states the locality as the Mediterranean Sea. His references were, first, to Born (1778, p. 36, and 1780, p. 48), a completely erroneous reference, as the species there given was Born's *C. aeolicum* (see *C. pectinatum* Linné, below), and then to the same figure from Gronovius which he had also used for his *C. citrinum serratum*. Chemnitz' own figures (*tom. cit.*, pl. 18, figs. 185–186) show a slightly longer shell which appears to be less fragile than the one shown in the figure (fig. 189) for *serratum*. This may well be considered to represent the Indo-Pacific species which Clench and Smith (1944, p. 23) believe to be *C. serratum* Linné.

Gmelin copied the Linnaean descriptions of both *serratum* and *laevigatum* and adopted the Linnaean names, but transposed the Chemnitz figures, citing figures 185–186 for *serratum*, and figure 189 for *laevigatum*, the latter with the "Atlantic and American Oceans" as locality, and the former with "Mediterranean and Indian Seas." In other

words, Gmelin apparently believed that Chemnitz' conception of the two species was erroneous, and that the American shell was *laevigatum* Linné, and the Indo-Pacific shell *serratum* Linné. This view was followed by Bruguière (1789, 1792) and by many later authors. The name *serratum*, however, is still frequently used for the West Indian species.

The vagueness of most of the early figures, the confusion in the localities, and the diametrically opposed views of Chemnitz and Gmelin have produced a nomenclatorial confusion that persists in the minds of many conchologists today. Dall (1890–1903, pt. 5, p. 1110) even believed that the differences between *serratum* and *laevigatum* were not of specific value. The latest discussion on the subject is that of Clench and Smith (*loc. cit.*); whose considered opinion is that the view of Gmelin was the correct interpretation of the two Linnaean species, that his *laevigatum* was the western Atlantic shell, and that *serratum* was the exotic Indo-Pacific species. These writers selected the Chemnitz figures, *as used by Gmelin*, as the type figures of the two respective species.

In the last analysis, while the weight of evidence seems to favor this opinion, a study of all the figures cited by Linnaeus' immediate successors, the many demonstrably confused localities, and the failure of Linnaeus to differentiate sharply between these two closely related species should convince the investigator that no absolutely certain determination is possible. The allocation of the name *laevigatum* to the common egg-cockle of the western Atlantic, and of *serratum* to the eastern shell, is a useful and probably correct solution, but should be used with the reservation that it is to a certain extent arbitrary.

Neither of the species here discussed is *Cardium laevigatum* Da Costa, 1778, which is the shell later called *C. norvegicum* Spengler, 1790, a name that has, nevertheless, often appeared in the synonymies of *laevigatum* and *serratum* Linné. As an illustration of the perplexity of the early writers, Lamarck called *C. norvegicum* by the name *C. serratum*.

The newest and best photographic figures of the West Indian shell are found in Clench and Smith (1944, p. 12, figs. 1–5), and the reader is referred to their interesting discus-

sion of that species and its synonyms in the paper cited. Good figures of the Indo-Pacific species *serratum* are difficult to find, because the drawings of that shell are tainted with the suspicion that the authors did not clearly differentiate between the two members of this complex. Chemnitz' figures 185 and 186, which he referred to *laevigatum*, may be used if we accept the modern view. These are the drawings that Clench and Smith selected as the type figures of *serratum*.

#### *Cardium edule*

1758, *Systema naturae*, ed. 10, p. 681, no. 77.

1767, *Systema naturae*, ed. 12, p. 1124, no. 90.

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

"C. testa antiquata: sulcis xxvi, obsolete recurvato-imbricatis."

A marked specimen of this species is in the collection, which agrees so well with the description that the very authoritative figures cited are merely corroborative. It is the common edible "cockle" of Europe, and its identification has never been doubted.<sup>1</sup> It is now placed in the genus *Cerastoderma* Poli, 1795, and is the type of the genus, by subsequent designation, von Martens, 1870.

The name *Cerastoderma* was first proposed by Poli in 1795 in the "Testacea utriusque Siciliae" (1791, 1795, vol. 2, pp. 252, 258), but many commentators are unwilling to accept the proposal as valid, on the grounds that that work was not consistently binomial, although it has not yet been declared unavailable by the International Commission. These writers credit the name to Mörch, 1853, who revived the name in the Yoldi Catalogue. Thus Thiele (1931, 1935, vol. 2, p. 880) uses the style "(Poli 1795) Mörch 1853," and Grant and Gale (1931, p. 307) cite it as "Poli

<sup>1</sup> In spite of the apparently complete concordance between the description of *C. edule*, the marked specimen in the collection, the cited figures, and the locality, the complete synonymy of the species reveals that 16 different specific names have been applied to it, that most commonly used being *rusticum* (of Chemnitz, 1782; Donovan, 1802; Montagu, 1803; Lamarck, 1819; Philippi, 1836, 1844; and others, *non* Linné). Even as late as 1866 Brusina so described it. The shell is extremely variable in form, sculpture, and color, and the great number of synonyms was the result of this variability. Many of these are today recognized as mere varieties, of which 21 different named forms were recognized by Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, pp. 292-297; vol. 2, atlas, pls. 46-47).

in Mörch, 1853." Until the question of the availability of Poli's work shall have been settled, it is wiser to consider him the author of the name.<sup>2</sup> Many modern arrangements of the Cardiidae do not give generic rank to *Cerastoderma*. For example, Thiele (*loc. cit.*) makes it a subgenus of *Cardium* Linné, while Grant and Gale (*loc. cit.*) treat it as a subgenus under a very comprehensive genus, *Laevicardium*.

Figured in Reeve (1843-1878, vol. 2, *Cardium*, pl. 4, sp. 22).

#### *Cardium rusticum*

1758, *Systema naturae*, ed. 10, p. 681, no. 77.

1767, *Systema naturae*, ed. 12, p. 1124, no. 91.

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

"C. testa antiquata: sulcis XX, remotis interstitiis rugosis. . . Testa aliis ferruginea fasciis lividis; aliis minor nivea fasciis ferrugineis."

It is conceded today that this name is a synonym of *C. tuberculatum* Linné, and that Linnaeus described *tuberculatum* from an adult specimen in good condition (which, however, was not found in the collection), and *rusticum* from a young and worn example which still remains in his cabinet marked with the name *rusticum*. The appearance of the latter specimen justifies the use of the word "antiquata" in the description of *rusticum*. The figures cited in the synonymy of *rusticum* clearly show *tuberculatum*, with the exception of the figure taken from Rumphius, which must have been inserted in error. It seems to be an *Arca*.

Figured in Reeve (1843-1878, vol. 2, *Cardium*, pl. 3, sp. 16, as *rusticum*).

#### *Cardium pectinatum*

1758, *Systema naturae*, ed. 10, p. 681, no. 79.

1767, *Systema naturae*, ed. 12, p. 1124, no. 92.

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

"C. testa subcordata pectinata. . . Testae striae distantes sursum scabrae; cavitas sub um-

<sup>2</sup> In the same volume of Poli's work he constituted the genus *Cerastes* (*non* *Cerastes* J. Laurenti, 1768) for the species *Cerastes gracilis* Poli. This species is demonstrably identical with *Cardium edule* Linné, and the genus *Cerastes* thus becomes an exact synonym of *Cerastoderma* Poli, with the type *Cerastes gracilis* = *Cardium edule* Linné, by subsequent designation, Keen, 1937. *Cardiarius* Duméril, 1805, is also identical with *Cerastoderma* Poli, with the same type, as designated in Frieriep, 1806 (*vide* Iredale, 1916).



bonibus flava. Anus ovatus, impressus marginibus prominulis."

Linnaeus did not mention his possession of this species, and there is nothing in the collection that conforms to the description. No shell answering to the description is found in the locality cited (the Mediterranean), and the language of the description is not enlightening and could be made to fit a number of species by the exercise of a little imagination. The only reference given by Linnaeus in both the tenth and twelfth editions ("Gualt. test. t. 75, f. A") is a rough but fairly recognizable picture of *Gafrarium pectinatum* (Linné), the *Venus pectinata* of the "Systema." The use of this figure is referred to below.

The species was first identified by Spengler with *Cardium aeolicum* Born (1780, p. 36; Born, 1778, not seen), and this determination was accepted by Bruguière, 1792, Dillwyn, 1817, Deshayes, 1831, and Reeve, 1844. The most exhaustive comment was made by Deshayes and Milne-Edwards (1835-1845, vol. 6, p. 404, footnote) in discussing the *aeolicum* of Born: "Whoever will trouble to read attentively the description of *Cardium pectinatum* which Linné gives in the Museum of the Princess Ulrique, will be convinced that the shell which Linné had before him was the same which was later named *Cardium aeolicum*. It is true that Linné cited, as a synonym of his *Cardium pectinatum*, a figure from Gualtieri which represents the *Venus pectinata*, but with a description so exact, we are forced to suppress that figure; then the name *Cardium pectinatum* becomes simple to identify."

It is clear that the same shell was described in the "Systema" and in the "Museum Ulricae." The short "Systema" main description was copied verbatim in the latter work, and the "Systema" listing was specifically referred to. The following detailed and graphic language pertaining to the sculpture was added: "Striae longitudinalis sunt in latere anteriore: transversales ad angulum acutum tangunt longitudinalis in latere posteriore. Hae striae sunt distantes, subtilissime dum digiti deorsum ducuntur scabrae, non vero sursum." The Gualtieri figure cited in the "Systema" is again referred to.

*Cardium aeolicum* Born is a comparatively

rare shell, which has been reported from Gaboon, West Africa, as well as from the Cape Verde Islands. In outline and sculpture it somewhat resembles its congener *Lyrocardium lyratum* (Sowerby), 1840. It has the asymmetrical, divaricate sculpture of *lyratum*, but lacks the smooth posterior area of that species. Its shape cannot be called subcordate, but is, rather, roughly quadrate. I can find little in the description of *pectinatum* which justifies our accepting *aeolicum* as its representative, in spite of the almost unanimous opinion of the early writers and the strongly expressed views of Deshayes and Milne-Edwards, and in spite of the improved description in the "Museum Ulricae." Hanley (1855, p. 53) had no doubt of the identification with *aeolicum* "despite of the reference to Gualtier," but suggested, however, that Linnaeus' disregard of two other figures (Buonanni, 1681, vol. 2, Classe Bivalvia, fig. 91, and Lister, 1678, pl. 314, fig. 150) casts some doubt upon this identification. He implied that these figures were representations of Born's *aeolicum* and that it was strange that Linnaeus, who possessed both of these works, should have passed them over. An examination of the two figures substantiates Hanley's query. The Buonanni plate fairly represents *aeolicum* or a very close congener (although it was cited by Chemnitz for *Cardium laevigatum*). The Lister figure is obviously *aeolicum*.

Chemnitz, alone of the early writers, disagreed with the then accepted identification of *aeolicum* with *pectinatum*, although his objection is based partly on an error. I mention it merely for the sake of completeness. He describes (1780-1795, vol. 6, p. 191, pl. 18, figs. 187-188) a shell which he calls "Die Ost-und Westmuschel. Das Janusherz mit zwei Gesichtern. *Cardium aeolicum*," a very graphic name for the species. He cites Born's description and the two above-mentioned figures from Buonanni and Lister which were not used by Linnaeus in the latter's description of *pectinatum*. The Chemnitz figures 187 and 188 are obviously those that Reeve later used for *aeolicum*.<sup>1</sup> I quote Chemnitz' remarks in full:

<sup>1</sup> All the extant figures of *aeolicum* appear to be based on, or copied from, the original Buonanni drawing referred to in the above text.

"I would suppose that in this shell we had found the long and vainly sought for *Cardium pectinatum* L., because all of the minutely described characteristics of that shell in the Mus. Ulr. fit it perfectly. Only one detail still puzzles me. In this species the anus is [described as] *marginē prominens*, whereas it should be *anus ovatus impressus* [to agree with the description of *C. pectinatum*]. Also our *C. aeolicum* does not agree with Prof. Murray's figure of *Cardium pectinatum* (Testaceolog). And the Gualtieri figure, pl. 75, fig. A is of no help because it shows *Venus pectinata* and not *Cardium pectinatum*."

Although I agree with the conclusion reached by Chemnitz, his reasons have little weight. There is nothing inconsistent between a depressed lunule and one with raised edges. The two features often are combined in the same species, and indeed the description of *pectinatum* in the "Museum Ulricae" covers both features, as it reads, "Anus ovatus, impressus marginibus prominulis" (Chemnitz merely misread the Linnaean description), and the failure, in the description of *aeolicum*, to mention that the lunule was depressed is hardly the real reason for denying its identity with *pectinatum*. It was, in any case, a fault of omission—a fault of which the earlier authors were only too often guilty, and it should not be given too much weight.

I have already expressed my feeling that little weight should be given to Linnaeus' references except for their possibly confirmatory value. The iconographies available in his day not only contained extremely poor drawings, for the most part, but they did not by any means cover the entire list of the "Systema" species. In the latter cases Linnaeus frequently selected as a reference that figure which showed the nearest approximation to the specimen before him, or which showed one or more of the principal shell characters. In one case, at least, that of *Venus marica*, he stated that a figure was used for this reason. I have already referred, in these pages, to other reasons for my unwillingness to consider his references as having much probative value, but the above reason is the one that applies to the present case. He had before him some species with divaricate radial sculpture and selected what is apparently a figure of *Venus pectinata* mere-

ly in order to illustrate that type of sculpture. If it be contended that this argument is weakened by the fact that two other fairly characteristic figures were available to him, it could be replied that that would be but saying that *C. pectinatum* was, in fact, *C. aeolicum*, an identification with which I disagree. A further weakness in the argument that the Gualtieri figure proves the case for the proponents of the theory that the present species is identical with *V. pectinata* (and a weakness that exposes the fallacy of putting too much faith in Linnaeus' use of figures) is the fact that of the four figures that he cited for *V. pectinata* a few pages later in the "Systema," not one can be said to represent that species. They all show an orbicular shell with symmetrical concentric sculpture, not remotely resembling *Venus pectinata*.

There is hardly a point of similarity between the descriptions of *Cardium pectinatum* and *Venus pectinata*, and the description of the latter is even more generalized than the "Systema" description of the former. *C. pectinatum* is called "subcordata." The other is "sublentiformi." The whole diagnosis of the venerid species: "Testa sublentiformi, sulcis longitudinalibus rugosis, pube antrorsum ramosa," suggests nothing referable to the description of the *Cardium* species, and it is inconceivable to me that Linnaeus was describing the same shell in each. The hinge of *V. pectinata* is a venerid hinge and bears little similarity to that of any *Cardium*. The anteriorly sloping teeth and anteriorly placed and anteriorly directed umbones are typically venerid characters and are unlike the hinge and umbonal region of a *Cardium*, with its centrally placed teeth, directed inward in the plane of the diameter of the shell.

I have been very frank, in discussing the shells of Linnaeus, to criticize the brevity and vagueness of many of his descriptions, his indifferent Latin, and his errors of transcription, and have referred, too, to his pardonable failure to appreciate relationships that have been accurately determined only since his day. But he was a great naturalist and a careful observer, although working under handicaps that would have discouraged the modern investigator, and I cannot be persuaded that he would have knowingly placed the same species in both *Cardium* and

*Venus*, using two descriptions which have hardly one detail in common. I am convinced that *C. pectinatum* is not *C. aeolicum* as Deshayes and Milne-Edwards thought, and I am unwilling to believe that it was *Venus pectinata*. It should be dropped from our lists as an undetermined species.

A further confusion was for a time introduced into this problem by some authors who identified *Lyrocardium aeolicum* (Born) with *Cardium pectinatum* Lamarck, 1819. The real *Cardium pectinatum* Lamarck is a synonym of *C. edule* Linné.

For reference purposes, *Lyrocardium aeolicum* (Born) is figured in Reeve (1843-1878, vol. 2, *Cardium*, pl. 2, sp. 14). Its congener *lyratum* Sowerby is figured on the same plate, as species 12.

Lister figures both *C. aeolicum* Born, on plate 314, figure 150, and *V. pectinata* Linné, on plate 313, figure 149, on one page. The juxtaposition of these figures is instructive.

The genus *Lyrocardium* is commonly cited as of Meek, 1876. A question might be raised, however, as to the validity of Meek's erection of the genus. Prior to his work (1876, p. 173) the two species *aeolicum* Born and *lyratum* Sowerby had been placed by some writers in *Laevicardium* Swainson, 1840, and by others in *Protocardia* Beyrich, 1845. Meek's real or attempted constitution of *Lyrocardium* is contained in a footnote (*loc. cit.*) as follows: "Whether these two recent species can be properly retained in the genus *Laevicardium* or should be referred to the more ancient group *Protocardia*, they certainly form a very marked subgenus, differing from *Laevicardium* in having radiating posterior striae or costae, and oblique anterior markings; while they also differ from *Protocardia* in having the sculpturing on the anterior half of the valves oblique, and running out on the anterior margin, instead of being concentric, or parallel to the marks of growth. *Lyrocardium* would be a good name for this section" (italics mine). The name has been widely used, but the casual language in which it was proposed would hardly seem sufficiently authoritative to support a new genus.

#### *Cardium virgineum*

1758, *Systema naturae*, ed. 10, p. 682, no. 81.

1767, *Systema naturae*, ed. 12, p. 1124, no. 93.

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

"C. testa triangulo-rotundata aequilatera: rugis transversis membranaceo-recurvatis, cardinibus caeruleis. . . . Testa pulchella, fasciata lineis retrorsum imbricatis, remotis, epidermide glauca obtecta. Cavitas alba, sed cardines caerulei: dentibus lateralibus longitudinalibus linearibus fere Mactrae, sed cardo Cardui."

The description of this species is lengthy without being illuminating. The 1758 definition is repeated in 1767, with the addition of the words "fere Mactrae" after the description of the lateral teeth, followed by the further phrase "sed cardo Cardui." A manuscript note in Linnaeus' own copy of the tenth edition shows that he planned at that time to place the species in *Mactra* in the next edition. Although he changed his mind before the publication of that work, it seems evident that he was still not entirely convinced as to the generic placement of the species. No figures were cited by Linnaeus, no marked specimen is found in the collection, and the locality is puzzling, as no shell answering to the description has been reported from the Mediterranean.

Chemnitz does not cite the name. Brugière and Dillwyn thought that it was a variety of *Cardium edule*. Gmelin copied the description in the "Systema," and, while he cited no references for the principal species, he did list a variety  $\beta$  for which he gave two references: Gronovius (1781, pl. 18, fig. 5) and Chemnitz (1780-1795, vol. 6, pl. 18, fig. 181). The figure from Gronovius, which that author called *Cardium rugatum*, is so vague that nothing can be based on it, although it has been sometimes considered that he was depicting the shell which is now *Papyridea hiatus* Meuschen, 1787. The figure from Chemnitz shows a suborbicular shell, with flat, unsculptured ribs, and a slight posterior prolongation. It is shown with a red spot of considerable size under the umbones. Chemnitz called it *Cardium apertum* and gave the Gronovius figure as a reference. He did not refer to the Linnaean *virgineum*. Wood omits *C. virgineum* entirely as being too ambiguous.

Hanley (1855, pp. 53-54) concluded that the words "rugis transversis membranaceo-recurvatis" were not applicable to *Cardium apertum*, which Gmelin referred to for *virgineum* variety  $\beta$ . However, the name *C.*

*virgineum* appears on the list of shells owned by Linnaeus, and therefore Hanley adopted the expedient he used in such cases of comparing the description with every bivalve in the collection. This resulted in one of the most extraordinary determinations in his book. He concluded that the specimen of *Cyrena fluminea* (Müller), 1774, found in the collection was the only specimen present that agreed perfectly with the description and therefore decided that "no doubt can be entertained of its typical authority." He also mentioned that Philippi had independently reached the same conclusion, and that Philippi's figure of *C. fluminea* (1845-1851, vol. 2, *Cyrena*, pl. 1, fig. 3) "may be regarded as a fair portraiture" of the specimen of that shell in the collection. This figure, which so impressed Hanley, bears little if any relation to the description of *C. virgineum*. It shows a small, solid trigonal shell, either black or with a very dark epidermis, and with heavily eroded beaks such as are commonly found in many species of fresh-water bivalves. Hanley did not, however, suggest retaining the name *virgineum* for this *Cyrena*, as the former could not have been identified from the diagnosis alone.

I agree with L. C. Smith (1945, p. 1) that *C. apertum* Chemnitz is probably identical with Linnaeus' *Cardium virgineum*, and consider, further, that it is equal to Gmelin's *virgineum* variety  $\beta$ . Chemnitz' names, in the volume of the "Conchylien Cabinet" in which his *apertum* appeared, are not accepted, and as *virgineum* is not unequivocally identifiable from the Linnaean diagnosis, we should take the next available, validly described name, which is *C. apertum* Brugière, 1789. Brugière referred to the same figures which Gmelin cited for *virgineum* variety  $\beta$ .

The *Solen bullatus* of the "Systema," which, under the name *Cardium bullatum* or *Fulvia bullata*, has been identified with the present species and with *Cardium apertum* by many nineteenth century writers and most recently by L. C. Smith (1945, pp. 1-2), is discussed above (pp. 37-38). I there express my opinion that the *Fulvia bullata* of some commentators is not the *Solen bullatus* of the "Systema"; that *Solen bullatus* is a *species dubius*, and therefore the specific name *bullatus*, as used in the genera *Cardium*

or *Fulvia* as of Linnaeus, should be dropped. It is worthy of note that Gray, who erected *Fulvia* in 1853, does not share any responsibility for the perpetuation of this error. His genus was constituted with a single species, *Fulvia aperta* (author not stated), which is therefore the type, by monotypy. He did not refer to *Solen bullatus* or claim any Linnaean ancestry for his type species, which, we can assume, was the *C. apertum* of Chemnitz and Brugière. *Cardium apertum* Brugière, which, with *C. virgineum* (Linné) and the other names above-mentioned, appear frequently in the synonymy of "*Fulvia bullata*" will thus be raised to the rank of a good species.

Not only has the description of *Solen bullatus* no recognizable points of similarity with that of *Cardium virgineum* or *Cardium apertum*, but the figure from Rumphius, which Linnaeus cited for *bullatus*, is unrecognizable and was either an error of transcription or was one of the numerous instances where Linnaeus, in the absence of an existing good figure, substituted an approximation to the shell he was describing. Indeed Dall (1890-1903, pt. 5, p. 1107) and others have said that the figure was supposed to represent an *Arca*. Dall also said (*op. cit.*, p. 1076), in discussing *Fulvia* Gray: "The type of this section has been erroneously cited as *C. bullatum* Linné, causing confusion." As far as I can determine Dall was the first to call attention to this fact.

The *Cardium apertum* of Brugière is figured in Reeve (1843-1878, vol. 2, *Cardium*, pl. 12, sp. 63 [a-b], as *Cardium rugatum* Gronovius). Reeve included in the synonymy of *rugatum* "*C. virgineum*, var.  $\beta$  Gmelin," and "*C. apertum* of Chemnitz, Lamarck and Sowerby." Reeve also figures (*tom. cit.*, pl. 2, sp. 8) a *Cardium bullatum* (Linné), for which he referred to *Solen bullatus* Linné and to the figures which Chemnitz called *C. bullatum* (1780-1795, pl. 6, figs. 49-50). These figures may well be taken for *Papyridea hiatus* (Meuschen), 1787, and the description of *bullatum* by Reeve is a perfect definition of *P. hiatus*, save for the number of ribs. Thus, while Reeve did not fall into the error of identifying our *apertum* with *Solen bullatus* Linné, he did accept another common error of his time by identifying the latter species with the shell we now know as *Papyridea hiatus*.

In summary, it is my opinion that *Cardium virgineum* Linné is a name that cannot be retained owing to the vagueness of its diagnosis, but that the shell we know as *Cardium apertum* (*Fulvia aperta*) is probably the species which Linnaeus described, and that the latter name is not a synonym of *Solen bullatus* Linné.

#### *Cardium lithocardium*

1771, *Mantissa plantarum, regni animalis*, appendix, p. 544.

LOCALITY: Not given, except the habitat, "inter Petrificata."

"Testa cordata subtrilatera valvulis transverse sulcatis: antice longitudinaliter striata. . . Testa aliquatenus similis *C. hemicardio*, at non quadrilatera. Valvulae antice carinatae, pone carinam transverse remote parallele sulcatae sulcis acutis. Carinae crenulatae. Vulva ovata: mons veneris planiusculus, longitudinaliter crenulato-striatus cum carinula altiore. Nates approximatae."

An unmarked specimen of *Trigonia costata* Bruguière, 1789, variety *elongata* Bruguière,<sup>1</sup> is among the fossil shells preserved in the Linnaean collection, and Hanley (1855, p. 453) said that *C. lithocardium* was "apparently" this fossil. The description in the "Mantissa" is characterized more by its length than by its clarity and, were it not for the specimen of *Trigonia* in the collection, it would be impossible to tie it to any particular species. As it is, the identification is extremely doubtful.

The reader should consult the figures of *Trigonia costata* and its variety *elongata* in the "Tableau encyclopédique" (1797, pl. 238, figs. 1-2). Both the typical species and the variety are described by Deshayes (1830,

<sup>1</sup> The genus *Trigonia* has generally been credited to Lamarck, 1799, as Bruguière did not describe the group in the text of volume 1 of the "Histoire naturelle des vers," 1789, 1792 (*Encyclopédie méthodique*), the only volume of that work written by him, although plates 237 and 238 of the "Tableau encyclopédique" (the plate volumes of the "Encyclopédie"), published in 1797, show several unnamed species of the genus. An unpublished Opinion of the International Commission on Zoological Nomenclature, referred to in a footnote on page 29 of this paper, under *Mya pictorum*, now validates the name *Trigonia* as of Bruguière, 1797, the date of the plates. In my opinion, however, it is not necessary to invoke the authority of the 1797 plates in order to support Bruguière's authorship of the genus, as he had already validly described it in the *Index* (1789) to volume 1 (Dodge, 1947b, pp. 489-491).

1832, vol. 2, p. 1049) in his revision and continuation of Bruguière's work. The locality given is "les argiles des Vaches-Noires, ainsi que l'oolite ferrugineuse des environs de Caen et de Bayeux," which places the fossil in the Callovian formation of the Upper Jurassic of Normandy.

A more convincing attempt at identification was made by Lamarck (1805, p. 340). He questionably referred the Linnaean species to his *Cardita avicularia*, there described, with the notation, "? An *Cardium lithocardium*, Mant. 2, p. 544." *Cardita avicularia* was figured the following year (1806, pl. 19, figs. 6a-b). It is a very distinctive shell in both shape and sculpture. It is, as Lamarck said, "inequilateral, a little compressed, like *Cardium cardissa* but in the contrary sense," and its peculiar outline is as difficult to describe as that of *C. cardissa*. The language of Linnaeus' description of *C. lithocardium*, with its mention of the crenulate carinae and acute ribs, and its reference to the resemblance of the shell to "*Cardium hemicardium*, at non quadrilatera," certainly more aptly describes Lamarck's shell than it does *Trigonia costata*. It must, however, remain a *species dubius*, in spite of the slight evidence afforded by a specimen of the latter species in the collection.

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

*Cardium corallinum*, no. 75, moved to *Maetra* (*corallina*, no. 98)

*Cardium solidum*, no. 76, moved to *Maetra* (*solida*, no. 100)

*Cardium stultorum*, no. 80, moved to *Maetra* (*stultorum*, no. 99)

*Cardium humanum*, no. 82, moved to *Chama* (*cor*, no. 154)

In the dismemberment of the genus *Cardium* Linné, *C. triste*, no. 74, was passed over and does not appear in the twelfth edition. The suggestion of earlier commentators, that it may have become the *Maetra glabrata* of the later edition, seems to have little merit. (See the discussion of the latter species, below.)

#### MAETRA LINNÉ

The genus *Maetra* appeared for the first time in the twelfth edition of the "Systema." It was erected for the reception of three spe-

cies of *Cardium* from the tenth edition (*corallinum*, *stultorum*, and *solidum*), *Myalutaria* from the tenth edition, and several hitherto undescribed species. It has also been suggested that *Cardium triste*, a name that was abandoned by Linnaeus after its appearance in the tenth edition and the "Museum Ulricaë," may have become the *Macetra glabrata* of the twelfth, but this idea has not received much support and seems to me unjustified.

The genus forms a very compact group, although it has been radically split up by subsequent reviewers. It has several very constant features. The sculpture, if present, is always concentric and in some species very prominent. The cardinal tooth in each valve is normally bifid, although this member is more obvious in the left valve, the cardinal in the right appearing more like a pair of divergent teeth of which the upper ends have coalesced. Lateral teeth are present in all the groups represented in the "Systema," and, indeed, throughout the genus *sensu lato*, save in *Anatinella* Sowerby, 1833. In *Cardilia* Deshayes, 1835, there is a so-called lateral tooth which is so feeble as to make its category doubtful. The most characteristic and constant feature is the chondrophore, which is excavated to receive the cartilage and usually very large. Other than these constant generic traits, the shape of the shell ranges from trigonal to rounded-trigonal to oval or transversely elongated. It is sometimes gaping posteriorly. The umbones are usually prominent and always prosogyrous. The ligament may be external or internal.

The variation in the hinge characters and the size and shape of the chondrophore have to a large extent been the basis of differentiation in the creation of the subgeneric groups which have been carved out of *Macetra*, *sensu lato*, but the major factor has been the position of the ligament and its relation to the chondrophore, as is shown in the discussion of the individual species.

All the genera of Mactridae (with the exception of *Cardilia* Deshayes, 1835, a group with very peculiar hinge characters that make its inclusion in the family at least questionable) show a feeble to strong lamellar tooth in the left valve, immediately adjacent and posterior to the bifid cardinal tooth.

The hinges of several of the Linnaean *Macetra* are very graphically illustrated by Lamy (1917, *M. corallina*, p. 177; *M. plicataria*, p. 180; *M. solida*, p. 292; *M. spengleri*, p. 295; *M. lustraria*, p. 360).

The most accurate and comprehensive study of the mactroid hinge that has been undertaken is found in the excellent discussion by Dall (1890-1903, pt. 4, pp. 862-869). All variations of the hinge, resilium, and ligament are described in the greatest detail, from both the anatomical and mechanical viewpoint, and an adequate knowledge of this remarkable mechanism is hardly possible without a study of this paper.

Many of the subgenera are now given generic rank, but some of them are treated as subgenera or even sections by most conchologists. There is certainly no unanimity as to the arrangement of the Mactridae, although the family has been extensively monographed, notably by Lamy, Dall, Gray, and Packard.

#### *Macetra spengleri*

1767, Systema naturae, ed. 12, p. 1125, no. 94.  
LOCALITY: "Ad Cap b. Spei" (1767).

"M. tests laevi, vulva plana: rima lunula hiante. . . . Testa magnitudine fere manus, laevis, subtriangularis, pallida, subdiaphana. Latus anterior angulo subcarinatum distinctum a limbis. Vulva ad nates lunata, acuta, tota hians in fosulam cardinis. Latus posterior planiusculum, striatum. Nates incurvae. Dentes laterales carines trianguli."

This hitherto undescribed species, which Linnaeus received from his pupil Lorenz Spengler, is represented in the collection by a specimen that, although unmarked, is the shell we know today under the same name. The identification is corroborated by its complete agreement with the unusually ample and characteristic description, even in the absence of any cited figures. The locality, Cape of Good Hope, is correct. Chemnitz also received a specimen of this shell from Spengler and his excellent figures (1780-1795, vol. 6, pl. 20, figs. 199-200) must have been used by the early conchologists as being strongly corroborative of the accepted identification.

This species is placed in *Scissodesma* Gray, 1837, emended by Gray in 1847 to *Schizodesma*. It is the type of the genus, by subse-

quent designation, Gray, 1847. The genus is characterized by a ligament contained in a deep slit which opens below into the chondrophore and extends upward to a point under the apex of the umbones. The ligament itself, although most of it is internal, is visible externally at its extreme upper end. It is not separated from the chondrophore by the shelly plate that is present in *Mactra*, *sensu stricto*, *Anatina*, and *Schizothaerus*. *Schizodesma* is usually used as a subgenus of *Spisula* Gray, 1837, notably, and most recently by Dall (1890-1903; Lamy, 1917; Thiele, 1931, 1935). *Spisula*, *sensu stricto*, as does *Schizoderma*, lacks the shelly plate between the chondrophore and the ligamental pit, but its ligament can more accurately be called external than that of *Schizodesma*. In fact, the position and shape of the ligamental pit of *Schizodesma* and the location of the ligament itself appear to me to be traits which, as they are found nowhere else in the Macridae, might well be considered of generic importance.

Linnaeus listed this species as "*sprengleri*," and this misspelling was used generally throughout the "Systema." In this instance, however, he corrected the mistake by a note in his copy of the twelfth edition.

Figured in Reeve (1843-1878, vol. 8, *Mactra*, pl. 10, sp. 40). Hinge figured in Lamy (1917, p. 295).

#### *Mactra plicataria*

1767, *Systema naturae*, ed. 12, p. 1125, no. 95.  
LOCALITY: "In Java" (1767).

"M. testa transverse rugoso-plicata diaphana, vulva planiuscula, ano compresso oblongo. . . Testa latitudine ovi, alba, tenuis instar papyri, transversaliter plicata rugis parallelis. Vulva planiuscula, lanceolata, carina ab umbonibus distincta, laevis. Anus ovato-lanceolatus, magis impressus, laevis. Cardinis dentes laterales ex duobus parallelis membranis. Nates incurvae, recurvatae."

A marked specimen of this shell is in the Linnaean collection. Although no figures are cited for it, the strongly marked features of the species are in such close agreement with the long and careful description that there has never been any doubt as to its identification. Indeed most of the species in this genus are so lengthily described that conchologists

have had no difficulty in determining their identity.

The species was placed by Gray in his *Mactrinula*, 1853, and there selected as the type of the genus.<sup>1</sup> *Mactrinula* Gray is frequently used as a good genus, although Lamy, whose arrangement I am following, makes it a subgenus under *Mactra* Linné. Dall, on the other hand, treated it as a section of subgenus *Mactrella* Gray, 1853. *M.(M.) plicataria* is an exact synonym of *Mactra subplicata* Wood, 1828, which should not be confused with *M. subplicata* Lamarck, 1818. The latter name is (*vide* Dëshayes and Hanley) the equivalent of *Mactra laevis* Chemnitz, 1782, which is *Mactra striatula* Linné, the next species discussed. E. A. Smith (1885, p. 57) believed that *M. laevis* Chemnitz, above mentioned, was a mere form of *M. plicataria*. This suggestion, which would make *plicataria* identical with, or a form of, *striatula*, has not, so far as I am aware, been accepted.

The present species is found throughout the Indian Ocean region. It is ornamented with widely spaced concentric plications and is oblong-trigonal in shape, with a produced and rounded anterior end and angulated posteriorly, with a pronounced keel.

Figures in the "Tableau encyclopédique" (1797, pl. 255, figs. 2a-b)<sup>2</sup> and in Reeve (1843-1878, vol. 8, *Mactra*, pl. 7, sp. 26)

#### *Mactra striatula*

1767, *Systema naturae*, ed. 12, p. 1125, no. 96.  
LOCALITY: "In M. Mediterraneo" (1767).

"M. testa laevis diaphana, umbonibus substriatis, vulva laevi impressa carina circumscripta. . . Testa alba, latitudine juglandis. Vulva lanceolata in medio longitudinaliter impressiuscula, laevis, carina utrinque distincta. Umbones striati."

We have unimpeachable evidence of the identity of this species in the presence of a specimen in a marked box in the Linnaean collection, which satisfactorily agrees with the description. No figures were cited, as is the case with all of the hitherto undescribed

<sup>1</sup> Gray here misspelled the name as "*plicaria*."

<sup>2</sup> These figures were at first thought by Lamarck (1818-1819, vol. 5, p. 471) to illustrate a variety of his own *Lutraria crassiplicata*, though he cited them for that species with a query. Later in the same volume Lamarck definitely cited them for *Mactra plicataria* (p. 476).

species in *Macra* Linné. Between the work of Gmelin and the determination of the species by Hanley (1855, p. 55), the Linnaean specific name was not used, the shell having been listed under the following names, among others: *M. spengleri* Born, 1780, *non* Linné, 1767; *M. laevis* Chemnitz, 1782; and *M. subplicata* Lamarck, 1818, *non* Wood, 1828. It should be noted that Hanley (1842-1856, p. 29) followed Gray in identifying *striatula* Linné with *M. alata* Spengler, 1802, withdrawing this identification after examining the Linnaean cabinet in 1855.<sup>1</sup> The two species are not unlike in general appearance. It will be remembered, from the discussion of the previous species, that E. A. Smith (1885, p. 57) was of the opinion that *M. laevis* Chemnitz, a synonym of Linnaeus' *striatula*, was only a form of *plicataria* Linné.

The description in the "Systema" is ample and characteristic as far as it goes, but the words "laevis," "umbonibus substriatis," and, later, "Umbones striati" fail to mention the fact that the characteristic sculpture appears also on the upper part of the lateral areas of the shell, although the median area is almost smooth, and that in both areas the sculpture is grossly rugose rather than merely "substriate." In the expanded description provided by Hanley (1855, p. 55), his language ("praecipue sublaevigata, umbonibus tantum subplicatis") is more accurate, but still does not refer to the lateral sculpture.

The available figures are equally unconvincing. Hanley (*op. cit.*, pl. 2, fig. 3) supplied a figure which Lamy (1917, p. 271) says was meant to represent the type species of Linnaeus. This figure shows large, rope-like rugosities over the whole shell except the posterior slope, almost as heavy as the rugose sculpture of *Venus paphia* Linné. The figure does not at all conform to Hanley's description. Lamy, apparently because of the lack of a good existing figure, gives a photograph

(*ibid.*, pl. 6, fig. 4) of the specimen in the Museum of Natural History in Paris, labeled "*M. subplicata* Lk." This figure is much more satisfactory, although the shell appears too smooth, the umbonal rugae being only faintly visible, probably the result of faulty reproduction.

Other figures, none of them being entirely satisfactory, are found in Reeve (1843-1878, vol. 8, *Macra*, pl. 7, sp. 27, as *Macra laevis*) and in the "Neue Folge," or second edition, of Martini and Chemnitz (1837-1907, vol. 11, pt. 2, pl. 3, figs. 1-2) in the section on *Macra* by Weinkauff, 1884. These latter figures are only a slight improvement over the original figures in the first edition of the Martini and Chemnitz work (Chemnitz, 1780-1795, vol. 6, pl. 21, figs. 205-206).

Specimens of *M. striatula* in the author's collection show the species to have a rounded-trigonal shape, with a deeply curved ventral margin, elongated and rounded anteriorly and strongly carinate posteriorly, the posterior slope descending at a right angle and forming, with the valves closed, a long, longitudinally striated depressed area, strongly circumscribed and extending the entire length of the posterior margin. The umbones are deeply rugose, especially laterally, these rugae extending on either side about a third of the distance to the ventral margin, gradually becoming obsolete. The sculpture over the remainder of the shell consists of very fine concentric striae, becoming coarser towards the ends of the shell, giving the whole median area an appearance of smoothness. The species is placed in the subgenus *Macrinula* Gray, 1853.

#### *Macra glabrata*

1767, *Systema naturae*, ed. 12, p. 1125, no. 97.

LOCALITY: "In O. Africano" (1767).

"M. testa laevi diaphana striata, umbonibus laevissimis, vulva anoque striatis. . . Testa magnitudina N. coryli, alba. Nates et umbones laevissimi, glaberrimi, nec striati. Limbus striatus. Vulva nulla carina distincta."

A specimen of this shell, bearing the proper identification, is in the collection. It agrees so well with the description of *glabrata* that its authority as the type cannot be questioned. No figures were cited. All authorities agree that it is the *Chama lisor* of Adan-

<sup>1</sup> This error of both Gray and Hanley probably stemmed from Gmelin's confusion about *striatula* Linné. Dall (1915, p. 61) was of the opinion that Gmelin had described *M. alata* Spengler under the name *striatula*. Dall (1894a, p. 26) had already called attention to the error by referring to *M. alata* as being equal to "*M. carinata* Lamarck 1818 plus *M. striatula* Auct. non L."



son, 1757, a pre-Linnaean name. Deshayes attempted to identify *glabrata* with *M. australis* Lamarck, 1818, but Lamy (1917, p. 196) points out the error in this identification by referring to the Chemnitz figures of the latter species (1780-1795, vol. 6, pl. 22, figs. 216-217), which Chemnitz called *M. polita*. Deshayes was probably influenced by an earlier error by Schröter, who mistakenly gave the name *glabrata* to *M. polita* Chemnitz.

Hanley (1855, p. 56) suggested that this species might be the *Cardium triste* of the "Museum Ulricae," and Lamy (1917, p. 197, footnote) cites this suggestion without comment. Linnaeus described *triste* in the tenth edition, repeated it in the "Museum Ulricae" (1764), and abandoned the name before the twelfth edition. The original description is short and unconvincing. It is copied verbatim in 1764 and supplemented by an elaborate diagnosis covering all parts of the shell. There is little in this latter description which conforms to the *glabrata* of the twelfth edition, however, and I have not been able to satisfy myself that Hanley's suggestion has any merit.

The species falls in the typical subgenus of *Mactra*.

It is figured in Martini and Chemnitz (Neue Folge, 1837-1907, vol. 11, pt. 2, *Mactra*, pl. 13, figs. 6-7).

#### *Mactra corallina*

1758, Systema naturae, ed. 10, p. 680, no. 75 (as *Cardium corallinum*).

1767, Systema naturae, ed. 12, p. 1125, no. 98 (as *Mactra corallina*).

LOCALITY: "In M. Mediterraneo" (1758, 1767).  
"M. testa laevi subdiaphana alba, fasciis lac-  
teis."

#### *Mactra stultorum*

1758, Systema naturae, ed. 10, p. 681, no. 80 (as *Cardium stultorum*).

1767, Systema naturae, ed. 12, p. 1126, no. 99 (as *Mactra stultorum*).

LOCALITY: "In O. Europaeo" (1758, 1767).  
"M. testa subdiaphana laevi obsolete radiata,  
intus purpurascens, vulva gibba. . . Variat  
colore fusco, cinereo, testaceo, saepius pallido  
radiata."

These two names should be discussed together. I am convinced not only that the descriptions of each in the two editions have not

been studied in sufficient detail, but that Linnaeus himself was confused by the identity and relationship of the two shells. The present practice is to give specific rank to *corallina*, and to treat *stultorum* as a variety. This is the view which is developed in some detail by Lamy (1917, pp. 180-191) who, with Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, pp. 557-558), recognizes seven varieties of *corallina* as distinct and mentions several others as of possible varietal importance.

We do know that the *stultorum* of the "Systema" was considered by Linnaeus to be identical in both the 1758 and 1767 editions, as in the later edition he specifically refers to the listing of the species in the earlier.<sup>1</sup> In the case of *corallina* we cannot be absolutely certain of this (although the synonymy, with the exception of the mutilated reference to Buonanni, is identical in both editions), as he did not, in the twelfth, refer back to *Cardium corallinum* in any way. Moreover the description omits the very significant language "antice posticeque obtusissima."

The failure to cite the earlier *corallina*, although puzzling, is not, of itself, of any great significance. In the case of *Mactra solida* (below) he cites as a synonym the *Cardium solidum* of the "Fauna Suecica." In the case of *Mactra lutraria* (below) he cites the *Mya lutraria* of both the "Fauna Suecica" and the "Museum Ulricae," but in neither case does he mention the species of the tenth edition, as he did for *Mactra stultorum*, although he cites the original generic name. There are, of course, instances, as mentioned in the Foreword to these papers, where we know that the species described in one or both of these intermediate works is not the same as the species given the same name in the tenth edition, but these instances are not numerous. If we should find that in nearly all of the cases in which he moved species from one genus to another when preparing the twelfth edition, or changed its specific name, or both, he confirmed its identity by a specific reference to its position in the tenth, we might reasonably conclude that when such reference is lacking the name in the twelfth is

<sup>1</sup> Linnaeus, in his twelfth-edition reference to *Cardium stultorum* of the tenth edition, erroneously refers to number 8 instead of number 80.

not the same shell, but is either a new species in the twelfth, or in one of the intermediate works if one or the other of them is cited. This does not prove to be the fact. I have examined all cases in which a species is changed in genus, in specific name, or in spelling. The result is that of the 31 species whose genus was changed, only eight referred back to the tenth edition, and four of these eight were changed either in specific name or in spelling (other than a change in gender). This radical change was, of itself, an adequate reason for Linnaeus to emphasize the origin of the name, which did not exist in the cases of mere change of genus, and, as a matter of fact, we know that many more than eight of the 31 species are identical in the two editions—indeed, the great majority of them are. Nine species were left in the same genus, but with some change in the specific name. Only three of these give us a reference back to the tenth edition, and these three represent the creation of lettered varieties designed to supplant identical but differently named species in the tenth. Here again, there was an even greater reason for Linnaeus to make himself perfectly clear by mentioning their exact position in the earlier work.

I feel that we may fairly conclude that Linnaeus did not follow any rule in these cases. He mentioned the tenth edition position when it occurred to him to do so, and one of the compelling reasons was a change in specific name or the demotion of a species into a variety. He was not consistent. Why, for instance, should he have listed *Chama cor* in the twelfth edition, with only a reference to the "Museum Ulricaë" and no hint that the species was, in fact, the *Cardium humanum* of 1758, leaving us with the necessity of conning over many earlier descriptions in the tenth edition, before we could be convinced that the shell there cited was identical? And why should he have listed *Tellina inequivalvis* with no synonymy whatever and with no mention of the identical *Solen inequivalvis* of the tenth edition, when in many less difficult cases he was so careful to give us complete details of the original position of the species? I do not wish to labor the point, but I am convinced that the presence or absence of a reference to the earlier edition in these cases is of very slight significance.

The differences and inconsistencies in the respective descriptions of *corallina* and *stultorum* in the two editions are impossible to reconcile and are apparently due to the extreme variability of this confusing and widely distributed complex, which has an astonishing temperature range, being found from Norway to the eastern Mediterranean. We are not much helped by the contents of the collection. A paper contains a specimen of the oval form of *Maetra solida* (? *M. elliptica* Brown, 1827, figured by Reeve, 1843–1878, vol. 8, *Maetra*, pl. 18, fig. 101). On this paper is written the word "nondescripta," in an unknown handwriting, but the word is crossed out and "*corallina*" substituted in a hand much like that of Linnaeus. It is possible that this specimen is the type of *M. corallina* of the tenth edition. The figure cited from Plancus might be said to represent it. There is also a specimen marked for *Cardium stultorum*, but this is the rounded-trigonal shell we call *corallina*. Hanley (1855, pp. 56–57) identified this specimen with *M. inflata* Bronn, 1831,<sup>1</sup> said it represented the *M. stultorum* of the tenth edition, and added that the *stultorum* of British waters was an elongated form of it. The *stultorum* of the twelfth edition, he said, was *M. stultorum* Philippi, 1836, the original description of which mentions the protrusion of the dorsal margin, a feature that was in fact brought out by Linnaeus in the twelfth edition description of *stultorum* in the words "vulva gibba."<sup>2</sup> Thus Hanley was of the opinion that the two editions described two different shells. The modern view seems to be that held by Locard and Lamy, both of whom recognize *stultorum* Philippi and *inflata* Bronn as synonyms of *stultorum* Linné of 1758 and 1767.

If we accept the names of the shells known to us today as *M. corallina* and its variety *stultorum*, we must realize that we are using an arbitrary nomenclature. The descriptions contain too many inconsistencies to permit of an absolute identification. Some of these are:

A. *M. corallina* is described as "antice posticeque obtusissima" in the tenth edition and also as "triangulo-rotundata." The two

<sup>1</sup> *M. inflata* Bronn is figured in Philippi (1836, 1844, vol. 1, pl. 3, fig. 1).

<sup>2</sup> Philippi's language is "lunule distincta, area gibba, subcarinata."

expressions are inconsistent. One of the forms under consideration is elongate, with blunted ends, while the other is sharply rounded-trigonal.

B. *M. stultorum* is described as "vulva gibba" in the twelfth edition, and "subrotunda aequilatera" in the tenth. Neither shell has both of these traits. The shell having the protruding dorsal margin is the form that is inequilateral. This gives some ground for believing that two different shells were described in the two editions, in spite of the twelfth edition reference to the tenth.

C. The very paucity of the description of *corallina* in the twelfth edition and its utter dissimilarity to the diagnosis of *Cardium corallinum*, particularly the abandonment of the phrase relating to the shape of the ends, are certainly suggestive of the fact that the two descriptions refer to different forms. It is true that the synonymies are practically identical, but the mutilation of the reference to Buonanni and my own feeling as to the authority of all figures cited in the "Systema" do not do much to allay my suspicion.

It would be idle to suggest changes or to attempt to make our nomenclature conform to that of Linnaeus, as we are faced with the more serious problem of not knowing what he himself meant. *M. corallina* and its varieties are clearly distinguished today to the satisfaction of conchologists, although our acceptance of the names is arbitrary. I do not know what Linnaeus meant by any of the four descriptions, and on this basis I am willing to call both of the forms *species dubii*. We must have names for them, however, and the ones we now use will do as well as any.

*Mactra corallina* and its varieties belong to the genus *Mactra*, *sensu stricto*, the type of which is *M. stultorum* Linné, by subsequent designation, Anton, 1939. The figures of the two forms here discussed are untrustworthy, especially in the older works, because of the difference of opinion among the early writers as to Linnaeus' meaning. The clearest and most accurate figures of the shell we know as *M. corallina* are those in Martini and Chemnitz (Neue Folge, 1837-1907, vol. 11, pt. 2, pl. 7, figs. 3-10). For figures of our variety *stultorum* see the same plate (figs. 1-2). Reeve also figures *stultorum* (1843-1878, vol. 8, *Mactra*, pl. 4, sp. 15).

*Mactra corallina* Linné is not *M. corallina* Chemnitz, 1782, the latter being identical with *M. nitida* Spengler, 1786.

The variety *stultorum* is not *M. stultorum* Pennant, 1777, which is *Spisula subtruncata* (Da Costa), 1778, nor *M. stultorum*, variety  $\beta$ , Chenu, 1843, which is a synonym of *M. glabrata* Linné.

#### *Mactra solida*

1758, *Systema naturae*, ed. 10, p. 681, no. 76 (as *Cardium solidum*).

1767, *Systema naturae*, ed. 12, p. 1126, no. 100 (as *Mactra solida*).

LOCALITY: "In O. Anglico" (1758): "in O. Europaeo" (1767).

"M. testa opaca laeviuscula subantiquata. . . Testa crassa, alba s. flavescens, saepe cingulis lacteis subimbricata et fere antiquata. Cardo dentibus lateralibus minus elongatis: foveola major quam in reliquis et dens intermedium minor."

As in the case of all of the other species of the *Mactra* of Linnaeus, a specimen of this shell is found in the collection, marked with the appropriate number. It corresponds in every detail with the clear and characteristic description, although the diagnosis is considerably altered in the twelfth edition, in language but not in import. The synonymy is accurate and is identical in the two editions. The locality is correctly amplified in the later edition, as the species is found not only in the English Channel but along the whole of the western coast of Europe. The *Mactra solida* of the twelfth edition is expressly referred to *Cardium solidum* of the "Fauna Suecica," but inasmuch as the shell there listed is demonstrably identical with that of the tenth edition, the omission of any reference to that edition is unimportant. This subject has been fully covered in the discussion of *M. corallina* and *stultorum* (above).

It is a member of the genus *Spisula* Gray, 1837. Gray originally erected this genus as a very comprehensive group, containing many species which have since been placed in various subgenera and sections. In 1853 he materially cut down his broad *Spisula*, confining the name to the group of species now contained in *Spisula*, *sensu stricto*. In 1847 he selected *Spisula solida* (Linné) as the type of the genus. All members of *Spisula*, *sensu lato*, are distinguished by the absence of the shelly

plate or ridge that in *Mactra*, *Schizothaerus*, and other genera in Mactridae separates the ligamental pit from the chondrophore. The ligament of *Spisula* is small and visible from the exterior, the only genus in the family that has an entirely internal ligament being *Mulinia*, a group not represented in the "Systema."

Figured in Brown (1827, pl. 41, figs. 3, 4).

#### *Mactra lutraria*

1758, *Systema naturae*, ed. 10, p. 670, no. 18 (as *Mya lutraria*).

1767, *Systema naturae*, ed. 12, p. 1126, no. 101 (as *Mactra lutraria*).

LOCALITY: "In O. Europaeo ad ostia fluviorum" (1758); "ad ostia fluviorum Oceani Europaei" (1767).

"M. testa ovali oblonga laevi, dentibus lateralibus nullis. . . . Cardo destituitur dentibus lateralibus, quibus a congeneribus tantum differt."

Conchologists have apparently had little difficulty in identifying this common western European species, although Lamarck, after citing it as the example of his genus *Lutraria* in the "Prodrome" of 1799, changed its name to *Lutraria elliptica* in 1818, and many later writers persisted in the use of that name, notably Turton in 1822, Deshayes in 1835, Philippi in 1844, Gray in 1853, and even, more recently, Locard in 1899 and Lamy in 1913.<sup>1</sup>

It falls into the genus *Lutraria* Lamarck, 1799, of which it is the type, by monotypy, as well as by absolute tautonymy.

Based upon the language of the description in the twelfth edition, this identification is not completely satisfactory. There the species is definitely said to lack lateral teeth ("dentibus lateralibus nullis" and later, "Cardo destituitur dentibus lateralibus") and to differ from the other *Mactra* to this extent ("quibus a congeneribus tantum differt"). The shell known to us as *Mactra lutraria*, however, has lateral teeth, but they are so short and so feebly developed that it is conceivable that they escaped the notice of Linnaeus, and are so extremely thin that, in the alternative, they may have been broken off or eroded in the specimen on which the description was

based. An even more acceptable explanation of Linnaeus' language is that these undoubted lateral teeth are so close to the cardinals (especially in the case of the anterior laterals) that they may well have been considered by him to be mere accessories to the cardinals, rather than true laterals.

If we accept the tenth edition description as referring to the same shell (as to which I have considerable doubt), then Linnaeus himself has possibly given us some confirmation of this second theory. Immediately after the 1758 description of the cardinal tooth he speaks of the smaller teeth by saying "cum accessorio dente sursum rigende plicato."

This 1758 description (as *Mya lutraria*) gives many details not repeated in the twelfth edition, and the earlier description of the hinge is so unenlightening that I have not been able to satisfy myself that it describes the same shell, in spite of the fact that the figures cited in both editions are the same, with the exception of the erroneously transcribed reference to Rumphius which may have been a mere printer's error of "N?" for "M." It is possible, of course, that the author, who had not yet delimited the characteristics of his *Mactra*, was so preoccupied with the idea that *lutraria* was a *Mya* that this unconsciously influenced his description. He did, however, recognize that the chondrophore is directed in the plane of the shell, rather than being erect, as in the true *Mya*, by the words "non attolitur, sed horizontalis est (quo a praecedente [*Mya arenaria*] differt)."

*Mactra lutraria*, of the twelfth edition, is figured in Reeve (1843-1878, vol. 8, *Lutraria*, pl. 1, sp. 3, as *Lutraria elliptica* Lamarck).

Attention should be called to an apparent error by Hanley which may have a bearing on the identification. He says (1855, p. 58) that the shell marked for *Mya lutraria* in the collection was "*Lutraria oblonga* (Brown Ill. Conch. G. B. pl. 43, f.2)." The Brown plate referred to is entitled "*Lutraria elliptica*," Lamarck, 1818, which is an exact synonym of *Lutraria lutraria* (Linné). Hanley thus cited the proper figure but for some reason attributed the wrong name to it. The *lutraria* of Linnaeus has never been called *oblonga*, which is a distinct, though closely related species first described by Chemnitz in 1782 (1780-1795, vol. 6, p. 27, pl. 2, fig. 12) as *Mya ob-*

<sup>1</sup> Lamy later recognized the priority of the Linnaean specific name *lutraria* (1917, p. 363).

*longa*.<sup>1</sup> The error is unfortunate in that it adds a further hint of doubt to the uncertainty surrounding *lutraria*. Chemnitz' *oblonga* presents a disposition of the lateral teeth which more nearly conforms to Linnaeus' words "dentibus lateralibus nullis" than any other of the latter's *Maetra* species. In the left valve, the anterior lateral is so near to the cardinal that Lamy describes it (1917, p. 373) as "simulating a second cardinal tooth." In the right valve, the anterior lateral is parallel to the anterior cardinal, and so close that, as Lamy says (*loc. cit.*), "the contiguity of these two lamellae simulate a bifid tooth." The posterior laterals in both valves have completely disappeared. These facts at least raise an unfortunate suspicion that what Linnaeus had before him was *Lutraria oblonga*.

As is noted in the discussions of *M. coralina* and *M. solida*, the twelfth edition description does not specifically tie the species to that described in the tenth edition, the references in the present case being to the "Fauna Suecica" and to the "Museum Ulricaë." I have already expressed the view that too great weight should not be attached to this omission, unless other evidence points to a different shell in one of the lesser works. The description of *Mya lutraria* in the "Fauna Suecica" is identical with the main description in the tenth edition of the "Systema," although it omits the somewhat equivocal subdescription already referred to, and while none of the tenth edition's figures are cited,<sup>2</sup> and indeed there is no reference to the "Systema," it seems incontrovertible that Linnaeus was describing the same shell. A word-for-word repetition of the main part of

the description is surely the best evidence of the identity of the two listings. In the "Museum Ulricaë" the author again repeated the same language and moreover specifically referred to "Syst. Nat. 10, p. 670, n. 18," as well as "Fn. Suec. 2128." The twelfth-edition description of *Maetra lutraria*, the appearance of the specific name in both of the intermediate works having been cited, therefore unquestionably refers to the same shell, although any reference to the tenth edition is omitted.

The most recent and satisfactory figure of *M. lutraria* is found in Thiele (1931, 1935, vol. 2, p. 903).

#### DONAX LINNÉ

The Linnaean genus *Donax* contained only eight species in the tenth edition. Two more were added in the twelfth: *scortum*, which was transferred from *Venus*, and a new species, *striata*.

The genus, as it left the hands of Linnaeus in 1767, was a heterogeneous group, as, in addition to its eight true donaces, it contained a *Venerupis* and a *Sunetta*, both venerid genera. *Cuneus* Da Costa, 1778 (*non* Megerle von Mühlfeld, 1811), was a substitute for the Linnaean *Donax* rather than an attempt at dismemberment and should be regarded as an exact synonym. Scopoli, in 1777, made the first attempt to eliminate the discordant species, and the dismemberment by Schumacher in 1817 left the restricted genus about as we know it today.

Lamarck, in the "Prodrome" of 1799, made the first attempt to designate a type for *Donax*, but his choice of *D. trunculus* as the "example" of the genus is not recognized as a valid type designation under the strict interpretation of the Rules. Children's 1823 selection of *D. scortum* was also invalid, as the species was not on the original list of *Donax*. Schumacher's designation of *D. rugosus* (1817) was the first valid designation of a type for the restricted genus. Later designations were those of Herrmannsen in April, 1847, and of Gray in November, 1847, both selecting *rugosus*. Herrmannsen's type was applied to the genus as restricted by Schumacher, while Gray's selection was specifically referred to the *Donax* of Linnaeus. Some writers continued to use *D. trunculus* as type

<sup>1</sup> *Chama magna* Da Costa (1778, pl. 17, fig. 4), sometimes cited in the synonymy of *L. lutraria* (Linné), appears, from Da Costa's figure, to be *Lutraria oblonga* (Chemnitz), but, *vide* Turton (1819, p. 86), Da Costa's description and references apply to *Lutraria lutraria*.

<sup>2</sup> The figures cited by Linnaeus for *M. lutraria* in the two editions of the "Systema" are even less informative than the average of the drawings of the pre-Linnaean iconographers. Details of sculpture are either absent or vaguely suggested, and the hinge, where shown, does not indicate any of the generic or specific variations. About all that we can say for them is that most of them represent *Maetra* species, but this is largely because they show or suggest the mactroid chondrophore. As an aid to identification they are all but worthless, and this is true of almost all of the figures cited for the other species in Linnaeus' *Maetra*.

until comparatively recent times, relying upon Lamarck's use of that species as "example," and others apparently still disregard Schumacher's designation and cite either that of Herrmannsen or Gray as the earliest. Grant and Gale (1931, pp. 378-379), for instance, use both, although noting that the two designations were for the broad and restricted genera, respectively.

As now conceived, *Donax* is an exceedingly compact and homogeneous group. Its essential characteristics of shape, sculpture, serration of margin, and hinge are remarkably constant, and divergences from these traits are in most cases of no generic significance. The division of the genus into sections is based largely upon the shape of the shell, whose normal wedge shape may, in certain species, become almost trigonal, on the existence and prominence of the posterior carination and the steepness and sculpture of the posterior slope, on the degree of serration of the inner margins, and on the strength of the lateral hinge teeth. Radial sculpture of varying prominence is observable throughout the genus, and concentric sculpture is present only in the sections *Latona* Schumacher and *Hecuba* Schumacher, where it is much more conspicuous than are the radial striae. It is, however, not generally agreed that this latter group can be placed with the true donaces, as it appears to be intermediate between *Donax* and *Heterodonax* Mörch, 1853, in shell characters. Its inclusion in either genus would involve some expansion of their generic definitions, and there is some ground for giving it separate generic rank.

Linnaeus treated *Donax* as a feminine noun, as appears from the adjectival terminations of his specific names, and his orthography has been generally followed. The name, however, is masculine, having been adopted from that of a fish (*Donax*) described by Pliny, a name that was also applied to a "sea-scallop." One or two writers have attempted to remedy this grammatical inconsistency, and in some cases the practice has apparently befuddled writers to the extent of using masculine and feminine terminations in the same list. The error, however, should be corrected, and I am here adopting the masculine terminations except in the headings for the species. This is predicated on my opinion

that Article 19 of the Rules, covering errors of transcription and similar errors, is overridden by the more basic Article 14 (a) to the effect that adjectives, when used as specific names, must agree with the generic name.

#### *Donax scortum*

1758, *Systema naturae*, ed. 10, p. 686, no. 103 (as *Venus scortum*).

1767, *Systema naturae*, ed. 12, p. 1126, no. 102 (as *Donax scortum*).

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

"D. testa triangulo-cordata, vulva plana."

It is difficult to understand why Linnaeus should have placed this species in *Venus* in the tenth edition, as the shell could not be mistaken for a venerid by a modern conchologist. The hinge, to mention only one characteristic, is quite different. The cardinal teeth are much weaker than in the strong hinge of the Veneridae, and the lateral teeth much more remote and ordinarily much more prominent. Likewise the beaks in *Donax* are smaller and much less prosogyrous.

The species is now placed in the section *Hecuba* Schumacher, 1817, and is the type of the section, by original designation. This group is characterized by a conspicuous posterior carination, by prominent radial sculpture in front of the carina, and by a sharp groove in the right dorsal margin in front of the socket for the anterior lateral tooth.

The species is the largest and, at least in the juvenile stage, one of the most strikingly sculptured members of the genus. The shell is roughly elongate-trigonal, the umbones being almost central. Both the anterior and posterior slopes are bounded by salient carinae, and the anterior slope is extremely concave, the lower end running out into a point. The concentric sculpture consists of a series of lamellae, which in young shells are much wider and more everted towards the posterior margin and which are themselves sculptured by radial grooves. The young shell is also provided with a series of sharp denticles along the anterior carina. There is thus a striking difference between the two growth stages of the shell, and this difference was responsible for an error in identification which persisted throughout the published works of Linnaeus.

The word "glabra" in the description in the tenth edition (as *Venus scortum*) is misleading. From its use it appears obvious that the original specimen (or figure), on which the description was based must have been either a senile or very much worn shell. Hanley (1855, p. 59) concluded that Linnaeus had a specimen which had been artificially polished. It must have been this fact which led the author to cite a figure from Argenville (pl. 85, fig. F) which, although its outline is approximately that of *scortum*, shows a completely smooth shell. The word "glabra" was omitted in the twelfth edition, but the same figure was cited, and Linnaeus continued to omit any reference to sculpture. The answer lies in the fact that Linnaeus had already, in the tenth edition, unwittingly described a young species of *scortum* as *Donax pubescens*, a name to which he gave no pictorial references but which was supplied with an excellent description that takes into account not only the sculpture of the disk of the shell but also the denticles or spines along the carina of the juvenile shell. He thought that the spineless adult and the spine-bearing juvenile forms were different species. Even after he moved *scortum* to the genus *Donax* in the twelfth edition, he still retained *pubescens*, with its original description, as a good species. In the intermediate work, the "Museum Ulricaе," he also cited both names, supplying elaborate descriptions of the characteristics of what we now know as the juvenile and adult stages. He gave no references to either, but specifically referred to the tenth edition listing of each.

No specimen that can be identified as Linnaeus' type specimen of *scortum* is found in the collection, nor is the name on the list of species that he owned. It is therefore probable that he described it from a borrowed shell or merely from data supplied him by a colleague. It is even possible that he based it solely on the Argenville figures. One of these drawings does show a gape at the posterior end, which may have been the reason for his expression "vulva plana hiante," although "hiante" is omitted in the "Museum Ulricaе" and the twelfth edition. (*D. pubescens* is described as "Rima hians" throughout.)

Thus there is nothing in any of his published writings that indicates that he ever

learned of the common identity of *scortum* and *pubescens*. The collection, however, contains a specimen of *scortum* on which is written "*Donax pubescens, Venus scortum*." It is impossible to say just when this specimen was added to the collection and thus labeled or by whom. The fact that he continued to separate the two names even in the last edition, 1767, indicates that it was acquired later. Moreover, by manuscript notes after the twelfth edition was published, he added new and different references for each of the two names. We do not know the date of these notes. It may be that the specimen was added thereafter, but before his death. It may be that it was added by another hand after his death. The legend on the shell, referring to the *Venus scortum*, might make one surmise that it was done before *scortum* was transferred to *Donax*, and yet it could hardly be urged that Linnaeus would have continued to cite the two names separately after he had learned of their common identity. The evidence, or rather the lack of evidence, indicates that Linnaeus never knew that he was dealing with a single species.

On the question of the specific name *scortum*, Hanley was of the opinion that it should be dropped and the name *pubescens* retained. In his discussion of *pubescens* (1855, p. 59) he said: "Since the name of either this or the preceding [*D. scortum*] must be abolished, and the latter . . . was most incorrectly defined in the tenth edition, where the former, on the contrary, . . . was fairly enough defined, it seems both just and expedient to retain *pubescens*, rather than the immodest epithet of the more aged shell." It is of course perfectly permissible, under Article 27 of the Rules, to select as the earliest available name one given to a mere stage in the life history of the species, and under Article 28 the first reviewer who recognizes two names as referring to the same species may select one of them to be retained. Hanley's selection, however, does not seem a valid one. In the first place it is based on a fanciful objection to the meaning of the word *scortum*, and, secondly, he chose a name that was unsupported by a figure in preference to one for which a figure was supplied, in derogation of the Recommendations under Article 28 of the Rules.

In the first hundred years after the publication of the tenth edition I find no valid selection of either name. Born (1780), Gmelin (1791), Chemnitz (1780-1795), Schröter (1786), Bosc (1801), Dillwyn (1817), and Wood (1828) all listed both names as good species. Link (1807), Montfort (1810), Schumacher (1817), and Blainville (1825) all listed *scortum* but omitted *pubescens*. Deshayes and Milne-Edwards (1835-1845, vol. 6, pp. 239-240) used both as good species in the text, giving equal prominence to each, but in a footnote (*loc. cit.*), which was apparently an afterthought, said that *pubescens* "appears to us to have been based upon a variety of the preceding [*scortum*]," and in speaking of the spines of *pubescens* said that they are better preserved "in the young than in the old individuals." Thus they may have discovered the truth as to the identity of *pubescens* at some time during the preparation of their work, but the attempt to explain their conclusions is certainly not equivalent to the selection of one name and the throwing of the other into its synonymy. Some years later Deshayes (1839-1853, vol. 1, p. 454) said: "Linnaeus created a distinct species (*Donax pubescens*) for the variety with long scales; the other varieties fall into *Donax scortum*." This statement is even less indicative of his knowledge of the real identity of *pubescens*.

The first authoritative selection was that of Reeve (1843-1878, vol. 8, *Donax*, text covering *D. scortum* and pl. 1, sp. 1 and 3). The plate and accompanying text were issued in September, 1854. *Donax scortum* is there cited and figured as a good species and in its synonymy appears the notation: "Testa juvenis, *Donax pubescens* Linnaeus." Since that date *scortum* has been used by virtually all writers, and the name *pubescens* has been dropped from the nomenclature.

It is admitted that this is one of the cases where identification has been based on evidence not inherent in Linnaeus' own diagnosis. It is therefore only to avoid the creation of a technical *species dubius* that we cite *scortum* as of the date of any of his published works. Although other evidence convinces us that our *scortum* is, in fact, the *scortum* as well as the *pubescens* of the "Systema," our style of citing it is justified only by tradition and convenience.

The locality stated ("in America") is erroneous in both editions. The correct locality ("O. Indico") is given under *pubescens*.

Figured in Reeve (1843-1878, vol. 8, *Donax*, pl. 1, sp. 1 and 3). Sowerby also figures the species (1847-1887, vol. 2, pl. 280, figs. 1-3).

#### *Donax pubescens*

1758, *Systema naturae*, ed. 10, p. 682, no. 83.

1767, *Systema naturae*, ed. 12, p. 1127, no. 103.

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

"D. testa antice spinis ciliata. . . . Testa argute decussatim striata: antice plana laterum angulo carinato, versus apicem spinis e striis enatis membranaceis ciliato. Rima hians ovata; nymphis nudis. Anus ovato-oblongus."

This species is discussed above under *Donax scortum*.

#### *Donax rugosa*

1758, *Systema naturae*, ed. 10, p. 682, no. 84.

1767, *Systema naturae*, ed. 12, p. 1127, no. 104.

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

"D. testa antice rugosa gibba, marginibus crenatis."

The identification of this species was rendered simple by the presence of a properly marked specimen of the shell we know as *rugosus*, which conformed adequately with the short though intelligible description. The only figure cited by Linnaeus (from Gualtieri) is unrecognizable. The description was improved by the addition of the words "albido-radiata" and "rima ovata" in manuscript notes in Linnaeus' copy of the twelfth edition. The word "laevis" was added by his son, although this was certainly done under a misapprehension. The species is the type of the restricted genus *Donax*, by subsequent designation, Schumacher, 1817. (See discussion of *Donax*, above.)

Figured in Reeve (1843-1878, vol. 8, *Donax*, pl. 2, sp. 9a, b, c) and in Sowerby (1847-1887, vol. 3, pl. 281, figs. 27-29). Donovan (1799-1803, vol. 1, pl. 24) believed that this species was identical with *D. denticulatus* Linné (below), as he placed both in the synonymy of his *Donax crenulatus*, reported as from Great Britain.

#### *Donax trunculus*

1758, *Systema naturae*, ed. 10, p. 682, no. 85.

1767, *Systema naturae*, ed. 12, p. 1127, no. 105.



LOCALITY: "In Oceano Europaeo." (1758, 1767).  
 "D. testa antice laevi, intus violacea, marginibus crenatis."

The box marked for *trunculus* in the Linnaean collection contains two different shells, one a specimen of *Donax vittatus* Da Costa, 1778 (*D. anatinus* Lamarck, 1818), a fairly common species on the French Atlantic coast and in the British Isles, and the other a specimen of the *Donax trunculus* of most of the earlier Continental writers and the species that is now universally called by that name. The latter is a native of the Mediterranean. The two are superficially similar, but *trunculus* can be readily distinguished by its more abrupt posterior truncation, by the fact that the dorsal margin of the left valve slightly overlaps that of the right valve, by the faintness or obsolescence of the interior serrations on the posterior margins of both valves, and by the absence of lateral teeth. A great deal of confusion between the two is found in the early literature, which Hanley (1855, p. 60) felt was due to the different interpretations of the Linnaean description as well as to the presence of two different shells marked for *trunculus*. This confusion was largely due to the British writers, to whom Da Costa's *vittatus* was necessarily the more familiar of the two shells.

The description is short and far from comprehensive but is sufficiently characteristic to point to *trunculus*. The words "antice laevi" fit *trunculus* rather than *vittatus*, as does the phrase "intus violacea." The Mediterranean shell always shows a violet interior, while that coloring is comparatively rare in *vittatus*. The distinction is further brought out in the "Museum Ulricae," where the mention of the absence of lateral teeth points to *trunculus* and away from *vittatus*.

The references cited in the tenth edition further emphasize Linnaeus' failure to separate the two species. Two of them (from Gualtieri and Buonanni) show the truncated shell from the Mediterranean. The reference to Lister (an English writer) clearly shows the more northern species, *vittatus*. The Argenville figure is too vague to be placed with any certainty, but looks more like *trunculus*. Thus the preponderance of evidence, based on the figures alone, is in favor of *trunculus*, although I feel that it is not necessary to rely on this

hodge-podge of drawings. The description is sufficient to indicate *trunculus*, whatever may have been the specimen Linnaeus used as the type. Two further figures were added in the twelfth edition, both of which were erroneous as not conforming with the description.

From the standpoint of identification, the species presents an unusual situation, even for the "Systema." Although Linnaeus obviously confused the two shells in his mind, he unwittingly described *trunculus* by his language. We have accepted the *trunculus* of all modern authors as the species of the "Systema."

The Mediterranean *trunculus* is figured in Sowerby (1820, 1825, 1834, vol. 1, pl. 61, fig. 3) and in Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, pl. 68, figs. 1-8). The latter authors show *D. vittatus* Da Costa on the same plate (figs. 9-14).

Bucquoy, Dautzenberg, and Dollfus were of the opinion that Linnaeus not only confused *trunculus* and *vittatus* in the description, but that the language of the description was so equivocal that (*tom. cit.*, p. 458) "it would be difficult to preserve the name *trunculus* for one or the other of the two shells if Born had not clearly pictured under this name, in 1780, that which we are here discussing." I call attention to the fact that this reasoning is specious. A later figure by another author cannot remedy a defect in the original description, or serve validly to separate two species that were originally described as a composite species.

The species that Lamarck (1818-1819, vol. 5, pp. 548-549) cited as *Donax vittatus* and stated that it was "communiqué par M. Leach, Ocean Brittanique," is not the *D. vittatus* of Da Costa, but *Tellina trifasciata* Linné.

*Donax trunculus* falls in the section *Serrula* (Chemnitz) Mörch, 1853. Chemnitz did not use the name in a supraspecific sense, and therefore the name must be attributed to Mörch, who first so used it. It was not a monotypic group, and Mörch selected no type. The first type designation was by Dall, 1900, who selected *trunculus*.

#### *Donus striata*

1767, *Systema naturae*, ed. 12, p. 1127, no. 106.  
 LOCALITY: "In Europae australis Oceano" (1767).

"D. testa antice obtusissima undique striata, margine denticulato, vulva ovata. . . Reliquis magis gibba et tota, exceptis natibus, striata, et alba."

The description of *D. striata* is not illuminating. As to the shape of the shell, the only detail given is "antice obtusissima" (by which, as usual, the posterior end is probably meant) and the indication that the shell is more inflated than Linnaeus' other donaces. The striations covering the entire shell and the denticulated margins are characteristic of many *Donax* species. It was described as "alba." Fortunately a marked specimen of the *Donax striatus* of authors is in the collection, which is in complete agreement with the short description and therefore is accepted as the type. No references were given.

Prior to Hanley's examination of the Linnaean collection of mollusks in 1855, which was, strangely enough, the first time that the contents of the cabinets had been critically studied, some conchologists were not willing to accept the "Systema" description as pointing to the *Donax* that we know as *striatus* today. The principal early uses of the name follow:

Chemnitz (1780-1795, vol. 6, p. 261, pl. 26, fig. 255) described and figured a *Donax striatus* which he attributed to Linnaeus with a query, but his figure is almost certainly not a representation of the *striatus* of authors. It shows an almost equilaterally triangular shell, with little evidence of truncation, the two ends descending at almost the same angle, in contrast to Linnaeus' phrase "antice [*sic*] obtusissima."

Gmelin cited the species, using the "Systema" description, with the usual grammatical changes, and supplied a figure from Knorr (1772, pt. 6, pl. 28, fig. 8). This figure shows a shell with a wide posterior truncation, the umbones at the extreme end of the shell, and the posterior slope almost perpendicular to the long axis of the shell, which is white, with deep pink concentric bands of color. It was possibly meant for *striatus*, although the truncation is much exaggerated. Another figure from Knorr was available, and is a much better representation of *striatus* (pt. 6, pl. 7, fig. 7) and was in fact used by Hanley (1842-1856, pl. 14, fig. 32) as the model for

his figure of *striatus* and later cited by him in "Ipsa Linnaei Conchyliia" (1855, p. 61).

Lamarck passes over *striatus* entirely. Sowerby (1847-1887, vol. 3, p. 309, pl. 281, fig. 52) gives an adequate description of the species, but his figure goes to the other extreme and, like the Chemnitz figure, shows almost no truncation. He says (*loc. cit.*), "There is no reason to doubt the identity of Deshayes' *lamarckii* with this." This latter name I have not been able to find in any of Deshayes' works available to me, and I believe it was never published. It is apparently to be found in his manuscript comments on the specimens in the Cuming collection, many of which were published in the Proceedings of the Royal Society of London. The name *lamarckii* was adopted by Reeve (1843-1878, vol. 8, *Donax*, pl. 5, sp. 27), who cites it as of "Deshayes MSS., Mus. Cuming," with a description which fairly describes the *striatus* of authors and agrees with the "Systema" description except that the shell is said to be "everywhere densely ridged," instead of "tota, exceptis natibus, striata." Reeve's figure is almost identical with the figures of Knorr and Hanley, and is like the Sowerby drawing, except for the latter's concave posterior slope. Reeve does not cite *striatus* either in the synonymy of *lamarckii* or elsewhere. It may well be that *lamarckii* is identical with Linnaeus' *striatus*, as Sowerby thought. I do not know what it was, but, in any event, Reeve validated the name, which should be cited, for what it is worth, as *D. lamarckii* Deshayes in Reeve 1854. Reeve gave no locality.

Hanley (1855, *loc. cit.*) identified Linnaeus' *striatus* with the *striatus* of authors, and since his day this determination has been consistently accepted.

In Linnaeus' own copy of the "Systema" we find, attached to this species, a manuscript note to serve as a direction to the printer of the proposed "revised twelfth edition" ("locatur post 103") which would place it just before *D. rugosus*, to which it is much more nearly allied than would be indicated by its position in the twelfth immediately following *D. trunculus*. This may be considered as evidence to some extent confirmatory of the accepted identification.

*Donax denticulata*

1758, *Systema naturae*, ed. 10, p. 683, no. 86.

1767, *Systema naturae*, ed. 12, p. 1127, no. 107.

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

"D. testa antice obtusissima, labiis transverse rugosis, margine denticulato, nymphis dentiformibus. . . . Testa cuneiformis, laevis, longitudinaliter punctato-striata, albida, purpurascensubfasciata. Vulva subrotunda, minima; antice obtusissima, area media transverse rugosa, laterali recta; margo denticulatus. Intus albicans."

The very detailed subdescription of this species and the presence of a marked specimen in the collection, wholly in agreement with the language of Linnaeus, determined the identification beyond question, in spite of the error in locality. It is the common *Donax denticulatus* of the West Indies. The listing of the species by Donovan in his "Natural history of British shells,"<sup>1</sup> is probably due to the fact that specimens, from ballast, had been found on British beaches.

One feature of the sculpture of *denticulatus*, which was rather clumsily described by Linnaeus but which is very characteristic of the species, is the presence of two types of sculpture on the posterior slope. That area in each

valve is divided by a secondary keel, and the peripheral side of the area is transversely and very crookedly wrinkled, while the inner side is provided with fine radial striations.

*Donax denticulatus* is usually placed in the section *Chion* Scopoli, 1777, as type of the section, by monotypy.

Figured in Reeve (1843-1878, vol. 8, *Donax*, pl. 7, sp. 48a, b, c), and in Sowerby (1847-1887, vol. 3, pl. 281, figs. 32-36). The latter are poor figures, and it may be mentioned that it is difficult to find good representations of any of the species of this genus. They seldom show the sculpture of the posterior slope, and the slight differences in those species having radial striae are difficult to reproduce. Sowerby's description of the sculpture of the posterior end of *D. denticulatus* is, however, extremely graphic.

*Donax cuneata*

1758, *Systema naturae*, ed. 10, p. 683, no. 87.

1767, *Systema naturae*, ed. 12, p. 1127, no. 108.

LOCALITY: Not given in either edition.

"D. testa cuneiformi, marginibus integerrimus. . . . Testa parva, ovata, compressa, violacea s. vario colore."

Linnaeus possessed this species at the time of the publication of the tenth edition, as it appears on his list of owned species at that time, although it was omitted from the corresponding list of the twelfth edition. The description in the twelfth edition is, however, identical. The "Systema" diagnosis is barely sufficient to identify the species, and the only words that are exclusively characteristic are "marginibus integerrimus," as it is the only one of the Linnaean donaces thus described, with the exception of *D. irus*, which is easily distinguishable. The description in the "Museum Ulricaе" is much more detailed and exact, identifies *cuneatus* beyond any doubt, and exactly conforms to the unmarked specimens of the *cuneatus* of authors found in the collection.

It is the type of the section *Latona* Schumacher, 1817. This group and *Hecuba* Schumacher, 1817, contain the only species of *Donax* showing concentric sculpture. In *D. cuneatus* the concentric sculpture dominates the radial, which, in some specimens, can be seen only with the aid of magnification.

<sup>1</sup> Plate 24 of the first volume of Donovan's work (1799) shows several views of a shell that the author called "*Donax crenulata*," but that appears to be intended to represent *denticulatus* Linné. Moreover, Donovan listed both *denticulatus* and *D. rugosus* Linné in its synonymy. He states the locality as "very common on the western coasts of England, and also on those of Ireland and Scotland." If the shell was in fact *denticulatus* of the West Indies, as it appears to be, the words "very common" are certainly an overstatement. Forbes and Hanley (1853, vol. 1, p. 340) have this to say as to the British locality: "A West Indian shell first introduced as British by Da Costa, under the name of *Cuneus truncatus*. As regards the *denticulatus* of Pennant (ed. 1, vol. 4, p. 93, pl. 53, f. 46), neither the drawing nor the language of that author sufficiently coincide with the characters of this well-known *Donax* to render its identity at all probable. Indeed the elongated form of his engraved figure (which bears more resemblance to the true *rugosus* of Linnaeus), supported by his assertion of its exceeding the length of *anatinus*, must be fatal to such an hypothesis. Several of our British authors have admitted it in their works, but, we believe, no proof of its indigenoussness has yet been furnished. Mr. Bean informs us that very many years ago he took a valve from a fishing boat at Scarborough; but as, during his many years residence on the same spot, he has never procured a second example, we think it most probable that the shell came from some foreign vessel."

Figured in Reeve (1843-1878, vol. 8, *Donax*, pl. 3, sp. 15a, b) and in Sowerby (1847-1887, vol. 3, *Donax*, pl. 282, figs. 88-90).

*Donax scripta*

1758, *Systema naturae*, ed. 10, p. 683, no. 88.

1767, *Systema naturae*, ed. 12, p. 1127, no. 109.

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

"D. testa ovata compressa laevi, scripta lineis purpureis undatis, rima acuta, marginibus crenulatis."

This species was identified by Linnaeus' successors by the aid of the excellent description alone, in spite of the fact that the specimens of the *scripta* of authors in the collection were unmarked and in spite of a partially incorrect synonymy. It was soon recognized, however, that it had features that were inconsistent with the other species in *Donax* Linné, and that it was, rather, a venerid. It was for many years placed in *Meroe* Schumacher, 1817, a genus founded upon *Venus meroe* Linné, but later, when the little-known work of Link, "Beschreibung der Naturalien-Sammlung der Universität zu Rostock" (1807), came to the attention of conchologists, it was found that Link had described the group included in Schumacher's *Meroe* under the generic name *Sunetta*, and this name, being several years earlier, is universally used today.

*Sunetta* is in the family Veneridae, subfamily Sunettinae, and its type is the present species, by subsequent designation, Dall, 1902. It differs from all other genera in Veneridae by the fact that the anterior end of the shell is the longer and by the deeply excavated pit in which the ligament is sunk. There are many forms of the species *scripta*, largely based on color pattern, and, although many of these forms have received specific names from time to time, they are all referable to the same species.

The figure which Linnaeus cited from Buonanni represented a shell said to come from Naples and which, according to Hanley (1855, p. 62), was meant for *Tapes geographica* (Catlow and Reeve, 1845). It is possible that the incorrect locality given by Linnaeus was due to a misunderstanding of this figure. It is a Pacific species.

*Sunetta scripta* is figured in Reeve (1847-1878, vol. 14, *Meroe*, pl. 2, sp. 6a, b, c) and

Sowerby (1847-1887, vol. 2, pl. 126, figs. 3-8).

*Donax muricata*

1758, *Systema naturae*, ed. 10, p. 683, no. 89.

1767, *Systema naturae*, ed. 12, p. 1128, no. 110.

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

"D. testa ovata: striis muricatis, margine denticulato. . . Testa gibba, rufescens; margo anterior denticulatus. Rima hians, terminata antice utrinque dente compresso. Anus nullus."

This was not one of the shells included in the Linnaean collection, and the description in the "Systema" mentions details which seem to differentiate the species from any of the known donaces with the possible exception of *D. scortum*. The latter shell has flutings on the concentric striae which might be termed "striis muricatis" by stretching Linnaeus' use of words, and the reference to the escutcheon of *muricata* ("Rima hians, terminata antice utrinque dente compresso") might be loosely said to cover the denticulations of the anterior end of the juvenile *scortum* (*D. pubescens*). However, if Linnaeus meant "posterior" by his expression "antice," as is usually the case, this latter comparison must be abandoned, as the spines of *scortum-pubescens* occur only anteriorly. Further, as opposed to this comparison, the latter species lacks the denticulated margins, as the description of *muricata* demands, it is not "rufescens," and its oval lunule does not conform to Linnaeus' words "anus nullus" for *muricata*.

Hanley decided (1855, p. 62) that the described sculpture was "more that of a *Cardium*, a *Lucina*, or a *Cypricardia*," and, indeed, the suggestion that it might have been a *Cardium* seems not entirely unreasonable. I know of no *Donax* that answers to the description of *muricata*.

The description of this species in the "Museum Ulricae" is more detailed but is still not sufficiently characteristic of a *Donax* to permit an identification. It is possible that the specimen on which the name was based is still in the University of Upsala and conforms to the description in both works. In default of finding and authenticating the type the name must remain a *species dubius*. The impossibility of unequivocally locating a Linnaean type in the Upsala collection is commented upon above (p. 17).

**Donax irus**

1758, *Systema naturae*, ed. 10, p. 683, no. 90.

1767, *Systema naturae*, ed. 12, p. 1128, no. 111.

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

"D. testa ovali, rugis membranaceis erectis striatis cincta. . . . Testa magnitudine Phaseoli, ovalis, alba, antice obtusissima, rugosa: rugis arcuatis, membranaceis, reflexo-erectis, striatis, fere crispis, exterioribus sensim anterioribus majoribus. Cardo utrinque dentibus duobus minimus; altero bifido."

The diagnosis of this species in the "Systema" makes its identification simple. The description is sufficiently clear and characteristic, and a marked specimen of the *irus* of most authors, in the collection, conforms strictly to its language. The locality, although too restricted, is correct, and the cited figure (Gualtieri, pl. 95, fig. A), although a crude drawing, shows most of the details mentioned in the description. There is no other specimen in the Linnaean cabinet that could be mistaken for it.

The species is a venerid, one of the two species in Linnaeus' *Donax* that the author wrongly included in that genus. It had been traditionally placed in *Venerupis* Lamarck, 1818, but the better opinion today puts it in the genus *Irus* Oken, 1815, of which it is the type by absolute tautonymy. Grant and Gale (1931, p. 332) explain the relationship of the two genera as follows: "This genus appears to be a specialized derivative of *Venerupis*, modified in characters by the burrowing habit assumed by the animal. It lives in holes burrowed Pholad fashion into soft mudstones, and like *Petricola* may take almost any shape according to the varying hardness of the surrounding material."

Oldroyd (1924-1927, vol. 1, p. 160) gives *D. irus* as the type of *Venerupis* Lamarck, but Children, in 1823, had already designated *Venus perforans* Montagu, 1803 (*V. pullastra* Montagu) as the type of that genus.

It is figured in Reeve (1843-1878, vol. 19, *Venerupis*, pl. 4, sp. 22) and in Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, atlas, pl. 67, figs. 9-12 as the typical form; figs. 13-19 as what the authors call "deformations" and varieties). The species, as said above, is subject to such variation that I should hesitate to describe or name any departures from the "typical" form.

Two color varieties, *Venerupis irus rosea* Requier, 1848, and *flava* Monterosato, 1878, were also cited by Pallary (1938, p. 54), who calls attention to the fact that specimens taken at Beirut, Syria, were "of great size and very lamellose."

**VENUS LINNÉ**

The tenth edition of the "Systema naturae" listed 36 species under *Venus*. Five new names were added in the twelfth edition (*flexuosa*, *islandica*, *tigerina* [number 141], *borealis*, and *virginea*). Owing to the fact that *Venus scortum* of the tenth edition was moved to *Donax*, while two tenth-edition species were reduced to varieties, and one unnamed variety in the earlier work was raised to full specific rank, the net number of good species in the genus, as it left the hands of Linnaeus in 1767, is 39. In addition to the "Systema" species, six more were proposed in the "Regni animalis" appendix of the "Mantissa plantarum" of 1771. The descriptions of all six are unsatisfactory, as is true of almost all of the diagnoses in this appendix. Two of them have been identified (*puerpera* and *tripla*). In the case of the other four it is impossible to state even their modern genus with any confidence.

Few of the Linnaean genera are so difficult to evaluate, and few have been so subdivided by subsequent reviewers. A number of species have even been transferred to other families, i.e., *V. deflorata* to *Asaphis* in Tellinidae, *V. fimbriata* to *Fimbria* in Fimbriidae, *V. islandica* to *Cyprina* in Pleurophoridae, and *orbicularis*, *pennsylvanica*, *punctata*, *borealis*, *edentula*, and probably both species called by Linnaeus *tigerina* to various genera in Lucinidae. All but nine have been identified, although it must be admitted that some of the determinations are not entirely convincing, and four of the nine are "Mantissa" species.

It is in the subdivision of the true venerids that the greatest difficulty has been encountered, and this has resulted in a vast and unwieldy number of supraspecific names which is the greatest obstacle to an understanding of the family. We know that Linnaeus himself felt that his genus was too comprehensive, but his plan to divide it into two groups in the proposed "revised twelfth edition" was not a rational one and was not adopted by any of his successors. A manu-

script note, under *Venus*, in his own copy ("Dividenda in margine integerrimo et crenulato") explains his intention. Many arrangements have been attempted, but the striking differences which they exhibit, in the groupings of the families, subfamilies, genera, and subgenera, and in the allocation of species to each, illustrate the confusion in the minds of the conchologists and invertebrate paleontologists who have endeavored to monograph the venerids or to outline a classification.

The family is an important group to the paleontologist. Although it is not among the oldest of the lamellibranch families, as it possibly had its origin no earlier than the Cretaceous,<sup>1</sup> many of its species have become valuable index fossils in the Cenozoic and late Mesozoic formations in which they are found, not only because of the prodigious populations but because the morphological development of the shell is so strikingly marked stratigraphically. It is therefore important that any classification of the family should be based upon fossil as well as Recent species, and, in fact, the best-known and most useful classifications have been so conceived. As already said, there is a wide divergence between the several proposed arrangements. One that will satisfy all students has not yet been suggested and possibly can never be drawn up. In any discussion such as the present, however, even though only a handful of species is involved, it is necessary to select some one arrangement and consistently follow it. I therefore, in stating the taxonomic position of each of the Linnaean species, adhere to the classification proposed by Frizzell (1936).<sup>2</sup>

<sup>1</sup> The Upper Jurassic genus *Eocallista* H. Douvillé has been tentatively assigned to the subfamily Pitarinae in Veneridae, but the proof of its position as a venerid must await further study of specimens. In Cretaceous times many genera appeared, and by the early Tertiary great differentiation had taken place. The family has reached its greatest development at the present time (after Frizzell, 1936).

<sup>2</sup> It has often been pointed out that the older arrangements, such as those of Cossmann in 1886-1887, Dall in 1902 and 1890-1903, and Jukes-Browne in 1908-1914, did not adhere strictly to the Rules of Nomenclature as now accepted and understood. While the later works of these and other writers are more acceptable from a nomenclatorial point of view, they show an even greater clash of concepts of the systematic categories. I consider Frizzell's work to be the most

In accepting this arrangement I must call attention to two points. First, it is, as it is entitled, only a preliminary classification, which Frizzell has regrettably not followed up by a later, more comprehensive work. It is incomplete in that it assigns only a few genera to each of its supraspecific groups, and it is necessary to fill in these gaps. In this I have been immeasurably and most generously helped by Dr. Myra Keen of Stanford University, to whose custody Dr. Frizzell entrusted his notes upon transferring his talents to another branch of invertebrate paleontology.

Second, I depart from his arrangement only so far as to treat his family groups not as families in the superfamily Veneracea but as subfamilies under Veneridae, *sensu lato*, and to consider his subfamilies as tribes. This seems to me a more conservative and less confusing approach, while at the same time it does not sacrifice systematic accuracy.

Before the individual species of *Venus* Linné are discussed, one comment on the entire family should be made. Among the most characteristic features of its species are the excavated areas in front of and behind the beaks, called respectively the "lunule" and the "escutcheon." It is curious how these names came to be attributed to these particular areas and unfortunate that we should continue to use them. They are not only employed in a sense almost diametrically opposed to their Latin derivation, but one of them at least ("lunule") is inappropriate to either area. I have suggested (1950b) that, rather than that their application be reversed, they should be abandoned and the words "sigilla" and "vallis" be adopted in their place.

The student of the Linnaean species of Veneridae is considerably handicapped by the brevity of many of the descriptions. The main descriptions, with the exception of the description of *Venus dione*, are usually short and often omit important characters, so that the language might cover several species. Many species are not supplied with subdescriptions, which are often the most significant part of the Linnaean diagnoses, and,

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reasonable classification, as well as being the one which conforms most closely to the Rules.

when these are present, they often refer only to the size and color of the shell.<sup>1</sup>

#### Venus dione

1758, *Systema naturae*, ed. 10, p. 684, no. 91.

1767, *Systema naturae*, ed. 12, p. 1128, no. 112.

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

Quotation of the elaborate subdescription is unnecessary. The main description, "V. testa subcordata transverse sulcata, pube spinosa," is adequate, with the rest of the diagnosis, to identify the species.

The description of this species in both the tenth and twelfth editions of the "Systema" is the most voluminous and characteristic of any of the diagnoses of mollusks, and in the

<sup>1</sup> Since the preparation of the above section on *Venus* Linné, a new classification of the family Veneridae has been published, in skeletal form, by Dr. A. Myra Keen of Stanford University (1951, pp. 1-10). This classification will be republished, at more length, in the forthcoming "Treatise on invertebrate paleontology," under the editorship of Dr. Raymond C. Moore. Although it follows Frizzell's arrangement in most particulars, so far as the systematic placing of the Linnaean species is concerned, it suggests certain changes in the arrangement and authorship of supraspecific groups and the designation of types. It should be studied, not only because it fills in the gaps left by Frizzell, but because it will undoubtedly become the standard to be used by invertebrate zoologists for many years to come.

In the case of the Linnaean venerids, Keen's departures from the Frizzell arrangement are as follows:

*Venus dione* (this page). Keen places this species in Pitar Römer, 1857, subgenus *Hysteroconcha*, as did Frizzell, but attributes the latter name to Herrmannsen, 1847, instead of to Dall, 1902. Both recognize *V. dione* Linné as subgenotype, by subsequent designation, Fischer, 1887.

*Venus marica* (p. 88 below). Frizzell placed it in the genus *Timoclea* Brown, 1827, subgenus *Leucoma* Römer, 1857. Keen (personal communication, 1951) doubted that *Leucoma* was distinct from *Timoclea*. In the new classification she now abandons the name *Leucoma*, Römer, apparently as having been invalidly proposed and substitutes for it *Nioche* Hertlein and Strong, 1948, a name covering a different group. As now arranged, *V. marica* falls in the genus *Timoclea*, subgenus *Glycydonia* Cotton, 1936, as subgenotype, by original designation.

*Venus dysera* (p. 89 below) and *Venus cancellata* (p. 93 below). Referring to my suggestion that the *V. dysera* of Linnaeus is the *V. plicata* of Gmelin and is not the same as *dysera* Chemnitz, 1782, which is the Linnaean *cancellata*, Frizzell was not sufficiently explicit to present the problem. Keen recognizes the difficulty and expresses the type of *Chione* Megerle von Mühlfeld, 1811, as "'*Venus dysera* L.' = *V. cancellata* Linnaeus (SD Gray, 1847)."

*Venus casina* (p. 93 below). Keen treats *Ventricola* Römer, 1867, as equal to *Venus* Linné, whereas Frizzell accepts it as a good subgenus of *Venus*.

entire "Regnum animale" is exceeded in length only by that of *Homo sapiens* and of *Apis mellifera*, the honeybee. It leaves no doubt but that it was intended for the strikingly sculptured, spinose shell called by the early writers the "true Venus clam," the "*Concha veneris occidentalis*" of Argenville, and the *dione* of all modern authors.<sup>2</sup> A properly marked specimen is found in the collection, and the locality is correct. The cited figures are reasonably accurate.

The species was placed by Gray, 1847, in his new genus *Dione*, which is unavailable as being a homonym of *Dione* Hübner, 1816, in

*Venus erycina* (p. 97 below). Keen places this species in Pitarinae, genus *Callista* Poli, 1791, subgenus *Costacallista* Palmer, 1927, of which it is the subgenotype, by original designation. Frizzell included it in Meretricinae, genus *Amiantis* Carpenter, 1864. There is considerable authority for holding that *Costacallista* and *Amiantis* are identical.

*Venus lupinus* (p. 112 below) and *Venus exoleta* (p. 113 below). Both classifications place both species in *Dosinia* Scopoli, 1777. Keen includes *lupinus* in subgenus *Asa* Basterot, 1825, as type by "monotypy?" The question mark is Keen's. Frizzell placed *exoleta* in the subgenus *Artemis* Poli, 1795, whereas Keen placed it in the subgenus *Pectunculus* Da Costa, 1778 (not Lamarck, 1799), which she uses as an earlier name for the same group as Poli's *Artemis*.

*Venus decussata* (p. 121 below). Frizzell placed it in the genus *Tapes* Megerle von Mühlfeld, 1811, and in the subgenus *Amygdala* Römer, 1857, as the subgenotype of the latter. Keen abandons the name *Amygdala* Römer and substitutes the later name *Ruditapes* Chiamenti, 1900, with the same type.

<sup>2</sup> The description of *V. dione* does not mention the degree of spinosity of the shell. Three other members of the genus *Hysteroconcha* are provided with spines of varying length [*H. lupanaria* (Lesson), 1830; *H. multispinosa* (Sowerby), 1855; and *H. brevispina* (Sowerby), 1855]. Inasmuch as all three species are native to the tropical and subtropical waters of the west coast of the American continent, it is highly improbable that they were known to Linnaeus. *H. dione* is, however, a tropical Western Atlantic shell, from which region he possessed many species of mollusks. No name in the "Vermes Testacea" of the "Systema" is given an American west coast "habitat," and I know of no "Systema" species whose type can be proved to have been collected there. Although Europeans had visited the region prior to 1758, these were either casual or colonizing expeditions, and in no sense scientific, as were the visits of Hasselquist to the Levant and of Peter Kalm to eastern North America. We are justified in assuming that the shell described as *V. dione* was the common *Hysteroconcha* of the West Indies, the only member of the genus found there, and that the locality must be restricted to the American east coast.

Insecta.<sup>1</sup> Fischer, 1887, revived the pre-Linnaean name *Hysteroconcha* Lang, 1722, but only by placing it in the synonymy of *Dione* Gray. In 1902 Dall used the name *Hysteroconcha* for this group, but, although he credited it to Fischer, he validly re-described it, so that the name must date from his use of it. He also selected *H. dione* as type. The species is usually so placed today, although there is still a considerable difference of opinion as to the systematic value of *Hysteroconcha*, it being used variously as a good genus or a subgenus. Some early authors included *dione* in *Meretrix* Lamarck, 1799, or in *Cytherea* Lamarck, 1818. Frizzell properly treats *Hysteroconcha* as a valid genus as of Dall, 1902, in the family Meretricidae, subfamily Pitarinae, which I prefer to use as a subfamily of Veneridae, and a tribe, respectively.

#### *Venus paphia*

1767, *Systema naturae*, ed. 12, p. 1129, no. 113.

LOCALITY: "In O. Lusitanico" (1767).

"V. testa subcordata, rugis incrassatis, pube rugis attenuatis, labris complicatis. . . . Affinis adeo Dyserae, ut multis examinatis speciminibus vix ac vix limites dentur."

Although this name appeared for the first time in the twelfth edition, it is apparent that it represents the shell that was referred to in the tenth edition as variety  $\beta$  of *Venus dysera*, the figures cited for that variety having been moved bodily to the synonymy of *paphia*, with two new figures added. All these figures fairly represent the *paphia* of modern authors. A fuller discussion of the varieties of *V. dysera* is reserved for the treatment of that species (below), but one fact should be noted here. In the description of *paphia* Linnaeus says that it is so close to *dysera* that an examination of many specimens scarcely reveals any line of demarcation. We realize that Linnaeus was not at all sure of the relationship of the members of the *dysera* complex, but it is strange that he could not separate the type species of *paphia*, which he possessed, from his typical *dysera*, or, having failed to do so, why he should have listed them both as good species in the twelfth edition.

<sup>1</sup> Gray used the name *Dione* again in 1851, for the group of species included in *Callista* Poli, 1791, with *Venus chione* Linné as type.

The description was improved by manuscript notes in Linnaeus' copy of the work ("Cren.," probably for "marginem crenulato," and "lab[ia] truncata").

The species is now included in the subfamily Chioninae, genus *Lirophora* Conrad, 1863. The type of *Lirophora*, designated by Dall in 1902, is *Venus athleta* Conrad, 1863.<sup>2</sup> I have referred to the type of *Lirophora* because of the frequent erroneous identification of *latilirata* Conrad, 1841, with *paphia* Linné. The two species are quite distinct. The coarse rugae in *latilirata* extend across the entire shell, whereas these ribs in *paphia* become pinched out and lamellar towards the posterior border, leaving an area only partly invaded by the lamellar terminations of the ribs. This difference is very noticeable and constant. Likewise *paphia* Linné appeared only in Recent times, while *latilirata* is a Tertiary species common in the Miocene and Pliocene of the Atlantic slope in southeastern United States, and still living in the western Atlantic.

There are few good figures of *Venus paphia*. The best is found in Sowerby (1847-1887, vol. 2, *Venus*, p. 720, pl. 155, fig. 61). *L. latilirata* Conrad is figured in Dall (1890-1903, pt. 5, pl. 42, fig. 3).

The locality given in the "Systema" for *V. paphia* is incorrect, as it is exclusively a tropical and subtropical Western Atlantic species.

#### *Venus marica*

1758, *Systema naturae*, ed. 10, p. 685, no. 92.

1767, *Systema naturae*, ed. 12, p. 1130, no. 114.

LOCALITY: "In O. Americae."

"V. testa subcordata decussatim striata, pube lamellosa. . . . Proxima huic est Argenv. conch. t. 24. f. B."

<sup>2</sup> Conrad's *Venus latilirata* was described in 1841 as a Miocene fossil. In 1857 Tuomey and Holmes described, as "*latilirata*," a shell which they believed to be Conrad's, citing it as of Conrad, 1841. Later, when Conrad constituted his *Lirophora* in 1863, he realized that the shell described by Tuomey and Holmes and attributed to him was a distinct species, and its name was therefore a homonym. He therefore changed it to *Lirophora athleta*.

Tuomey and Holmes, in describing their 1857 "*latilirata*," put *V. paphia* Lamarck in its synonymy. Lamarck's *paphia* (1818-1819, vol. 5, p. 608) does not seem to be the same as *paphia* Linné and was probably *V. latilirata* Conrad, 1841, as it was stated by Lamarck to be a fossil from "Wilminster [*sic*] dans la Caroline du Nord." Moreover *paphia* Linné has not been found fossil, at least on the North American continent.



This species is mentioned in the list of shells owned by Linnaeus, and while no marked specimen is found in the collection, a specimen is present which Hanley (1855, p. 64) felt was in perfect accord with the description of *marica*. He said that "no doubt can be entertained of the typical authority of that specimen. It is, as might be expected, the well-known *Venus marica* of conchological writers (Encycl. Méth. Vers, pl. 275, f. 2), who easily recognized it from its peculiar style of lamellation." The shell that bears the name *V. marica* today is an almost trigonal shell whose slightly lamellar concentric ribs are provided with crenulations arranged in radial rows, giving the shell a cancellated appearance. It can in no sense be described as decussate sculpture, and seems to bear little resemblance to the short Linnaean description.

No references were supplied in the tenth edition, and in the twelfth, except for a reference to the "Museum Ulricae," only a single illustrative figure is cited, which Linnaeus himself admitted was only an approximation, in the words, "Proxima huic es Argenv. conch. t. 24. f. B." This figure has some resemblance to *V. paphia* and may have been intended for that species. It bears no resemblance to the description of *marica*. Argenville called it "la vieille ridée." However, the *marica* of authors has been accepted as the shell Linnaeus described in the six equivocal words quoted above.

It is placed in the subfamily Chioninae and may be generically included in *Timoclea* Brown, 1827, and, tentatively, in subgenus *Leucoma* Römer, 1857, although the latter name is only doubtfully distinct from *Timoclea*. Dr. Myra Keen (personal communication) voices this doubt, but Frizzell (1936, pp. 42, 55) distinguishes the two. Frizzell cites the type of *Timoclea* as *Venus ovata* Pennant, by monotypy, as does Jukes-Browne (1914, p. 77). The latter, however, considers *Timoclea* to be indistinguishable from the typical section of *Chione* Megerle von Mühlfeld, 1811. Cotton, 1936, makes *V. marica* the type of his new genus *Glycydonta*, by original designation, and it seems reasonable to accept *Glycydonta* as a good subgenus of *Timoclea* to receive *V. marica*.

The *V. marica* of authors is figured in

Reeve (1843-1878, vol. 14, *Venus*, pl. 22, sp. 104).

It is impossible to determine on what shell Linnaeus' description of *V. marica* was based, but it seems obvious to me that it was not the specimen of the *marica* of authors which Hanley selected as the type, and I must consider the species as inadequately defined.

Gmelin (1791, p. 3268, no. 3) repeated the Linnaean description, expunged the reference to the Argenville figure, and added the following references: "List. t. 280, f. 118" [with a "?"], "Argenv. t. 2, f. C," and "Chem. 6, t. 27, f. 282-286." He gave the species an American locality ("rarissima in Oceano Americano . . ."). The Lister figure is worthless, as it fails to show any concentric sculpture. The Argenville figure cannot be located and was apparently an error of transcription. The figures from Chemnitz adequately show the *marica* of authors but the Chemnitz description, which refers to the "Systema," is no improvement on the language of Linnaeus.

Lamarck's 1818 description is a paraphrase of that of Linnaeus and Gmelin, but with little improvement. He cited the same figures, with the addition of two poor drawings from the "Tableau encyclopédique" (1797, pl. 275, figs. 2a-b) which also fail to show any concentric sculpture. The locality is partially corrected to "Timor et dans les mers d'Amerique."

Deshayes (1830-1832, vol. 3, p. 1116) first repeated Lamarck's inadequate description and then added language that may be considered as the first clear and unequivocal definition of the *marica* of all authors. I quote the passage in full:

"The exterior of the shell shows a great number of radial ribs [sillons longitudinaux rayonnans], convex and very regular; these are cut across by concentric lamellae which are short, erect, regular and slightly thickened, and whose free edge is cut into scallops, the raised portions of which lie along the line of the radial ribs [correspondent aux côtes longitudinaux]."

#### *Venus dysera*

1758, *Systema naturae*, ed. 10, p. 685, no. 93.

1767, *Systema naturae*, ed. 12, p. 1130, no. 115.

LOCALITY: "In O. Americae" (1758); "in O. Americae, Asiae" (1767).

"V. testa subcordata: sulcis transversis remotis reflexis, margine crenulato."

The *Venus dysera* of the tenth edition comprised a principal species and three varieties lettered "β," "γ," and "δ." In the twelfth edition, as already mentioned, variety "β" was raised to the rank of a good species, as *V. paphia*, leaving the typical *dysera* and varieties "γ" and "δ" with their references intact and two new references for the typical species.

By manuscript notes in his copy of the twelfth edition Linnaeus further limited the references by striking out one of the two figures for variety "γ" and the two new references for the principal species, leaving the synonymy of the complex as follows:

*V. dysera*. Argenv. Conch., pl. 24, fig. K.

*V. dysera* var. "γ" Klein. Ostr., 10, figs. 48, 49.

*V. dysera* var. "δ" Argenv. Conch., pl. 24, fig. Q.

The figure from Klein for variety "γ" is a mere copy of the other figure stricken out by Linnaeus from the synonymy of that variety and therefore may be considered as having been also repudiated by him, leaving variety "γ" without any diagnosis. The remaining figure for variety "δ" is obviously intended for the next species, *V. verrucosa*. Thus all three varieties of *dysera* can be eliminated. I am in accord with the opinion of Hanley (1855, p. 64) that Argenville's figure "K," although a crude drawing, represents the shell later called *Venus plicata* by Gmelin, and that the Linnaean name *dysera* should be restored.

If the diagnosis of *dysera* in the "Museum Ulricae," which was published between the dates of the last two editions of the "Systema," is studied before one has examined that in the twelfth edition, and before realizing that Linnaeus eliminated several of the references after the twelfth was published, the question of identities becomes unnecessarily confused. In the intermediate work Linnaeus cites eight varieties of the species. One is what I am suggesting is the typical *dysera* (*V. plicata* Gmelin). One is *V. paphia*. Another is *V. verrucosa*. One is supplied with references later expunged, and the other four, unsupported by any references and with only a few words of description relating to the character of the concentric sulcae, are either repetitions of one or another of the identified forms, or are quite unrecognizable.

The major confusion in the treatment of the *dysera* affinity by subsequent writers was caused by Chemnitz:

A. He first described and figured (1780-1795, vol. 6, p. 290, pl. 27, figs. 279-281) a shell for which he uses the name "*Concha Veneris orientalis*." He did not refer to the *dysera* of the "Systema" but does cite the *dysera* of the "Museum Ulrique," variety "ε," although with a query. This variety is described only as "sulcis acutis, ani ambitu compresso." The figures show a shell with a few widely spaced lamellar concentric ribs rising into points near the posterior edge, and with spines along the margin of the escutcheon. This I believe to be the *V. thiara* of Dillwyn, 1817.

B. He next described and figured (*tom. cit.*, p. 294, pl. 28, figs. 287-290) a shell which he lists as *Venus dysera*, and cites Linnaeus, 1758 and 1767, as well as the listing of *dysera* in the "Museum Ulricae" in his synonymy. Thus he specifically conceived it to be Linnaeus' *dysera*. The figures, however, are obvious representations of *Venus cancellata* Linné and appear to have been taken from one of Lister's figures which Linnaeus eliminated from the synonymy of *dysera* by a manuscript note, as already said (pl. 278, fig. 115). Indeed his reference to Gronovius (1781, vol. 3, pl. 1, fig. 8) is followed by the words "*Venus cancellata*." This then is the shell that has been referred to by so many writers as "*V. dysera* Chemnitz," which is a synonym of *V. cancellata* Linné.

C. He then (p. 297) uses the name *Venus dysera* a second time and refers in his synonymy to *dysera* Linné, variety "γ." His figures for this form (pl. 28, figs. 291-292) are, however, unrecognizable. It will be remembered that Linnaeus' variety "γ" of the "Systema" was the form that Linnaeus had left without any diagnosis by abandoning the originally cited references, a fact of which Chemnitz was certainly not aware.

D. When he came to the listing of *V. cancellata* (pl. 29, figs. 304-305) the figures supplied might be taken for the true *cancellata* but are not clear enough to be unequivocally identified. The significant fact is that they are not by any means so characteristic of that shell as are the drawings he gave for the shell which he called *V. dysera*, referred to in paragraph B above.

E. On page 299 Chemnitz described a "*Venus foliaceo lamellosa*," "La Grande Vielle ridée," citing Davila (vol. 1, no. 844, p. 365), who referred to it as "une conque de Venus orientale très rare." Chemnitz figured for this (pl. 28, figs. 295-297) a large shell having fairly close concentric raised ribs and a prominent carina posteriorly. These are the figures which Gmelin cited for his *Venus plicata*. Moreover, they are obviously drawn from the original Argenville figure (pl. 24, fig. K) which was the sole figure cited by Linnaeus for his typical *dysera* in both editions of the "Systema." This shell of Chemnitz is, I submit, the most likely candidate to be considered the representative of the Linnaean *dysera* (principal species) and to be the shell that became *Venus plicata* in Gmelin's thirteenth edition of the "Systema." The concordance of figures, at least, is perfect and the description adequate. One argument against this choice, and in favor of the shell which Chemnitz called "Concha Veneris orientalis" (paragraph A above) is the fact that Linnaeus' sole reference for his typical *dysera* (Argenville, fig. K) was called by Argenville by the same trinomial. This argument, however, seems of considerably less weight than that supplied by the figures themselves.

I believe that these various figures show not only that the confusion in Linnaeus' mind in regard to the *dysera* affinity was shared by his immediate successors, but that Chemnitz thought that the typical *dysera* of Linnaeus was identical with *V. cancellata*, and that he was probably led into this error by the presence among Linnaeus' references of Lister's figure 115. Although this figure was later expunged, it is hardly possible that Chemnitz was aware of its unpublished deletion.

The Linnaean *dysera* (*V. plicata* Gmelin) is now in the genus *Chione* Megerle von Mühlfeld, 1811, and Gray, in 1847, designated it as the type of that genus. It is probable that the use by many authors of *Venus cancellata* Linné (*V. dysera* Chemnitz, figs. 287-290) as the type, has been due not so much to their ignorance of Gray's designation as to their unconscious desire to use the well-known and common *cancellata* as type rather than the exotic and much rarer *dysera*. I am sure that

the early confusion between *dysera* Chemnitz and *dysera* Linné must have played a great part in this choice. On this basis, *V. cancellata* Linné cannot be the type, and we must revert to the first designation, that of Gray.

My feeling that the typical *dysera* of Linnaeus is *V. plicata* Gmelin is not, unfortunately, susceptible of proof. It is based largely on the concordance of the figures, and the issue is clouded by the confusion of the post-Linnaean authors between the *dysera* of Linnaeus and of Chemnitz. The matter is important, however, as it bears not only on the concept of the genus *Chione* but on its type. An appeal to the International Commission on Zoological Nomenclature would be preferable to a purely legal interpretation by an individual, but I feel that the Commission would be loath to identify *dysera* with *plicata*, as the latter is the type of *Circumphalus* Mörch, 1853, which is in the Venerinae and not the Chioninae. This is perhaps the greatest hurdle any solution must face. It is possible that the Commission would be willing to act on the matter if the argument should be advanced that *dysera* Linné is a *species dubius* and that therefore we should use the first type designation for *Chione* which recognized that the *dysera* of Linnaeus and Chemnitz were not identical. Gray's selection was not such a designation. The first unequivocal designation of *cancellata*, based on all the facts, was that of Dall (1890-1903, vol. 3, pt. 6, p. 1287). Dr. Myra Keen (personal communication) calls my attention to the fact that some support for this action is supplied by Megerle von Mühlfeld's synonymy in his proposal of *Chione*. He there cites for *Chione dysera*, "Lin. Gen. 309, sp. 4a; Chem 6, t. 28, figs. 287-290." The first part of this reference is to Gmelin rather than to Linnaeus. The second is to the Chemnitz figures which are clearly of *Venus cancellata* Linné. Therefore it could be argued that *V. dysera* Linné, strictly speaking, was not on the original list.<sup>1</sup>

I know that many conchologists will disagree with my identification of *V. dysera* with *V. plicata*, and I am fully aware of the diffi-

<sup>1</sup> Römer (1857, p. 16) designated *V. plicata* Gmelin as the type of *Chione*. This may be disregarded, as *plicata* was not on Megerle von Mühlfeld's original list, even though it be synonymous with *V. dysera* Linné. Römer here spelled the genus *Chiona*.

cult nomenclatural problems involved in settling the question of the type of *Chione*. I would be content to leave *V. dysera* Linné a *nomen dubium* until the International Commission can act on a more carefully prepared and ample argument than is possible in the space to be devoted to this problem here. For the present I merely state the problem and call attention to the difficulties that will be encountered in its solution.

#### *Venus verrucosa*

1758, *Systema naturae*, ed. 10, p. 685, no. 94.

1767, *Systema naturae*, ed. 12, p. 1130, no. 116.

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

"V. testa subcordata: sulcis membranaceis striatis reflexis, antice imprimis verrucosis, margine crenulato. . . Statura et maculis ad Paphiam accedit, ut forte varietas laevigata."

The description of this species is reasonably clear and characteristic, and the presence, in an authoritatively marked box in the Linnaean collection, of a specimen of the well-known *Venus verrucosa* of all authors, with which the description sufficiently agrees, makes it unnecessary to dwell upon the minor defects in the diagnosis. Linnaeus' words, "Statura et maculis ad Paphiam accedit, ut forte varietas laevigata," are not understood. The resemblance between any form of *verrucosa* and any form of *paphia* is purely superficial. The coarse rugae of *paphia* are rounded except at the posterior end, while over the disk of *verrucosa* the striae are sharp, reflexed, and more numerous. It would have been somewhat more exact to have compared *paphia* with the typical form of *casina*, the succeeding species. In the tenth edition, the words are ". . . ad praecedentem accedit . . .," the preceding species there being *dysera*, and it will be recalled that *paphia* was created out of one of the varieties of the tenth-edition *dysera*.

The only figure cited for *verrucosa* in the twelfth edition (Gualtieri, 1742, pl. 75, fig. H) is a poor drawing and hardly suggests *verrucosa*.<sup>1</sup> Hanley (1855, p. 65) doubted that it was meant for the present species, but Buc-

quoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, p. 367) accepted it as correct. I am not willing to say what it was designed to represent, and I consider it as a figure Linnaeus chose as the nearest approach to *verrucosa* that he could find at that time. Linnaeus added two other figures by a manuscript note, one of which (Petiver, 1713, pl. 93, fig. 17) was one of the references removed by him from the synonymy of the typical *V. dysera* of the twelfth edition, as mentioned under that species. The other (Lister, 1770, pl. 284, fig. 122) was new. Both figures are clearly meant for *verrucosa*, especially the excellent figure from Lister.

The locality ("in Europa australi") is correct but too restricted. The species is not only a native of the Mediterranean but ranges from Iceland and British waters to Madeira and the Canaries. Sowerby even reports it from the Cape of Good Hope, under the name *V. simulans* Sowerby, 1844. That shell, which he believed to be a variety of *verrucosa*, is quite distinct, although a close relative. Bucquoy, Dautzenberg, and Dollfus recognize and figure two varieties of *verrucosa* (*tumida* and *transversa*). *Venus subcordata* Montagu, 1803, and *V. lemani* Payraudeau, 1826, are only names given to juvenile stages of *verrucosa* according to the above authors. Rivieri states that *V. cancellata* Olivi, non Linné, is also a juvenile synonym.

The systematic position of the species is in the subfamily Venerinae, genus *Venus* Linné. It is the type of the genus, by subsequent designation, Gray, 1847. Lamarck first attempted to designate a type for *Venus*, using *V. mercenaria* as his "example" in 1799, and changing it to *verrucosa* in 1801. Although neither were valid designations under the strict interpretation of the Rules (and, in the case of the 1801 designation, under Opinion 79), many writers continued to use *mercenaria* as type until comparatively recent times. *V. verrucosa* is also the type of *Venusarius* Frierip, 1806, which equals *Venusarius* Duméril, 1806, a *nomen nudum*, and of *Clausina* Brown, 1827, an exact synonym of *Venus* Linné. Mörch (1852-1853, pt. 2, p. 25) put *verrucosa* in Klein's *Omphaloclathrum*. This is not only a pre-Linnaean name, but it contained only two species (*V. puerpera* and *V. reticulata* Linné) which are far removed

<sup>1</sup> The reference in the "Systema" reads "Gault. test. t. 75, f. 11," but this is obviously a printer's error for "f. H." There are no numbered figures in the Gualtieri folio, and figure H of the plate mentioned is the only one that resembles *verrucosa* in any way.

from *verrucosa*. Their placement is discussed in proper order.

The species is well figured by Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, atlas, pl. 57, figs. 1-8). These are excellent photographs, showing both the typical form and the two varieties mentioned above. It is also figured in Reeve (1843-1878, vol. 14, *Venus*, pl. 12, sp. 4a, b). Donovan (1799-1803, vol. 2, pl. 44, inner and outer aspects) figures the hinge very accurately.

#### *Venus casina*

1758, *Systema naturae*, ed. 10, p. 685, no. 95.

1767, *Systema naturae*, ed. 12, p. 1130, no. 117.

LOCALITY: "In O. Europaeo, frequenter etiam fossilis" (1758, 1767).

"V. testa subcordata: sulcis transversis recurvis acutis, margine postico crenulato: pone anum canaliculato."

This is the comparatively rare *Venus casina* of the Atlantic coast of Europe and the Mediterranean. No references were supplied for the species, and the description has often been criticized as insufficient to identify it. It has been said that the expression "sulcis transversis recurvis acutis" applies equally well to *V. verrucosa*. This is true if the description is read alone. If, however, it is compared with the description of *verrucosa*, which immediately precedes it in the "Systema," it is seen that the author partially distinguished the two by pointing out the tuberculate character of the striae of the latter, at least on the posterior end of the shell, and the crenulation of their edges. As against this it may be urged that the striae in *casina* also change in character posteriorly, although there the change consists of a foliation and an increase in the amount of eversion of the striae rather than the appearance of tubercles. The shell we recognize as the typical *casina* is principally distinguished from its congener by wider, generally less everted, and more widely spaced concentric sculpture, a distinction not brought out in its description, and by having the sculpture less acute, a fact quite at variance with the description. Herein lies the defect in the diagnosis.

The identification of the name *casina* was confirmed to the satisfaction of conchologists by the finding of an unlabeled fossil specimen of the shell in the collection. Linnaeus noted

the common fossil occurrence of the species in Europe ("frequenter etiam fossilis").

We are not given so clear a diagnosis of *casina* as we could wish, but as we are satisfied as to what the author meant it is best not to disturb the accepted identification because of these minor inconsistencies of language. The description is no worse than many others that have been accepted as being adequately characteristic.

*Venus casina* is placed in the subfamily Venerinae, and genus *Venus* Linné. It is a species showing considerable variation in the sharpness of the concentric sculpture, and the closeness of the striae. Both the typical form and two named varieties are well illustrated by Bucquoy, Dautzenberg and Dollfus (1882-1898, vol. 2, atlas, pl. 59, figs. 1-8). I have not seen specimens of the variety *aradasi*, named by these authors and there figured, but the crowded and sharply lamellar ridges shown in the figure suggest that the variety might well deserve a subspecific rank. It is a Mediterranean form. Aradas and Benoit (1870, p. 58) believed that it was *Cytherea cygnus* Lamarck, 1818, but the latter was so scantily described that its identity is uncertain. It seems to me highly probable that the specimen on which the description of *casina* was based was, in fact, this form *aradasi*. This would explain Linnaeus' words "sulcis transversis recurvis acutis" in the description. The form that we have come to regard as the typical one, with broad, rounded striae, was fixed by Gmelin, who referred to the Chemnitz figures of the shell (1780-1795, vol. 6, pl. 29, figs. 301-302).<sup>1</sup>

#### *Venus cancellata*

1767, *Systema naturae*, ed. 12, p. 1130, no. 118.

LOCALITY: "In Oceano Africana" (1767).

<sup>1</sup> I should call attention to an error that tends to complicate the examination of many of the pelecypod descriptions in the "Systema" and is apt to confuse the student, unless he is on his guard. It is illustrated in the descriptions of *V. verrucosa* and *V. casina*, namely, the frequent use of the word "sulcus" (a furrow) for "costa" (a ridge or rib). Thus, for *verrucosa*, "sulcis membranaceis" is used, and for *casina*, "sulcis transversis recurvis acutis." This error is particularly noticeable in the *Cardium* descriptions: for *Cardium costatum*, one of the few species in the genus which is correctly described in this respect, Linnaeus said "costis elevatis." Compare *C. ciliare* which is described as having "sulcis elevatis," and *C. fragum*—"sulcis notatis lunulis elevatis."

"V. subcordata, striis transversis membranaceis remotis, ano cordato. . . Testa cinerea, leviter striata a natibus ad marginem. Striae transversae, remotae, elevatae, membranaceae, erecto-patentes. Anus cordatus. Margo subcrenulatus. Variat striis longitudinalibus et absque his striis."

This species is unequivocally defined by its description, in spite of the erroneous locality. It is the common *Chione cancellata* of the sub-tropical and tropical western Atlantic, and it is also found in great numbers in the Pliocene of the Atlantic slope in southeastern United States. Its distinctive and delicate sculpture makes it simple to identify. Its identity is further confirmed by the presence of several specimens in a marked box in the Linnaean collection.

Only one feature of the description needs comment. The name *cancellata* was obviously chosen because of its cancellated appearance due to the combination of concentric and radial ribs. After noting this feature Linnaeus concludes with the words: "Variat striis longitudinalibus [radial ribs] et absque his striis." Linnaeus had evidently seen worn examples of the shell from which all traces of radial ribbing had disappeared.<sup>1</sup> It is curious that the sole reference given for *cancellata* (Gualtieri, pl. 88, fig. D) is a figure which shows no visible radial ribs. It may have been drawn from a worn specimen or may not have been intended for a *Chione*. This figure had, however, already been used by Linnaeus for variety "e" of *Venus dysera* in the "Museum Ulricae," although the description of this variety does not refer to the presence or absence of radial ribs.

*Venus cancellata* is now placed in the genus *Chione* Megerle von Mühlfeld, 1811, and most modern authors cite it as the type of the genus, by subsequent designation, Gray, 1847. The question of the type of *Chione* is discussed in connection with *Venus dysera* Linné (above).

Many good figures of this common species are available. Perhaps the most characteristic is found in Maxwell Smith (1941, pl. 21, fig. 5b).

[*Venus ziczac*]

1758, *Systema naturae*, ed. 10, p. 689, no. 119.

LOCALITY: "In O. Indica" (1758).

<sup>1</sup> Another possible reason for the quoted language is referred to in the treatment of *Venus ziczac*, the next species.

"V. testa lentiformi: striis stransversis membranaceis erectis. . . Testa griseo-Ziczac ad rimam et anum latius picta. Nates apice recurvae. Anus impressus, cordatus, rufus.

This name appears in the tenth edition and again in the "Museum Ulricae," but was passed over in the twelfth edition. It has been often suggested that *Venus cancellata* Linné, which appears for the first time in the latter edition, was *V. ziczac* under a new name, probably chosen by Linnaeus as being more descriptive, and this view is supported by some evidence. The descriptions reveal several points of similarity and also certain obvious inconsistencies:

*Venus ziczac*: "V. testa lentiformi: striis transversis membranaceis erectis. Testa griseo-Ziczac ad rimam et anum latius picta. Nates apice recurvae. Anus impressus, cordatus, rufus."

*Venus cancellata*: "V. subcordata, striis transversis membranaceis remotis, ano cordato. Testa cinerea, leviter striata a natibus ad marginem. Striae transversae, remotae, elevatae, membranaceae, erecto-patentes. Anus cordatus. Margo subcrenulatus. Variat striis longitudinalibus et absque his striis."

The words "striis transversis membranaceis erectis" of *ziczac* are repeated for *cancellata*, with the addition of "remotis" and with the shifting of the word "erectis" to the latter part of the description as "erecto-patentes." The lunule is "cordatus" in both cases. Beyond this, the two diagnoses show little similarity and are partly inconsistent. The concentric striae in *cancellata* are accurately and graphically described as "remotis," whereas this word is not used for *ziczac*. *V. cancellata* is said to be lightly striated from the umbones to the margin, whereas radial sculpture is not mentioned in the description of *ziczac*, a most significant omission. It is highly improbable that Linnaeus would have omitted, in the description of *ziczac*, a feature that was so patent that it undoubtedly provided the name for the twelfth edition *cancellata*. No detail of coloring is mentioned in the description of *cancellata*. This feature of *ziczac* is described in a way which does not make it certain just where the coloring occurs. *V. cancellata* has a lunule which is consistently dark colored, an escutcheon which is either wholly or partly provided with slanting

(? zigzag) brown streaks, and with a surface color pattern, not present in all specimens, of brown rays increasing in size towards the ventral margin, or, less often, tented or zigzag brown markings. It is difficult to compare the coloring of *ziczac*, as described, with what we know of *cancellata*. The failure to mention the crenulation of the margin in *ziczac* is not significant. Linnaeus often omitted to refer to this feature, where present, although he sometimes supplied it in a manuscript note. The most important difference in the two diagnoses, and the most cogent argument against the common identity of the two names, is the word "lentiformi" as applied to *ziczac*. This is so inappropriate to a shell so strikingly cordate as *cancellata* that it does not seem reasonable to suppose that Linnaeus could have used it carelessly.

The listing of *ziczac* in the "Museum Ulricae" is referred to in the synonymy of *cancellata*, and this has been used as one of the strongest reasons in favor of treating them as identical. It is difficult to explain this away. However, the description in the latter work reproduces the salient details of the tenth edition, including the word "lentiformi" and the omission of any mention of the light radial sculpture. The answer probably lies in the final words of the description of *cancellata*: "Variat striis longitudinalibus et absque his striis." Thus Linnaeus believed that there existed a form of *cancellata* without radial (longitudinal) sculpture.

While there are no species of *Chione*, *sensu strictu*, which are devoid of radial ribs, certain members of this group and of the closely related genus *Anomalocardia* Schumacher, 1817, possess concentric sculpture which is so dominant over the radial that in worn specimens the latter are often obliterated. The type of *ziczac*, which Linnaeus described both for the "Systema" and the "Museum Ulricae," may have been such a specimen.

Another answer is suggested by the description of the new fossil genus *Securella* Parker (1949, pp. 587-593), which the author separates from *Chione* Megerle von Mühlfeld, 1811. The new genus has as type *Chione securis* (Shumard), 1858, and presents a very unusual sculptural and structural feature. I quote from the generic definition (Parker, p. 587): "sculpture of evenly spaced, thin

concentric ridges arising from a layer of concentrically disposed shelly material; *this layer underlain by distinct radial ribs, not visible on surface*; this condition of exclusively concentric ribs usually modified by erosion of shell, so that the common worn and leached specimens exhibit ornamentation with varying degrees of prominence and numbers of radial and concentric ribs" (italics mine). *Securella*, so far as is known at present, is confined to the Late Tertiary of the American Pacific coast, and to Kamchatka and Sakhalin. While it is most unlikely that Linnaeus could have received a specimen from that region, I mention the peculiar ribbing of the genus merely to suggest that Linnaeus might have possessed, as the type of *ziczac*, an unworn specimen of some member of the Chionidae, from some region available to collectors in 1758, which had this feature of hidden radial ribs. Certainly his statement that some forms of *Venus cancellata* were devoid of radial sculpture cannot be entirely disregarded. It is idle to speculate on the identity or source of the specimen he examined, but he must have had some reason for his statement.

*Venus ziczac* must be left as an unidentified species.<sup>1</sup>

#### Venus gallina

1758, *Systema naturae*, ed. 10, p. 685, no. 96.

1767, *Systema naturae*, ed. 12, p. 1130, no. 119.

LOCALITY: "In M. Mediterraneo (1758); in M. Mediterraneo, Norvegico, Asiatico" (1767).

"V. testa subcordata radiata: striis transversis obtusis, cardinis dente postico minimo, margine crenulato. . . . Testa colore varians, saepe glaberrima licet striata; striae apparent crenulatae, quamvis non sint.

Linnaeus' description of this species is entirely adequate, and the early post-Linnaean writers had no difficulty in identifying it with the well-known *Venus gallina* of the Mediterranean Sea and the west coast of Europe as far north as Norway. In the tenth edition

<sup>1</sup> It might be added that the position of *ziczac* in the tenth edition, between *V. orbicularis* and *V. pectinata*, suggests, at least, that it was either a lucinid or a *Gafrarium* or something close to one of those groups. Linnaeus must have had some reason for this position. In any case it is far removed from the *dysera* group of species, to which Linnaeus conceived *V. cancellata* to belong.

the locality was restricted to the Mediterranean as the author undoubtedly supposed that the northern form of the shell was a distinct species, but in the twelfth edition he extended the range to include Norwegian waters and unfortunately added "Asiatico." We do not know from what data he derived this error and it would be idle to suggest what exotic species he had in mind. The northern European form of the species was called *Pectunculus striatulus* by Da Costa in 1778, and this name has occasionally appeared in the literature, Locard using it as late as 1892. The northern shell is, however, conspecific with *gallina* and represents merely a geographic race.

No references were supplied by Linnaeus in the earlier edition, but in the twelfth he cited "Bonan. recr. 2. t. 64, 65." These figures resemble a *Donax* and do not in the least suggest *V. gallina*. They were later stricken out in the copy of the "Systema" owned by the son of Linnaeus.<sup>1</sup> Specimens of the typical Mediterranean form of the shell are in the collection, wrapped in a paper upon which the name is written. This method of storage was often used by Linnaeus for specimens acquired by him after the publication of the last edition of the "Systema," but unless the handwriting on the paper is that of Linnaeus, as to which there is some doubt in this case, the specimens have no evidential value as types.<sup>2</sup> In the case of *gallina*, however, the clear description makes it unnecessary to resort to these specimens as proof.

*Venus gallina* is a member of the subfamily Chioninae and of the genus *Chamelea* Mörch, 1853, of which it is the type, by subsequent designation, Bucquoy, Dautzenberg, and Dollfus, 1893.

The Mediterranean form of the species is

<sup>1</sup> The Buonanni reference might have been more accurately expressed. There are no plate numbers in the work, and the "2" refers to "Classe seconda de bivalvia" in the plate volume. Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, p. 45) say that Linnaeus meant "plate 21, figs. 64-65," but that this was an error for "plate 17, fig. 45." As said above the plates are not numbered, and figure 45 does not remotely resemble *V. gallina*.

<sup>2</sup> Hanley (1855, p. 67) does not mention whether the writing is that of Linnaeus, and may not have been able to recognize it. Bucquoy, Dautzenberg, and Dollfus (*loc. cit.*) erroneously quote Hanley as saying that the name *gallina* was "in Linnaeus' handwriting."

figured by Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, atlas, pl. 56, figs. 1-2, 6-7). The northern form, which also ranges down the west coast of Europe as far as Gibraltar, is also shown (*tom. cit.*, pl. 56, figs. 3-5, 8-15).

#### *Venus petulca*

1758, *Systema naturae*, ed. 10, p. 685, no. 97.

1767, *Systema naturae*, ed. 12, p. 1131, no. 120.

LOCALITY: "In O. Europae australioris" (1758, 1767).

"V. testa subcordata subsulcata, margine crenulato, rima subovata hiante, nymphis acutis. . . Testa magnitudine Avellanae, alba fuscoque nebulosa. Anus oblongus."

This is a *species dubius*. The description, although it points out a number of important shell characters, is not referable to any one known species, and indeed its language fits, or partially fits, too many of the venerids in the collection. Its position between *V. gallina* and *V. flexuosa* suggests that it belongs in the subfamily Chioninae and may have possibly been an *Anomalocardia*. The stated size, "as large as a filbert," reveals nothing, nor does the name *petulca* ("butting like a goat"), which was certainly not used by Linnaeus with the intention of selecting a descriptive name. The locality (southern Europe) is not helpful, and no references were given.

It is noted in the tenth edition as being one of the shells owned by Linnaeus, but is not so listed in the twelfth. The significance of this omission is negligible, however, as Linnaeus continued to use the name in the later edition. Several writers have listed it among the unidentified species, and I do not know of any suggestion as to its determination.

#### *Venus flexuosa*

1767, *Systema naturae*, ed. 12, p. 1131, no. 121.

LOCALITY: "In Indiis" (1767).

"V. testa subcordata: sulcis transversis obtusis, vulvae labiis angulo elevato distinctis. . . Testa magnitudine seminis Aesculi, albida, rufo punctata. Striis transversis vix crenatis, obtusis, juxta vulvam saepe bifidis. Vulva retusa, rufa, oblique striata angulis lateralibus elevatis et gibbis. Margo vix manifeste crenulatus, juxta vulvam inflexus."

Linnaeus wrote a clear, unequivocal description of this species, which points to the



*Anomalocardia flexuosa* of modern authors. It lacks only a reference to the pronounced rostration of *A. flexuosa*, and that is undoubtedly attributable to the fact that the marked specimen found in the collection, and on which the description was probably based, is somewhat worn. The language of the diagnosis ("Margine . . . juxta vulvam inflexus") does suggest a moderate degree of posterior rostration, however, and the type specimen, which is reproduced by Hanley (1855, pl. 4, fig. 1), was a shell with this characteristic. A further example of the genus *Anomalocardia* (*A. macrodon* Lamarck, 1818), a closely related species, is also in the collection. It was originally marked for *flexuosa*, but the name is scratched through. We do not know that this was done by Linnaeus, but the specimen cannot reasonably be taken as the type of *flexuosa* as it was described from Brazil, whereas Linnaeus' correct locality ("in Indiis") is vouched for by his friend and pupil, Solander.

*Venus flexuosa* Linné is in the subfamily Chioninae, and genus *Anomalocardia* Schumacher, 1817, and is the type of the genus, by original designation. Schumacher's type was described as *A. rugosa*. It is also the type of *Cryptogramma* Mörch, 1853, by subsequent designation, Frizzell, 1936. A good figure is found in Crouch (1826, pl. 7, fig. 7).

#### *Venus erycina*

1758, *Systema naturae*, ed. 10, p. 686, no. 98.

1767, *Systema naturae*, ed. 12, p. 1131, no. 122.

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

"V. testa cordata transversim parallele sulcata, sulcis obtusissimis, vulva glabra, ano ovato. . . Simillima Chione, sed sulcis numerosis profundioribus."

The description, although clear, might be stretched to cover several non-Linnaean species. Inasmuch, however, as only one specimen in the Linnaean collection can be said to conform to the language used, that specimen (the *Cytherea erycina* of most of the early authors) may safely be taken as the type, although it is unmarked. *Venus erycina* Pennant, 1812, was a different species and was a synonym of *V. verrucosa* Linné. By a manuscript note Linnaeus added the abbreviation "int.," probably for "margine

integerrimo," thus adding some confirmation to the identification.

No references were supplied in either edition, and plate 268 from Lister (1770), added by a manuscript note, is of little value as it merely shows a shell of the general appearance of *erycina*. In spite of the fact that the European locality was vouched for by Fagraeus, who, we may assume, collected the shell, it is completely erroneous, as *erycina* is an Indo-Pacific species. This is one of the few instances of a mistaken locality in cases where Linnaeus gave the name of the collector.

There has been some difference of opinion as to the systematic position of this species. Dall (1909, p. 197) placed it in *Paradione*, a name which he proposed as a section of *Macrocallista* Meek, 1876, to replace *Chionella* Cossmann, 1886.<sup>1</sup> Palmer (1926) proposed a new name, *Costacallista*, which she treated as a subgenus of *Callista* Poli, 1791, and designated *V. erycina* Linné as subgenotype. Palmer's name, however, appears to be an exact synonym of *Amiantis* Carpenter, 1864. Under Frizzell's classification the species falls into subfamily Meretricinae, tribe Pitarini, and genus *Amiantis*.

This species presents an interesting distributional situation. It appeared first in the Middle Tertiary in Europe and persisted there as late as the Pliocene. It then disappears and comes to light again as a Recent species in the Indo-Pacific.

Figured in an excellent photograph in Nichols and Bartsch (1945, pl. 3, fig. 2). The earlier figures are less characteristic.

#### *Venus mercenaria*

1758, *Systema naturae*, ed. 10, p. 686, no. 99.

1767, *Systema naturae*, ed. 12, p. 1131, no. 123.

LOCALITY: "In Pennsylvania. . . In montibus Sveciae fossilis" (1758); "In Norvegia copiose ad ostia maris" (1767).

"V. testa cordata solida transverse substriata laevi, margine crenulato, intus violacea, ano

<sup>1</sup> Dall there said: "In my Synopsis of the Veneridae (Proc. U. S. Nat. Mus., 1902, vol. xxvi, p. 351) I adopted the name *Chionella*, Cossmann, 1886, for a section of *Macrocallista*, Meek, 1876. *Chionella*, however, had been previously used by Swainson ("Malacology," 1840, p. 335, note), and I will now substitute for it the name *Paradione*, with the type *Cytherea ovalina*, Deshayes."

ovato. . . . Testa prae reliquis crassa est et ponderosa. Limbus tantum testae interne violaceus est."

The detailed and clear account Linnaeus gave of this species has left no doubt of its identity. It is the hard-shelled clam of New England, which ranges south as far as Florida. Not only is the shape, sculpture, and heaviness of the shell pointed out, but the description mentions and accurately locates the position of the purple patch in the interior of the shell and notes that "money" was made from this portion by the Indians.<sup>1</sup> The presence of a marked specimen of *V. mercenaria* in the collection, together with an acceptable locality,<sup>2</sup> is confirmatory of this identification.

The figure from Lister (1678, p. 229, pl. 4, fig. 22)<sup>3</sup> referred to shows a fossil specimen of what was either *V. mercenaria* or a very close congener, and Linnaeus remarks that the species is found fossil in the Swedish mountains. In the manuscript notes of Linnaeus' son another Lister figure (1770, pl. 271, fig. 107) shows what is unmistakably the present species.

*Venus mercenaria* was used by Lamarck (1799) as the "example" of *Venus* Linné, and throughout the nineteenth century many writers continued to cite it as the type of the genus, relying on this fancied designation.

It is often difficult to distinguish between the *mercenaria* of Linné and *V. campechiensis* Gmelin, 1791, on the one hand, and between *mercenaria* and its form *V. mercenaria notata* Say, 1822, on the other. The ranges of these

<sup>1</sup> The passage reads: "e qua Sylvestrium Nummi paruntur."

<sup>2</sup> Pennsylvania has no coast line on the Atlantic Ocean, and if P. Kalm, the collector to whom Linnaeus refers, meant the State of Pennsylvania proper, the specimen must have been collected in the tidal waters of the Delaware River. However, the territory of the present State of Delaware, which has a considerable Atlantic coast line, was united with Pennsylvania in early Colonial days, and, though it had a partially independent status from 1702, had a governor in common with Pennsylvania until the American Revolution. It would, therefore, have been natural for the collector to have called the whole coast of Delaware by the name "Pennsylvania." There is considerable reason to amend the type locality to "Delaware."

<sup>3</sup> Linnaeus was guilty of an error of transcription in citing this figure. He stated it as "229, t. 4. f. 22," whereas plate 4 bears the legend "p. 107" at the top. Page 229 is not a plate page.

shells largely overlap, and the gamut of the intermediate forms between the typical *mercenaria* and *notata* is so extensive that it is impossible to find any point of discontinuity which would justify subspecific rank. *Venus campechiensis* has its own "varieties," known under many names, which differ only in the presence, position, and extent of the colored rays or other markings on the surface of the shell. In the case of both of these species the colored forms have no ecological or geographical bases of distinction but occur as individuals with the typical forms. Clench (1928, pp. 120-124) suggests that *V. mercenaria notata* is merely a recessive form. Palmer (1926, pp. 184-191) discusses the two species and their forms very fully, but inclines to the view that subspecific rank should be given to many of them.

*Venus mercenaria* was removed from *Venus* Linné by Schumacher in 1817, and made the type of his new genus *Mercenaria*, by absolute tautonymy, under the name of *M. violacea*, but the Linnaean specific name has properly been restored. Its systematic position, under my amended classification after Frizzell, is in subfamily Chioninae, genus *Mercenaria* Schumacher, 1817. *Crassivenus* Perkins, 1869, is an exact synonym of *Mercenaria*, having the same type, by original designation.

The species is figured in Reeve (1843-1878, vol. 14, *Venus*, pl. 2, sp. 40a, b) and in Maxwell Smith (1941, pl. 21, fig. 6). The form *notata* is illustrated by De Kay (1843-1844, p. 218) and by Gould (1870, p. 135, fig. 52).

#### *Venus islandica*

1767, *Systema naturae*, ed. 12, p. 1131, no. 124. LOCALITY: "In Islandia" (1767).

"*V. testa cordata transversim striata rudi, nymphis hiantibus, ano nullo. . . . Similes V. mercenariae, sed vix ovo gallinaceo major, colore alba.*"

This species resembles *V. mercenaria* superficially, and Linnaeus compared it to that species but commented that it was "only as large as a hen's egg." It is not, however, a venerid, but belongs in the family Pleurophoridae. It is readily distinguishable from *V. mercenaria* by its dark brown epidermis, the absence of the purple spot inside, and the absence of a lunule, which is replaced by a

small pit. A marked specimen of the shell now known as *Cyprina islandica* is in the collection and agrees entirely with the reasonably characteristic description. It is a common shell of our northern Atlantic waters and is also found in British waters and Scandinavia. Linnaeus attributed the preceding species, *V. mercenaria*, not only to America but, erroneously, to Norway. It is probable that the supposed Norwegian *mercenaria* was the present species. Hanley (1855, p. 69) remarks that *islandica* was not constituted when the Norwegian locality was given to *mercenaria*, but in this he was in error, as the words "In Norvegia copiose ad ostia maris" were not added to the diagnosis of *mercenaria* until the twelfth edition, contemporaneously with the erection of *islandica*. The specimen of *islandica* on which the description was based was probably not the one that is found today in the collection. The type specimen must have been one that had entirely lost its epidermis, which would account for the words "colore alba."

No references were supplied for the species in the "Systema," although a good figure from Pennant (1812, pl. 53, fig. 47) was added by a manuscript note.

As said above, *islandica* has been taken out of Veneridae and placed in *Cyprina* Lamarck, 1818, which is usually considered a genus in Pleurophoridae. Lamarck called it *Cyprina vulgaris*.<sup>1</sup> It is the type of the genus, by subsequent designation, Anton, 1839.

*Venus islandica* Linné is figured in Sowerby (1847-1887, vol. 2, *Cyprina*, pl. 168, figs. 1-3) and in Maxwell Smith (1941, pl. 13, fig. 9). A good figure of the inside of the right valve, showing the characteristic hinge, is given in Thiele (1931, 1935, vol. 2, p. 856).

#### Venus chione

1758, Systema naturae, ed. 10, p. 686, no. 100.

1767, Systema naturae, ed. 12, p. 1131, no. 125.

<sup>1</sup> Linnaeus' *islandica* is not *Venus islandica* Fabricius, 1780, a cardiid having the same American range as *islandica* Linné. Fabricius' name, being a homonym, has given way to the later *Cardium groenlandicum* Bruguière, 1789, and that species is now placed in the genus *Serripes* Gould (Beck MS), 1841, as the type of the genus, by monotypy. *S. groenlandicum* (Bruguière), as *Aphrodite columba* Lea, 1834, is also monotypic for Lea's genus, non Hübner, 1816, in Insecta.

LOCALITY: "O. Asiatico, forte etiam in Europaeo" (1758, 1767).

"V. testa cordata transverse subrugosa laevi, cardinis dente posteriore lanceolato. . . . Testa magnitudine fere ovi gallinacei, alba aut subferruginea; margo integerrimus est."

The concordance of the description of this species with the marked specimen of *Callista chione* found in the collection fixes the identification. The locality, strictly speaking, is erroneous, as the shell has never been reported from the Indo-Pacific region, but is fairly common in the Mediterranean Sea. Of the references cited, only those from Gualtieri and Regenfuss correctly show *V. chione*, the others being only approximations. The Lister figure, listed in the tenth edition with a question mark, is omitted in the twelfth.

The systematic position of *chione* is in the subfamily Meretricinae, tribe Pitarini, and genus *Callista* Poli, 1791. It is the type of that genus by subsequent designation, Meek, 1876. I have already referred to the doubts cast on the validity of Poli's genus as it is constituted in the first volume of his "Testacea utriusque Siciliae" (1791-1795). Thus Palmer (1926, p. 71) cites it as "(Poli 1791) Mörch 1853," saying that it "cannot be used in a rigid interpretation of Zoological rules" but does not explain just how its publication violates these rules, even technically. An examination of Poli's constitution of the name does not reveal any infraction. The most recent commentators upon the subject<sup>2</sup> accept *Callista* Poli as validly proposed.

Poli, as was his frequent practice, gave a different name to the animal of the species from that which he gave to the shell. In this case he called the shell *Venus chione* and the animal *V. coccinea*. In Gray's use of *Callista*, after the Leach manuscript, he used only the name *coccinea* and does not mention the name *chione*. It is to be assumed that he was referring to the shell as well.

Figured by Reeve (1843-1878, vol. 4, *Dione*, pl. 4, sp. 13) and in Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, atlas, pl. 52, figs. 1-2, 7, 8-10). A good figure of the hinge is shown by Donovan (1799-1803, vol. 1, pl. 17).

<sup>2</sup> See Grant and Gale (1931, p. 343) and Frizzell (1936, p. 25). Keen (1950, personal communication) accepts the validity of the name.

*Venus maculata*

1758, *Systema naturae*, ed. 10, p. 686, no. 101.

1767, *Systema naturae*, ed. 12, p. 1132, no. 126.

LOCALITY: "In O. Americano" (1758); in O. Americano, Africano" (1767).

"V. testa cordata laevi: maculis exoletis sparsis. . . Variat magis minusque oblonga."

The specimen of the shell now known as *Macrocallista maculata* which is in the Linnaean collection is the only one present which agrees with the very brief description. The perfect concordance between the description, the cited figures, and the type specimen insures the identification beyond any doubt, even though the specimen is unmarked. It is admitted, however, that it would have been difficult to make the determination from the description alone.

The species is a native of a very wide range of the tropical and subtropical waters of the western Atlantic, being found from Cape Hatteras to Brazil. Clench (1942, p. 7) selected Cayo Francés, Caibarien, Cuba, as the type locality. We may only guess what influenced Linnaeus to add "Oceano Africano" to the locality in the twelfth edition.

The species belongs in subfamily Meretricinae, tribe Pitarini, and genus *Macrocallista* Meek, 1876. This genus was originally established as a subgenus of *Callista* Poli, 1791, with the type *M. nimbose* 'Solander' Humphrey, 1786 (*Venus gigantea* Gmelin, 1791).

Figured by Clench (1942, p. 7, pl. 5).

*Venus meretrix*

1758, *Systema naturae*, ed. 10, p. 686, no. 102.

1767, *Systema naturae*, ed. 12, p. 1132, no. 127.

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

"V. testa cordata glabra, vulva fusca gibba, nymphis hiantibus."

The identification of this name with the *Meretrix meretrix* of all authors is probably too well established to question, yet there is some evidence that it stands for a composite species.

Chemnitz, in addition to citing and figuring *V. meretrix* as a good species (1780-1795, vol. 6, p. 350, pl. 33, figs. 347-348) and attributing it to Linnaeus, 1758, listed a further shell which he called "Varietas conchae Veneris quae Meretrix seu impudica vocatur" (*tom. cit.*, p. 352, pl. 33,

figs. 349-352). The references cited for this variety are not the same as those he cited for *meretrix*. The six figures mentioned show obvious differences, and two of them (figs. 350, 351) probably represent the shells called *Cytherea impudica* and *castanea* Lamarck, 1818.

Lamarck (1818-1819, vol. 5, p. 562), in his treatment of *V. meretrix*, says, however: "This *cytherea*, as well as the three preceding [*impudica*, *castanea*, and *zonalis*] are included under the name of *venus meretrix* by authors. This species also seems to me to justify being separated. I do not know of any figure of it."

Sowerby (1847-1887, vol. 2, p. 619, *Cytherea*, sp. 24) suggested that the color variation, which Lamarck used to separate *meretrix* Linné and *petechialis* Lamarck, 1818, was an untenable distinction, and was "almost persuaded" that *meretrix* and eight other species which he listed (*tom. cit.*, pp. 619-621) might well be included under the name *meretrix*.

Hanley, on the other hand (1855, p. 70), called attention to the questionable evidence presented by the sole figure cited by Linnaeus (Argenville, pl. 24, fig. F). In the 1742 and 1757 editions of Argenville's work<sup>1</sup> that figure seemed to be "a foreshortened view of the *Cytherea lusoria* of Chemnitz and Lamarck." In the Favanne edition of Argenville (1780) this figure, said Hanley, was amended to look like *C. zonaria* Lamarck, and to be "not unlike the *meretrix* of Chemnitz (*impudica* Lam.)." All these names were included by Sowerby in the list of eight names, above mentioned, which he felt should be included in *meretrix* Linné.

I refer to the views of some of the earlier writers in some detail, in order to illustrate the confusion that has grown up as to the identity of the typical *meretrix*. If we agree with Hanley's views, then *meretrix* is a composite species. The Argenville figure in its original form was certainly intended for one of them. If we agree with Lamarck and Sowerby, then *meretrix* is merely a species that is

<sup>1</sup> Loven (1887, p. 34) states that the 1742 edition of Argenville's work was the one always cited by Linnaeus, and that he "never knew the second of 1757." Loven does not cite any authority for this statement, but it may be presumed that he was in possession of a complete list of Linnaeus' library.

very variable as to color and shape. The diagnosis in the "Systema" not only contains no reference to the color of the shell, but is much too brief, standing alone, to provide an identification. Linnaeus did not possess the shell, and it is therefore impossible to say on what type specimen the description is based, or even whether he had ever seen a specimen or not. Our acceptance of the universally accepted identification of the Linnaean name with the typical form of the *meretrix* of authors must be based solely on tradition and convenience. My strong impression is that the *meretrix* of Chemnitz (the *C. impudica* of Lamarck) is the Linnaean species, and that Sowerby was correct in considering that the several names mentioned above should be given, at best, only varietal significance.

*Venus meretrix* is in the subfamily Meretricinae, tribe Meretricini, and falls in the genus *Meretrix* Lamarck, 1799, of which it is the type, by absolute tautonymy.

Figured in Reeve (1843-1878, vol. 14, *Cytherea*, pl. 3, sp. 10). The several varieties referred to by Sowerby are shown under their respective names (*tom. cit.*, pls. 128-129). None of these latter figures is particularly good, but they are the best available.

#### *Venus laeta*

1758, *Systema naturae*, ed. 10, p. 686, no. 104.

1767, *Systema naturae*, ed. 12, p. 1132, no. 128.

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

"V. testa subcordata tumida glaberrima albo radiata, labiis subviolaceis. . . Testa flavescens, nitidissima, radiis aliquot latis albis depicta. Labia obscuriora. Anus ovatus."

The Linnaean collection contains a specimen marked for *Venus laeta* which conforms closely to the description. Hanley reproduced both the outer and inner aspects of this specimen in two good figures (1855, pl. 1, figs. 2-3), but admitted that he was unfamiliar with the shell and that he could not locate a second specimen "even in the magnificent collection of Mr. Cuming." He also, rather unnecessarily, furnished a much expanded description of the Linnaean specimen as "*C. laeta* Lin. (haud auctorum)." The sole reference supplied by Linnaeus (Gualtieri, pl. 88, fig. V) is merely an approximation to the species.

Sowerby (1847-1887, vol. 2, p. 636) cites

*laeta* as of Linnaeus and adds: "Mr. Cuming's specimens are from Albay, Island of Luzon, Philippines." Sowerby's figures are characteristic (*tom. cit.*, pl. 133, figs. 123-124), and are remarkably like the shell figured by Hanley. The conflicting statements of Hanley and Sowerby, as to the presence of this species in the Cuming collection, cannot be reconciled.

Sowerby, in his comments on *Cytherea laeta* Linné, refers to *C. prora* Conrad as a synonym. This species was described by Conrad (1837?, vol. 7, p. 253) in a paper covering new marine shells from "Upper California," although, in addition to the West Coast species, a number of exotic and western Atlantic species were included. *C. prora* is described as from "the Indo-Pacific, probably towards the coast of New Holland." The description of the shell shows that it is very closely related to *laeta* Linné as described by Sowerby and Hanley (the latter description, as said above, being based upon the actual Linnaean specimen). The distinguishing mark of *prora*, however, is the conspicuous angle on the anterior margin which is absent in *laeta*. *Cytherea obliquata* Hanley, 1844, is a later name for Conrad's *prora*.

Sowerby also puts *Venus affinis* Gmelin, with a query, in the synonymy of *Cytherea laeta* (Linné), but I am inclined to the view that they are distinct. Gmelin's conception of this complex is not clear. He listed both *laeta* Linné and his own *affinis* as good species. The *laeta* of Gmelin is demonstrably the *laeta* of the twelfth edition, as the description is almost identical and the reference to the Gualtieri figure cited by Linnaeus is repeated, with the addition of two new figures from Knorr. Gmelin's description of *affinis* reads as if he were describing a different species, but although he refers to a different figure from Gualtieri, he adds one of the Knorr figures, which he had already cited for *laeta*. The diagnosis concludes with the words "laetae affinis testa radiis, maculis. . . ." A study of the two descriptions and of the various figures convinces me that the two shells were distinct although very close species, although I cannot hazard a guess as to what *affinis* really is. Reeve, in listing *laeta* Linné (as *Dione laeta*), adopts the view that the two names were synonymous.

Lamarck in 1818 described a *Cytherea*

*laeta*,<sup>1</sup> which I believe to be *laeta* of Linnaeus, and also named a *Venus florida*, which has occasionally been identified with *laeta* Linné. His *florida*, however was *V. laeta* Poli, 1795, not Linné, a *Tapes*.<sup>2</sup>

Frizzell does not mention this species. I am placing it in the subfamily Dosiniinae, tribe Dosiniini, and genus *Dosinia* Scopoli, 1777.

In addition to the figures mentioned above, Reeve's figure is clear and characteristic (1843-1878, vol. 14, *Dione*, pl. 9, sp. 35a-b).

#### *Venus castrensis*

1758, *Systema naturae*, ed. 10, p. 687, no. 105.

1767, *Systema naturae*, ed. 12, p. 1132, no. 129.

LOCALITY: "In O. utriusque Indiae" (1758, 1767).

"V. triangulo-rotundata gibba glaberrima characteribus angularis inscripta."

The complete agreement of the marked specimen of *Lioconcha castrensis* found in the collection with the language of the brief but unmistakably worded description leaves no doubt as to the shell Linnaeus here described. When certain errors of transcription in the synonymy are corrected, consisting of references to the wrong volume or wrong plate, the figures, with one exception, are accurate representations of the shell. The figure from Regenfuss (1758, pl. 1, fig. 4) must be disregarded as incorrect. Linnaeus' locality is correct, although, considered as an expression of the range of the species, it is too narrow, as *castrensis* is found as far north as the Philippines and as far south as Australia.<sup>3</sup> Under Frizzell's arrangement *castrensis* belongs in the subfamily Meretricinae, tribe Pitarini, and is the type of the genus *Lioconcha* Mörch, 1853, by subsequent designation, Stoliczka, 1870.

<sup>1</sup> Frizzell (1936) thought Lamarck's shell to have been something different from the *laeta* of Linnaeus, but did not give any reasons.

<sup>2</sup> Poli's work also contains a *Venus florida*. This is also a *Tapes* and is probably identical with *Tapes decussata* Linné (see below).

Lamarck, in addition to his *Venus florida*, listed a *Cythera florida*. This is a quite distinct species, which should belong in the genus *Amiantis* Carpenter, 1864.

<sup>3</sup> Linnaeus' locality, "O. utriusque Indiae" (both Indies), probably refers to what was known to the early geographers as "Hither India," the Indian Peninsula projecting into the Indian Ocean, and "Farther India," the eastern, or Malay, Peninsula and the nearby islands of the East Indies.

Figured in Reeve (1843-1878, vol. 14, *Circe*, pl. 7, sp. 28) and in Sowerby (1847-1887, vol. 2, *Cytherea*, p. 642, pl. 134, figs. 151-154).

#### *Venus phryne*

1758, *Systema naturae*, ed. 10, p. 687, no. 106.

1767, *Systema naturae*, ed. 12, p. 1132, no. 130.

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

"V. testa subcordata laevi antice posticeque transverse striata, ano obcordato venis violaceis."

This name does not appear on the list of species owned by Linnaeus. In the tenth edition no references were given except the letters "M.L.U.," indicating that the author intended to describe it in his projected catalogue of the "Museum Ulricae." The latter work, however, does not contain the name and moreover lists no venerid which can be compared to the language of the description in the tenth edition. In the twelfth edition *phryne* appears again, with the original description and locality, and with no reference to the "Museum Ulricae." It seems apparent that the author was at first under the erroneous impression that the Swedish museum contained the shell. The description itself is not enlightening, and *phryne* is generally conceded to be an undetermined species. Its position between *castrensis* and *meroe* suggests, at least, that it was closely allied to one or both of them, with the angular markings of both, or with the faint sculpture apparent at the two ends of the shell in *castrensis*. This latter feature is, indeed, mentioned in the description of *phryne*. Solander referred the species to *Venus flexuosa*, but it is difficult to read into the description any resemblance to the generic characters of *Anomalocardia*. It must be left as a *species dubius*.

Lamarck (1818-1819, vol. 5, p. 571) describes a *Cytherea trimaculata*, which is characterized in the synonymy as "An *Venus phryne*? Gmel. no. 21." Gmelin's *phryne* is obviously the same species described by Linnaeus under that name. The slight changes in the description are merely grammatical improvements, except that the word "subcordata" is omitted, and no substitute word covering the shape of the shell is supplied. Lamarck's description is quoted here, in conjunction with that of Linnaeus:

Linnaeus: "V. testa subcordata laevi antice

posticeque transverse striata, ano obcordato venis violaceis."

Lamarck: "Testa oblique cordata, superne transversim sulcata; castanea; natibus laevibus anoque violaceis; intus alba, trimaculata."

A comparison of these two descriptions shows a similarity only in the color of the lunule and in the general shape of the shell. These are hardly significant, as they are common venerid characteristics. On the other hand the language covering the sculpture is conflicting in the two diagnoses, and Linnaeus does not mention the maculation of the interior, which was so important that it was responsible for Lamarck's specific name. Lamarck was wise to add a query to the identification of his shell with *phryne* Linné, and I am not willing to accept it even as a possible determination.

Reeve publishes a very clear figure of *trimaculata* Lamarck (1843-1878, vol. 14, *Circe*, pl. 8, sp. 33). It is an obliquely cordate shell, with several alternating brown and white streaks, darker towards the posterior end, and with sculpture which seems to cover the whole shell. His description, like Lamarck's, does not conform to that of Linnaeus' *phryne*, which must be dropped as undefined.

#### Venus meroe

1758, *Systema naturae*, ed. 10, p. 687, no. 107.

1767, *Systema naturae*, ed. 12, p. 1132, no. 131.

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

"V. testa ovata compressa transverse striata, sutura postica hiante. . . . Testa alba venis leucophaeis. Nates remotae. Sutura hians pone anum oblongum, obsoletum. Vulva excisa. Affinis plurimum Donaci scriptae."

A specimen of the shell that still bears this specific name is marked for *meroe* in the collection. The tenth edition description is a fairly satisfactory definition of *meroe*, except for the word "subrotundata." The shell is more produced anteriorly and less gibbous than this language would suggest. In the twelfth edition the objectionable word is replaced by "ovata compressa," and the identification with the species we know as *meroe* is further confirmed by a reference to its relationship with *Donax scripta* Linné ("Affinis plurimum Donaci scriptae").

The species has had a rather troubled his-

tory from the point of view of nomenclature. It remained in *Venus* in Gmelin's thirteenth edition. In the 1797 plates of the "Tableau encyclopédique," it was moved to *Donax*, undoubtedly because of its affinity with *Donax scripta* Linné. Megerle von Mühlfeld put it in his related donacid genus *Cuneus*, 1811. Lamarck, in 1818, also cited it as *Donax meroe*. It was properly returned to Veneridae by Schumacher in 1817 and included in his new genus *Meroe* as the type of that genus, by original designation, but with a change of the specific name to *picta*, possibly to cover a fancied objection to a tautonymic name, and it was known as *Meroe picta* for many years. However, with the rediscovery of Link's 1807 catalogue of the natural history collections of the University of Rostock, or, rather, the recognition of the work as being validly published, it was found that Link's venerid genus *Sunetta* had 10 years' priority over *Meroe* Schumacher. *Sunetta* is now universally used.

*Venus meroe* is in the subfamily Sunettinae, genus *Sunetta* Link,<sup>1</sup> of which the type is *Donax scripta* Linné, by subsequent designation, Dall, 1902.

Figured in Reeve (1843-1878, vol. 14, *Meroe*, pl. 2, sp. 5a-c) and in Sowerby (1847-1887, vol. 2, *Meroe*, p. 609, pl. 126, figs. 1-2). Both these authors cite it as *Meroe picta* Schumacher. A very good figure is to be found in Crouch (1826, pl. 7, fig. 5, as *Cytherea meroe*). Crouch's excellent figures are not sufficiently known and used.

#### Venus deflorata

1758, *Systema naturae*, ed. 10, p. 687, no. 108.

1767, *Systema naturae*, ed. 12, p. 1133, no. 132.

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

"V. testa ovali longitudinaliter rugosa antice violacea nymphis atris. . . . Testa latitudine ovi, a cardine ad peripheriam rugosa, albida. Latus anterior, praesertim interne, violaceum."

A specimen of the shell now known as *Asaphis deflorata* (Linné) is marked for this name in the Linnaean collection. The locality is incorrect, as was the case with so many

<sup>1</sup> The genus *Sunetta* is distinguished from all other genera in the Veneridae by the fact that in the great majority of species the anterior end of the shell is more produced than the posterior. In the few cases where this is not so, the two extremities are equidistant from the umbones.

of Linnaeus' western Atlantic shells. However, the concordance between the specimen in the collection and the characteristic description proves the identification beyond any doubt, in spite of the error in locality and the absence of any pictorial synonymy. For many years the species was included in the genus *Sanguinolaria* Lamarck, 1818, but *Asaphis* Modeer, 1793, was validly proposed and has priority.<sup>1</sup>

This common West Indian species has long been reported, under the same name, from both the Indian Ocean and from the western Pacific. This writer has not been able to examine any specimens from these regions. It has been collected by Oostingh (1929) from Halmahera and by Abbott (1950, p. 97) from the Cocos-Keeling Islands, and both of these writers agree that the Indo-Pacific and West Indian shells are the same species. Abbott suggests (*loc. cit.*) that, if and when any specific difference can be proved, the name *deflorata* Linné be reserved for the West Indian shell and that the exotic form take the next available name, which would be *Venus violascens* Forskäl, 1775.

The genus *Asaphis* is in the Tellinidae. That genus was founded upon this species alone which is therefore its type, by monotypy. *Asaphis* has a long list of synonyms, including *Capsa* (sp.) Bruguière, 1792, not 1797; *Capsa* Lamarck, 1801, not 1799 nor 1818; *Corbula* Röding, 1798, not Bruguière, 1792; *Capsula* Schumacher, 1817; *Psammocola* (*partim*) Blainville, 1824; *Sanguinolaria* Lamarck, 1818, not 1799; *Pleiorytis* Conrad, 1862; and (*fide* Dall, 1890-1903) probably *Heteroglypta* von Martens, 1880.

An unfortunate type designation by Schmidt, 1818, makes *V. deflorata* Linné the type of *Capsa* Lamarck, 1799, a generic name that is a synonym of *Apolymetis* Salisbury, 1929. *Apolymetis* and *Asaphis* are radically different, yet by this designation they become synonymous. (See Stewart, 1930, p. 285, and Grant and Gale, 1931, p. 363).

<sup>1</sup> Thiele (1931, 1935, vol. 2, p. 908) uses *Asaphis* Modeer and *Sanguinolaria* Lamarck as covering different groups of species, making *A. deflorata* Linné the type of the former and *S. sanguinolenta* Gmelin, 1791, the type of the latter.

The present species is figured by Reeve (1843-1878, vol. 10, *Capsa*, pl. 1, sp. 1a-f).

#### *Venus fimbriata*

1758, *Systema naturae*, ed. 10, p. 687, no. 109.

1767, *Systema naturae*, ed. 12, p. 1133, no. 133.

LOCALITY: "In O. Indico (1758); "in O. Indiae orientalis" (1767).

"V. testa ovali gibba longitudinaliter striata, transverse sulcata, margine crenulato."

It is fortunate that the Linnaean collection contained an authoritatively marked specimen of the shell on which the description of *Venus fimbriata* was based, and that this specimen conforms to such of the shell characters as were included in the extremely generalized description. Otherwise the species could not have been identified with any certainty. The description omits any reference to the characteristic development of the concentric sculpture at the two ends of the shell and to the numerous fine riblets between the radial ribs which give the shell its peculiar pitted appearance. In order to utilize the five references supplied by Linnaeus it is necessary to correct errors of transcription in four of them. The figures "C" and "G" of Gualtieri and Argenville, respectively, after having been correctly given in the tenth edition, are transposed in the twelfth. Linnaeus' almost invariable error in citing plate 43 of Rumphius for plate 42 is again committed, and Lister's figure 142 (1685-1692) is found on plate 335 and not on 336 as stated. Even with these corrections we find that both the Klein and the Lister figures belong to the succeeding species, *Venus reticulata*. This synonymy should serve as a deterrent to those workers who are prone to pin too much faith on Linnaeus' references. As corrected, three of the figures cited were probably meant for *fimbriata*, but this necessity of correcting the author's mistakes by searching the pre-Linnaean iconographies for drawings which he may have intended to select considerably weakens the value of many of his synonymies.

The species has been almost universally placed in *Corbis* Cuvier, 1817. The earlier name *Fimbria* Megerle von Mühlfeld, 1811, is an exact synonym of *Corbis*, but has always been rejected as being a homonym,



as Bohadsch in 1761 used it for a nudibranch. However, as Nicol (1950a, p. 82) has recently pointed out, Opinion 185 excluded Bohadsch's work from use under a suspension of the Rules, thus legalizing the priority of *Fimbria* Megerle von Mühlfeld. The present species must therefore be cited as *Fimbria fimbriata* (Linné), 1758. It is unfortunate that the long-established name *Corbis* should be abandoned in favor of the little-known *Fimbria*. Nicol correctly argues, however, that it would be unwise to ask for a suspension of the Rules in order to retain the use of *Corbis*. It was another suspension which legalized *Fimbria*, and repeated suspensions rather tend to vitiate the authority of the Rules than to stabilize them, as some nomenclaturists have contended. Nicol also erects the new family Fimbridae to replace Corbidae. It is a very small family whose only genus, *Fimbria*, contains but two living species, *fimbriata* and the comparatively rare *F. soverbii* Reeve, 1842, although the family was represented by a considerable number of species in Jurassic and Cretaceous times.

Figured in Crouch (1826, pl. 6, fig. 2, as *Corbis fimbriata*). It is difficult to find a good figure of this species.

#### *Venus reticulata*

1758, *Systema naturae*, ed. 10, p. 687, no. 110.

1767, *Systema naturae*, ed. 12, p. 1133, no. 134.

LOCALITY: "In O. Indico" (1758); "in O. Africano" (1767).

"V. testa subcordata: striis elevatis decussatis, ano cordato, margine integro."

This species is identifiable as the common Indo-Pacific shell which is now generally placed in *Periglypta* Jukes-Browne, 1914, of which the type is the closely related *P. puerpera* Linné, by original designation. It does not appear on the list of species owned by Linnaeus, and no specimen is found in the collection. The author's confusion as to its origin is shown by the two versions of its stated locality.<sup>1</sup>

<sup>1</sup> Based only on the locality as stated there need be no confusion, as "O. Africano" could mean the western part of the Indian Ocean. However, Linnaeus cited a figure from Adanson's "Sénégal" (1757, pl. 16, fig. 3) in the twelfth-edition synonymy. Even though this figure does not represent *reticulata*, its use shows that Linnaeus conceived of the species as occurring in the eastern Atlantic.

It is unidentifiable from the description, which is the same in both editions of the "Systema," as the language might refer to any one of several species with decussate or cancellate sculpture. The references are of no value. Both figures cited in the tenth edition are incorrect. One of them was omitted in the twelfth edition and the other stricken out by a manuscript note in Linnaeus' copy of the twelfth edition. Four further figures were given in the later edition, but none of them can fairly be referred to *reticulata*, as they show an orbicular rather than a subcordate shell. In this situation the species would have been considered a *species dubius* as of either 1758 or 1767. Fortunately the diagnosis in the "Museum Ulricae" is clear and unequivocal, as it not only describes the sculpture in unmistakable language but refers to the characteristic orange-colored teeth of the shell.

It is an Indo-Pacific shell with a very wide range, from the Red Sea and Madagascar to the Philippines. It was for a long time reported as being common in the Hawaiian Islands, but Dall, Bartsch, and Rehder (1938, p. 162-164) have demonstrated that the Hawaiian shell is specifically distinct and have given it the name *Periglypta edmondsoni*.

Relying on Frizzell's notes I am not using *Periglypta* Jukes-Browne for the reception of this species. He places both *reticulata* and its congener *puerpera* in the subfamily Venerinae and genus *Dosina* Gray, 1835 (a group not to be confused with *Dosinia* Scopoli, 1777). Most modern authors now use *Periglypta*, but I am inclined to agree with Frizzell that it is doubtfully distinct from *Dosina*. Earlier writers consistently used *Antigona* Schumacher, 1817, for the *puerpera* group of species, some of whom subdivided that genus and used *Dosina* as a subgenus. Thiele (1931, 1935, vol. 2, p. 889) goes much farther and makes *Dosina* Gray an exact synonym of *Venus* Linné, with *Antigona* and *Periglypta* among a long list of subgenera.

*Venus reticulata* is figured in Reeve (1843-1878, vol. 14, *Venus*, pl. 10, sp. 34) and in Sowerby (1847-1887, vol. 2, *Venus*, pl. 153, figs. 11-13). None of these figures gives a particularly graphic idea of the sculpture. The best figure for that purpose is in Dall,

Bartsch, and Rehder (1938, p. 43, figs. 1-4) showing *P. edmondsoni*. That species is practically identical with *reticulata* except for its more distantly spaced concentric lamellae. A good photographic figure, although on too small a scale to show the slight difference in sculpture between it and *edmondsoni*, is found in Nichols and Bartsch (1945, pl. 2, fig. 1).

#### *Venus squamosa*

1758, *Systema naturae*, ed. 10, p. 688, no. 111.  
1767, *Systema naturae*, ed. 12, p. 1133, no. 135.  
LOCALITY: "In O. Indico" (1758, 1767).  
"V. testa subcordata reticulato-striata retrorsum squamosa."

This is another species that cannot be identified from the published description alone. So far as the outline of the shell is concerned, the primary characteristic of the species is the pronounced rostration of the posterior end, a rostration even more pronounced than that of its nearest congener, *Venus flexuosa* Linné. The description, without a mention of this characteristic, might refer to any species with squamous radial sculpture. Although other evidence convinces us that Linnaeus was referring to the species we know as *Anomalocardia squamosa*, the description does not even suggest a member of that genus.

The species is identified by two other pieces of evidence. The single figure cited (Rumphius, pl. 44, fig. M) is a satisfactory representation of *A. squamosa* and therefore we can say that the species was at least pictorially defined. Moreover it conforms to the few shell characters specified in the description. Second, Linnaeus has supplied a manuscript note to this species which considerably elaborates the original diagnosis, reading: "Testa supra vulvam producta, striis decussatis transversalibus submembranaceis recurvis: margo crenulatus. Anus ovatus, ferrugineus, magnus. Vulva longa, clausa, albidula, laevis."<sup>1</sup>

There is no specimen in the collection that

<sup>1</sup> In the phrase "Testa supra vulvam producta," the word "supra," which has a primary meaning of "above," is evidently used in its secondary meaning of "beyond." This latter meaning makes it a preposition of degree, as a synonym of "over and above," rather than a preposition of location. Linnaeus, however, was not a good Latinist and, conceivably, misused the word.

can be referred to the very vague description. The "Museum Ulricae" does not list the species. In this situation we have a case where the identification rests squarely and solely upon a figure and an unpublished manuscript note. This is sufficient, under the almost universally accepted theory, to permit the species to be cited as of Linné, 1758. Although I have accepted this theory, as explained in the Foreword, I have done so with some reluctance because of the existence of extreme cases like the present one.

Chemnitz lists *V. squamosa*, supplies a good description, and accurately figures it (1780-1795, pl. 31, fig. 335). The first adequate description of the species in a completely binomial work was that of Schröter (1783-1786, vol. 3, p. 185).

It is placed in the subfamily Chioninae, genus *Anomalocardia* Schumacher, 1817, and subgenus *Anomalodiscus* Dall, 1902. The latter name was constituted by Dall for the reception of this species.

It is figured in Reeve (1843-1878, vol. 14, *Venus*, pl. 21, sp. 101). This is an indifferent figure. Much better figures are given by Sowerby (1847-1887, vol. 2, *Venus*, pl. 156, figs. 83-84).

#### *Venus tigerina* (first use)

1758, *Systema naturae*, ed. 10, p. 688, no. 112.  
1767, *Systema naturae*, ed. 12, p. 1133, no. 136.  
LOCALITY: "In O. Indico" (1758, 1767).  
"V. testa lentiformi: striis crenatis decussatis, ano impresso ovato."

#### *Venus tigerina* (second use)

1767, *Systema naturae*, ed. 12, p. 1134, no. 141.  
LOCALITY: "Intra Tropicos" (1767).  
"V. testa lentiformi decussatim striata, ano ovato impresso."

#### *Venus orbicularis*

1758, *Systema naturae*, ed. 10, p. 688, no. 118.  
1767, *Systema naturae*, ed. 12, p. 1134, var.  $\beta$  of *V. tigerina*, no. 141.  
LOCALITY: "Intra Tropicos" (1758, 1767).  
"Testa interne, ad anum et rimam rufescens."

This affinity is treated together, as a great deal of speculation has resulted from the use of the name *tigerina* twice in the twelfth edition, from the reduction in rank of *V. orbicularis* from a good species in the tenth edition to a variety of *tigerina* number 141 in

the twelfth, and from Linnaeus' confused citation of figures and unexplained changes in the descriptions of these species. The comments of his successors during the next century did little to answer the apparent riddle, which I believe can be resolved only by basing our conclusions on the tenth edition alone and eliminating the diagnoses of 1767.

In the tenth edition *tigerina* number 112 is described as "suborbiculata" and the sculpture as "striis crenatis decussatis." The locality is given as "Oceano Indico," and reference is made to Rumphius, plate 43, figure "G." This figure is misshapen and drawn from such an unusual angle as to be unidentifiable and, moreover, is found on plate 42, not 43. *Venus orbicularis*, the common western Atlantic species, is described as "lenticiformi compressa" and the sculpture as "longitudinaliter profundius transversim tenuissime striata." This language graphically describes the form of the shell and the dominance of the radial over the concentric sculpture. "Ano cordato minimo" is also characteristic of the lunule, which is extremely small for the size of the shell. No references are given, and the locality, "intra Tropicos," is correct, although not illuminating.

In the "Museum Ulricae" only one of these species (*Venus tigerina*) is listed (1764, p. 503, no. 65). The original description of the tenth edition is repeated, with important additions. The shell is said to be "orbicularis"; the appearance and prominence of the concentric sculpture are emphasized in the phrase "exasperata striis elevatis transversis undatis crenatis, et striis minoribus longitudinalibus" (italics mine), thus sharply differentiating the sculpture from that of *orbicularis*. The umbones, the lunule and escutcheon, and the position and appearance of the ligament are well described. The only unanswered question is Linnaeus' change of the reference from figure "G" of Rumphius to figure "H," which is also found on plate 42, not 43 as Linnaeus stated. This latter figure, if anything can be deduced from it, looks more like *orbicularis* than the East Indian *tigerina*. In spite of this, it is certain that the author was describing the *tigerina* of 1758 as that species was specifically referred to.

If we were left with the tenth edition and the "Museum Ulricae" alone no problem

would arise. In the twelfth, however, it is not possible to say whether Linnaeus had changed his views of the two species, or had introduced a new species which must be considered undetermined, or had made a series of mistakes explainable only by his absentmindedness. The name *tigerina* is first used for number 136. Although the same locality is given as for the *tigerina* of 1758 ("O. Indico"), and the sculpture is described in the same language as in the earlier edition, the shell is called "lenticiformis," which was the shape of *orbicularis* in the tenth edition. This is not a serious change. Linnaeus' conception of the word "lenticiformis" was very broad, as is illustrated in many places in the "Systema." As a matter of fact, while the Indian Ocean *tigerina* is more swollen than the West Indian *orbicularis*, the latter is not markedly compressed except in very young shells. The reference to Rumphius' figure "H" is again given and the listing in the "Museum Ulricae" referred to.

On the next page of the "Systema" the author lists another *V. tigerina* as number 141. Again the shell is "lenticiformi," and the rest of the description is but slightly changed ("decussatim striata" instead of "striis-crenatis decussatis"), a change that is inconsiderable, except for the omission of "crenatis." A subdescription is added referring to the reddish color of the interior in the region of the lunule and escutcheon, which is an attribute of many specimens of *orbicularis*.<sup>1</sup> The locality is that of *orbicularis* of the tenth edition, "intra Tropicos." Most important is the mention of a variety as " $\beta$ , *Venus orbicularis*, Syst. Nat. 10, p. 688, n. 118." Thus, *orbicularis*, here reduced to a variety of *tigerina* number 141, which carries the description of the tenth edition *tigerina* and *tigerina* number 136 of the twelfth edition almost word for word, is completely identified with the characteristically described *orbicularis* of the earlier work. What Linnaeus conceived the "typical"

<sup>1</sup> The reddish tinge near the interior dorsal margin of the western Atlantic *orbicularis* is not a constant feature. I have not seen a Florida specimen of this shell which showed it, among many hundreds of specimens, and in lots from the West Indies, where this color is present, it is extremely fugitive.

*tigerina* number 141 to be is impossible to guess.

A specimen of the American *orbicularis* is in the collection, bearing the numerals "118, 136." As these are the numbers of the *orbicularis* of the tenth edition and of the *tigerina*, as first used, of the twelfth edition, respectively, the specimen shows a double identification and leaves us in doubt as to Linnaeus' conception of his twelfth edition listings, as he marked the shell not only for the American species but for what we are forced to believe is the Indian Ocean *tigerina* as well.

It is difficult to discuss Hanley's comments on this problem intelligently, as they are most confusedly expressed (1855, pp. 73-74). In his efforts to be brief he succeeds only in being vague. He did recognize the mistake of using the same name twice and said that in the twelfth edition Linnaeus "united two shells which he had clearly distinguished in his tenth edition, where, likewise, he had appended correct localities." Beyond that, his remarks are not clear. He does, however, reflect the erroneous opinion of his day, in saying: "It is not, perhaps, expedient to change the accepted nomenclature, for the name *tigerina* has been almost invariably accepted for the *tigerina* var. of the twelfth edition" (italics mine).

Chemnitz (1780-1795, vol. 7, p. 6, figs. 390-391) cites "*Venus tigerina* Linnaei," supplying a long list of references, all of which were used later by Gmelin, and referring specifically to numbers 112 and 118 of the tenth edition of the "Systema" and numbers 136 and 141 of the twelfth edition, that is, to all the numbers for *tigerina* and for *orbicularis* as well, thus making no distinction between the two undoubted species. He also referred to the listing in the "Museum Ulricaе." The figures mentioned show a shell much like our *orbicularis*, with an interior pinkish area near the umbones. He gives the locality as "Mari Indico." He does not use the name *orbicularis* here or elsewhere.

Gmelin (1791, p. 3283, no. 69) also cited only *Venus tigerina*. The description is identical with that of *tigerina* number 136 of the twelfth edition, and he refers to the "Museum Ulricaе" listing. His list of references, including Rumphius' figure "H," are

those used by Chemnitz and show both species. The most interesting detail of his diagnosis is that he follows Linnaeus in citing a variety " $\gamma$  *Venus orbicularis*, Syst. Nat. X. 1. p. 688. n. 118." He evaded the issue of locality by using "Oceano americano et indico," but his description is clearly that of *orbicularis*, particularly the phrase "striis perpendicularibus evidentioribus." Thus Gmelin followed Chemnitz in lumping both species under one name.

Lamarck (1818-1819, vol. 5, p. 574) varied this treatment slightly. He placed the two species in his new genus *Cytherea*, but cited only *tigerina* as a good species, and listed two varieties, as follows:

"(2) var. testa intus penitus alba.

(3) var. testa exasperata, subgranosa; striis transversis eminentioribus."

The first variety may be *orbicularis*, as Lamarck may not have seen specimens with a pink-tinged interior. The second, with its dominating concentric sculpture, is surely the *tigerina* of the Indian Ocean. His locality again includes both American and Indian waters, and his description is completely innocuous. The only mention of sculpture is that it is "trellised," which would apply to either of the species in question, and the "rose-tinted" color of the interior is mentioned. I would hesitate to say that he was describing anything but *orbicularis*. Thus far, therefore, no author had felt able to separate the two species and assign them to their respective proper localities.

The first writer who realized that *tigerina*, at least, was not properly placed in the Veneridae, but was in fact a lucinid, was Deshayes. In a note written on the genus *Lucina* (1826, pp. 530-531), after calling attention to the fact that Linnaeus "had confused the Lucinids partly with *Venus* and partly with *Tellina*," he says, "Based upon what I have said above, we refer this species [*tigerina*] here." He does not cite *orbicularis*, but we may assume that he would have given it the same placement. In any event, the two species were thenceforth included in *Lucina*.

Reeve (1843-1878, vol. 6, *Lucina*, pl. 1, sp. 3), in listing *Lucina tigerina*, erroneously referred it to *tigerina* number 136

of the twelfth edition of the "Systema" (first use), as the figure he gives clearly shows the West Indian *orbicularis*. He said, referring to the then current misconception: "This and the following species [*Lucina exasperata*, Reeve, *tom. cit.*, pl. 1, sp. 4] from the Bay of Honduras have mostly been confounded together under the head of *L. tigerina*." *Lucina exasperata* Reeve was wrongly identified by him with Lamarck's "*Cytherea tigerina* var. 3," which is the Indian Ocean shell. *L. exasperata* Reeve is very close to *orbicularis* in all features. It occurs in the western part of the Caribbean. The only difference is in the slightly larger size, more centrally placed umbones, and more salient radial ribs which are scaly or prickly. This is undoubtedly the shell which Reeve reported from the "Bay of Honduras."

Thus, I consider *tigerina* Linné, 1758, *tigerina* Linné, 1767 (no. 136, first use), *Cytherea tigerina* Lamarck "typical," and Lamarck's *tigerina* var. 3 to be identical and to describe the Indian Ocean *tigerina* of modern authors. Reeve's *tigerina* was actually the *orbicularis* of the tenth edition and the var.  $\beta$  of *tigerina* number 141 of the twelfth edition, the West Indian species. Reeve's *exasperata* is a good name and is the comparatively rare shell found in the western Caribbean, and the Reeve report from "Bay of Honduras" is therefore probably correct.

A further complication has been introduced by writers who have referred to a "*Lucina exasperata* Adams." There is no such species. Charles B. Adams (1849-1852, p. 244) in the paper entitled "Catalogue of species of *Lucina* which inhabit the West Indian seas," cites *Lucina exasperata* Reeve (Reeve, 1843-1878, vol. 6, *Lucina*, pl. 1, sp. 4). Adams had seen several specimens of a *Lucina* said to have been collected in the East Indies, which he called *exasperata* Reeve and tied them to *L. tigerina* Lamarck, variety 3, which is the East Indian shell. Adams, however, remarks (*op. cit.*, p. 244): "If Lamarck's statement of habitat were more reliable we might suppose, therefore, as his *L. tigerina* is said to inhabit 'l'Océan Indien et Américain,' that this was his East Indian type. But Mr. Reeve quotes Dyson as an original collector of the shell in Honduras." I cite this usage of the name by

Adams merely to point out that there is only one *exasperata*, that of Reeve, and because Chavan (1937-1938, vol. 82, p. 229) speaks of the *Venus orbicularis* of Linnaeus as being equal to "*Codokia exasperata* Adams, non Reeve." There are still other views of the identity of *exasperata* Reeve. Lamy (1920-1921, p. 240) referred it to the *tigerina* of the Indo-Pacific. Dautzenberg (1923, p. 69) makes it a variety of *orbicularis* of the western Atlantic, but Dautzenberg and Bouge (1933, p. 461) revert to Lamy's opinion and place it in the synonymy of *tigerina*.

The two Linnaean species here under consideration are now generally put in the genus *Codokia* Scopoli, 1777, of which *C. orbicularis* is the type. Scopoli's name *Codakia* was emended to *Codokia* by P. Fischer in 1887, on the very proper grounds that Scopoli had based his genus on Adanson's *Chama codok*, but had misspelled the specific name. Adanson's species was *Venus orbicularis* Linné.<sup>1</sup>

*Codokia orbicularis* is shown in an excellent photograph by Maxwell Smith (1941, pl. 19, fig. 5) and *tigerina* number 136 of the Indo-

<sup>1</sup> Chavan (1937-1938, vol. 81, p. 271) does not concede the availability of the name *Codokia*, or *Codakia*, Scopoli, on the following grounds: (a) that Scopoli's generic description was broad enough to include several bivalve groups ("Testa bivalvis subumbonata. Cardio valvae unius tridentatus, alterius bidentatus"); and (b) that his type, *Chama codak* (*sic*), was never supplied with any reference as required by the Rules, either by Scopoli or by any of his successors. The figure provided by Adanson (1757, pl. 16, fig. 3) is dismissed by Chavan as being insufficient in not showing the hinge. Chavan would therefore retain *Codokia*, if at all, merely as a generic term of general usage, but would prefer to adopt in its place the equivalent generic name *Lentillaria* Schumacher, 1817 (type *Venus punctata* Linné), which was correctly defined under the Rules. There is considerable reason in Chavan's first objection. While there is no justification for condemning a description merely because it is short or uncharacteristic, and the International Commission on Zoological Nomenclature has never passed upon the meaning of the word "description" in the Law of Priority, nevertheless it would seem unnecessary to rule that a description must be understandable, that is, sufficiently lucid to indicate with certainty the genus or species it was intended to cover. The description of *Codakia* does not, to my mind, do that. Chavan's second objection does not seem sound. Even if we should be forced to disregard the "description," the name was accompanied by an "indication" in the form of a "definite citation of an earlier name for which a new name is proposed" and also a "published figure," as required by Opinion 1.

Pacific in Reeve (1843-1878, vol. 6, *Lucina*, pl. 1, sp. 3). Reeve wrongly located this shell in the Bay of Honduras.

**Venus prostrata**

1758, *Systema naturae*, ed. 10, p. 688, no. 113.

1767, *Systema naturae*, ed. 12, p. 1133, no. 137.

LOCALITY: "In O. Indico" (1758); "in O. Indico, Tranquebar" (1767).

"V. testa orbiculata transverse striata, labiis scabro-membranaceis. . . Testa subscabra, exolete testacea radiis albis. Nates reflexae. Rima oblonga, patula. Anus cordatus."

This species was represented in the collection by an authoritatively marked specimen of *Dosinia prostrata*, which conforms to the clear language of the description and can be accepted as the type upon which the species was based. The name is also listed in the "Museum Ulricae," but the description there adds little to that of the "Systema." Hanley thought it possible that a different shell was described in the later work and based this doubt on the fact that "the peculiarities of sculpture are not mentioned in the details of the 'Museum Ulricae.'" He could not have read the latter carefully, as such details of sculpture as are given in the tenth edition are reported in the other. Neither description, however, gives a very characteristic account of the sculpture. The shell has fine, crowded, and slightly irregular concentric ribs, which become coarser, and more wrinkled and lamellate at both the anterior and posterior margins. The most characteristic feature is the position and direction of the umbones, which, as in the case of most members of *Dosinia*, are almost in line with the anterior margin of the shell and point directly forward.

This species is in the subfamily Dosiniinae, tribe Dosiniini, and genus *Dosinia* Scopoli, 1777.

It is well figured in Reeve (1843-1878, vol. 6, *Artemis*, pl. 4, sp. 23). Born (1780, pl. 5, fig. 6) shows a good figure, and Hanley (1855, pl. 1, fig. 7) reproduces the type specimen from the Linnaean collection.

**Venus pensylvanica** (emend. *pensylvanica*)

1758, *Systema naturae*, ed. 10, p. 688, no. 114.

1767, *Systema naturae*, ed. 12, p. 1134, no. 138.

LOCALITY: "In America septentrionali" (1758, 1767).

"V. testa lentiformi glabro-rugosa alba, antice utrinque sulco longitudinali."

This species is the best-known of the several lucinids which Linnaeus included in his comprehensive genus *Venus*. A specimen of the common *Lucina pensylvanica* of the western Atlantic is in the collection, but by error it is numbered 139, the "Systema" number of the succeeding species *Venus incrustata*, instead of 138. The error is obvious, as Linnaeus did not own a specimen of the latter shell, and the description of *incrustata* does not at all conform to that of *pensylvanica*. This carelessness in numbering does not vitiate the identification of this species, as its description is in perfect accord with the type. It should be pointed out, however, that Linnaeus' specimen was a much worn individual, the species, when fresh, having a heavy, light brown, and peculiarly lamellar epidermis, the color of the shell itself being white. This fact accounts for the words "glabro-rugosa alba" in the description. Thus corrected the description is sufficiently accurate, taken in connection with the condition of the type, to insure the identification of the species. The single reference from Argenville, although a crude drawing, was probably intended for *pensylvanica*. The locality is incorrect, as it is a subtropical shell. I have seen no records of its appearance north of Cape Hatteras.

As this is the first mention of the name *Lucina*, a short comment on its history should be inserted here. The name was first used by Bruguière in 1797 as the heading of a plate of unnamed figures ("Tableau encyclopédique," pl. 284), which were later identified by Deshayes and Dillwyn as *Lucina pensylvanica* Linné, *L. edentula* Linné, and *Venus jamaicensis* Chemnitz, 1784. Bruguière thus included both edentate species and those having hinge teeth. These plate headings have now been validated as proposing good generic names as of the date of the plates, by the unpublished opinion of the International Commission on Zoological Nomenclature already referred to (footnote, p. 29, above), so that *Lucina* must now be cited as of Bruguière, 1797, as many have done in the past. Lamarck used the name two years later in the "Prodrome" of 1799, with *V. edentula* Linné as his "example." The

genotype was established by Schumacher in 1817 as "*L. pensylvanica* Delam.," but he did not refer to the original Bruguière figure and cited the genus *Lucina* as of Lamarck. He complicated the matter still further by referring to his type in the next sentence as "*Venus pensylvanica* Lin." Dillwyn in the same year identified the unnamed figure 1 of the Bruguière plate as "*V. pensylvanica*." Stewart (1930, p. 176) says that Dillwyn's identification was "presumably earlier" than Schumacher's selection of type and probably bases this presumption on the fact that Schumacher chose that species as type. This seems too great an assumption to make. Schumacher did not mention the Bruguière figure, and moreover Dillwyn's identification was not a prerequisite to Schumacher's act, as *pensylvanica* Linné was not only a well-known species but was specifically cited by Schumacher, both as of Linnaeus and of Lamarck.

Schumacher's selection of *pensylvanica* as type was criticized as unsatisfactory by Stewart (*loc. cit.*), because, as Dillwyn had fixed the species, the selection was valid only if Dillwyn's act had preceded Schumacher's and, he might have added, if Schumacher had known of it. The objection seems to have no weight, as noted above. Another objection has been made, that Schumacher was selecting a type for *Lucina* Lamarck, a genus represented at the date when Schumacher wrote by one edentate species, *V. edentula* Linné, and that the selection of a species with hinge teeth was invalid. This argument is also captious, as, in spite of Lamarck's edentate "example," his generic definition expressly mentions teeth: "dents cardinales variables; deux dents laterales ecartées." In my opinion Schumacher's selection was valid, but in any case Anton, in 1839, also selected *L. pensylvanica* Linné and cited the appropriate figure from the Bruguière plate. In 1847 Gray constituted the genus *Phacoides*<sup>1</sup> with *P. jamaicensis* (Lamarck), 1801,<sup>2</sup> as type,

<sup>1</sup> Blainville had already used the name *Phacoides* in 1824 and 1825, but both uses were in the vernacular.

<sup>2</sup> *L. jamaicensis* Lamarck (*Venus jamaicensis* Chemnitz, 1784) is a synonym of *Tellina pectinata* Gmelin, 1791. Although the Chemnitz name is unavailable, Gmelin's specific name has several years' priority over Lamarck's *jamaicensis*.

but as this species belongs to the same systematic group as *pensylvanica*, already selected as type of *Lucina*, Gray's name falls into the synonymy of the latter genus.

Thiele's treatment seems too drastic. He confines *Lucina* (which he cites as of Lamarck, 1799, as I consider proper prior to the pronouncement of the Commission in favor of Bruguière) to the edentate species, listing the lack of teeth as a generic character and using *L. edentula* (Linné) as type of the genus as thus restricted. His *Lucina* is an exact synonym of *Anodontia* Link, 1807, but is certainly not the *Lucina* of Lamarck, 1799, which was a genus covering species with teeth, as noted above.

*Venus pensylvanica* is figured by Maxwell Smith (1941, pl. 15, fig. 1a, b), and in Reeve (1843-1878, vol. 6, *Lucina*, pl. 6, sp. 29). Reeve's figure is somewhat misleading, as the artist's attempt to reproduce the rough epidermis of erect scales might be taken for a representation of sculpture.

#### *Venus incrustata*

1758, *Systema naturae*, ed. 10, p. 688, no. 115.  
1767, *Systema naturae*, ed. 12, p. 1134, no. 139.  
LOCALITY: "In O. Indico" (1758, 1767).  
For description, see below.

The identity of this species has not been satisfactorily determined. Although the description seems, at first glance, to be fairly comprehensive, it is impossible to refer it to any one known species, with the possible exception of the next succeeding one, *V. punctata*. Linnaeus did not report the shell as being in his own collection, although he had, of course, examined the specimen in the "Museum Ulricae." The description in the "Museum Ulricae" provides several additional details but adds nothing to our knowledge of the species. The superfluous word "opaca" is added and the color of the exterior is noted, "Extus alba aut ad carneum vergens." There is also the added detail "Rima fissa Nymphis emaciatis," and a description of the hinge, "Cardinis dens unicus et marginalis angulatus approximatus juxta et pone anum." As he did in fact base his description on the examination of an actual specimen, it may have been a worn or diseased individual of *punctata* which he did not recognize as such. The two descriptions are

much alike, particularly the language relating to the interior and to the lunule:

*V. incrustata*. *V. testa lentiformi glaberrima laevissima punctis excavata. . . Testa intus crusta crassa albida. Ani vestigium foramine rotundo sub natibus.*

*V. punctata*. *V. testa lentiformi longitudinaliter sulcata, intus punctata. . . Testa intus obducta crusta crassa albida, sed punctata. Anus ut in praecedente.*

The name *incrustata* was not chosen to describe a crusted or callous appearance of the exterior as some writers have thought, as that idea is completely negated by the phrase "glaberrima laevissima" for the outside, and "intus crusta" for the interior. *Venus punctata*, in common with other lucinids, often shows a considerable thickening of parts of the interior, and in *incrustata* Linnaeus may have been describing an abnormally calloused example. If, in addition to this, the specimen was worn, he might have assumed from its smooth surface that it was distinct from *punctata*, which was "longitudinaliter sulcata."

The above assumptions are at least plausible, and it is not difficult to convince oneself that the two names refer to the same species. In the last analysis, however, an unequivocal identification is impossible, and we are compelled to leave *incrustata* as a *species dubius*.

#### *Venus punctata*

1758, *Systema naturae*, ed. 10, p. 688, no. 116.  
1767, *Systema naturae*, ed. 12, p. 1134, no. 140.

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

The description of this species is quoted under the preceding species.

The description in the "Museum Ulricae" is in some degree confirmatory of its identity with *V. incrustata*. It repeats the language of the tenth edition with the following addition: "Testa ut *V. incrustata*, sed minus crassa exarata sulcis longitudinalibus et striis transversis vix manifestis; colore albo lateribus saepe rubro. Intus obducta cortice crasso albido-flavescente ut in *V. incrustata* et insuper notata punctis excavatis sparsis."

Linnaeus did not have this species in his collection. The single reference is "Rumph. mus. t. 43. f. G," and little reliance can be placed upon it. In the first place Rumphius,

plate 42, figure G, had already been cited for *Venus chione*, and it is impossible to guess whether Linnaeus had transposed these two plate numbers, as he so often did, in either or both of these cases. Second, the figure "G" on neither plate shows the concentric sculpture demanded by the description.

The diagnosis of *punctata* in the "Systema" is sufficiently clear to tie it to the *Lucina punctata* of later authors, and the helpful language of the "Museum Ulricae" is merely confirmatory. The sculpture of the species is unusual for a lucinid. The radial ribs are so dominant over the concentric sculpture that the latter is scarcely distinguishable from lines of growth. The former may be described as smooth flat ribs or as deep, regular, *Cardium*-like furrows in a smooth surface.

The species falls in the genus *Codakia* (emend. *Codokia*) Scopoli, 1777, of which it is the type, by monotypy, as *Chama codok* Adanson, 1757. It is figured in Sowerby (1820, 1825, 1834, vol. 1, *Lucina*, pl. 59, fig. 1) and in Reeve (1843-1878, vol. 6, *Lucina*, pl. 1, sp. 2).

#### *Venus exoleta*

1758, *Systema naturae*, ed. 10, p. 688, no. 117.

1767, *Systema naturae*, ed. 12, p. 1134, no. 142.

LOCALITY: "Ad Garnsey" (1758); "Ad Garnsey; in Norvegica" (1767).

"*V. testa lentiformi transversim striata pallida, obsoleta radiata, ano cordato. . . Testa intus crusta crassa albida. Anus ferrugineus; valde affinis 139, 140.*"

In the twelfth edition of the "Systema" Linnaeus mentions, as variety "β" of *Venus exoleta*, the *V. lupinus* which was listed as a good species in the tenth edition (no. 123). Unmarked specimens of a shell which Hanley (1855, p. 76) called *lupinus* are in the collection, but they cannot be accepted as the syntypes of *V. lupinus*, 1758, as the description in the tenth edition is insufficient and might apply to any one of several shells.

The relationship of *V. exoleta* Linné, *V. lupinus* Linné, and *V. lincta* Pulteney, 1799, has puzzled conchologists ever since these names were established. As for *exoleta* and *lupinus*, after having been merged in the twelfth edition of the "Systema," they were almost universally considered by Linnaeus'



immediate followers as forms of the same species. Pennant, 1778, Gmelin, 1791, Poli, 1795, Montagu, 1803, Maton, 1804, and Dillwyn, 1817, all believed that *lupinus* was a variety of *exoleta* and, in the case of Dillwyn, that it represented the young of that species. From this time on, however, we find writers who separate *lupinus* (or its synonym *lincta* Pulteney) from *exoleta*. Hanley (1855, p. 76) said that they were "apparently distinct." Finally Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, pp. 340-354), in discussing the two names in great detail, established a convincing basis for the separability of the two species.

The acceptance of *V. lincta* Pulteney as a good species distinct from *V. lupinus* has also been strongly urged. Indeed most of the writers on the European fauna until comparatively recent times have considered them identical. Bucquoy, Dautzenberg, and Dollfus, however (*tom. cit.*, p. 352), basing their opinion on an extensive series of specimens, concluded that *lincta* and *lupinus* are forms of the same shell, and this is today the accepted view and, I submit, the correct one. The later name *lincta* therefore falls into the synonymy of *lupinus*.

The typical *lupinus* is a flattened shell, shining and with fine striations, and is the common Mediterranean variety. Form *lincta* is somewhat more inflated, rounder, and with stronger concentric sculpture. It is the dominant Atlantic form. These differences are not constant, and the two forms intergrade with no discernible point of cleavage. Form *lincta* Pulteney is figured by Sowerby (1847-1887, vol. 2, *Artemis*, pl. 141, fig. 16), and both forms are shown by Bucquoy, Dautzenberg, and Dollfus (*tom. cit.*, pl. 55, figs. 1-6, the typical Mediterranean *lupinus*, and figs. 7-11, the Atlantic form *lincta*). Reeve cites and figures only *lincta* (1843-1878, vol. 6, *Artemis*, pl. 1, sp. 2).

To return to the question of the separability of *exoleta* Linné and *lupinus* Linné (*lincta* Pulteney), the difference is largely one of coloration, although this difference is remarkably constant. The two are well illustrated in Poli's figures (1791, 1795, vol. 2, pl. 21). Figures 9, 10, and 11 of that plate show *exoleta*, a shell with broad radial rays and tents, while figure 8 is *lupinus*, a colorless

shell which is often described as shining. Bucquoy, Dautzenberg, and Dollfus figure the typical *exoleta* (*tom. cit.*, pl. 54, figs. 1-2) and certain so-called varieties on the same plate (figs. 3-11). Nobre (1931, pl. 64, figs. 1-2) shows *exoleta* and (pl. 64, figs. 3-5) *lupinus*.

Both *exoleta* and *lupinus* are now included in *Dosinia* Scopoli, 1777, after having been placed in *Cytherea* Röding, 1798, by Lamarck, Sowerby, Philippi, and others, and in *Artemis* Poli, 1795, by most of the other nineteenth century authors. They are, however, in different subgenera. *D. lupinus* falls into subgenus *Asa* Basterot, 1825, as the subgenotype, by monotypy. *D. exoleta* is in subgenus *Pectunculus* Da Costa, 1778 (not Lamarck, 1799), where it was described as *P. capillaceus*, and is the subgenotype, by subsequent designation, Jukes-Browne, 1911. It is also the type of *Artemis* Poli and (*vide* Thiele, 1931, 1935, vol. 2, p. 888) of *Orbiculus* Megerle von Mühlfeld, 1811, which Thiele uses as a section of *Dosinia* Scopoli. The names *Artemis* and *Orbiculus* seem to be exact synonyms of *Pectunculus* Da Costa. The type of *Dosinia* is *Venus concentrica* Born, 1780, by monotypy. The latter name is identical with *Chama dosin* Adanson, 1757, from which Scopoli's *Dosinia* derived its name.

#### *Venus borealis*

1767, *Systema naturae*, ed. 12, p. 1134, no. 143.

LOCALITY: "In Oceano Europaeo" (1767).

"V. testa lentiformi: striis transversis membranaceis erectis remotissimis. . . . Resta alba, angulata, ad rimam recta et quasi truncata; striae inaequales, membranaceae."

A specimen which Hanley (1855, p. 77) called *Lucina radula* Lamarck is marked for *borealis* in the Linnaean collection and agrees with the diagnosis. The specimen possesses concentric ridges which are a little more widely spaced than is usual in this species, and this peculiarity is reflected in the words "striis . . . remotissimis" in the description. Lamarck's *radula* is a synonym of *borealis*, but even with the complete concordance between the type and the description, Hanley made no suggestion to restore the Linnaean name, which is now universally adopted. The reference to Lister (1678) may be disregarded. It shows a nearly smooth shell and has no confirmatory value. This is primarily

a boreal species, but extends into fairly warm waters on both sides of the Atlantic. It has been reported from as far south as Massachusetts. Reeve mentions a specimen from the Cuming collection, said to have been collected in Manila Bay. His figure of this specimen (1843-1878, vol. 6, *Lucina*, pl. 3, fig. 14) looks a little darker than the Atlantic *borealis*, but seems otherwise identical. I have not seen any other record from the Pacific and suspect that Cuming's shell was a different species. In the most recent Philippine list (Faustino, 1928) the species is noted from Manila Bay, but as the only reference given is the above-mentioned comment and figure by Reeve, it is presumed that Faustino's record is merely copied from the "Conchologica iconica" and that he was referring to Cuming's specimen.

This lucinid is included by Chavan (1937-1938, vol. 82, p. 83) in *Lucinoma* Dall, 1901, a group which is treated as a good genus by Chavan but is usually used as a subgenus of *Lucina*. Grant and Gale (1931, p. 286) make it a section of subgenus *Myrtea* Turton, 1822. This is a clearly characterized group of species with a wide distribution in cold waters, being frequently found in abyssal depths. It contains large, usually lentiform shells with a heavy epidermis and concentric, sometimes lamellose sculpture. Its type is *Lucina filosa* Stimpson, 1851, a species which ranges farther south than most of its congeners, being found on this side of the Atlantic as far south as Cape Florida.

*Lucinoma borealis* (Linné) is figured in Reeve (1843-1878, vol. 6, *Lucina*, pl. 3, sp. 13 and 14).

#### *Venus pectinata*

1758, *Systema naturae*, ed. 10, p. 689, no. 120.

1767, *Systema naturae*, ed. 12, p. 1135, no. 44.

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

"V. testa sub-lentiformi, sulcis longitudinalibus rugosis, pube antrorsum ramosa."

The genus *Gafrarium*, to which this species belongs, was constituted by Röding in the "Museum Boltinianum" in 1798.<sup>1</sup> He included 12 named species in the genus, one of which was identical with *Venus fimbriata*

<sup>1</sup> The use of the Röding genera, in this paper, is referred to above (footnote, p. 60).

Linné, one was *Venus reticulata* Linné, five were forms of *Venus pectinata* Linné, and three have not been satisfactorily identified. He thus included species with divaricate radial sculpture on the posterior slope (the *pectinatum* complex) and those in which the radial sculpture was directionally symmetrical. In 1817 Schumacher erected the genus *Circe*, listing but a single species *C. violacea*, which was merely a new name for *Venus scripta* Linné. It is the type by monotypy as well as by original designation. Schumacher's generic definition mentions the shape of the shell and describes the hinge in great detail but does not mention sculpture. It is not clear, therefore, whether or not he would have placed *V. pectinata* in his new genus.

*Circe* was later largely expanded to include three distinct groups of species: (a) the *V. scripta* affinity, comprising very compressed, lenticular shells with concentric sculpture; (b) the divaricately, radially sculptured species of the *V. pectinata* type; and (c) *V. castrensis* Linné and its allies, which show weak, concentric ribs, a color pattern of tents (reflecting the specific name *castrensis*), and a shell relatively smoother and more gibbous than in the other groups. The last two groups apparently overlap in *Circe intermedia* Reeve, 1863, where concentric plications over most of the shell are replaced by a small area of divaricate sculpture on the umbones. It is likewise to be noted that the *pectinata* group, so-called, contains species with both radial and concentric sculpture.

*Circe* Schumacher has been variously subdivided by later systematists. *Venus castrensis* and its allies have been transferred to *Lioconcha* Mörch, 1853. As to the remainder of its members there is no general agreement. By some authors *Circe*, as restricted to the *pectinata* group, is used as an exact synonym of *Gafrarium* Röding. As already stated, *Gafrarium* is here used as a good genus to contain at least the *pectinata* affinity until further action by the International Commission. Many American writers retain *Circe* and its subgenus *Circenita* Jousseau, 1888, for these species and others. Thiele recognizes *Gafrarium* as valid but places under it as subgenera: *Gafrarium*, *sensu stricto*, for *V. pectinata*; *Circe* Schumacher for the *V. scripta* group; and *Circenita* for a

group close to his *Circe*, but with a difference in the hinge. Jukes-Browne (1914) uses *V. scripta* as the type of his conception of *Circe* Schumacher, with *Gafrarium* Röding in its synonymy, and makes *Crista* Römer, 1847, a subgenus with *V. pectinata* Linné as subgenotype, a classification which seems devoid of authority. In this latter group, *Crista*, he places not only the radiately, pectinate, divaricately sculptured species, but some having concentric sculpture as well, which other writers have retained in *Circe*, *sensu stricto*. Dall, on the other hand (1890-1903, pt. 6, p. 1246), treats *Gafrarium* as a good genus, with *V. pectinata* as type, and uses *Circe* Schumacher as a subgenus under it, with *V. scripta* as type.

The description of *pectinata* in the "Systema" has apparently been sufficient to identify the species, but neither it nor the references are particularly convincing. Surely the striking change in sculpture as the posterior slope is reached could have been more graphically described than by the words "pube antrorum ramosa," which are all that we are told as to the sculpture. The references were said by Hanley (1855, p. 77) to be designed for this species or for a very close congener, but they are all very crudely drawn. The figure from Argenville might be taken for our *G. pectinatum*. The other two, from Rumphius and Gualtieri, respectively, are unrecognizable. From the diagnosis in the "Systema" alone I cannot say that the species has been defined. The description in the "Museum Ulricae," however, which refers back to the *pectinata* of the "Systema," clears up any doubt as to what Linnaeus meant. The portion relating to the sculpture is quoted in full: "Testa minus exacte orbiculata, exarata striis obtusis catenulato-nodosis 12 pluribusque, qua, exceptis 2 s. 3 primis, semibifidae evadunt. In area antica striae elevate 12 circiter, excurrentur antrorsum, simplices, nodosae."

This language reveals two facts. In the first place, it is a most graphic description of the *pectinata* group of species, as the pronounced change in the direction of the striae on the "anterior" (*sic*) slope is clearly expressed. The bifid character of the major striae is referred to, as is the lack of this feature on the divaricate ribs. In the second

place, it is clear that Linnaeus was not describing the *pectinata* of authors, but the species later called *Cytherea gibba* by Lamarck. The type specimen described for the "Museum Ulricae" was said to have 12 or more ribs on the main portion of the shell and "about 12" on the posterior slope, whereas the shell we know as *G. pectinatum* has but six or occasionally seven on the latter area. Our *pectinatum* is a definitely ovate shell and could not be described as even "minus exacte orbiculata," whereas *gibba* approaches an orbicular outline. In fact, the "Museum Ulricae" description is not only an excellent but a meticulously phrased description of *gibba*, with its rounded outline and its 12 to 14 divaricate ribs. The description in the "Systema" uses the word "sublenticiformi," and this, together with the vastly different language of the "Museum Ulricae" and the reference back to the "Systema," indicates that Linnaeus described two different shells in the two works but apparently was not aware of the fact. The *pectinata* of the "Systema" was probably the *pectinata* of authors, as I know of no other *Gafrarium* with divaricate sculpture which can be called "lenticiform." In other words, the "*V. pectinata*" of Linnaeus was a composite species, although it is apparent that he conceived that it was one variable species.

The collection contains no species marked for *pectinata*, although the *pectinata* of authors and *gibba* are both present in the same tray, a further confirmation of the possibility that the author considered them identical. Reeve, while treating them both as good species, says of *pectinata* (1843-1878, vol. 14, *Circe*, sp. 20), "It varies considerably and passes into the gibbosity of the next species [*gibba*]." This language, read with the modern concept of speciation in mind, would, if taken literally, be tantamount to saying that the two were forms of the same variable species. Mörch (1852-1853) pronounced them identical. Based on the series that has been available to me the two seem quite distinct, as I have been unable to find intermediate forms that would connect the two species. In addition to the gibbosity of the species *gibba* and the difference in outline, it has coarser and less elaborately sculptured ribs, and the posterior area is less markedly

divaricate than in *pectinata*. Hanley himself (*loc. cit.*) was somewhat preoccupied with the suggestion that "*pectinata* Linné" might have been a composite species, as, from the point of view of shell outline, he considered that the Rumphius figure and at least one of the Gualtieri figures cited by Linnaeus suggested *gibba*, whereas the Argenville figure might be meant for *pectinata*, and, further, that the appearance of the ribbing, in all except the Argenville figure, was more like *pectinata*.

In addition to the two species mentioned, specimens of *Cytherea divaricata* Lamarck, 1818, are present in the collection. Hanley (*loc. cit.*) called attention to this fact. However, while the word "sublentiformi" fits *divaricata*, the latter shell shows a divarication of sculpture which is symmetrical, or nearly so, dividing the shell into almost equal halves, whereas in the other two species the line of demarcation between the two diverging sets of ribs is at the beginning of the posterior slope. Many of the details of the "Museum Ulricae" likewise exclude *divaricata* from being considered the type of *pectinata*.

In brief we have, to assist us in the identification of *V. pectinata*, the presence of three species mingled in the same tray, a description which is not only brief and uninformative but which has details which can be made to apply to both, a list of references, most of which apply in part to both and all of which are too crude for certain identification, and a description in the "Museum Ulricae" which, although it refers to the "Systema" description, is apparently that of a different species. If *pectinata* and *gibba* are distinct species, as I believe them to be, then it cannot be said that the identity of *pectinata* Linné can be specifically determined. The difficulty is not lessened by the fact that Linnaeus cited the equivocal figures from Gualtieri (pl. 72, figs. F and E) for this species, when he could have found (*op. cit.*, pl. 75, fig. A) a recognizable drawing of the shell we know as *pectinata*, and that this same figure A had already been erroneously cited for *Cardium pectinatum*. Although the figures used by Linnaeus seldom have much probative value, this confusing use of them casts the gravest doubts on the identity of both the venerid and the cardiid *pectinata*.

The acceptance of the *Gafrarium pectinatum* of authors as the representative of the Linnaean species is so solidly entrenched in the literature that it is certainly inexpedient to disturb it now, but it should be recognized that it is based on tradition and on what Linnaeus probably meant rather than on an interpretation of what he said.

*Gafrarium pectinatum* of authors is in the subfamily Circinae Dall, 1913, genus *Gafrarium* Röding, 1798, of which it is the type, by subsequent designation, Dall, 1902. It is an Indo-Pacific species, with a range from the Red Sea to the Philippines.

Figured in Reeve (1843-1878, vol. 14, *Circe*, pl. 5, sp. 20a, b, c). Figure c is the form which (*vide* Reeve) approaches the outline and gibbosity of *gibba* Lamarck. The various forms of the latter species are also figured (*loc. cit.*, sp. 21a, b, c, d). A good photograph of *pectinata* is shown by Thiele (1931, 1935, vol. 2, p. 885, fig. 835).

#### Venus scripta

1758, *Systema naturae*, ed. 10, p. 689, no. 121.  
1767, *Systema naturae*, ed. 12, p. 1135, no. 145.  
LOCALITY: "In Indiis" (1758, 1767).

"V. testa lentiformi compressa striata postice angula recto angulata. . . Impressio ani lanceolata."

Linnaeus recorded his possession of this species, and although nothing in his collection is marked for *scripta*, a specimen of the *scripta* of authors is present and is the only one that conforms to the fairly characteristic description. Although further details in the "Museum Ulricae," which is given as a reference in the twelfth edition, confirm this identification beyond question, we are safe in accepting the "Systema" description as a good definition of the species.

The figures cited show the tented color pattern seen on some forms of the *scripta* of authors but are drawings of orbicular shells and, with one exception (Gualtieri), fail to show the close concentric sculpture. They are such crude figures that they may be disregarded as being confirmatory of the description. Linnaeus' broad and continually repeated locality, "in Indiis," is not helpful.

This is an extremely variable species as to color pattern, and the several names that

have been given to these forms, among them *undatina* Lamarck, 1818, *fulgurata* Reeve, 1863, *personata* Deshayes, 1853, and possibly *albida* Deshayes, 1853, should properly be included under the one specific name *scripta*. The type specimen in the collection appears to be referable to Sowerby's figure (1847-1887, vol. 2, pl. 139, fig. 38).

Frizzell apparently places the species in the subfamily Circinae, genus *Circe* Schumacher, 1817, of which it is the type by monotypy as *C. violacea* Schumacher. It is figured in Sowerby (1847-1887, vol. 2, *Circe*, pl. 139, figs. 38-43) and in Reeve (1843-1878, vol. 14, *Circe*, pl. 1, sp. 1a, b, c). Reeve's figure 1b shows the typical form of the shell. Figure 1c probably represents the form called *Cytherea undatina* by Lamarck, 1818.

#### Venus edentula

1758, *Systema naturae*, ed. 10, p. 689, no. 122.

1767, *Systema naturae*, ed. 12, p. 1135, no. 146.

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

"V. testa lentiformi subgloboso-lenticulata rugosa edentula; ano ovato. . . Testa subglobosa, diaphana, alba. Anus ovato-acutus, valde excavatus, angulo acuto."

The description quoted above contains almost all the details necessary to identify the species, although the word "lentiformi" is hardly accurate, and its use in connection with "subglobosa" is to some extent a contradiction in terms. No references were given. The species was not in Linnaeus' collection at the date of the publication of the tenth edition as it did not appear on the tenth edition list. There is a specimen of *Lucina ovum* Reeve, 1850, in the cabinet which, according to Hanley (1855, p. 80), Linnaeus may have regarded as the young of *edentula* and which thus might have been the type specimen. The language of the description, however, shows this suggestion to be erroneous. The words "anus ovato-acutus, valde excavatus, angulo acuto" do not apply to *L. ovum*, and that shell is not "rugosa."

For many years after the publication of the "Systema" the only known edentate *Lucina* was the West Indian *V. edentula*, described and figured by Chemnitz (1780-1795, vol. 7, p. 34, pl. 40, figs. 427-429), and, as this

shell conformed reasonably well with the details of the Linnaean description, it was accepted as the *edentula* of the "Systema." The later discovery of many edentate members of the genus rendered the determination more difficult, but the traditional identification remained, as it still does, with the West Indian shell. Philippi had a specimen of an edentate *Lucina* from an unknown locality, which he believed to be the *edentula* of Linnaeus. Reeve, however, disagreed, saying that Philippi's shell, which he figured (1843-1878, vol. 6, *Lucina*, pl. 5, sp. 53), was not "subdiaphana" as the description in the "Museum Ulricae" demanded (the term in the "Systema" is "diaphana"), as it was an opaque shell covered with an epidermis. He therefore named Philippi's shell *philippiana* and retained the name *edentula* for the species described by Chemnitz and later by Lamarck. Reeve did not, however, believe that the latter species (*op. cit.*, pl. 2, sp. 9) was in fact the *edentula* of Linnaeus, as the "Systema" description was "very indefinite throughout, and applicable to half a dozen species."

The arguments against the theory that *edentula* Linné was not the West Indian species are: First, the word "alba" could not apply to that species with its deeply orange interior. It is possible, however, that the word simply reflects the fact that whatever specimen he examined (probably the one described for the "Museum Ulricae") was worn and faded, although this argument would be difficult to sustain (*vide* Hanley, 1855, p. 79), as the deepness of the orange interior would not be completely effaced by any ordinary amount of bleaching. Nevertheless, this writer has collected many specimens of this very common shell which retain only a suggestion of color inside, too little to have been mentioned by Linnaeus. The second argument advanced is that the locality ("in Indiis") could not apply to the West Indies. This is not of much weight. Linnaeus obtained many specimens from that area, and in a significant proportion of them gave the locality "in Indiis," "O. Indico," or comparable language, and in no case did he use the locality "Indiis occidentalibus" or any words signifying the West Indies, although it is a fair assumption

that he knew the origin of many of those specimens.<sup>1</sup>

Another argument has received some support, and was advanced by Hanley (*op. cit.*, p. 79): If Linnaeus had meant the species later described and figured by Chemnitz, he would have referred to the figure on plate 260 of Lister, 1770, which (*vide* Hanley, 1855, p. 79) served as the model for Chemnitz' figure, as Lister's work was in Linnaeus' library in 1767 and is constantly cited in the twelfth edition. This reasoning involves too great an assumption. We must be asked to assume that Lister's drawing, a wretched piece of work, was in fact Chemnitz' model, whereas an examination of the two does not bear this out. Second, the Lister work referred to ("editio altera," 1770) was not published until three years after the twelfth edition of the "Systema." The original edition (1685-1692 [-1697]) contained no plate 260.

After discussing the question in some detail, Hanley concluded by taking no position on the matter, saying, "I shall not pretend to solve this knotty problem."

Without having before me the specimen on which the description of *edentula* was based, I agree with Hanley that an unequivocal identification is impossible. Even though that description gives a number of very characteristic details, it is too generalized in the light of what we know now of the edentate lucinids and contains inconsistencies. The evidence seems to favor the West Indian shell as against the other edentate species, and this is based largely on the use of the word "diaphana" and the phrase "anus ovatus acutus, valde excavatus, angulo acuto." It would serve no good purpose, in any case, to disturb the accepted identification.

Thiele, as noted above under *V. pennsylvanica*, restricts the name *Lucina* to the edentate species and uses *V. edentula* as type of the restricted genus, this treatment evidently stemming from his view that Lamarck not only erected the genus but validly selected *edentula* as type in 1799. As so used

<sup>1</sup> Although the early sixteenth century theory that the Antilles and the Central American mainland were a part of India was soon dispelled by later discoveries, nevertheless the use of the word "Indiis" for the region persisted for many years.

*Lucina* is an exact synonym of *Anodontia* Link, 1807, which also had the same "sole example," Link's *Anodontia alba* being equal to Linnaeus' *V. edentula*.

Inasmuch as *Lucina* is a broader genus than Lamarck's 1799 conception of it,<sup>2</sup> and inasmuch as Link definitely separated the edentate species to form his *Anodontia*, the latter name becomes the valid genus to contain *V. edentula*. For those who are satisfied with the Linnaean description of the species, it may be cited as *Anodontia edentula* (Linné), 1758. Those who feel that the Linnaean diagnosis is an insecure basis for identification, even though it is fairly certain what Linnaeus meant, must cite it as *Anodontia alba* Link, 1807. The commonly used name *Loripinus chrysostoma* Philippi, 1847, must yield to the earlier name. C. W. Johnson (1934, p. 42) makes *L. chrysostoma* Philippi equal to "*L. edentula* of authors in part," but I am strongly of the opinion that it is the *edentula* of Linnaeus, even though the latter did not mention the striking orange interior of fresh specimens of the shell. *Venus edentula* was one of the species figured on the Bruguière plate in the "Tableau encyclopédique" (1797, pl. 285, figs. 1a, b) later identified by Deshayes.

The *edentula* of authors, the West Indian shell, together with *L. philippiana* Reeve, is figured on the Reeve plates referred to above. A good interior view is shown in Thiele (1931, 1935, vol. 2, p. 867, fig. 826).

#### Venus literata

1758, Systema naturae, ed. 10, p. 689, no. 124.

1767, Systema naturae, ed. 12, p. 1135, no. 147.

LOCALITY: "In Europa australi et India" (1758); "in Europa et India" (1767).

"V. testa ovata antice angulata, striis transversis subundulatis. . . Color saepe cinerascens, sed plurimum varians, saepiusque characteribus notatus; variat etiam rugis antice longitudinalibus, in majoris imprimis et indicis."

No difficulty was experienced in the identification of this species with the *literata* of most authors. The description is adequately characteristic, and its only weakness is the

<sup>2</sup> Lamarck's selection of *V. edentula* as the "example of *Lucina*," after stating in his generic description that the group had "teeth variable, two lateral teeth widely separated," is an inconsistency that cannot be explained.

common error of Linnaeus in reversing the modern application of the words "anterior" and "posterior."

It is placed in the subfamily Tapetinae and in the typical subgenus of *Tapes* Megerle von Mühlfeld, 1811, of which it is the type by monotypy. Its distinguishing feature is the dorsally arched posterior slope, which is markedly truncated below. The markings mentioned in the description are very variable, and several color forms have received separate specific names. The only other species which could be mistaken for it is *Venus turgida* Lamarck, 1818, the posterior area of which is more gibbous, the gibbosity taking the form of an elevated and rounded keel much more marked than the faint keel in *literata*.<sup>1</sup> The erroneous locality "Europa" was due (*vide* Hanley, 1855, p. 80), to Linnaeus' impression that the European *Tapes geographica* (Catlow and Reeve, 1845) and *Tapes pullastra* (Montagu, 1803) were dwarf forms of *literata*. All three species were represented in the collection, but none of the specimens were marked.

*Venus adspersa*<sup>2</sup> Chemnitz (1780-1795, vol. 7, p. 44, pl. 42, fig. 438) was once confused with *literata* but seems to be quite distinct. It is more ovate and less squarely truncate posteriorly, shows three interrupted rays of spots, as in *turgida* Lamarck, is generally of a darker reddish color, and lacks the prominent tents of *literata*, for which are substituted very small tents or spots. This is the shell which was referred to by Gmelin as "var.  $\delta$ " of *literata*, for which he cited the Chemnitz figure mentioned above. Lamarck (1818-1819, vol. 5, p. 595) referred to this same figure, as well as a figure of *V. papilionacea*<sup>3</sup> from the "Tableau encyclopédique" (1797, pl. 282, figs. 1a-b) in describing *V. adspersa*, saying that *adspersa* was larger than *papilionacea* and was neither the typical *literata*

nor a variety of that shell. Deshayes and Milne-Edwards (1835-1845, vol. 6, p. 352) also said of *adspersa*: "This species is quite distinct from *Venus literata*, with which Gmelin and Dillwyn confused it. It seems to us that Lamarck has here united two species; the figure 439 of Chemnitz [*V. literata radiata*] and figure 1 of plate 282 of the Encyclopédie [*V. papilionacea*]. . . ."

The present species is not *V. literata* Pennant, 1777, which is *V. decussata* Linné, nor *V. literata*, Poli, 1795, which is the same as *V. geographica* above referred to, first described by Chemnitz (1780-1795, vol. 7, p. 45, pl. 43, fig. 440).

Figured in Reeve (1843-1878, vol. 2, *Tapes*, pl. 1, sp. 2a, b, c), and in Sowerby (1847-1887, vol. 2, *Tapes*, p. 264, pl. 147, figs. 43-49) as *Tapes literata* Chemnitz, although Chemnitz' shell is identical with that of Linnaeus). It is an Indo-Pacific species of very wide distribution.

#### *Venus rotundata*

1758, *Systema naturae*, ed. 10, p. 690, no. 125.

1767, *Systema naturae*, ed. 12, p. 1135, no. 148.

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

"V. testa ovata antice subangulata; strii transversis, cardinis dente intermedio bifido. . . . Testae anus ovato-lanceolatus, fuscus, retusus, Dentes cardinis utrinque tres; medio bifido."

This species was known by the early writers under three different specific names, and it is not certain whether or not it was always recognized as the *rotundata* of Linnaeus. Chemnitz called it *Venus ala-papilionis* (1780-1795, vol. 7, p. 46, pl. 42, fig. 441) but did not mention *rotundata* Linné in the synonymy or make any reference to the "Systema." Gmelin preserved the Linnaean specific name, accurately paraphrased the Linnaean description, and gave as references the "Museum Ulricae" (where the species described was demonstrably the same as in the tenth edition) and Chemnitz' figure 441. Röding, in the "Museum Boltzenianum" (1798, p. 175), revived the Chemnitzian specific name *ala-papilionis* and placed it in his genus *Paphia*. He nevertheless referred to *V. rotundata* Gmelin and Chemnitz' figure 441. Lamarck (1818-1819, vol. 5, p. 594) changed the name to *papilionacea* but cited the Chemnitz figure 441 and *V. rotundata* Gmelin, as

<sup>1</sup> Lamarck's *turgida* is also marked by a somewhat coarser concentric sculpture over the posterior area and a greater tendency of the scattered tents or other markings to align themselves into rays. Lamarck's *V. dorsata* and *ovulosa*, 1818, are mere forms of *turgida*.

<sup>2</sup> The specific name was emended to *aspersa* by Sowerby in 1835.

<sup>3</sup> Lamarck's *V. papilionacea* was a new name for *V. ala-papilionis* Chemnitz, 1784, and *Paphia ala-papilionis* Röding, 1798, and is identical with *V. rotundata* Linné, the next species discussed.

well as two figures from the "Tableau encyclopédique" (pl. 282, figs. 3a-b) which clearly represent this shell. Deshayes and Milne-Edwards (1835-1845, vol. 6, p. 352) continued the use of Lamarck's name *papilionacea* for this species but also refer to *rotundata* Gmelin and say in a footnote, "It is right and proper to restore the Linnaean name to this species." It is not clear from their statement whether they believed that *rotundata* Linné and *rotundata* Gmelin were in fact identical. Gmelin's "thirteenth edition" of the "Systema" was for many years spoken of as a mere edition of Linnaeus' work, rather than a new work, the major portion of which was added material. Likewise there are many cases where the real Linnaean authorship is unquestioned but where writers cited species as of Gmelin, possibly because they possessed the "thirteenth edition" and did not have access to Linnaeus' own work. In any case, Deshayes and Milne-Edwards were the first writers to fix the name *rotundata* as the earliest valid name of the species. An examination of Gmelin's diagnosis leaves no doubt but that it was a mere redescription of *rotundata* Linné.<sup>1</sup>

The description in the "Systema," while it contains a characteristic picture of the hinge, is not only too brief as to the other shell characters but is confusing in at least two particulars. It refers to the posterior margin of the shell as being "subangulata." This is a somewhat misleading term. One would expect, from this description, to find an appreciable angulation, even though it was less marked than in other members of the genus *Tapes*, whereas the posterior end of *rotundata* is almost as perfectly rounded as is the anterior end, with the merest trace of an irregularity in some specimens and certainly not enough to justify even the word "subangulata." Indeed the specific name reflects the roundness of the ends. Second, the escutcheon is stated to be "ovato-lanceolatus, fuscus, retusus." It is difficult to understand how a lanceolate feature can be "blunt."

<sup>1</sup> This conclusion is not shared by all conchologists. In one of the most recent systematic works (Grant and Gale, 1931, p. 324) the authors, in referring to the type of *Paphia* Röding, give it as "*P. ala-papilionis* Bolten (= *rotundata* Gmelin, in part, not Linnaeus)." They give no reasons.

A marked specimen of *rotundata* is present in the collection, and as it agrees with the few clear details of the description and does not show characters at variance with it, it may be accepted as the type specimen, in spite of the two confusing details above mentioned. These are unfortunate but may be put down either to Linnaeus' carelessness or to his frequent misuse of Latin words, a fault that is often encountered in his writings.

Hanley (1855, p. 81) criticized the description even more severely. He said that as it was impossible to identify the species from the description, "the name *rotundata* has no claim to precedence." In most other cases Hanley seems to agree that an authentically marked specimen is sufficient to counteract minor defects in the description, provided that the specimen in question agrees with the main details and does not obviously fail to conform to any of the language. Under the theory of identification advanced in this paper, however, the name *rotundata* Linné is nomenclatorially valid.

The species is in the subfamily Tapetinae, genus *Tapes* Megerle von Mühlfeld, 1811, and subgenus *Paphia* Röding. Jukes-Browne (1914) includes it in *Paratapes* Stoliczka, 1871, a synonym of *Paphia* Röding, and Thiele, (1931, 1935, vol. 2, p. 893) lists it under *Paphia* Röding, 1798, as *P. ala-papilionis*. It is identical with *Venus laeta* Poli, 1795, and Philippi, 1836,<sup>2</sup> not of Linnaeus. It is easily distinguishable from all other *Tapes* by its outline, which is slenderly ovate, evenly rounded at both ends, and with the posterior dorsal margin much less highly arched than in most of the other species of the genus.

There are several fine figures of this species available: Thiele (1931, 1935, vol. 2, p. 893, fig. 837, as *ala-papilionis* Röding); Crouch (1826, pl. 7, fig. 98, as *ala-papilionis* Lamark); and Sowerby (1847-1887, vol. 2, *Tapes*, pl. 145, figs. 1-2). A good diagrammatic figure of the hinge is found in Grant and Gale (1931, p. 325, fig. 5a).

<sup>2</sup> Philippi referred to *V. laeta* Poli as being equal to *V. virgineo* Linné rather than to *V. rotundata* Linné, but an examination of the figures disposes of this conclusion.



*Venus decussata*

1758, *Systema naturae*, ed. 10, p. 690, no. 126.

1767, *Systema naturae*, ed. 12, p. 1135, no. 149.

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

"V. testa ovata antice angulata decussatim striata. . . . Testae anus minimus, retusus, macula nulla impressa. Color intus albidus, saepius cum tinctura crocea."

The manifest error in the locality of this species was corrected by Gmelin, who changed it to "Mediterranean Sea." It is very common throughout its range, which includes not only the Mediterranean but the eastern Atlantic from the British Isles to Morocco.

No references were given by Linnaeus. The description, however, is clear enough to point to the shell which has long been known as *Tapes decussata* and which is represented in the collection by a marked specimen of the Mediterranean form of the species. The early writers, who were not preoccupied with any question of priority, used a number of specific names for it, as well as including it in several different genera. It was the *Venus literata* of Pennant, 1777, *V. deflorata* of Born, 1780, *Cuneus reticulatus* Da Costa, 1778, *V. obscura* Gmelin, 1791, and *V. florida* Poli, 1795. It has been included in *Venerupis* Lamarck, 1818, or *Pullastra* Sowerby, 1826, by many writers. The specific name *decussata* was soon restored, however, and is now exclusively used. The species belongs in the subfamily Tapetinae, genus *Tapes* Megerle von Mühlfeld, 1811, and subgenus *Amygdala* Römer, 1857, as the subgenotype. *Amygdala* Römer, is an exact synonym of *Ruditapes* Chiamenti, 1900, which has the same type. Thiele uses *Amygdala* as a subgenus under *Venerupis* Lamarck.<sup>1</sup> *Tapes* is not an easy genus to divide into subgeneric groups, as it was so strictly and perfectly defined by Megerle von Mühlfeld. Broadly speaking, we place the species with flat, concentric sculpture, of the type of *T. literata* (Linné), in the typical subgenus, the shells with reticulate and decussate sculpture, where the radial ribs are more prominent than the concentric, falling into the genus *Amygdala* Römer.

<sup>1</sup> *Amygdala decussata* was Römer's first species but was not specifically selected by him as type. It has nevertheless been used in subsequent works as the type of *Amygdala* and is generally so regarded.

Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, p. 434) considered the more finely sculptured Mediterranean form of *decussata* to be the typical one, possibly because only shells from that area were found in the Linnean collection. They figure both forms (*tom. cit.*, pl. 65, figs. 1-4, the Mediterranean form; pl. 66, figs. 1-8, the Atlantic form, which they call "variety *fusca* Gmelin"). Reeve figures the species (1843-1878, vol. 14, *Tapes*, pl. 11, sp. 57a-b).

*Venus virginea*

1767, *Systema naturae*, ed. 12, p. 1136, no. 150.

LOCALITY: "In Indiis" (1767).

"V. testa subovata antice subangulata, striis transversis inaequilineatis, vulva tumida. . . . Similis fere V. decussatae, sed magis rotunda, pallide incarnata, vix radiata, transverse striata, sed striae versus vulvae regionem saepius confusae. Vulvae regio tumidior, quam in reliquis, oblique striata."

This species, which was listed for the first time in the twelfth edition, was provided with no references, with an incorrect locality (it is a European species), but with a description that not only accurately describes the *Tapes virginea* of authors but clearly and in considerable detail distinguishes it from the preceding species. In spite of this, Linnaeus' successors gave it many different specific names. It is a well-known species of the British Isles, marked by the virtual absence of any posterior angulation of margin, the generally ovate shape of the shell, the irregularity of the concentric ribs, which become coarser at the two ends of the shell, and the pale pinkish tinge usually found on both the exterior and interior. While each of these features except the color might apply to one or another of the members of the genus *Tapes*, the pink color is confined to *virginea*. This trait is referred to in the description. An unmarked specimen of the British shell is in the collection, which agrees in all essential points with the language of Linnaeus. It is included in the typical subgenus of *Tapes* Megerle von Mühlfeld.

Figured in Reeve (1843-1878, vol. 14, *Tapes*, pl. 4, sp. 17a). Figure 17b of the same plate shows a shell said by Reeve to be a dark-rose colored form of *virginea*, but as it has thick concentric rugae covering the en-

tire shell, it cannot be conspecific with that species. It would be idle to speculate upon the species for which Reeve figured it.

THE "MANTISSA" SPECIES OF  
*Venus* LINNÉ  
*Venus puerpera*

1771, *Mantissa plantarum, regni animalis* appendix, p. 545.

LOCALITY: "In India orientali" (1771).

"Testa cordata subrotunda: striis membranaceis decussatis, labiis flexuosis. . . Testa magnitudine pugni, ponderosa, subrotunda, gibba, pallida s. subferruginea, antice fuscata: striis transversalibus submembranaceis; longitudinalibus obsoletioribus. Color intus supra vulvam violaceus. Vulva (non excisa) sub nymphis retractis. Labia superne incumbentia. Anus ovatus. Margo crenulatus. Affinis *V. reticulatae*."

The description of *V. puerpera* is more enlightening than that of any of the other "Mantissa" species; in fact, with the exception of that of *V. tripla*, it is the only one which permits us to make a certain identification. The relationship of the species to *V. reticulata* (p. 105, above) is clearly pointed out, not only by the details of the language but by a specific reference to that shell. By a manuscript note in his own copy of the twelfth edition, Linnaeus indicated that the species was to be placed immediately after *reticulata* in the proposed "revised twelfth edition." The synonymy figures two utterly dissimilar species, neither of them resembling *puerpera* and both unrecognizable.

Like *reticulata* it is in the subfamily Venerinae and the genus *Dosina* Gray, 1838. Frizzell's paper did not place this species, but Dr. A. Myra Keen advises me (personal communication) that, based on Frizzell's notes, this is where he probably would have put it. Most conchologists today use *Periglypta* Jukes-Browne, 1914, for the reception of *V. puerpera*. (See discussion of *V. reticulata*.)

Figured in Reeve (1843-1878, vol. 14, *Venus*, pl. 4, sp. 10), and in Sowerby (1847-1887, vol. 2, pl. 152, figs. 1-2). Both the figures in Chemnitz (1780-1795, vol. 6, pl. 36, figs. 388-389) and in the "Tableau encyclopédique" (1797, pl. 278, fig. 1) are of a shell which is closely related to *puerpera* and are

apparently meant for *V. magnifica* Hanley, 1845.

*Venus rugosa*

1771, *Mantissa plantarum, regni animalis* appendix, p. 545.

LOCALITY: Not given.

"Testa cordata sulcata rugis transverse striatis, ano minutissimo subrotundo. . . Testa magnitudine pollicis, cinerea, albo variegata, crassa, rotundata: sulcis 16 longitudinalibus, parallelis: rugis teretiusculus, transverse striatis. Vulva simplex. Anus puncti instar, ferrugineus. Nates subrecurvatae. Margo plicatus."

Little information is available for this unidentified species, and no modern writer has hazarded a guess as to what Linnaeus intended to describe. Both Gmelin and Chemnitz describe a *Venus rugosa*. Gmelin obviously believed that he was referring to the *rugosa* of the "Mantissa," as its listing in that work is specifically referred to, but his description varies so much from that of Linnaeus that it is difficult to believe that he was describing the same shell. The fact that he redescribed the species (using entirely different language) indicated that he had a specimen of something before him, but it is not possible to identify it. The description as a whole is confused. He also referred to a Chemnitz figure (1780-1795, vol. 6, pl. 29, fig. 303).

Chemnitz (*tom. cit.*, p. 308) called it *Venus rugosa orientalis*, but supplied no references. His figure 303, cited in the synonymy of Gmelin's *rugosa*, shows a large orbicular shell with regular concentric plications, having much the appearance of *Venus casina* Linné but with the anterior dorsal margin rising into a crest almost to the level of the umbones, as in *Anodontia alba* and other lucinids.

Hanley said (1855, p. 454) of *rugosa* Linné: "Gmelin has supposed it to be the *Venus rigida*!" Hanley apparently referred to *V. rigida* Dillwyn, 1817, as, while Gmelin did not list a *V. rigida*, he referred, as said above, to Chemnitz' figure 303, which is identified with *V. rigida* Dillwyn. Gmelin's conception of *rugosa* Linné was therefore very wide of the mark, as the Dillwyn shell, as well as the Chemnitz figure 303, bears little resemblance to the description of *rugosa* Linné. Lamarck labored under the same error, as he cited *V.*

*rugosa* as of "Lin. Gmel. no. 31" and cited for it the same figure 303 from Chemnitz.

Deshayes and Milne-Edwards (1835-1845, vol. 6, p. 339) felt sure that *V. rugosa* Gmelin was "var. B" of "*V. dysera* L. 12th Ed." This comment is not helpful, as variety "β" of the tenth-edition *dysera* was raised to specific rank in the twelfth edition as *V. paphia*, and the latter edition listed a typical *dysera* and varieties "γ" and "δ," omitting any reference to a variety "β." (See discussion of *V. dysera*, above.)

The description in the "Mantissa" is extremely confusing. In the main description Linnaeus speaks of "sulcata rugis transverse striatis . . ." and in the supplementary details he says, "sulcis 16, longitudinalibus, paralellis: rugis teretiusculis, transverse striatis." Bearing in mind that he ordinarily used the word "transverse" when speaking of concentric sculpture, and "longitudinaliter" in the case of radial ribs, we cannot be certain whether he was here describing a shell with cancellate sculpture or was guilty of a *lapsus calami* in the use of one or the other of the words. Hanley evidently interpreted Linnaeus' language as indicating only radial sculpture, as he said (1855, p. 454): "*Venus rugosa* was so briefly characterised that even its generic position can only be guessed at: the plicated margin and thick subcylindrical radiating ribs remind one of the ordinary features of a *Cardita*."

Sowerby (1847-1887, vol. 2, p. 728) lists "*V. rugosa* Gmelin 3276" and gives as synonyms: "*V. rigida* Dillwyn; Chem., fig. 303; *Test. jun. V. cincta* Chem., fig. 387." His figures (pl. 160, figs. 185-186) show an orbicular shell, much the shape of *V. puerpera* Linné, having the forward-pointing umbones of that species, and with regular concentric laminae. It is yellow, with irregular brownish rays. His description reads: "A very ventricose shell, laminae smooth and continuous. Under each one there is generally a small secondary riblet giving the appearance, where the edges have been rubbed off, of duplicate ribs. Dorsal margin is different in the two valves; one is smooth, the other laminated. West Indies."

The *Venus cincta* Chemnitz (1780-1795, vol. 6, p. 372, pl. 36, fig. 387) cited by Sowerby as the young of *V. rugosa* is, according to the

Chemnitz figure, a cordate shell with brown markings. It has the shape of *Chione cancellata* (Linné) and might be taken for that shell except that it lacks any concentric sculpture.

Based on the original description of *V. rugosa* it is impossible to refer it to any West Indian species, as Sowerby's diagnosis requires, and the conflicting references of Linnaeus' successors do little to assist us. I am not aware of any suggested identification since Sowerby's, the references to which are conflicting. It must be left as a *species dubius*.

### Venus tripla

1771, Mantissa plantarum, regni animalis appendix, p. 545.

LOCALITY: Not given.

"Testa subtriangulari laevi antice posticeque retusa. . . . Testa laevissima, magnitudine extimi pollicis, retusa s. ani regione versus vulvae regionem compressa, ut fere triangula; adeoque latus anterius et posterius respectu ad ipsam testam perpendicularia. Fornix et latus posterius intus violacea. Vulvae vix vestigium. Nymphae latentes, angulatae, solidae. Anus minutus. Margo integerrimus."

The description of this species in the "Mantissa," although unsupported by either references or locality, is sufficiently clear to enable us to identify it with the shell so long known as *Cytherea tripla* Lamarck, 1818. Its unusual shape and other shell characters are well described. A note by Linnaeus, in his copy of the "Systema," indicates that he proposed to insert it immediately after *Venus castrensis* in the "revised twelfth edition," and this to some extent confirms its inclusion in the group for which Lamarck erected his *Cytherea*.

Many good figures are available. The earliest are those of Chemnitz (1780-1795, vol. 6, pl. 31, figs. 330-332) with a good description on page 328. It was also illustrated by Reeve (1843-1878, vol. 14, *Cytherea*, pl. 5, sp. 16a, b) and by Sowerby (1847-1887, vol. 2, *Cytherea*, pl. 128, figs. 18-22). An excellent pair of figures, showing both the exterior and interior of the shell, are found in Crouch (1826, pl. 7, figs. 3a, b).

*Venus tripla* Linné is in the subfamily Meretricinae, tribe Meretricini, and genus *Tivela* Link, 1807.

The type of *Tivela* Link is *Venus tripla*

Linné, but the manner in which it is cited raises a question which should be considered, as I find that there is a wide divergence of opinion as to the application of Article 30 of the Rules in this case.

Link listed two species in his genus: *Tivela vulgaris* (which he said was a new name for *Venus corbicula* Gmelin, 1791, and which appears to be identical with *V. mactroides* Born, 1780) and *T. tripla* Linné. In his synonymy of the latter species appears the name "Le Tivel" of Adanson, 1757, which, in the writer's opinion, is sufficiently close to *Tivela* to permit *trippla* Linné to be considered the type by virtual tautonymy under the terms of Article 30. As I read the Article, the type, in cases of tautonymy, is the species that has the tautonymic name in its synonymy and not the synonym itself. If it be argued that Article 30 does not cover, and was not designed to cover, the case of a synonym that is a vernacular name, it may be answered that no such limitation is written into that Article. Indeed the difference between a French and a closely similar classical word is a difference no greater than that involved in accepting two different classical names, which have the same meaning, as constituting a case of virtual tautonymy, and the latter is specifically used as an example in the Article (e.g., *Equus caballus*). It has also been suggested to the writer that type by subsequent designation (of which one exists in this case and is discussed below) takes precedence over one by virtual tautonymy. There is no basis for that view in the text of the Article in question. If it be argued, further, that the part of Article 30 relating to virtual tautonymy is included only as a Recommendation in selecting a type by subsequent designation, rather than in that part relating to types accepted solely on the basis of the original publication, I think it can reasonably be answered that the framers of the Code, never intended that the principle of virtual tautonymy should not be used to validate an automatic or *ipso facto* type and that it should be applied in the same manner as absolute tautonymy. A type based on a virtually tautonymic synonym in the original publication should be cited as type as of the date of that publication, and not as of the date of some subsequent writer who specifically selected it or another species.

Herrmannsen in 1849 (1846-1852, vol. 2, p. 578) designated a type for *Tivela* Link. His selection is worded in an equivocal and partially incorrect manner, as: "Typus: Tellina Tivel Adans. (falso ad Veneram triplam L. citata)." In the first place he incorrectly stated the type to be the synonym and not the Linnaean species. Secondly, he said, in effect, that Linnaeus' *trippla* was not identical with Adanson's Tivel. With the latter statement I emphatically disagree. The overwhelming weight of evidence points to the common identity of the two names. In this connection the paper of Fischer-Piette and his co-authors on the Adanson species (1942, p. 334, pl. 15, fig. 7) should be read. These authors identify Tivel Adanson with *trippla* Linné beyond any doubt. In any case, the matter of identity is wholly irrelevant to the type question. It is the similarity of the names that governs, not the identity of the synonym.

Dall (1902, p. 349) made a later designation and selected *Venus mactroides* Born, 1780, which, as said above, equals *Tivela vulgaris* Link.

On all counts, therefore, I suggest that the Herrmannsen designation be disregarded. In any case, *Venus tripla* is the type of *Tivela*, even though my conception of the manner in which the type was constituted should be questioned. (See also Hemming, 1950, pp. 151-152).

#### *Venus succincta*

1771, Mantissa plantarum, regni animalis appendix, p. 546.

"Testa cordata sulcis transversis remotis excavatis, margine crenulato. . . . Testa magnitudine extimi digiti, subrotunda-cordata: sulcis transversis, remotis, 14: rugis distantibus, subreflexis, obtusis. Vulvae rima excisa. Anus ovatus, impressus. Margo interior crenulatus."

The only indication of the group in which this species belongs is a note by Linnaeus that it was designed to follow *Venus erycina* in the "revised twelfth edition," which suggests that it was close to that species, or at least a member of some modern genus in the tribe Pitarini. The description is so generalized that no subsequent writer, so far as I have been able to determine, has suggested a solution to its identity. It must remain a *species dubius*. It is not the *Venus succincta* of Valen-

ciennes, 1827 (*Chione californiensis* Broderip, 1835).

#### *Venus tumidula*

1771, Mantissa plantarum, regni animalis appendix, p. 546.

"Testa orbiculata gibba, sulcis transversis remotis obsoletiusculis . . . Testa suborbiculata, gibba: sulcis transversis, parallelis, distantibus, obsoletioribus. Vulva rima simplici. Anus impressus, rhombeo-excavatus. Margo integerrimus."

By the same evidence as was afforded us in the case of the last two species, we know the general placement of *tumidula*. It was to have been placed between *V. incrustata* and *punctata* in Linnaeus' revision, and this indication, together with certain details of the description, strongly suggests that it was a lucinid and probably an extremely globose form close to *L. jamaicensis* Lamarck, 1801. The species called *Lucina tumida* by Reeve, 1850, answers fairly well to the description except that *tumida* is an edentulous species, and it may, I think, be assumed that Linnaeus would have mentioned this fact. The description of *tumidula* contains considerable detail, but is too generalized to point to any one species.

#### *Venus compressa*

1771, Mantissa plantarum, regni animalis appendix, p. 546.

"Testa subcordata compressissima transverse sulcata. . . . Testa cordato-ovalis, compresso-planiuscula: rugis transversis, remotis, parallelis. Vulva linearis, subexcisa. Anus linearis, subexcisus, vulvae simillimus. Margo integerrimus."

Here also the description is broad enough to point to more than one species. Its position in the proposed revision was not noted by Linnaeus, and it is possible that he had abandoned it as a good species. No helpful suggestions have been advanced as to its identity, and the name should be dropped from the nomenclature. In common with all the venerids of the "Mantissa" except *puerpera* no references and no locality were supplied.

NOTE: The following species, placed in *Venus* in the tenth edition, was moved, in the twelfth edition, to the genus indicated:

*Venus scortum*, no. 76 Moved to *Donax (scortum)*, no. 102.

#### SPONDYLUS LINNÉ

*Spondylus* Linné contained only four spe-

cies; *S. gaederopus* and *S. regius* date from 1758; *S. plicatus* was added in 1767 in the twelfth edition of the "Systema"; and *S. antiquatus*, an unrecognizable species, was first described in the "Mantissa" in 1771.

The genus is closely allied to *Pecten*<sup>1</sup> not only in shape and sculpture but in the fact that the species of both genera lie normally on the right valve and are attached by a byssus when young. In the case of *Spondylus*, all species, with one exception, are attached by the right valve to rocks, corals, or other foreign bodies. This valve has accordingly been developed in the direction of coarseness and size. It has less prominent and less regular sculpture than, and usually lacks the brilliant color of, the upper valve. The single exception mentioned is *S. regius* Linné, which is not ordinarily attached and consequently shows a more regular and symmetrical growth of both valves and comparable sculpture on each. This sedentary habit produces great variation in the right valve, depending on the nature and contour of the object chosen for attachment and the size of the area of this valve which is actually adherent.

The genus arose in the Triassic and is a form evolved from the original *Pecten*, which had already appeared in the Carboniferous,<sup>2</sup> the evolution being manifested not only by the increasing coarseness of the lower valve and the increasing tendency of the animal to attach its shell, but by the profound modification and strengthening of the hinge, which is the heaviest and most efficient of that of any of the pelecypods, with the possible exception of *Cardium* and some of the larger venerids.

The species of *Spondylus* are difficult to identify. The original descriptions and figures are unusually vague, and, as is usual in the case of the fixed bivalves, the shells are peculiarly liable to deformation. This has resulted in the appearance of a great number of specific names, most of which are synonyms.

<sup>1</sup> Linnaeus' conception of the group was based merely upon the appearance of the shell, and took no account of its phyletic history. His comment is contained in a footnote on the page on which *Spondylus* begins, in both the tenth and twelfth editions: "Spondyli tota sua structura testae ad Ostreas accedunt, sed dentibus cardinis differunt, et spinis valvularum Chamas referunt."

<sup>2</sup> W. J. Dakin (1928, p. 354) has traced the evolution of *Spondylus* from the primitive *Pecten*.

Even the free upper valve is subject to great variation in color and in sculpture, as we often find in the same species a wide range of color, and types of rib decoration ranging from recurved, tubular, or spatulate spines to prominent or low foliated scales. A glance at the early descriptions and an examination of the figures cited for them show that many of the earlier described shells were either composite species or identical with species already named.

#### *Spondylus gaederopus*

1758, *Systema naturae*, ed. 10, p. 690, no. 127.

1767, *Systema naturae*, ed. 12, p. 1136, no. 151.

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

"S. testa subaurita spinosa. . . . Natum altera longior, hinc plana, ac si arte secta aut abrasa fuisset."

The short description of this species is identical in the 1758 and 1767 editions. The locality is the same, and the numerous references in the earlier edition are repeated in the latter with a few corrections of plate or figure and with the addition of a series of 14 drawings from Seba. In all, 28 figures from nine authors are cited in the twelfth edition, making the species one of the most amply supplied with references of any of the Linnaean shells. Unfortunately, this gallery of figures shows a great number of different *Spondylus*. The description, although perfectly clear as far as it goes, is so short and generalized that it could almost be taken for a generic definition. Thus, based on the published diagnosis alone, *gaederopus* must be considered a composite species and therefore specifically undefined. There is, however, a specimen of the common *gaederopus* of the Mediterranean in the collection, which, although unidentified with name or number, can safely be taken as the Linnaean type specimen. Not only does it agree perfectly with the few details of the description but was one of the only two *Spondylus* present, the other being the easily distinguishable *S. plicatus* Linné. This is perhaps not an identification that is supported by the most satisfactory sort of evidence, but we may rest assured that Linnaeus was in fact describing the *gaederopus* of the Mediterranean Sea, and this determination has been accepted since

the earliest times. Several names have been applied to color and sculptural forms, none of which are specifically separable. Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, p. 48) list a number of these names as varieties, but it is best to suppress them.

Hanley (1855, p. 82), realizing that the description and the references left the species undefined, followed the lead of his predecessors and based the identification squarely upon the Mediterranean locality. The species was so well known in Linnaeus' day that the locality must have had great weight. It was not necessary, however, to stress the locality in this case, as the existence of the specimen in the collection was a much more authoritative piece of evidence.

The present species is the type of the genus *Spondylus* Linné, by subsequent designation, Children, 1827. It is found not only throughout the Mediterranean, but in the eastern Atlantic from Morocco to Senegal, and in the Atlantic islands. Pallary (1938, p. 48) reports a very large race from the Syrian coast.

Figured in Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, atlas, pl. 10, figs. 1-5, fig. 5 representing the young of var. *aculeata*). The Reeve figure (1843-1878, vol. 8, *Spondylus*, pl. 3, sp. 13) is of a shell with spines of an exaggerated length, more resembling *S. regius* than *S. gaederopus*.

#### *Spondylus regius*

1758, *Systema naturae*, ed. 10, p. 690, no. 128.

1767, *Systema naturae*, ed. 12, p. 1136, no. 152.

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

"S. testa inaurita spinosa. . . . Simillima praecedente, sed major spinis et sulcis validioribus; forte insignis tantum varietas."

The only difference between the main description of this and the preceding species is that *gaederopus* is characterized as being "subaurita spinosa," whereas *regius* is "inaurita spinosa." Linnaeus was moreover apparently not satisfied that the two species were in fact distinct. Not only did he remark in his subdescription that the two were alike except for the strength of the spines and sulcations in *regius*, but he called attention to the variability of the latter species, "Simillima praecedenti, sed major spinis et sulcis validioribus; forte insignis tantum varietas." Moreover, the figure G from plate

23 of Argenville, which was cited for *regius* in the tenth edition and in the "Museum Ultricae," was transferred to the synonymy of *gaederopus* in the twelfth, and then by a manuscript note for the "revised twelfth" was returned again to the synonymy of *regius*. The differences pointed out by Linnaeus are, however, specific. The ears in *gaederopus* are present, although not highly developed, and the spines are generally longer, although both species are extremely variable in this respect. As Hanley says (1855, p. 83), the final allocation of the Argenville figure to the synonymy of *regius* was undoubtedly due to the size of the shell shown in that figure and its highly developed spines.

The *Spondylus regius* of Chemnitz (1780-1795, vol. 7, pl. 46, fig. 471), which is cited as of Linnaeus, agrees with the ampler language of the "Museum Ultricae" and has usually been cited as the type figure. It would, however, be difficult to identify *regius* Linné with the *regius* of authors from the description in the "Systema" alone.

As said in the introduction to this genus, *regius* is not generally found attached, and consequently the shell shows a more regular and symmetrical growth, both valves having the same outline and similar sculpture. The species ranges from Japan to New Guinea.

It is figured in Delessert (1841, pl. 20, fig. 1) and in Reeve (1843-1878, vol. 9, *Spondylus*, pl. 5, sp. 20). Reeve cites it as of Linnaeus, 1767. The Chemnitz figure mentioned above is undoubtedly *regius*, although the color is not accurate, being shown in variegated shades of brown, and the length of the spines seems much exaggerated.

#### *Spondylus plicatus*

1767, *Systema naturae*, ed. 12, p. 1136, no. 153.

LOCALITY: "In Java" (1767).

"S. testa inaurita mutica plicata."

Linnaeus gave only four words of description for this species. It is evident that it belongs to the group to which Lamarck gave the generic name *Plicatula* in 1801. It has been identified with *Plicatula gibbosa* Lamarck, 1801 (*Plicatula ramosa* Lamarck, 1819), the western Atlantic species, by many of the earlier conchological writers, including Lamarck himself, but this identification cannot be supported. In the first place,

the locality is stated to be Java, and in this case the locality is deserving of somewhat more credence than usual in the "Systema" as it was not drawn from one of the pre-Linnaean works cited as references. Further, an excellent drawing of *P. gibbosa* is found in Sloane's work on the natural history of Jamaica (1707, 1725, vol. 2, pl. 241, figs. 10-11), and, although this work was in Linnaeus' library and was often cited by him, the figure was not used. The two figures he did cite for this species cannot be referred to *gibbosa*. The reference "Gualtieri, t. 99. f. 2," as corrected,<sup>1</sup> represents a *Plicatula* which cannot be identified. The Rumphius (pl. 47) reference shows a shell on which the plications are smooth and not ramose. In both figures the plications are more numerous than in *gibbosa*, which ordinarily possesses only five to eight plaits. In the "Museum Ultricae" the description is more detailed and notes that the species has "circiter plicis decem." Both of the figures cited in the "Systema" agree in this respect with a specimen marked for *plicatus* in the Linnaean collection.

Hanley (1855, p. 84) identified this specimen as *Plicatula imbricata* Menke, 1843, which is now generally accepted by most conchologists as being the *Spondylus plicatus* of the "Systema." This is one of the cases where the brevity and inadequacy of the description of a Linnaean species may, I suggest, be overcome by the presence of a specimen in the collection, authoritatively marked for the species in question, and which conforms to such of the characteristics as are mentioned in the description. In other words, the documentation of the specimen is sufficient proof that it was the Linnaean type, even where the specific description, as in the present case, is little more than a generic diagnosis.<sup>2</sup>

*Plicatula plicata* has large angular plaits which are heavily imbricated. Thus it can-

<sup>1</sup> The Gualtieri citation reads "f. 2." There is no figure 2 on the plate, as Gualtieri always used lettered drawings. By a manuscript note Linnaeus corrected this entry to "f. E." The plate in question, furthermore, shows two drawings lettered "E," one showing a *Spondylus* and the other an unidentifiable *Plicatula*.

<sup>2</sup> By an interleaved manuscript note in his own copy of the tenth edition Linnaeus amplified the description of *S. plicatus*, but again the language is so generalized as to be of little additional assistance.

not be confused with *P. gibbosa* Lamarck, in which the radial ribs are much flatter and ramose rather than imbricate. It is an Indo-Pacific species, ranging from the Red Sea to Australia, China, and the Philippines. Lamarck himself attributed his *gibbosa* to the Linnean *plicatus* and cited the Chemnitz figures for the Indian Ocean shell (1780-1795, vol. 7, p. 90, pl. 47, figs. 479-480). Nevertheless he stated the locality to be "les mers d'Amerique." Thus he was in error in his identification, and chose the wrong figures, but gave the correct locality.

In addition to *Plicatula imbricata* Menke,<sup>1</sup> the following are synonyms: *P. chinensis* Mörch, 1852; *P. ramosa* Vaillant (*non* Lamarck), 1865; *P. spondyloidea* Lamy, 1911; *P. gibbosa* Dautzenberg (*non* Lamarck), 1929; and *P. ramosa* Dautzenberg (*non* Lamarck), 1933. This list shows what is possibly a curious persistence of the confusion caused by Lamarck's original error of identification.

*Plicatula plicata* (Linné) is figured in Reeve (1843-1878, vol. 19, *Plicatula*, pl. 1, sp. 4a, b, c, d, as *P. imbricata*).

#### *Spondylus antiquatus*

1771, Mantissa plantarum, regni animalis appendix, p. 547.

LOCALITY: Not given.

"Testa orbiculata longitudinaliter sulcata porcis squamosis. . . . Testa antiquata, magnitudine extimi pollicis, suborbiculata, nivea, (*non* plicata), dorsis sulcorum aequaliter granulatis, quasi crenulato-serratis. Margo interior subcrenatus quasi unguibus alternis, duplicatis. Cardo Spondylii."

This species has not been identified. Gmelin omitted it, and none of his successors has attempted to cite it as anything but a *species dubius*. Hanley (1855, p. 455) merely suggested that it might have been a fossil. Linnaeus' only further reference to it is a manuscript note designed to indicate to the printer that it should follow *S. plicatus* in the "revised twelfth edition." This, in a genus of only four species, is not a particularly helpful clue. Its position at the end of the list does not necessarily mean that it was related

<sup>1</sup> *P. imbricata* Menke is itself a homonym, as Koch and Dunker in 1837 used the name for a fossil *Plicatula* from the Lower Cretaceous of northern Germany. This is an additional reason for restoring the Linnaean name for the Indo-Pacific shell.

to any of them except the last. We know from the description that the shell was small, "magnitudine extimi pollicis," and suborbicular, and that the margins were not plicated although it was provided with the granular sulcations of most of the *Spondylus*. It was evidently not a *Plicatula*, and neither these details nor any of the other recorded characteristics point to any known *Spondylus*, either Recent or fossil.

#### CHAMA LINNÉ

The genus *Chama* of the tenth edition of the "Systema naturae" contained only 10 species. Four more (*cor*, *trapezia*, *satiata*, and *arcinella*) were added in the twelfth, and two (*rugosa* and *gryphica*) in the "Mantissa" of 1771, making in all 16 names. It was an extremely heterogeneous group as it was conceived by Linnaeus. Only two of the names (*lazarus* and *gryphoides*) are generally recognized as belonging in *Chama* as that genus is at present constituted, and the other identified species have fallen into various genera of the families Carditidae, Isocardiidae, Tridacnidae, and Trapeziidae, and one in *Arcinella* in Chamidae. Three names, including the two described in the "Mantissa," I am unable to identify, and one name is a mere duplication of another.

The type of *Chama* Linné is *Chama gryphoides*, by subsequent designation, Schumacher, 1817, which antedates by six years Children's designation of *Chama lazarus* Linné. The latter species was also selected by Lamarck in the "Prodrome" of 1799 as the "example" of the genus.

The dismemberment of *Chama* began very early. Bruguière (1789, 1792, p. 401) described the new genus *Cardita*, in which he included several of Linnaeus' non-sedentary species of *Chama*, and in the "Tableau encyclopédique" (1797, pls. 235-236) fixed the name *Tridacna* which has now been validated by the International Commission as a good Bruguière name as of 1797.<sup>2</sup> In 1798, in the "Museum Boltzenianum," Röding created

<sup>2</sup> Prior to the opinion of the International Commission, as yet unpublished, validating the Bruguière generic names used as plate headings in the "Tableau encyclopédique," the earliest name for the group was *Tridacnes* Röding, 1798. The question of whether the Röding name was validly proposed is now academic, as Bruguière's *Tridacna* has one year's priority.



the genus *Beguina* for those species that are now generally included in *Glans* Megerle von Mühlfeld, 1811, *Mytilicardia* Anton, 1839, and other groups. In the "Prodrome" of 1799, Lamarck erected *Isocardia* for the reception of *Chama cor* Linné and *Hippopus* for *Chama hippopus* Linné and gave these species as the "examples" of the two respective genera. Later (1818-1819, vol. 6, p. 27), he described *Cypricardia*, to contain *Chama oblonga* Linné as first species (called by Lamarck *Cypricardia guiniaca*) and several other related species, Recent and fossil, most of them being new.

Many other generic names have been published since then for groups represented by species in *Chama* Linné, but there is unfortunately no unanimity of opinion among conchologists as to the value and coverage of these various supraspecific names. The exact taxonomic position, for instance, of *Cardita* Bruguière, 1792, *Glans* Megerle von Mühlfeld, 1811, *Arcinella* Oken, 1815, *Beguina* Röding, 1798, *Mytilicardia* Anton, 1839, *Cypricardia* Lamarck, 1819, and other related genera needs much further study, which is outside the scope of this review.

#### *Chama cor*

1758, *Systema naturae*, ed. 10, p. 682, no. 82 (*Cardium humanum*).

1767, *Systema naturae*, ed. 12, p. 1137, no. 154 (*Chama cor*).

LOCALITY: "In M. Mediterraneo rarius" (1758); "in M. Adriatico versus Dalmatiam" (1767).

"C. testa subrotunda laevi, natibus recurvatis, rima hiante. . . Testa crassa, subrotunda, exalbido-lutescens. Nates evidentius quam in aliis, cornu arietis in modum oblique versus anum convolutae. Rima nymphis nudis, hymene obtectis. Ano regio sub natibus retusa. Cardo callis compressissimis."

Although Linnaeus' *Cardium humanum* of the tenth edition<sup>1</sup> is not referred to in the diagnosis of *Chama cor*, it is obvious that the two names cover the same species. The short main descriptions are identical and the longer subdescriptions almost the same, ex-

<sup>1</sup> This is not the *Cardium humanum* of Chemnitz (1780-1795, vol. 6, p. 153, pl. 14, figs. 145-146), which, as Chemnitz states, is "*cardissa* Lin." He did not cite the "*Systema naturae*" in his synonymy, although he refers to the "*Museum Ulricae*" (p. 484, no. 32) which cites the *Cardium cardissa* of the tenth edition.

cept for a few minor changes in the twelfth edition, largely involving a choice of words. The four references in the tenth are copied verbatim in the later edition, with two additions from works which were not available to Linnaeus in 1758. The amended locality is merely a limitation of the original range.

The combination of the ample and characteristic description and the unusually accurate synonymy identifies the species. It is the *Isocardia cor* of the Mediterranean Sea and near-by Atlantic waters. The species has had a disturbed nomenclatorial history. Bruguière (1789, 1792, p. 401; 1797, pl. 232, figs. 1a, b, c, d) placed it in his *Cardita*, but Lamarck (1799, p. 86) erected the genus *Isocardia* for its reception, using it as the "example" of that genus. Later (1801, p. 118) Lamarck called the species *Isocardia globosa*, but resumed the specific name *cor* in his major work (1818-1819, vol. 6, p. 31). Mörch (1852-1853, vol. 2, p. 38) transferred the species back to *Cardita*, using *Isocardia* only as a monotypic genus for a Chinese species, *Isocardia vulgaris* Reeve, 1845. It is now, however, universally placed in *Isocardia* Lamarck and is the type of the genus, by monotypy. It was also designated as the type by Children in 1823. Dall (1890-1903, vol. 3, pt. 5, p. 1064) very properly restored the tenth-edition specific name *humanum*, calling it *Isocardia humana*. Lamy (1920b, p. 292) and Thiele (1931, 1935, vol. 2, p. 855) followed Dall. It is still known by most conchologists, however, as *Isocardia cor*, although there is every reason to use the earliest validly published name.

It is surprising that Linnaeus, in describing *Chama cor*, did not refer back to the *Cardium humanum* of 1758. His only reference to his own works was to the "*Museum Ulricae*," where it was given another specific name, *cordiformis*. I have already referred, under *Maetra corallina*, to the casual manner in which Linnaeus documented his changes of generic and specific names. It is even more surprising that Hanley, in his exhaustive study of the Linnaean writings and collections, did not perceive the identity of the two names, or at least did not mention it (1855, pp. 84-85).<sup>2</sup>

<sup>2</sup> In Bruguière's listing of the species as *Cardita cor* (1789, 1792, vol. 1, p. 401) he, too, failed to mention *Cardium humanum* and referred only to the twelfth

Good figures of the species are found in Bucquoy, Dautzenberg, and Dollfus (1882–1898, vol. 2, atlas, pl. 51; figs. 1–2 showing the Mediterranean specimens, and figs. 3–5 those from the Atlantic). The interior of the shell is shown in Thiele (1931, 1935, vol. 2, fig. 818).<sup>1</sup>

#### *Chama gigas*

1758, *Systema naturae*, ed. 10, p. 691, no. 130.

1767, *Systema naturae*, ed. 12, p. 1137, no. 155.

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

"C. testa plicata fornicato-squamosa, ano hiante crenato. . . Testae pondere librarum 532 in M. L. U., adeoque omnium testaceorum maximae. Variat rugis transversis confertissimis."

The description of this species is identical in both editions of the "Systema" except for the following change in the twelfth: "fornicato-squamosa" for "squamosa" and the addition of the words "variat rugis transversis confertissimis" to the subdescription. The list of six references is the same, as is the locality. The name *gigas* is on the list of species owned by Linnaeus, but the collection contains no marked example of the shell. There are two *Tridacna* present, a specimen of *T. squamosa* Lamarck, 1819, and a juvenile specimen of what is apparently *T. elongata* Lamarck, 1819. It is evident from the very generalized description and the number of different species apparently portrayed in the

edition of the "Systema." Chemnitz, on the other hand, in his discussion of *Chama cor* Linné (1780–1795, vol. 7, p. 102), specifically refers to the *Cardium humanum* of the tenth edition.

<sup>1</sup> Since the above comments on *Isocardia humana* (*Cardium humanum* Linné–*Chama cor* Linné) were written, Nicol (1951, pp. 142–146) has pointed out that the name *Glossus* Poli, 1795, which had been almost lost sight of, is a good name for the genus to receive Linnaeus' *humanum* as having four years' priority over *Isocardia* Lamarck, 1799.

The assumed invalidity of the Poli names stemmed from the theory that the Poli 1791–1795 work was not binomial. Most earlier writers passed over *Glossus* without mentioning it. Dall (1890–1903, pt. 5, p. 1064), although he placed it in his synonymy of *Isocardia*, stated that it was not binomial. This is hardly a correct interpretation of Poli's method. He used two generic names in all cases, one for the animal and the other for the shell, the latter always ending in "derma"—hence *Glossus* and *Glossoderma*. This does not seem a valid reason for rejecting Poli's names, and the Linnaean species should be cited as *Glossus humanus* (Linné), 1758, the name *Glossus* being preferred over *Glossoderma* because of page priority.

pictorial synonymy, that Linnaeus regarded the several *Tridacna* there shown, as well as those present in the collection, as mere varieties of the same shell. Thus the *gigas* of the "Systema," based on the references and the collection, must be considered a composite species. The description, however, refers to a specimen in the "Museum Ulricaë" which weighed 532 "libra"<sup>2</sup>—"the largest of all shells." This, of course, was the giant clam of the Pacific. Undoubtedly he conceived of the others as being juvenile shells or varieties. The more ample and characteristic description in the "Museum Ulricaë" does not indicate that Linnaeus had by that time clearly differentiated the separate species, and, moreover, three years later, in the twelfth edition, he repeated the description and references of the tenth.

Lamarck (1818–1819, vol. 6, p. 105) lists a *Tridacna gigas* for which he cites a number of references, including one (Rumphius, pl. 43, fig. B) which was cited for the present species by Linnaeus (with the usual error of pl. 42 for 43), but in citing *gigas* Linné as a synonym he adds a question mark. His synonymy is much more accurate, however, and his description more characteristic, and there can be no doubt but that he means the huge *gigas* of all subsequent authors.

Hanley (1855, p. 85) believed that *gigas* Linné was in fact *Tridacna squamosa* Lamarck, 1819, basing his opinion on the fact that it was described as "decussatim striata" in the "Museum Ulricaë." This fits *squamosa* only, as that shell has decussate sculpture not only on the ribs but in the intercostal spaces, whereas *gigas* is described by Lamarck as having no sculpture between the ribs—"costarum interstitiis non striatis." Therefore, Hanley declares, Lamarck's acceptance of Linnaeus' *gigas* as describing the giant clam, even though this acceptance is limited by a query, was unfortunate, as on the next page he describes *squamosa* in a way which clearly identifies it with *gigas* Linné.

This identification of *gigas* with *squamosa* has been suggested from time to time ever since Hanley's day, the most recent comment on the matter being by Hedley (1917, pp. 686–688). Hedley felt that *Chama gigas*

<sup>2</sup> The Roman "pound" of 12 ounces.

Linné was a composite species "embracing the whole of the modern genus *Tridacna*" but adds, "For the name *gigas*, as restricted to a single species, the candidates are the shell subsequently named *squamosa* by Lamarck and a huge species whose valves in the Ulrica Museum, together weighed 498 pounds." Hanley based his opinion in part on the unstable basis that a specimen of *squamosa* Lamarck is in the Linnaean collection, but as this specimen is not documented by name or number it has no probative value whatever, and its authenticity as the type of *gigas* Linné is further impugned by the presence of a specimen of *C. elongata* Lamarck, also unmarked. It is true that most of Linnaeus' references look more like *squamosa* than like the great clam now generally known as *gigas*, and that many of Linnaeus' contemporaries and immediate followers, notably Born, 1780, and Chemnitz, 1784, figured the smaller shell as *gigas* Linné. As against this argument we have, however, the explicit language of Linnaeus mentioning the huge specimen in the "Museum Ulricae." This language is part of the description of the species and as such should be given greater weight than the references or the opinions of certain of Linnaeus' followers. It could not be applied to any specimen of *squamosa* ever reported.

Hanley's argument, however, so convinced Hidalgo that in 1903 the latter renamed the largest species *Tridacna lamarcki*. Perry in 1811 had already renamed it *Chama gigantea*. Nevertheless there is no doubt that Linnaeus, although he may have considered *squamosa*, *elongata*, and others of the later-named *Tridacna* to be forms or varieties of the bigger shell, was in fact describing the huge specimen in the "Museum Ulricae" when he wrote his diagnosis of *gigas*. On this basis the specific name *gigas* must be retained as it is generally used today.

Hedley (1917, p. 687) did not unequivocally accept the opinion of Hanley and Hidalgo, but left the question open, with the following suggestion: "As the young of the giant has not yet been traced to the adult, it is still possible that *squamosa* is a juvenile deeper-water form of the large intertidal and abraded *gigantea*." There are several mollusks that produce their eggs in shallow water and the

young of which make their way to deeper water to pass the juvenile stage, returning to the intertidal zone when approaching full growth. It is possible, therefore, that further research can demonstrate that this migration takes place with the young of *gigas*, and that *squamosa* represents these young individuals. This seems to me, however, to be highly improbable. The sculpture of *squamosa* is very elaborate and characteristic and quite different from that of *gigas*, and I have not seen any intermediate forms which intergrade into one another. Until such a series is produced the two species must be considered distinct. A more cogent argument is that full-sized specimens of *squamosa* bear all the morphological earmarks of adult shells.

*Chama gigas* is well figured by Reeve (1843-1878, vol. 14, *Tridacna*, pl. 1, sp. 1a, and pl. 2, sp. 1b, c). *Tridacna squamosa* is also figured by Reeve (*tom. cit.*, pl. 3, sp. 3a; pl. 4, sp. 3b, c, d).

#### *Chama hippopus*

1758, *Systema naturae*, ed. 10, p. 691, no. 131.

1767, *Systema naturae*, ed. 12, p. 1137, no. 156.

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

"C. testa plicata muricata, ano retuso clauso dentato."

The entire diagnosis of this species in the tenth edition is copied in the twelfth with no additions. The description is completely adequate to identify the shell, as well as to distinguish it from the preceding species, and indeed from any other *Tridacna*, by the reference to the fact that the shell is not gaping in the region of the lunule and that the latter is bordered with denticles, "ano retuso clauso dentato." This distinction was the acknowledged basis for Lamarck's separation of the genus *Hippopus*, 1799, for the reception of this species, of which it is the type, by monotypy.<sup>1</sup> In 1801 Lamarck changed the specific name to *maculatus*, and continued to use this latter name in 1819. Many authors have used the Lamarckian specific name,

<sup>1</sup> Lamarck said (1818-1819, vol. 6, p. 108), "I have separated *Hippopus* from the tridacnas solely because the lunule is closed, the edges of the valves in this region being toothed although touching one another. This characteristic of the shell indicates a special modification of the animal's habit, since it appears that it cannot attach itself to rocks by a byssus like that of the tridacnas. Only one species of this genus is now known."

and indeed Thiele cites the type of *Hippopus* Lamarck as "*Hippopus maculatus* Lamarck," possibly on the theory that Lamarck's species was different from that of Linnaeus or that Linnaeus' diagnosis was an insufficient basis for a specific name. I can see no reason for either of these theories. The two species are demonstrably the same, and Linnaeus' diagnosis is clear and convincing. There is every reason for restoring once for all the Linnaean name.

A specimen of *hippopus* is present in the collection which, although unmarked, agrees uniquely with the description.

It is figured in Chemnitz (1780-1795, vol. 7, pl. 50, figs. 498-499, figures that were cited by Lamarck, 1818-1819), and in Reeve (1843-1878, vol. 14, *Hippopus*, pl. 1, sp. 1). Thiele (1931, 1935, vol. 2, p. 883, fig. 834) figures the interior of the shell.

#### *Chama antiquata*

1758, *Systema naturae*, ed. 10, p. 691, no. 132.

1767, *Systema naturae*, ed. 12, p. 1138, no. 157.

LOCALITY: Not given in 1758; "in O. Africano" (1767).

"C. testa subcordata, sulcis longitudinalibus striisque transversis."

In this species we find, as is the case in most of the *Chama* descriptions, an exact concordance of language in the two editions. In 1758 Linnaeus referred only to Gualtieri (pl. 1, fig. L), but in the later edition several other references were added. The species was identified by the early writers with Bruguière's *Cardita sulcata*, 1792, although some doubt was cast on this identification by the presence of an unmarked shell, referred to by Hanley as *Cardita bicolor* Lamarck, 1819, in the same tray as the unmarked specimen of *antiquata*. Reeve gives a good figure of the species, calling it *antiquata* (1843-1878, vol. 1, *Cardita*, pl. 6, figs. 29a, b) and in the text cites *C. turgida* and *C. bicolor* Lamarck as synonyms. He says, "Having identified the shell here figured with the *Chama antiquata* of Linnaeus, by an examination of the very shell described by that illustrious writer in the possession of the Linnaean Society, I restore the ancient name." *C. sulcata* Bruguière is listed and figured by Reeve separately as a good species (*tom. cit.*, pl. 7, sp. 35a, b) and is stated by

him to be synonymous with "*Chama antiquata* Poli, (not Linnaeus)." He further comments (text for pl. 7): "The *Cardita sulcata* and *antiquata* have been so confounded together by authors that it is extremely difficult to arrange the synonyma; an examination of the identical shell described by Linnaeus under the latter title (in the Museum of the Linnean Society) enables me, however, to certify that the *Chama antiquata* of Linnaeus is not the *Chama antiquata* of Poli."

I have quoted Reeve in full on this question in order that my own doubts on the subject may be excused. His statement is not a satisfactory explanation of the problem. I agree that the *antiquata* of Linnaeus and Poli are not identical, but I believe that Reeve is wrong in tying Bruguière's *sulcata* to Poli's *antiquata* and, further, that we should accept the general view that Linnaeus' *antiquata* is *sulcata* Bruguière.

The species varies considerably in shape, particularly as to the degree of extension of the posterior end and the flatness or rotundity of the ribs. Lamarck's *bicolor* and *turgida* were apparently based on these variations. I am therefore not disturbed by the presence of a specimen of *bicolor* in the tray with *antiquata*. The description and the presence of authenticated varieties of the shell certainly justify the retention of the Linnaean name *antiquata*. The most recent commentator on this species, Thiele (1931, 1935, vol. 2, p. 847), does not go this far. He cites the type of *Cardita, sensu stricto*, as "*C. (C.) sulcata* Bruguière=*antiquata* Linné," thus recognizing the common identity of the two names but failing to acknowledge the prior validity of the Linnaean name. Grant and Gale (1931, p. 272) cite the type of *Cardita* in the same manner.

The genus *Cardita* was erected in 1792 by Bruguière. The present species was designated as its type by Children, 1823, as "*Cardita sulcata* (*Chama antiquata* Linn.)" The exact distinction between *Cardita, Glans* Megerle von Mühlfeld, 1811, *Cyclocardia* Conrad, 1867, and *Venericardia* Lamarck, 1801, is still a matter of controversy.

In addition to the Reeve figures referred to above, good photographs of the species and its varieties are found in Bucquoy, Dautzen-

berg, and Dollfus (1882-1898, vol. 2, atlas, pl. 38, figs. 1-9) who place it in *Venericardia* Lamarck, 1801.

Although conchologists are seemingly unanimous in identifying the Linnaean species with Bruguière's *Cardita sulcata*, most writers have been unwilling to restore the Linnaean specific name (cf. Thiele, and Grant and Gale, above). Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, pp. 222-225) comment extensively on this question. They treat *antiquata* Linné as a very doubtful species, criticizing the description, the accuracy of the synonymy, and the lack of documentation of the specimens in the collection. The locality, "O. Africano," suggests to them that Linnaeus was describing *Cardita ajar* Bruguière, and they mention the undoubted fact that the figure Linnaeus cited from Adanson showed the latter species. Parenthetically, the locality of the Mediterranean shell might well be given as "O. Africano." They then refer to the fact that most writers have preferred to use the Bruguière name *sulcata*, but treat that name as a homonym which cannot be retained, as there exists a well-known Eocene fossil in the same group which was described in 1766 by Solander (*in* Brander) as *Chama sulcata*. They therefore accept the name *antiquata*, saying (*op. cit.*, p. 225): "Under these circumstances and in order to avoid proposing a new name, we have decided to follow the example of those who have preserved the name *antiquata*. . . ." It is obvious that this decision is not based on their conviction as to the propriety of using the name but merely on their desire to find an easy way out of a difficulty. In addition to the entirely unjustifiable willingness of these authors to cut corners in order to avoid an issue, they would be in error today in considering *sulcata* Bruguière as a homonym, as an examination of the Brander work shows it to be consistently non-binomial and therefore nomenclatorially unavailable.<sup>1</sup>

<sup>1</sup> The Brander work is a catalogue, with descriptions, of a collection of fossil shells from the Hampshire cliffs in England, which is lodged in the British Museum. As Brander states in his foreword, the descriptions were written by Solander. Any species there described should therefore be cited as Solander *in* Brander, 1766. The names of the species are all polynomials, and, in the case of the shell now under discussion (p.

### *Chama trapezia*

1767, *Systema naturae*, ed. 12, p. 1138, no. 158.

LOCALITY: "In Oceano Norvegico."

"C. testa trapezia gibba, sulcis longitudinalibus crenulatis. . . Testa magnitudine pisi, gibbosa ut Arca Noae, fere trapezia, ferruginea. Nates parum recurvatae, anus ovato-cordatus. Vulva oblonga, distincta, plana, extus crenata. Striis totius 20, longitudinalibus, crenatae, nodulis obtusis. Margo crenulatus."

In the case of this species a properly marked tray contains a specimen of the *Cardita trapezia* of most modern authors, which conforms so completely with the accurate and ample description that no doubt has ever been raised as to the shell to which Linnaeus referred. No references were given.

I am tentatively following Grant and Gale (1931, p. 276) in placing the species in *Glans* Megerle von Mühlfeld, 1811, of which it is the type, by monotypy. Thiele (1931, 1935, vol. 2, p. 848) also puts it in this genus, which he makes a section of *Beguina* Röding, 1798.<sup>2</sup>

140), the name *sulcata* is even in parentheses, as "*Chama (sulcata) testa subcordata, longitudinalibus sulcata, porcis crenulatis.*" Brander's figure (fig. 100) shows a shell which is readily distinguishable from Bruguière's *Cardita sulcata* as the latter is described and figured in Bruguière's text and plates (1789, 1792, vol. 1, p. 403; 1797, pl. 233, fig. 2). Bruguière's shell is an obliquely inequilateral species, whereas Brander's fossil is almost globular. The latter is identical with the fossil *Venericardia subglobosa* of James Sowerby (1812-1829, vol. 3, p. 61, pl. 289, upper and middle figures) and with the *Cardita sulcata* of d'Orbigny (1850, vol. 2, p. 423). It is not the *Cardita sulcata* of James Sowerby (1822, 1825, 1834, vol. 1, pl. 76), which, although only the inner aspect is figured, is probably Linnaeus' *antiquata*, as Sowerby states, nor the *Chama sulcata* of Deshayes (1824, p. 250, pl. 35, figs. 8-9) which is an obvious *Chama* with concentric lamellate sculpture and the typical *Chama* hinge.

<sup>2</sup> The name *Beguina*, from the "Museum Boltenianum," was resurrected after its synonym *Trapezium* (not *Trapezium* Megerle von Mühlfeld, 1811) was invalidated by Opinion 51 of the International Commission on Zoological Nomenclature, which declared invalid all names in the "Museum Calonnianum," 1797. Dall had already (1890-1903, pt. 6, preface, p. x) expressed his criticism of this work by saying: "This compilation from the manuscript of Hwass, edited by Da Costa, and printed for the auctioneer, George Humphrey, has usually been credited to the latter. I confess my desire to settle the nomenclature on a firm basis, though great, has not been equal to the acceptance of these anonymous, undefined, worthless names, which would involve the loss of much that is fundamental in the nomenclature of mollusks. I still hope that the common-sense of naturalists will find a way—if necessary, an arbitrary

Although Linnaeus' northern European localities are almost always correct, he made a strange error in this case in spite of the fact that the collector's name (Zoega) was given, as *trapezia* is a Mediterranean shell. I know of no *Cardita* from Norwegian waters.

A few authors have denied that the common *trapezia* of our collections is the one that Linnaeus described. Lamarck (1818-1819, vol. 6, pt. 1, p. 23) did not list the "Systema" in the synonymy of his *Cardita trapezia*, citing it as "*Chama trapezia* Mull. Gmel. p. 3301," and "*Cardita trapezia*, Brug. dict., p. 236, tab. 8, f. 17." He also gives the locality as "la mer de Norwége." Reeve also cites *trapezia* as "*Chama trapezia* Müller" but gives it a correct locality, "Coast of Sicily." Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, p. 231) identify it with *Cardita squamosa* Lamarck, 1819, another Mediterranean shell, which they figure (*tom. cit.*, atlas, pl. 38, figs. 21-25).

*Glans trapezia* is figured in Reeve (1843-1878, vol. 1, *Cardita*, pl. 4, sp. 25) as of Müller.

#### *Chama semiorbiculata*

1758, Systema naturae, ed. 10, p. 691, no. 133-1767, Systema naturae, ed. 12, p. 1138, no. 159-

LOCALITY: Not given in either edition.

"C. testa semiorbiculata compressa rudi decussate striata. . . Testa longitudinaliter striata, imbricata squamis annotinis. Lobus ani albidus marginae postice crenato."

The description, identical in the two editions, is clear and in complete accord with a specimen of a shell in the Linnaean collection which was called *Cardita phrenitica* Born, 1780, by many of the earlier writers. No figures nor locality was cited.

Both Bruguière and Deshayes and Milne-Edwards<sup>1</sup> considered that the Linnaean description was clearly applicable to *phrenitica*,

way—to eliminate this publication from authorized sources of nomenclature."

*Beguina* Röding has been adopted by many workers in addition to Thiele. It is very close to *Glans* Megerle von Mühlfeld, 1811.

<sup>1</sup> Bruguière says (1789, 1792, vol. 1, p. 410): ". . . it is very probable that this *phrenitica* is the shell which Linnaeus described under the name of *Chama semiorbiculata*, a fact which has not been recognized by authors, although his description was sufficiently accurate, doubtless because this naturalist did not cite figures."

Deshayes and Milne-Edwards' comment is (1835-1845, vol. 6, p. 430): "The description which Linné gives, in the Museum of the Princess Ulricae, of *Chama*

and that the diagnosis in the "Museum Ulricae" confirmed this view. Born (1780, p. 83) and Chemnitz (1780-1795, vol. 7, pp. 135-137) synonymize *phrenitica* with no reference to Linnaeus' *semiorbiculata*. Lamarck was in doubt. He said, in his synonymy of *Cardita phrenitica* (1818-1819, vol. 6, pt. 1, p. 24), "*An chama semi-orbiculata [sic]? Lin.*," although he lists "*Cardita semi-orbiculata*. Brug. Dict." without a query, in spite of Bruguière's pronouncement that the two names probably referred to the same shell. Reeve (1843-1878, vol. 1, *Cardita*, pl. 3, sp. 10) came closer to the truth but still was unwilling to restore the Linnaean name. He cited *semiorbiculata* as of Bruguière, supplied a good figure of the species, but placed both *semiorbiculata* Linné and *phrenitica* Born in its synonymy.

There is little doubt that the two names refer to the same species, and there seems ample reason from the evidence available to restore the Linnaean name. I am tentatively placing *semiorbiculata* in *Glans* Megerle von Mühlfeld, 1811. Thiele also recognized that *semiorbiculata* is the prior and valid name but puts the species in the typical subgenus of *Beguina* Röding, 1798, as the subgenotype rather than in the subgenus *Glans*. He considers *Beguina* as a good genus and as replacing the *Trapezium* of the "Museum Calonnianum," 1797, of which all the names have been declared unavailable by Opinion 51, as noted in the comment on the preceding species, *Chama trapezia*.

#### *Chama calyculata*<sup>2</sup>

1758, Systema naturae, ed. 10, p. 692, no. 134.

1767, Systema naturae, ed. 12, p. 1138, no. 160.

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

"C. testa oblonga, sulcis imbricatis, antice retusa. . . Testa magnitudine extimi articuli digiti, alba, oblonga, sulcis longitudinalibus imbricatis, squamulis fornicatis. Nates obtuse gibbae, auctae testa juventutis fusca. Rima minima.

*semiorbiculata*, is such that it cannot be doubted but that it is identical with this species [*Cardita phrenitica*]; it is proper, therefore, to restore the Linnaean name."

<sup>2</sup> The name *calyculata* suggests a shell shaped like a cup, or calyx, or containing a calyx-shaped part, but the present species is no more cup-shaped than any of the other members of the genus. The name calls up a picture of the *Cardita concamerata* of Bruguière, 1792 (*Thecalia concamerata*), which has a cup-shaped depression inside, bounded by an incurving sinus of the margin. No such feature is present in *calyculata*. It is curious that Linnaeus chose this name for the shell.

Venter antice compresso-gibbus; supra rotundatus. Dorsum compressum, retusum. Anus orbiculatus, minimus; pone anum angulus obtusiusculus valde prominulus exit."

The long and extremely graphic description of this species, identical in both editions, is sufficient for certain identification. The sole reference in the tenth edition (Gualtieri, pl. 91, fig. F) shows a tolerably clear drawing of the *calyculata* of modern authors. The two other references added in the twelfth edition (figures from Adanson and Lister) show two different shells, neither of which resembles the present species, Lister's figure probably representing *C. variegata* Bruguière. No marked specimens are found in the collection, but there are numerous unmarked examples of the *calyculata* of authors, and a single valve of *C. variegata* is in a tray of mixed shells which cannot be positively said to have been the property of Linnaeus. Although the ribs of *variegata* are much more numerous than those of *calyculata*, both species could be tied to the description, which does not mention the number of ribs. The Mediterranean locality, however, the word "alba" in the description of the present species, the failure to mention the conspicuous pattern of reddish crescents on the ribs of *variegata*, and the lack of authority suggested by the manner in which the specimen of *variegata* was housed in the collection have been sufficient to exclude the latter species from consideration.

Born (1780, p. 82, pl. 5, figs. 10-11), Chemnitz (1780-1795, vol. 6, pp. 133-135, pl. 50, figs. 500-501), and several of the other early writers confused the two species under the name of *calyculata*. Bruguière was the first to separate them by applying the new name *variegata* to the more highly colored shell. The ribs in *calyculata* number 18 as against 21 in *variegata*, the scales on the ribs are smaller and more numerous, the intercostal spaces are wider, and the shell is a uniform yellow-white, with only an occasional trace of the color pattern of *variegata*. Deshayes and Milne-Edwards dismissed the claims of the latter species as the representative of *calyculata* Linné (1835-1845, vol. 6, pp. 431-432, footnote). Reeve, while he placed *calyculata* in the synonymy of *variegata*, did so with a query (1843-1878, vol. 1, *Cardita*, pl. 1, sp. 3). Since Reeve, I cannot

find that the two species have been confounded. I do not consider that the existence of the specimen of *variegata* in the collection, suspect as it is, is any ground for calling *calyculata* a composite species.

Lamarck was also confused on the subject of these two shells. In 1799 he selected *calyculata* Linné as the "example" of *Cardita* Bruguière. In 1801 he selected *variegata*. In his major work (1818-1819, vol. 6, p. 24) he returned to the error of certain of his predecessors. The shell he there calls *calyculata*, for which he cites "Lin. Gmel. no. 7," is certainly not *calyculata* Linné, and his description sounds much like *variegata* and was probably meant for that shell as it is described as "maculis fuscis lunatis picta." This error, says Reeve (*loc. cit.*), "was unconsciously perpetuated both by Sowerby and myself; by Sowerby in 'The genera of Recent and fossil shells,' and by myself in the 'Conchologica Systematica.'" Lamarck then further increased the confusion. He listed a *Cardita subaspera* (*tom. cit.*, p. 25) which he identifies with *C. variegata* Bruguière, and said: "It is upon this shell, which I possess, that Bruguière based his description [of *variegata*]." Lamarck's description of *subaspera* specifies 23 ribs, more than in either *calyculata* or *variegata*, and his only reference to color pattern is the word "rufus." The real *calyculata* Linné is probably the same as *Cardita sinuata* Lamarck, 1819. This was the opinion of Deshayes and Milne-Edwards (1835-1845, vol. 6, p. 427), and in recent years Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, p. 230) have expressed the same belief. The description of *sinuata* clearly leads one to this view.

*Chama calyculata* is now placed in the genus *Arcinella* Oken, 1815, although it is still often cited as in *Cardita*, and is the type of *Arcinella* by subsequent designation, Stewart, 1930. This genus is not recognized by Thiele who puts *calyculata* in section *Mytilicardia* Anton, 1839, under *Beguina* Röding, 1798, as the type of the section. Oken's *Arcinella* is not *Arcinella* Schumacher, 1817,<sup>1</sup> nor *arcinella* Philippi, 1844.<sup>2</sup>

<sup>1</sup> *Arcinella* Schumacher, being a homonym, is supplanted by *Echinochama* P. Fischer, 1887.

<sup>2</sup> *Arcinella* Philippi, another homonym of *Arcinella* Oken, 1815, is supplanted by *Saxicavella* P. Fischer, 1887.

*Chama calyculata* is figured in Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, atlas, pl. 38, figs. 10-13) as *Cardia calyculata*. Named varieties recognized by these authors are shown on the same plate, figures 14 to 20. They are of the opinion that *C. subaspera* Lamarck, *C. calyculata* Lamarck, and *C. variegata* Brugière are merely three names for the same species.

The frequency of deformed specimens of *Arcinella calyculata* is due to its habit of living in crevices of rocks or in the abandoned holes of burrowing mollusks, and the surface is so often encrusted with *Serpula* tubes, calcareous algae, and other foreign matter that the sculpture is altered or hidden.

#### *Chama cordata*

1758, *Systema naturae*, ed. 10, p. 692, no. 135.

1767, *Systema naturae*, ed. 12, p. 1138, no. 161.

LOCALITY: Not given in either edition.

"*C. testa cordata transversim striata, hinc elongata compressa. . . Testa testacea, inferne (non versus marginem exteriorem) sulcis transversis, distinctis, obtusis. Angulus inter rimam et marginem exteriorem elongatus obscurior.*"

The description of this species seems at first glance to be ample and sufficiently detailed, but it cannot be satisfactorily tied to a particular species. Linnaeus did not possess the shell, did not know its locality, and supplied no references. Hanley (1855, p. 88) was unable to identify it but suggested that the improved description in the "*Museum Ulricae*" affords some basis for thinking that it was a *Crasatella*. The description in that work is: "*Testa ferruginea seu flavescens, superne (non vero versus marginem tenuiorem seu exteriorem) sulcus distinctis transversis obtusis aequalibus. Angulus anterior inter rimam et marginem exteriorem elongatus magis fuscis lateribus angulatus. Rima exacte clausa cavitate ovato-lanceolata. Carinis dens duplex compressus, retrorsum obliquus, exceptus a sinu.*" Hanley emphasized particularly the gradual obsolescence of the concentric sculpture towards the margin and the produced and angular posterior end and suggested that the description of the lunule indicates that there was no ligament. If it were a *Crasatella*, he concluded, it would be a species similar to *C. kingicola* Lamarck, 1805.

Gmelin's citation of *Chama cordata* copied the Linnaean description verbatim and gave as a reference merely the "*Museum Ulricae*" as Linnaeus had done. He listed no locality. The inference is, therefore, that he could not identify the species. Yet, strangely enough, he added a variety " $\beta$ " which he called *C. reniformis*, for which he cited "Knorr 2, t. 23, f. 7" and "Chem. 7, t. 50, figs. 502-503." Both of these references show a shell which is unmistakably *Chama semiorbiculata* Linné, and which Chemnitz described (*op. cit.*, pp. 135-137) as *Chama phrenitica* (*Chama semiorbiculata* Linné, discussed above). Gmelin further adds to the Linnaean sub-description a few words covering his variety " $\beta$ ," " $\beta$ ) in mari rubro et indico, testa ferruginea  $\beta$ ) spadicea."<sup>1</sup>

Gmelin's apparent identification of variety " $\beta$ " and his failure to identify the typical species other than by a reference to the "*Museum Ulricae*" are puzzling. It is possible that *cordata* was in fact a form of *semiorbiculata* which appeared to Gmelin, as it might have to Linnaeus, to justify a specific name. Certainly the variety is Linnaeus' *semiorbiculata*.

Chemnitz, in his comments on *Chama phrenitica* (*Chama semiorbicularis* Linné), calls attention to another attempt, although anonymous, to unite the two names *cordata* and *semiorbiculata*. He said (1780-1795, vol. 7, p. 137): "One of my Swedish conchological friends tries to persuade me that this [*phrenitica*] is *Chama cordata* Linné. I wish that he were right, and I would gladly admit it. However, his suggestion is highly improbable."

It may be that the shell Linnaeus described was, in fact, either *Chama semiorbiculata* or a variety of that species, but that theory is not susceptible of proof. I am not able to find in the literature any further considered suggestions as to its identity and therefore leave it as a *species dubius*.

#### *Chama satiata*

1767, *Systema naturae*, ed. 12, p. 1138, no. 162.

LOCALITY: Not given.

<sup>1</sup> Gmelin apparently used the half-parenthesis after " $\beta$ " as a comma, but the significance of the later use of " $\beta$ " with the half-parenthesis in the same description is not understood.



"C. testa subrotunda, sulcis dentatis punctis interstinctis, ano retuso. . . Testa alba, extus rufescens: sulci elevati, longitudinaliter dentati alternis brevioribus. Margo crenulatus. Anus cordatus, retusus."

This name appeared for the first time in the twelfth edition of the "Systema." Based on the description and in the absence of any stated locality or any pictorial synonymy it would have been impossible to identify the species. Linnaeus' successors, who probably did not have access to his manuscript notes, omitted the name in their discussions of *Chama* Linné. However, a manuscript note in the author's copy of the twelfth edition opposite the listing of *C. satiata* reads "eadem 167," and the name itself was erased. Thus Linnaeus believed that it was identical with *Chama arcinella* which he described on the next page, and this identification has been accepted tacitly, it seems, by most conchologists.

We do not know whether Linnaeus described *satiata* from a specimen before him or from a communication from a colleague or collector. If the former, it has been suggested that it was a young specimen of *arcinella*. It can hardly have been a worn specimen as that would seem to be excluded by the words of the description: "sulci elevati, longitudinaliter dentati." On the other hand, the language is hardly emphatic enough to suggest the extraordinary development of the spines in *arcinella*, even those in a young shell. Furthermore, *arcinella* is a white shell with a pale brownish tinge near the umbones in some specimens. This coloration hardly justifies the words "extus rufescens" in the description of *satiata*.

I believe that Linnaeus was wrong in his later identification. If the two species were held to apply to the same shell an unfortunate nomenclatorial situation would be presented, as *satiata* has page priority over *arcinella* and would supplant it. In my opinion this situation need not be met, and I am treating *satiata* as a *species dubius*.

#### *Chama oblonga*

1758, *Systema naturae*, ed. 10, p. 692, no. 136.  
1767, *Systema naturae*, ed. 12, p. 1139, no. 163.  
LOCALITY: Not given in either edition.

"C. testa oblonga antice angulata, dentibus

anticis acutis. . . Testa subtilissime decussatim striata, alba, intus lactea; anterius angulo utrinque excurrente."

In the absence of any indication of locality or of figures and in spite of the fact that no specimen is found in the collection which agrees with the description, this name has been satisfactorily identified from the description alone as the shell that under several different genera has been long known by the Linnaean specific name. It is not, so far as the "Systema" description is concerned, a completely convincing determination, but the ampler language of the "Museum Ulricae," which obviously covers the same species, is entirely adequate. The 1758 description is, however, sufficiently characteristic to permit us to cite the species as of that year.

Chemnitz (1780-1795, vol. 7, p. 137, pl. 50, figs. 504-505) called it *Chama guinaica*, and Lamarck retained this name, using it as the first species of his *Cypricardia* (1818-1819, vol. 6, p. 27) and listing both *Chama oblonga* "Lin. Gmel." and the Chemnitz figures in its synonymy. The main description in Gmelin is an exact copy of the Linnaean words (except for the substitution of the word "anterius" for Linnaeus' "antice"), although the subdescription is more elaborate and clearer. It is obvious that Gmelin was describing the same species. Lamarck's diagnosis of *guinaica*, therefore, which referred to the *oblonga* as described by Gmelin, is demonstrably the Linnaean *oblonga*.<sup>1</sup>

Reeve describes and figures both names as good species (1843-1878, *C. oblonga* in vol. 1, *Cypricardia*, pl. 1, sp. 4; *C. guinaica* in vol. 1, pl. 2, sp. 13). He says of *guinaica* Chemnitz, "This is not the *Chama oblonga* of Linnaeus . . . as was supposed by Lamarck and Deshayes; it is a shorter, stouter shell, and invariably smaller." This was an obvious error which stemmed from the fact that James Sowerby (1820, 1825, 1834, vol. 1, pl. 77) had already described another *Cypricardia oblonga* which Reeve erroneously

<sup>1</sup> In almost every instance where Lamarck referred to a species which Gmelin had taken from Linnaeus' twelfth edition he cited it as "Lin. Gmel." He either did not possess a copy of the work of Linnaeus, which hardly seems possible, or if he did, he did not use it as a source.

believed to be the Linnaean species. Hanley (1855, p. 89) later detected this error and correctly reunited *oblonga* Linné and *guinaica* Chemnitz and Lamarck. As Sowerby's name was preoccupied, Hidalgo, in 1903, renamed it *Cypricardia sowerbyi*.<sup>1</sup>

The genus is now in the genus *Trapezium* Megerle von Mühlfeld, 1811 (not *Trapezium* Hwass in "Museum Calonnianum," 1797),<sup>2</sup> which has several years' priority over its exact synonym *Cypricardia* Lamarck. It is the type of *Trapezium*, by subsequent designation, Lamy, 1920, and, as *C. guinaica*, is the type of Lamarck's genus, by subsequent designation, Children, 1823. Thiele (1931, 1935, vol. 2, p. 856) uses *Libitina* Schumacher, 1817, for this species, with both *Trapezium* and *Cypricardia* as synonyms, but does not state upon what grounds he dismisses the priority of *Trapezium*. The publication of the latter name seems to fulfill all the requirements of the Rules.

*Trapezium oblongum* is identical with *Cardia carinata* Brugière, 1792, *Corbula tumida* Röding, 1798, *Cypricardia californica* Conrad, 1837,<sup>3</sup> *Cypricardia duperreyi* Deshayes, 1839, and (*vide* Abbott, *loc. cit.* in footnote), *Cypricardia rostrata* Lamarck, 1819.

Good figures of this species are difficult to find. The best available drawings are the Chemnitz figures referred to above.<sup>4</sup>

<sup>1</sup> Hidalgo (1903, p. 364) said: "Sowerby and Reeve considered this shell to be the *Chama oblonga* of Linné, while Hanley in his 'Ipsa Lin. Conch.' page 89 believed that the Linnaean species corresponded to the *Chama Guinaica* Chemnitz, or *Cypricardia Guinaica* of modern authors. This was also the opinion of Lamarck and Deshayes. The description by Linnaeus in the *Museum Ludovicae Ulrica*, page 515 . . . does not fit the *Cypricardia oblonga* of Sowerby and Reeve, for which reason I here designate a new name."

<sup>2</sup> It was supposed until recently that Humphrey was the author of the "Museum Calonnianum," but Dall (1917, p. 471) has pointed out that the work should be attributed to Hwass.

<sup>3</sup> Dall, Bartsch, and Rehder (1938, p. 123) separated *Trapezium californicum* Conrad from *T. oblongum* (Linné) by omitting the latter from the synonymy of *californicum*. Abbott (1950, p. 95), after an examination of a series of both forms, found no constant differences. The specific name *californicum* was selected by Conrad under the erroneous belief that it existed on the west coast of America. It is an Indo-Pacific species, as is *oblongum*.

<sup>4</sup> Reeve's figure of *oblonga*, as mentioned on page 137 above, is not the *oblonga* of Linnaeus but of James

### *Chama lazarus*

1758, *Systema naturae*, ed. 10, p. 691, no. 129.

1767, *Systema naturae*, ed. 12, p. 1139, no. 164.

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

"C. testa imbricata lamellis laceris, nate oblique subspirali."

The synonymy of this species is most imperfect. The figures from Argenville, Seba (1758), and Browne (1707–1725) show shells only faintly resembling *lazarus*. Indeed, one of the Seba drawings is evidently meant for a *Spondylus*. The description, however, is reasonably clear, and as it agrees perfectly with the properly documented specimen of *lazarus* in the collection, the identification can be safely accepted.

Lamarck (1818–1819, vol. 6, p. 93) lists a *Chama lazarus* as of "Lin. Gmel. 3302" from the "Océan Américain." He also lists a *Chama damaecornis* on the same page, from the "Océan des Grandes Indes." It seems quite clear, as Deshayes and Milne-Edwards pointed out (1835–1845, vol. 6, p. 580), that an examination of the synonymy, description, and locality of the two shells reveals that Lamarck had chosen the wrong species to bear the Linnaean name and that his *damaecornis* was in fact *lazarus* Linné. (His *lazarus*, moreover, was the common *Chama macerophylla* Chemnitz, 1784 [Gmelin, 1791], of the West Indies.) This is borne out by an examination of the specimen of *lazarus* in the Linnaean collection, as Hanley (1855, p. 89) has shown.

This is one of the two Linnaean species in the genus which is a true *Chama*. It is figured in Reeve (1843–1878, vol. 4, *Chama*, pl. 2, sp. 4a, b). A good figure of the interior of the shell is shown in Thiele (1931, 1935, vol. 2, p. 877, fig. 831). Crouch (1826, pl. 10, fig. 2) shows a satisfactory figure.

It is often cited as the type of *Chama* Linné, based on Children's, 1823, designation. However Schumacher's designation of *Chama gryphoides* (1817) has six years' priority. Fleming, in 1818, also designated *C. lazarus* as the type of the genus.

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Sowerby. His figure of *guinaica*, however (pl. 2, sp. 13), is the Linnaean species. It is less clear and characteristic than Chemnitz' figures.

**Chama gryphoides**

1758, *Systema naturae*, ed. 10, p. 692, no. 137.

1767, *Systema naturae*, ed. 12, p. 1139, no. 165.

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

"C. testa orbiculata muricata: valvula altera planiore; altera nate productiore subspirali. . . . Valvulae albae, orbiculatae, punctis muricatae, altera adhaerente alii corpori. Nates obsolete recurvatae, in spiram contortae, intus auriformis."

This species, if we base our identification on the references alone, is a composite species. The figures cited, although most of them are not recognizable, are all single valves and interior views and show several species. The only one certainly recognizable is a figure of *Chama macerophylla* Gmelin, the *C. lazarus* of Lamarck. The confusion is not lessened by the finding of two marked specimens of *macerophylla* in the collection, one bearing the tenth-edition number of *gryphoides* (137) and the other the tenth-edition number of *lazarus* (129). The synonymy may be entirely dismissed as any aid in the identification of the species, as it would seem to show, if it shows anything, that Linnaeus included under the name *gryphoides* several of the true chamas that are short-scaled. Certainly the *macerophylla* of the western Atlantic is included in the synonymy and in the collection. Dillwyn (1817, vol. 1, p. 221) appears to have selected *macerophylla* as the representative of *gryphoides*. In the last analysis, it seems to be evident that Linnaeus was in doubt whether to refer *macerophylla* to *lazarus* or *gryphoides*.

As to the identification of *gryphoides* itself, there is little doubt. The language of the description clearly points to the *gryphoides* of authors, the common Mediterranean shell. The phrases "valvulae albae" and "punctis muricatae" are descriptive of *gryphoides* and are not at all applicable to the high coloring and laminated sculpture of the American *macerophylla*. Moreover, the locality ("in M. Mediterraneo Africam alluente"), which is vouched for by Brander, is highly confirmatory of this conclusion. The identification with the *gryphoides* of authors is universally accepted.

It is the type of *Chama* Linné by subsequent designation, Schumacher, 1817, which

antedates Children's selection of *C. lazarus* in 1823.

Lamy (1928, pp. 350-351) was so impressed by the discordance in the references and the presence of two specimens of *C. macerophylla* in the Linnaean collection, one marked for *gryphoides* and the other for *lazarus*, that he was unwilling to attribute the species to Linnaeus and used the style "*C. gryphoides* (Linné) Lamarck" and in his synonymy cites "*Chama gryphoides* (pars) Linné," thus treating the whole Linnaean diagnosis as covering a composite species. Lamarck (1818-1819, vol. 6, pt. 1, p. 94) simply listed the species as of Linnaeus. Lamy, however, accepted the common *gryphoides* of the Mediterranean Sea as the *gryphoides* of Linnaeus, saying (*loc. cit.*), "Nevertheless, as the diagnosis and the Mediterranean locality are applicable to the European shell for which Lamarck retained the name *gryphoides*, one may accept . . . the interpretation of the species as advanced by Lamarck and consecrated by usage."

On the theory as to the method of identification of the Linnaean species that I am urging in this paper, Lamy's argument becomes not only inconsistent but unnecessary. If he accepted Lamarck's interpretation he should cite the species, not as he did, but as "*gryphoides* Linné." Moreover, if he uses the word "diagnosis" ("la diagnose") as covering the description alone, as the context seems to indicate, then under the method here used he should not have treated *gryphoides* Linné as a composite species but as being properly and adequately defined in the description. As I read the Linnaean description, it clearly described *gryphoides*, and I feel no hesitancy in citing the species as of Linné, 1758.

The species is figured in Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, atlas, pl. 50, figs. 1-4).

It is identical with *C. unicornis* Philippi, 1836, and *C. cristella* Lamarck, 1819.

**Chama bicornis**

1758, *Systema naturae*, ed. 10, p. 692, no. 138.

1767, *Systema naturae*, ed. 12, p. 1139, no. 166.

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

"C. testa valvulis conicis: natibus corniformibus obliquis tubulosis valvula longioribus. . . .

Singulae valvulae referunt Patellam cucullatam obliquam, hinc praecedenti multum affinis."

This name can be stricken from the list of the Linnaean species, as it was based entirely on an error in reading a figure. In Colonna's "Purpura" (1616, p. 30) there is shown what are obviously two views of the same single valve of a very long-beaked *Chama*. Klein and Lister copied these figures, and all three references were used by Linnaeus in the synonymy of his *C. bicornis*. Bruguière (1789, 1792, p. 393) pointed out the obvious inference that Linnaeus must have believed that these drawings represented the right and left valves of the bivalve and hence gave it the name *bicornis*. Nothing in the collection is marked for *bicornis*, and the name is possibly represented by some worn single valves of either *gryphoides* Linné or *macero-phylla* Gmelin which have exceptionally long beaks.<sup>1</sup>

#### *Chama arcinella*

1767, Systema naturae, ed. 12, p. 1139, no. 167.

LOCALITY: "In O. Americano" (1767).

"C. testa sulcata muricata excavato-punctata, cardinis callo sessili. . . Testa magnitudine pruni, longitudinaliter sulcatae sulcis excavato-punctatis, poris imbricato-muricatis; margo crenulatus. Nates subaequales. Ani regio cordata, intrusa, papillosa, rugosa. Cardines callus prominens, valde singularis sulcis 4 angustis, quas lamellae totidem, in opposita cavitate, intrant."

The clear description of this species insured its early identification. That Linnaeus possessed the shell is shown by its inclusion in his list of owned shells, and the unmarked specimen of the *arcinella* of all authors found in the collection agrees uniquely with the description.

It belongs in the genus *Echinochama* Fischer, 1887, and is the type of the genus, by monotypy.

Although the description is adequately characteristic to point to *Echinochama arcinella*, it might be noted that, as was said under *Chama satiata*, Linnaeus might well have used more graphic language to describe the long spines on the ribs of well-developed specimens. His words "sulcata muricata

<sup>1</sup> This is not *Chama bicornis* Bruguière, 1792, a fossil from the region of St. Mihiel, France. Bruguière's species is listed by Lamarck (1818-1819, vol. 6, pt. 1, p. 91) as a synonym of the latter's *Diceras arietina*.

excavato punctata" and "poris imbricato-muricatis" hardly do justice to the extraordinary development of the spines in some adult specimens.

*Echinochama* Fischer is a strictly tropical American genus and is one of the few groups in Chamidae of which the species are attached by the right valve rather than by the left, as is the most usual case. In all such shells the beaks are sinistroygyrous. In *Echinochama* only the young shells are fixed. The adults are completely or almost free. The point of attachment is readily seen in young shells, even in beach specimens, but in the free adult shell the scar of the former attachment is usually obliterated by new growth of shell material. Two varieties of *E. arcinella* have been recognized by some writers—var. *cristagalli* Martyn for the long-spined form and var. *hystrix* Martyn for the form with shorter spines. *Arcinella spinosa* Schumacher, 1817,<sup>2</sup> and *Arcinella cornuta* Conrad, 1866, are synonyms.

The species is figured in Reeve (1843-1878, vol. 4, *Chama*, pl. 5, sp. 26a, b) showing both the long- and short-spined forms. These are exaggerated and badly drawn figures, as are most of the drawings of this species. Good photographs of three views of the short-spined shell are shown in Maxwell Smith (1941, pl. 14, figs. 1a, b, c). Perhaps the best of the early reproductions are those of Chemnitz (1780-1795, vol. 7, pl. 52, figs. 522-523).

#### *Chama rugosa*

1771, Mantissa plantarum, regni animalis appendix, p. 546.

LOCALITY: Not given.

"Testa suborbiculata, sulcis profundissimis, rugis subimbricatis, margine dupliciter plicato. . . Testa magnitudine extimi digiti, gibba, crassa, alba: Sulcis 30, profundis, paralellis. Rugis compressis, dorso subimbricatis: squamis obsoletioribus, distantibus, numerosis. Margo interior plicatus, obtusus; exterior unguibus, eminentibus, concavis, e ruga eductis. Cardo sulcis 2 s. 3, obliquis, declinatis versus vulvam."

<sup>2</sup> *Arcinella* Schumacher, 1817, is displaced by *Echinochama* Fischer, as a homonym, as Oken used the former name in 1815 for a group of carditids now generally given generic rank. (Cf. *Chama calyculata*, above.) *Arcinella* Philippi, 1844, is a later homonym, used for the group called *Saxicavella* by Fischer, 1887.

In common with most of the species of mollusks listed in the "Mantissa" this species has not been definitely identified. Hanley (1855, p. 454) refers to Solander's opinion that it was *Cardita ajar* Bruguière, 1792, but notes that the latter species has not the requisite number of ribs—30 in the case of *rugosa*. Hanley offers, as a more likely guess, that it is identical with the fossil *Venericardia imbricata* Gmelin, 1791, of which a good figure is found in Chemnitz (1780–1795, vol. 6, pl. 30, figs. 314–315), and in the "Tableau encyclopédique" (1797, pl. 274, fig. 4) where it is included in *Venus*. I know of no later opinion on this debatable species. The only contemporary hint of its identity is found in a manuscript note by Linnaeus, to the effect that in the proposed "revised twelfth edition" it was to have immediately preceded *Chama antiquata*.

#### *Chama gryphica*

1771, Mantissa plantarum, regni animalis appendix, p. 546.

LOCALITY: "In Barbaria" (1771).

"Testa obliqua lacuna laterali, rugosa, cardinis collo dentato. . . . Testa magnitudine pugni, facie omnino Anomiae gryphi, ponderosissima, crassissima, transversim rugosa, latere altero latiore lacuna lata longitudinali distincta. Cavitas parva, valde fornicata. Nates oblique versus anum incurvatae. Anus longitudinaliter concavus. Vulva longitudinaliter canaliculata, obliqua versus nates. Cardo Chamae, dente obtuso pluribus striis transversim secto, ut in Ch. arcinella."

There is present in the Linnaean collection a large fossil *Chama* marked "gryphita." As the specimen perfectly agrees with the description of *gryphica*, Hanley (1855, p. 454) concluded, probably correctly, that it was the type. Linnaeus' notes indicate that it was to have followed *Chama bicornis* in the "revised twelfth edition," which would place it immediately before *Chama arcinella*. *C. arcinella* is referred to in the description, which mentions that the cardinal tooth is cut by several transverse striae "ut in Ch. arcinella." The remainder of the description, however, has no points of similarity to *arcinella* and, though ample, is not suggestive. The marked specimen in the collection is reproduced by Hanley (1855, pl. 5, fig. 11). Although only an external view is shown and the hinge is not visible, the specimen appears to be a *Gryphaea*

(Lamarck, 1801) and shows many of the features of several species of that genus from the Lower Cretaceous of Texas in the author's collection. It has also been suggested that it is a species of *Exogyra* (Say, 1820). Both genera are groups of fossil oysters.

#### ARCA LINNÉ

Of the 17 species described by Linnaeus in his genus *Arca*, only seven fall properly in the family Arcidae as that family is at present generally constituted, which includes the genus *Arca*, *sensu stricto*, and several other groups which have been carved out of *Arca*, *sensu lato*, and which are variously treated as good genera or subgenera. Of the remaining 10 species, seven belong to the typical genus of the family Glycymeridae, and one each belongs in the genera *Nuculana* (family Nuculanidae), *Nucula* (family Nuculidae), and *Brachidontes* (family Mytilidae). Although several classifiers do not give separate family rank to the glycymerids and include the genus *Glycymeris* Da Costa, 1778, as a group in Arcidae, it seems clear that the characters of that group have suprageneric value. The glycymerids form a very compact family, and it is only in comparatively recent times that its subgeneric groupings have been carefully worked out. The same is true of the nuculids and nuculanids.

Among the true *Arca*, however, a host of supraspecific names have been proposed since very early days, giving the family a gross nomenclature rivalling that of *Venus* Linné and almost equalling that of *Helix* Linné. Many widely divergent arrangements have been proposed, ranging from the splitting of *Arca*, *sensu lato*, into a dozen or so genera (or subgenera) to the highly diversified classifications of Reinhart (1935) and MacNeil, the latter of which, as yet unpublished, is used in the arrangement of the Arcacea in the United States National Museum. From the standpoint of phylogenetic accuracy the ideal arrangement of any group of mollusks should be based upon historical grounds. The arcid and nuculid pelecypods are ancient groups, and when relationships between Recent forms and their ancestors are studied it is usually found necessary to use a much more elaborate classification than would be needed if only Recent species were involved.

It does not seem necessary, however, in a paper of this kind, to attempt to follow any of the highly involved arrangements. In the discussion of the genus *Venus*, the writer followed as closely as possible the arrangement recently proposed by Frizzell for the venerids. In the case of *Arca*, however, where so few Linnaean species are involved, all of them Recent, the adoption of any of the extremely complicated classifications, all of which are still to a great extent controversial, would be confusing and, I suggest, unnecessary. The task here is one of identification rather than taxonomy, and therefore the Linnaean species are attributed to the traditional genera in which they were included by the majority of nineteenth century commentators.

The question of the type of *Arca* Linné has been so debated and was so difficult because of the number of different good or attempted type designations that it became necessary to ask for an opinion from the International Commission on Zoological Nomenclature.

The first "example" of the genus was suggested by Lamarck in the "Prodrome" of 1799 as "*Arca noe* [sic] Lin.," but under the terms of Rule 30, 2 (g) this was not a valid type designation.

Schumacher in 1817 attempted to designate *Arca antiquata* Linné, but he used the word type as meaning "typical species" in the morphological or taxonomic sense rather than in the nomenclatorial sense. Moreover his designation was only of the hinge of the species.<sup>1</sup> This has been justly criticized as an ineffective designation.

The next year Schmidt designated *Arca noae* Linné as type (1818, pp. 65, 178). This seems to be a good designation in spite of the complicated manner in which Schmidt made it.

Children in 1823 designated *Arca tortuosa* Linné as type. This was for long considered to be the first valid designation (as the work of Schmidt was only recently brought to the attention of conchologists), but it was an unfortunate choice, as it makes the very

small and peculiar genus *Trisodos* Oken, 1815, which is certainly atypical, the typical subgenus of *Arca*.

Anton designated *Arca barbata* Linné as the type in 1839, and finally Gray in 1847 designated *Arca noae*, which had already been the subject of Schmidt's designation and of Lamarck's ineffectual attempt.

Gray's selection of *Arca noae* has been used by the majority of writers, but the debatable merits of some of the other selections had been pressed so strongly and had been so frequently used that an application to the Commission was finally made. In Opinion 189, dated October 5, 1944, the Commission ruled that: "(1) All type designations for the genus *Arca* Linnaeus 1758 . . . made prior to the date of this opinion, are hereby set aside, and (2) *Arca noae* Linnaeus is hereby designated as the type of the genus." The Opinion also added *Arca* Linnaeus to the Official List of Generic Names in Zoology, as name number 622. It is clear that the type should no longer be cited as of Gray, 1847, or of any other author, but under the style "by action of the International Commission on Zoological Nomenclature, October 5, 1944 (Opinion 189)."

In effect the opinion acknowledges that *Arca tortuosa*, as designated by Children in 1823, was the first valid designation, but the Rule was suspended in order to retain the currently used type, and it seems obvious that the Commission was also influenced by the fact that the use of *tortuosa* would bring about a difficult situation from the point of view of the "typical subgenus." It was suggested to the Commission by Pilsbry that "Linnaeus' citation of '*Arca noae* Rumphius' in his synonymy of *Arca noae* should be a sufficient indication to make the species type by tautonymy," but the Commission questioned whether this constituted absolute tautonymy under the Rule.

The group of *Arca noae* Linné, once known as *Navicula* Blainville, thus becomes the typical subgenus of *Arca* Linné.

#### *Arca tortuosa*

1758, *Systema naturae*, ed. 10, p. 693, no. 139.

1767, *Systema naturae*, ed. 12, p. 1140, no. 168.

LOCALITY: Not given in tenth edition (1758);

<sup>1</sup> Schumacher's language (1817, p. 172) was: "For the type of the genus I have selected fig. 2, pl. 19 of the hinge of the *Arca antiquata* Lin., which one finds figured in Chemnitz 7, pag. 201, Tab. 55, fig. 548."

"in . . . Norvegia similis sed minuta (1767).

"Testa parallelipipeda striata, valvula oblique carinata, natibus recurvis, margine integerrimo."

No alterations were made in the description of this species in the twelfth edition nor any additions to or changes in the synonymy, except for the substitution of figure 122 of Buonanni for figure 128 which was originally cited. The locality was unknown to Linnaeus, and the words added to the twelfth edition are not understood, as *tortuosa* is an Indo-Pacific shell, and there is no European *Arca* that remotely resembles it.

The description, although brief, cannot be tied to any group other than that comprising the genus *Trisidos*, although the author might well have put greater emphasis on the peculiarly twisted shape of the shell and the long hinge line. The words "parallelipipeda striata" involve a misuse of a word. A parallelipedum is a prism the bases of which are parallelograms, not a plane figure. The sculpture might better have been described simply as decussate. This same word was also used by Klein (1753), from whom Linnaeus borrowed it, in a generic sense, and by Born (1780, p. 87) descriptively. Indeed the description might stand for any one of the several members of the genus *Trisidos* known today, were it not for the presence in the collection of a marked specimen of the *tortuosa* of all authors, which proves that Linnaeus described *tortuosa* and not one of its closely related congeners.

The species is now placed in the genus *Trisidos* Röding, 1798, of which it is the type, by monotypy. *Parallelepipedum* Klein, 1753, and *Trisis* Oken, 1815, are exact synonyms. As already stated in the foreword to *Arca*, Children selected it as the type of that genus.

The Chemnitz figures of this species (1780-1795, vol. 7, pl. 53, figs. 524-525) are clear and accurate. A good color photograph is found in Platt (1949, p. 70, fig. 6).

#### *Arca noae*

1758, *Systema naturae*, ed. 10, p. 693, no. 140.

1767, *Systema naturae*, ed. 12, p. 1140, no. 169.

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

"A. testa oblonga striata apice emarginata,

natibus incurvis remotissimus, margine integerrimo hiante."

The description of this species is inadequate, the only characteristic mentioned which effectively distinguishes it from the other Linnaean *Arca* being the statement that the umbones are "remotissimus." The collection, however, contains a marked specimen of the *Arca noae* of all authors, which is the only shell in the collection which is in complete accord with the description. The references, when errors of transcription are corrected, confirms the identification.

*Arca noae* has been given a very wide and varied range. Linnaeus' locality of "Red Sea, Mediterranean Sea and Indian Ocean" is of course too broad. Lister (1770, pl. 368, fig. 208) reported it from Barbados; Petiver (1713, pl. 17, fig. 10) from Amboina; Sloane (1707, 1725, vol. 2, pp. 257-258) from Jamaica and Barbados as well as from the Mediterranean, and the latter says (*loc. cit.*) "all which shells by what I can observe differ very little in any thing one from another"; Adanson lists it in his "Histoire naturelle du Sénégal" (1757, p. 250). Lamarck (1818-1819, vol. 6, pt. 1, p. 37) is the only one of the early writers who limited its range to European waters. Even in recent years Cockerell (1894, p. 105) reported it from Jamaica, and Kobelt (*in* Martini and Chemnitz, 1837-1907, Neue Folge, vol. 8, pt. 2, p. 10) received specimens from Bermuda which he could not distinguish from the Mediterranean shell. The Museum National d'Histoire Naturelle in Paris possesses (*vide* Lamy, 1907, p. 17) specimens labeled Panama, Gulf of Campeche, Martinique, and Bermuda. It is, however, a strictly Mediterranean species, and it seems clear that reports of its existence in the western Atlantic, at least, are due to its similarity to the West Indian *Arca zebra* Swainson, 1833<sup>1</sup> (*non* *A. zebra* Reeve, 1844). Kobelt (*loc. cit.*) even recognized the existence and separability of *A. zebra*, but asserted that the specimens of "*Arca noae*" that he received from Bermuda were quite different from *zebra*, which he called by its earlier-used name *occidentalis* Philippi. Apparently

<sup>1</sup> The specific name *zebra* has 14 years' priority over its synonym *occidentalis* Philippi, 1847, which was used for many years.

his specimens were in fact *zebra*, which shows a certain amount of distortion and variability in gerontic individuals, making them approach the appearance of *noae*.<sup>1</sup> Kobelt's thesis was in brief that *zebra* and *noae* existed side by side in the West Indies. *Arca zebra* Swainson is generally a smaller and lighter species, with a narrower cardinal area and a much more oblique contour, although it sometimes attains the size of the Mediterranean *noae*.

*Arca noae* was placed by Swainson in his *Byssosarca*, 1833, a genus erected for the reception of those *Arca* provided with a byssus. Swainson's name, however, is an exact synonym of *Navicula* Blainville, 1825 (*non Navicula* Spix, 1827, a gastropod group), which has several years' priority. *A. noae* is the type of *Navicula* Blainville, by monotypy, and as noted in the foreword to *Arca* is now the type of *Arca* Linné, by decision of the Commission.

Hanley (1855, p. 92) in commenting on the Buonanni figure of *Arca noae* cited by Linnaeus, said: "Buonanni, usually so inaccurate in his delineations, has represented the peculiar pattern of incised lines upon the ligamental area which distinguishes the European species from its nearly-allied congeners of Asia and America." (Italics mine.) Insofar as the American *zebra* is concerned, this distinction does not hold good. Examination of a considerable series of *zebra* from the western Atlantic shows that in unworn, adult individuals the incised lines are always present, although they are possibly less numerous and less deeply cut than in *A. noae*. In young individuals, while the reddish brown lines in the ligamental area show up clearly, the incised lines have not yet appeared, and in badly worn adult specimens the incised lines themselves sometimes disappear.

*Arca noae* Linné is figured in Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, atlas, pl. 30, figs. 1-6), and a good view of the inner aspect of the shell is to be found in Thiele (1931, 1935, vol. 2, p. 792, fig. 793). The best figure of the western Atlantic *zebra* is provided by Swainson himself (1832-1833,

pl. 2), showing the outer, inner, ventral, and umbonal aspects of the shell. In the text opposite the plate, Swainson distinguishes *zebra* from *noae*: "It differs in sculpture, color, and in the umbones being less remote from one another." Curiously enough, however, he reports the species both from Jamaica and from the Bay of Naples.

#### *Arca barbata*

1758, *Systema naturae*, ed. 10, p. 693, no. 141.

1767, *Systema naturae*, ed. 12, p. 1140, no. 170.

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

"A. testa oblonga striis barbata, natibus incurvis approximatis, margine integerrimo clauso. . . . Testa apice rotundata, integra; striae ex punctis callosis concatenatis: alternis striis majoribus. Barba striis versus apicem imprimis tenuiorem rigens."

The reasonably clear and accurate description in the "Systema," together with the presence of a specimen of the *Barbatia barbata* of all modern writers in the Linnaean collection, identifies the species without question. The only questionable words in the description are "margine integerrimo clauso." The shell has a byssal gape in the ventral margin, although it is much narrower than the gape in its congener *B. candida* Gmelin, 1791, and in other *arcas*, notably *Arca umbonata* Lamarck, 1819.

Five of the figures to which Linnaeus refers are tolerably characteristic representations of *barbata*, but the remainder must be eliminated. The species was not described in the "Museum Ulricae," although Linnaeus referred to a listing in that work in his twelfth edition synonymy of *barbata*. Species number 1147 of the "Fauna Suecica" (second edition), also cited by Linnaeus, is an error of transcription for number 2147, which the author there called *Arca barbata* but which obviously does not represent that shell.<sup>2</sup> The figures cited from Seba (1758, pl. 88, fig. 13) and from the "Museum Tessinianum" (1753, p. 116, pl. 6, fig. 1) represent *Arca lacerata*, a rare East Indian species which Linnaeus described in the Tessin Catalogue, but later wrongly included in the synonymy of *barbata* in both the tenth and twelfth editions of the "Systema."<sup>3</sup>

<sup>1</sup> Both *A. zebra* and *A. noae* are extremely variable in shape owing to the fact that they are sedentary forms which are attached by a byssus and become deformed by their habit of nestling in crevices in the rocks.

<sup>2</sup> Hanley suggested (1855, p. 92) that the "Fauna Suecica" figure was *Arca nodulosa* Loven.

<sup>3</sup> *Arca lacerata* is a bearded shell, close to *barbata*.



The reports of the occurrence of this species are as confused as in the case of *Arca noae*. Buonanni, Argenville, and Linnaeus in the "Systema" state the locality as "Mediterranean Sea." In the "Fauna Suecica" the last-named places it in the "Norwegian Ocean." Lister in 1770 reported it from Barbados. In recent times Lamy (1907, p. 49) gives its locality as the Mediterranean, and Bucquoy, Dautzenberg, and Dollfus extend its range to the Cape Verde Islands (1882-1898, vol. 2, p. 185). For many years after Lister's report no further mention is made of an *Arca barbata* from the western Atlantic. American authors, however, have long listed under this name a very common and widespread bearded *Arca* from the West Indies and the subtropical American coast. I have compared a considerable number of specimens from Florida and the West Indies with specimens from the Mediterranean, but I cannot find any differences that I would be willing to call specific. The European form tends to be larger and more sturdy, and somewhat shorter in proportion to the distance from umbone to ventral margin than the American shell, but I suggest that these variations are merely evidence of the evolution of geographical races. In fact, the shape and proportions of the West Indian *barbata* itself show considerable variation. The writer has found, in the same colony of individuals, shells which range from a ratio of about  $1\frac{1}{2}$  to 1, length to breadth, to extremely elongate shells with a ratio of about 3 to 1.

*Arca barbata* is a member of the genus *Barbatia* Gray, 1847 (p. 197),<sup>1</sup> and is the type

This writer has not seen a specimen, but from Chemnitz' figures (1780-1795, vol. 7, p. 189, pl. 54, figs. 536-537) it is a much more oblique and inequilateral shell, more heavily bearded over a greater area of the shell, and with the ventral margin deeply rounded, rather than being almost straight as in *barbata*. It has, from the figures, about 20 ribs, whereas the ribs of *barbata* are numerous and closely spaced.

<sup>1</sup> There were two earlier uses of the name *Barbatia* by Gray. In 1840, in edition 42 of the "Synopsis of the contents of the British Museum" he first used it as a genus name, but this was a *nomen nudum* according to Neave and to Grant and Gale (1931, p. 143). Lamy, however (1907, p. 47), cites the genus as of Gray, 1840. In 1842, in edition 44 of the "Synopsis," Gray uses the name again, and (*vide* Neave) this was the first valid use. The 1847 appearance of *Barbatia* Gray was certainly a valid proposal, and as the two above-mentioned editions of the "Synopsis" were not avail-

able to me, I cite the genus as of Gray, 1847, as is done by most American authorities.

able to me, I cite the genus as of Gray, 1847, as is done by most American authorities. The species is identical with *Arca reticulata* Turton, 1819, and *A. cylindrica* Wood, 1828. *A. magellanica* Chemnitz, 1784, and *A. eximia* Dunker, 1858, are often placed in the synonymy of *A. barbata* and probably represent deformities, the ventral margin being shown in the figures as much constricted in the middle. Chemnitz gives the locality of his species as "Straits of Magellan" (1780-1795, vol. 7, p. 192, pl. 54, fig. 539), stating that the unique specimen was in the Spengler collection. It seems obvious that *barbata*, a warm-water species, could not exist in the locality reported. As for the locality of Dunker's *A. eximia* (1858, p. 90, pl. 3, figs. 1-3) the author merely says "Patria ignota." A comparison of the figures of the two forms shows them to be apparently identical, the only difference being that the Dunker figure shows the periostracum.

*Arca barbata* Linné is figured by Reeve (1843-1878, vol. 2, *Arca*, pl. 13, sp. 83). The American form is shown by Maxwell Smith (1941, pl. 4, figs. 2a, b, c, d).

#### *Arca modiolus*

1767, Systema naturae, ed. 12, p. 1141, no. 171. LOCALITY: "In M. Mediterraneo" (1767).

"A. testa oblonga striata antice angulata. . . . Testa magnitudine Fabae majoris, extus flavescens, intus alba aut subviolacea, figura omnino Mytili Modioli. Valvulae striatae ad latus valvae s. anterius profundius; ad vulvae superiora angulus compressus; posteriora natibus vix vel parum longiora. Nates recurvae. Cardo elongatus, longitudinaliter crenatus s. denticulatus."

The nomenclature of this species has had a troubled history. It is unquestionably the small striated West Indian mytilid with the yellow epidermis which was called *Mytilus citrinus polydentatus* by Chemnitz (1780-1795, vol. 8, p. 175, pl. 84, fig. 754), *Mytilus citrinus* by Röding (1798, p. 159), *Mytilus excustus* by Schröter<sup>2</sup> (1783-1786, vol. 3, p.

able to me, I cite the genus as of Gray, 1847, as is done by most American authorities.

<sup>2</sup> Although *Mytilus excustus* as described by Schröter was referred by that writer to *M. excustus* Linné, it was in fact the *citrinus* of Röding and Chemnitz (*Arca modiola* Linné), as Schröter gave as reference for it the excellent figure of *citrinus* from Chemnitz already cited (1780-1795, vol. 8, pl. 84, fig. 754). The same

432) and d'Orbigny (1845, p. 349), and possibly *Mytilus exustus* Gmelin (1791) and Lamarck (1818-1819, vol. 6, pt. 1, p. 121). In the same volume (p. 113) Lamarck described *Modiola sulcata*, which is *citrinus* Röding and may be identical with his *exustus*. Although he cited, for *M. sulcata*, the wrong figure from Chemnitz (*tom. cit.*, pl. 85, fig. 760), a figure which shows neither the divaricate sculpture nor the yellow color of *citrinus*, his second reference ("Encyclop.," pl. 220, fig. 2) shows the West Indian shell very accurately. (See further discussion under *Mytilus exustus* Linné, p. 212 below.) The names *sulcatus* and *citrinus* have been used indiscriminately since then.

Reeve (1843-1878, vol. 10, *Modiola*, sp. 61, fig. 74) Dall (1889, p. 38) and Lamy (1920a, pp. 150-151) called it *sulcata*, although the last-named reverted to the name *citrinus* in 1936-1937 (vol. 80, p. 157). Neither of the specific names *sulcatus* nor *citrinus* can be said to have been commonly accepted or become firmly fixed in the literature, and therefore little confusion would be caused by restoring the Linnaean name *modiolus*. The description in the "Systema" is clear and convincing, and the marked specimen in the collection, an example of the West Indian shell, conforms perfectly with its language. Although no references were supplied by Linnaeus, confirmation is supplied by a manuscript note in his copy of the twelfth edition which refers to "List. 366" [an error in transcription for Lister's fig. 365 (1770) where the species is accurately portrayed]. The only erroneous item in the diagnosis is the locality, "Mediterranean Sea." This is one of the few instances where a locality said to be vouched for by the collector, in this case J. Zoega, a pupil of Linnaeus, is found to be wrong, and the error is probably not the fault of Zoega.<sup>1</sup>

figure was used both by Gmelin and Lamarck for their *exustus*, and both d'Orbigny's good figure and clear description of his *exustus* (1845, p. 349) point definitely to *citrinus*. D'Orbigny there said that *exustus* was "flavicante . . . radiatim costata; costis divaricatis, bifurcatis" (a graphic description of the color and sculpture of *citrinus*). D'Orbigny's figures are found in the atlas to volume 5 (pl. 28, figs. 6-7).

<sup>1</sup> Zoega, of all the pupils of Linnaeus, was probably the one closest to his teacher. He accompanied him on many collecting expeditions in Scandinavia, with

There has been an apparent unwillingness on the part of writers to use the Linnaean specific name *modiolus*, probably because there was already a *Mytilus modiolus* in the "Systema," now *Vulsella modiolus* (Linné). Today most writers place *Arca modiolus* in *Brachidontes* Swainson, 1840, using *Brachidontes* as a good genus, and therefore the question of whether or not *Vulsella modiolus* is a homonym does not arise, although it is unfortunate that the same specific name should occur in two genera so closely related. Some classifications show *Brachidontes* as a subgenus of *Volsella*, and such an arrangement does bring about a case of homonymy. Thiele (1931, 1935, vol. 2, p. 799) does not accept the use of the Linnaean name *Arca modiolus*, although using *Brachidontes* as a valid genus. He cites the type of the genus as *Brachidontes sulcatus* (Lamarck), which he locates in south and east Asia, in fresh water.

It is odd that Chemnitz did not cite *Arca modiolus* Linné as such. His only mention of the name occurs in his discussion of the arcas, under the species *Amygdalum frixum sive tostum* (1780-1795, vol. 7, p. 185, pl. 54, fig. 534), where he queries the identity of that shell with *A. modiolus* Linné by the words, "An *Arca modiolus* Lin. in Syst. Nat. Edit. 12. no. 171, pag. 1141?" The locality of his species is given as "the West Indian Antilles." While the locality is correct for the present species, the figure 534, which is drawn from a difficult angle, shows a shell with low radial sculpture (not divaricate) and seemingly orbicular in shape rather than mytiliform. I cannot identify the drawing or Chemnitz' description, where the shell is said to have decussate sculpture.

The species is the type of *Brachidontes*<sup>2</sup>

Fabricius making the third in the party, and it is believed that his expeditions to Iceland and to the Mediterranean were financed by funds raised by Linnaeus. There is no record of his having visited America. The shell furnished by Zoega to his teacher might have come from any of the lands visited by him. It is certainly not the type specimen found in the Linnaean collection, and the error must be attributable to a mistake of Linnaeus.

<sup>2</sup> In 1847 Gray designated the type of "*Brachydonates*" Swainson as *Mytilus exustus* Linné. This was not only seven years after the erection of Swainson's genus, but *exustus* was not on Swainson's original list. Moreover Gray's spelling of the generic name was an inadmissible alteration.

Swainson, 1840, by monotypy, as *Modiola sulcata* Lamarck.

It hardly seems necessary to call attention to the curious fact that Linnaeus should have placed an obvious mytilid in his *Arca*, when in the same work he had erected the proper genus for its reception. Indeed he specifically suggests the similarity of shape with the mytilids by the phrase "figura omnino Mytili Modioli" in the description. His only excuse would seem to be that the hinge of his species, described as "Cardo elongatus, longitudinaliter crenatus s. denticulatus," seemed to him to resemble the taxodont hinge of the true *Arca* species.

The species is figured in Reeve (1843-1878, vol. 10, *Modiola*, pl. 10, sp. 61 of text, fig. 74).

#### *Arca pella*

1758, *Systema naturae*, ed. 10, p. 693, no. 142.

1767, *Systema naturae*, ed. 12, p. 1141, no. 172.

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

"A. testa ovata pellucida substriata; vulva prominente distincta, margine integerrimo, cardine ciliare. . . Testa magnitudine seminis Helianthi annui, alba, pellucida, oblique striata, nitidissima. Vulva valde prominens, transverse striata. Cardines dentis subulati acutissimi, (quod non in reliquis) imprimis sub vulva."

The description of this species in the twelfth edition, above, is so clear and characteristic that its identification is free from doubt. Although no references were supplied and no marked specimen is found in the collection, nor indeed any specimen which conforms to the description, Linnaeus was clearly describing the *Nuculana pella* of most authors. The stated locality, Mediterranean Sea, which was validated by the name of one of Linnaeus' pupils, Fredrik Logie, is confirmatory.

The species is placed in the Linnaean "subgeneric" group "Margine integerrimo, natibus inflexis," the last two words being substantially an addition to the description.

The words "oblique striata" together with the language describing the prominence of the posterior dorsal margin are alone sufficient to determine the species. The tenth edition description was identical, with the addition of the words "ut testa fere rostrata, distincta utriusque fossula" immediately following "vulva valde prominens." Linnaeus

possibly omitted the quoted words in the twelfth edition, feeling that they gave an exaggerated picture of the prominence of the feature referred to, but when the difference between the genus *Nuculana* and its close relative *Nucula* is considered, the omitted language proves to be of significance. The striations of the shell are so characteristic a feature that Lamarck, who placed it in his *Nucula*, 1799, described it in 1819 as "élégement sillonnée" and adopted "sillonnée" as the French name of the species (1818-1819, vol. 6, pt. 1, p. 58).

Lamarck (*tom. cit.* p. 60) after listing *Nucula pella* as of "Lin. Gmel." (according to his almost invariable custom),<sup>1</sup> described a *Nucula emarginata*, based on a Miocene fossil from southwest France. He gave as a reference: "An *Arca pella*? Brocchi test. 2, p. 481, t. 11. fig. 5a, b." and in his sub-description says: "This is not the *Arca pella* of Linnaeus, although its margin is entire. It is somewhat rostrate anteriorly, with a sulcus [échancrure]." In spite of this statement, several authors have used the name *emarginata* Lamarck as being equal to *pella* Linné. Thus Bucquoy, Dautzenberg, and Dollfus concluded that the two are not specifically distinct, saying that the differences between them are very slight and not constant. They attempt to explain Lamarck's statement by saying (1882-1898, vol. 2, p. 219), "We must not lose sight of the fact that for this author the *Arca pella* of Linné was the species which we have hereinabove described as *Leda fragilis*."

*Leda fragilis* is a species of Chemnitz (*Arca fragilis*, 1780-1795, vol. 7, p. 199, pl. 55, fig. 546) which that author referred to specifically as "*Arca pella* Linnaei." His figure is not clear. It is obviously a *Nuculana*, but the sculpture is shown as symmetrically concentric rather than oblique. The explanation of Bucquoy and his co-authors is not clear until we examine their synonymy of *Laeda fragilis* (*tom. cit.*, p. 215) where it appears that they consider *fragilis* to be equal to "*Arca pella* Gmelin, (non Linné)." I am unable to agree that Gmelin's *pella* is not the *pella* of Linnaeus. The figure from Chemnitz cited by Gmelin was the figure referred to

<sup>1</sup> Cf. footnote, page 137, under *Chama oblonga*.

above for Chemnitz' "*Arca fragilis*. *Arca pella Linnaei*," and Gmelin's description, although it is to some extent a rewording of Linnaeus' language, contains all the features that enable us to identify *pella* Linné. The two authors are obviously describing the same shell. On this basis *fragilis* Chemnitz is the same as *pella* Linné and Gmelin.

Bucquoy, Dautzenberg, and Dollfus make their *Leda fragilis* equal to *Arca commutata* Philippi, 1844, which Reeve refers to *Arca pella* Bruguière. Reeve's figure (1843-1878, vol. 18, *Laeda* pl. 7, sp. 42) of *commutata* shows a shell with a long acuminate rostration and nearly symmetrical concentric sculpture which is quite unlike *pella* Linné. In citing and figuring the latter species both Reeve (*tom. cit.*, pl. 7, sp. 43a, b) and Sowerby (1847-1887, vol. 3, pl. 228, figs. 65-66) show identical figures of a shell with the oblique sculpture characteristic of *pella* Linné, and which is well described by Sowerby. The latter cites only *pella* Linné in the text and does not give any synonyms, but in his Index after *pella* Linné he lists the following: "*pella* Gmelin = *fragilis*"; "*pella* Sowerby = *confusa*"; "*pella* Brug. = *commutata*," which does not lessen the confusion.

The species is no longer in *Nucula* Lamarck, 1799, but in *Nuculana* Link, 1807, subgenus *Lembulus* Risso, 1826, the Nuculanidae differing from the Nuculidae in the lack of a posterior truncation so characteristic of *Nucula* and in the elongation or rostration of the posterior end, the less nacreous interior of the shell, and the development of a ligament. For many years *Leda* Schumacher, 1817, an exact synonym of *Nuculana*, was used for this group and is still occasionally employed, especially by paleontologists, but *Nuculana* has 10 years' priority. Link's work was almost unknown until 1931, when a facsimile reprint of the pages covering the Mollusca brought it to the general attention of conchologists. Thus Bucquoy, Dautzenberg, and Dollfus, as late as 1891, put *pella* in the family Nuculidae, genus *Leda* Schumacher, although Stoliczka (1870-1871), Meek (1876), and Harris (1897), who were incidentally all paleontologists, recognized and used *Nuculana*. The acceptance of the latter name is not, however, universal. Dall (1890-1903, pt. 4, p. 572) refused to adopt it, as

being "a mere modification, on the score of taste" of *Nucula* Lamarck, a completely unfounded objection. Thiele (1931, 1935, vol. 2, p. 786), who uses *Leda* Schumacher for this group, treats *Nuculana* Link as a mere synonym of *Nucula* Lamarck. The subgenus *Lembulus* Risso, of which the present species is the type, has been considered by some writers to be identical with *Leda* Schumacher (*Nuculana* Link). As a subgenus of *Nuculana*, however, it includes only those species characterized by a strong oblique sculpture.

Link erected the genus *Nuculana* on a single species, *Arca rostrata* Chemnitz, 1784, which becomes the type, by monotypy. Inasmuch as this volume of Chemnitz is nomenclatorially unavailable (and indeed the type is a polynomial, *Arca Martini rostrata*), the type may be expressed as "*Arca rostrata* Chemnitz = *Arca rostrata* Gmelin." Gmelin's work was the first available work which provided an adequate description of the species *rostrata*.

*Arca pella* Linné is figured in Reeve (1843-1878, vol. 18, *Laeda*, pl. 7, sp. 43a, b) and in Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, atlas, pl. 37, figs. 32-35).

#### *Arca lactea*

1758, *Systema naturae*, ed. 10, p. 694, no. 143.

1767, *Systema naturae*, ed. 12, p. 1141, no. 173.

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

"A. testa subrhomboidea obsolete decussatim striata diaphana, natibus recurvis, margine crenulato. . . Testa magnitudine fabae equinae."

The description and locality are identical in the two editions. No references were given, although fairly good figures were available in the works of Lister, Buonanni, and Petiver. Nevertheless the mention of the size and rhomboidal outline of the shell and its thinness and faint decussate sculpture points clearly to the common Mediterranean *Arca lactea* of all subsequent authors. The locality, being authenticated both by Brander and Logie, the latter one of Linnaeus' pupils, is a further confirmation. The species, however, has a much wider range than the Mediterranean, being found along the entire European Atlantic coast from England southward to the Canary Islands. The specimens of *lactea* in the collection, while they are beach-worn and completely devoid of periostracum,

are nevertheless the only shells present that conform to the description.

This species is the *Arca barbata* of Pennant, 1777 (*non* Linné), and the *Arca modiolus* of Poli, 1795 (*non* Linné), and was known by several other specific names during the first half of the nineteenth century, *Arca crinita* Pulteney, 1799, *A. perforans* Turton, 1819, *Arca quoyi* Payraudeau, 1826, *A. reticulata* Risso, 1826 (*non* Chemnitz), and *A. pennantiana* (Leach MS) Gray, 1852. In regard to the last-mentioned name, while Lamy and others synonymize it with *A. lactea*, Leach himself was very certain of its separability. He said (1852, p. 338): "This species is most decidedly distinct from the *Arca lactea* of Linnaeus: of this I am well assured, having compared it with the *A. lactea* in the Museum of my worthy friend Le Chevalier De Lamarck, taken in the Mediterranean, where Linnaeus says it inhabits." Lamarck's *lactea* is seemingly the *lactea* of Linnaeus. I am ignorant of the whereabouts of the type of Leach's shell. His description is, however, an almost exact translation of Linnaeus' *lactea*.

Pulteney (1799, p. 34) called the British form of the shell *Arca crinita*, insisting that it possessed characteristics which were not conformable to the Linnaean description of *lactea*, and several of the other names mentioned above were based upon this supposed difference. Donovan (1799-1803, vol. 4, text for pl. 135) discussed these divergent views very thoroughly and came to the conclusion, which is now generally accepted, that the British form, by whatever name called, was in fact the *lactea* of Linnaeus.<sup>1</sup>

*Arca lactea* Linné is a member of the genus *Striarca* Conrad, 1862, type *A. centenaria* Say, 1824, by monotypy.

It is figured by Reeve (1843-1878, vol. 2, *Arca*, pl. 17, sp. 116) and by Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, atlas, pl. 37, figs. 1-5).

<sup>1</sup> Donovan (*loc. cit.*) also cites Solander as calling the British form of *Arca lactea* by the name *crinita* in the Portland Catalogue (1786). This was an error, as the name *crinita* is not mentioned in that catalogue. Dillwyn reported *crinita* as being listed in the Solander manuscript in the British Museum, but it apparently was never published.

#### *Arca antiquata*

1758, *Systema naturae*, ed. 10, p. 694, no. 144.

1767, *Systema naturae*, ed. 12, p. 1141, no. 174.

LOCALITY: "In O. Americano" (1758); "in O. Americano, Africano" (1767).

"A. testa oblique cordata multisulcata sulcis muticis, natibus recurvis, margine crenato. . . Vulvae regio quasi angulo compresso prominens."

The identification of this species was based rather on the marked type in the collection than on the somewhat vague description. The type specimen, however, agrees in all respects with those few characters in the description that are not too generalized. The prominent angular "ear" into which the posterior margin is compressed ("Vulvae regio quasi angulo compresso prominens") and the phrase "oblique cordata multisulcata sulcis muticis" are, taken together, completely characteristic of the specimen of the *antiquata* of authors found in the collection and properly authenticated. The references, with the possible exception of the figure from Gualtieri, are valueless. No good figure of *antiquata* can be found in the works known to have been in Linnaeus' library.

The original type specimen is much worn but is accompanied by a fresh specimen which is thought to have been added by Sir James Smith after his acquisition of the collection. This latter specimen is the *Arca scapha* of Meuschen, 1781, a form very close to *antiquata* and usually considered to be a variety, although some authors give it specific rank. While *antiquata* is extremely variable in sculpture it is probably correct to reserve the Linnaean name for the form in which the anterior ribs are divided by a more or less noticeable furrow down the center. This is the *Arca scapha*, variety "b" of Lamarck, 1819, a form which is rather equivocally described as "costis pluribus indivisis," while Lamarck's typical *scapha* (1818-1819, vol. 6, pt. 1, p. 42) appears from its description ("costis sulco divisus") to be a form in which the median as well as the anterior ribs are furrowed. In *A. scapha* Meuschen the furrow is replaced by a fine median thread, often with a lateral thread on each side. Lamarck's *antiquata*, which follows his *scapha* and which he refers to *antiquata* Linné, may be *scapha* Meuschen, although the description is confusing. In the Latin de-

scription he refers to the posterior [*sic*] ribs as being "bifidis," while in the French description he says, "a côtes plus simples que la précédente." I am unable to hazard a guess as to the identity of Lamarck's *antiquata*, but there is a possibility that he reversed the names of the two species (or varieties). It is also doubtful just which form Linnaeus described as *antiquata*, as he characterized the sculpture only as "sulcis muticis." The Chemnitz figure cited by Lamarck for typical *scapha* (1780-1795, vol. 7, pl. 55, fig. 548) shows furrowed ribs at the anterior end, while the Chemnitz figure which Lamarck used for *antiquata* (*tom. cit.*, fig. 549) shows all ribs apparently smooth. Lamy (1907, p. 223) suggested that Lamarck's typical *scapha* was the western Atlantic *Arca secticostata* of Reeve, 1844, in which both the anterior and median ribs are furrowed, as he found among the Lamarckian types in the Paris museum a specimen of *secticostata* labeled *A. scapha* in the handwriting of Lamarck. While this is somewhat persuasive, the identification of *secticostata* with either the *antiquata* of authors or *scapha*, both Indo-Pacific forms, seems extremely doubtful. Not only are the ranges of the species very widely separated, but *secticostata* has the furrowing of the ribs carried over a much greater area of the shell. It is, moreover, a much longer shell laterally than either of the exotic species.

The attribution of Linnaeus' *antiquata* to either of the Indo-Pacific forms would be doubtful therefore, if based upon the description alone. Indeed there is nothing in the description which is inconsistent with *A. secticostata* Reeve, and Linnaeus gave "O. Americano" as one of his localities. Those localities, however, were probably taken from the erroneous figures he cited from Lister and Adanson and are therefore without significance. The identification of *antiquata* must be based largely on the marked specimen in the collection.

Prior to the fixing of *Arca noae* Linné as the type of *Arca* (see introduction to this genus above), the *antiquata* group was considered by a considerable body of conchologists to be the typical subgenus, with *antiquata* as type. *Anadara* Gray, 1847 was an exact synonym of the *Arca, sensu stricto*, of such workers and had *A. antiquata* Linné as type, by original designation. *Scapharca* Gray, 1847, was

erected on the same page of the same work as a good genus, with *A. inaequivalvis* Brugière, 1789, as type, by original designation, but it is doubtful whether it can be separated from *Anadara*.<sup>1</sup> With the shifting of the typical subgenus to the *Arca noae* group, the name *Anadara* must replace *Arca, sensu stricto*, for the *antiquata* group, and the latter species should be cited as *Anadara antiquata* (Linné), 1758.

It is figured by Hanley (1855, pl. 4, fig. 3), and *A. scapha* Meuschen is figured in the same work (pl. 1, fig. 4). Both of these figures were drawn directly from the two specimens found in the Linnaean collection. The typical *antiquata* is figured by Reeve (1843-1878, vol. 2, *Arca*, pl. 4, sp. 24, as *A. maculosa* Reeve).

The diagnosis of *A. antiquata* in the "Museum Ulricaë" is said by Hanley (1855, p. 94) to be one of the frequent instances where a shell bearing the same specific name as a species in the "Systema" is demonstrably different. The description in the "Museum Ulricaë" notes that the ligamental area has angular grooves ("Nates . . . spatio rhombeo plano, striato ad angulum obtusum"), words which recall the very marked chevron-shaped grooves in the cardinal area of the *Arca noae* group. Hanley added that this area in *A. antiquata* is "simple." This is too great an assumption to make. The hinge area of *antiquata* (as of other species in its group, and indeed of most of the groups in *Arca*) does show these grooves. They are, however, either at right angles to the hinge line or if, as is occasionally seen, they are chevron-shaped, they are infrequent. In worn shells they are obsolescent or have completely disappeared. Linnaeus' type of *antiquata* was a worn specimen as appears from Hanley's comments, from the appearance of his figure of the type, and from the photographs of the type supplied by Woodring (1925, pp. 40-41, pl. 4, figs. 1, 2). Woodring adds (p. 41): "Its cardinal area is moderately wide, but no ligament grooves are visible." The "Museum

<sup>1</sup> Most American paleontologists use the name *Scapharca*, while Europeans prefer to use *Anadara*. Dall (1890-1903, pt. 4, pp. 617-619) considered them synonymous and classed all the species of that group under *Scapharca*. While the latter name really covers the species with a thinner shell and a narrower cardinal area than *Anadara*, the two grade into each other.

Ulricae" specimen was unworn, so that the angular grooves were still seen.

#### *Arca senilis*

1758, *Systema naturae*, ed. 10, p. 694, no. 145.  
1767, *Systema naturae*, ed. 12, p. 1142, no. 175.  
LOCALITY: "Ad Jamaica" (1758); "ad Jamaica, inque O. Africano" (1767).

"A. testa oblique cordata octosulcata laevi, natibus recurvis, margine plicato."

The description, references, and locality of this species in the tenth edition are repeated in the twelfth, with only two additions: Linnaeus added a reference to a figure from Adanson (1757, pl. 18, fig. 5) and expanded the West Indian locality by adding "O. Africano." The mention of "Jamaica" is of course erroneous, and the African locality is obviously the result of his finding that Adanson has reported<sup>1</sup> a "*Pectunculus*" species, the figure of which corresponded to the type specimen of *senilis* in his collection, from the west African coast, under the name of "Le Fagan." The description is entirely adequate and is sufficient to identify the species with the *senilis* of virtually all writers. The Linnaean phrase "octosulcata" refers to the spaces between the broader and more salient principal ribs. There are, in addition, four or five smaller ribs on the posterior slope.

Röding called the species *Arca grandaeva* (1798, p. 174), and Meuschen gave it the name of *Arca cor* (Meuschen's work not seen; cf. Mörch, 1852-1853, vol. 2, p. 41). Aside from these two the literature reveals no synonyms. Linnaeus' pictorial synonymy gives us very tolerable drawings of this heavy, coarse, and peculiarly shaped and sculptured *Arca*, and the diagnosis is confirmed by the presence of a properly documented specimen in the collection.

It is a common species on the west African coast from Senegal to Angola, and has been reported from the Cape Verde Islands. It is included in the genus *Senilia* Gray, 1847,<sup>2</sup> as the type of the genus, by monotypy. Thiele cites the type as *senilis* Lamarck, on what theory I am unable to say. The Linnaean description is clear, and Lamarck is clearly describing the same shell.

It is figured by Chemnitz (1780-1795, vol.

<sup>1</sup> The Adanson description (p. 246) is the clearest and most characteristic I have found.

<sup>2</sup> See footnote, page 145, under *Arca barbata* Linné.

7, pl. 56, figs. 554-556) and by Reeve (1843-1878, vol. 2, *Arca*, pl. 7, sp. 45).

#### *Arca granosa*

1758, *Systema naturae*, ed. 10, p. 694, no. 146.  
1767, *Systema naturae*, ed. 12, p. 1142, no. 176.  
LOCALITY: "In Europae meridionalis" (1758, 1767).

"A. testa subcordata sulcis muricatis, natibus recurvis, margine crenato."

This description, identical in both tenth and twelfth editions, might be taken to refer to a number of *arcas* except for the phrase "sulcis muricatis." This phrase affords the only suggestion of anything specifically characteristic and was responsible for the identification of the species with the Indo-Pacific *Arca granosa* of all authors. Even this phrase is equivocal. In the first place Linnaeus has again used the word "sulcus" instead of "costa," and the word "muricatis" is hardly descriptive of the nodulous ridges across the ribs of this shell. The specific name *granosa* is much more graphic. The references contain good and bad figures. The figure from Columna shows a fossil *Arca* with many closely crowded ribs, quite unlike the widely spaced, gracefully spreading ribs of the *granosa* of authors. Buonanni's drawing is of the inner aspect of an unrecognizable *Arca*, which Hanley suggested might be meant for *A. diluvii* Lamarck, 1819. The Argenville figure, which seemed to satisfy Hanley, is an umbonal view of something which was possibly meant for *granosa*, although this aspect of a shell is always deceptive. The Gualtieri figure, the only one which is recognizable, was clearly meant for *granosa*, so that the species may be said to be pictorially defined.

The only *Arca* with which the language of the description could be confused is *A. rhombea* Born, 1780. The nodulations of the ribs of this species are, however, less prominent than in *granosa*, and the umbones are much higher. Fortunately the collection contains a specimen of the *granosa* of authors, which, although it is unmarked by name or number, is the only specimen in the collection that agrees with the description. As the species was on Linnaeus' list of his shells this specimen may be taken as the type of the species. No specimen of *A. rhombea* is present. The erroneous locality was borrowed from Buonanni.

This species is extremely variable in the shape of the shell, in the number of ribs, and in the prominence of the umbones, and this variation has given rise to several specific names, most of which are of varietal value only or are based on growth stages. Gmelin described an *Arca corbicula* which he called "ovate," whereas the typical adult *granosa* is an almost equilateral fan-shaped shell. He cited Chemnitz' *Arca granosa minor* for it (1780-1795, vol. 7, p. 222, pl. 56, fig. 559) and speaks of his species as "granosae affinis." He gave the locality as the Nicobar Islands in the Bay of Bengal, as did Chemnitz. The name was probably founded on a young specimen of *granosa*. Lamarck also listed *corbicula*, citing it as of Gmelin, but changed the locality to the Cape of Good Hope. Lamarck's *granosa* (1818-1819, vol. 6, pt. 1 p. 43) mentioned three varieties. The first, to which he attributed 25 to 26 ribs (much more than in the typical *granosa*) was possibly *A. rhombea* Born, 1780, a good species. Varieties "b" and "c," each of which was said to have 18 to 20 ribs, are both generally considered to be the typical *granosa*, variety "b," described as having the umbones widely separated and the ribs with widely spaced tubercles, being the adult shell, and variety "c," to which he attributed closely converging umbones and "costis crenatis," being based on young specimens. Probably Chemnitz' *Arca granosa* Linnaei (*tom. cit.*, fig. 557), *Arca corbula* (*tom. cit.*, fig. 558) and *Arca granosa minor*, as well as Gmelin's *corbicula* and Lamarck's *granosa* varieties "b" and "c," are properly placed in synonymy with *granosa* Linné. *A. aculeata* Bruguière, 1789, and *A. cuneata* Reeve, 1844, are also synonyms.

The species is widely dispersed in the Indo-Pacific region from the Arabian Sea to the Philippines and Australia. It is placed, with *A. antiquata* Linné, in the genus *Anadara* Gray, 1847.

It is figured in Reeve (1843-1878, vol. 2, *Arca*, pl. 2, sp. 15a, b).

#### THE GLYCYMERIDS OF *Arca* LINNÉ

Seven of the species included in the *Arca* of Linnaeus, numbers 177 to 183 inclusive, have been moved to *Glycymeris* Da Costa, 1778. The essential characteristics of the

genus are the heavy orbicular or suborbicular and generally equilateral shell, the arched hinge line bearing a series of heavy parallel teeth, the outer ones being smaller and more or less horizontal, and the occasional obliteration of the median teeth to a greater or less degree by the ligamental area especially in senile individuals, a ligamental area that is narrow as compared to that of the true arcas, and subequal muscle scars the inner margins of which are slightly raised.

In Lamarck's "Prodrome" of 1799 the genus *Pectunculus* was erected for this group, with *Arca pectunculus* Linné as "example," and this name remained in use for many years and is still used by many European commentators, notably the French.<sup>1</sup> However, the name *Glycymeris* Da Costa, 1778,<sup>2</sup> covers the same group, was validly proposed in a consistently binomial work, and has 21 years' priority, as was pointed out by Dall (1890-1903, pt. 4, p. 607). This view is followed by most American writers. Lamy and his French colleagues do not base their use of *Pectunculus* on Lamarck's genus, but rather on its alleged use in Huddesford's "editio altera" of Lister's "Historiae," which appeared in 1770, several years before Da Costa's proposal of *Glycymeris*. The argument

<sup>1</sup> *Pectunculus* Lamarck is not *Pectunculus* Da Costa, 1778, a name proposed for a group of species in Veneridae.

<sup>2</sup> *Glycymeris* Da Costa is not *Glycymeris* Lamarck, 1799, proposed for a genus in Saxicavidae. The latter genus is a homonym under the terms of Opinion 147, which extended to generic names the provisions of Article 35 (a) of the Rules covering slight variations in the spelling of specific names. Even before the promulgation of the Opinion Lamarck's *Glycymeris* was generally considered to have been preoccupied and was supplanted long ago by *Panopea* (emend. *Panope*) Ménard, 1807, which has the same type as *Glycymeris* Lamarck, *Panope glycymeris* (Born), 1778, originally described as *Mya glycymeris* and so cited by Lamarck. The confusion in orthography was possibly aggravated by Da Costa's own error of transcription. In the Index at the end of the 1778 work he lists the genus as *Glycymeris*, with the species *argentea* (*Arca nucleus* Linné) and *orbicularis* (*Arca glycymeris* Linné), whereas in the text (p. 168), to which the Index refers, the genus is spelled *Glycymeris*, with the same two species. Even without the unnecessary and possibly questionable argument that the text takes precedence over an index, the text mention of the name here has page priority. In any case the text use has priority, as it is accompanied by a clear description. None of the Da Costa genera have specified types, *orbicularis* being the type, by absolute tautonymy, as it equals *A. glycymeris* Linné.



of the French writers is, as stated by Lamy (1921, pp. 81-84), that the name *Pectunculus* as used in a generic sense in the preface to Luddesford's edition. An examination of the latter work does not sustain this argument. The preface contains no mention of any generic name. In the indexes at the back of the book Index 1 uses the plural name "Pectuncululi" merely as a general term covering a number of species, apparently arcas, all of which are expressed polynomially. In Index 2 the name is used only specifically, as *Arca pectunculus*. These are the only times the name, or any derivative of it, is used.

It is often difficult to distinguish the anterior and posterior ends of many glycymerids, owing to the almost perfect symmetry of the shell and the fact that the umboes in many species are not directed to either side.<sup>1</sup> In general, however, the posterior end is obtusely carinate and either angular or truncate, while the anterior end is rounded and in the inner aspect shows a less pronounced coloring. The positions of the umboes in relation to the ligament are discussed under the species *Arca decussata* and *A. undata*, below.

The first division of the glycymerids was the separation of the group into two subgenera: *Pectunculus, sensu stricto* (*Glycymeris, sensu stricto*), with *Arca pectunculus* Linné as type, and *Axinaea* Poli, 1791, with *Arca glycymeris* Linné as type. The former was designed to cover the shells with strong radial sculpture, and the latter the species in which the radial sculpture is obsolescent, consisting merely of superficial grooves or indented lines so shallow that in worn specimens almost entirely disappears. This distinction is no longer generally employed. Deshayes (1839-1853, vol. 1, p. 319) commented that the division has little real value, as the crenulations of the inner margin of all members of the group suggest that, in the case of the smooth or nearly smooth species, there were ribs on the outside of the shell which had become overlain by shelly material. This,

<sup>1</sup> An informative discussion of the orientation of the shell in Glycymeridae is found in Fischer (1887, p. 978). He points out the difference between the shape of the anterior and posterior muscle scars and notes that the anterior is generally more highly colored on the posterior side.

he said, is proved by the fact that in fossil specimens the decortication of the surface discloses ribs of some prominence which end in the crenulations of the margin.

As the glycymerids received more intensive study during the past half century or so, many new supraspecific names were proposed, and of these a considerable number have been accepted by conchologists as having real generic or subgeneric value. Woodring, Marwick, and Iredale, who have made the most critical studies of the group, were the authors of many of these now-accepted names.<sup>2</sup>

It is a curious and unexplainable fact that Linnaeus did not mention the characteristic curved hinge line in the description of any of his glycymerids, nor did he refer to the teeth in any way, whereas in describing *Arca nucleus*, a nucleid, he referred to the hinge in the words "cardine arcuato," and for *Arca pella*, a nuculanid, he said: "Cardine ciliari" and "Cardinis dentis acutissimi (quod non in reliquis), imprimis sub volva." It is no less strange that he did not refer to the taxodont hinge in the description of any of the true arcas.

#### *Arca decussata*

1758, Systema naturae, ed. 10, p. 694, no. 147.

1767, Systema naturae, ed. 12, p. 1142, no. 177.

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

"A. testa lenticulari decussatim substriata, marginibus recurvis, margine crenato, rima clausa."

There seems to be little question but that Linnaeus was here describing the western Atlantic shell called *Pectunculus pennaceus* by Lamarck (1818-1819, vol. 6, pt. 1, p. 51). Lamarck himself was not entirely convinced of this identification, as he placed the Linnaean name in synonymy with a question mark.

Chemnitz cited the species under the Linnaean name and gave the proper references to both the tenth and twelfth editions of the "Systema" as well as furnishing a reasonably accurate figure (1780-1795, vol. 7, p. 226, pl. 57, fig. 561) in which the decussation of the surface is, however, badly drawn and somewhat overemphasized. He gave the locality as the "West Indian Sugar islands" and noted that his figure was drawn from a specimen

<sup>2</sup> The most recent and most exhaustive digest of these supraspecific names is found in Nicol (1945).

from St. Thomas. Lamarck also cited this figure with a query, and adopted the Linnaean locality, "la mer des Indes."

Not only is the specimen marked for this name in the Linnaean collection a specimen of the West Indian *Glycymeris pennaceus*, but it agrees with the accurate but somewhat brief description. Even without the aid of the type the description seems sufficient to have identified the shell, particularly when it is compared with the description of *A. undata*, its close relative (below), for which the later name *Glycymeris lineatus* (Reeve), 1843, is now generally used. My comments on the latter species are somewhat anticipated at this point.

*Arca decussata* is described by Linnaeus as "decussatim striata" and "natibus recurvis." *Arca undata* is characterized as "laeviuscula" and "vix rugosa, minime sulcata," without any reference to decussate sculpture, and the umbones are not said to be "recurvis" but "inflexis," which I interpret as meaning that they are directed inward in the plane of the thickness of the shell and are not twisted to one side, as in *decussata*. The difference in the sculpture is evident in all specimens of the two species that I have examined. The West Indian *pennacea* (*decussata* Linné) is plainly although not markedly decussate, the concentric sculpture taking the form of low ribs which are more marked as they pass over the radial ribs, giving the latter a nodolous appearance. In the West Indian *lineata* (*undata* Linné) the concentric ribs are virtually obsolete in adult shells, and the sculpture could not be described as decussate. In juvenile specimens of *lineata* the concentric sculpture is stronger. The most significant difference, however, is in the position of the umbones, as Linnaeus pointed out.<sup>1</sup> In *pennacea* their termini almost meet over the extreme anterior

<sup>1</sup> Attention is called to the fact that Linnaeus, in the treatment of the glycymerids, used the word "recurvis" not only for *decussata* but for *A. pallens* as well, and used "inflexis" (or "incurvis") in the descriptions of *undata*, *pectunculus*, *glycymeris pilosa*, and *nummaria*, i.e., all the remaining glycymerids. Moreover this differentiation of species based on the position of the umbones is reflected in the titles he gave to two of the so-called "subgeneric" groups in *Arca*. The first two species mentioned are included under the title "Margine crenato; natibus recurvatis." The remainder are under the title "Margine crenato; natibus inflexis."

end of the ligament, whereas in *lineata* they are central in relation to the length of the ligament. Lamarck noted this difference. In his description of *Pectunculus pennaceus* (1818-1819, vol. 6, pt. 1, p. 51) he says, "natibus ligamenti extremitate antica inflexis," and in his French description, "remarquable . . . par les crochets qui ont leur pointe dirigée tout-à-fait à l'extrémité antérieure du ligament, de manière que ce ligament est entièrement hors de l'intervalle qui les sépare." He describes *Pectunculus undulatus* (*A. undata* Linné; *P. lineata* Reeve) as "natibus recte incurvis." Reeve also mentioned this difference (1843-1879, vol. 1, *Pectunculus*, pl. 5, sp. 24). D'Orbigny, on the other hand, used both *P. lineatus* Reeve and *P. pennaceus* Lamarck as synonyms of *Arca undata* Linné (D'Orbigny, 1845, p. 341), but the species are quite distinct. Umbonal views of the two species, which clearly illustrate this characteristic difference, are shown by Lamy (1912, pl. 3, figs. 7-8).

Linnaeus supplied no references for *A. decussata*, as no recognizable figure existed in his day, and fortunately he refrained from his frequent confusing practice of citing the nearest approximation he could find.

One peculiarity of the sculpture of *decussata* has apparently never been described. In unworn specimens the shell is divided roughly into three sculptural zones. On the anterior half of the shell the radial ribs are extremely narrow, giving the appearance of closely packed threads. Next to this there is a triangular zone with broader ribs. On the posterior slope the ribs again tend to be almost, if not quite, as narrow as those on the anterior half. This can be plainly seen on a specimen which has lost all or a part of its epidermis but is not worn. This difference in the size of the ribs is also noticeable in *undata* Linné, but to a much less marked degree.

Although the name *pennacea* Lamarck has become fairly well established for this species, any disturbance of the nomenclature brought about by the restoration of the name *decussata* would be only temporary. Zoologists should be most reluctant to abandon a Linnaean specific name which was well defined, when its identity with the later-used

name is universally conceded, and therefore I feel that the accuracy and even the stability of our nomenclature would be best served by restoring the Linnaean specific name. The species is the type of the subgenus *Glycymerella* Woodring, 1925, by original designation.

#### *Arca pallens*

1758, *Systema naturae*, ed. 10, p. 694, no. 148.

1767, *Systema naturae*, ed. 12, p. 1142, no. 178.

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

"A. testa lenticulari subobliqua decussatim striata, natibus recurvis, margine crenato rima angustissima. . . Testae color pallidus. Rima laevis."

The description of *pallens* is so generalized as to be ambiguous, and there is no specimen in the collection that can be fairly referred to it. No references are supplied except a mention of its listing in the "Museum Ulricae," and the description of the species of the same name in that work discloses a discrepancy which leads to the belief that a different shell was being described. In the "Systema" the umbones are said to be "recurvis," whereas in the later work they are described as "ad nullum latum obliquatae." The position and direction of the umbones in *Glycymeris* are a sufficiently specific character to make such a discrepancy important. Moreover, as has already been pointed out in the Foreword, an examination of the Queen's collection, which Hanley suggested in the present case, will not assist us, as Linnaeus prepared no labels for the specimens but merely placed them in the cabinet in the order in which he numbered them in the catalogue. The existing labels are the work of a later curator. The Linnaean description in the "Systema" points to a probable *Glycymeris*, and there is a respectable body of opinion which holds that it is the *Pectunculus violacescens* of Lamarck, 1819 (frequently misspelled *violascens*), but the language is not sufficiently descriptive of that species to be convincing. The locality, "in Indiis," is not helpful and, if it is to be believed, certainly points away from the *violacescens* of the Mediterranean. Hanley (1855, p. 97) suggested the identity of *pallens* with *violacescens* "as a mere surmise," and Mörch (1852-1853, vol. 2, p. 42) arrived at the same conclusion.

Lamy (1912, p. 149) also united the two

names but did not use either as a good species, placing both in the synonymy of an earlier name, *Pectunculus cor* Lamarck, 1805, a fossil species of southwest France which Lamarck had described in an earlier paper (1805, p. 217, note). Lamy also synonymized under the same species *Arca nummaria* Linné (discussed below) and *P. transversus* and *P. nudicardo* Lamarck, 1819 (1818-1819, vol. 6, pt. 1, pp. 55-56), the two latter being also fossil species. Lamarck's description of the fossil *P. cor*, however, has very little in common with the Linnaean language describing *Arca pallens*, and the same may be said of the other two Lamarckian fossils, except that *P. transversus* is described as having decussate sculpture, and the description of *P. nudicardo* contains language that might be read to mean that type of ornamentation. Dollfus, 1909, who also examined the Lamarck types in the Paris museum, came to the same conclusion as Lamy. One must question with great reluctance the opinion of those who have seen the types, which this writer has not, but it is difficult to convince oneself, from the descriptions alone, that any of these species is in fact the *Arca pallens* of Linnaeus, and it seems clear that we must leave *pallens* as a *species dubius*. Its identity with *Pectunculus cor* Lamarck has, however, been accepted by some writers.<sup>1</sup>

#### *Arca undata*

1758, *Systema naturae*, ed. 10, p. 695, no. 149.

1767, *Systema naturae*, ed. 12, p. 1142, no. 179.

LOCALITY: "Ad Jamaicam" (1758, 1767).

"A. testa lenticulari inaurita laeviuscula, natibus inflexis, margine plicato. . . Testa picta uti *A. pectunculus*, sed crassior, vix rugosa, minime sulcata, basi rotundata, margine plicata."

By identical diagnoses in the tenth and twelfth editions of the "Systema" Linnaeus described the West Indian shell later called *Pectunculus lineatus* by Reeve (1843, p. 80), a name which has since that date been traditionally used for the species, at least in the United States. A marked specimen of that

<sup>1</sup> Lamarck's original name for his *P. cor* is poly-nomial. It reads: "There is found in abundance near Bordeaux, a fossil *Pectunculus* which is different from the species mentioned above. I name it: *Pectunculus (cor) inaequilateralis, subcordatus ventricosus, obsolete sulcatus; arca ligamenti sulcis profundis exarata n. I will give the description elsewhere.*"

shell in the Linnaean collection, which entirely agrees with much of the description, substantiates this identification, although the type is so worn that, had it not been authenticated by Linnaeus, it would have been difficult to have referred it to the description. The locality, Jamaica, is correct. The single reference, a figure from Buonanni, is a very bad drawing which may have been meant for *Arca glycymeris* Linné and is probably another instance of the selection of an approximately accurate figure by Linnaeus.

The Linnaean name *undata* has been occasionally used since the date of Reeve's *lineatus*. Mörch used it in the Yoldi Catalogue (1852-1853), and Dall used it as late as 1886 (p. 190). Hanley (1842-1856, p. 162) adopted for the species the name *undulatus* Lamarck, although he later (1855, p. 97) changed to *lineatus* Reeve. His earlier use of *undulatus*, however, was with a query, as he apparently shared the doubts of Lamarck himself as to its identity with *A. undata* Linné. Bruguière (1789-1792, p. 113) believed that the shell which Chemnitz described and figured as *A. undata* Linné (1780-1795, vol. 7, p. 224, pl. 57, fig. 560) was in fact the common Mediterranean shell which Deshayes later identified, from one of the posthumous plates of Bruguière, as *Arca glycymeris* Linné. Chemnitz had correctly departed from the Linnaean diagnosis by locating *undata* in the West Indies. D'Orbigny (1845, p. 341) united under the name *undata* both *lineatus* Reeve and *pennaceus* Lamarck, which are quite different species and are readily distinguished by the position and direction of the umbones, as described in my comments on *Arca decussata* (above).

Reeve's name *lineatus* is the almost universally accepted name for the species today. It is, however, a homonym. Philippi (1836, 1844, vol. 1, p. 62) described a *Pectunculus lineatus* seven years before Reeve's proposal of the name. Philippi's figure (*tom. cit.*, pl. 5, fig. 4) is too small to be suggestive, and his description is not illuminating. He calls the species "minuta" and says that it is distinguished from *P. violacescens* because it is "non transversa, non subaurita," and from *P. pilosa* and *P. glycymeris* because of its "defectu striarum longitudinalium." Lamy (1912, p. 131) believed Philippi's *lineatus* to

be a synonym of *P. glycymeris* Linné (probably being based on a very young shell because of the use of the word "minuta") and placed it in his synonymy of that species. Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, atlas, pl. 34, figs. 3-4) show a shell which they refer to "*Pectunculus glycymeris* Lin.," but which Pallary (1904, p. 243), in referring to those figures, called *P. lineatus* Philippi, which he accepted as a good species. In any case, whether Philippi's *lineatus* is *glycymeris* or a distinct species, it was a validly proposed name and was not *lineatus* Reeve, which thus becomes a homonym and unavailable. Inasmuch as the species long known as *lineatus* Reeve is conceded to be *Arca undata* Linné, there is no valid reason against the restoration of the clearly defined Linnaean name.

The description of *Arca undata* is accurate, with one possible exception: the phrase "Testa picta uti A. Pectunculus" needs clarification. In most specimens of *undata* the brown markings consist of irregularly disposed and shapeless blotches, whereas in *pectunculus* the spots tend to be squarer and to be grouped in broken and irregularly transverse bands. The pattern in both species is, however, very variable, and therefore the quoted words do not seriously impugn the accepted identification with *lineatus* Reeve.

Dall thought that *Arca scripta* Born, 1780, represented the juvenile *Arca undata* Linné, but Lamy (1912, p. 118) pointed out that individuals of *scripta* are often seen which equal or even exceed the average size of *undata*. Chemnitz described and figured an *Arca variegata aequilatera* (1780-1795, vol. 7, p. 227, pl. 57, fig. 562). This became *A. aequilatera* in Gmelin and *Pectunculus castaneus* in Lamarck (1818-1819, vol. 6, pt. 1, p. 53), a shell that has been separated from the species under discussion by some writers. It seems, however, to be at most a mere color variety of *undata* (*lineatus* Reeve), a form where the reddish brown blotches predominate on a white base.

In 1826 Defrance (p. 225) described a shell from North Carolina, *Pectunculus americanus*, which has been confused with *lineatus* Reeve. Some authors, while using *americanus* as a good species, consider *lineatus* as its subspecies. It is very close to *lineatus*. Its um-

bones are central, as in *lineatus*, but the sculpture is conspicuously different. Its principal radial ribs are very broad, being in effect wide but low undulations of the surface of the shell, and each is marked by five to seven parallel radial threads, which also appear in the interspaces. There is no visible decussate sculpture in any specimens that I have examined. It is a somewhat more inflated shell than *lineatus* Reeve and seems to be specifically distinct.

*Arca undata* probably belongs in the typical subgenus of *Glycymeris* Da Costa, 1778.<sup>1</sup> It is found throughout the tropical and subtropical parts of the western Atlantic.

In addition to the Chemnitz figures referred to above, it is figured in Reeve (1843-1878, vol. 1, *Pectunculus*, pl. 5, sp. 25).

It is the *Arca decussata* of Born, 1780, *non* Linné, 1758, and probably the *A. undata* of Chemnitz, 1784 (1780-1795, vol. 7, p. 224, pl. 57, fig. 560), and of Bruguière, 1789, and possibly *A. angulata* Bruguière, 1789, and *A. angulifera* Gmelin, 1791. It is conjectural whether *P. angulatus* Lamarck, 1819, was the same species.

#### *Arca pectunculus*

1758, *Systema naturae*, ed. 10, p. 695, no. 150.

1767, *Systema naturae*, ed. 12, p. 1142, no. 180.

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

"A. testa lenticulari subaurita sulcata sulcis subimbricatis, natibus inflexis, margine plicato."

The type specimen of this species is authoritatively marked in the Linnaean collection and agrees in all particulars with the rather brief description. The synonymy is unusually good, and any deficiencies in the description are compensated by the very ample and characteristic details in the "Museum Ulricae," which, even in the absence of a marked type, would have identified the species beyond question. The type is an individual of the shell which has been always known to conchologists by the Linnaean specific name *pectunculus*, or as *Pectunculus*

*pectiniformis* Lamarck, 1819. The latter author referred his species to *Arca pectunculus* Linné and cited two of the four references supplied by Linnaeus. It has been argued that he discarded the name *pectunculus* in order to avoid a tautonymic appellation, as he seemingly did in other cases, but his unfortunate tendency to rename species was so marked that it seems unnecessary to invent excuses for his changes. It is to be noted that he used this species, as *Arca pectunculus* Linné, as the "example" of his new genus *Pectunculus* in the "Prodrome" of 1799, changed it to *P. subauritus* in 1801, and changed it again to *pectiniformis* in 1819. The locality in the "Systema," "O. Americano," is incorrect as it is an Indo-Pacific species. Lamarck reported it from "l'Océan asiatique et américain."

An excellent pair of figures, showing both the inner and outer aspects of the shell, is found in Chemnitz (1780-1795, vol. 7, pl. 58, figs. 568-569). It is also figured by Reeve (1843-1878, vol. 1, *Pectunculus*, pl. 3, sp. 11a, b, as *P. pectiniformis*). Crouch (1826, pl. 8, fig. 12) has an admirable figure. The use of the specific name *pectiniformis* is not sufficiently widespread today to justify its substitution for the original name, which was well defined and should be retained.

The species belongs in the genus *Tucetona* Iredale, 1931. It is distinguished from all the other glycymerids of the "Systema" by its heavy rounded ribs and narrow interspaces, and by its color pattern which is described in the discussion of *Arca undata* (above).

#### *Arca glycymeris*

1758, *Systema naturae*, ed. 10, p. 695, no. 151.

1767, *Systema naturae*, ed. 12, p. 1143, no. 181.

LOCALITY: "Ad insulam Garnsey" (1758); "ad insulam Garnsey, inque O. Africano" (1767).

"A. testa suborbiculata gibba substriata, natibus incurvis, margine crenato."

The description of *A. glycymeris*, which remained unchanged in the twelfth edition, is very brief and differs very little from the descriptions of Linnaeus' other glycymerids. The word "gibba" is, however, characteristic and was used only for this species, and the marked type in the collection agrees with the brief diagnosis. The type specimen is the *Glycymeris glycymeris* of all modern authors,

<sup>1</sup> The species has been tentatively placed in *Glycymerella* Woodring, 1925, by some workers. Nicol advises me (personal communication) that, although his studies on the classification of the glycymerids is not completed, he would for the moment put *undata* in *Glycymeris*, *sensu stricto*, although with a certain reservation. At best, *Glycymerella* Woodring can be considered only a subgenus.

although many other specific names were applied to it during the first century after Linnaeus. In fact, Da Costa, who based his genus *Glycymeris* on this and one other species, called it *G. orbicularis*. It was the *Pectunculus marmoratus* of Lamarck, 1819, *non* Chemnitz, 1784; the *P. pilosus*, *undatus*, and *decussatus* of Turton, 1827, *non* Linné; and probably the *P. lineatus* of Philippi, 1836-1844, *non* Reeve, 1843. Hanley (1842-1856, p. 162), believed the type specimen was *Pectunculus violacescens* Lamarck, 1819,<sup>1</sup> but corrected this error in the Appendix to the 1842-1856 work, and in the "Ipsa Linnaei conchyliæ" (1855, p. 98) acknowledges that the specimen in the collection is the common *P. glycymeris* of the British Isles, the French Atlantic coast, and the Mediterranean.

The references are either erroneous or unidentifiable, with the exception of a figure from Lister, 1770, there called *Chama glycymeris*, which is a fair representation of *glycymeris* Linné. The figures from Gualtieri (pl. 82, figs. C-D) might have been intended for *P. violacescens*.

Most authors have united *glycymeris* Linné with *pilosa* Linné, the succeeding species in the twelfth edition of the "Systema," and much ink has been expended upon the relationship of these two names. The shells are very similar, and the majority of conchologists still hold that *pilosa* is merely a well-marked variety of the typical *glycymeris*. In its extreme form it is less rounded, more equilateral, and more gibbous than the typical species, with heavier sculpture. The periostracum is heavier and more persistent over most of the shell. Monterosato (1884, p. 14) considered that *pilosus* was found only in the Mediterranean and that the Atlantic form was the true *glycymeris*. Martel (1908, p. 152), on the contrary, was convinced that both were forms of an extremely variable species which intergraded into each other, the differences being largely ecological. His theory was that the Atlantic form was more apt to be eroded and thus to lose its periostracum and the comparative coarseness

of its sculpture because of the scouring action of quartz sand, and that this condition existed to a less degree in the Mediterranean. While this argument may sound far fetched, it seems to be true that the commoner shell in the Mediterranean is *pilosus*, and that the Atlantic form is *glycymeris*. Whether we are to call the former identical with the latter, or a geographical race or a variety, it is agreed that it has no specific validity. I have not been able to examine any considerable series of the two forms but call attention to the opinion of Lamy, who had access to the large Paris museum collection (1912, p. 135): "One finds all possible combinations of the characteristic traits; shape more or less oblique, flattened or gibbous, interior white or with brown blotches, growth lines heavy or, on the contrary, light or even lacking. These characteristics are therefore not specific and *P. glycymeris* and *P. pilosus* should be regarded as forming but a single species with two varieties." It is suggested that Lamy's language, implying as it does the perfect intergrading of the two forms, hardly justifies even the establishment of varieties. So far as the Linnaean descriptions of the two names are concerned, the significant words "gibba" in that of *glycymeris* and "aequilatera" and "pilosa" in that of *pilosa* show that the author was describing the two extreme forms, and in fact the two marked specimens in the collection are in strict accord with the difference in language. The respective localities, excluding the questionable "O. Africano" for *glycymeris*, are confirmatory. Nevertheless Linnaeus called attention to the close relationship of the two forms in the subdescription of *pilosus*: "Simillima C. Glycymeri, sed testa perfecte regularis, et extus toto limbo holoserici veluti instar pilosa; intus alba; A. Glycymeris vero parum irregularis est." The "C" as the generic abbreviation before "Glycymeri" was a *lapsus calami*, *Chama glycymeris* of Lister having been referred to in the synonymy. The white interior described for *pilosa* is not entirely accurate, as the common Mediterranean form usually has a brown blotch at the posterior end. There exists a third form which has been accepted by some writers as a variety, *Pectunculus punctatus* Calcare, 1840. This latter form is identical

<sup>1</sup> *Pectunculus violacescens* Lamarck is possibly a synonym of *Arca pallens* Linné, as already noted, and of *A. nummaria* Linné, discussed below. It bears no relation to *Arca glycymeris* Linné.

with *P. nummarius* Turton, 1822, *non* Linné.

The references given for *A. pilosa* in the "Systema" are inaccurate with the exception of that from Buonanni, which was so good that Linnaeus wrote on the specimen in his collection "Bonan, recr. f. 80" and adopted the specific name of Buonanni, *Nux pilosa*, for his species. This legend is equivalent to writing the proper "Systema" number on the shell.

*Arca glycymeris* Linné, as *Glycymeris orbicularis* Da Costa, is the type of the genus *Glycymeris*, *sensu stricto*, by absolute tautonymy. It is figured by Reeve (1843-1878, vol. 1, *Pectunculus*, pl. 3, sp. 12a, b), and in Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, atlas, pl. 34, figs. 1-6). These authors figure *pilosus*, as a distinct species, with several varieties of its own, on plate 33, figures 1-7.<sup>1</sup>

#### *Arca pilosa*

1767, *Systema naturae*, ed. 12, p. 1143, no. 182.

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

The description and identity of this species are covered in the discussion of the preceding name, *Arca glycymeris*.

#### *Arca nummaria*

1758, *Systema naturae*, ed. 10, p. 695, no. 152.

1767, *Systema naturae*, ed. 12, p. 1143, no. 183.

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

"A. testa subrotunda laevi subaurita transversim striata, natibus incurvis, margine crenulato. . . . Testa magnitudine unguis, undato-rufa, non perfecte lenticularis, vix manifeste transversim striata, auribus vix manifestis."

I agree with Hanley's conclusion that this species was inadequately described. No references were cited, but the box marked for the species in the collection contained specimens of the shell called *Pectunculus violacescens* by Lamarck, 1819, which agree with the characteristics stated in the description, so far as they go. The stated locality, the Mediterranean, supports this identification.

<sup>1</sup> Bucquoy, Dautzenberg, and Dollfus discuss *Pectunculus glycymeris* (*tom. cit.*, pp. 195-199). They locate it only in the Atlantic, particularly along the English and French coasts. The Mediterranean reports of this species were believed by them to refer to *P. bimaculatus* Poli. They comment on *P. pilosus* on pages 199-202, as a purely Mediterranean shell, saying: "We do not think that *P. pilosus* really lives in the Atlantic Ocean."

Hanley recognized the common identity of the two shells, but objected to the restoration of the name *nummaria*, giving two reasons, neither of which is valid. He said (1855, p. 100), "The species, as it appeared in print, not being adequately defined, and the description being unsuitable to mature individuals, the name *nummaria* has no valid claim to preference." The real or fancied inadequacy of the description is, however, cured by the presence of an identified type in the collection which conforms to the description. Hanley's other objection has no weight today. Rule 27 (f) provides that the oldest available name is retained where any stage in the life history of the species is named before the animal itself. Lamy (1912, p. 152), even though writing after the promulgation of the Code, nevertheless cited Hanley's conclusion with approval.

In spite of the fact that the description of *nummaria*, standing alone, is not perfect, and that we must have recourse to the marked type in the collection in order to fix its identity, and in spite of the fact that Linnaeus described only the young of the shell, the species was adequately defined and identified by its author. The position taken today, however, in cases of this kind, is that the restoration of the earliest name, even though well defined, in place of a later name which has become familiar by long use, is inadvisable, as the basic purpose of the Code of Nomenclature is to promote stability in the nomenclature and to avoid confusion. The Commission has before it a proposal to retain any later name which has been in general use for at least 50 years.

As is said in the discussion of *Arca pallens* Linné above, Hanley (1855, pp. 97, 100) suggested the identity of *violacescens* Lamarck not only with *nummaria* but with *pallens*, thus uniting the two latter species, although Hanley, in the case of *pallens*, made the identification with considerable diffidence. Dollfus (1909, p. 366) then proved, at least to his own satisfaction, that a glycymerid described by Lamarck in 1805 from a fossil specimen from southwest France (1805, p. 217, note), under the name of *Pectunculus cor*, was in fact identical with Lamarck's *violacescens* and should therefore take precedence over that name. Lamy adopted this

view (1912, p. 149) and used *cor* as the earliest valid name for the species, with *pallens* Linné, *nummaria* Linné, and *violascens* Lamarck in its synonymy. Whether *P. cor* is in fact identical with these other names is of only historical interest, as its proposal in 1805 was not valid (see discussion of this species under *Arca pallens* above), and in Lamarck's work (1818-1819, vol. 6, pt. 1, pp. 52, 55), it must yield to the page priority of *P. violascens*.

*Arca nummaria* Linné, as *Pectunculus violascens* Lamarck, is the type of the subgenus *Pseudaxinea* Monterosato, 1892. It has not to my knowledge been figured in its young stage. The adult shell is figured by Reeve (1843-1878, vol. 1, *Pectunculus*, pl. 9, sp. 9b), as *violascens*. Reeve does not mention either *pallens* Linné or *nummaria* Linné in the synonymy.

#### *Arca nucleus*

1758, *Systema naturae*, ed. 10, p. 695, no. 153.

1767, *Systema naturae*, ed. 12, p. 1143, no. 184.

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

"A. testa oblique ovata laeviuscula, natibus incurvis, margine crenulato, cardine arcuato. . . . Testa magnitudine avellanae. Inter Nates Rima triangularis, erecta."

The above description has been generally accepted as defining the *Arca nucleus* of later authors. I suggest that it is so decidedly inadequate that it is impossible to identify it specifically. Hanley (1855, p. 100) could not even guess at its genus.

We are given a considerable list of characters, but not only are some of them applicable to more than one species, but two of them do not describe the *nucleus* of authors. The latter is not "laeviuscula" but has fine radial and concentric sculpture and has a hinge line which is not "arcuato" but angulated. The word "arcuato" might refer to any glycymerid, or to several of the true *Arca*. The hinge of the *nucula* of authors has an anterior and posterior series of taxodont teeth separated under the umbones by a ligamental pit, the anterior series being quite straight and the posterior series only slightly curved, the two series meeting at approximately a right angle. Moreover it is surprising that Linnaeus did not follow his usual practice in describing pelecypods of re-

ferring to the interior color of the shell where that was in any way striking. He did not mention the silvery sheen of the interior of *nucleus*, a character that is so marked that both Bruguière and Lamarck based their name for this species, *margaritacea*, on it, and Da Costa called the species *Glycymeris argentea*. It is referred to in all later descriptions. This omission is not to be explained away by the fact that the specimens on which Linnaeus based the species might have been worn, as both Gualtieri and Petiver use the phrase "intus argentea," and these two authors were represented in Linnaeus' library and were continually referred to. Indeed Linnaeus, who gave no references for *nucleus* in the "Systema" as published, added a manuscript note for this species citing "Pet. gaz. t. 17, f. 9." This figure, which undoubtedly shows a *Nucula* and is generally cited for the present species, may have been intended to portray another species in the same group. Hanley suggested (*loc. cit.*) that it was meant for *N. radiata* Forbes and Hanley, 1849 (which Bucquoy, Dautzenberg, and Dollfus treat as a variety of *N. nucleus*), or *N. nitida* Sowerby, 1833.

The specimens marked for *A. nucleus* in the Linnaean collection are single valves and are so worn as to defy specific identification. In any case the name "*Arca nucleus*" written on the paper containing them is not in Linnaeus' handwriting, and it may be inferred that they were added to the collection after his death and probably after its acquisition by Sir James Smith. They are therefore devoid of any probative value.

Da Costa's *Glycymeris argentea* is indisputably the *Nucula nucleus* of all authors and is supplied with the first adequate description of the species. It is here set forth in full (1778, p. 170): "A small species, about the size of a filbert kernel, of a somewhat triangular shape, with dissimilar sides and moderately concave. When fresh and perfect the outside is of an olive green color, with some few transverse wrinkles; but when rubb'd or worn, quite white, and almost smooth. It is thick for its size and semitransparent. The beaks are pointed and sideways, or not central; and the bottom margins on this side are plain.

"The inside is of a fine silvery splendor,



and smooth; the bottom margins are very finely notched; and the hinge is semi circular, and curiously set with numerous transverse small teeth, like plates."<sup>1</sup>

The identification of *Arca nucleus* Linné with the *Nucula nucleus* of authors is so sanctified by tradition that it would be difficult to disturb it. Moreover the general practice in nomenclature, where a Linnaean specific name has persisted in general use, is to adopt it as a valid name as of Linnaeus, even though the Linnaean diagnosis is so inadequate as to defy identification. I feel that this practice should be deplored. Where we do not know what Linnaeus meant by a given diagnosis his name should be classed as a *nomen dubium*, and the species in question should be attributed to the first author who adequately describes it, whether under the Linnaean specific name or another. On this basis the shell we know as *Nucula nucleus* would be called *Nucula argentea* (Da Costa), 1778.

The genus *Nucula* was erected in 1799 by Lamarck to receive this species, which is its type, by monotypy.

Good figures of the species are difficult to find, as is often the case with the smaller shells. Perhaps the clearest are found in Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, atlas, pl. 37, figs. 15-21). *Nucula radiata* Forbes and Hanley, 1849, which the first-mentioned authors treat as a variety of *nucleus*, is figured on the same plate (figs. 22-25). Thiele (1931, 1935, vol. 2, p. 786) shows a good drawing of the hinge.<sup>2</sup>

#### OSTREA LINNÉ

*Ostrea* is one of the oldest of molluscan names, having been used by Aristotle for a number of edible bivalves and having been later described by Pliny. The genus is world-

<sup>1</sup> The only weak point in Da Costa's description is the description of the hinge as "semi circular." The first of the earlier authors who accurately described the hinge was Gmelin, who said "cardine triangulari." The rest of Gmelin's description is not helpful.

<sup>2</sup> Crouch (1826, pl. 8, fig. 13) supplied both an exterior and interior view of this species, and this figure is the only good representation of the shell which shows the sculpture. Crouch's figures are always worth consulting. Although he did not figure many species, his drawings are by far the best of any of the plates of Mollusca prior to the advent of photography.

wide in its distribution. Its members are found in all seas and tolerate all conditions of water temperature.

Of the 32 species listed by Linnaeus in the twelfth edition of the "Systema Naturae" and the "Mantissa" only three, *O. diluviana*, *O. folium*, and *O. edulis*, remain in the genus today. Fifteen recognized species are now placed in *Pecten*, *sensu lato*; two in *Lima* Bruguière, 1797; two in *Amusium* Röding, 1798; one each is in *Malleus* Lamarck, 1799, and *Isognomon*, *sensu stricto*, "Solander" Humphrey, 1786; and three are in *Melina* Retzius, 1788, the latter group being usually used as a subgenus of *Isognomon*. Seven of the species are generally held to be unidentified (*O. striatula*, *minuta*, *pellucens*, *sanguinea*, *flavicans*, *fasciata*, and *orbicularis*), although in the case of *flavicans* I am constrained to follow a tentative suggestion of Hanley (1855, p. 112) which seems to have considerable weight. This is referred to under *O. flavicans* below.

The species of this genus fall into two major groups: one, the pectens and their close relatives the limas and amusiums; the other, the true oysters and their allies. Linnaeus, however, grouped them under four "sub-generic" headings which have much less morphological and diagnostic value than he believed. They are:

Pectines auriculati, aequaliteres  
Pectines auricula altera intus ciliato-spinosa  
Pectines valvulis altero latere magis gibbis  
Rudes, vulgo Ostreae dictae

The first two headings are made up of members of the modern genera *Pecten*, *sensu lato*, and *Amusium*; the third, the two *Lima* species and *flavicans*, which is undoubtedly a *Pecten*; the fourth, the oysters.<sup>3</sup> Thus Linnaeus recognized that this extremely diversified genus embraced at least two very different groups.

*Ostrea* has been one of the most difficult groups from the point of view of identification. In the case of the pectens the descrip-

<sup>3</sup> The International Commission on Zoological Nomenclature held, by Opinion 124, that the various subdivisions of genera in the 1758 edition are not to be accepted, as of 1758, as of subgeneric value. The opinion does not pass upon the value of the subheadings in the 1767 edition, but it may be assumed that the view would be the same in that case.

tions are even less illuminating than the average of the Linnaean definitions, and it is usually necessary to refer to the description in the "Museum Ulricae" for a convincing determination. In the case of the oysters the shape of the shell and the details of sculpture are so variable, owing to the sedentary and gregarious habit of almost all the species, and the shell of a given species may present such extraordinary irregularities that specific identification is difficult if not, in some cases, almost impossible.<sup>1</sup> This has given rise to a host of specific, subspecific, and varietal names, most of which should be considered as synonyms of identified species or, at best, as ecological forms or geographical races. The Linnaean collection gives us less help than it does for most of the other genera. The majority of the original numbers or names on the specimens have been erased and another code substituted, to which no key has been found. These substituted marks correspond to nothing in the "Systema" or to the numerals of the classification suggested by Linnaeus' son. In brief, only three species of *Ostrea* have authoritatively marked types; in four cases the tray containing the specimen or specimens is so marked; the remaining species are either absent from the collection or bear the substituted marks above referred to. In some instances the names are written on the specimen in pencil, as in the case of *O. radula* and *O. ziczac*, but the handwriting is not that of Linnaeus and the note is thought to be the work of the botanist, Sir James Smith, who purchased the Linnaean collections. It is well known that in the case of the botanical collection he used a pencil to distinguish his labeling from that of Linnaeus.

The figures cited in the references, especially for the pectens, are almost uniformly bad, as most of them show sculpture so vaguely or in such a stylized fashion as to be useless as an aid to identification. It is therefore difficult to check the description against the pictorial references. The stated localities are no more broad than is usual in the "Systema," although it is pointed out that in the case of 11 species, where the locality becomes

<sup>1</sup> Jackson (1890, p. 282) says on this point, "As the result of my studies I have come to the conclusion that the *ostrean form* of the shell is due to the mechanical conditions of direct cemented fixation."

an important factor in the identification, we are told that the shell comes from "Oceano Meridionali" or "Oceano Australiori," a locality broad enough to take us entirely around the globe.

#### THE PECTINIDAE OF *Ostrea* LINNÉ

The pectinids are an old group geologically, appearing first in the Paleozoic era, where they were represented by the genus *Lyriopecten* Hall, 1883,<sup>2</sup> the Devonian genus *Aviculopecten* M'Coy, 1851, *Lima* Bruguière, 1797, which developed in the Carboniferous age, and other genera. In the early Mesozoic appeared *Pecten*, *sensu stricto* (Triassic), *Aequipecten* Fischer, 1886 (Jurassic), and many other still living genera, and by the end of the Tertiary age the Pectinidae had become a world-wide and numerous family. The phylogeny of the family is exhaustively treated by Jackson (1890, pp. 277-392).

Jackson (1890, p. 282) calls attention to an anatomical peculiarity of the monomyarian pelecypods such as the pectens and oysters. The position of the animal within the shell is at right angles to the position of the dimyarian animal. Therefore the auricles of the shell in the Pectinidae, instead of being called anterior and posterior, are designated as ventral and dorsal, respectively, and the words anterior and posterior are accordingly applied to the hinged ends and the free ends of the shell, respectively. These terms, as used in describing the shell, are biologically accurate and are used in the following pages, although they are not in general use. The byssus in Pectinidae is always ventral and the left (upper) valve has therefore the byssus on the left.<sup>3</sup>

The author of the genus *Pecten* has been

<sup>2</sup> Not be confused with *Lyropecten* Conrad, 1862, a genus that did not appear until the Tertiary.

<sup>3</sup> Jackson was not the first to call attention to this peculiarity, but his language may be quoted here. He said (*loc. cit.*): "In dimyarians the hinge is dorsal and in monomyarians the hinge is also considered dorsal almost universally. Profs. Hyatt (28), Brooks (91), Ryder (60) and Lacaze-Duthieu (39) have pointed out the true condition of affairs in *Ostrea* and *Anomia*, where on account of the changed position of the axis of the body, the hinge line is anterior, not dorsal. . . . For instance, in *Pecten*, the hinge line being anterior, the free ends of the valves are posterior and the ears are truly ventral and dorsal, not anterior and posterior as usually described."

the subject of some discussion, and there is still a lack of unanimity on the subject. The majority of writers use *Pecten* Müller, 1776, as the earliest valid proposal of the name, with the type *Ostrea maxima* Linné, 1758, by subsequent designation, Schmidt, 1818, and I am adhering to this view. An earlier use of the name, *Pecten* Osbeck, 1765, type *P. adscensionis* Osbeck, is accepted by some authors, the most vigorous protagonists for this view being Grant and Gale (1931, pp. 157-158) who are followed by most West Coast conchologists. Thiele (1931, 1935, vol. 2, p. 807) also uses *Pecten* Osbeck. The arguments advanced by them, however, are not convincing, and I follow Dall, Bartsch, and Rehder (1938, p. 94) in treating the Osbeck usage as a *nomen nudum*.

There are few of the molluscan families that have been responsible for so many proposals of generic names as the Pectinidae. It is far beyond the scope of this paper to synonymize completely the species or to attempt to solve the generic, subgeneric, and sectional placement of even the Linnaean shells, even if it were possible to do so categorically. Many systematists have monographed the group and many more will do so before we shall come to an arrangement that will satisfy everyone.<sup>1</sup> I therefore confine myself to discussing the identity of the Linnaean species, commenting upon the suggestions that have been made in the progress of such identification, and placing the species in the genera and subgenera that seem to have been most widely accepted.

#### *Ostrea maxima*

1758, *Systema naturae*, ed. 10, p. 696, no. 154.

1767, *Systema naturae*, ed. 12, p. 1144, no. 185.

LOCALITY: "In Oceano Europaeo" (1758, 1767).

"O. testa inaequalvi radiis rotundatis longitudinaliter striatis."

This description leaves something to be desired as there are several pectens with rounded and longitudinally striated ribs, al-

<sup>1</sup> The best-known modern arrangements of the Pectinidae are those of Verrill (1897, pp. 41-96), Dall (1890-1903, pt. 4, pp. 689-758), Arnold (1906, pp. 1-264), and Thiele (1931, 1935, vol. 2, pp. 804-809). Arnold's classification covered only the California Tertiary and Quaternary species. A study of these arrangements will demonstrate how far apart are the conceptions of the various commentators.

though the word "inaequalvi" somewhat cuts down the number. It is not necessary, however, to rely exclusively on the description, as a specimen of the *Pecten maximus* of almost all subsequent authors is found in the collection and is one of the few of Linnaeus' specimens that is correctly marked with both name and number. The cited figures, as might be expected in the case of such a well-known shell, are accurate and characteristic. The *maxima* of the "Museum Ulricae" and the "Fauna Suecica" is demonstrably the same shell. The identification is thus so complete and was recognized so early that only two other specific names were ever given to the species, Da Costa, 1778, calling it *Pecten vulgaris* and Schumacher, 1817, *Janira intermedia*. Reeve says of it (1843-1878, vol. 8, *Pecten*, pl. 9, sp. 8), "This well-known scallop is chiefly distinguished from its nearest ally, the *P. jacobaeus* by the broad, gentle convexity of its right ribs." (See discussion of *O. jacobaea*, the next species.)

*Ostrea maxima* is the type of the genus *Pecten* Müller, 1776, by subsequent designation, Schmidt, 1818. Lamarck, 1799, used the succeeding species, *Ostrea jacobaea*, as the "example" of *Pecten*. In 1817 Schumacher erected the genus *Janira* which is a synonym of *Pecten* Müller, at least in part, and designated as type *Janira intermedia* Schumacher, which was either identical with *P. maximus* Linné or a form of that species. *Janira* is not generally used today, though some conchologists treat it as a good subgenus of *Pecten*, to contain those species with nearly equal ears and with the byssal notch nearly obsolete. On this basis *Janira* is considered to be intermediate between *Pecten* and *Amusium*. Indeed Grant and Gale (1931, p. 157) suggest that possibly *Janira* should be treated as a subgenus of *Amusium* in spite of their radical differences in appearance.

The species is figured by Reeve (1843-1878, vol. 8, *Pecten*, pl. 9, sp. 38); by Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, atlas, pl. 14, figs. 1-2); and more recently by Nobre (1938-1940, pl. 54, figs. 1-2). It is a native of all northern European seas. It is not found in the Mediterranean, and reports of the shell from that area are probably based on juvenile specimens of *P. jacobaeus*, as in the young stage the two species are difficult

to separate, the distinctive sculpture of each not being differentiated in the young shell. Even though the range of the two species is distinct and the sculpture is clearly different, there was some confusion between the two on the part of the early authors. This is well illustrated by the figure that Crouch (1826, pl. 12, fig. 3) supplied for *O. maxima*. His very clear drawing was obviously made from a specimen of *jacobaea*.

#### *Ostrea jacobaea*

1758, *Systema naturae*, ed. 10, p. 696, no. 155.  
1767, *Systema naturae*, ed. 12, p. 1144, no. 186.  
LOCALITY: "In M. Mediterraneo" (1758, 1767).

Once having identified *Ostrea maxima*, the identification of *O. jacobaea*, from the description alone, becomes almost a matter of course. This description reads: "O. testa inaequali radiis 14 angulatis longitudinaliter striatis." The substitution of the word "angulatis" for *jacobaea* for the "rotundatis" of *maxima* adequately differentiates the two species. The mention of 14 ribs is not significant, as both species are somewhat variable in the number of ribs, the average being 14 to 15 for both. The extended description in the "Museum Ulricae" is amply confirmatory. A specimen of the *P. jacobaeus* of authors is present in the collection, which, although unmarked, agrees not only with the description but with all of the cited figures except the Regenfuss drawing, which represents *O. maxima*.

It is a Mediterranean species, as stated by Linnaeus. It was called the "Cappa de St. Geronimo" in the early days of the Christian era, as the scallop shell was the emblem of St. James. Tradition has it that the saint was buried in the Cathedral of Santiago de Compostela in northern Spain, and the pilgrims who had visited that shrine wore scallop shells, probably this species, on their hats, as a sign of their pilgrimage. At all events *Pecten jacobaeus* became known as the St. James Pecten.

The species is figured in Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, atlas, pl. 12, figs. 1-2), and the juvenile shell is also represented (*tom. cit.*, pl. 13, figs. 1-4, 6-7). The discussion of the species by these authors should be read. Crouch (1826, pl. 12, fig. 3) has an excellent figure of

the shell, which, through an error, is attributed to *O. maxima*, as mentioned under the preceding species. Donovan's figure of the species (1799-1803, vol. 4, pl. 137) is also very characteristic. He states that the shell is rare in England but cites several English localities for it. This is the only report from the British Isles that I have seen, and Donovan does not specifically say that the specimen from which the figure was drawn was collected there. Bucquoy, Dautzenberg, and Dollfus (*tom. cit.*, p. 67) comment that several authors have reported it from the English Channel, but conclude, ". . . they probably gave the name to specimens of doubtful origin or to exceptionally striated specimens of *P. maximus*, for this locality has not been confirmed."

It must be emphasized that the characteristic differences in sculpture between *maxima* and *jacobaea* are almost entirely confined to the right or lower valve. In *jacobaea* the ribs in the right valve are markedly salient and angular and cut by three deep, longitudinal furrows, and the interspaces are deeper and more square. In *maxima* the ribs of the lower valve are definitely rounder and have about 10 longitudinal striations, which are continued into the interspaces. The left valves of both species are more nearly alike in sculpture, the ribs being almost equally rounded. It is therefore somewhat difficult to separate the species by looking at the left valve alone, although the ribs of that valve in *maxima* may be slightly rounder in certain individuals. The most constant diagnostic difference in the left valve is that in *jacobaea* the valve is slightly but symmetrically concave, whereas the left valve of *maxima* tends to be concave only anteriorly (according to the system used by Jackson), and has a well-marked area of convexity immediately posterior to the concave area. This latter difference tends to make the umbonal depression of *maxima* look more extensive, shallower, and at the same time more conspicuously delimited than in *jacobaea*.

The species is placed in the genus *Pecten*, *sensu stricto*.

#### *Ostrea ziczac*

1758, *Systema naturae*, ed. 10, p. 696, no. 156.  
1767, *Systema naturae*, ed. 12, p. 1144, no. 187.

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

"O. testa inaequali radii 18 explanatis. . . . Testa valvula plana radii obsoletis, sed intus versus marginem plicis duplo pluribus conspicuis."

The Linnaean species has been universally recognized as the *Pecten ziczac* of all subsequent authors, the flat-valved *Pecten* of the tropical and subtropical western Atlantic. The species is so variable in the number and relative width of the ribs of its left valve that the above description, although accurate as applied to the specimen on which it was based, is still the description of a specimen rather than of a species, and it can hardly be said that there is a "typical" *ziczac*. An examination of a series of this shell reveals that on the upper valve all the ribs are very low and flat and in some cases obsolescent. In most specimens it is possible to count about 18 ribs which are somewhat wider and higher than the rest. These are irregularly disposed, sometimes occurring singly and sometimes in groups of two or three. The remaining ribs grade from mere raised threads to developed ribs almost as wide and prominent as the "major" ribs. These are also irregularly disposed, so that the valve presents a sculpture of between 30 and 40 ribs of very variable size, the wider and narrower arranged with little semblance of order. This valve is only slightly concave and on its ventral and dorsal margins has unsculptured areas of considerable convexity. The right valve bears 20 or more rounded ribs, which are flatter and less prominent near the dorsal and ventral margins of the shell and are as closely spaced as the ribs of the flat valve. In the interior of both valves the ribs appear as pairs of ridges which, in the upper valve, are obsolescent except near the posterior margin.

Linnaeus did not own a specimen of the species at the time of the publication of the tenth edition, as it did not appear on his list, but referred to the specimen in the "Museum Ulricae." He later acquired the shell, as the name does appear on the list accompanying the twelfth edition, and a specimen is present in the collection, although unmarked.

In the "Museum Ulricae" the upper and lower valves of *ziczac* are referred to as the

"operculum" and the "fornix." This style is used generally throughout the work, not only for all the species of *Pecten* with a flat or concave upper valve (as in *maxima*, *jacobaea*, and *ziczac*), but also for *pleuronectes*, *pusio*, and others with upper valves of a certain degree of convexity. Even the lower valve of *gibba* is called the "fornix." Born also used one or both of these words in describing all pectens having an upper valve that was not markedly convex.

The description, in both the "Systema" and the "Museum Ulricae," contains an apparent contradiction in terms. In the first work the ribs are said to be "explanatis" and at the same time "obsoletis." In the other work the same words are used with the added phrase "ut difficillime numerentur." It would seem that ribs that are so obsolete as to be difficult to count could hardly be called "explanatis," which has only the one meaning of "clear" or "plain." It has been suggested to me that Linnaeus gave to the word the meaning "plain" in the sense of being "unsculptured," but he used the word so often in its real meaning that this suggestion is hardly a reasonable one. Hanley (1855, p. 103) did not mention this point but was troubled by the fact that the specimen in the Linnaean collection appeared to him to have "about thirty" ribs in the upper valve, instead of the 18 mentioned in the "Systema" and the "18 seu 20" of the "Museum Ulricae," and concluded that two different species were described in the two works. He said, "What *Pecten* was really intended in that work ['Museum Ulricae'] I shall not conjecture, although the account is almost adequate enough to tempt one to do so." To anyone who has examined the upper valves of a series of *ziczac* with their ribs of different sizes and degrees of prominence, Hanley's doubts seem ill founded. The only real defect in the otherwise good description in the "Museum Ulricae" is that the ribs on the lower valve are said to be "obliteratis," whereas they are well rounded and prominent except that they tend to flatten out at the sides of the shell.

Whatever may be the slight inconsistencies or defects in the descriptions, and even though no references are supplied and the locality is so broad as to be useless, there is

no question as to the identification of the name *ziczac*. The type in the collection, which agrees with no other description, is adequate proof of identity.

The species is the type of the subgenus *Euvola* Dall, 1898, by original designation. Good figures of the shell are rare, partly owing to the fact that the earlier workers were so confused by the variability of the sculpture of the upper valve that their drawings tend to become stylized. Thus Chemnitz' figures, usually cited for *ziczac* (1780-1795, vol. 7, pl. 60, figs. 590-592) are almost useless as guides. Reeve's figure (1843-1878, vol. 8, *Pecten*, pl. 6, sp. 29) is uncharacteristic, and the figures from Sowerby (1847-1887, vol. 1, pl. 16, figs. 129-131) are but little better. Maxwell Smith (1941, pl. 7, fig. 1) shows a good photographic figure of the upper valve of a specimen with about 35 apparently equal ribs.<sup>1</sup>

#### *Ostrea striatula*

1758, *Systema naturae*, ed. 10, p. 696, no. 157.

1767, *Systema naturae*, ed. 12, p. 1144, no. 188.

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

"O. testa inaequalvi radiis 16 obliteratis transverse membranaceo-striatis, margine integerrimo. . . . Valvula convexior paulo magis gibba, quam planior; color intus flavescens radiorum interstitiis albis."

This species has not been identified. The above description from the twelfth edition (a copy of that in the tenth except for the addition of the word "inaequalvi") is merely sufficient to identify it as a *Pecten*

which seems to be allied to *Pecten ziczac*. The words "transverse membranaceo-striatis," however, are not applicable to any member of the subgenus *Euvola*. They recall rather the crowded and lamellar concentric sculpture found in gerontic individuals of *Pecten nodosus* Linné. Moreover the statement that the lower valve is but little more convex than the "flatter" upper valve takes it out of *Euvola* as described by Dall. The longer description in the "Museum Ulricae" gives us no additional assistance. No references are supplied, the shell is not in the Linnaean collection, and thus we are left with a clearly worded but unidentifiable description and the statement that Linnaeus believed that the species came from the Indies. The author, by a manuscript note, supplied a figure from Lister (1770, pl. 170). This vague drawing was used by Gmelin as the sole authority for his *Pecten crenata*, but it is impossible to identify it specifically, and it does not conform in the least to the Linnaean description of *striatula*. It is probable, as Hanley said (1855, p. 103), that Linnaeus selected it merely as an approximation to his recollection of a specimen which he did not himself possess.

Chemnitz, Gmelin, and Lamarck do not list this species. No references are found in the literature until Sowerby (1847-1887, vol. 5, p. 349) cited it as one of the unidentified species. Reeve did not use it, and Hanley found it undetermined.

#### *Ostrea minuta*

1758, *Systema naturae*, ed. 10, p. 696, no. 158.

1767, *Systema naturae*, ed. 12, p. 1144, no. 189.

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

"O. testa inaequalvi radiis 20 convexis. . . . Testa gibbosior, admodum convexa, parvula. T. planior profunde plicata plano-convexa."

There has been even less attention paid to this name in the literature than in the case of *O. striatula*. The description, with its reference to the plications of the "flatter" valve, is still farther from the characteristics of the *Euvola* group than is that of *striatula*. The combination of characters stated does not point to any known *Pecten*. *P. raveneli* Dall, 1898, from the western Atlantic has the proper number of ribs on the upper valve and may, at least in comparison with *P.*

<sup>1</sup> Cox (1929, pp. 203-204) is not satisfied that the *Pecten ziczac* of authors is the species that Linnaeus described under that name. He says (*loc. cit.*): "The identity of the Linnaean species is doubtful (Hanley). *P. ziczac auct.* is recorded by Chemnitz from both the West Indies and the Red Sea, and his records are usually reliable. G. B. Sowerby and Reeve, followed by Issel and Kobelt, give the Red Sea and Philippines as localities, but, being based on specimens in the Cuming collection, these records are less trustworthy. All the authentically localized specimens of the species that I have seen come from the West Indies, but there is a possibility that a closely related form may exist in the Red Sea." I cannot read Hanley's comments (*loc. cit.*) as saying that the *P. ziczac* of all authors is not the "Systema" species, or that the identification is a doubtful one. Hanley merely said that the unmarked specimen in the Linnaean collection did not conform to the description in the "Museum Ulricae" and that he did not know what shell was intended in the latter work.

*ziczac* and certain other members of *Euvola*, be said to have ribs that are "convexis" and the upper valve to be "profunde plicata," but this valve in *raveneli* is markedly concave rather than "plano-convexa." The Indo-Pacific species in this group also have a slightly concave upper valve.

Judging from the specific name and the use of "parvula" in the description, Linnaeus, who did not own the shell, apparently based his diagnosis on a young specimen. The description in the "Museum Ulricae" adds no helpful details, and the species must be considered undetermined.

#### *Ostrea pleuronectes*

1758, *Systema naturae*, ed. 10, p. 696, no. 159.

1767, *Systema naturae*, ed. 12, p. 1145, no. 190.

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

This species, the *Amusium pleuronectes* of later authors, is accurately defined in the short description, "O. testa aequalvi radiis 12 duplicatis, extus laevi," which not only places it unequivocally in the genus *Amusium* Röding, 1798, but defines it specifically in the phrase "radiis 12 duplicatis," by which we must assume from the context that the inner side of the valves is meant.<sup>1</sup> A specimen of the *pleuronectes* of authors is present in the Linnaean cabinet, which, although un-

<sup>1</sup> In this species the pairing of the lirae in the right valve is somewhat more conspicuous than in the left, although there is considerable lack of uniformity in both valves in the width of the pairs and in their distance from each other, and it is often impossible to say whether a given group of lirae consists of double or single elements. In *Amusium japonicum* (Gmelin), 1791, a very close relative of *pleuronectes*, the enumeration of the number of lirae or pairs is even more difficult, as the internal sculpture grows very faint or disappears towards the umbonal cavity as well as on the dorsal and ventral margins. Thus many of the ridges appear to be single.

The vagueness of the pairings, in both species, is such a handicap, and the counting of the lirae, whether in pairs or apparently single, takes so much ingenuity and is so inconclusive, that I suggest, in the interest of accuracy, that any phrase describing all the lirae as paired, even indistinctly, be omitted from future descriptions of these two species and that less categorical and more detailed language be used. The description in the "Museum Ulricae" is no improvement over the language of the "Systema" in this respect. Born (1780, p. 99) omitted all reference to pairing in his description of *pleuronectes* as did Lamarck (1818-1819, vol. 6, pt. 1, pp. 164-165), but recent authors have been less careful.

marked, is obviously the type on which the description was based, and all the references cited by Linnaeus accurately portray this species.

It is the type, by subsequent designation, Herrmannsen, 1846, of *Amusium* Röding, 1798, which was emended by Herrmannsen to *Amusium*. Megerle von Mühlfeld also described *Amusium* in 1811. Schumacher in 1817 designated *A. japonicum* (Gmelin) as the type of Megerle's genus, but this change in type does not affect the use of *Amusium*. *A. japonicum* was on Röding's original list in the Bolten Catalogue.

The present species is figured by Reeve (1843-1878, vol. 8, *Pecten*, pl. 13, sp. 48) as *Pecten pleuronectes*. Reeve does not describe the difference in the interior liration of this species and *japonicum*, but says, "Chiefly distinguished from *P. japonicus* by its smaller size and line-rayed painting." An excellent photograph of the interior of the shell is shown by Thiele (1931, 1935, vol. 2, p. 806, fig. 801). It is an Indo-Pacific species, being most common in Chinese waters.

#### *Ostrea radula*

1758, *Systema naturae*, ed. 10, p. 697, no. 161.

1767, *Systema naturae*, ed. 12, p. 1145, no. 191.

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

"O. testa subaequalvi radiis 12 convexis: striis decussatis crenatis, auriculis aequalibus."

The Linnaean name has been almost universally applied to the *Pecten radula* of authors. However, based on the description alone, the language is not all that could be desired. The ears of *radula* are not equal, one being considerably more developed than the other. The words "striis decussatis crenatis" are not accurate. The sculpture of neither the ribs nor the interspaces can be so described.

The references in the tenth edition ("Rumphius, t. 44, f. D," and "Klein, t. 9, f. 34"), the latter of which is a copy of the former, are completely erroneous as they bear no resemblance to *radula*. They were probably meant for *Ostrea lima*, and in fact the Rumphius version of the figure was used for the later species in the twelfth edition. They were omitted in the diagnosis of *radula* in the later edition, and "Rumph. mus. t. 44, f. A B" was substituted. This figure A is a

very fair picture of *radula*, although the ribs are too numerous. Figure B is inaccurate and was later very properly erased by a manuscript note of Linnaeus, leaving the synonymy entirely correct, with the single figure A of Rumphius. Linnaeus, rather inconsistently, retained the name *radula* for the species, which was Rumphius' name for the incorrect and abandoned figure D, showing *O. lima*.<sup>1</sup>

An unmarked specimen of *Ostrea radula* is present in Linnaeus' cabinet, but as the name does not appear on the author's list of owned species it was probably added later and therefore cannot be considered as the type specimen. Good figures of *radula* are to be found in Argenville (1742, pl. 27, fig. D) and in Gualtieri (1742, pl. 74, fig. L). Linnaeus owned both works and might well have cited these figures, which were, in fact, later referred to the species by his son.

When all these evidential factors are taken into consideration, the species cannot be held to be particularly well defined, the identification being based on a single figure and the description in the "Museum Ulricaë" which, although more detailed, repeats the questionable details of the "Systema" already referred to. The traditional identification has, however, always been accepted and probably with justification. The only voice raised against the use of the name is that of Iredale (1939, p. 360). Iredale there erects the genus *Comptopallium* and takes exception to the retention of the specific name *radula* because of the incorrectness of Linnaeus' synonymy. He cites Hanley's explanation (1855, pp. 104-105) of the changes and corrections made by Linnaeus and referred to above and says: "Be it noted that neither of Rumphius' figures A B show '12 radiis,' each giving more—A, 14 or 15, and B, 20—and while the former is like the *radula*, the latter is like the *pallium* style. Hence *radula* cannot be preserved for the Scallop in any manner, and the Queensland shell hitherto so

called is named as above [*Comptopallium pauciplicatum*]." Iredale is quite correct as to the inadequacy of Rumphius' figure B, but fails to admit that Linnaeus later expunged it. His criticism of figure A seems trivial. In any event all that he asserts is that *radula* was weakly defined pictorially. That is, however, not a reason for suppressing the Linnaean name. He might have been justified in criticizing the "Systema" description or in commenting on the fact that the specimen in the collection was not authoritatively documented. He placed his argument squarely on the asserted inadequacy of the references, which is not enough to condemn an identification. We must admit that the evidence in favor of the identification of *radula* Linné with the shell now known by that name is weaker than we would wish, but its weakness does not lie in the facts adduced by Iredale.

This species has been traditionally placed in *Pallium* Schumacher, 1817, but both Cox (1929, p. 201) and Rehder (1944, p. 54) have pointed out that Schumacher's name is preoccupied by *Pallium* Schröter (1802, pp. 135-136) which is a substitute name for, and an exact synonym of, *Pecten* Müller, 1776, with the same type, *P. maximus* Linné. The elimination of the generic name *Pallium* Schumacher throws the species into *Comptopallium* Iredale, 1939, type *C. pauciplicatum* Iredale (equals *Ostrea radula* Linné), by original designation. The most obvious diagnostic characters of *radula* are the marked compression of the left valve in the umbonal region and the distinct obliquity of the shell.

It is figured by Reeve (1843-1878, vol. 8, *Pecten*, pl. 21, sp. 83) and by Chemnitz (1780-1795, vol. 7, pl. 63, figs. 599-600). Chemnitz called the species "*Pera* [error for *Perna*] *Venatoria. Ostrea Radula* Linnaei" and refers to the "Systema" and "Museum Ulricaë" listing of *O. radula*. In a supplemental plate (*tom. cit.*, pl. 69, fig. G) Chemnitz shows a shell which is undescribed but listed in the index of pectens on page 265 of the same volume as "*Perna Venatoria imbricata et squamosa*." He gave no references and the figure, which resembles *radula*, has only eight (or ? nine) ribs and ears that are too unequal. It does not recall any species with which I am familiar. The best figures of *radula* are the

<sup>1</sup> Petiver, Argenville, Favart d'Herbigny, and Chemnitz, in addition to Rumphius, used the monomial "Radula" for *Ostrea lima*, and Klein used it as "*Radula Rumphiana*." It was from these sources, and particularly from Klein, that Mörch, in 1853, borrowed the name when he erected his genus *Radula* for the *lima* group.



color photographs of both valves in Platt, (1949, p. 49, figs. 1, 3).

#### *Ostrea plica*

1758, *Systema naturae*, ed. 10, p. 697, no. 162.

1767, *Systema naturae*, ed. 12, p. 1145, no. 192.

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

"O. testa subaequivalvi radiis 6 convexis laeviusculis, decussato-striata."

This description is inadequate as a definition of the shell that has been accepted generally as the representative of the Linnaean species, the *Pecten plica* of authors, as there are several pectens with as few as six ribs (the description in the "Museum Ulricae" says "5 s. 6") that conform to some of the other characters mentioned. The inconsistency, moreover, between the phrases "laeviusculis" and "decussato-striata" cannot be reconciled and makes the whole description suspect. The *P. plica* of authors has five ribs, each of which is provided with about 12 radial sulci on both valves, the interspaces being similarly furrowed in the left valve, and the right valve having the interspaces smooth. There is no sign of any concentric sculpture except for the infrequent appearance of growth lines. The word "decussato-striata" is completely inaccurate as applied to our *P. plica*. Not even the expanded description in the "Museum Ulricae" throws any light on the species, although it omits the inconsistent words "laeviuscula" and "decussato." It may well be that this is one of the cases where Linnaeus described a different shell in the 1764 work but gave it the "Systema" name. The references show figures that are only doubtfully accurate, although they have been consistently cited for the *plica* of authors. The figure from Argenville (pl. 27, fig. C) looked to Hanley more like *P. undulatus* Sowerby, 1842 (date of Sherborn) (1847-1887, vol. 1, pl. 19, fig. 05). However, *plica* is represented in the collection by a specimen of the *plica* of authors, var. *subplicata*, Sowerby, 1842, which confirms the accepted identification. This is not an entirely satisfactory determination, as the specimen is unmarked, but as the specimen agrees uniquely with at least a part of the description, it may, with a mental reservation, be accepted as the type.

Linnaeus' in his notes for the proposed

"revised twelfth edition," made two changes in the description. He expunged the objectionable word "decussato-striata" and substituted "striatis" and added the phrase "auriculis aequalibus." The latter is not an illuminating choice, if he was speaking of our *plica*, the ears of which can possibly be called equal in size although quite different in shape.

The early conchologists showed a certain lack of confidence in identifying this Linnaean name. Chemnitz (1780-1795, vol. 7, p. 292) called it *Pecten plicatus*, although he referred to the Linnaean name as listed both in the "Systema" and the "Museum Ulricae." His figures (*tom. cit.*, pl. 62, figs. 598a-b) are excellent views of both the exterior and interior of the shell of the *plica* of authors. Schumacher, in erecting his genus *Pallium* in 1817, listed as sole species *Pallium striatum* which is accepted as being the *Pecten plicatus* of Chemnitz and the *O. plica* of Linnaeus. Lamarck (1818-1819, vol. 6, pt. 1, pp. 167-168) credits his *P. plica* to the Linnaean species. Both his Latin and the French descriptions are, however, curiously and unexplainably equivocal. He said, "radiis 5 s. 6 supernè evanidis, infernè laevibus." This must refer to the major plications of the shell and as such is unintelligible. The plications do not tend to disappear at the "top" of the shell and are not smooth at the "bottom." The French words are "stries longitudinales bien marquées dans sa moitié supérieure." This apparently refers to the minor striations on the ribs themselves and is equally erroneous. The striations are well marked only at the base of the shell (posterior margin) and are obsolete at the umbonal end (anterior margin). The same figures cited by Linnaeus were included in the synonymy as well as the Chemnitz figure referred to above.

It is not quite accurate to describe *plica* as having six ribs. It has on the left valve three major ribs which are approximately of the same size and degree of salience. There are two, or sometimes three, marginal ribs which are much narrower and less elevated. On the right valve there are two centrally placed ribs which are wider than any on the left valve, a somewhat narrower rib on either side of these, and a much less obvious rib at either margin. The shell cannot be described as

having equal ribs, as many descriptions state. It should be noted that the ribs are so elevated and the margin consequently so markedly crenulate that each rib is offset in relation to its companion on the other valve to a more marked degree than in most pectens, and it is this that causes the difficulty in counting the ribs and the possible difference in their number in the two valves.

As the genus *Pallium* Schumacher has been found to be preoccupied by *Pallium* Schröter, 1802, for another group (see discussion under the preceding species, *O. radula*), the present species belongs in *Decatopecten* Rüppel in Sowerby, 1839. This spelling was emended to *Decatopecten* in the later editions of Sowerby's "Manual," and Sherborn indicates that the original spelling was in error. The original manuscript of Rüppel was not available to the writer. *Dentipecten* Rüppel in Gray, 1847, is another exact synonym. *D. plica* (Linné), 1758, is the type of Rüppel's genus.

In addition to the figures cited above, the species is figured in Reeve (1843-1878, vol. 8, *Pecten*, pl. 3, sp. 16). Chemnitz describes and figures a *Pecten danicus* (1780-1795, vol. 11, p. 265, pl. 207, fig. 2043), from Scandinavian waters, which he believed to be a close relative of *Pecten plica*, and says (*loc. cit.*), "Linnaeus would have declared that this species was a species very close to his *Ostrea plica*." Hanley (1855, p. 105) suggested that even the longer description of *Ostrea plica* in the "Museum Ulricae" might cover more than one *Pecten* and gave as an example *P. danicus* Chemnitz, specimens of which, unmarked, are in the collection. The locality of *danicus* is, however, very remote from the "O. Indico" of *plica* Linné, and the Chemnitz figure of *danicus* shows a shell with five sharply angular ribs quite different from the broad and rounded ribs of *plica*. The relationship of the two species would not seem to be close.

*Ostrea pallium* 𑌒𑌒𑌒𑌒𑌒 𑌒

1758, *Systema naturae*, ed. 10, p. 697, no. 163.

1767, *Systema naturae*, ed. 12, p. 1145, no. 193.

LOCALITY: "In O. Australiore et Indico" (1758, 1767).

"O. testa aequalvalvi radii 12 convexis, striata scabra squamis imbricata."

As in the case of all the other members of *Ostrea* Linné, a word relating to the difference (or similarity) in the respective sizes of the valves was added in the twelfth edition. Otherwise the entire diagnosis of the tenth edition was copied.<sup>1</sup> The combination of characters stated in the description points very clearly to the *Pecten pallium* of authors, and this is confirmed by the finding of a properly documented specimen in the collection. The references are for the most part correct. The Regenfuss and Gualtieri figures are good drawings of *pallium*. The reference to plate 44, figure B, of Rumphius is correct, and the erroneous figure C, cited in both editions, is expunged by a manuscript note. The Argenville reference (pl. 27, fig. I) is decidedly inaccurate, although his very graphic description of the species may be said to cure the error in his figure.

The distinguishing features of the species are, first, the triple row of sharp scales on each rib, the rows being so distinctly separated that the rib appears almost trifid,<sup>2</sup> and

<sup>1</sup> As a practical matter the word "inequivalve" should logically be applied to bivalves in which the difference in the size of the valves is based on the fact that the margins are not aligned throughout all or a part of their length, that is to say, in which one valve fits into the other because its actual length or breadth is less. A striking illustration of this feature is found in the genus *Corbula* and in certain members of *Pecten*, *sensu stricto*, such as the Linnaean species *P. maximus*, *jacobaeus*, and *ziczac*. The pectens, however, have been the cause of a rather far-fetched use of the word. Basing the word "inequivalve" on differences in the gibbosity of the two valves is to me an illogical use and one that is apt to confuse the student. Likewise, in the pectens, the anterior edge of the ventral ear (and in some cases of the dorsal ear) on the lower valve is often projected above the edge of the companion ear on the upper valve, so that the pair of ears on the same side or sides of the shell differ in size. This fact has apparently often led to calling the shell inequivalve, but is also confusing and illogical. Linnaeus seems to have been the first to employ these very broad uses of the word. He called *P. radula*, *plica*, *nodosa*, *pes felis*, and *opercularis* all "inequivalve," although in these species the valves only differ in gibbosity or in the extension of one or both of the ears of the right valve above their opposite ears. Lamarck apparently found this difference in all pectens as he says in his "Observations" on the genus (1818-1819, vol. 6, pt. 1, p. 162), "The shells of this genus . . . [are] always inequivalve, although more or less . . ."

<sup>2</sup> The triple row of scales on the ribs is an adult feature and does not appear on the umbonal area of the shell, where there is but one row of scales which arch completely over the rib. Young specimens, therefore, do not show three rows.

the two rows of scales in the interspaces; and, second, the brilliant and variegated coloring of the shell, a combination of red, purple, and yellow shades roughly arranged in transverse bands. The ears are subequal and extremely squamous, especially those on the right valve, where their anterior edges rise above those in the left valve and are provided with a row of erect and heavy arched scales. The colors of the exterior are reflected in the staining of the inner margin, including the inner margin of the ears.

The species belongs, under modern arrangements, in the genus *Gloripallium* Iredale, 1939, the name *Pallium* Schumacher for this group having been superseded by *Pallium* Schröter, as mentioned under *O. radula* above. It is figured by Reeve (1843-1878, vol. 8, *Pecten*, pl. 17, sp. 63a, b, c) and Chemnitz (1780-1795, vol. 7, pl. 64, fig. 607). The Chemnitz figure is not accurate as to color pattern, but shows, although perhaps too schematically, the tripartite arrangement of the imbrications on the ribs. It is the type of *Gloripallium* by original designation.

#### *Ostrea nodosa*

1758, *Systema naturae*, ed. 10, p. 697, no. 164.

1767, *Systema naturae*, ed. 12, p. 1145, no. 194.

LOCALITY: "In *O. Africano et Indico*" (1758, 1767).

"*O. testa inaequalvi radiis 9 nodoso-vescicularibus.*"

This species, or rather this complex, is so distinctive in appearance that the difficulty has been not in identifying the Linnaean name but in fixing the localities of the different members of its group, in reconciling some of the erroneous localities, and in purifying its synonymy.

Here, too, the word "inaequalvi" is misleading. The only evidence of any difference in size of the valves is in the slightly higher ears of the right valve. The ears of this valve are also armed with a series of arcuate scales on their anterior edge, which are lacking in the ears of the left valve. The ventral ears are sometimes twice as long as the dorsal. The description in the "Museum Ulricae" very properly changes "inaequalvi" to "valvulis aequalibus," and it is perhaps significant that Chemnitz, who copies

the "Systema" and "Museum Ulricae" descriptions in his references to the species, italicized the two words, seemingly to call attention to Linnaeus' correction. The "Museum Ulricae" description more than confirms the identification of the species with the *Pecten nodosus* of later authors, as it is more detailed and uses graphic language to describe the sculpture of the ribs and interspaces, "radiis convexis, obtusis, articulatis, obtuse sulcatis, sulcis 5 et 6; interstitiis etiam sulcatis."

Chemnitz called the form from the West Indies, and, as he says, from Guinea (West Africa), *Pecten corallinus* (1780-1795, vol. 7, p. 306). His figures (*tom. cit.*, pl. 64, figs. 609-611) are crude but fairly accurate. His description, however, gives an excellent account of the West Indian form of the shell.

One is always suspicious of reports of a species from widely separated areas. Linnaeus gave the locality of *nodosus* as "African and Indian Oceans." Chemnitz says he received his specimens of *corallinus* from the Danish West Indies and from Guinea. Lamarck (1818-1819, vol. 6, pt. 1, p. 170) says "l'Océan africain et américain." One form of the species is known to all American collectors as the *Pecten nodosus* of the West Indies and both coasts of Florida. D'Orbigny described a *P. corallinoides* from the Canary Islands, and has this to say of his shell (1836-1844, p. 102): "This species much resembles *Pecten nodosus* Lin. (*Pecten corallinus* Chemnitz) which is found in the Antilles; but it is much more gibbous, more irregular in its shape; its ribs are less salient; its nodes less marked; its ears shorter, and everything indicates a related but quite distinct species." It is very probable that this was Chemnitz' "Guinea" shell. Conrad described a shell from the West Indies which he called *P. fragosus*. This form is usually classed by American writers as a subspecies of the West Indian *nodosus*. It has fewer and wider ribs and produces crowded transverse laminae which are most evident in the interspaces.

It must be admitted that most of the specimens from all these widely separated areas are so similar that it is difficult to find in their characteristics anything more than subspecific significance. Grant and Gale (1931, pp. 179-182) gave the type localities

as follows: for *nodosus*, African and Indian oceans; for *corallinus* Chemnitz, Danish West Indies; for *corallinoides* d'Orbigny, Canary Islands; for *fragosus*, West Indies. It is evident that these authors merely followed the locations given by the first describer of the various forms. They also cite several California fossil forms, with localities. They apparently copied the "Indian Ocean" type locality for *nodosus* from the original Linnaean description, and they state that the species is living in east Africa. I very much doubt that the form from that area is Linnaeus' *nodosus* or that it is the West Indian form. The Indian Ocean congener and close relative of our *nodosus* is (*vide* von Martens, 1880, p. 313) the *Pecten noduliferus* Sowerby, 1842 (date *vide* Sherborn) (1847-1887, vol. 1, p. 64, pl. 13, figs. 38-39, pl. 14, fig. 94) for which Sowerby gives no locality. Von Martens cites *P. noduliferus* in his work on the mollusks of Mauritius and the Seychelle Islands, as coming from Réunion and Mauritius. He also lists *P. corallinoides* d'Orbigny in connection with *noduliferus*, but only because Reeve improperly gave the locality of the former as Zanzibar (1843-1878, vol. 8, *Pecten*, pl. 6, sp. 27), whereas it is in fact an eastern Atlantic shell. It is much like the West Indian *nodosus* from which it is barely distinguishable. Grant and Gale (*loc. cit.*) state that all these forms have no more than varietal significance and suggest migration as the basis for their great similarity, saying that since the beginning of the Miocene the species *nodosus* has migrated nearly around the world, and they advance the plausible argument that the pectens, because of their extreme mobility, can travel more widely than other mollusks, given a suitable climate. I would be inclined to agree that *nodosus* has migrated to great distances but suggest that the evolutionary changes in the shell, which are now apparent, are of at least subspecific value. The possible exception to this would be the case of *Pecten subnodosus* Sowerby, 1835, from the Panamic province, which is so common in the Gulf of California. This seems to be a mere variety, if the term "variety" has any biologic meaning, which I doubt, of the western Atlantic *nodosus*, although most American writers

give it subspecific, and sometimes specific, rank. It seems to be an ecological and evolutionary form of *nodosus* and suggests a migration of that species in Miocene times by an ocean passage through what is now Central America. Although the correlation between the two sides of the continent is still uncertain, the existing evidence, according to Grant and Gale (*loc. cit.*), points to the Atlantic occurrence as being the older. Dall says of *subnodosus* (1890-1903, pt. 4, p. 717): "There seems to be little reason for separating this form from the *P. nodosus* of the Antilles. Both vary through a strictly analogous series of mutations."

The species *nodosus* and its subspecies or other ecological or evolutionary forms belong in the genus *Lyropecten* Conrad, 1862, type *Pallium estrellanum* Conrad (Upper Miocene of California), and in the subgenus *Nodipecten* Dall, 1898, of which it is the type, by original designation. *Nodipecten* was erected by Dall as a section of subgenus *Chlamys* Röding, 1798, and *Lyropecten* was treated by him as another subgenus. Some later writers have insisted that *Nodipecten* is based on differences that have no more than specific value, but the comparatively large number of species in the group and their distinctive characteristics seem to warrant at least subgeneric rank. Dall's description of *Nodipecten* (*tom. cit.*, p. 695) reads: "Shell like *Lyropecten*, but the ribs intermittently nodose, with more or less hollowed nodes or bullae; radial striations pronounced; ears unequal, the posterior smaller, the valves often more or less oblique, imbricate surface layer sometimes very marked."

*Pecten nodosus* is figured in Reeve (1843-1878, vol. 8, *Pecten*, pl. 3, sp. 15). This figure has too many ribs and seems to have been copied from the Chemnitz figure. The most accurate figure is the color photograph in Platt (1949, p. 43, fig. 7).

#### *Ostrea pes-felis*

1758, *Systema naturae*, ed. 10, p. 697, no. 165.

1767, *Systema naturae*, ed. 12, p. 1146, no. 195.

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

"O. testa inaequali radii 9 striatis scabris, auricula altera minuta. . . Testa parva, pellucida, novem radiis sensim undata."

No references were supplied for this species in either edition of the "Systema." The description is sufficiently ill drawn and so out of line with that in the "Museum Ulricae" that not only has the identification of the "Systema" species been difficult, but it is possible that the shell described in the other work was something different. In the tenth edition the ribs are stated to be seven in number ("radiis 7 striatis scabris") in the main description, but in the subdescription we read "novem radiis sensium undata." While the change from "seven" to "nine" in the twelfth edition is probably the mere correction of a misprint or *lapsus calami*, it does not increase our confidence in the description. The word "parva" is used for this species alone of all the pectens, except the unidentified *Pecten minutus*, whereas the shell cannot be called small, unless Linnaeus had a juvenile shell as his type. "Pellucida" is not descriptive of the shell we know as *pes-felis*. In spite of these confusing details, most conchologists now accept the identity of the Linnaean species with the *P. pes felis* of authors.

In the "Museum Ulricae" the ribs are stated to be "radiis novem" in one place and "radiis 7" in another, the words "parva" and "pellucida" are repeated, and the remainder of the description is partially contradictory. The word "laevis" is used. "Margine spinoso-ciliato" and "exasperatis squamis" ill accord with such a definition. In fact the description of the species in both works as being scabrous tends to point away from the *pes-felis* of authors.

Born (1780, p. 103, pl. 6, fig. 2) figures the *pes-felis* of authors under the name of *Ostrea elongata*, stating that it has eight ribs. He did not refer to its identity with the Linnaean species of that name and was ignorant of its locality.

Chemnitz (1780-1795, vol. 7, p. 312, pl. 64, fig. 612, pl. 65, fig. 613) described it as the *pes-felis* of Linnaeus. His figures are accurate drawings of our *pes-felis*. He gives the ribs as "7 vel 8 et 9."

This is not an inequivalve shell as Linnaeus stated in the twelfth edition, and in his notes for the proposed "revised" edition he corrected this to "aequivalvi." The phrase "sensum undata" is also replaced in these

later notes by the more graphic words "plicata utrinque striata," words that are better suited to the *pes-felis* of authors. But while Linnaeus' corrections and improvements bring the description more into line with the characters of the shell we know as *pes-felis*, and while the latter is in fact somewhat variable in the number of ribs and in other respects, we are left without that feeling of conviction that makes for a satisfactory identification. It is probable that the accepted determination is correct, but I confess to a mental reservation.

Several specimens of the *pes-felis* of authors are found in the Linnaean collection which may be said to agree partially with the very brief "Systema" description. They are unmarked, and none of them can be taken as the type on which the description was based, as one specimen has seven ribs (and can therefore be taken as the type only if we agree that Linnaeus' "radiis 7" was not an error or misprint), while the others have eight ribs. The difference in the size of the ears in these specimens is very marked and accords with the words "auricula altera minuta" of the "Systema." The use of the phrase "auriculae subaequales" in the "Museum Ulricae" is an added reason for suspecting that the shell there described was a different species. It seems scarcely credible that Linnaeus could have described a species under a given name in 1758 and 1767, and in the intermediate work given the same name to a different species, yet it is clear that he did so in several instances.

The stated locality, the African Ocean, probably means in this case the north African coast, as the shell is a well-known although far from common Mediterranean species. Chemnitz reports it from "Barbary on the African coast." There is little discussion of the species in the literature, and we are unfortunately deprived of the comments of Bucquoy, Dautzenberg, and Dollfus, as the species had never been reported from the Roussillon, though it had been collected on the French Mediterranean coast as far west as Toulon.

It belongs in the genus *Chlamys* Röding, 1798, subgenus *Manupecten* Monterosato, 1889, which has been often used as a section of the preoccupied *Pallium* Schumacher,

1817. It is the type of *Manupecten*.<sup>1</sup> It is identical with *P. bornii* Payraudeau (*vide* Reeve) and *Ostrea corallina* Poli, 1795 (*non* Chemnitz, 1784).

In addition to the Chemnitz figures already referred to, the species is figured by Reeve (1843-1878, vol. 8, *Pecten*, pl. 19, sp. 66a, b).

#### *Ostrea pellucens*

1758, *Systema naturae*, ed. 10, p. 698, no. 166.

1767, *Systema naturae*, ed. 12, p. 1146, no. 196.

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

"O. testa subaequalvi radiis 9, laevi: fornice squamis cochleari-hemisphaericis."

This is an unidentified species. The single reference cited ("Argenville, t. 27, f. H") is a crude although unmistakable figure of *Pecten varius* (Linné), showing the numerous ribs of that species instead of the nine required of *pellucens* Linné. We can be certain that *pellucens* is a *Pecten*, but the combination of the nine smooth ribs of the left valve, the squamose ribs of the right valve, or fornice, and the descriptive name *pellucens* has defied any specific determination.

Dillwyn, according to Hanley (1855, p. 107), suggested its identity with *P. ornatus*, by which it is assumed he meant the species of that name described by Lamarck (1818-1819, vol. 6, pt. 1, p. 176), a common West Indian shell.<sup>2</sup> That shell, however, has 18 to 20 ribs, the scales are present on both valves, and, although arcuate, these scales are low and cannot be called "cochleari-hemisphaericis," language which recalls the rib sculpture of some of the *Trachycardium* species. It is utterly inapplicable to *ornatus*. The smaller ear of *ornatus* is virtually obsolete, which fact would certainly have been noted by Linnaeus. The sum of these features would be a shell so remote from the descrip-

<sup>1</sup> Monterosato, who listed several species in his original list (1889, p. 21), did not select a type until a decade later (1899, p. 190), when he stated "Type: *P. pes felis* Auct." He evidently felt an understandable hesitancy in identifying it with the Linnaean species.

The name *Felipes* (Locard) Carus, 1889, was published later in 1889 than Monterosato's *Manupecten* and covers the same group of species.

<sup>2</sup> I have been unable to find, in any of Dillwyn's works, the comparison between *pellucens* and *ornatus* which Hanley attributed to him. It may have been contained in a personal communication to Hanley or was an error of transcription on the latter's part.

tion of *pellucens* that Dillwyn's suggestion may be disregarded. The only similarity between the two is that *ornatus* is a fragile shell and might be called pellucid.<sup>3</sup>

The species does not appear on the list of shells owned by Linnaeus, and there is nothing in the Linnaean cabinet that agrees with its description. Hanley (1855, p. 107) suggested that the diagnosis in the "Museum Ulricae," where the species is rather more elaborately defined, might apply to *Pecten imbricatus* (Gmelin). While the number of ribs of that species is the same as in the description of *pellucens* Linné, and the color pattern is similar, the rest of the description is inapplicable, as, although the scales in *imbricatus* are truly hemispherical, they are even more developed on the left valve than on the right, while the left valve of *pellucens* is said to be "laevi."

Chemnitz, in his discussion of "*Pecten solaris clarissimi Bornii*" (1780-1795, vol. 7, p. 336, pl. 67, figs. 638-640), refers to a suggestion that that species was the *pellucens* of Linnaeus. The figures supplied by him do not bear this out and he disposes of the suggestion by saying (*tom. cit.*, p. 337): "One of my Swedish friends who sent me this shell has tried to convince me that it is *Ostrea pellucens* Linné because of its marked transparency. Now, if it were only a question of transparency, I would not argue against this identification. It is also, however, a question of 'costis' and 'squamis hemisphaerico concavis, longitudinaliter secundam costas digestis' (cfer. Mus. Reg. L. Ulr. no. 110. pag. 528). As no trace of these characters is found in the smooth, yellow shell, how can it be the *Ostrea pellucens*?"

Chemnitz also refers to *pellucens* in his comments on "*Pecten inaequaliter striatus*" (*tom. cit.*, p. 326, pl. 66, figs. 625-627), as follows: "Probably Linnaeus' *Ostrea pellucens* should be referred to this species." The figures Chemnitz reproduces for the species look much like *P. ornatus* Lamarck, already referred to as Dillwyn's choice as the representative of *pellucens*, and that identification,

<sup>3</sup> Lamarck's comment on the relationship between *pellucens* and *ornatus* is significant in this connection. He said (*loc. cit.*), "Our species [*ornatus*] seems to be the same as the *Ostrea pellucens* of Gmelin, without being that of Linné."

as I have said, has no justification. Lamarck (1818-1819, vol. 6, pt. 1, p. 176) seemingly had the same idea as Chemnitz and Dillwyn, however, as he cites all three of Chemnitz' figures (625-627) for the two varieties of his *P. ornatus*. Lamarck did not refer to *pellucens* in the synonymy of *ornatus*, but his use of these figures is suggestive. He did mention *pellucens* Linné in the synonymy of his *Pecten rastellum* (*tom. cit.*, p. 166) but with a query. The latter shell is, however, described as having "squamis raris erectis," without specifying whether one or both valves bear the scales, and the locality (northern seas) does not accord with the locality of Linnaeus' *pellucens*.

After Lamarck the literature contains nothing helpful to the identification of this species, and it must be left as undetermined.

#### *Ostrea obliterata*

1758, *Systema naturae*, ed. 10, p. 697, no. 160.

1767, *Systema naturae*, ed. 12, p. 1146, no. 197.

LOCALITY: "In *O. australiore*" (1758); "in *Europa australiore*" (1767).

"*O. testa radiis 24 duplicatis, extus laevi.*"

The very brief description merely suggests a member of the genus *Amusium* and, while the sole reference cited ("Gualt. test. t. 73. f. C.") is extremely crude, the species was readily identified by the description in the "Museum Ulricae," which was much expanded and, incidentally, specifically mentioned the similarity of the shell to *O. pleuronectes*.

In the tenth edition of the "Systema" *obliterata* is placed immediately after *pleuronectes*, where it logically belongs. In the twelfth it was moved to a position following *pellucens* in the "subgeneric" group "*Pectines auricula altera intus ciliato-spinosa.*" The reason for this confusing change in position is not apparent, unless Linnaeus felt that the slight inequality of the ears in *obliterata* did not warrant leaving it with *pleuronectes* in the group of species having ears of equal, or almost equal, size. The ears of the species are in fact subequal, although but little more so than some of the other species in the group from which it was moved. Chemnitz (1780-1795, vol. 7, pp. 324-325) calls attention to the change and mentions that the ears are somewhat unequal.

Linnaeus did not own the species, and therefore there is no type specimen available. The identification must rest solely on the description in the "Museum Ulricae." It is an Indo-Pacific species and not, as stated in the 1764 and 1767 descriptions, from southern Europe. It is distinguished from *pleuronectes* by its smaller size, by the slight inequality of its ears, by its almost smooth exterior (Chemnitz called it "Der spiegelglatte Mantel"), but principally by the prominent development of the numerous and closely crowded ribs on the inside of the valves, particularly the lower.

Lamarck (1818-1819, vol. 6, pt. 1, p. 165) places it, as *Pecten obliteratus*, in his group of "Oreillettes égales ou presque égales."

It is a member of the genus *Amusium* Röding, 1798, and is well figured by Reeve (1843-1878, vol. 8, *Pecten*, pl. 19, sp. 70).

#### *Ostrea sanguinea*

1758, *Systema naturae*, ed. 10, p. 698, no. 167.

1767, *Systema naturae*, ed. 12, p. 1146, no. 198.

LOCALITY: "In *O. Australiore*" (1758, 1767).

"*O. testa aequivalvi radiis 22 scabris, semiaurita.*"

The identification of this species has not been satisfactorily determined. We are supplied with a description (identical in the two editions of the "Systema" except for the addition of "aequalivi" in 1767), but it is too brief to be intelligible in the absence of a marked type, and the single reference to Gualtieri ("t. 74. f. N") is too crude to be indicative of any specific *Pecten*. The description in the "Museum Ulricae" adds no significant details. The language quoted above contains a word, "semiaurita," which Linnaeus used for no other *Pecten* or *Lima*. The other words used by him to describe the ears, "aequalibus," "minuta," "uniaurita," "brevisima," "exoletis," and the like, have reasonably clear meanings, although they are not always entirely accurate as applied to the species they describe, but in the case of "semiaurita" we cannot be sure whether he meant "with only one ear" or "with small ears." The first of these interpretations is possibly repelled by his use of "uniaurita" for *O. varia*, a species with only one ear, but at best it is an unfortunate choice of a word. Linnaeus apparently discloses his meaning

in a manuscript note in his copy of the twelfth edition, reading "auriculae pares" which, taken in connection with the original "semiaurita," would indicate a shell with small but equal ears.

The type specimen of *O. sanguinea* is stated on Linnaeus' list to be in his collection, but there is no specimen so marked. An example of *O. senatoria* (Chemnitz) Gmelin, 1791, is present and best agrees with the description, but not perfectly, as the ears of *senatoria* are definitely subequal and fairly large. Hanley (1855, p. 108) believed that this specimen was the type, although he admitted the impossibility of reconciling it with the description of the ears.

Chemnitz' treatment of these two species is interesting and should be read. He first lists a *Pecten sanguineus* (1780-1795, vol. 7, p. 326) as of Linnaeus, and calls it "Der blutrothe Mantel" and states that its ears are "inaequaliter." His description, with this exception, adds nothing to that of Linnaeus. The locality is given broadly as the West African coast, the Mediterranean, and the West Indies. He comments on the fact that it was called *sanguinea* by Linnaeus because of its red color, and he mentions the 22 scaly ribs. His figure (*tom. cit.*, pl. 66, fig. 628) shows a small shell, not over an inch in height, with what are apparently 17 or 18 rounded, scaly ribs. I am unable to identify this form.

He also described a species which he called *Pallium senatoris* (*tom. cit.*, p. 320, pl. 65, fig. 617), giving as references only a figure from Valentyn (1773, pl. 16, fig. 20) and one from Regenfuss (1758, pl. 3, fig. 36), the latter with a query. Both of these figures greatly resemble the drawing which Chemnitz supplied for the species. Although he did not give *sanguineus* Linné as a reference, as he cited that species separately, he does call attention in the text to its possible identity with *senatoris*, saying (*loc. cit.*): "This admirable *Pecten* seems to have an affinity with *Ostrea sanguinea* Linnaeus in shape and structural plan [Bildung und Bauart]. Moreover the number of the ribs and interspaces of the two is the same." He placed *senatoris* in the East Indian seas, particularly on the shores of the Moluccas.

Gmelin also listed both of the above species. For his *O. sanguinea* he referred to

figure 628 which Chemnitz had used for the same species, and gave the locality as the Mediterranean, the Atlantic, and American seas. He described it as "radii viginti duobus scabris, semiaurita . . . subrotunda planiuscula sanguinea, spadicea aut kermesina . . . radiorum interstitiis perpendiculariter striatis." For *O. senatoria* (note that he changed the termination, the *Pallium* used by Chemnitz being a neuter noun) he cited Chemnitz' figure 617, which the latter used for the same species, and the Regenfuss figure, also with a query. Gmelin's treatment of the two species is therefore virtually adapted from Chemnitz.

Lamarck (1818-1819, vol. 6, pt. 1, p. 174) lists both names as referring to good and distinct species. For *Pecten senatorius* (Gmelin) he referred to the Chemnitz figure 617. His description is in many respects a paraphrase of both *sanguinea* of the "Systema" and *senatoria* Gmelin. For *Pecten sanguineus* (*tom. cit.*, p. 175), to which he refers as "Lin. Gmel.," he cites figure 628 of Chemnitz, which the latter used for *sanguineus*. His description does not follow that of the "Systema" very closely, as he says the shell is subequivalve, and adds the phrase "radiorum lateris antice interstitiis sulcato-granulatis." It is impossible to be certain that he is describing the same shell as the Linnaean *sanguinea*.

Sowerby (1847-1887, vol. 1, p. 77, pl. 19, figs. 221-222) uses *sanguineus* as "Linn. according to Gmelin" and says, "The author cannot doubt the identity of the red variety of this species with the figure quoted by Gmelin." As I cannot identify the figure mentioned (Chemnitz, fig. 628) I am not certain to what shell Sowerby referred. He also lists *P. senatorius* as distinct, with no reference to the *sanguinea* of Linnaeus, Gmelin, Chemnitz, or Lamarck, but places in its synonymy *Ostrea porphyria*, *citrina*, and *aculeata*, all of Gmelin, as well as *Pecten florens* and *P. aurantius* Lamarck.

Reeve does not cite *P. sanguineus* as a good name, but places it in the synonymy of *P. cruentatus* Sowerby (1843-1878, vol. 8, *Pecten*, pl. 19, sp. 69) as "*Pecten sanguineus* Sowerby (not of Gmelin)." This contradicts to some extent the treatment of the species by Sowerby. Reeve says, "The shell noticed



by Mr. Sowerby as a dark variety of the species . . . is certainly distinct."

While the early authors through Lamarck seemed to be entirely confident as to the identity of *sanguinea* Linné, except for Chemnitz' conjecture as to its affinity with his *senatoris*, I suspect that to a great extent they merely accepted the existing identification and based their views largely on figures and the opinion of a previous describer. They all accepted *sanguineus* and *senatorius* as distinct and good species. The mid-nineteenth century writers were somewhat less categorical, as is illustrated by the discordant views of Sowerby and Reeve as to the shells described by Linnaeus, Gmelin, and Sowerby, respectively. Since that time the name *P. sanguineus* has virtually dropped out of the literature except as a *species dubius*. I confess that, based on the various descriptions, figures, and localities of the authors mentioned, I am unable to identify the shell to which Linnaeus referred.

Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, p. 76) have this to say: "The *Ostrea sanguinea* of Linné is a species which has not been satisfactorily identified. Nevertheless, as Hanley pointed out, the name probably refers to an Indian Ocean shell described by Chemnitz under the name *P. senator* [sic]. It was in error that Poli applied the name of *sanguinea* to the Mediterranean form of *P. opercularis*."

The most recent reference to the species is that of Bavay (1936, p. 307). In his catalogue of the pectens in the Paris museum he places "*sanguineus* Linné," along with several other species, in the synonymy of *Chlamys senatoria* Gmelin.

These two recent writers may be correct, but the confusion among the eighteenth and nineteenth century writers, together with the paucity of data in the Linnaean diagnosis, renders their decisions anything but convincing.

#### *Ostrea varia*

1758, *Systema naturae*, ed. 10, p. 698, no. 168.

1767, *Systema naturae*, ed. 12, p. 1146, no. 199.

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

"O. testa aequalvi radiis 30 scabris compressis echinatis, uniaurita . . . Simillima priori, sed numero radiorum differens. Color maxime variat."

The early literature contains references to

the fact that this species is somewhat similar to *Ostrea sanguinea* Linné, with the exception of the larger number of ribs, and this is reflected in the Linnaean description. The words "aequalvi" and "echinatis" were added in the twelfth edition. The combination of characters in the description clearly identifies Linnaeus' shell with the *Pecten varius* of all modern authors, a specimen of which, properly marked and agreeing in every respect with the description, is in the collection. The Gualtieri figure (pl. 74, fig. R), the only one cited, is too crude to have much evidential value, although it was probably meant for *varius*. The manuscript of Linnaeus' son lists two good figures (*vide* Hanley, 1855, p. 109): Argenville (pl. 27, fig. H) and Pennant (1776-1777, pl. 61, fig. 64), the first of which was available to Linnaeus.

The only misleading detail in the description is the word "uniaurita," which also appears in the diagnosis in the "Museum Ulricaë." All individuals of this species have two ears, although they are strikingly unequal in size. Linnaeus' use of the word was probably an oversight, as at least two of the books at his disposal contain a proper description of this feature. Klein says "inaequaliter auritus," and Argenville comments, "having but one well-formed ear and the mere commencement of another," although he called the species by the enigmatical name "*Pecten semiauritus*." Buonanni used the very confusing and incorrect words "aliquando in uno, aliquando in utroque auritus," which undoubtedly indicate that some of his specimens were worn. The first post-Linnaean author to describe the ears correctly was Da Costa (1778, p. 151) who used the phrase "inaequaliter auritus." In this he was followed by Chemnitz (1780-1795, vol. 7, p. 331, "inaequaliter aurita") and Lamarck (1818-1819, vol. 6, p. 175, "fort inégales"). Donovan (1799-1803, vol. 1, pl. 1, and text) describes it as having "one ear," though in a footnote he says, "It has two ears, but one is considerably larger than the other."

The ears of the species are its most striking feature, as their prominent transverse ribs are as heavily squamose as are the ribs on the disc of the shell, having large, spoon-shaped

scales which are most markedly developed on the anterior edge of the ventral ear in the right valve. The shell in its fresh state has all of its ribs studded with these arcuate scales, although in beach specimens they are obsolescent except on the lateral areas.

Both the description of Linnaeus and that of most of his followers mention 30 ribs. Lamarck (1818-1819, vol. 6, p. 175) gives 26 to 30. The figures supplied by these writers, however, all show fewer than 30. I have not seen a specimen that has more than 26, although Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, pp. 101-102) state that the Mediterranean form has 28 to 32. The shell shows the greatest variability in color, ranging from gray to chocolate-brown, yellow, and deep red, including a form that is white, with rose-colored spots arranged loosely in concentric bands.

The species lives in the Mediterranean Sea and on the European Atlantic coast as far north as England and Wales. Bucquoy, Dautzenberg, and Dollfus treat as the typical form the Mediterranean shell, which is a uniform red marbled with grayish white.

It is now placed in the subgenus *Chlamys*, *sensu stricto*, Röding, 1798. It is figured in Reeve (1843-1878, vol. 8, *Pecten*, pl. 25, sp. 102a, b). These are uncharacteristic figures. The best available figures are those by Donovan (*tom. cit.*) which show several color forms, and the photographic figures by Bucquoy, Dautzenberg, and Dollfus (*tom. cit.*, pl. 15, figs. 1-7).

#### *Ostrea pusio*

1758, *Systema naturae*, ed. 10, p. 698, no. 169.

1767, *Systema naturae*, ed. 12, p. 1146, no. 200.

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

"O. testa aequalvi radiis 40 filiformibus, uniaurita. . . . Testa magnitudine nucis coryli, utrinque aequaliter convexa. Auricula fere unica."

The identification of this species with the common *Pecten pusio* of authors presents more difficulties than the apparent credulity of conchological writers seems to warrant. As no references are given, as there is no properly documented type in the Linnaean collection, and as the locality is too broad to be of any assistance, we are forced to rely on the very equivocal description alone.

In the first place the *pusio* of most authors

is not equivalve, although the peculiar distortion of almost every specimen is so marked that it is often difficult to say whether the two valves are equal or not. Next, it is certainly not "uniaurita," as it has two well-developed ears which are no more unequal in size than in most of the pectens which are characterized as having unequal ears. The phrase "auriculae fere unica" is a possible slight concession to the appearance of our *pusio*, but is clumsy Latin and virtually untranslatable. Indeed in some individuals of *pusio* the ears seem almost equally large, although the irregularities and overgrowths on the shell are apt to be deceiving. In general the species has much larger ears in proportion to its size than do most pectens.

Finally most individuals are considerably larger than the hazelnut by which Linnaeus measured it, although it may be that his type was a small or juvenile individual. The only details of the description that are in accord with the *pusio* of authors are the 40 filiform ribs and the fact that the valves are equally convex. The first is distinctive; the second would apply to many members of the genus. The description in the "Museum Ulricae," though longer, adds nothing helpful except details as to color and repeats the questionable phraseology of the "Systema."

The species is very equivocally represented in the collection. A tray marked for it had apparently been used as a "catch-all" for single valves of some of the smaller pectens, including several valves of the *pusio* of British writers and of *P. albolineatus* Sowerby, 1842. There is no specimen in the tray, or elsewhere in the collection, which adequately agrees with the description. The details of the color of the upper valve given in the "Museum Ulricae" ("color operculi albis striis nigris venisque albis undatis") apply to *albolineatus* but certainly not to the *pusio* of authors. "Fornicis albis" is incorrect even for *albolineatus*. In the same tray is a white lower valve of *P. islandicus* Müller, 1776, and Hanley suggested (1855, p. 109) that, as practically none of the pectens in the collection are in pairs, Linnaeus might have imagined that this valve belonged with one of the colored upper valves of *pusio*. In that case this reconstructed pair would have agreed very fairly with the description in the

"Museum Ulricaë." This is too great an assumption to make. In any case no known species conforms to these requirements. In the last analysis the *pusio* of authors comes closest to being in accord with the descriptions in both works, although it is a very imperfect concordance. The early British writers accepted the identification without question, and modern conchologists, with few exceptions, agree. It is, however, a determination that must be considered questionable.

The "Palliolum" of Chemnitz (1780-1795, vol. 7, p. 333) which that author believed to be the *pusio* of Linnaeus, is a different species. His locality is Nicobar, and the two figures he supplies (*tom. cit.*, pl. 67, figs. 635-636) are quite different in appearance and are both remote from *pusio*. I cannot hazard a guess as to what they represent.

Lamarck (1818-1819, vol. 6, pt. 1, p. 177) cites *P. pusio* as of "Lin. Gmel.," but his description, mentioning 30 ribs and an outline that is "oblongo-ovali," does not sound like the *pusio* of his successors or of Linnaeus. In the French description he confirms the choice of his French specific name, "Peigne dégénéré," "This *Pecten* appears to be a depauperate or degenerate *P. varius*." He located it in the Mediterranean and "European Seas." In spite of the locality and the reference to the depauperate appearance of the shell, one cannot disregard the fact that Lamarck had already described (*tom. cit.*, p. 175) a species that seems much nearer to the *pusio* as we know it. This is *P. sinuosus*, the *Ostrea sinuosa* of Gmelin. The description fits our *pusio*; the locality is correct, and Lamarck said of it, "A very distinct species, but remarkable for its deformities." Of the figures he cites for *sinuosus*, those from Da Costa and Pennant are very fair representations of our *pusio*. That from Lister is of the inside of an undeterminable species.

Sowerby (1847-1887, vol. 1, p. 72) said, in discussing *pusio* Linné: "The above name has been erroneously applied to the irregular attached shell properly called *Hinnites sinuosus*. The shells are somewhat similar in their young state."

The common Mediterranean form of the *pusio* of authors was called "*Pecten multistriatus* Poli sp. (1795)" by Bucquoy, Dautzenberg, and Dollfus, and these authors ques-

tioned its identity with *pusio* Linné. They say (1882-1898, vol. 2, p. 106): "As Hanley explained, it is impossible to know upon what form Linnaeus based his *Ostrea pusio*. Its diagnosis is insufficient and the box which bears the name *O. pusio* in Linnaeus' collection contains lower valves of several different species, among which one can recognize, in addition to the present species, *P. albolineatus* Sby., *P. islandicus* of Chemnitz [*sic*] (juvenile), etc. Under the circumstances it is best to eliminate the name of *P. pusio* from the nomenclature, especially as it has been variously interpreted. . . . The *pusio* of Lamarck is uncertain. It should probably be referred to the juvenile stage of *P. varius*." In spite of the very proper lack of confidence by these authors in the identification of *pusio* Linné, they place both it and *pusio* Lamarck in the synonymy of *P. multistriatus*, although with a question mark.

The name *pusio*, as of Linnaeus, was used by virtually all the writers of the last half of the nineteenth century, with the exception of Bucquoy, Dautzenberg, and Dollfus, and including d'Orbigny, Deshayes and Milne-Edwards, Philippi, Forbes, Sowerby, Reeve, Jeffreys, Hidalgo, Kobelt, and Locard. It is almost universally employed today for the shell called *multistriatus* Poli, 1795, by Bucquoy, Dautzenberg, and Dollfus. Although I have grave doubts that the *pusio* of authors is the *pusio* of the "Systema," this is one of the cases in which the accepted though questionable name should be retained to avoid confusion in the nomenclature.<sup>1</sup>

As *multistriatus*, it is figured by Bucquoy, Dautzenberg, and Dollfus (*tom. cit.*, vol. 2, atlas, pl. 16, figs. 1-5). These figures show shells from the Mediterranean and from the Atlantic at Brest. As *pusio*, Donovan supplies a full page of figures of the British shell (1799-1803, vol. 1, pl. 34) in which the characteristic deformities are well shown, although his coloring is somewhat fanciful.

Woodward and several of the other nineteenth century conchologists have placed the species in *Hinnites* Defrance, 1821, a name originally suggested as a good genus to contain the same group included in Osbeck's

<sup>1</sup> Poli's diagnosis of *multistriatus* does not refer to *pusio* Linné. His figure (1791, 1795, vol. 1, pl. 28, fig. 14) is a very fair drawing of the Mediterranean shell.

*Pecten*. The members of this group are free-swimming in the young stage but fixed as adults and in the latter stage are subject to great deformation. The species is, however, usually placed in the typical section of sub-genus *Chlamys* Röding, 1798.

#### *Ostrea glabra*

1758, *Systema naturae*, ed. 10, p. 698, no. 170.

1767, *Systema naturae*, ed. 12, p. 1146, no. 201.

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

"O. testa aequalvis radiis 10 laevibus planiusculis, internis striis elevatis duplicatis. . . Testa subrotunda, glabra absque striis extus, obsolete plicata, incarnata. Auriculae aequales."

The word "aequalvis" was moved to the main description from its position in the subdescription in the tenth edition. "Extus," which appears after "incarnata" in the earlier edition, was omitted in the twelfth.

The almost endless variety of sculpture and color pattern of this shell makes it a truly polymorphous species, and these sculptural and color forms have received many names. It would be impossible to write a satisfactory specific description from a single specimen. The Linnaean language illustrates this. The 10 ribs referred to by him sometimes become 11 or 12. In some specimens they are of equal size; in some the alternate ribs, or several of the ribs, are narrower than the rest; in others only one or two are narrower. The surface of the ribs varies from smooth to a form that is sculptured with fine radial threads which appear more prominently in the interspaces of all individuals. Linnaeus described the shell as "obsolete plicata," but I have not seen a specimen where the plications or ribs were not too prominently developed to be called obsolete. The word "incarnata" shows that the author used as type a single color variety. The ears are not "aequales" but noticeably different in size.

The description in the "Museum Ulricae" is much more graphic and is probably sufficiently characteristic to identify the species. It repeats, however, the phrases "glabra," "absque striis," and "incarnata" of the "Systema" and says that the ribs are "10 vix distinguendis." It is obvious that Linnaeus' type was an extremely smooth, possibly worn, specimen. There is no authenticated specimen in the collection.

The accepted identification with the *Pecten*

*glaber* of authors is not a perfect one but is acceptable when the extreme variability of the shell is taken into account. The first Regenfuss figure referred to in the synonymy (pl. 1, fig. 10) was (*vide* Hanley, 1855, p. 110), probably meant for the yellow variety of *glaber*.<sup>1</sup> The other figure from Regenfuss (pl. 2, fig. 16) was properly erased by Linnaeus' son as being incorrect. The Gualtieri figure (pl. 73, fig. H) is an approximation to the general appearance of *glaber*, but is very crudely drawn.

Chemnitz called attention to the great range of sculpture and color in this species (1780-1795, vol. 7, p. 339), as did Lamarck. The latter says (1818-1819, vol. 6, pt. 1, p. 168), "very variable in its color and characters and most difficult to describe briefly." Chemnitz figures five quite different forms (*tom. cit.*, pl. 67, figs. 641-645), two of which (figs. 642-643) are interesting as they illustrate what was, I believe, the model of Lamarck's description of his *glaber*, "radiis 10 laevibus, superne dilatato-evanidis." Lamarck, incidentally, made several species out of Linnaeus' *glaber*: *flavidulus*, *distans*, *griseus*, and *virgo*, most of which Reeve (1843-1878, vol. 8, *Pecten*, pl. 14, sp. 53a, b) synonymized with *glaber*. Even Reeve's description, however, shows that it was based on a single form, although he admitted the variability of the species as to color. He erred, however, in saying that "sculpture varies little and form not at all." Reeve also made it synonymous with *Ostrea citrina* and *rustica* Poli, 1795, the figures of which are undoubtedly meant to illustrate two forms of *glaber*.

I am strongly inclined to believe that the form *virgo* Lamarck was the basis of the Linnaean description. That form is described as "radiis glabris" and "roseo partim tincta." Lamarck's other forms are described as either yellow, gray, or "tres variée" in color, and all except *virgo* are said to be "striata."

Bucquoy, Dautzenberg, and Dollfus select as the Linnaean type a figured shell which agrees with Lamarck's description of *virgo*, although they do not refer to the latter name in this connection. They say (1882-1898, vol. 2, p. 87): "We consider as the true *P. glaber* of Linnaeus the form with 10 equal

<sup>1</sup> Hanley probably meant the form which was called *P. flavidulus* by Lamarck, 1819 (*P. solaris* Chemnitz, 1784).

ribs . . . and we refer to it, as varieties only, *P. distans* Lamarck, 1819, *P. sulcatus* Born, 1780, *P. anisopleurus* Locard, 1888, and *P. unicolor* Sowerby, 1847 (*non* Lamarck, 1819)." They recognize the *glaber* of authors as distinct from *glaber* Linné, the former being a variety of *P. proteus* Solander. This concept of the *P. glaber* of authors is a novel one and one that I have not seen referred to elsewhere. Several Mediterranean forms of *glaber* are figured by them (*tom. cit.*, atlas, pl. 19, figs. 1-2, *glaber* Linné; figs. 3-6, var. *distans* Lamarck; pl. 20, figs. 1-2, var. *sulcata* Born; fig. 3, var. *ponica*, named by them).

The locality in the "Systema" is correct. The species occurs throughout the Mediterranean and into the Black Sea and (*vide* Nobre, 1938-1940) on the Atlantic coast of Portugal. Nobre's shell, which is probably Lamarck's *distans*, is figured (*op. cit.*, pt. 1, pl. 57, figs. 4-5).

*Pecten glaber* belongs in *Flexopecten* Sacco, 1897, which was erected as a subgenus of *Chlamys* Röding. It is close to, and possibly identical with, *Peplum* Bucquoy, Dautzenberg, and Dollfus, 1889, one distinguishing mark being that in *Peplum* (see *Ostrea pes-lutrae* below) the ears are short and square as in the shells of the group formerly given the preoccupied name of *Pallium*, *sensu stricto*, whereas in *Flexopecten* the ears are somewhat longer and pointed. Likewise *Flexopecten* has a prominent inner cardinal ridge just below the anterior side of the ears, thus bringing the group very close to *Aequipecten* Fischer, 1886. It is possible that it should be treated as a section of *Aequipecten*.

#### *Ostrea opercularis*

1758, *Systema naturae*, ed. 10, p. 698, no. 171.

1767, *Systema naturae*, ed. 12, p. 1147, no. 202.

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

"O. testa inaequali radiis 20, subrotunda decussatim striato-scabra, operculo convexiore. . . . Testa opercularis magis quam altera convexa."

The combined characters that identify the *opercularis* of authors with the shell described by Linnaeus are the 20 finely scabrous ribs, the delicate decussate sculpture of the whole shell, and the fact that the left valve is more convex than the right. The shell is somewhat higher than it is wide and is slightly inequilateral, which was probably

what Linnaeus meant by the word "subrotunda." The greater convexity of the left valve gave the shell its specific name, and, according to Hanley (1855, p. 111) this was due to an error on the part of Linnaeus, as none of the pre-Linnaean writers used the name *opercularis*. Hanley suggested that Linnaeus has "an erroneous belief that the paler valve of a *Pecten* was necessarily the lower, and, as the richer colored valve was more convex than the other, it was doubtlessly to draw attention to the circumstance that the appellation was bestowed." Hanley made a difficulty where none exists. The lower valve, in *opercularis* as in most pectens, is the paler valve, and Linnaeus made no mistake.

The excellence of the description and the fact that a properly documented specimen of *opercularis* is present in Linnaeus' collection unequivocally identify the species. The description in the "Museum Ulricae" paraphrases that in the "Systema" but adds no further diagnostic details. Hanley (*loc. cit.*) felt that this later description was decisive and necessary to the identification, but the "Systema" contains all that is required for that purpose.

This is a species with a very wide European range. It is found not only in the Mediterranean but along the Atlantic coast as far north as the British Isles and Norway. Chemnitz (1780-1795, vol. 7, p. 341, pl. 67, fig. 646) reports it from Sweden and even as far north and east as Helsinki, but I have seen no recent reports of the shell from the Baltic. No references were supplied by Linnaeus except a notation of its inclusion in the "Museum Ulricae." In his manuscript notes he added the following words, "Scabrities constat squamis imbricatis minoribus O. palli, sed radii plures," but as the species bears no close relationship to *P. pallium* in form, sculpture, or color, this note adds nothing to our conception of the species.

The *Pecten opercularis* is the type, by monotypy, of *Aequipecten* Fischer, 1886, a group very closely allied to *Chlamys* Röding, 1798, from which it is chiefly distinguished by its fewer and more prominent ribs, which sometimes have radial striations, by its generally circular outline, and its nearly equal ears with a smaller byssal notch.

Five of Gmelin's pectens (*Ostrea elegans*,

*versicolor*, *rubra*, *radiata*, and *regia*) are probably mere varieties of *opercularis*, which he also lists, and its variations in color and sculpture are so wide that later authors have been responsible for a number of other names.

It is figured in Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, atlas, pl. 17, figs. 1-8, pl. 18, figs. 1-8), in Nobre (1938-1940, pt. 1, pl. 55, figs. 1-2, pl. 56, figs. 1-2), and in Donovan (1799-1803, vol. 1, pl. 12). Donovan called it *Ostrea subrufus* Pennant.

#### *Ostrea gibba*

1758, *Systema naturae*, ed. 10, p. 698, no. 172.

1767, *Systema naturae*, ed. 12, p. 1147, no. 203.

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

"O. testa aequalvi radiis 20 glabris, gibba. . . . Valvula utraque convexa et sanguinea."

This species is a member of a complex so widely distributed in American waters and the members of which present such a wide range of variation that a long list of specific names has been proposed, only a very few of which have even a subspecific value. Neither color or color pattern, number of ribs, degree of flatness or convexity of ribs, nor the degree of gibbosity or strength of the shell is a completely constant character even in a given form, and thus, in any nomenclatural treatment of the complex, one is apt to find non-conforming individuals within any chosen species or subspecies.

Reserving for the moment the generic and subgeneric position of what I consider the good species, the western Atlantic produces only two:

1. *Pecten irradians* Lamarck, 1819. There are three distinct forms of this species. The first is the typical *P. irradians irradians*, which was called *borealis* by Say (1822, p. 259). It ranges from the sub-boreal waters of eastern Canada to New Jersey. This northern form is a large, fairly compressed shell with 17 or 18 rounded ribs. It is occasionally sub-equivalve. Its coloration is generally subdued, the left valve being usually a brownish or bluish gray and the right valve white, with a brown suffusion usually present near the umbones. One form has a somewhat more brilliant coloration, being a light tan with darker brown concentric markings. Except for this form, the color pattern is always arranged radially. The typical *irradians*

is figured by Maxwell Smith (1941, pl. 7, fig. 7a-b) and by Delessert (1841, pl. 15, fig. 4a-b). The latter figure is of the type specimen in Lamarck's collection.

The second subspecies is the shell called *P. concentricus* by Say (1822, p. 260). It has more ribs than the typical subspecies (usually 20 to 22) and narrower interspaces. The ribs are squarish or flattened, rather than rounded and the color of the left valve is predominantly blue-gray, usually with one or more of the ribs either all white or flecked with white. The right valve is white as in the northern shell, but the brown suffusion near the umbones is less frequently found. The right valve is noticeably more gibbous than the left. It may be cited as *P. irradians concentricus* Say, 1822. Its range is cut into two distinct areas by the peninsula of Florida. It is found from New Jersey, the southern terminus of the area in which *irradians irradians* is dominant, to northern Florida. It then disappears from the Florida east coast and reappears on the west coast at the islands off the entrance to Charlotte Harbor and ranges northward from there to Louisiana. It is not a species that is at home in the warmer waters of southern Florida and the West Indies as is *P. gibbus* Linné which is discussed below. It seems likely that it found its way to the west coast of Florida during Pliocene times when the southern end of the Florida peninsula was submerged. The writer has collected *irradians concentricus* Say in the Caloosahatchee marl west of Clewiston, Florida, a Pliocene formation.

Another subspecies of *irradians* is *irradians amplicostatus* Dall, 1898. It occurs in the western part of the Gulf of Mexico from Texas to Cartagena, Colombia, and is thus isolated from the other subspecies. It has only 12 major ribs, with a variable number of narrower, obsolescent, or undeveloped ribs at the extreme ventral and dorsal edges of the shell, but its other characters follow very closely those of *concentricus*, having flattened ribs, a gibbous left valve, and the subdued gray-blue coloration of that shell.

2. *Pecten gibbus* Linné. This species is subtropical, either geographically or based on water temperature. It is plentiful from the latitude of Cape Hatteras southward along the Florida east coast and up to Tampa on

the west coast, and throughout the West Indies. Its range therefore overlaps that of *irradians concentricus*, although from Hatteras to a point roughly halfway down the Florida east coast it is only found in the warmer off-shore waters of the Gulf Stream. It also has squarish ribs and is markedly gibbous in both valves. Its most distinguishing characteristic is, however, the brilliance and variety of its color pattern, in which red, yellow, orange, brown, and white occur alone or in bicolored or tricolored combinations, usually arrayed radially but, less often, in vague concentric bands. Many specimens show a pattern of irregularly disposed blotches, which has earned for this type the name of Calico Shell in certain localities. It also averages much smaller than *irradians* and its subspecies.

This is the *Ostrea gibba* of the "Systema." The name does not appear on the list of the contents of Linnaeus' cabinet, but the collection does contain a single valve which agrees with the illustration in the author's sole reference—the "Jamaica" of Browne. It is apparent from the word "sanguinea" in the description that the specimen on which it was based was a predominantly red individual, a form that this writer has not observed. The description is faulty in one respect, as the ribs of *gibbus* are not smooth as the words "radiis 20 glabris" would have us believe. All forms of both *gibbus* and *irradians* have the interspaces between the ribs filled with very fine, crowded, concentric lamellae. These are continuous over the ribs, giving the latter a peculiarly rough texture which can be felt with the finger in fresh specimens. In beach-worn shells these laminae tend to disappear except in the interspaces. It is quite possible that Linnaeus based *gibbus* solely on the figure from Browne, which does not show the laminae, and that the specimen in the collection was not added until later, perhaps by some other hand. The description in the "Museum Ulricae" is somewhat more elaborate but adds nothing useful. Indeed it introduces a phrase, "interstitiis angustissimis substriatis," which is equivocal and makes one suspect that the author might have been describing a different shell. It hardly seems possible that Linnaeus would have described the wavy concentric lamellae of *gibbus* as

striations, and while the interspaces of the species are narrower than in the northern form of *irradians*, because of the greater number of ribs, the word "angustissimis" is an unnecessarily strong term. The specimen that Linnaeus examined in the Queen's collection was also an all-red shell.

The generic position of the forms here discussed has been variously stated. Grant and Gale (1931, pp. 206, 215) place them all in subgenus *Aequipecten* Fischer, 1886, type *P. opercularis* Linné, by monotypy, and in section *Plagiectenium* Dall, 1898, type *P. ventricosus* Sowerby, 1842, by original designation. Oldroyd (1924-1927, vol. 1, p. 58) disregards Fischer's *Aequipecten* and puts them in subgenus *Chlamys* Röding, 1798, type *P. islandicus* Muller, 1776, by subsequent designation, Herrmannsen, 1846-1847, and in section *Plagiectenium*. Thiele (1931, 1935, vol. 2, pp. 807-808) treats both *Aequipecten* and *Plagiectenium* as sections of subgenus *Chlamys*, with the same types.

I place *gibbus* and the other species mentioned in *Aequipecten* Fischer, disregarding section *Plagiectenium* Dall, as I agree with the tentative suggestion of Grant and Gale (*ibid.*, pp. 198-199) that Dall's name, which he based on the absence of radial striations, is of questionable value even as a sectional division. This group, as indeed the entire family Pectinidae, needs much further critical study. For instance, the specific separation of *irradians* and *gibbus* is not acknowledged by many modern conchologists.

For a more exhaustive account of the members of this group and a more detailed discussion of the supraspecific names *Aequipecten* and *Plagiectenium* than can be given here, the reader should consult Grant and Gale (*ibid.*, pp. 198-220).

Good figures of *gibbus* are rare. The best available is the color photograph of the species in Platt (1949, p. 46, fig. 5) showing one of the color forms. Maxwell Smith (1941, pl. 9, fig. 2) has a characteristic black-and-white photograph.

#### *Ostrea flavicans*

1758, *Systema naturae*, ed. 10, p. 698, no. 173.

1767, *Systema naturae*, ed. 12, p. 1147, no. 204.

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

"O. testa subaequalvalvi gibba radiis 8 striatis,

margine altero rotundato. . . . Testa quasi obliqua. Auricula altera brevissima; color albus fusco rubroque varius; intus albus radiis flavis."

This description from the twelfth edition, in which the only change from the 1758 language was the addition of the word "subaequalvi," would seem at first glance to be sufficiently detailed to identify the species, but nothing is present in the Linnaean collection that conforms to it, and later commentators, with one exception, have been unable to suggest any shell that meets Linnaeus' specifications.

Hanley (1855, p. 112) very tentatively suggested *Pecten tigris* Lamarck, 1819, as the species that comes closest to the description but points out that that is a very compressed shell which would hardly have been called "gibba." With this exception, and the fact that *tigris* has nine ribs on the left valve, the description fits it very fairly.

The species is the first of three falling under the "subgeneric" heading "Pectines valvulis altero latere magis gibbis." The exact meaning of the quoted language is not entirely clear. The other two species in the group are *Ostrea lima* (*Lima lima*) and *Ostrea fasciata* which is undoubtedly a *Lima* but specifically unidentifiable. If, as Hanley suggested, the Latin heading "referred merely to the distorted look produced by the projecting obliquity of the ventral edge," which is a character of *Lima*, then one objection to the identification of *flavicans* with *tigris* is removed, but we are still left in the dark as to why Linnaeus should have grouped a *Pecten* with his two *Lima* species. The color described by the author and the small number of ribs are much more descriptive of a *Pecten* than of a *Lima*. Moreover, while the meaning of the "subgeneric" heading is not clear, Hanley's interpretation seems far-fetched.

The species is not mentioned by Chemnitz or Lamarck or by any of the other early followers of Linnaeus except Gmelin who apparently merely lifted it bodily from the twelfth edition of the "Systema." Gmelin's description is almost identical with that of Linnaeus except for a reshuffling of the details into a different order. His one omission is of the word "gibba," which amounts to a more cogent argument for the identification with *tigris* than did Hanley's theory.

Linnaeus, in the earliest list of his shells (1758), mentions the species as being owned by him. In the later list (1767) it is entered and then erased. As to whether this erasure signified that Linnaeus became doubtful of the separate identity of the species or of his concept of it, it is impossible to hazard even a guess.

The description of *flavicans* in the "Museum Ulricae" copies the language of the "Systema," with added details that add nothing to our knowledge of the species. It does recognize the possibility of nine ribs ("Radiis 8 seu 9") and says that the ribs at the sides of the shell are "crenatis." The word "gibba," while used, is somewhat qualified by the phrase "Operculum paulo magis planum quam Fornix."

A form of *tigris* may have been used as the basis of Linnaeus' two descriptions, and certainly the concordance of that shell with the description is so close that it cannot be entirely disregarded. The word "gibba," however, which he uses for both of the other *Lima* species, points away from such a theory. Inasmuch as a real doubt exists, based largely on the inclusion of the species with the limas, the name should be rejected as a *species dubius*.

#### *Ostrea fasciata*

1758, Systema naturae, ed. 10, p. 699, no. 174.

1767, Systema naturae, ed. 12, p. 1147, no. 205.

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

"O. testa aequalvi gibba radiis 20 scabris: interstitiis striatis, auriculis aequalibus exoletis."

Based on the description alone the species is clearly a *Lima*. The Gualtieri figure cited (pl. 74, fig. E) shows an undoubted *Pecten* and does not agree with the "auriculis aequalibus exoletis" of the description. It is certain, however, that this figure was an error of transcription. It shows three dark concentric bands which may have suggested the name *fasciata* to Linnaeus. He did not own a specimen of his *fasciata* as it does not appear on either the tenth or twelfth edition lists of his collection, and it is hard to explain how he could have described a *Lima* and yet have chosen a name based on a figure of a *Pecten*.

The figure to which he apparently intended to refer was figure "EE" on the same plate of Gualtieri. This shows a shell which is un-



questionably a *Lima*. In a manuscript note in his own copy of the tenth edition he supplied the missing "E." This new reference ("Gualtieri, t. 74. f. EE") then appears in the diagnosis of *fasciata* in the "Museum Ulricae," but by what seems to be a further error Linnaeus reverts to the original figure "E" in the twelfth edition.

The description in the "Museum Ulricae" points even more clearly to a *Lima* but does not conform to the Gualtieri figure "EE" there cited. It has been already noted in the Foreword to this paper that in some cases species designated by the same name in the two works are in fact quite distinct, although Linnaeus never knowingly changed his concept of a species in the two last editions of the "Systema." This description in the "Museum Ulricae" may be such a case. It adds, among other details, that the 20 ribs are narrow and deeply divided; that the interspaces are "transversim striatis"; and that the valves are only slightly convex. This last detail agrees neither with the "gibba" of the "Systema" nor with the "valde tumida" of Chemnitz' *Pecten inflatus*, a species that has often been suggested as the *fasciata* of Linnaeus and is referred to in the next paragraph.

Gualtieri's figure "EE," while a *Lima*, is not clear enough to be specifically identified. Hanley (1855, p. 112) suggested that it may have been meant for *L. tenera* Sowerby, 1846. Chemnitz, with a query, put both the *fasciata* of the "Systema" and the "Museum Ulricae" in the synonymy of his *Pecten inflatus* (*Lima inflata* Lamarck, 1819), but said (1780-1795, vol. 7, pp. 347-348): "Is this shell really the *Ostrea fasciata* of Linnaeus? . . . *fasciata* Linnaei is only *parum convexa* and has only 20 ribs. The present species [*inflatus*] is *valde convexa* and has a shell which is greatly inflated and tumid. Also a full thirty ribs or striae may be counted on its upper valve. Can it then possibly be the *Ostrea fasciata* Linnaei? That is for someone else to decide." Chemnitz' disclaimer was, however, passed over by several later authors who repeated his queried synonymy with more assurance. Reeve (1843-1878, vol. 18, *Lima*, pl. 4 sp. 17) accepted Linnaeus' *fasciata* as a well-defined species with *inflata* Lamarck in its synonymy. Sowerby (1847-1887, vol. 1, p. 85) cites a *Lima fasciata* as of Linnaeus, with

*inflatus* Lamarck as a synonym, and even makes the erroneous statement that a specimen of the shell is in the Linnaean cabinet.<sup>1</sup> He says: "Although obscurely described, there can be little doubt of this being the true *Lima fasciata* of Linnaeus. A specimen now exists in the Linnaean collection, differing markedly from the one subsequently introduced by Sir James Smith, which we refer to the following species [*L. ventricosa*]." Sowerby's figures (*tom. cit.*, pl. 21, figs. 15-16) show an extremely oblique shell with close-set, angular, and unsculptured ribs much like Chemnitz' figure of *inflatus* and not at all conformable to the description of *fasciata* Linné.<sup>2</sup>

Lamarck described his *Lima inflata*, which is a common species of the western Atlantic, in much the same terms as did Chemnitz and referred to the latter's figure. He, however, omitted any reference to *fasciata* Linné.

Hanley (*loc. cit.*) was unable to identify *fasciata* and was convinced that the name should be dropped. He could find nothing in the collection that agreed with the description and thus disagreed sharply with the opinion of his contemporaries Sowerby and Reeve. Since Hanley's day it seems to be generally agreed that the species is unidentifiable. Bucquoy, Dautzenberg, and Dollfus say of it (1882-1898, vol. 2, p. 55): "The *Ostrea fasciata* of Linné is a very dubious species as Hanley has shown (*Ipsa* Linn. Conch., p. 112); it is even doubtful that it belongs to the genus *Radula*, as one of the Gualtieri references on which it is based shows a *Pecten*. It is therefore best to expunge the name from the nomenclature." They add that the *fasciata* of Schröter, Sowerby, and a few other lesser-known conchologists is the *inflata* of Chemnitz and Lamarck.

<sup>1</sup> There is a specimen of *Lima inflata* in the collection, but it was collected by Lord Valentia and added later, as is shown by the collector's name written inside the shell.

<sup>2</sup> Hanley, who examined the Linnaean collection with the most scrupulous care subsequent to the publication of the above statement of Sowerby, does not mention any specimen of *inflatus* other than the one added by Lord Valentia. I have not been able to identify Sir James Smith, the well-known botanist, with the obscure peer Lord Valentia, and, indeed, the Viscounty of Valentia is a title which long antedates the knighthood conferred upon Smith.

The most recent comment on the subject of *fasciata* is that of Iredale (1939, p. 388) who advises "its absolute rejection as undeterminable." He reviews the confusion in the figures and comes to the correct conclusion that neither of the Gualtieri figures fits the Linnaean description. As I cannot refer *Lima inflata* Lamarck to the very equivocal description of *fasciata* in either the "Systema" or the "Museum Ulricaë" and as the confusion in the references and the disagreement of both of them with either description makes them valueless, I agree that the name should be dropped.

#### *Ostrea lima*

1758, Systema naturae, ed. 10, p. 699, no. 175.

1767, Systema naturae, ed. 12, p. 1147, no. 206.

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

"O. testa aequalvi gibba radiis 22 imbricatis squamis, altero margine rotundato, auriculis oblitteratis. . . Testa alba oblonga aequalvis. Auriculae obsoletae. Nates hiantes, acutangulae."

The word "aequalvi" in the main description and the last sentence in the sub-description were added in the twelfth edition. Four new pre-Linnaean references were also added in that edition supplementing the single reference to an Argenville figure in the tenth. All the figures given are reasonably good pictures of the *Lima lima* of all modern writers, a marked specimen of which is present in the collection. The identification is thus supported by an excellent description, adequate figures, and a marked type.

Lamarck used this species, under the Linnaean specific name, as the "example" of *Lima* in the "Prodrome" of 1799, but later changed the name to *squamosa* (1818-1819, vol. 6, pt. 1, p. 156), probably because of his apparent antipathy to tautonymic names. Lamarck's name was consistently employed by his immediate followers, but since the middle of the nineteenth century *lima* is seen as often as *squamosa*. As it cannot be said that either has become fixed in the literature, no confusion would be caused by the suppression of the Lamarckian name. Most recent writers throw it into the synonymy of *lima*.

Chemnitz (1780-1795, vol. 7, p. 349) lists a species called by the monomial "*Radula*" and referred it to *Ostrea lima* Linné. His figure,

however (*tom. cit.*, pl. 68, fig. 651) is either badly executed or represents another species, as it shows only about 15 ribs.

The figures cited by both Linnaeus and Lamarck are in the main identical. Chemnitz and Lamarck both changed Linnaeus' Argenville reference from plate 27, figure E, to the same lettered figure on plate 24, but this means only that they used the 1757 edition, whereas Linnaeus used the earlier edition of 1742, where the plates were differently numbered. Lamarck also changed the Gualtieri reference from figure F to figure E of plate 88, an unfortunate change as the latter figure shows a shell with smooth ribs.

Some confusion has been caused by the several localities given for this species. Linnaeus' "habitat" was "O. Meridionali," which is almost completely uninformative. Chemnitz located his "*Radula*" in Tranquebar and the Red Sea. Lamarck was the first to place it properly in American waters. Nevertheless two comparatively recent authors give a European locality to *lima*. The first, Bucquoy Dautzenberg, and Dollfus (1882-1898, vol. 2, p. 52), have this to say: "It is evident that Linné, under the name *Ostrea lima*, confused two very close species, one of which lives in the Mediterranean, and the other in the Indian Ocean and the Red Sea. The exotic species was distinguished by Deshayes under the name *Lima bullifera*. Under the circumstances it seems wise to preserve the Linnaean name for the Mediterranean shell, since the name *squamosa* Lamarck also applied to both species." These authors did not give an American locality for any form of the species.

The most recent comment is that of Lamy (1930-1931, p. 101). He cites Bucquoy, Dautzenberg, and Dollfus and adheres to their view that *lima* is confined to the Mediterranean and continues: ". . . there is a shell in the Pacific Ocean which is a closely related but distinct species. But, as Lischke . . . has recognized, specimens absolutely identical with the Mediterranean shell have been found in the Red Sea (*L. sowerbyi* Deshayes), in the Seychelle Islands, Madagascar, Ceylon, Java, the Philippines, Japan, Australia, New Zealand, (*L. zealandica* Sowerby), and in the Gulf of California (*L. tetrica* Gould)." In the continuation of his discussion Lamy finally states categorically that all the

species mentioned above are distinct in spite of his apparent adherence to Lischke's belief that *sowerbyi*, *zealandica*, and *tetrica* are "identical" with the *lima* of the Mediterranean. He did not report any form of *lima* from the western Atlantic except to quote Dall (1890-1903, pt. 4, p. 767) to the effect that it occurs in the West Indies and Brazil. He also referred to E. A. Smith (1885, p. 289) who said that he could not separate *L. multicostrata* Sowerby, 1843, from New Zealand, from *L. caribaea* d'Orbigny, 1845. *L. multicostrata* is a shell which Suter (1913, p. 884, pl. 58, fig. 12) called a subspecies of *L. lima* Linné. The form *caribaea* has (*vide* Lamy) been reported both from Bermuda and the Pacific and Lamy says of it (*loc. cit.*): "It resembles *L. lima* by its oblique and subtrigonal shell but has ribs which are more numerous (36) and finer, with more delicate imbrications." Apparently the Paris museum had no specimen of *L. lima* from the western Atlantic. As to d'Orbigny's *caribaea*, American writers do not refer to it, and I suspect that it was *Lima lima* or a variety or geographical race of that species.<sup>1</sup> The student is referred to Lamy's discussion for a very full account of the reports of the widespread occurrence of *Lima lima*, its so-called forms and varieties, and its close congeners. Little can be gained from the earlier writers, not only because of their confusion as to locality, but also because of the very equivocal drawings which they supplied.

I have examined a considerable series of specimens labeled *lima* from the western Atlantic and from the Mediterranean Sea, and I can find no differences that would justify their specific or even subspecific separation. The species is variable in the sparseness or frequency of the imbrications on the ribs, in the prominence of these imbrications, and in their occurrence on different areas of the shell, but the same variability in this respect is found in specimens from both regions. They seem to have no significance and are

<sup>1</sup> D'Orbigny said of his *caribaea* (1845, p. 354), "Lamarck confused this species with *L. squamosa* which is distinguished from it by its more numerous ribs, a narrower cardinal region and a more restricted byssal gape. M. Auber has sent it to us from Cuba." As said above, d'Orbigny probably erred in separating his species from *squamosa* Lamarck (*L. lima* Linné).

probably purely ecological. It is even impossible to describe geographical races from the two regions.

*Lima lima* is the type of *Lima* Bruguière, 1797, by absolute tautonymy.<sup>2</sup>

The name *Radula*, inherited from Rumphius and Klein, has been often used for this genus. Mörch used it in 1853 and Thiele (1931, 1935, vol. 2, p. 810) used "Radula (Klein) Mörch" as a section of *Lima*, *sensu stricto*, making *L. lima* Linné the type of the section. Incidentally, Thiele cites *Lima* as of Chemnitz, 1784, his citation being prior to the publication of Opinion 184 on the validity of the Chemnitz names, and makes *L. scabra* Born, 1780, the type of the typical section. The name *Mantellum* Röding was also revived by Mörch as a good genus in place of *Lima*, and was later used by H. and A. Adams in 1858, Chenu in 1862, as well as by Tryon, Fischer, and others, as a good subgenus, to contain those species that gape on both sides, such as *L. inflata* and *hians* Gmelin. But whatever be the final decision on the Röding generic names, *Lima* Bruguière has one year's priority.

The Mediterranean *lima* is well figured in Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, atlas, pl. 11, figs. 1, 2, 3) as *Radula lima*, and by Reeve (1843-1878, vol. 18, *Lima*, pl. 2, sp. 10) as *Lima squamosa*. I know of no good figure of a western Atlantic specimen.

#### THE OYSTERS AND THEIR ALLIES IN *Ostrea* LINNÉ

The oysters and their close relatives are not the oldest group of bivalves, geologically speaking, but they have the distinction in paleontology of being the group of which the tremendous expansion in Cretaceous time was the principal cause of putting the lamelli-branches ahead of the brachiopods for the

<sup>2</sup> Until the recent Opinion of the International Commission validating as good generic names the so-called "plate-headings" of Bruguière as of the dates of the respective plates, an Opinion discussed above in this paper (p. 29), Cuvier, who described *Lima* in 1798, was generally accepted as the author of the genus. Röding, 1798, has been occasionally used as the author, but it is not necessary to establish that Cuvier's use was earlier than the publication of the "Museum Boltenianum," as Röding used the name only specifically, as *Mantellum lima*.

first time in geological history, both in number of species and in total populations. The genera *Gryphaea*, *Exogyra*, *Inoceramus*, and others, which were largely responsible for this great increase, are now extinct, but several other genera that still survive, such as *Ostrea* and *Pteria*, were already in existence in the Cretaceous.

In the case of the true oysters, as in the case of all sedentary and attached bivalves, the difficulty of distinguishing species is a very real one, as the form and sculpture of the individual depend on its manner of attachment and the nature of the object to which it is attached. Likewise the gregarious habit of the oyster often modifies the appearance of the individual very materially.

Excluding those species that have been transferred to the families Pectinidae and Limidae by Linnaeus' successors, *Ostrea* Linné contains only nine species. These are the true oysters and their allies and are grouped in the "Systema" under the heading "Rudes, vulgo Ostreae dictae." Only three remain in the genus *Ostrea* today (*C. diluviana*, *folium*, and *edulis*). *O. malleus* is now contained in *Malleus* Lamarck, *orbicularis* is unidentified, and the remaining four (*semi-aurita*, *perna*, *ephippium*, and *isognomum*) were destined by Linnaeus to be moved to his new genus *Perna* which he proposed to erect in his "revised twelfth edition," as appears by a manuscript note in his copy of the last edition of his work. All four belong in another genus under modern arrangements.

As neither the "revised edition" nor the notes themselves were ever published, the name *Perna*, as of Linnaeus, has no standing. The first author validly to propose the name was Bruguière (1789) whose *Perna* covers the same group as that contemplated by Linnaeus. However, there were already two earlier names for the group: *Isognomon* "Solander" Humphrey, 1786, type *Ostrea isognomum* Linné, 1758, and *Melina* Retzius, 1788, type *Ostrea ephippium* Linné, by subsequent designation, Herrmannsen, 1847. The latter is now generally used as a subgenus of *Isognomon* and is restricted to those species that lack the posterior wing, as *O. ephippium* Linné. Lamarck's *Perna* of the "Prodrome" of 1799, with *O. ephippium* as "example,"

was probably designed to cover the same group and as such falls into the synonymy of *Melina* Retzius. The *Perna* of Linnaeus, Bruguière, and Lamarck is not the *Perna* of Retzius, 1781, which belongs in the Mytilidae. The difference between *Isognomon*, *sensu stricto*, and *Melina*, based on the outline of the shell, is accepted by Dall, Bartsch, and Rehder (1938, pp. 61-62), but Rehder (personal communication) now says that he is "somewhat doubtful of whether the presence or absence of this posterior wing or elongation is a good character for a subgeneric distinction. However, this matter should have further study." I shall tentatively continue to use *Melina* as a subgenus.

Another name that has been used by many conchologists for the species contained in *Melina* until comparatively recent times is *Pedalion*, usually cited as of Solander (Hud-desford), 1770. Not only did Solander never use the name, but it only appeared in Hud-desford's Index to Lister's figures. As it was there employed as a monomial and with no indication as to whether it was intended as a generic or specific name, it is a *nomen nudum* and must be rejected.

#### *Ostrea malleus*

1758, Systema naturae, ed. 10, p. 699, no. 177.

1767, Systema naturae, ed. 12, p. 1147, no. 207.

LOCALITY: "In O. Asiatico, pretiosus" (1758); "in O. Asiatico, pretiosa" (1767).

"O. testa aequivalvi triloba: lobis transversis. . . Testa rudis, nigra, oblonga, linearis, hinc flexuosa. Lobi laterales transversis; subulati. Cardo hians lacuna, in cuius medio fossula transversa. Cavitas admodum parva."

The original description consisted of only the first six words quoted above, but even without the ample and characteristic language added in 1767 there could have been little doubt as to the genus to which the shell belonged. The twelfth edition fixes the identification specifically. *Malleus* Lamarck is a comparatively small genus, and none of its markedly trilobed species, except *malleus*, complies with the "nigra" of the twelfth edition. The language of the "Museum Ulricae" is even more detailed and confirms, if confirmation be necessary, that Linnaeus was describing the *Malleus malleus* of almost all

subsequent authors. A specimen of that shell is in the collection and, of all the bivalves present, uniquely agrees with the description. Most of the references are adequately characteristic.

Linnaeus borrowed the specific name, either directly or in translation, from his predecessors. Buonanni referred to it as "*Malleum manubrio insertum*." Rumphius spoke of the "Messhammer." Petiver called it the "Hammer-Oyster"; Argenville, "le Marteau"; Klein and Seba, "*Tudes Polonica*." Linnaeus' specific name *malleus* persisted in the works of the later eighteenth century writers, and Lamarck used it as the "example" of his genus *Malleus* in 1799. In 1801, however, Lamarck changed it to *vulgaris*, possibly because of what seems to have been his constant desire to avoid cases of tautonymy.<sup>1</sup> The Lamarckian name is found almost exclusively in the works of European writers until comparatively recent times and Thiele and Lamy used it as late as 1935 (Thiele, 1931, 1935, vol. 2, p. 802; Lamy, 1935a, p. 67). American workers have been more prone to restore the name *malleus*, as is proper.

The species is the type of *Malleus* Lamarck, 1799, by monotypy, of which *Pinctada Röding*, in part, is a synonym. It is figured by Chemnitz (1780-1795, vol. 8, pl. 70, figs. 655-656). The second figure of Chemnitz is certainly not *M. malleus*, as it depicts a shell much more regular in shape and of a bright yellow color, whereas *malleus* is consistently a dark blackish brown. Chemnitz says of this figure (*tom. cit.*, p. 14): "In figure 656 . . . I have pictured the white Hammer, le Marteau blanc." He said it was transparent (?translucent) and mentions its golden color, and while he apparently identified it with *malleus* he suggests that it might have been a diseased specimen. The original of the figure was at that time in the collection of the University of Copenhagen. It is not the *Malleus albus* of Lamarck, 1819, in spite of the Chemnitzian description of it as "le Marteau blanc," as Lamarck's species is white within and with-

<sup>1</sup> In the 1801 work Lamarck cited two of Linnaeus' references but did not refer to Linnaeus' publication of the species. In 1819 (1818-1819, vol. 6, pt. 1, p. 144), however, he put "*Ostra malleus* Lin. Gmel." in the tautonymy but continued the use of the name *vulgaris*.

out and is so described.<sup>2</sup> *M. malleus* is also well figured by Reeve (1843-1878, vol. 11, *Malleus*, pl. 2, sp. 5). Both the Reeve figure and Chemnitz' figure 655 are extremely characteristic and accurate.

#### *Ostrea diluviana*

1767, *Systema naturae*, ed. 12, p. 1148, no. 208.

LOCALITY: "Fossilis in nostris montibus calcaresis" (1767).

"O. testa inaequali extus plicata, margine dentibus erectis acutangulis. . . Testa magnitudine O. edulis et ultra. Margo introrsum erectus ad angulum rectum cum testa. Dentes hi perfecte acutanguli, quasi serra exsecti, extusque videntur constare lamellis imbricatis; margo dentium planus, saepe transversim striatus. Cardinem distincte non vidi. Valvulae pectinatim plicatae rugis acutis."

A properly documented specimen of this well-known fossil oyster, which conforms closely to the very elaborate description, is present in the Linnaean collection and may be safely accepted as the type. No references were supplied by the author, although by a manuscript note he referred to Lister (1770, pl. 486) which he undoubtedly cited as the nearest approximation of the species available. It is only vaguely like *diluviana*.

Both Lamarck and d'Orbigny recognized the species from the description and redescribed it, although we do not know if either had seen the type. Lamarck's reference to "Lin. Gmel." is, however, preceded by a question mark, and he calls attention (1818-1819, vol. 6, pt. 1, p. 214) to the fact that his *diluviana* is found fossil in France, whereas Linnaeus reported it from Sweden. It occurs in the Cretaceous of both countries. It was for a long time considered to be confined to European horizons, but later specimens sent to the United States National Museum from the Cretaceous of Bell County, Texas,

<sup>2</sup> Lamy (1935a, p. 67), in his discussion of *Malleus vulgaris* (*Ostrea malleus* Linné), comments on this "white Hammer" of Chemnitz (fig. 656) as follows: "He [Lamarck] listed a variety 'b,' albida, with short ears, established on figure 656 from Chemnitz." Lamarck's variety "b" may possibly be the shell Chemnitz represented by the figure mentioned, although there is no hint in Lamarck's description of the gold color described and figured by Chemnitz. In any case it is not *Malleus albus*, which Lamarck described separately.

were found to be identical with the European fossil. C. A. White (1882-1883, p. 295), in commenting on the Texas specimens, says, "This shell has a toothed margin, and to some extent, also, the outline of *Alectryonia*, and it ought perhaps to be ranged under that genus." The most characteristic figures of the species are found in White's paper cited above (pl. 40, fig. 1, pl. 41, figs. 1-2). White also figures (pl. 43, figs. 1-4) a very closely related species, *O. carinata* Lamarck, 1819. The latter shell, which appears in the "Tableau encyclopédique" (1792, pl. 187, figs. 3-5) was confused with *diluviana* by the earlier writers, but a comparison of White's figures of the two, and also of the drawings in the "Tableau" where *diluviana* also is shown on the same plate (figs. 1-2) with the Linnaean species, is sufficient proof that the Linnaean shell is the *diluviana* of modern writers.<sup>1</sup>

Chemnitz described a shell which he called "Die fälschlich so genannte *Ostrea diluviana* Lin. *Ostrea falso sic dicta diluviana*" (1780-1795, vol. 8, p. 26). His description and figure (*tom cit.*, pl. 72, fig. 668) are sufficient to distinguish his shell, which he says is a Recent species from Chinese waters, from *diluviana* Linné. He gave no references for the "false" *diluviana*, and I am unable to recognize it.

White's tentative placement of the species *diluviana* Linné in the genus *Alectryonia* is probably sound. Recent commentators are not entirely agreed on either its identification or its generic position. Cragin (1893, p. 203) supplied no figure and apparently leaves the species in *Ostrea*, *sensu stricto*. Hill (1901) uses *Alectryonia* as a subgenus. He refers to the species in his text as "*Ostrea diluviana*," but his figure (1901, pl. 45, fig. 2), which is entitled "*Ostrea (Alectryonia) diluviana*," he attributes to Lamarck. This is possibly a *lapsus calami*, as I know of no other commentator who does not accept the name as of Linnaeus. Hill also places *O. carinata* Lamarck in subgenus *Alectryonia*. Deussen (1924, pl. 10, fig. 1, opp. p. 36) figures *diluviana* and calls it "*Ostrea sp. O. diluviana* L." Adkins (1928, p. 104) is even less confident of the identity of the Texas Cretaceous form with *diluviana* Linné, although he also puts it

in *Alectryonia*. He refers to it as "*Alectryonia sp. aff. diluviana* Linnaeus."

#### *Ostrea folium*

1758, *Systema naturae*, ed. 10, p. 699, no. 178.

1767, *Systema naturae*, ed. 12, p. 1148, no. 209.

LOCALITY: "Ad Jamaicaem" (1758, 1767).

"O. testa inaequali ovata lateribus obtuse plicata parasitica. . . . Valvula altera medio longitudinali adhaeret Gorgoniis. Cardio lacuna est, unde diversa a *Mytilis* parasiticis."

#### *Mytilus frons*

1758, *Systema naturae*, ed. 10, p. 704, no. 208.

1767, *Systema naturae*, ed. 12, p. 1155, no. 245.

LOCALITY: "In Pelagi Indici Gorgoniis" (1758, 1767).

"M. testa plicata laeviuscula, labro altero scabro. . . . Cardio absque lacuna, unde diversus ab *Ostrea folio*."

The above two species are considered together, not only because of their similarity, but because there has been a difference of opinion as to which name should be applied to the Pacific species and which to that of the western Atlantic.

The two species are much alike. They are both "Tree Oysters," clinging to the stems of mangroves or other intertidal plants, or to gorgonians, by means of two rows of shelly, hook-like processes which are produced on either side of the median line of the lower valve. In both species the edges of the valves are markedly plicate and interlock, as do the valves of *Ostrea cristagalli*. In both the stems to which they are attached not only produce a longitudinal depression in the lower valve, but this effect is transferred to the upper valve as well, probably because of the consequent displacement of the soft parts, resulting in a more or less well-marked and clearly delimited ridge on that valve. This central ridge, and the normal ribs of the shell diverging from it, undoubtedly gave the names *folium* and *frons* to the two species.

In 1781 Gronovius changed the locality of *folium* to "mari Americano" but did not list *frons*. Chemnitz cited both species, placing *folium* in the West Indies and the Moluccas (1780-1795, vol. 8, p. 21, pl. 71, figs. 662-666), and *frons*, which he moved to *Ostrea*, in the West Indies (*tom. cit.*, p. 61, pl. 75, fig. 686), Gmelin in 1791 definitely separated the localities of the two species, but completely reversed the localities given by Linnaeus, listing

<sup>1</sup> Hanley (1855, p. 114) reports Dillwyn as believing that the Lister figure cited by Linnaeus in manuscript was *O. carinata*. I have not been able to find any such statement in Dillwyn's works.

*folium* from "O. Indico" and *frons* from "Oceano Americano." These Gmelin localities have been generally used since that time, although occasional references occur in the literature which return to the original Linnaean disposition. Thus Cockerell (1894, p. 115), on the authority of E. A. Smith, reported *folium* from Jamaica. Smith was a careful student and being in London had access to the Linnaean collection which contains a specimen of *frons* but not of *folium*.

I have before me photographs of the specimen of *frons* in the Linnaean collection and photographs of the specimen of *folium* in the Queen's collection at Upsala (Museum Ulrica). The former, at least, are authoritative. I have also examined the specimens of both in the collections of the American Museum of Natural History and the United States National Museum, and one significant difference is to be noted. The Pacific species is consistently wider and more oval than the West Indian. The latter tends to a narrower shell in proportion to its length than the former. Likewise the ridge or keel on the upper valve of the Pacific shell is more pronounced and more strictly delimited than that feature in the West Indian shell. These differences are apparent in the figures from Chemnitz above referred to, as well as in the photographs of the ostensible types of each. The original descriptions of the two species are quite unlike, but two significant differences should be noted. The word "ovata" is used for *folium* and not for *frons*. The word "longitudinali," applying to the direction of adherence of the shell, is also used for *folium* and not for *frons*. The Pacific shell is always attached longitudinally to the stem, while the West Indian species is occasionally found attached transversely. I conclude therefore that Linnaeus was in error as to his localities; that the Pacific species is in fact *O. folium*, as most modern authors use the name; and that the West Indian shell is *O. frons*.

Both species belong in the subgenus *Lopha* Röding, 1798 (see the discussion as to the validity of this name, under *Mytilus crista-galli* below).

#### *Ostrea orbicularis*

1758, *Systema naturae*, ed. 10, p. 699, no. 179.  
1767, *Systema naturae*, ed. 12, p. 1148, no. 210.

LOCALITY: Not stated in either edition.

"O. testa orbiculata plana, margine integro crenato. . . Testa magnitudine extimi articuli pollicis, compresso-plana, margine obtusissimo crenato."

This species has not been identified. Not only is the description totally inadequate, but Linnaeus did not own the shell, and there is nothing in the collection that fits the description. The single figure cited ("Gualt. test. t. 104. f. G") answers to the description but is unrecognizable as a known species. Indeed, as Hanley says (1855, p. 115), it is a shell "the characters of which one could almost fancy were drawn up solely from Gualtier's figure." It was not included in the "Museum Ulrica."

Chemnitz (1780-1795, vol. 8, pp. 44-46, pl. 74, fig. 680) describes a shell which he calls "Corbiculus" and which he identifies with *orbicularis* Linné. He gives as references the Gualtieri figure cited above, the two editions of the "Systema," and three lesser known writers, the descriptions and figures of whom are not helpful. Chemnitz' own figure shows an orbicular brick-red shell, with wide, rounded ribs sculptured by wavy concentric imbrications. He says that it inhabits the East Indies and that ships returning from that region have their hulls fouled with these shells. Neither this figure nor the description of this habit of the species has led to any reasonable suggestion as to its identity. Indeed, the oyster figured is so markedly plicate as to point away from the Linnaean description of *orbicularis*, in spite of the words "margine crenato."

Schröter did not accept the figure as representing the Linnaean species. Hanley (1855, p. 115) merely suggested that it might be a variety of *Ostrea plicata* Chemnitz (*O. plicatula* Gmelin ?) which it greatly resembles. The most recent comment on *orbicularis* Linné is by Lamy (1929-1930, p. 85, footnote 3) who seems to admit that it was a plicate shell but agrees that it is unidentifiable. He says: "Fide Hanley . . . the *O. corbiculus* Chemnitz . . . is perhaps only a variety of this *O. plicata*, which possesses obvious plications; but in any case it is not, as Chemnitz believed, the *orbicularis* L. (1758, *Syst. Nat.* ed. 10, p. 699) which remains an insufficiently defined species."

The opinion of conchologists may best be

expressed by the following from Hanley (*loc. cit.*): “. . . I feel, with Dillwyn, that the *Ostrea orbicularis* must ever be included among the doubtful species of our author. For how can any member of a genus so polymorphous as *Ostrea*, be indisputably determined from a most meagre description and uncharacteristic figures.”

#### *Ostrea edulis*

1758, *Systema naturae*, ed. 10, p. 699, no. 180.

1767, *Systema naturae*, ed. 12, p. 1148, no. 211.

LOCALITY: “In Oceano Europaeo” (1758, 1767).

“O. testa inaequalvi semiorbiculata membranis imbricatis undulatis, valvula altera plana integerrima. . . . Frequentes in coenis Asotorum, vivae epulae. Ostreae recens natae celerrime natandi facultate gaudent undulato Branchiarum, tunc parum e testis exsertarum, motu, quod saepius vidit Cel. Baster. subs. v. 2. lib. 3. p. 146; idem de alia Concha Ledermullerus.”

The very name of this species, coupled with its stated locality, was sufficient for its recognition. A specimen of the European edible oyster is marked for it in the Linnaean collection. The references, though numerous, are uniformly bad, as are all of the pre-Linnaean figures of the shell. It is the *Ostreum vulgare* of Gualtieri and Lister.

In common with most of the oysters, *O. edulis* is extremely variable in form and in sculpture, as is stated above in the introduction to this group. Being a sedentary species, its shape is influenced by the nature and shape of the foreign body to which it is attached as well as by the ecologic conditions of its habitat, such as the temperature, turbulence or calmness and relative cleanliness of the water, and the character of the bottom. This variability has not only produced a host of specific names for geographical and ecological forms but has made it difficult at times to distinguish certain forms of *edulis* from other good species. Lamy (1929-1930, pp. 16-25) lists 15 varieties of the species in addition to what he calls the “typical” *edulis*. The latter he places on the European Atlantic coast from Norway to Portugal and adds that it does not occur in the Mediterranean. The named varieties are mostly Mediterranean forms, some of which are also found in the eastern Atlantic. *Ostrea*

*edulis* is the type of *Ostrea* Linné, by subsequent designation, Children, 1823.<sup>1</sup>

Because of this variability it is difficult to select a figure of the “typical” *edulis*. In general it has a rounded or oval shape; it is inequivalve, the lower valve being much larger and deeper and generally provided with radial plications, 20 to 30 in number, and with irregular concentric growth lines. The upper valve is smaller, flatter, and at times concave, without radial plications but with numerous concentric lamellae. The umbones are only slightly developed and may be directed centrally or inclined to the right or left. The hinge of the adult shell is edentate, although teeth exist in the embryonic state. The shell is coarse and thick.

Reeve (1843-1878, vol. 18, *Ostrea*, pl. 5, sp. 8a-f) gives a fair representation of the “typical” shell. Of the earlier illustrations Chemnitz' figure (1780-1795, vol. 8, pl. 74, fig. 682) is reasonably characteristic. Crouch (1826, pl. 17, fig. 8) shows an excellent figure, as does Sowerby (1820, 1825, 1834, vol. 1, pl. 120, fig. 1).

#### *Ostrea semiaurita*

1758, *Systema naturae*, ed. 10, p. 700, no. 181.

1767, *Systema naturae*, ed. 12, p. 1149, no. 212.

LOCALITY: “In O. meridionali” (1758, 1767).

“O. testa ovata semiaurita laevi, basi obliqua.”

This species, together with the three following, was designed by Linnaeus to be included in a new genus to be called *Perna* in his proposed “revised twelfth edition.”

The description is not sufficiently detailed to serve as a guide to identification, and there is no specimen in the collection which either is marked for it or satisfactorily answers to the few details of the description. Linnaeus did not own the shell at the time of the publication of the tenth edition but apparently acquired it later, as the name appears on the list of owned species interleaved in his own copy of the twelfth. Its present absence from the collection is unexplained.

<sup>1</sup> Stenzel (1947, p. 177) calls attention to the fact that Orton, in 1928, erected the subgenus *Monocciostrea* for *O. edulis*, but points out that as proposed the name is equivalent to *Ostrea*. Orton called it a “type subgenus.” It must therefore have the same type as *Ostrea* and, being an exact later synonym, is superfluous. Iredale, in 1939, designated *O. edulis* as the type of Orton's subgenus.



A fairly common subtropical western Atlantic shell is now suggested as the species that Linnaeus described as *semiaurita*. This is the *Perna bicolor* of C. B. Adams (1848, p. 9), described from Jamaica, which not only possesses the single lateral extension of the hinge line that might explain the name *semiaurita* but conforms to the few other details of the Linnaean description of that shell. The restoration of the Linnaean specific name is now accepted by some workers, but such action must be based on the single figure cited by Linnaeus (Gualtieri, pl. 84, fig. H), which is a recognizable drawing of Adams' *bicolor*, as there is nothing else in the Linnaean diagnosis that unequivocally points to this identification. The name *bicolor* was undoubtedly based on the fact that the exterior of the shell is horn-colored in the upper half, becoming much darker towards the lower margin. Likewise the interior possesses a sharply defined patch of brilliant iridescent blue, leaving the margin and the entire lower half of the interior horn-colored.

In his manuscript notes on *semiaurita* Linnaeus uses the expression "cardo ut sequentibus," and this note elicited an apparently meaningless comment from Hanley who said (1855, p. 117), "I fear, however, from the 'cardo ut sequentibus' of his manuscript that he had forgotten his own borrowed type." Not only do we not know that he ever had a borrowed type, but the following three species have, and are all described as having, a hinge provided with many parallel teeth. Thus the hinge of *O. perna* and *isognomon* is described as "cardines multoties sulcata" and that of *ephippium* as "cardine sulcis transversis." As the hinge of *bicolor* Adams can also be so described, Hanley's comment is not understood unless he conceived *semiaurita* to be something far different from *bicolor*. I believe that *bicolor* is Linnaeus' *semiaurita*, but, as it must be admitted that the identification is based on very weak grounds, I would question the advisability of restoring the Linnaean name.

The early writers were understandably confused as to this species. Chemnitz described a *Concha semiaurita* (1780-1795, vol. 7, pp. 250-252) for which he referred to *semiaurita* Linné, but supplied two figures, neither of which conforms either to the Linnaean

description or to *bicolor* Adams. The first (*tom. cit.*, pl. 59, fig. 579) seems to represent *Perna listeri* Hanley, 1843 [*Isognomon (Melina) listeri*], although Hanley himself (1855, p. 116) called the figure *Perna radiata* Anton, 1839 (*P. vulsella*, var. b Lamarck, 1819).<sup>1</sup> Chemnitz' second figure (pl. 59, fig. 580) is a very small and badly executed drawing which, by a stretch of the imagination, could be said vaguely to resemble *bicolor*. Schröter and Gmelin thought that Linnaeus was describing a *Crenatula*, a Lamarckian genus closely related to *Perna*. Deshayes believed that the Linnaean type was a *Meleagrina (Pinctada) Röding*, 1798). Chemnitz (*loc. cit.*) stated that his figure 580 was drawn from a West Indian shell which came from the Spengler collection, although Spengler called it *Ostrea perna* Linné. This locality is some confirmation of the identity of the species with *bicolor*.

By far the best figures of *bicolor* are the photographic reproductions of the inner and outer aspects of the type in the Adams collection in the Museum of Comparative Zoölogy, Cambridge (Clench and Turner, 1950, pl. 48, figs. 6-7).

Adams' *bicolor* must now be known as *Isognomon (Melina) bicolor*.

#### *Ostrea perna*

1767, *Systema naturae*, ed. 12, p. 1149, no. 213.

LOCALITY: "In Indiis" (1767).

"O. testa aequali obovata inaequali: hinc rotundiore cardine multoties sulcato. . . Testa facie Perna, subdiaphana, colore ligni putridi s. ferruginea."

This description is not sufficiently clear to provide an identification. The description of the hinge shows it to be an *Isognomon*, and the rest of the language relating to the shape and color merely suggests the *Isognomon perna* of modern writers. An unmarked specimen of that shell is found in the Linnaean collection, which Hanley called *Perna sulcata*. A figure of this specimen, which Hanley suggested might be the type of *perna* Linné, is reproduced by him (1855, pl. 2, fig. 7). He inserted this figure with the explanation that he did so (*op. cit.*, p. 118), "partly because I know of no characteristic delineation of it,

<sup>1</sup> See discussion of the next species, *Ostrea perna*.

partly because it is highly probable that such was really the object he [Linnaeus] wished to define." Hanley's figure is not convincing. It shows a shell of a pale tan color, with radial stripings of darker brown which may or may not indicate sulci. It is extremely oblique and has very sharply bent beaks. Except for its shape it recalls the figure used by Chemnitz for *semiaurita* (fig. 579) which I compared to *Isognomon listeri*.

I am not entirely satisfied that either the *I. perna* of authors or *Perna sulcata* Lamarck, 1819, which I conceive to be distinct, can be referred to the *Ostrea perna* of Linnaeus. As to *sulcata*, Lamarck's description contains the phrase "sulcis longitudinalibus, radiantibus" which does not fit either the shell we call *perna* Linné today or the Linnaean description of *Ostrea perna*. Moreover, *sulcata* is an inequivalve shell, which conflicts with the "aequivalvi" of the Linnaean description. Likewise the specimen in the collection, as figured by Hanley, has such a striking color pattern that Linnaeus' language "colore ligni putridi s. ferruginea" is scarcely descriptive of it. The figures referred to by Lamarck for *sulcata* all show a shell similar in shape to the *perna* of authors but again indicate what are either stripings of dark color or sulci; it is impossible to say which. In any case, they are such crude work that little can be deduced from them.

It is noteworthy that on the same page of Lamarck (1818-1819, vol. 6, pt. 1, p. 141) the author lists a *Perna vulsella*, whose variety "b" he describes as having "lineis coloratis longitudinalibus radiata." This language is strongly reminiscent of the color pattern of *I. listeri*, and the Chemnitz figure cited for the variety (1780-1795, vol. 7, pl. 59, fig. 579) is the figure Chemnitz used for *O. semiaurita* Linné, which was referred to above under that species as being probably meant for *listeri*. That Chemnitz himself was doubtful of his *semiaurita* is indicated by his footnote (*tom. cit.*, p. 251): "Let others decide whether or not this is *Ostrea perna* Linnaei." It is also to be noted that for typical *P. vulsella*, Lamarck used *Ostrea perna* Linné as a synonym, although with a query. It is possible that much of the confusion between *semiaurita* Linné, *perna* Linné, the *perna* of authors, and the two Lamarckian names has

been caused by Lamarck's own erroneous conception of these species.

The most recent comment on Linnaeus' *perna* is that of Iredale. He was unable to associate the species either with the *perna* of authors or with Lamarck's *sulcata*. He says (1939, p. 321): "Hanley . . . stated that this recalled *Perna sulcata* and gave a figure (pl. 2, fig. 7) of a shell from the Linnaean cabinet. His doubt as to the determination is rather inexplicable until the word 'aequivalvi' is considered, when it is remembered that the species *sulcata* is rather notably inequivalve. Chemnitz ('Syst. Conch. Cab.' (Chem.) 7, p. 249. 1784) drew attention to this when figuring a shell from Tranquebar (pl. 58, fig. 577) which is of the form which Pfeiffer determined as *marsupium* Lamarck. Chemnitz's figure had, however, been named *Isogonum marsupiale* by Bolten ('Mus. Bolt.', pt. 2, p. 168, Sept. 1798). This appears to be the name for *perna auct.*"

I am strongly inclined to agree with Iredale that the shell called *perna* today is the *marsupiale* of Röding (*P. marsupium* Lamarck) and that *perna* Linné is not identical with *P. sulcata* Lamarck and must be considered a *species dubius*. There is, however, weighty authority against this view. The United States National Museum accepts the Linnaean species as well defined and so labels its specimens of what I suggest are *I. marsupium* Lamarck. Abbott (1950, p. 93) also accepts *perna* Linné and lists it, without description, from the Cocos-Keeling Islands in the Indian Ocean. In any event the Linnaean species belongs in *Isognomon* "Solander" Humphrey, 1786, and in subgenus *Melina* Retzius, 1788, along with *I. semiaurita* (above) and *I. ephippium* (below).

#### *Ostrea isognomum*

1758, *Systema naturae*, ed. 10, p. 699, no. 176 (as *O. isognomum*).

1767, *Systema naturae*, ed. 12, p. 1149, no. 214 (as *O. isognomum*).

LOCALITY: Not given in 1758; "in Indiis" (1767).

"O. testa lobo laterali acutangulo, margine exteriori transverse sulcato" (1758); "O. testa aequivalvi lobo laterale majore, cardine multoties sulcata. . . Cardine cum sequenti convenit" (1767).

There is no question but that the two de-

scriptions refer to the same shell. That in the "Museum Ulricae" is, as usual, more detailed, refers to the tenth edition listing, and is entirely confirmatory.

Although no specimen of this shell was found in the Linnaean collection, it was at once identified by the clear description in the "Museum Ulricae" and by the references. It belongs in the typical subgenus of *Isognomon* "Solander" Humphrey, 1786 (Portland Catalogue), of which it is the type.

The original spelling of this specific name in the tenth edition was *isognomum*. In the "Museum Ulricae" (1764) Linnaeus amended it to *isognomon* and made a further change to *isognomum* in the twelfth edition. Possibly each of the later spellings was a *lapsus calami*.<sup>1</sup> Gmelin and Lamarck reverted to the spelling *isognomum* of the tenth edition, although *isognomon* is almost universally used today. The name was used generically even before Linnaeus, being spelled *Isognomon* by Klein (1753). Humphrey's use was the first valid proposal of the genus, however, and he continued the spelling *Isognomon*. There can, of course, be no question as to the validity of this spelling. Humphrey was erecting a new genus and could name it anything he chose, regardless of the various spellings of the species on which it was based.

The type of the genus is the Linnaean species, and it is commonly cited as *Ostrea isognomon* Linné, as that is the way Humphrey spelled it. Technically, however, under the Rule of Priority, the species should be called *isognomum*, as that was the original form in 1758. In stating that the type is one by absolute tautonymy, as is usually done, we are therefore not technically correct. When the species is correctly described as *Isognomon isognomum*, it is at best the type by virtual tautonymy only.

A further complication arose from the fact that two spellings of the generic name were used in the Portland Catalogue—*Isognomon* and *Isognoma*. Although the latter spelling occurs first, all authors have used the other spelling, both before and after Humphrey.

<sup>1</sup> It is to be noted, however, that the source from which Linnaeus drew the name (Klein) used the spelling *isognomon*, so that it was the tenth-edition spelling which was the *lapsus calami*, unless Linnaeus changed Klein's spelling deliberately.

Dall, Bartsch, and Rehder (1938, p. 61–62) consider *Isognomon* the original form and the other a misspelling, and the reasons on which their opinion is based are adopted here.

The species is figured by Reeve (1843–1878, vol. 11, *Perna*, pl. 5, sp. 24) as *Perna isognomon*. Reeve also figured a *Perna marsupium*, from an unknown locality (*tom. cit.*, pl. 3, sp. 15) which Iredale (1939, p. 320) believes to be the true *O. isognomum*. It is described by Reeve as "a dark colored shell with a fairly long anterior wing." The Chemnitz figure of *isognomum* (1780–1795, vol. 7, pl. 59, fig. 584) is somewhat stylized and shows an exaggerated anterior wing.

#### *Ostrea ephippium*

1758, *Systema naturae*, ed. 10, p. 700, no. 182.

1767, *Systema naturae*, ed. 12, p. 1149, no. 215.

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

"O. testa aequivalvi orbiculata compresso-membranacea, cardine sulcis transversis pluribus. . . Testa compressa ut vix cavitas appareat, extus rudis fusca, distinctissima ab *Anomia Ephippio* et *Placenta*."

The description of this species in the "Museum Ulricae" is more detailed, but it is scarcely necessary to refer to it as the "Systema" description is too clear to admit of doubt. Only one defect is found in the "Museum Ulricae." There eight grooves are mentioned in the hinge, whereas most specimens of *ephippium* show 14 to 16. It is not clear why Linnaeus thought it necessary to distinguish the species from the two *Anomia*.

The name does not appear on either list of the contents of Linnaeus' cabinet, but subsequent writers had no difficulty in identifying it with the common Pacific *ephippium*. It belongs in *Isognomon* "Solander" Humphrey, as do the three preceding species, and falls in the subgenus *Melina* Retzius, 1788, of which it is the type, by subsequent designation, Herrmannsen, 1847. In the shape of the shell, its marked compression, and its rough flaky exterior, it is very close to its western Atlantic congener *Isognomon (Melina) alatum* Gmelin, with which it has often, and until a comparatively recent date, been confused by certain writers. Reeve, for instance, transferred the name *ephippium* to a shell from Honduras, which was clearly *alatum* (1843–1878, vol. 11, *Perna*, pl. 2, sp. 8), while he

called the Pacific shell *Perna cumingi* (*tom. cit.*, pl. 1, sp. 3). The confusion stemmed from the fact that Gmelin put *ephippium* Linné in the synonymy of his *O. alata*, a species which he reported as being "rara in Oceano Americano."

Good figures are found in Crouch (1826, pl. 4, fig. 6), and in Sowerby (1820, 1825, 1834, vol. 1, pl. 106, fig. 2). The Chemnitz figure (1780-1795, vol. 7, pl. 58, fig. 576) is well drawn and characteristic.

#### *Ostrea pes-lutrae*

1771, *Mantissa plantarum, regni animalis appendix*, p. 547.

LOCALITY: Not given.

"Testa aequivalvi inauri cuneata, plicis senis obtusis. . . . Testa obovato-cuneata, purpurascenti pallidoque variegata, longitudinaliter subtilissime striata, plicata: plicis sex (praeter laterales solitarios breviores), aequaliter distantes, apice prominentes. Margines laterales assurgentes versus cavitatem, quasi plica minore. Auriculae vix ullae s. altera minuta."

The identification of this species was effected only in comparatively recent times. It is probably identical with *Pecten septemradiatus* Müller, 1776, and though that shell is fairly common in northern European waters it was given several specific names by the early conchologists, who did not associate it with *pes-lutrae* Linné. Gmelin's *Ostrea hybrida* is probably identical, as is Lamarck's *Pecten aspersus* (1818-1819, vol. 6, pt. 1, p. 167), although Lamarck suggested in another place that *pes-lutrae* was close to his *P. quadriradiatus*, a shell which he obtained from Péron's Australian voyage, but for which he gave no locality and no references. He said of the latter species (*tom. cit.*, p. 173): "It is close to *Ostrea pes-lutrae*, Lin. Gmel. no. 132; but has small rounded ears, which are almost equal." The *Pecten danicus* of Chemnitz (1780-1795, vol. 11, p. 265, pl. 207, fig. 2043) has also been identified with the *septemradiatus* complex as has *P. clavatus* Poli, 1795. Gmelin referred to the same figures for *pes-lutrae* and for *Ostrea plica* Linné, and it was this fact which (*vide* Hanley, 1855, p. 455) possibly led Dillwyn to conclude that Linnaeus had based the description of *pes-lutrae* on a worn example of *plica*. Jeffrey (1863, pp. 63-64), was the first

to unite all these names under *P. septemradiatus* Müller, although he did not associate that species with the Linnaean *pes-lutrae*. He pointed out that it was plentiful on the coast of Scotland, and continued: "It is extremely variable in respect of shape and the number of ribs, as well as the proportionate size of the ears. . . . A dozen names have been given by different conchologists to this species. If the authority of O. F. Müller, the original discoverer, were at all questionable, Gmelin's name of *hybridus* would have priority over that of *Danicus*, which was proposed by Chemnitz nineteen years after the publication of the *Prodromus* to the 'Zoologica Danica.'"

Chemnitz' conception of *danicus* was not that proposed by Jeffreys. He (*tom. cit.*, p. 265) tentatively referred *danicus* to *O. plica* Linné, as did Dillwyn, saying: "The ears are almost equal and the hinge is like that of the other *Pecten*. Linnaeus would have taken this species for a close relative of his *Ostrea plica*." Chemnitz' figure shows a shell with five narrow, angular ribs and wide concave interspaces, the color being a pale tan, thickly flecked with brown. It is described as having five or six angular ribs on the upper valve and six ribs, with obtuse striations, on the lower valve.

Hanley (*loc. cit.*) called attention to the fact that some specimens of *P. danicus* Chemnitz, with mutilated ears, are in the Linnaean collection, and that they correspond "fairly enough" with the description of *pes-lutrae*. With the exception of Lamarck's comment, already quoted, this is the first mention of the *septemradiatus-danicus* complex in connection with the species under discussion.

Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, p. 68) in their discussion of *Pecten clavatus* Poli, 1795, distinguished that species from *septemradiatus* Müller, which latter name they refer to *pes-lutrae* with a query. The Linnaean name appears in the synonymy of *clavatus* as a questionable synonym, along with what they designate as "*septemradiatus* Müller var. *Dumasi* Payraudeau, as of Jeffreys, 1863." They say (*loc. cit.*): "Many authors have confused the *P. clavatus* with a northern European species *P. septemradiatus* Müller, which is nevertheless distinct. *P. septemradiatus* is larger, thinner, more rounded

and more equivalve than *P. clavatus*. . . . The *Ostrea pes-lutrae* Linné (Mantissa) is a very doubtful species, and was probably based, according to Hanley, on specimens of *P. septemradiatus* with mutilated ears." Although these authors, in the text, do not accept *pes-lutrae* as a well-defined species, they do cite it as a good species in an Appendix which lists all shells found in the Mediterranean although not reported from the Rousillon area, and in this they are followed by Bavay (1936, p. 316) who uses it as a synonym of *septemradiatus* Müller.

The United States National Museum has accepted the name *pes-lutrae* for this very protean species and has so labeled its very extensive series of specimens. An examination of this series shows its extreme variability, as Jeffreys (*loc. cit.*) has noted, and there are present many individuals which conform closely to the figure of *P. danicus* in Chemnitz. This wide range of variability in color, number of ribs, and degree of angularity of the ribs, together with the fact that Linnaeus probably had a worn specimen, explains in great measure the difference in the figures of the species and in the description of Linnaeus, Müller, Gmelin, Chemnitz, and the later writers. I think it very probable that Linnaeus had before him one of the many forms of *septemradiatus*, probably the worn valves of *danicus* which Hanley mentioned. In the light, however, of the unsatisfactory description in the "Mantissa" and the lack of any authoritative type, I hesitate to use the Linnaean name and suggest that *septemradiatus* be revived, even though the name itself is not an apt one for those forms that have only five or six ribs as required by the Linnaean description. The species is an exclusively northern European one, and the Mediterranean shell, which is figured by Bucquoy, Dautzenberg, and Dollfus (*tom. cit.*, vol. 2, atlas, pl. 16, figs. 10-17),<sup>1</sup> must take another

<sup>1</sup> Figures 10 and 11 in this plate show the "typical" *clavatus* from the French Atlantic coast; figures 12 to 16 are Mediterranean forms which these authors call *inflexa* Poli and *dumasii* Payraudeau; figure 17 is *dumasii* from the Gulf of Gascony (Atlantic). The similarity of all of these forms, as depicted in the photographs, is striking except as to color and color pattern. The authors state that the photograph of *clavatus*, "typical," was of a juvenile shell, and that that of *inflexa* was an adult specimen, as were apparently the others.

name. The earliest is *P. clavatus* Poli, 1795, as used by these authors. The figures which Linnaeus cited in the "Mantissa" from Gualtieri, Argenville, and Lister are unsatisfactory. The first might represent *clavatus* Poli or *flexuosus* Poli. The second shows a shell with eight ribs and with such narrow interspaces that the ribs are practically contiguous. The third might be any of the sparsely ribbed species of *Pecten*.

By whatever name the Mediterranean shell should be called, it probably belongs in the genus *Flexopecten* Sacco, 1897, type *P. flexuosus* Poli, 1795, with *P. glaber* (Linné). Sacco listed the latter species in his genus. He did not mention *pes-lutrae*.

#### ANOMIA LINNÉ

Of the 28 names comprising *Anomia* Linné (including one in the "Mantissa") only seven are mollusks, the remainder consisting of 20 brachiopods, and one, the *Anomia sandalium* of the "Mantissa," an object that has been identified as a fossil coral. Four of the seven molluscan names must be united under a single species (*Anomia ephippium*). Of the other three, *A. gryphus* is an oyster, *A. placenta* is now *Placuna placenta*, and *A. patelliformis* is a dubious species which may be (*vide* Dall) the common *A. simplex* of the western Atlantic.

Linnaeus and his contemporaries and immediate followers believed that the species now included in the Brachiopoda were mollusks because of their calcareous bivalve shell. The existence of the byssal plug or peduncle<sup>2</sup> was taken by them to be a mere modification of the fibrous byssus found in many genera of bivalve pelecypods, and the presence of the foramen in the lower valve but a development of the auricular sinus in *Pecten* and other molluscan genera, through which the byssus passes. It was not until the publication of the "Zoologie analytique" of Duméril (1806, p. 170) that the name Brachiopoda appeared, although that author still considered the group to constitute the fifth order of the Mollusca. Owen, Deshayes, and Agassiz thought that *Anomia* was the con-

<sup>2</sup> Recent brachiopods all have the byssal plug and are attached during their entire life span, but among the fossil species there are many that lost it in the adult stage and became free swimming.

necting link between the lamellibranchs and the brachiopods. The first statement that I can find which definitely proposed that the brachiopods had no biological affinity of any kind with the mollusks is a short comment by Steenstrup (1848, pp. 74-75).

Since Steenstrup it has been agreed by most zoologists that the Brachiopoda should be placed in a separate category from the Mollusca, but their exact systematic position has been variously conceived. Morse (1873, pp. 315-372) and Kovalevski (1874, pp. 1-40) came independently to the conclusion that their affinity was with the annelid worms rather than with the Mollusca or any of the other categories suggested by their predecessors. Brooks (1878, pp. 78-107) considered them to be polyzoons. Huxley (1881, p. 402, footnote) put them in the Molluscoidea, a phylum (or subkingdom) erected by Milne-Edwards to include Bryozoa and Tunicata. Although there is no agreement on the subject today, Pratt (1935, p. 312) states his opinion that the Brachiopoda fall in the Bryozoa, while admitting that their affinities are still obscure.

As to the molluscan genus *Anomia*, the closest affinity of the group is with *Pecten*. The foramen in the lower valve is a demonstrable modification of the byssal gap in that genus, a modification which, although it appears profound, loses much of its significance when it is found, as Morse proved, that it begins in the embryonic or very young shell, as a mere open sinus on the edge of the valve (Morse, 1871, p. 151, figs. 1-6). The solidified byssal plug in *Anomia* begins, in the young shell, as a true fibrous byssus.

The brachiopods are one of the oldest invertebrate groups. Many families had already appeared in the Cambrian, and they reached their greatest development in the Ordovician. In Mesozoic time they had become far less numerous, and it may be said that, in comparison to their former greatness, they are almost extinct today. The genus *Anomia*, on the other hand, did not appear until the Jurassic era and has never reached in the past the development that it shows today, either in diversity of species or in the size of populations.

The worker must be cautioned against placing too much reliance on the sculpture

of the lower valve in *Anomia*. There are species that are normally ribbed on both valves. In these species the ribbing is always radial and never transverse or concentric. On the other hand, there are species like *A. ephippium* Linné, most of the forms of which are normally smooth, and *A. simplex* d'Orbigny, of which all forms are normally smooth, which show in some specimens a sculpture that is not produced by the normal growth of the shell but is adventitiously acquired through the adherence of the individual to a foreign body having ribs, such as one of the strongly costate pectens. The *Anomia* in question may show ribs which are radial or concentric or disposed at any angle depending on the angle at which it lies on the ribbed object. It is often noted in these cases that the upper valve, which would be normally smooth, also bears more or less marked sculpture corresponding to that on the lower valve. I know of no explanation of this, unless it be that a distortion or misplacement of the soft parts, caused by the inequalities of the surface of the foreign body, influences the upper valve as well.

In the following pages only the mollusks in *Anomia* Linné are discussed, although the brachiopods are to be found listed alphabetically in the Locator Index, as is also the species *Anomia sandalium* of the "Mantissa" which is referred by paleontologists to a fossil coral, *Calceola sandalina*.

#### *Anomia ephippium*

1758, Systema naturae, ed. 10, p. 701, no. 185.

1767, Systema naturae, ed. 12, p. 1150, no. 218.

LOCALITY: "In M. Mediterraneo et America" (1758); "in M. Mediterraneo et Americano" (1767).

"A. testa suborbiculata rugoso-plicata: planiore perforata. . . . Testa alba, magnitudine volae, intus argentea-nitidissima; utraque valvula saepe plicis quinque longitudinalibus, nec ad cardinem concurrentibus. Planior testa magno foramine."

The identification of this abundant European species has never been in doubt, although several specific names have been allotted to its many forms. It is an extremely variable species, its variability being due partly to its sedentary and gregarious habit and partly to its wide dispersion in waters of a great range of temperature. It is found from

Iceland and the Shetland Islands to the north coast of Africa, and throughout the Mediterranean. The Linnaean description is adequately characteristic; the pictorial synonymy is entirely correct, and a documented specimen of the *A. ehippium* of all European authors is preserved in the Linnaean collection.

The three following species in the "Systema" represent varieties of *ehippium*, and it is hardly to be wondered at that the author conceived them to be separable, as this truly polymorphic species varies in shape, color, the smoothness or rugosity of its upper valve, and most significantly in the weight and sturdiness of the shell. As do the oysters and other fixed species, it assumes different shapes according to the contour and sculpture of the object to which it is attached. The form to which Linnaeus gave the name *ehippium* is that common on the west coast of France. The shell of this variety is thick, as large as the palm of the hand ("magnitudinae volae"), and often of a flaky texture and with a nacreous, silvery interior. This form, as do all the other varieties, differs in texture in the various growth stages, in the depth at which it lives, and from other ecologic factors.

The locality "M. Americano" given by Linnaeus in addition to the correct Mediterranean locality was the cause of an error, for the persistence of which the early American conchologists were responsible. A common American *Anomia* was for many years considered by them to be identical with the European *ehippium* and was commonly so called. D'Orbigny (1845, p. 371)<sup>1</sup> recognized that the forms from the two regions were specifically distinct and named the American form *Anomia simplex*. It is well recognized today that *ehippium* is restricted to European waters. As late as 1870, however, the Linnaean name was used for the New England shell by Binney (p. 204). Verrill (1872, p. 288), while he recognized the distinction between the European and American shells, renamed the latter *A. glabra*, passing over the earlier d'Orbigny name, possibly because he was unfamiliar with the de la Sagra work. Verrill's

<sup>1</sup> The fifth volume of de la Sagra's work is dated 1845, but on page 371 d'Orbigny lists *Anomia simplex* as "d'Orbigny, 1846."

name was current in this country for many years, and as late as 1902 H. F. Carpenter used it (1901-1902, pp. 130-131), giving as a synonym "*A. ehippium* Gld. (Binney's) non Linné" but failing to cite the name *simplex*. He said (*loc. cit.*): "The *Anomia ehippium* of Linnaeus is a very common European shell, and the great naturalist was deceived in our American shell, supposing it to be the same species, and called it by the same name, giving as its habitat, Pennsylvania. All authors since have known it under that name, even down to Dall's revision of the Mollusca of Mass., Mar. 16, 1870,<sup>2</sup> but Prof. A. E. Verrill has shown it to be a distinct species and named it *Anomia glabra*, V., Am. Jour. Sci. iii, 213, 1872."

The Chemnitz figures (1780-1795, vol. 8, p. 81, pl. 76, figs. 692-693) represent very accurately one form of the shell, but no figure of a single specimen can adequately illustrate the species.

Both *ehippium* and *simplex* have many synonyms. In addition to the three Linnaean synonyms (discussed under those names below) forms of the European shell have been called *A. punctata* Chemnitz, 1785; *flexuosa*, *rugosa*, and *cylindrica* Gmelin, 1791; *margaritacea*, *sulcata*, and *pectiniformis* Poli, 1795; *cymbiformis* Maton and Rackett, 1807; *violacea* and *striatula* Bruguière, 1789; *polymorpha* and *scabrella* Philippi, 1836; *striolata* and *tubularis* Turton, 1822; and *coronata* Bean, 1835. In addition to *A. glabra* Verrill, the American species has taken the Linnaean names *electrica* and *squamula* for two of its forms, and (*vide* Dall's label in the United States National Museum) a specimen from the northern end of its range is called *A. patelliformis* Linné.

Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, atlas, pls. 7-9) figure many forms of the European *ehippium*, including the "typical" *ehippium* and *patellaris* Lamarck, and *cepa*, *electrica*, and *squamula* Linné. There are few good figures of the American *simplex*.

<sup>2</sup> Dall's paper was read March 16, 1870, but not published until 1871 (1871, pp. 240-257). Although he there (*ibid.*, p. 254) called the American shell *A. ehippium* Linné, he later corrected this error (1899, p. 32), citing it as *A. simplex* d'Orbigny. He did not mention Verrill's *glabra*, which is now thrown into the synonymy of *A. simplex*.

The most characteristic are the drawings in Dall (1889, pl. 53, figs. 1-2). D'Orbigny's figures (1845, atlas to vol. 5, pl. 28, figs. 31-33) are fair.

Linnaeus' *A. ephippium* is the type of *Anomia* Linné, by subsequent designation, Children, 1823. The type is a rounded, thick, uniformly white shell with no ribs. This form is represented by a specimen in the Linnaean collection which bears a very close resemblance to the shell pictured by Mawe (1832, p. 65, pl. 15, fig. 6). The lower valve, the one shown in Mawe's drawing, shows no ribs but seems to be imbricated by irregularly disposed flutings, giving it a flaky appearance.

#### *Anomia cepa*

1758, *Systema naturae*, ed. 10, p. 701, no. 186.

1767, *Systema naturae*, ed. 12, p. 1151, no. 219.

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

"A. testa obovata inaequali violacea: superiore convexa, inferiore perforata. . . Magnitudine Nucis Juglandis, sed altera testa plana."

This species, with the two following, are now considered to be conspecific with *ephippium* as either growth stages or varieties. The latter species varies considerably throughout its wide range from the Shetland Islands to the eastern Mediterranean in size, sculpture, color, and structure, and this has been responsible not only for the four specific names in the "Systema" but for others proposed by later authors. In structure it varies from fragile, semi-transparent forms to the heavy, dense, and coarse shells of northern waters. In the sculpture of the upper valve we find ribbed forms, such as the shell described by Linnaeus as *ephippium*, and the smooth forms called by him *electrica* and *squamula*.

The variety *cepa* is distinguished by its small size, smooth upper valve, and generally oval outline with a broadening of the base and a thinner structure. The word "violacea" in the description reflects the brownish violet exterior and the clearer violet of the interior of the shell, and Bruguière in fact proposed the specific name *violacea*. The only material difference in the original descriptions of *ephippium* and *cepa* illustrates two of these distinguishing features, "rugoso-plicata" for the first and "violacea" for the second. *A. cepa* is a Mediterranean form, as Linnaeus noted.

Specimens of the upper valve of the species are in the collection, properly marked.

#### *Anomia electrica*

1758, *Systema naturae*, ed. 10, p. 701, no. 187.

1767, *Systema naturae*, ed. 12, p. 1151, no. 220.

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

"A. testa subrotunda flava laevi: altera convexo-gibbosa."

This shell was called *electrica* for many years, but it is now acknowledged to be only a variety of *ephippium*. It is distinguished by its small size, smooth orbicular shell, and yellow color. The examples of the shell in the Linnaean collection are in a box properly marked with the name *electrica* and conform to the figure which Chemnitz supplied for the species (1780-1795, vol. 8, p. 79, pl. 76, fig. 691).

As is said in the discussion of *A. ephippium*, that species, or a form of it, was formerly considered to be common on the New England coast, but the American writers had confused it with *Anomia simplex* d'Orbigny (*A. glabra* Verrill), a purely American shell. This error may have originally stemmed from the American locality which Linnaeus added to his Mediterranean "habitat" in the "Systema." In addition to the supposed *ephippium*, the American writers listed an *electrica* Linné, an orbicular yellow shell with a variably convex upper valve and a *squamula* Linné, an oblong-oval and somewhat oblique white form. It is hardly surprising that the American writers confused the yellow shell with the yellow form of the European *ephippium*, but it is agreed today that all the names mentioned can be referred to the very polymorphous *Anomia simplex* d'Orbigny, just as the European varietal names are referred to the *A. ephippium* of the "Systema." Chemnitz followed Linnaeus' error in placing *ephippium* in the "East and West Indies" but gave no western Atlantic locality for *electrica* or *squamula*, although he also reported *cepa* from the West Indies. Binney (1870, p. 206), although he listed *ephippium* as a good New England species, said of *electrica* and *squamula* that they were "not positively made out." Under *electrica* (*op. cit.*, p. 205) he also admitted: "This species is very common at Newport. I suppose it to be the *electrica*." He does not figure the supposed *squamula*, but for



*electrica* he gives (*loc. cit.*) an excellent line drawing of *Anomia simplex*.

Figures of the Linnaean varieties are scarce. The Chemnitz figure of *electrica* (cited above) is reasonably characteristic and was used as a reference by Lamarck for his species of the same name (1818-1819, vol. 6, pt. 1, p. 227).

#### *Anomia squamula*

1758, *Systema naturae*, ed. 10, p. 701, no. 188.

1767, *Systema naturae*, ed. 12, p. 1151, no. 221.

LOCALITY: "In Oceano Svecico super Cancros, Fucos" (1758, 1767).

"A testa orbiculata integerrima plana margine altera gibba laevi."

This is also a form of the European *ephippium*, and both it and the supposed American *electrica* are discussed under the previous species. Linnaeus reported the name in the list of his collection, and specimens are found in his cabinet which are the only shells present that agree with the description. These specimens are juvenile examples of the northern form of *ephippium*.

That Linnaeus was suspicious of the specific separability of the last four names is shown by the following manuscript note in his own copy of the "Systema": "Hae tres, *cepa*, *electrica*, *squamula*, an varietates."

Chemnitz' figure for *squamula* (1780-1795, vol. 8, p. 86, pl. 77, fig. 676) is reasonably characteristic although lacking in detail.

#### *Anomia patelliformis*

1767, *Systema naturae*, ed. 12, p. 1151, no. 222.

LOCALITY: "In Oceano Norvegico" (1767).

"A. testa ovata convexa subdiaphana striata, vertice postico recurvo laevi."

This description, in common with most of the descriptions in *Anomia* Linné, is too brief and in this case is not clear except that we are told that it is a striated, diaphanous form. Chemnitz (1780-1795, vol. 8, p. 89, pl. 77, fig. 700) described an *Anomia patelliformis* in terms which are not too discordant with the "Systema" description and attributed the name to Linnaeus. His figure, however, shows both valves of a shell which is patently an *Anomia*, closely ribbed above and below and subtriangular in outline. The figure shows no feature that accords with Linnaeus' phrase "vertice postico recurvo." From its sculpture and outline it suggests some of the trigonal *Cardium* species, and indeed Chemnitz said of

it (*loc. cit.*): "Anyone who might examine this *Anomia* without having the other pierced valve at hand might think that the single valve was either a *Cardium* or a *Patella*. If it were only somewhat smaller and longer it would be very much like a *Patella*." The figure bears not the slightest resemblance to a *Patella*, and, unless Linnaeus' *patelliformis* was a different shell, one wonders at his choice of the specific name. This is one of the few cases in the "Systema" where a descriptive specific name becomes a handicap rather than a help to identification. Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, p. 36) comment on the Chemnitz species: "*A. patelliformis* Linnæi of Chemnitz (1785, *Conch. Cab.* 8, p. 89, pl. 77, fig. 700) is not *patelliformis* Linné but the variety *radiata* Brocchi (= *sulcata* Poli) of *A. ephippium*. The figures 700 of the Conchylien Cabinet have been reproduced in the Encyclopédie, pl. 171, figs. 18-19, and Bory de St. Vincent (1824, *Encyc. Meth. Vers.*, vol. 10, p. 145) gives them the name of *A. pecten* Valenciennes." These authors apparently had no difficulty in recognizing Linnaeus' *patelliformis* and placed it in the genus *Monia* Gray, 1849, saying (*tom. cit.*, p. 41): "Its sculpture, consisting of numerous radial ribs more or less imbricate, is constant, whatever be the nature of the body on which the *Anomia* is growing." I quite agree that Chemnitz' species is not *patelliformis* Linné. The shell figured by Bucquoy, Dautzenberg, and Dollfus (*tom. cit.*, pl. 9, figs. 1-2) as *patelliformis* Linné looks much like a form of *ephippium*, but its upper valve shows low radial ribs. The lower valve shows none. These authors also say (*tom. cit.*, p. 42): "*A. patelliformis* is distinguished from *A. ephippium* by the number of muscular impressions of the left valve, which are only two, by its sculpture which is constant no matter what is the nature of the body on which it lies. . . ." They describe the sculpture of the left valve as being made up of numerous radiating ribs, more or less imbricate; the right valve is flat, thin, and fragile, without radial sculpture.

A single specimen labeled *A. patelliformis* Linné, an upper valve numbered 360096, is in the collection of the United States National Museum. Its locality is "Fasca floi" [*sic*, ?Faxa Floi] Iceland, and on the synonymic list in the tray containing it, in Dall's writing,

it is said to be a variety of *A. ephippium* Linné. It is radially ribbed over the lower two-thirds, the umbonal third being smooth, with a fairly sharp demarcation between the ribbed and smooth portions. This is the only specimen labeled with this name that I have been able to find. It resembles very closely the figures supplied by Bucquoy, Dautzenberg, and Dollfus, and I am willing to conclude that it is the *patelliformis* of Linnaeus and that it is a variety of *A. ephippium*. The valve is too worn for the number of muscular impressions to be determined.

#### *Anomia gryphus*

1758, *Systema naturae*, ed. 10, p. 701, no. 192.

1767, *Systema naturae*, ed. 12, p. 1151, no. 226.

LOCALITY: "Fossilis" (1758, 1767).

"A. testa oblonga laevi: altera plica laterali obsoleta: nate incurvata: altera brevi planiuscula."

This species is represented in the Linnaean collection by a fossil oyster bearing the number 192, the number of *A. gryphus* in the tenth edition of the "Systema." Linnaeus may have discovered his error in including *gryphus* among the *Anomia*, as there is a manuscript note to the species in his copy of the "Systema" reading "sed cardo Ostreae." The type specimen in the collection, although worn, was identified by three of Hanley's contemporaries, Sharpe, Salter, and Davidson, as *Gryphaea obliquata* Sowerby (1812-1829, vol. 2, pl. 112, fig. 3).<sup>1</sup>

The genus *Gryphaea* was erected by Lamarck in 1801 (pp. 398-399). He did not list a *Gryphaea gryphus*, and none of his species seems to be based on it. There has been some discussion as to the type of the genus. It was erected with nine original species. Three of these are *nomina nuda*, as they were not accompanied by "an indication, or a definition, or a description," as required by Article 25 of the Rules. The remaining six names are supplied with a bibliographic reference or references, thus fulfilling the requirements of an "indication" within the terms of Opinion 1. Anton (1838-1839, p. 21) designated *G. arcuata* Lamarck as type, one of the original valid

species. The priority of this selection is upheld by most conchologists, the most recent being Stenzel in his excellent synopsis of the supraspecific groups in Ostracidae (1947, p. 174). Children (1823, vol. 15, p. 43) had already designated *G. angulata* Lamarck, but the latter was one of Lamarck's invalidly proposed original species and was therefore clearly a *nomen nudum*. Ranson (1948, pp. 514-516) urged the acceptance of Children's 1823 designation of *G. angulata* Lamarck, apparently on the assumption that we must consider Children as having chosen the *angulata* of Lamarck, 1819 (the first valid publication of that name), as he has recently formulated an application to the International Commission on Zoological Nomenclature requesting the Commission, under its plenary powers, to rule that *Gryphaea* should rank from Lamarck, 1819 (vol. 6, pt. 1, p. 197), rather than from Lamarck, 1801; that the latter use of the name should be suppressed; and that the type species should be *G. angulata* Lamarck, 1819. This application is fully discussed by Hemming (1951, pp. 239-240) who points out the two alternatives presented to the Commission in making its decision. It is difficult for this writer to follow the logic of Ranson's views.

The description of *Anomia gryphus* in the "Systema" is brief and might conceivably be read to cover *G. obliquata* Sowerby or *G. arcuata* Lamarck, as the words "nate incurvata" would apply equally to the moderate incurving of the beaks in *obliquata* or to their more pronounced inward flexure in *arcuata* (the *incurva* of Sowerby, *tom. cit.*, vol. 2, pl. 112, figs. 1-2). The marked specimen of the former in the Linnaean collection should, however, be conclusive, and I would recommend the restoration of the Linnaean specific name *gryphus*, as none of the later names can be said to be fixed in the literature.

#### *Anomia placenta*

1758, *Systema naturae*, ed. 10, p. 703, no. 205.

1767, *Systema naturae*, ed. 12, p. 1154, no. 241.

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

"A. testa orbiculata plana pellucida, cardinum callis linearibus binis testae interne adnatis. . . Cardio rufescens. Valvulae aequales integrae."

The subdescription was added in the twelfth edition. The main description, with its graphic and characteristic language cover-

<sup>1</sup> Hanley was not a paleontologist, was not a student of the brachiopods, and was accustomed to call upon Sharpe, Salter, or Davidson for assistance in the identification of the fossil brachiopods in the Linnaean collection. This is the only instance in which he consulted these writers in the identification of a fossil mollusk.

ing the peculiar hinge, is amply sufficient to identify the species as a member of the genus *Placuna* "Solander" Humphrey, 1786. Solander's use of the name has three years' priority over *Placuna* Bruguière, 1789<sup>1</sup> and two years' priority over *Placenta* Retzius, 1788, which latter name was in use for many years.

Based on the references of Linnaeus, *Anomia placenta* is a composite species. The Gualtieri figure (pl. 104, fig. B) shows *A. papyracea* Lamarck, 1819; the several figures on the Seba plate (vol. 3, pl. 90), all of which were referred to, show not only *A. placenta* but *A. papyracea* and *A. sella* Gmelin, 1791; the reference to Lister ("1685-1692, 3. B. s. 2. c. 2. t. 1") shows a shell somewhat resembling *placenta*, but with certain features of *papyracea*. The description of *placenta* in "Museum Ulricae" clears up any doubt that might be caused by this discordant synonymy by calling attention to the marked difference in the length of the anterior and posterior teeth, and the fact that their apices are deflected posteriorly. The latter is a diagnostic character of the species, and there is no doubt that Linnaeus, in the latter work, had before him the same species he described in the "Systema." He thus confirmed, if confirmation were necessary, the restriction of the 1758 name to the shell that has always been known as *placenta*, a specimen of which, adequately documented, is in his cabinet.

The words "Cardo rufescens" in the sub-description in the twelfth edition are meaningless and inaccurate as applied to this species.

Of the three species confounded in the synonymy, only *placenta* can be called orbicular, both *papyracea* and *sella* being markedly

<sup>1</sup> The genus *Placuna* was not described by Bruguière in the text of volume 1 of the "Histoire naturelle des vers" (1789, 1792) as that volume, the only one from his pen, covered only the genera in alphabetical order through *Comus*. Accordingly *Placuna* has been usually cited as of Lamarck, 1799, which was long considered as the first valid proposal of the name (and recently as of Bruguière, 1792, since the unpublished Opinion of the Commission validating the Bruguière plate headings has been brought to the attention of conchologists). However, in the Index (1789) preceding the text of volume 1 Bruguière listed not only all the genera that he included in the text of that volume but also all those he proposed to include in all later volumes, and each of these generic names was adequately described in such Index. The validity of the Index descriptions was more fully discussed by this writer in another paper (1947b, pp. 484-492).

subquadrilateral. Thus the Linnaean description itself should be sufficient to restrict the name *placenta* to the shell commonly so known today. One characteristic of the hinge of the species is not brought out in either description—the slight divergence of the teeth in comparison to those in its congeners. Of the three species confounded by Linnaeus in his references, *placenta* has narrowly divergent teeth of markedly unequal length the junction of which at the umbo is deflected to one side; *sella* has widely divergent teeth of equal length and straight, without any terminal deflection; *papyracea* has widely divergent teeth the apex of which is not deflected but which are of slightly subequal length.

Hanley (1855, p. 135) did not attach great weight to the word "orbiculata" in the description, saying: "Thus no less than three out of the four known *Placunae* are included in the synonymy, and as the term 'orbiculata' was not formerly used in so restricted a sense as at present . . . all these would, perchance, have alike merited the name *placenta* had it not been for the details mentioned in the 'Museum Ulricae' . . ." I have not noted in the "Systema" any such broad use of the word as Hanley suggests, and I question whether Linnaeus would have described either *sella* or *papyracea* as "orbiculata." The "Museum Ulricae" description does cure the defects in the synonymy, but I suggest that the 1758 description is sufficient to fix the species.

*Anomia placenta* is the type of *Placuna* "Solander" Humphrey, by subsequent designation, Iredale, 1915. It is also the type of *Placenta* Retzius, by monotypy, as *P. orbicularis* Retzius.

There are many good figures of *placenta*. The earliest is that of Chemnitz (1780-1795, vol. 8, pl. 79, fig. 716). Sowerby (1820, 1825, 1834, vol. 1, pl. 124) shows excellent exterior and interior views. Crouch has, as usual, a good figure (1826, pl. 12, fig. 4). Reeve figures it adequately (1843-1878, vol. 18, *Placuna*, pl. 3, sp. 3a, b, c).

#### MYTILUS LINNÉ

This is a very old name for the mussels, having been used by the Greeks as *Mitulos* and by the Romans as *Mitulus*, *Mitylus*, and *Mytilus*. Linnaeus gave it a much broader

interpretation than the ancients, as his genus includes many dissimilar groups in addition to the true mussels.

As conceived by Linnaeus, it is one of the most heterogeneous of his molluscan genera. Although it contains but 22 species, including two described in the "Mantissa plantarum" of 1771, its members are now contained in 11 different genera, only three species being retained in *Mytilus* as at present restricted, that is to say, bivalves of a generally cuneiform shape, with terminal beaks, having small or obsolete cardinal teeth, and a surface generally smooth or with concentric sculpture, except in the subgenus *Aulacomya* Mörch, 1853, which is radially ribbed.

The principal genus that has been removed from *Mytilus* Linné is that group in which the beaks are not strictly terminal but are situated slightly below the termination of the valves, being surmounted by an extension of the posterior side. These species were first placed by Lamarck in his new genus *Modiolus*, 1799. He emended the spelling to *Modiola* in 1801 and continued the emendation in the 1818-1819 work. The latter form of the name was used for many years by most European and American writers but was later abandoned in favor of the earlier *Modiolus*. There is, however, an earlier name for the group, *Volsella* Scopoli, 1777, a validly proposed name which must replace *Modiolus*. There has been much opposition to the use of *Volsella* on the part of Continental writers, many of whom contend that it was based on a misidentification of species. This point of view was expressed by Lamy (1936-1937, vol. 80, p. 75) who said: "Scopoli . . . established the group *Volsella* for the species having one or more little teeth in the hinge and place *Mytilus modiolus* Linné in that group as having a tooth. We evidently have here a question of a shell whose identification was erroneous, the true *Mytilus modiolus* being edentulous." The opposite, and today the accepted, American view is stated by Dall, Bartsch, and Rehder (1938, p. 43): "In Scopoli's diagnosis of *Volsella* he says that the obsolete hinge is terminated by a minute, hardly visible denticle, and he credits *Mytilus modiolus* with one tooth. In young specimens of this species there is a little toothlike projection at the anterior end of the ligamental

groove, and this is undoubtedly what Scopoli considered a tooth. We have therefore merely a case of misinterpretation, and not one of ignorance." Not only is it apparent that Lamy had failed to examine the young shell of *modiolus*, but I suspect that he adopted a somewhat chauvinistic view in his more or less obvious desire to preserve the Lamarckian generic name.

Opposition to *Volsella* was not confined to the French. Dall (1890-1903, pt. 4, p. 786), treated the Scopoli name as being founded on a misidentification.<sup>1</sup> Jukes-Browne (1904, p. 101) also rejected it. Deshayes (1860-1866, vol. 2, p. 2) made a somewhat more reasonable observation in saying that the Scopoli name is too close to *Vulsella* Rumphius, 1711 (Röding, 1798), a name given to a different group, to be admitted to the nomenclature. This comment has no real weight, however, under the Rules, as *Vulsella* Rumphius is pre-Linnaean and *Vulsella* Röding was proposed 21 years later than *Volsella* Scopoli. The latter name is used as valid in this paper.<sup>2</sup>

The generic definition of the genus *Mytilus* in the "Systema" contains the word "edentulus," which in connection with the other diagnostic characters mentioned may in part explain Linnaeus' inclusion of species belonging to many other genera remote from *Mytilus*, *sensu stricto*, such as *Ostrea*, *Hiatella*, *Anodontia*, and others. Many of the genera represented in *Mytilus* Linné either have teeth that are small or obscure or are present only in the juvenile shell. In either case there is some reason for their having escaped the attention of Linnaeus and his contemporaries. As examples: *Mytilus*, *sensu stricto*, and *Septifer* contain some species with very small, hardly noticeable teeth. *Pteria* has obsolete

<sup>1</sup> It is not apparent that Dall ever changed his view on *Volsella*. The above-mentioned work authored by "Dall, Bartsch, and Rehder" was published long after Dall's death and he was assigned senior authorship because much of the data contained in the work were based on an unpublished report by him.

<sup>2</sup> *Vulsella* Röding is in part equal to *Mya* Linné, 1758, being based on *Mya vulsella* Linné (*Vulsella lingulata* Lamarck, 1801). The *Vulsella* of the "Museum Calonnianum," 1797, is a synonym of *Isognomon* "Solander" Humphrey, 1786. Although earlier, the "Museum Calonnianum" has been rejected as a basis for any nomenclatorial work (Opinion 51 of the International Commission on Zoological Nomenclature).

teeth. *Volsella*, *Hiatella*, and *Brachidontes* are edentulous genera in the adult stage of their species, although some show teeth in the young shell. *Musculus* has fine notches in the hinge plate which are not real, functional teeth. Linnaeus, however, went contrary to his generic definition in the case of two species, as he erroneously admitted the existence of teeth in *M. unguulatus*, a form of the edentulous *M. edulis*, and also mentioned teeth in the description of *M. bidens*, which is here treated as a *species dubius*.

#### *Mytilus crista-galli*

1758, *Systema naturae*, ed. 10, p. 704, no. 206.

1767, *Systema naturae*, ed. 12, p. 1155, no. 243.

LOCALITY: "In *O. Indici Gorgoniis*" (1758, 1767).

"*M. testa plicata spinosa, labro utroque scabro. . . Labra interiora marginum testarum punctis eminentibus scabra.*"

The description and locality of this species are unchanged in the twelfth edition. One reference was added, plate 18, figure 1 from the first volume of Sloane's "Jamaica" (1707, 1725). The description alone would probably have been sufficient to have distinguished this shell from the other species grouped under *Mytilus* Linné and *Ostrea* Linné, but the identification is confirmed by the presence of an authoritatively marked specimen in the collection which agrees in all particulars with the description. The early recognition of the shell as *Ostrea crista-galli* was, however, probably based on the longer and more characteristic diagnosis in the "Museum Ulricae." It is distinguished by its extremely angular radial plaits in both valves which interlock with one another at the markedly serrate margin. *O. crista-galli* is usually found attached to corals by shelly processes developed in the lower valve in much the same manner as *O. folium* and *O. frons* are attached to the roots of mangrove and other intertidal plants.

The species was transferred to *Ostrea* Linné by all of Linnaeus' successors with the exception of Born (1780) and Gmelin (1791) who retained it in *Mytilus*. Chemnitz described and figured it among his "Austern" (1780-1795, vol. 8, p. 52, pl. 75, figs. 683-684) and specifically cites the "Systema" descriptions in his synonymy.<sup>1</sup>

This species has been placed by most of the earlier systematists in the genus *Lopha* Röding, 1798, a group used by them as a subgenus of *Ostrea* Linné. It is the type of *Lopha*, by subsequent designation, Dall, 1898. However, as Stenzel points out (1947, p. 177), *Lopha* is an invalid name, and this statement was undoubtedly correct as of the date of his paper. It is invalid under the published terms of Article 25, (a) of the Rules and Opinion 1 of the Commission, as it was proposed without a definition, description, or indication, as a mere heading of a list of several species, none of which was designated as type. Before any type species was designated, or any definition, description, or indication was published, G. Fischer in 1807 validly proposed the name *Alectryonia* for the same group, which thus became valid before *Lopha*, the latter falling into its synonymy. The type of *Alectryonia* is also *O. crista-galli* (Linné), by subsequent designation, Stoliczka, 1871. While under the Rules at present in effect *Lopha* is a *nomen nudum*, the matter is now only of academic interest. The proposed emendation of Article 25, (a) and the proposed cancellation of Opinion 1, which were recommended by the Commission to the International Congress at the recent Paris meeting, provide for the validation of a generic name which was merely accompanied by a list of one or more previously proposed nominal species (Hemming, 1950, pp. 78-80). Since all of the recommendations of the Commission were adopted by the Congress, the effective validation of the various proposals waits only for the mechanics of their official publication. *Lopha* may be considered, for all practical purposes, to have been validated.

*Ostrea crista-galli* (Linné) is figured in Reeve (1843-1878, vol. 18, *Ostrea*, pl. 11, sp. 22).

#### *Mytilus hyotis*

1758, *Systema naturae*, ed. 10, p. 704, no. 207.

1767, *Systema naturae*, ed. 12, p. 1155, no. 244.

LOCALITY: "In *Pelagi Gorgoniis*" (1758, 1767).

"*M. testa plicata imbricata squamis compressis patulis, labro utroque laevi.*"

<sup>1</sup> Chemnitz also describes and figures the shell in volume 9 of the "Conchylien Cabinet" (1780-1795, p. 150, pl. 116, fig. 998), but the figure there shown is a much less characteristic drawing.

The description, locality, and references are identical in the tenth and twelfth editions.

Until the publication of Chemnitz' "Conchylien Cabinet" this species remained in *Mytilus*. In that work it was transferred to *Ostrea* Linné, where it has since been universally cited. The description in the "Systema," though brief, is probably sufficient to identify the species. At least it serves to distinguish it from *M. crista-galli*, the only other member of *Mytilus* Linné with which it could be confused. Of the two references cited (Rumphius, pl. 47, fig. C, and Argenville, pl. 23, fig. H) the first adequately pictures the *Ostrea hyotis* of all authors; the latter is not sufficiently enlightening to be of much probative value. The expanded description in the "Museum Ulricae" removes all doubt as to the identification, not only through its added data, but particularly because of the stated distinctions between it and *crista-galli*. Unmarked specimens of the species are found in the Linnaean collection but cannot be taken as the type, because the name *hyotis* does not appear on Linnaeus' list of owned species, thus raising the probability that they were added later and possibly by another hand.

As does *O. crista-galli*, it belongs in the subgenus *Lopha* Röding, 1798. (See the discussion of *Lopha* under *M. crista-galli*.) It is an extremely variable species, especially in the degree of development of the tubular processes arising from the imbricate layers of the upper valve, and the available figures are confusing in that they usually represent the most highly developed form in this respect, a form that is rarely seen. Thus Chemnitz' figure (1780-1795, vol. 8, pl. 75, fig. 685) is hardly recognizable, unless one has been able to examine a large series of specimens. It is fairly well illustrated in Reeve (1843-1878, vol. 18, *Ostrea*, pl. 4, sp. 7).

*Ostrea hyotis* is typically a western Pacific species, but recently a specimen of *Ostrea* was collected in the Gulf of California at Guaymas, Mexico, which was identified by Ranson of the Paris museum as *hyotis* Linné and was said by him to be inseparable from the western Pacific shell. (Cf. Minutes no. 99, p. 9, of the Conchological Club of Southern California, April, 1950.)<sup>1</sup>

<sup>1</sup> Dr. Ranson called the species *Pycnodonta hyotis* Linné, using a generic name proposed by Fischer von

### *Mytilus frons*

1758, *Systema naturae*, ed. 10, p. 704, no. 208.  
1767, *Systema naturae*, ed. 12, p. 1155, no. 245.  
LOCALITY: "In Pelagi indici Gorgoniis" (1758, 1767).

This species is discussed under *Ostrea folium* Linné above.

### *Mytilus margaritiferus*

1758, *Systema naturae*, ed. 10, p. 704, no. 209.  
1767, *Systema naturae*, ed. 12, p. 1155, no. 246.  
LOCALITY: "In utriusque Indiae Oceano" (1758, 1767).

"M. testa compresso-plana suborbiculata, basi transversa, imbricata tunicis dentatis."

The word "dentatis" was added in the twelfth edition, as well as the following sub-description: "Altera testa (in minoribus) aurita est altero latere, uti Pecten. Cardo rectissimus longitudine totius testae. Lamellae testae, quibus est imbricata, valde dentatae sunt."

This is the *Pinctada margaritifera*, the pearl oyster, of the Indo-Pacific region, and the identity of the Linnaean name has never been in doubt. It must be admitted, however, that the description leaves something to be desired. In the first place the author did not refer to certain of the characteristics of this remarkable and unique genus and species. There is no mention of the deep infolding of the byssal notch in the right valve, which is a diagnostic character of all species of *Pinctada*. The coloring of the species is not described, a brownish olive base which is crossed by a series of broad, white, or pale tan radial rays broken into oblong patches as they pass over the flaky imbrications which make up the concentric sculpture of the shell. This color pattern is much more brilliant in young specimens, as in adult shells it is usually almost completely obscured by deposits

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Waldheim in 1835, as *Pycnodonte*, the unnecessary emendation having been made by Sowerby in 1842. Sowerby's emended name was rejected, as a synonym of *Pycnodonte*, by Opinion 148 of the International Commission. Stenzel (1947, p. 181) lists *Pycnodonte* as a valid name, as does Thiele (1931, 1935, vol. 2, p. 814) the latter writer using the form *Pycnodonta*. Fischer's genus was erected on a fossil species from the Crimea, but Recent members of the group exist. The removal of *hyotis* Linné from Röding's *Lopha* by Dr. Ranson is based on evidence which is not stated, and therefore I tentatively cite it as *Ostrea (Lopha) hyotis* Linné.

of coral, Bryozoa, worm tubes, and barnacles. It seems obvious that Linnaeus had seen only senile or at least heavily encrusted adult examples, and the specimen preserved in the Linnaean collection is such an individual. More curious still, the description contains no reference to the iridescent nacre which covers most of the interior of the shell, nor to the fact that the species is commercially valuable for its mother-of-pearl and the gem pearls that are frequently found in it. The darker olive band which borders the iridescence and through which the exterior rays can be seen, even though they are not visible on the outside, is not referred to. In fact the only hint as to the interior color is that implicit in the specific name itself and the references in the synonymy to the pre-Linnaean names "Concha margaritifera" and "Matrix perlarum." In the "Museum Ulricae" Linnaeus refers to the color of both the outer and inner aspects of the shell ("Extus . . . viridi-fusca, maculis albis radiata" and "intus nitens colore margaritarum, excepto solo margine obscuro") but reverts to the original unilluminating description in the twelfth edition. Nowhere is it mentioned that pearls are sometimes found in the shell or that it is a sought-for species.

In the second place, several of the details of the description are misleading. In adult individuals the exterior imbrications are often produced into blunt, tongue-like projections on portions of the shell. The expressions "imbricata tunicis dentatis" and "Lamellae . . . valde dentatae sunt" of the diagnosis, if they refer to this feature, are much too strong to fit the facts. The words "basi transversa" are hardly expressive of the slightly inequilateral outline of the shell. Finally, the characterization of the ears as "uti Pecten" is exaggerated and inapt.

The description in the "Museum Ulricae," however, cures many of these omissions and defects and leaves no doubt as to the identity of the species. Instead of "basi transversa" we read "utroque latere parum convexa, antica rotundata, postice transversa." The byssal notch is properly compared to that in *Ostrea semiaurita* (*Perna bicolor* Adams). The coloring, as mentioned above, is adequately described, and there is no mention of "teeth" on the scales.

The first comprehensive and characteristic

description of *margaritifera* is that of Born (1780, p. 123). Chemnitz (1780-1795, vol. 8, pp. 126-132) exhaustively described and discussed the species and referred to its value as a source of precious pearls, but his figure, though it shows a pearl, is merely of the interior of the shell and is a vague and poorly executed drawing (*tom. cit.*, pl. 80, fig. 717).

The genus to which the pearl oyster belongs has been variously named. The first generic name proposed was *Margaritifera*, by Patrick Browne in "The civil and natural history of Jamaica," 1756. The first edition of this work is pre-Linnaean and the second (1789) has been eliminated from consideration as a source of names by the terms of Opinion 89. *Margaritifera* Humphrey, 1797, from the "Museum Calonianum" is also invalid under Opinion 51. The first available name is *Pinctada* Röding, 1798, which has now come into general use. Later synonyms are *Unionium* Link, 1807; *Margaritiphora* Megerle von Mühlfeld, 1811; *Margarita* Leach, 1814; *Perlamater* Schumacher, 1817; and *Meleagrina* Lamarck, 1819.<sup>1</sup> The last name was used for many years in spite of the existence of the several prior names, and later the species was placed by many conchologists in *Pteria* Scopoli, 1777. Some recent writers who use *Pinctada* Röding for the species use that name as a subgenus or section of *Pteria*, notably Grant and Gale (1931, p. 147) and Thiele (1931, 1935, vol. 2, p. 803). The differences between *Pteria* and *Pinctada*, however, seem sufficiently pronounced to justify their generic separation,<sup>2</sup> although the two groups are very close.

Lamarck (1818-1819, vol. 6, p. 151) confused under the name *Meleagrina margaritifera* two different but closely allied species—the true *margaritifera* of the Indo-Pacific and his variety "b" which he referred to *Avicula*

<sup>1</sup> Lamarck also used the name *Meleagrina* in 1812, but in the vernacular.

<sup>2</sup> The shell in *Pinctada* is much less oblique than in *Pteria*, and the posterior wing of *Pteria* is either entirely absent in *Pinctada* or only slightly developed, the shell being almost quadrate in outline, as distinguished from the aviculoid shape of *Pteria*. The pedal impression is confluent with that of the adductor muscle. Moreover, while both groups are provided with a byssus, the callos, markedly infolded byssal notch of *Pinctada* is not found in *Pteria*. The *Pinctada* are consistently much more scaly than the pterids.

*radiata* Leach. His locality for the inclusive species was "Ceylon, Australian Seas, Gulf of Mexico, etc." The variety is only described as having "the scales terminating in points." The *radiata* of Leach, 1814, is a *Pinctada* and a very common shell in the western Atlantic, ranging from Georgia throughout the West Indies and into the Gulf of Mexico. It is, however, quite distinct from *P. margaritifera*. It is the *Avicula alaperdicis* of Reeve, 1857.<sup>1</sup>

An eastern Pacific shell known as *Pinctada mazatlanica* (Hanley), 1855, is very close to *margaritifera* and may not be specifically distinct. Jameson (1901, pp. 376-377) considered it a mere variety of the typical Indo-Pacific form. It ranges from the Gulf of California to Panama and is of considerable commercial importance.

*Pinctada margaritifera* is the type of *Pinctada* Röding, 1798, by subsequent designation, Iredale, 1915. It is figured in Reeve (1843-1878, vol. 10, *Avicula*, pl. 1, sp. 1) and in Sowerby (1820, 1825, 1834, vol. 1, pl. 111). Reeve also figures the young shell (*tom. cit.*, pl. 8, sp. 21).

#### *Mytilus unguis*

1758, *Systema naturae*, ed. 10, p. 704, no. 210.

1767, *Systema naturae*, ed. 12, p. 1156, no. 247.

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

"M. testa subrotunda longitudinaliter striata pellucida subaurita. . . Magnitudine unguis humani."

Linnaeus' diagnosis of this species gives us only a description which cannot be applied to any *Mytilus* from the Mediterranean or indeed to any member of the genus. There

<sup>1</sup> The pointed scales referred to by Lamarck for "*Avicula*" *radiata* are usually absent or only slightly developed, but occasional specimens, particularly from the Gulf of Mexico, have prolongations of the scales almost as long and highly developed as the spines on some of the Spondyli.

It may be noted that in Lamarck's time the formation of the precious pearls found in *P. margaritifera* was not understood. It was apparently not realized that they are the result of irritation of the mantle by a foreign body and are thus a morbid secretion rather than a mere accident of growth. Lamarck says in his foreword to *Meleagrina* (*loc. cit.*): "The nacreous lining is often thick and very brilliant; the production of the liquid which goes to form the periodical thickening of the interior of the shell, often gives rise to isolated deposits of this beautiful mother-of-pearl, which result in what we call 'pearls.'"

are no references. The description in the "*Museum Ulricae*" is more elaborate but no more illuminating. In the latter work the phrase "juxta basin altero latere inflexa ut Myt. margaritiferus" prompted Hanley (1855, p. 138) to suspect that it might be "an Aviculoid *Meleagrina*." The words "cardo margine plano excavatus sulcis tribus obsolete" from the same work recalled to Hanley the characteristics of a *Crenatula* or a *Perna*, but no member of either genus fits the words of the description in the "*Systema*." The literature since Hanley's day seems to be silent on this species. It must be left as one of the unidentified species.

Dall, in his paper on the Portland Catalogue (1921b, pp. 97-100, 124-132), lists two of Solander's *Mytilus* (*M. lingua* and *M. unguis*), both of which he refers to *Patella unguis* Linné. Whether or not *M. unguis* Solander is the same as Linnaeus' *M. unguis* is academic, as *Patella unguis* Linné was undoubtedly based on a single valve of *Lingula*, *anatina*, a brachiopod, and not on a *Mytilus* valve. Solander's two species were apparently both brachiopod valves.

#### *Mytilus lithophagus*

1758, *Systema naturae*, ed. 10, p. 705, no. 211.

1767, *Systema naturae*, ed. 12, p. 1156, no. 248.

LOCALITY: "In O. Indico, Europaeo, Mediterraneo" (1758, 1767).

"M. testa cylindrica utrinque extremitatibus rotundatis. . . Testa indica mollior et fere coriacea; Europaea vero magis fragilis."

While the Linnaean description is clear enough and can be taken as covering the *Lithophaga lithophaga* of modern writers, the search for the type was complicated by the fact that the receptacle marked for the species in the collection contains two different species. One was the Mediterranean shell that we know under the Linnaean name, and the other *Lithophaga teres* (Philippi), 1848, from the Indian and Pacific oceans. Both the description and all the references, however, point to the Mediterranean shell. The exotic species, though very close to *lithophaga*, is narrower, longer, and of a blackish brown color, while the Mediterranean shell is a lighter chocolate-brown. In spite of Linnaeus' mixture of species in his cabinet, his diagnosis and references permit us to accept the



European shell as the type of *Mytilus lithophagus*.

The pre-Linnaean authors, almost without exception, believed the species to be a *Pholas* and so named it. Born (1780, pp. 124-125, pl. 7, fig. 4) and Gronovius (1781, vol. 3, no. 1205, p. 279) followed Linnaeus in leaving the species in *Mytilus*, and their descriptions restrict the name to the Mediterranean shell. Chemnitz (1780-1795, vol. 8, p. 147, pl. 82, figs. 729-730) was influenced by Linnaeus' statement of the locality, but gave the shell an even broader range. After referring to the color as "vel nigra, vel castanea viridescente," he said (*tom. cit.*, p. 150): "The Stone Date with the coal black epidermis comes from Mauritius and the Isle Bourbon; the one with the chestnut-brown epidermis from the Mediterranean Sea, and that with a greenish epidermis which is nacreous inside from the West Indies and Guinea." There is nothing in the western Atlantic that conforms to the latter form, although several species of *Lithophaga* are found there.<sup>1</sup> It may be well to point out here that the very wide distribution given by Linnaeus to some of his "species" was undoubtedly due to his failure to appreciate the fact that, with very few exceptions, a given species of mollusk has a comparatively restricted range. For this reason he often grouped under one name, as a composite species, several closely allied but specifically distinct shells and reported the composite species from localities as widely separated as, for instance, the East and West Indies. With the exception of the circumpolar species, which often range from Arctic or Antarctic waters down both sides of the Atlantic and Pacific for considerable distances, and the further exception of shells, mostly pelagic, the presence of which in both oceans is due in many cases to the existence in geologic times of an open water passage between the two, the world-wide, or at least widely distributed species, are very few.

Lamarck, who did not list the species or its genus in either the "Prodrome" of 1799 or the "Système naturelle" of 1801, placed it in *Modiola* in the 1818-1819 work, and repeated the error of Chemnitz in locating it in "the

<sup>1</sup> Chemnitz did not figure the form (or species) with the greenish epidermis, said by him to come from the "West Indies and Guinea."

Mediterranean, the American and Indian Oceans, etc." His two varieties "a" and "b" were, respectively, the Mediterranean and Indo-Pacific shells, and he cited for them the appropriate figures from Chemnitz, but for some reason reversed the colors, describing *lithophaga* variety "a" as very dark chestnut-brown and variety "b" as yellowish. He nowhere refers to the "American" form except in his inclusive locality. Indeed he did not otherwise locate the two varieties, leaving us to assume that they existed side by side in all the regions stated.

The present species belongs in *Lithophaga* Röding, 1798, of which it is the type, by monotypy, as *L. mytiloides*. It is also the type, by absolute tautonymy, under the terms of Article 30, 1, d, of the Rules. Megerle von Mühlfeld emended the name to *Lithophagus* in 1811. It is identical with *Lithodomus* Cuvier, 1817, which has the same type.<sup>2</sup> Cuvier's name was used for many years during the time when the "Museum Boltenianum" was an almost unknown work.

*Tamarindiformis lithoglyphus* Meuschen, 1787, *Lithodomus dactylus* Sowerby, 1824, and *Lithodomus inflatus* Requier, 1848, are synonyms of *lithophaga* Linné. Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, p. 162) accept two named varieties of the Mediterranean shell: variety *inflata* Requier, which is the same as *L. curta* Monterosato, 1878 (*non curta* Lischke, 1874), and variety *rugosa* Monterosato, 1878.

The present species is a strictly Mediterranean shell and does not occur in the Atlantic. All species of *Lithophaga* are rock-borers. The shells of all species are more or less fragile, and the burrow is made not by the mechanical action of the shell itself but by chemical action of a secretion from glands, probably situated on the mantle edge, which dissolves the rock.

*Lithodomus lithophaga* is figured by Reeve (1843-1878, vol. 10, *Lithodomus*, pl. 2, sp. 9) and by Bucquoy, Dautzenberg, and Dollfus (*tom. cit.*, vol. 2, atlas, pl. 28, figs. 12-15) who also place the species in *Lithodomus*. The Chemnitz figures referred to above are adequate, and Thiele gives an excellent photo-

<sup>2</sup> *Lithodomus* should be used as a feminine genus, as it takes the gender of "*domus*," a feminine noun. It is, however, almost universally used as masculine.

graph of the shell (1931, 1935, vol. 2, p. 800, fig. 798).

#### *Mytilus rugosus*

1767, *Systema naturae*, ed. 12, p. 1156, no. 249.

LOCALITY: "In Norvegiae lacustribus; ostiis maris" (1767).

This species is fully discussed under *Mya arctica* Linné (*Hiatella arctica*) above. It unquestionably belongs in *Hiatella* Daudin in Bosc, 1901, and is close to *H. arctica*. As already pointed out, opinion is divided as to whether it should be given specific rank or treated as a form of *arctica*. In this paper it is tentatively considered distinct.

#### *Mytilus bilocularis*

1758, *Systema naturae*, ed. 10, p. 705, no. 212.

1767, *Systema naturae*, ed. 12, p. 1156, no. 250.

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

"M. testa caerulea striata, umbonibus fornicatis dissepimento albo."

The mention of the septum across the umbonal cavity indicates a member of the genus *Septifer* Recluz, 1848, even in the absence of any references to figures. The species did not appear on either of Linnaeus' lists of his collection, and therefore none of the unmarked specimens of several different species of *Septifer* in his cabinet can be considered to be the type.

Born (1780, pl. 7, fig. 5) figures a shell which he called *Mytilus exustus* (*non M. exustus* Linné) but which is certainly a *Septifer* and probably represents the *bilocularis* of all modern authors or a closely allied species. Chemnitz did not cite *bilocularis* and was unable to recognize it from the Linnaean diagnosis. In his description of *Mytilus Nicobaricus obscure viridis* (1780-1795, vol. 8, p. 155, pl. 82, figs. 736 a, b) he says (*tom. cit.*, p. 156): "Under the beaks one finds a pair of very small teeth, which can scarcely be seen with the naked eye, and therefore must be examined with a magnifying glass. There is also a white partition wall under the beaks in each valve. Some people therefore think that this is *Mytilus bilocularis* Linné no. 250 since it has *umbones fornicatas et dissepimentum album sub apice*. I would be glad if this were so because I have long studied the Linnaean spe-

cies and have been unable to recognize it. Identification with the present species I would consider doubtful. Probably Linnaeus did not know this Nicobar shell we are discussing, as it was only discovered a few years ago. Still I will gladly admit that his *Mytilus bilocularis* may have been very similar to it." Chemnitz also described and figured two other forms which were probably *Septifer* species, *Varietas mytili Nicobarici viridescentis* (*tom. cit.*, p. 157, pl. 82, figs. 737, nos. 1, 2, 3) and *Mytilus crenatus* (p. 165, pl. 83, figs. 744a, b). No locality is given for the first. The second is said to come from Tranquebar. But neither seems to be *bilocularis*, although the drawings are so crude that it is not possible to say what they represent. They are mentioned only because of the use that Lamarck made of them.

Lamarck described *Mytilus bilocularis* and listed four varieties. Variety "a" was said to be the Linnaean species and the figure cited for it was Chemnitz' figure 736a, b, which the latter used for his *nicobaricus* but was unable to refer to *bilocularis*. Variety "b" is described as "testa minore; epiderme viridi," and for this Chemnitz' figure 737 was cited (Chemnitz' "variety" of *nicobaricus*). Variety "c" was supplied with no figure but was described as "extus intusque fusca." Variety "d" was referred to the *Mytilus exustus* of Born, and the Chemnitz figures 744a-b were used, which Chemnitz called *Mytilus crenatus*. Lamarck, in his French description, says that it is a very distinct species "but offers many color varieties." The color of his "typical" *bilocularis* (variety "a") is described as "blue near the beaks and blackish-violet towards its top [sommet]" (a statement which is confusing) and as having a dark brownish green epidermis. It is probable that this is Linnaeus' *bilocularis*, but I confess to being quite in the dark as to Lamarck's other "varieties."

The Linnaean description, short as it is, contains the word "caerulea," and this should be sufficient to fix the "Systema" species on the blue form of the shell. This is the generally accepted view today and is undoubtedly correct. Lamy (1936-1937, vol. 80, p. 243) adopts this form as typical and agrees with Hanley (1855, p. 140) that it was the form on

which Linnaeus based his species. Lamy also (*loc. cit.*) places Chemnitz' *nicobaricus* in the synonymy of *bilocularis*, thus overruling Chemnitz' own opinion. Chemnitz' figures 737 (but only nos. 2 and 3) are called by Lamy "var. *Forskali Dunker*," and *Mytilus exustus* of Born and *Mytilus crenatus* of Chemnitz, which Lamarck also united, are both placed by Lamy in the synonymy of *M. bilocularis* Linné, variety *Kraussi* Küster.<sup>1</sup>

I have already said that it is dangerous to accept the specimens in the "Museum Ulricae" as at present arranged and labeled as representing the types that Linnaeus described in the catalogue of that collection. For what it is worth, there is a specimen of *bilocularis* in Upsala which is the "probable" type. Odhner discusses and figures this specimen (1917, pp. 18-19). He said: "Through the kindness of Prof. A. Wirén I am able to give a description and some figures of, as it seems, Linnaeus original specimen of this species. . . . Prof. Wirén communicates the following remarks on the shell: 'On account of the defective labeling in earlier times it is not absolutely certain that the specimen is the same as that described by Linné. The labels originate from Thunberg, the printed ones from a later time. Linné mentions that his *M. bilocularis* is to be found in M(useum) L(udovicae) U(lricae). . . . It can be shown that this collection was added to and altered during the period between Linné's examination of it and its presentation to Uppsala; however as only one specimen of *bilocularis* exists, it is, of course, very probable that this is really the one described by Linné. It agrees with the description and is, like many others of the royal conchylia, carefully polished.'" Odhner's figure of the "probable" type is unquestionably *M. bilocularis* or some form of that shell.

There is an element of conflict as to the

<sup>1</sup> As is noted below, the present opinion, with which I concur, is that both Chemnitz' *M. nicobaricus* and Born's *exustus* were in fact the *bilocularis* of Linnaeus. This is based not so much on Chemnitz' and Born's questionable figures as on the rest of their diagnoses and, particularly in the case of *nicobaricus*, on Chemnitz' statement that the unbonal shelf in his type specimen was white. Lamarck was the first to refer *nicobaricus* Chemnitz and *exustus* Born to *bilocularis* Linné, and they now generally appear in its synonymy.

color of the "type" specimen. On this point Odhner continues: "The color of its anterior and ventral part is, as Linné says (*Syst. Nat.* 10, p. 705), whitish with some violet flames towards the umbones and some traces of a reddish yellow tint at the ventral side, originally spread over this region. Its posterior and dorsal part is reddish brown, darker towards the margins. The interior is white in front, and below violet with a slight margaritaceous hue for the chief part, and reddish brown along the dorsal and posterior margins."

Odhner's description of the color of the specimen, which he attributes in part to the tenth edition of the "Systema," is not found either in that work or in the "Museum Ulricae." The "Systema" description merely characterizes the color as "caerulea," and that in the "Museum Ulricae" says: "Color caeruleus huic proprius, sunt tamen varietates nigricantes et fusco-ferrugineae." Thus the description of the supposed type specimen does not at all conform to either Linnaean diagnosis and raises the suspicion that the specimen now preserved at Upsala is not the one examined by him.

The identification of the particular form described by Linnaeus in the "Systema" is not completely unequivocal. The "blue" variety is, however, generally adopted as his species, and this view is probably sound. The color description in the "Museum Ulricae" points even more clearly to this form as being the typical one with which he was familiar.

The "teeth" referred to by the earlier describers of the species of *Septifer* are probably not the denticles under the ligament, which have a vague resemblance to a taxodont hinge, although not functional teeth, but are the small nodules, usually arranged in a group, just above the shelf at the beaks.

*Mytilus bilocularis* is figured in Reeve (1843-1878, vol. 10, *Mytilus*, pl. 9, sp. 42) as *M. nicobaricus* Lamarck. This is a very vague figure and might be taken for almost any species of *Septifer*. Clear and characteristic figures are difficult to find. Thiele (1931, 1935, vol. 2, p. 799, fig. 797) shows an excellent figure of the interior of the shell.

The species is the type of *Septifer*, by subsequent designation, Stoliczka, 1871.

**Mytilus exustus**

1758, *Systema naturae*, ed. 10, p. 705, no. 213.  
1767, *Systema naturae*, ed. 12, p. 1156, no. 251.

LOCALITY: "Ad Jamaicaam" (1758, 1767).

"M. testa striata ventre angulato, margine crenato."

As Linnaeus supplied no references for this very short and inadequate description, and there is no marked type in his collection, his immediate followers were in doubt as to what he intended to describe. The fact that it was described as striated places it in the third of the early gross divisions of the mytilids, *Aulacomya* Mörch, 1853. It is now accepted as the common *exustus* of the western Atlantic, which under modern usage belongs in *Brachidontes* Swainson, 1840, a genus that was separated from the other striated mytilids to include those species of which the entire inner margin, or the posterior side thereof, was crenulate. It falls in the subgenus *Hormomya* Mörch, 1853, of which it is the subgenotype. Three different species were referred to this name by the early authors. Born (1780, p. 125, pl. 7, figs. 5a, b) used it for a *Septifer* which was almost certainly *M. bilocularis*. Chemnitz (1780–1795, vol. 8, p. 163, pl. 83, figs. 742–743) called it *Mytilus magellanicus*, a species from the Straits of Magellan, a variety of which he located on the west African coast and in the West Indies. Gmelin referred it to *Mytilus sulcatus*, which (as is pointed out under *Arca modiolus* above) is *Brachidontes citrinus* Röding.

Both Hanley (1855, p. 140–141) and Lamy (1936–1937, vol. 80, p. 173) accept the *Mytilus exustus* of Lamarck, 1819, as being the *exustus* of the "Systema," although many of the earlier authors considered that Lamarck was describing a different shell and had confused the Linnaean species with *Modiola sulcata*. It is now generally accepted, however, that the *exustus* of the two authors are identical and that the western Atlantic shell is the Linnaean species. The locality is correct, and the unmarked specimen of *exustus* in the collection is the only *Mytilus* present that agrees with the description. (See discussion of *Mytilus bidens* Linné below, p. 215.) The name *exustus* appears on the list of the shells in Linnaeus' collection as of 1758 but is not on the 1767 list. Hanley (1855, p.

141) was puzzled by the species because he felt that the specimen in Linnaeus' cabinet, though it conformed to the description of *exustus*, agreed still better with the definition of *M. bidens*. As I am unable to identify *bidens* with any confidence, it is difficult to comment on Hanley's query.

The description in the "Museum Ulricaë," being ampler and more characteristic, fortifies the identification of our *exustus* with the Linnaean shell.

*Mytilus exustus* is figured in Reeve (1843–1878, *Mytilus*, vol. 10, pl. 4, sp. 10) as *M. exustus* Lamarck, and in Maxwell Smith (1941, pl. 11, figs. 5a, b).

**Mytilus barbatus**

1758, *Systema naturae*, ed. 10, p. 705, no. 214.  
1767, *Systema naturae*, ed. 12, p. 1156, no. 252.

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

"M. testa laeviuscula ferruginea, extus apice barbata."

There has been no question as to the identification of this species. The description, although brief, is adequate, with the exception of the phrase "apice barbata." The hairy epidermis of the species is usually confined to the ventral third of the shell or at least is heaviest in that region. It is the umbonal end which is usually called the apex, although that term is perhaps less apt in the case of the more or less oval *Modiolus* than when applied to the true mytilids, with their pointed umbones and generally cuneate outline.

Both of the references ("Ginanni, 2, p. 36, t. 27, f. 16" and "Gualtieri, t. 91, f. H") are accurate, and the collection contains a marked specimen of the *barbatus* of all authors, which conforms completely to the description. The actual type specimen is illustrated by Hanley (1855, pl. 2, fig. 2) and shows the peculiar red color of the species, with the hairy epidermis confined to a comparatively small width of the ventral margin.

The range of *barbatus* is from the English Channel along the European coast as far as Gibraltar, and throughout the Mediterranean Sea. Both Hanley (*op. cit.*, p. 141) and Bucquoy, Dautzenberg, and Dollfus (1882–1898, vol. 2, p. 153) suggest that the *barbatus* of the "Fauna Suecica" must have been a dif-

ferent shell, probably founded on immature specimens of *modiolus*, as *barbatus* has not been reported from northern European waters.

It is edentulous in the adult stage, but the young shell shows extremely minute denticles in the hinge which are easily overlooked. Linnaeus did not notice them, and indeed, in a manuscript note in his copy of the twelfth edition, he added to the description the phrase "dens nullus." The present species cannot be confused with any other of its eastern Atlantic or Mediterranean congeners because of the thickness of its shell, the abundant pilose epidermis, and the characteristic red color under the epidermis.

It belongs in the genus *Volsella* Scopoli, 1777, which, as mentioned in the introduction to *Mytilus* Linné, must take the place of Lamarck's *Modiolus*. It is the *Modiola gibbsii* of Leach, 1815, and (*vide* Monterosato) *Modiola villosa* Nardo, 1847. Writers on Mediterranean shells accept several named varieties (cf. Lamy, 1936-1937, vol. 80, pp. 262-265; Bucquoy, Dautzenberg, and Dollfus, *tom. cit.*, vol. 2, pp. 154-155).

It is figured in Reeve (1843-1878, vol. 10, *Modiola*, pl. 3, sp. 9, figs. 9-10) and in Donovan (1799-1803, vol. 2, pl. 70, all figs.). Donovan's specimens were said to come from Wales. This is the farthest north of any authoritative locality for the species. It is believed that reports of the occurrence of *barbatus* from Scotland and other subarctic European localities were based on young individuals of *Modiolus*.

#### *Mytilus edulis*

1758, *Systema naturae*, ed. 10, p. 705, no. 215.

1767, *Systema naturae*, ed. 12, p. 1157, no. 253.

LOCALITY: "In O. Europaeo, Indico et M. Balthico" (1758, 1767).

"M. testa laeviuscula violacea, valvulis antice subcarinatis, postice retusis, natibus acuminatis."

The subdescription of this common and commercially valuable mussel, being devoted to its habitats and use, is omitted here. The identification with the *edulis* of modern writers was unequivocally established by the characteristic description and the presence of a marked specimen of the shell in the Linnaean collection. The references are numerous, as might be expected, but they do not

all supply figures, and in those that do, the drawings are particularly crude and might stand for any of the *Mytili* having an outline approximately similar to that of *edulis*. The only defect in the description is the failure to identify the few small teeth on the edge of the hinge plate, and in the "Museum Ulricae" Linnaeus emphasized his failure to notice these "teeth" by the categorical language "cardo absque denticulo." By a manuscript note, however, destined to be inserted in his "revised twelfth edition," he finally recognized their existence by the rather negative phrase "cardo fere edentulus." It is not surprising that the author was so long deceived, as the denticles are extremely small and are usually concealed by the overlapping of the epidermis. Hanley (1855, p. 142) suggested that the positive language on this point in the "Museum Ulricae" made it "not unlikely" that the shell in that work was a different species. It is hardly probable that in this case, as in many others where a change in the description is noted, Linnaeus would have described two different species by the same name in 1758 and 1764 and then used the same name again in 1767 with the same description as in 1758.

The variation in this widely dispersed species has given rise to a number of specific names, all but one of which are certainly of only varietal significance and most of which represent ecological forms or geographical races. Many of these names have been dropped, but Lamy (1936-1937, vol. 80, pp. 84-88) and Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, pp. 137-139) describe eight forms which they call "varieties." The figures of the latter authors (*tom. cit.*, pl. 26, figs. 1-13) show forms both from the Mediterranean and the Atlantic that vary from a long and narrow to a short, broad, and ventrally blunt shell, and from those that have close and cleanly cut concentric wrinkles to those with coarser and more irregular surface ornamentation. In addition to the localities stated by Linnaeus *edulis* is found on both sides of the Atlantic from Arctic waters to Gibraltar and to North Carolina as well as on the west coast of America as far south as San Diego. In the western Atlantic the variation of the shell is much less pronounced, being usually con-

finer to a difference in the ratio of length to width.

The only form which calls for special mention is that called *M. pellucidus* Pennant, 1777. This is a much thinner shell and so much less dense that it is translucent, although this character varies to a considerable degree. It is lighter in color than the typically opaque black *edulis*, ranging from a rich brown to a light tan, both the translucence and the lighter color being more noticeable near the margins. Most specimens show darker rays, plainly visible inside and occasionally apparent on the outer surface as irregularly disposed radial lines. These rays are always seen by transmitted light, when they appear to be deep purple, and seen thus the whole shell has a purplish cast. The angle on the posterior side of the shell is more abrupt than in the typical *edulis* and is usually somewhat nearer the beaks. This is the shell referred to by Lamarck (1818-1819, vol. 6, pt. 1, p. 126), under *M. edulis*, as "(b) var. testa pellucida, violaceo-radiata." The two shells are always associated locally. *M. pellucidus* is regarded as a "variety" of *edulis* by most European authors, but in most recent American works it is treated as a good subspecies. The differences above are so marked and so constant that the shell is certainly deserving of subspecific rank, and I would be strongly inclined to consider it a good species.

Both Hanley and Bucquoy, Dautzenberg, and Dollfus report that the type specimen of *edulis* in the Linnaean collection is a shell which exactly conforms to that figured by Turton (1822, p. 197, pl. 15, fig. 1) and described as *Mytilus pellucidus*. This figure is an excellent drawing of the *pellucidus* of the western Atlantic and of the North Sea and the British Isles. This "form" is generally accepted as the type of *edulis* by European workers. On this basis *pellucidus* should receive the name *edulis*, and the commoner black shell should be given another name. Such a change in the name of this well-known and common species is, however, not practicable, as the name *edulis* for the black mussel is so firmly fixed in the literature that a change would cause unnecessary confusion.

*Mytilus edulis* is the type of *Mytilus* Linné, as restricted, by subsequent designation,

Gray, 1847. Schumacher (1817, p. 107) cited the "figure of the hinge of" *Anodonta anatina* (see *Mytilus anatinus* Linné below, p. 217) as the type of *Mytilus*. This designation, if valid, would make *Mytilus* the valid name for *Anodonta* Bruguière. Although Schumacher's manner of designating the type is certainly subject to criticism, it would be helpful if the International Commission on Zoological Nomenclature should validate the retention of *Mytilus* in the sense now universally used, as the transference of the name to the fresh-water genus *Anodonta* would bring about an extremely confused situation.

In addition to the figures already referred to, *M. edulis* is figured by Reeve (1843-1878, vol. 10, *Mytilus*, pl. 8, sp. 33) and by Donovan (1799-1803, vol. 4, pl. 128, fig. 1, both figs.). One of Donovan's figures is the black *M. edulis*, the other being apparently meant for *pellucidus*, although he figures the latter shell in another place (*op. cit.*, vol. 3, pl. 81, all figures). The most recent figures are reproductions of specimens in the American Museum of Natural History (Platt, 1949, p. 42, figs. 7-8), showing both the broad and narrow forms.

#### *Mytilus unguilatus*

1758, *Systema naturae*, ed. 10, p. 705, no. 216.

1767, *Systema naturae*, ed. 12, p. 1157, no. 254.

LOCALITY: "In Europae australi" (1758); "in Europae australi; ad Cap. b. spei" (1767).

"M. testa laevi subcurvata violacea, margine anteriore inflexo, cardine terminali obtusiusculo. . . . Valvulae valde convexa et juxta se positae unguilas pecorum referunt. An prioris varietas?" (1758). "M. testa laevi subcurvata margine posteriore inflexo, cardine terminali bidentado. . . . Valvulae valde convexa et juxta se positae unguilas pecorum referunt. Nates distantes, acutae. Cardo apicis dentibus 2, 3, s. 4 notatus. Color viridis aut caerulescens." (1767).

The two descriptions are set out above in full, with their significant differences, not only to suggest an apparent change in Linnaeus' conception of the species but to explain, in some measure, the handicaps that are encountered in its identification. While the species is apparently amply defined, it is not possible to point to any single species which conforms to all of the details given. Parenthetically, we have here another illus-

tration of Linnaeus' vagueness as to the orientation of the bivalve shell. In 1758 he said the anterior margin is "inflexo," but altered this to "posteriore inflexo" in 1767. As I am treating *ungulatus* as a name that is equivocally defined, it is impossible to state with any certainty which of the descriptions is correct. If *ungulatus* is a member of the *edulis* group, as I believe, then both descriptions are probably erroneous, as there is no incurving of either margin in *edulis* and its close allies. The curved *Mytili* show an incurve of the anterior side. The available figures which have been designated as *ungulatus* show a very slight inward flexure anteriorly just below the beaks.

Why did Linnaeus omit the word "violacea" in 1767? Why did he alter "cardine terminali obtusiusculo" to "cardine terminali bidentata"? And why did he suggest that *ungulatus* was a variety of *edulis* in 1758 and omit that suggestion in 1767? The original diagnosis refers to a European shell, but the author clouded the issue in 1767 by the addition of the Cape of Good Hope locality and a figure from Lister (1685-1692) which Lamarck later cited for his *Mytilus canalis* (1818-1819, vol. 6, pt. 1, p. 123), a radially ribbed species said to come from Jamaica. Two specimens are preserved in the collection to serve as the ostensible types of *ungulatus*, both bearing the tenth-edition number. One is a very large, distorted *edulis* which is uncharacteristically arcuate. The other is the shell called *M. gallo-provincialis* by Lamarck (*tom. cit.*, p. 126) which is very close to *edulis* but is given specific rank by many European writers. Lamarck said of *gallo-provincialis* (*loc. cit.*): "It resembles *M. unguatus* and *M. edulis* but is distinct from either." Lamy also treats it as a good species (1936-1937, vol. 80, p. 93), saying that it is the *M. edulis* of Poli, 1795, not of Linnaeus.

The *ungulatus* of the tenth edition is either a distorted form of *edulis* or is meant for *gallo-provincialis* Lamarck, which is so close to *edulis* that I prefer to consider it a form of that shell. In either case it has no specific validity and should be dropped. I cannot identify the twelfth-edition shell. Lamarck listed a *Mytilus unguatus* (*tom. cit.*, p. 123). The specimen on which his diagnosis was based was a shell from the Humboldt and

Bonpland collection from South American waters, and the name was borrowed directly from the account of Humboldt's voyages (1811, p. 223), although Lamarck said in his synonymy, "An *Mytilus unguatus* Lin. Gmel.?" Humboldt's and Lamarck's shell was not *ungulatus* Linné (*vide* Lamy, *tom. cit.*, p. 145), but was a Chilean species that has been identified by Clessin (1889, *in* Martini and Chemnitz, *Neue Folge*, 1837-1907, vol. 8, pt. 3, p. 65, pl. 9, figs. 1, 2) as *Mytilus (Chloromya) chorus* Molina, 1792. Lamy also said that Dall had made the same identification. In this he was in error, as in the paper referred to (1910, p. 287) Dall identified *M. chorus* with "*M. unguatus* Valenciennes, not Lamarck." Dillwyn also described a *Mytilus unguatus* (1817, vol. 1, p. 310), but this was a synonym of *M. (Chloromya) perna* (Linné) (*Mya perna* Linné, 1758). Donovan (1799-1803, vol. 4, pl. 128, fig. 2, both figs.) discussed and figured a *Mytilus unguatus* as of Linnaeus, said by him to have been collected on the coast of Cornwall, adding: "It was before known as an inhabitant of the Mediterranean, but not as a British species." The figures show a shell much like *edulis* in appearance but with markedly hooked beaks. He gives for it a translation of the description of *ungulatus* in the twelfth edition. Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, p. 136) were of the opinion that the name *ungulatus* should be dropped from the nomenclature because of the confusion to which it has given rise, and I am constrained to agree. Hanley supplied a figure of the specimen of *M. gallo-provincialis* preserved in the Linnaean collection (1855, pl. 2, fig. 4).

#### *Mytilus bidens*

1767, *Systema naturae*, ed. 12, p. 1157, no. 255.  
LOCALITY: "In M. Mediterraneo" (1767).

"M. testa striata subcurvata margine posteriore inflexo, cardine terminali bidentato . . . Simillima tota structura Mytilo unguato, sed striata longitudinaliter. Color cornu cinereus. Magnitudo pollicis transversi."

Hanley (1842-1856, p. 245) expressed the view that Linnaeus' *bidens* was identical with *Mytilus senegalensis* Lamarck (*M. puniceus* Gmelin) but he later changed his opinion and concluded that *bidens* was the same shell as "*M. exustus* Lamarck" (1855, p. 142). As

Hanley identified the latter species with the *exustus* of the "Systema," his view was that Linnaeus had described the same species twice.

Lamy (1936-1937, vol. 80, p. 171) accepts this latter identification and places *bidens* in the synonymy of *Brachidontes exustus* (Linné). There is little comment on this species in the literature, and Lamy's view is the most recent. It is difficult to reconcile the rather ample description of *bidens* in the "Systema" with the very brief diagnosis of *exustus*, particularly as no references were given for either. The Jamaican locality of *exustus* is suspiciously remote from the Mediterranean Sea, the locality of *bidens*, and, moreover, the latter is vouched for by Zoega who has been already referred to as being the closest to Linnaeus of all of the latter's pupils, and a competent and careful naturalist. The mention by Linnaeus that *bidens* was like *Mytilus unguulatus* in every way except for its radial ribs removes it still farther from *exustus*. The latter is heavily ribbed radially but is much smaller than *unguulatus*, lacks the hooked beaks of the latter, and its anterior side is much more incurved than appears in any of the illustrations of *unguulatus*, which, as already pointed out, is probably *Mytilus edulis* or one of its varieties, a species all the forms of which show a straight anterior side or even a slight convexity. Incidentally Linnaeus, in noting this feature in his description of *bidens*, was guilty of his frequent error as he says "margine posteriore inflexo." It seems most improbable, therefore, that *bidens* was *exustus*.

Schröter (1783-1786, vol. 3, p. 437) and Dillwyn (1817, vol. 1, p. 313) both referred *bidens* to the shell called *M. magellanicus* by Chemnitz (1780-1795, vol. 8, p. 162). This identification cannot be accepted. The Chemnitz species comes from the southern part of South America and is described as possessing only one tooth. *M. bidens* is smaller, "magnitudine pollicis transversi," and is said to possess two teeth. Chemnitz himself did not list *M. bidens* and, we must assume, could not identify it. In his description of the variety *viridescens* of his *Mytilus nicobaricus* (tom. cit., p. 157, pl. 82, fig. 737, 1-2-3) which has been already mentioned as a synonym of *Mytilus bilocularis* Linné, he

suggests its similarity to *bidens* saying: "The *Mytilus bidens* Linné, which is called 'gueule de souris' by the French conchologists, must be very similar in form to this species, except that the color of the present species, as illustrated, is very different from that of *Mytilus bidens*." The figures of variety *viridescens* are not only crude but do not conform with the description of *bidens*. I am forced to consider *Mytilus bidens* as a species *dubius*.

#### *Mytilus modiolus*

1758, Systema naturae, ed. 10, p. 706, no. 217.

1767, Systema naturae, ed. 12, p. 1158, no. 256.

LOCALITY: "In M. Mediterraneo" (1758); "in M. Mediterraneo, Norvegico edulis" (1767).

"M. testa laevi, margine anteriore carinato, natibus gibbis, cardine sublaterali . . . Testa saepe semipedalis, subviolacea cortice nigro; umbones tumidi, oblongi. Nates posteriora versus prominentes. Vulvae regio recurvata striata. Pars postica paulo ultra nates protuberat. Cardo cartilagineus ante nates, post vero nullus. Variat colore cinereo, luteo, nigro."

In spite of the diversity of the species represented in the synonymy of this name, the description in the twelfth edition unequivocally points to the common *Modiolus modiolus* of almost all authors, although the language of the tenth edition would fit almost any member of the genus. It is the *Mytilus barbatus* of Pulteney, 1799, *non* Linné, 1758; *Modiola papuana* Lamarck, 1819, and *Modiola vulgaris* Fleming, 1828.

Lamarck did not list *modiolus* as a good species but, with a query, placed it in the synonymy of his *Modiola tulipa*<sup>1</sup> (1818-1819, vol. 6, pt. 1, p. 111). The confusion that plagued the earlier writers was probably caused by the pre-Linnaean authors who associated it for some reason with an East Indian mussel which they called "The Amboina Muscle" (Petiver), "*Musculus papuanus*" (Argenville), and "Moule de la terre de Papous" (Davila). Chemnitz, who correctly used the name *Mytilus modiolus* Linné and cited the "Systema" and the "Museum

<sup>1</sup> *Modilus tulipus* of authors, *Volsella americana* (Leach), is attributed to Linnaeus by many recent American writers, through an error of which the origin is not clear. It is not a Linnaean name, and the species was first described by Lamarck in 1819.



Ulricae" descriptions, referred to it as "Die sogenannte papuanische Weissmuschel," as did Born in 1778, who called it "Die Pampusmuschel." Lamarck, in addition to placing *modiolus* in the synonymy of *tulipa*, with a question mark, listed a *Modiola papuana* (*loc. cit.*) but, in spite of the error implicit in the geographical name of the shell, stated plainly that it was found in the North Atlantic and the North American coast and adds, "Probably it is not found in New Guinea." It seems certain that Lamarck, despite the name he gave it, was familiar with the European and American *modiolus*. In the later edition of the "Histoire naturelle," however, Deshayes and Milne-Edwards said that they were unable to refer the Linnaean name to any known *Modiolus* and suggested its abandonment (1835-1845, vol. 7, p. 18). Even before Lamarck the British and German conchologists had generally recognized the species,<sup>1</sup> and since that time its recognition has been unquestioned.

The synonymy of *M. modiolus* in the "Systema" is very diversified, probably because of Linnaeus' inability to find anything but approximations to his species. The Argenville and Rumphius figures show a shell with merely the general outlines of *modiolus*. The figure from Bradley is certainly meant for *M. edulis*. Only one of the additional references in the twelfth edition, that of Gualtieri, shows any resemblance to *modiolus*. The Petiver and Lister drawings might be referred to Lamarck's "variety" of *Modiola tulipa*.

The species is circumpolar, ranging in the eastern Atlantic from Iceland and Spitzbergen to the Bay of Biscay and in the western Atlantic from Greenland to Cape Hatteras. In the Pacific it is found from Bering Strait to Lower California and Mexico and has been reported from Japan. It is the type of *Volsella* Scopoli, 1777, by subsequent designation, Gray, 1847, and was also validly designated as the type of *Modiola* Lamarck, 1801, by Fleming in 1818, using in this instance the word "type" rather than the phrase "represented by," a locution Fleming

<sup>1</sup> Donovan (1799-1803, vol. 1, pl. 23), Pennant (1812, p. 238, pl. 67, fig. 2), Da Costa (1778, pl. 15, fig. 5), Born (1780, p. 128); Chemnitz (1780-1795, vol. 8, p. 178, pl. 85, fig. 757, a poor figure probably representing another indeterminable species).

often employed in certain attempted type designations.

In addition to the figures cited above it is figured by Reeve (1843-1878, vol. 10, *Modiola*, pl. 1, sp. 2). Crouch's figure is also useful (1826, pl. 11, fig. 1), though he refers to it as *M. tulipa* Lamarck.

#### *Mytilus cygneus*

1758, *Systema naturae*, ed. 10, p. 706, no. 218.

1767, *Systema naturae*, ed. 12, p. 1158, no. 257.

LOCALITY: "In Europa, ad ostia fluviorum" (1758, 1767).

"M. testa ovata antice compressiuscula fragilissima, cardine laterali."

This is the common European fresh- and brackish-water *Anodonta cygnea*. Its early identification was based not so much on the somewhat incomplete description as on the European locality and the presence of an authoritatively marked specimen in the collection. The synonymy, as corrected, is accurate. The reference to Lister contains what is undoubtedly a typographical error, as figure 8 should be referred to Lister's plate 153, not 193 as stated by Linnaeus.

The species is the type of *Anodonta* Lamarck, 1799, by monotypy.

There are many good figures of this common shell. The best is found in Donovan (1799-1803, vol. 2, pl. 55), although it is somewhat exaggerated as to color. Gualtieri's drawing (1742, pl. 7, fig. F) is accurate and one of the best of his usually crude figures. It is well figured in Reeve (1843-1878, vol. 17, *Anodonta*, pls. 1-2, sp. 2, 2b). Crouch (1826, pl. 9, fig. 6) has a characteristic figure, as *Anodon cygnea*.

#### *Mytilus anatinus*

1758, *Systema naturae*, ed. 10, p. 706, no. 219.

1767, *Systema naturae*, ed. 12, p. 1158, no. 258.

LOCALITY: "In Europae aquis dulcibus" (1758, 1767).

"M. testa ovali compressiuscula fragilissima margine membranaceo, natibus decorticatis . . . Similis Myae pictorum sed fragillior et cardine distinctissimus. Anatum cibus."

This description is more characteristic than that of *M. cygneus* (the preceding species) and is sufficiently detailed to distinguish it from that shell. The specimen marked for *anatinus* in the Linnaean collection is repro-

duced in color by Hanley (1855, pl. 2, fig. 1). It is a characteristic portrayal of *Anodonta anatina*, except that the clear green color of that shell, much brighter than that in *cygnea*, is not brought out in the illustration. Hanley called this specimen *A. complanata* Rossmässler.

For many years *A. cygnea* and *A. anatina* were considered distinct species, but we are probably correct in treating *cygnea* as a very polymorphic species with many forms, of which *anatina* is one. The latter is much smaller than the typical *cygnea*, and its anterior wing is much more produced. Hanley (1855, p. 145) recognized that only one species was involved, but believed that the type specimen of *anatina* in the collection was not the variety usually called *anatina*, saying: "Had the winged variety of *cygnea*, ordinarily termed *A. anatina*, been designed by our author, he would scarcely have written in his own copy 'similis 28 (*Unio pictorum*) sed absque cardine.'" The fact remains, however, that Linnaeus' specimen is a winged form, as is clearly shown in Hanley's illustration (*op. cit.*, pl. 2, fig. 1).

The *A. complanata* of Rossmässler, to which name Hanley referred the shell marked for *M. anatinus*, is very close to *cygnea* but is considered by Ortmann (1911a, p. 23) to be a good species. Lea regarded it as a mere variety of *cygnea*. The question of the separation of the forms in the *cygnea* complex is perhaps academic, but it is at least certain that Linnaeus properly distinguished his two species. His *cygnea* was the form called *cellensis* by Rossmässler, and his *anatina* seems to have been *complanata* Rossmässler.

The references for *anatinus*, like those for *cygneus*, are for the most part inaccurate. Gualtieri (pl. 7, fig. E) shows a *Unio*, a genus with hinge teeth. Lister (1678, appendix, pl. 1, fig. 2) is apparently *cygnea*, and the other Lister figure (1685-1692, pl. 154, fig. 9) pictures, according to Hanley (*loc. cit.*), "a Virginian *Anodonta*" which he does not further identify. I am unable to guess what it represents or what Hanley supposed it to represent. The reference to the "Fauna Suecica" merely confirms that the form *anatina* occurs in the region covered by that work.

As in the case of *cygnea* many good figures

of the form *anatina* are available. Chemnitz' figure (1780-1795, vol. 8, pl. 86, fig. 763) is accurate, though with the common fault that it is too highly colored. Donovan's figure (1799-1803, vol. 4, pl. 113) is excellent. I have found no distinctive figure of *complanata*.

#### *Mytilus viridis*

1758, *Systema naturae*, ed. 10, p. 706, no. 220.

1767, *Systema naturae*, ed. 12, p. 1158, no. 259.

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

"M. testa laevi ovata membranacea pellucida, cardine terminali."

Although no references were supplied for this name, the description clearly points to a *Mytilus* and, conjoined to the specific name, is sufficient to identify it with the *Mytilus viridis* of later writers. A properly marked specimen of that shell is present in the collection. The type specimen is an immature individual, but, according to Hanley (1855, p. 145), Linnaeus apparently saw adult examples at some time, as a manuscript note to the species reads "oblonga, antice compressa, sublunata." It is not clear how this added language points to an adult rather than to a juvenile shell. It is also difficult to determine whether Linnaeus used the word "antice" properly. The shell is flatter (? "compresso") posteriorly.

*Mytilus smaragdinus* Gmelin, 1791, and Lamarck, 1819, as well as *M. opalus* Lamarck, 1819, were thought to be distinct species by the early conchologists, but they are now recognized to be identical with *viridis*. The diagnosis in the "Systema" is sufficiently accurate and characteristic to justify the retention of the Linnaean specific name.

The species belongs in *Chloromya* Mörch, 1853, a group that is treated today as a subgenus of *Mytilus*, with *Mytilus perna* (Linné) (*Mya perna* Linné, 1758) as subgenotype. This group is distinguished from *Mytilus*, *sensu stricto*, by the greater incurve of the anterior side and by the presence of only two (and frequently only one) small teeth in the cardinal plate of one valve and two in the other. In *viridis* the single tooth is in the right valve. In *perna* it is in the left.

The species ranges throughout the Indian Ocean and as far east as the Philippines.

It is well figured by Reeve (1843-1878, vol.

10, *Mytilus*, pl. 7, sp. 28) as *smaragdinus*. Chemnitz' figures (1780-1795, vol. 8, pl. 83, fig. 745, pl. 84, fig. 746) are crude and inaccurate, showing none of the characters of *viridis* except the green epidermis. Chemnitz' locality is, however, accurate, and his description is detailed and correct, although, strangely enough, he did not refer to Linnaeus' species.

#### *Mytilus ruber*

1758, *Systema naturae*, ed. 10, p. 706, no. 221.

1767, *Systema naturae*, ed. 12, p. 1158, no. 260.

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

"M. testa rugosa, valvulis obliquis antice dilatatis, margine cardinali apicem aequante."

Linnaeus' vagueness as to the orientation of the pelecypod shell is again illustrated here. The "postice dilatatis" of the tenth edition was erroneously changed to "antice dilatatis" in 1767.

This brief and unenlightening description has proved insufficient for the identification of the species. The sole reference (Argenville, pl. 25, fig. Q) is followed by a question mark in the tenth edition. It was probably based on a young individual of *Mytilus afer* Gmelin, though it does conform to the meager details of the description. The collection contains no specimen marked for *ruber*, although Linnaeus must have owned the shell at some time as it appears on the list of his cabinet. Of the present contents of the collection, the shell that most nearly agrees with the description is a worn specimen of *M. barbatus* which lacks the hairy epidermis. The concordance of the description with *barbatus* is, however, hardly close enough to be of significance. I have not been able to find any further suggestion as to the identity of *ruber*. Lamy (1936-1937, vol. 80, p. 266) merely mentions the above possible identification with *barbatus*, but concludes: "But this form, for which one cannot even state whether it is a *Mytilus s. str.* or a *Modiola*, remains ambiguous." The final bit of evidence from the hand of Linnaeus is a manuscript note reading "dens nullus" opposite the description of *ruber*. This might indicate a member of the genus *Volsella*, but is of little weight when one realizes Linnaeus' apparent confusion as to the presence of teeth in the hinges of the various species in his *Mytilus*. It will be remembered that he

used the same phrase in a manuscript note to *barbatus*. In the "Museum Ulricae" description, published between the dates of the tenth and twelfth editions of the "Systema," the phrase "dente brevissima" is used, possibly indicating that the shell there described was a *Mytilus*, and Hanley in fact (1855, p. 146) suggested as "probable" that the "Museum Ulricae" shell was a different species than that described in the "Systema." He agreed, however, that the name *ruber* should be dropped from the nomenclature. Certainly there is not sufficient evidence to identify it.

#### *Mytilus discors*

1767, *Systema naturae*, ed. 12, p. 1159, no. 261.

LOCALITY: "In Norvegia, Islandia" (1767).

"M. testa ovali cornea subdiaphana antice longitudinaliter postice transversaliter striata."

The elaborate subdescription of this species is not quoted, as the main description above is entirely sufficient to identify the species. No other member of *Mytilus* Linné conforms to it.

Two specimens are found in the Linnaean collection marked for *discors*, which were known in Hanley's day as *Modiola discrepans* Montagu, 1803, and *Modiola laevigata* Gray 1824, respectively, and were so identified by him (1855, p. 146). The earlier British conchologists considered the two shells as varieties of the same species, but Gray's *laevigata* is clearly distinguishable by its smaller size and by the fact that its posterior area, although more sharply delimited, lacks any radial sculpture. It is a circumpolar species the range of which is restricted to boreal waters. *M. discrepans* Montagu, the posterior area of which bears radial sculpture, more closely conforms to the description of *discors* and is therefore accepted as its representative. It is also a circumpolar species, but its range is much wider. It is found from Iceland and Greenland to the Bay of Biscay in the eastern Atlantic and as far south as Cape Cod on the American coast. The United States National Museum has specimens purporting to come from Long Island Sound. In the Pacific it ranges south to Oregon and Japan.<sup>1</sup>

<sup>1</sup> This is not *Modiola discrepans* Lamarck, 1819, which is an earlier name for *Modiolaria marmorata* Forbes, 1838.

*Mytilus discors* Linné has been traditionally placed in *Modiolaria* Beck, 1838, and that genus is still used for it by many European conchologists. The name *Musculus* Röding is an exact synonym, however, and should be used, as having many years' priority. The use of *Modiolaria* has been based partly on an uncertainty as to the validity of the Röding generic names and partly, in the case of those authors who wrote before the "Museum Boltenianum" came to the attention of students, on the mistaken view that it was preoccupied by *Musculus* Martyn, 1787, a name given to an entirely different group. The great majority of workers today do not accept the Martyn names, as his classification was non-Linnaean. The present species has also been placed by some of the early writers in *Crenella* Brown, 1827. *M. discors* is the type of *Modiolaria* Beck, *vide* Stoliczka, 1871, and of *Musculus* Röding, by subsequent designation, Iredale, 1915.

It is well figured in Reeve (1843-1878, vol. 10, *Modiola*, pl. 9, sp. 52, fig. 65) and in Sowerby (1820, 1825, 1834, vol. 1, pl. 99, fig. 4).

#### *Mytilus hirundo*

1758, *Systema naturae*, ed. 10, p. 706, no. 222.

1767, *Systema naturae*, ed. 12, p. 1159, no. 262.

LOCALITY: "In O. Meridionali, Mediterraneo" (1758, 1767).

"M. testa laevi, valvulis bilobis, lobo cardinali longiore tenuioreque . . . Testa basi contracta, alterius valvulae magis."

This name is referred today to the *Pteria hirundo* of the Mediterranean Sea and the French Atlantic coast, although it is obvious that the *hirundo* of the "Systema" was a composite species. The brief description covered all of the *Pteria* known to Linnaeus, and the synonymy supplied figures of several different species, among them being the *Avicula macroptera*, *semisagitta*, *crocea*, and *tarentina* of Lamarck, 1819, and the *Pinctada colymbus* of Röding, 1798 (*Avicula atlantica* Lamarck, 1819). The description in the "Museum Ulricae," although more detailed, has still the fault of being too comprehensive, and each of the references there cited shows a different species.

Chemnitz described and figured for *Mytilus hirundo* Linné (1780-1795, vol. 8, p. 136, pl. 81, fig. 722) a shell which cannot be recog-

nized from the highly stylized drawing, but which is certainly not the shell known as *hirundo* today. He said that he possessed specimens from the East and West Indies, the Mediterranean Sea, and the Guinea coast, thus disclosing that his species was also composite. He then described and figured (*tom. cit.*, p. 142, pl. 81, fig. 725) a species which he called "*Mytilus hirundo e mari Mediterraneo*," the figure of which is an undoubted drawing of the Mediterranean *hirundo* of all modern authors. Lamarck, who placed this group in his *Avicula*, was the first writer to break down this composite species and give specific names to the several forms comprised in the Linnaean description and references, but in so doing he omitted the name *hirundo* altogether. He used Chemnitz' figure 725, which most resembles the *hirundo* of authors, for his *Avicula falcata*, which he located in Australia. His only use of the name *hirundo* was in the following sentence from his "Observations" on the genus *Avicula*, "Linnaeus, who wrongly placed these shells among his *Mytilus*, only saw in them a single species—*Mytilus hirundo*." It is not absolutely certain which of the Lamarckian names is the *hirundo* of modern authors, but his *A. tarentina* is generally accepted as being identical.

I cannot find that any reviser has properly restricted this composite species to any one of its components, at least until 1898. In that year Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, p. 116) treated it as follows: "*Mytilus hirundo*, as Linnaeus conceived it, included all the *Avicula* known in his day and we can recognize, whether among his references or among the specimens in his collection, the shells we designate today under the names *A. crocea* Lk., *A. semisagitta* Lk. and *A. macroptera* Lk., in addition to the European species. But, if it were enough, in order to reject a Linnaean name, that it was too inclusive . . . there would remain only a small number of species in the 'Systema naturae.' It is true that most of the names of the other species have been consecrated by usage, while for our *Avicula* it is the *tarentina* of Lamarck which is most generally employed.

"What decided us to restore the name *hirundo* is that in 1795 Poli applied it espe-

cially to the Mediterranean shell and that since then the name has not been used in any other sense." (Italics mine.)

The above is possibly sufficiently definite language to restrict the name *hirundo* to a single species. It will be noted, however, that it is a mere reliance upon what a prior author is supposed to have said, but did not say. Poli (1791, 1795, vol. 2, p. 221) cited *hirundo* as of Linnaeus and copied most of Linnaeus' references. His whole diagnosis gives us no hint that he knew he was dealing with a composite species, and certainly he used no restrictive language. It is true that his figure (*tom. cit.*, pl. 32, fig. 17) is an adequate representation of the Mediterranean shell, but it could not have been otherwise as his book covered only the Testacea of "the two Sicilies." Prior to this, when Scopoli listed *hirundo* in erecting the genus *Pteria* in 1777, he merely lifted the name from the "Systema" without comment. Gmelin and the other writers did the same. Following Bucquoy, Dautzenberg, and Dollfus' work, Lamy (1935b, p. 129) referred to the comments of those writers, saying: "But this name *hirundo*, having been applied by Poli (1795, Test. utr. Sicil. 2, p. 221, pl. 32, figs. 17-21) exclusively to the Mediterranean shell generally called *A. tarentina* Lamarck, has been adopted by Bucquoy, Dautzenberg, and Dollfus (1890, Moll. mar. Roussillon, 2, p. 116)."

The action taken in both of these French works, although possibly adequate, is not to my mind sufficiently unequivocal to support a valid restriction, and as I cannot find any other author who has done so, I think it advisable here to restrict the name *Mytilus hirundo* Linné to the Mediterranean shell long known as *Mytilus tarentina* Lamarck, 1819, with a restoration of the Linnaean specific name.

The species, as so restricted, belongs in *Pteria* Scopoli, 1777, of which it is the type, by monotypy. In addition to the figures mentioned above, it is figured by Thiele (1931, 1935, vol. 2, p. 803, fig. 800) whose figure is almost identical with figure 725 from Chemnitz, and by Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, atlas, pl. 22, figs. 1-2, from the French Atlantic coast, and figs. 3-4, from the western Mediterranean).

#### *Mytilus pholadis*

1771, Mantissa plantarum, regni animalis appendix, p. 548.

LOCALITY: "In Oceano septentrionali."

The "Mantissa" description of this species need not be quoted, as *pholadis* is fully discussed above (p. 32) in connection with *Mya archica* Linné, 1767 (*Hiatella archica*). Opinion is divided as to whether it is a variety of *archica* or a distinct species. I am tentatively accepting the latter view.

#### *Mytilus striatulus*

1771, Mantissa plantarum, regni animalis appendix, p. 548.

LOCALITY: "In Oceano septentrionali."

"Testa subtilissime striata, cardine terminali unidentato . . . Testa magnitudine extimi pollicis, sublunata, antice dilatata, subdiaphana, grisea, subtilissime striata, striis, si advertas, subcrenatis. Margo extrorsum subtilissime crenatus."

There is some evidence that this dubious species is identical with *Mytilus exustus* Linné. The description suggests a *Brachidontes*, and Dall (1890-1903, pt. 4, p. 788) synonymizes it with *exustus*. The words "subtilissime striata," however, do not suggest the marked radial sculpture of *exustus*.

In Dall's synonymy (*loc. cit.*) the species is cited as *M. striatulus* Schröter (1786, p. 449, pl. 9, fig. 16), but Schröter clearly intended to describe *striatulus* Linné, as he cites it as of "Lin. Mantissa." His figure looks somewhat like *exustus*, although it shows a greater incurving of the anterior margin and has a slightly more hooked outline. It has rather heavy, close-set ribs, some of which appear to be bifid near the ventral margin, as in *exustus*. Hanley remarked (1855, p. 455) that "Schröter's identification seems to have been generally accepted." I am not certain, however, just what Schröter's identification was. His figure does not conform to the description of the radial sculpture of *striatulus*, nor to the outline of *exustus*.

It is possible that Linnaeus based his species on a degenerate or deformed specimen of *exustus* and that Schröter merely used a carelessly drawn figure. The weight of evidence, however, seems to be against an identification of *striatulus* as *exustus*. Not only are there elements of the description

that are inapplicable to *exustus* (witness the words "subtilissime striata," "sublunata," and "subdiaphana"), but the locality "Oceano septentrionali" is suspiciously far removed from the subtropical range of *exustus*. The literature contains no other comments on the identification of the present species.

#### PINNA LINNÉ

The eight species of *Pinna* in the "Systema" fall into two main groups separated by the presence or absence of a median sulcus in the interior nacreous layer of both valves, extending from the apex to a point about one-half to two-thirds of the distance to the posterior margin, that is, approximately to the site of the posterior adductor muscle scar. This groove divides the anterior portion of the shell into two areas, ending posteriorly in two lobes. Those species with the interior groove are left in the genus *Pinna*. Those lacking this feature fall into *Atrina* Gray, 1847.<sup>1</sup>

It should be pointed out that the interior median sulcus in *Pinna*, while a constant diagnostic character, is not an obvious feature in most species and is often difficult to detect in young shells. It is always accompanied, however, by a more or less pronounced keel on the exterior surface. This makes a cross section of the shell through its upper third markedly and symmetrically angulate, while a similar cross section of an *Atrina* is evenly rounded. This is the safest and most easily determined method of distinguishing the two genera.

*Streptopinna* von Martens, 1880, is a third genus represented in the *Pinna* of the "Systema." Its type is *Pinna saccata* Linné, by monotypy, and it is generally used as a subgenus of *Atrina*. "Its shell is more or less irregularly shaped and twisted. Sculpture consists of rather large coarse ribs; color yellow orange to reddish brown" (Dall, Bartsch, and Rehder, 1938, p. 76).

Winckworth (1929b, pp. 276-287) has written the most recent description of the anatomy, orientation, and development of both

<sup>1</sup> Gray also used the name *Atrina* in 1840 (p. 151). This use is generally held to be a *nomen nudum* (but see Iredale, 1913, p. 303). The 1847 publication of *Atrina* by Gray (p. 199) is accepted by most conchologists as the first valid proposal.

the shell and the animal in *Pinna*. He points out (p. 279) that the group is unique among bivalves in that the growth is almost entirely in a posterior direction, that is, away from the apex which is buried in the sea bottom and towards the broad posterior end which projects. There is also a very limited and almost unnoticeable growth anteriorly. As the apex is continually being worn away by the friction of burrowing, and sometimes broken through, new protective septa are laid down, probably to protect the soft parts, which must therefore retreat as successive septa are formed. This results, in adult specimens, in a series of narrow empty chambers separated by extremely thin and closely packed laminae. Another unique feature of the shell is that it consists of only two layers, an inner nacreous layer and an outer fibrous crystalline layer consisting of minute prisms. The nacreous layer is not deposited over the entire inner surface of the shell, the posterior third and most of the ventral margin being composed only of crystalline material.

Winckworth (p. 280) does not entirely accept the division of the *Pinnae* into the three genera mentioned above. He says: "The species of *Pinna* show such a general agreement in their more important features that it does not seem advisable to split the genus, with the possible exception of *P. saccata* Linné." He does, however, divide it to the extent of treating both *Atrina* and *Streptopinna* as subgenera of *Pinna* Linné. Thiele (1931, 1935, vol. 2, p. 804) makes *Atrina* a subgenus, with *Streptopinna* a section under it. I am adopting the view that all three groups are entitled to generic rank, which seems to be the opinion of most American conchologists.

One of the most striking features of the species of Pinnidae is the strong byssus which issues from the ventral margin near the apex and anchors the shell, apex down, in the sea bottom. The shell is thus fixed so securely that it is difficult to remove it without damaging the very fragile valves, as the adductor muscles are so strong that any disturbance causes the animal to close the valves suddenly and violently. The byssus is composed of very fine silky strands, which were used by the Greeks and Romans for the weaving of garments.

The *Pinnae* are very variable in form and often in color. The former is (*vide* Winckworth, 1929b, p. 280), a distortion of the shell due to the twisting of the animal in maintaining its position in a shifting bottom, to the influence of currents, and at times to the efforts of the animal to by-pass obstacles in its burrow. The variability in color is little more marked than in other groups and is probably entirely ecological. These variations have been in part responsible for the difficulty in identifying several of the species, but the greatest handicap in fixing the Linnaean names has been the almost uniform weakness of the pictorial synonymy in *Pinna*, and, in the case of the last two species (*digitiformis* and *lobata*), the absence of any references whatever. In the study of the phylogeny of the *Pinnae* little help is obtained from fossil shells, as the valves are so fragile that uncrushed specimens in good condition are extremely rare, and the outer shell layer is so often lost that the external sculpture is difficult to determine. Internal casts are of little diagnostic value for the same reason.

Another handicap to be overcome in the identification of the *Pinna* species, and particularly of the Linnaean names, is the necessity of unraveling the duplicating synonyms of some of the species. The Linnaean specific names *rudis*, *pectinata*, *nobilis*, *muricata*, and *rotundata* have been used so often for so many different species, and even for one another, that it is impossible to reassign them properly without abandoning usages that have been, locally at least, fairly well established. A glance at the labels in any of the large collections is sufficient evidence of this. Winckworth's "Appendix of Recent species," contained in the paper above referred to, has been an important contribution in the clarification of the nomenclature of the group.

#### *Pinna rudis*

1758, *Systema naturae*, ed. 10, p. 707, no. 223.

1767, *Systema naturae*, ed. 12, p. 1159, no. 263.

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

"P. testa sulcata: squamis fornicatis per series digestis . . . Testa rudior cornei coloris, longitudinaliter grosse sulcata s. rugosa 5 ad 8 sulcis; nec alba, tenuissimis numerosissimisque striis P. nobilis.  $\beta$  Testa rudis, facie pernae suillae, nigra

extus et intus, saepe non sulcata ad summos margines, ubi adultior, adspersa aquamis raris fornicatis."

The description of *P. rudis* is sufficiently detailed and reasonably characteristic, but contains some questionable language which may have been responsible for the subsequent confusion as to its identification and proper locality, and which is commented on below.

Many modern conchologists, even though Linnaeus gave no American locality for the species, insist that it is a West Indian shell, but I am convinced that it is a purely European species. Dall (1897, p. 25) cited it from Bermuda and the Bahamas as "*Pinna rudis* (Linné) Chemn. (+*pernula* Reeve non Chemn.)," and Johnson (1934, p. 22) reports it from the same localities. Winckworth (1929b, p. 295) says of it: "The West Indian species commonly so-called must take this name." It is difficult to understand the basis of this opinion. There exist only three members of the family Pinnidae in the western Atlantic (*rigida* "Solander" Humphrey, 1786 [usually cited as of Dillwyn, 1817], and *serrata* Sowerby, 1825, both of which are atrinas and easily distinguishable, and *carnea* Gmelin, 1791, which is a true *Pinna*). The last, though a slightly variable shell, is astonishingly constant in its major characteristics. It ranges from Cape Hatteras through the West Indies, being especially common in the Bahamas. It is a comparatively long and narrow shell of graceful form, fragile and pellucid, and almost always of a pink to reddish color, though some specimens, especially young shells, show only a faint pink tinge or are horn-colored. It has five to eight broad, rounded ribs which are usually sparingly spinose on the posterior end of the shell. A spineless form is common, although in most of these individuals the spines are obsolescent, being represented by a low tuberculation of the ribs.

The statement that *rudis* is found in the West Indies thus involves saying that two species of *Pinna*, *sensu stricto*, exist side by side in that region, as both *rudis* and *carnea* are usually listed as good species. The writer has collected *Pinna* rather extensively in Florida and the Bahamas (although not in Bermuda) and has never seen the shell that is

called *rudis* and has never seen a specimen of *carnea* that is sufficiently divergent from the typical form as to merit even a varietal name or that conforms to the description of *rudis*. The extensive series of *carnea* in the American Museum of Natural History and the United States National Museum include no specimen of *carnea* from the western Atlantic that could justify a division of the species, and no specimen that is called *rudis*. It should be noted that in the original description of *rudis* not only is no American locality stated but there is no hint that the shell is fragile or pellucid; rather it is called "Testa rudior," and this character is reflected in the specific name. Nor is there any mention of its pink color. I must conclude, therefore, that the use of the name *rudis* for any western Atlantic *Pinna* is based upon error.

There is, however, a species common in the eastern Atlantic islands which I suggest is the *rudis* of Linnaeus. It is a very close relative of the West Indian *carnea*, but its characters not only separate it from that shell but conform, in all particulars save one, to the description of *rudis*. A large series of this species from the Cape Verde Islands is in the collection of the American Museum of Natural History. As the Pinnidae in this collection have not been reclassified for many years, they are labeled *Pinna carnea* Gmelin. The shell in question is far heavier and coarser and somewhat shorter than *carnea*. It is only slightly pellucid. It has seven to eight ribs which are spinose in the same manner, and with the same variation in spinosity, as *carnea*, and as in *carnea* some specimens are spineless. It is of a dirty pink color, although the shell is so coarse and the specimens in question so heavily encrusted that the pink is hardly noticeable on the outside. The inner nacreous layer is a brownish red. If this is the *rudis* of Linnaeus, as I think it is, then the author had examined a horn-colored specimen, as the description reads "cornei coloris." This is the only divergence of the description of *rudis* from the Cape Verde Island shells, and it should be noted that, even in *carnea* of the West Indies, occasional specimens are found that display little or no pink color. I have never found anything remotely resembling the Cape Verde Islands specimens in the western Atlantic, nor have I seen anything

resembling them in the other large collections.

The history of the name *rudis* illustrates the confusion as to its locality. Gronovius, 1781, was the first to suggest an American locality for the species. He copied the Linnaean main description and gave as locality "Oceano Americano ad Curassaviam et in India." Chemnitz (1780-1795, vol. 8, p. 218, pl. 88, fig. 773) cites it as of Linnaeus and located it "on some of the West Indian Islands." His figure 773 is generally recognized for *rudis* but shows a very red shell which is much coarser than *carnea* and with more numerous and more highly developed spines. It is significant that Chemnitz also described and figured a *P. pernula* (*tom. cit.*, p. 242, pl. 92, fig. 785), the figure of which is in fact a much more accurate representation of *carnea* than the one he supplied for *rudis*. His specimen, on which he based figure 773, was said to come from "the West Indies on St. Croix Island." *P. pernula*, which must be cited as of Röding, 1798, is recognized by Winckworth (1929b, p. 294) as being a synonym of *carnea* and based on the Chemnitz figure 785. Lamarck (1818-1819, vol. 6, pt. 1, p. 150) confined *rudis* Linné to "the American and Atlantic Oceans" and refers to Chemnitz' figure 773, the figure that may possibly have been an exaggerated drawing of *carnea*. He also notes that the shell may reach a foot and a half in length, which far exceeds the greatest length reported for either *carnea* or *rudis*. Reeve (1843-1878, vol. 11, *Pinna*, pl. 10, sp. 19) describes *rudis* as having "a very irregular, blistered growth and deep orange-red in color" and adds that "the scales, which are large and semi-tubular, are also of a rude, irregular growth." He gives no references except the twelfth edition of the "Systema" and states the locality as "the West Indies." His figure is a fantastic drawing of a blood-red, twisted, and deformed shell with large, irregular, tubular spines. If it is meant either for *carnea* or the European *rudis* it must have been based upon a freak or diseased specimen. It is unrecognizable.

Later writers have seemingly followed blindly in the footsteps of their predecessors in saying that *rudis* Linné and *carnea* Gmelin exist side by side in the West Indies.

The description of *rudis* in the "Museum



Ulricae" paraphrases that in the "Systema" in many respects, but substitutes "feruginea" for "cornei coloris" and uses again the unfortunate phrase "numerosissimisque striis *P. nobilis*." The latter words make one suspect that a different shell was being described, as *rudis* has only five to eight ribs, but possibly Linnaeus was referring to the minor striations on the ribs. This would make the description conform in all respects to the Cape Verde Islands shell.

There is no specimen marked for *rudis* in the collection, but a small reddish fragment of a *Pinna* is present which may be from a young *carnea*.

The variety "β" of the "Systema," which was added only in the twelfth edition, is the shell that was called *Pinna nigra fumigata* by Chemnitz (1780-1795, vol. 8, p. 221, pl. 88, fig. 774) and *P. nigra* by Dillwyn, 1817. It should, however, fall into the synonymy of *P. vexillum* Born, 1780, of which it is an exact synonym. It is an Indo-Pacific species and is in no sense a variety of *rudis*. Its distinguishing characteristics are its jet-black color within and without, its rounded shape, and the marked incurving of the ventral margin near the apex.

*Pinna vexillum* Born is the type of *Atrina* Gray, 1847, by original designation. *Pinna rudis* Linné, which I conclude is the European shell, was designated as the type of *Pinna* Linné by Children in 1823 and by Gray in 1847, but in the discussion of *Pinna muricata* (below) it is shown that the latter species is the type by absolute tautonymy.

#### *Pinna pectinata*

1767, *Systema naturae*, ed. 12, p. 1160, no. 264. LOCALITY: "In India" (1767).

"P. testa dimidia longitudinaliter striata, latere altero transverse subrogoso."

The description is brief but, so far as it goes, is adequately characteristic. The only other pinnas showing the two different types of sculpture on the two sides of the shell that could be confused with it are *P. incurvata* Chemnitz (*P. incurva* Gmelin) (1780-1795, vol. 8, p. 229, pl. 90, fig. 778); Reeve, 1843-1878, vol. 11, *Pinna*, pl. 5, sp. 8) and *P. papyracea* (Chemnitz) Gmelin (*tom. cit.*, p. 243, pl. 93, fig. 786; Reeve, 1858, *tom. cit.*, pl. 8, sp. 14). In both *incurva* and *papyracea* the two

types of sculpture are divided by a slight keel, which is lacking in *pectinata*, and both are further distinguished by their elongate, narrow outline, their lighter structure, and the fact that their ventral portion is transversely wrinkled rather than being rugose.

The *pectinata* of Chemnitz (*tom. cit.*, p. 213, pl. 87, fig. 770) is probably the Linnaean species, although Reeve (*tom. cit.*, pl. 22, sp. 42) puts *inflata* (Chemnitz) Wood (*tom. cit.*, pl. 87, fig. 771) in the synonymy of *pectinata*. The two Chemnitz figures are much alike, but Winckworth (1929b, pp. 292, 294) distinguishes them and considers that *inflata* is based on figure 771, while *pectinata* is referred by him to figure 770.

The sole reference cited by Linnaeus for *pectinata* ("Gualtieri, t. 79, f. A") is a fair picture of the species and is in approximate agreement with the description.

Hanley (1855, p. 149) was of the opinion that the Gualtieri figure agreed with what he called "the abundant European species habitually thus named" and said that a specimen of this shell, as figured by Turton (1848, p. 222, pl. 19, fig. 1) was present, though unmarked, in the Linnaean collection. The Turton figure and the specimen referred to are in reality *Pinna fragilis* Pennant, 1777, which is also the *P. ingens* of Montagu, 1803. The specimen, however, is without authority, being unmarked and not on Linnaeus' list, and was probably added later. It is now recognized by most conchologists that *pectinata* is wholly distinct from the European *fragilis* and is confined to the Indo-Pacific region, as Linnaeus stated. It ranges from the coast of India as far east as the East Indian islands and the Philippines. Winckworth (1929b, p. 288) says of the Gualtieri figure: "But it would equally well serve as a figure for this species [*pectinata*] and Linnaeus definitely says the shell is East Indian. I do not see that we have any option but to fix the name on the Indian and not the English species, even admitting that the localities in the *Systema Naturae* are to be regarded suspiciously . . . the description fits the Indian species rather better in stating that the ventral side is subrugose." The last feature is not a character of *fragilis*.

Bucquoy, Dautzenberg, and Dollfus (1882-1898, vol. 2, p. 118), writing on the shells of

the western Mediterranean, were still of the opinion that *pectinata* was a European species. They list it from the Roussillon under that name and place both *fragilis* Pennant and *ingens* Montagu in its synonymy. They also list as synonyms *P. muricata* Da Costa, 1778 (*non* Linné), *rudis* Poli, 1795 (*non* Linné), and *truncata* Philippi, 1844. They place great confidence on the concordance of the Gualtieri figure with the Linnaean description, saying (*tom. cit.*, p. 122): "It is at least as variable as *nobilis*, but if the type of *nobilis* is difficult to fix, that is happily not true of *pectinata*. Gualtieri's pl. 79, fig. A, Linné's only reference, is precisely the huge shell with radiating ribs, not squamous, which has been called *ingens* and *fragilis* and *truncata*." They list as varieties of their supposed *pectinata*: *laevis* Donovan, 1803, which is the variety *incurvata* Born of *P. nobilis* Linné (see Reeve, *tom. cit.*, pl. 28, sp. 53, as *ingens*), *angusta* Weinkauff, 1867, and *spinulosa*, their own name. They give the range of "*pectinata*" as the English Channel, the French and Portuguese Atlantic coast, and the Mediterranean.

The Indian species, *pectinata* Linné, is very variable in sculpture, and this variability has resulted in several specific names which should be synonymized with *pectinata*. The form *P. assimilis* Reeve, 1858, is strongly spinose over the entire shell; *P. lurida* Reeve, 1858, is spineless, and the rugosity of the ventral side of the shell is comparatively slight; in *P. hanleyi* Reeve, 1858, the ventral rugosity is marked, and a few spines are present on the ventral margin. Other synonyms are (*vide* Winckworth, 1929b, p. 288), *P. cancellata* Mawe, 1823; *P. serra*, *japonica*, and *chemnitzii* Reeve, 1858; and *P. lischkeana* Clessin, 1891. The specific name chosen by Linnaeus is not particularly graphic, as the ribs on most of the forms are hardly pronounced enough to be called pectinate.

The present species belongs in *Atrina* Gray, 1847. No one figure will adequately cover this very polymorphous species. The reader is referred to the several figures in the "Conchologica Iconica" depicting the Reeve varieties listed above.

#### *Pinna nobilis*

1758, *Systema naturae*, ed. 10, p. 707, no. 224.  
1767, *Systema naturae*, ed. 12, p. 1160, no. 265.

LOCALITY: "In M. Mediterraneo" (1758, 1767)  
"P. testa striata: squamis canaliculato-tubulosis subimbricatis . . . Varietates potius quam distinctae species sunt sex priores hujus generis."

I have mentioned, under the species *P. rudis*, that the words of the description, "tenuissimis numerosissimisque striis *P. nobilis*," did not at all conform to the appearance of *rudis*. The words in the subdescription of the present species may give us a partial explanation. If Linnaeus thought it a possibility that the first six species in the genus were all varieties of the same shell, it is a little easier to understand, or at least to condone, the brevity of the descriptions in *Pinna* and their obvious incongruities.

Although *P. nobilis* is somewhat variable in its comparatively restricted range, its major characters are so constant that there is no doubt as to its identification. It has, however, received other specific names. Among its synonyms are *P. incurvata* Born, 1780, *P. gigas* Röding, 1798, *P. aculeato-squamosa* and *obeliscus* von Martens, 1866. It has also been confused with other Linnaean *Pinna* as it is identical with *P. rotundata* Schröter, 1786, (*non* Linné), *P. rotundata* Gmelin, 1791 (*non* Linné), *P. muricata* Poli, 1795, Da Costa, 1829, Philippi, 1836, Jeffreys, 1856, and Weinkauff, 1862, none of which were the Linnaean *muricata*.

It is the largest European pelecypod, and its appearance is unmistakable. Its close-packed striae, which are so thickly studded with short, tubular spines, at least over the posterior half of the valves, that the basic sculpture is almost concealed, set it apart from any other member of the genus. The spines, when unworn, lie at all angles to the shell, and in worn or senile specimens the remnants of the spines look like curved scales, giving the shell a pebbly appearance. The description hardly does justice to this peculiar rasp-like surface of the valves.

Of the two references that from Argenville (pl. 25, fig. B) was erased in the manuscript of Linnaeus' son, and the Buonanni figure was omitted in the "Museum Ulricaë." Neither of them shows the crowded tubular spines of *nobilis*. There is no specimen in the collection, and the name was not on Linnaeus' list. The identification of the species must have been based largely on the language in the "Museum Ulricaë" which describes

somewhat more graphically the *nobilis* of the Mediterranean Sea. Thus we have, in the 1758 and 1767 diagnoses, a somewhat weak description, two insufficient references, the absence of a type in the collection, and a correct Mediterranean locality on which to base the species. Linnaeus undoubtedly had before him the shell that we know as *nobilis*, but the identification leaves something to be desired.

The species is a true *Pinna*. The most characteristic figures are the two drawings in Chemnitz (1780-1795, vol. 8, pl. 92, fig. 784, called *Obeliscus*, and pl. 93, fig. 787, called *Pinna gigas*). The Reeve figure (1843-1878, vol. 11, *Pinna*, pl. 30, sp. 57) shows the irregular arrangement of the spines, but is otherwise uncharacteristic. The figure that Reeve called *P. rotundata* Linné (*tom. cit.*, pl. 2, fig. 3) is in fact an extremely good figure of *nobilis*.

#### *Pinna muricata*

1758, *Systema naturae*, ed. 10, p. 707, no. 225.

1767, *Systema naturae*, ed. 12, p. 1160, no. 266.

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

"P. testa striata: squamis concavis ovatis acutis . . . Hostis Sepia octopodia, custos Cancer Pinnotheres."

The entire diagnosis in the tenth edition is repeated verbatim in the twelfth.

The description is too brief for identification, and we are not assisted by the existence of any type specimen in the collection, as Linnaeus did not own the shell. Nothing is added in his manuscript notes. Again we are forced to resort to the "Museum Ulricae," where a very important diagnostic detail is added, a reference to the alternation of spinose and spineless ribs. Most of the references were evidently chosen as the nearest approximations to the species which the author could find in the works at his disposal and show several different species. None of them show the peculiar arrangement of spines noted in the "Museum Ulricae." Lister's figure (1685-1692, pl. 370, fig. 215) shows five or six ribs, which does not fit the "striis plurimis" of the description in the latter work. The Rumphius figure (pl. 46, fig. M) is, as usual, poor, but Winckworth believes that it represents the *muricata* which Linnaeus had in mind and which we know today under that name. The reference to Gualtieri (pl. 79, fig. D) pictures a broadly triangular

shell which might be referred to *Atrina vexillum* Born, 1780 (*nigra* Dillwyn, 1817), with a query.

This is not a Mediterranean species, as Linnaeus surmised, but is found in the Indo-Pacific. Chemnitz correctly located it in "East Indian Seas" (1780-1795, vol. 8, pl. 91, fig. 781), and his figure correctly pictures the sculpture of alternating spined and spineless ribs, although it shows an exaggerated concave ventral margin. Lamarck does not give a satisfactory diagnosis. His description is not characteristic of the species. He refers to the equivocal figures from Lister and Rumphius which Linnaeus cited, and he characterized the helpful figure 781 of Chemnitz as "mala." Furthermore, he says that *muricata* appears to be very close to his *Pinna seminuda*. That name was applied by several writers to the *Atrina rigida* of "Solander" Humphrey, 1786, and Lamarck's *seminuda* appears to be the same, a species quite remote from *muricata*. He refers to figure 775 of Chemnitz, which the latter used for *nobilis* Linné. Finally, he placed *muricata* in the "Atlantic Ocean and the Antilles," a locality even more remote from the Indo-Pacific than Linnaeus' "Mediterranean." It is probable that Lamarck was responsible for the repeated subsequent references to a *muricata* in the western Atlantic which appear in the literature, and which actually should be referred to *rigida* Solander. Reeve's *muricata* (1843-1878, vol. 11, *Pinna*, pl. 13, sp. 23) supplied the most important of these later erroneous locality references, as the "Conchologica Iconica" was so long and so widely used as a manual.<sup>1</sup> Reeve's figure, however, bears little resemblance to either *rigida* or the true *muricata*. It is pale in color, has too numerous and too regularly disposed spines, and these are more like scales than spines and are triangularly notched. Reeve says the shell "is of semitransparent horny-white substance, neatly scaled, the scales having a peculiarly open triangular growth." His figure parallels this description in every detail. The spines in *rigida* are tubular and somewhat slantingly truncate; in *muricata*

<sup>1</sup> Grant and Gale (1931, p. 145) suggest that Reeve's locality "West Indies" may have been due to a mistranslation of Chemnitz' "Ostindischen." This may be true. In any event, the error only served to crystallize Lamarck's original mistake in the minds of conchologists and in the literature.

they are squarely truncate. Neither can be described as having "an open triangular growth."

As late as 1890 Bucquoy, Dautzenberg, and Dollfus spoke of a *muricata* in the West Indies. They said (1882-1898, vol. 2, p. 128): "Now the *P. muricata* of Linné (Museum Lud. Ulricae and Syst. Nat.) is quite an obscure species with ribs alternately nude and squamous, a characteristic which is not found in any other *Pinna* in the European fauna, but which applies satisfactorily to the West Indian specimen figured by Chemnitz (1785, pl. 91, fig. 781) and Reeve (Conch. Icon., pl. 13, fig. 23)." Even today many specimens of *Atrina rigida* "Solander" Humphrey are labeled *Pinna muricata* Linné.

The present species has also been confused with *Pinna fragilis* Pennant, 1777. Donovan (1799-1803, vol. 1, pl. 10, and text) figures a British shell which he entitles *Pinna muricata*, and says, "The only British species of *Pinna* we are acquainted with, is the *P. muricata* of Linnaeus, or *P. fragilis* of Pennant, and that is very rare." Donovan cites for his supposed *muricata* "Concha Pinna" Hasselquist and several others of Linnaeus' references, as well as Pennant's *fragilis*. The *P. muricata* of Poli, 1795, Philippi, 1836, and Jeffreys, 1856, and others referred to under the preceding species, are all synonyms of *P. nobilis* Linné.

Winckworth, in his revision of the genus *Pinna* Linné (1929b, pp. 276-297), concluded that, although, based on the synonymy alone, *P. muricata* was a composite species, the Rumphius figure cited, both in the "Systema" and the "Museum Ulricae" (Rumph. mus., pl. 46, fig. M) represented the author's conception of the species. Winckworth identified the figure in question with the shell called *P. semicostata* by Conrad in 1837 and selected it as the limited meaning of *muricata*. It is to be hoped that Winckworth's view may not only thus permanently restrict the species but may serve to disassociate *muricata* entirely from the western Atlantic fauna.

Linnaeus' *muricata* is a true *Pinna*. Its range is from Ceylon to the Philippines, and Conrad described a form of the species, as *P. semicostata*, from the Hawaiian Islands. The type of *Pinna* was designated as *Pinna rudis*

by Children in 1823 and by Gray in 1847, but Grant and Gale (1931, p. 145) call attention to the fact that Linnaeus cited the "Concha Pinna" of Hasselquist's "Voyage to Palestine" (1757, p. 448, not 447 as stated by Linnaeus) as a synonym of *P. muricata* and under Article 30 (d) of the Rules and Opinion 16 *muricata* thus becomes the type by absolute tautonymy. It is found that Linnaeus wrote the names for Hasselquist, and the "*Pinna*" of "Concha Pinna" was used as the specific name of a synonym within the meaning of the Rule. Dall, Bartsch, and Rehder (1938, p. 73) also adopted this view.

#### *Pinna rotundata*

1758, Systema naturae, ed. 10, p. 707, no. 226.

1767, Systema naturae, ed. 12, p. 1160, no. 267.

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

"P. testa, squamis obsoletis, margine rotundata."

Schröter (1783-1786, vol. 3, p. 479) accepted as the representative of Linnaeus' *rotundatus* the figure 787 from Chemnitz (1780-1795, vol. 8, pl. 93) which the latter called *Pinna gigas*, but which shows a worn example of *P. nobilis* Linné. Schröter was here guilty of an error of transcription as he printed it as "figure 797" which shows a *Chiton*. Dillwyn (1817, vol. 1, p. 329-330) also referred to the same figure 787 for *rotundata* Linné. Winckworth (1929b, p. 295) was not able to identify the species.

The description of *rotundata* in the "Systema" is very brief, and that in the "Museum Ulricae," though longer, has not persuaded anyone after Dillwyn to suggest what shell was meant. Hanley was not able to identify it (1855, pp. 151-152).

Several details are said to point away from its identification with *P. gigas* Chemnitz (*nobilis* Linné), but not all of them are convincing. Linnaeus' sole reference for *rotundata* was Gualtieri (pl. 79, fig. C). *P. gigas* appears in Gualtieri as plate 80, figure C. The early writers, Schröter and Dillwyn, who identified *rotundata* with *gigas*, themselves transposed the plate numbers, and Hanley (*loc. cit.*) criticized this as a "correction" to bolster up their case. If it is kept in mind how often Linnaeus erred in citing plate or figure numbers, the "correction" seems entirely reasonable, and indeed the figures bear this out.

Hanley also said that Linnaeus did not mention the great size of his species. Such an omission does not carry much weight, as Linnaeus very frequently omitted such data even when important. Hanley also objects to the fact that *rotundata* in the "Museum Ulricae" was said to be "albida" instead of the "rufescente seu ferruginea" of Chemnitz' *gigas*. I have seen many specimens of pinnae that were so covered with limy concretions that they appeared white, and there are several other instances in the "Systema" where Linnaeus used "albida" or "alba" for encrusted or worn shells. Finally the language that gave the shell its name, as phrased in the "Museum Ulricae," is criticized by Hanley who said that it does not read "margo ad apicem rotundatus," as it should have been to fit *gigas*, but instead reads "ab apice extrorsum rotundatus." This seems a very captious objection, as the two phrases mean about the same thing.

There is no specimen in the collection that can be referred to *rotundata* and as the name is not on Linnaeus' list, we know that he did not possess it. Nor, as we have seen, is there any specimen of *nobilis*. I suggest the possibility, however, that the *rotundata* which the author examined might well have been a worn example of *nobilis* (*gigas* Chemnitz). Certainly the words "squamis obsoletis" suggest that this might have been the case. The posterior margin is "rotundata" as in the Chemnitz figure; the color "carneus" ("Museum Ulricae") can be said to fit that in the figure, and finally Chemnitz' *gigas*, with its obviously worn-down scales, fits the phrase "squamis obsoletis" of *rotundata*. The question is sufficiently debatable, however, to permit *rotundata* to remain, as Winckworth said, "At present unidentified."

#### *Pinna saccata*

1758, *Systema naturae*, ed. 10, p. 707, no. 227.

1767, *Systema naturae*, ed. 12, p. 1160, no. 268.

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

"P. testa laevi saccata erectiuscula subfastigata."

The description in the "Systema" is inadequate, and the wording is difficult to translate into a clear picture of the species. Again, we are compelled to resort to the description in

the "Museum Ulricae," and there the species is clearly defined and in language with which the two cited figures perfectly agree (Rumphius, pl. 41, fig. N, and Gualtieri, pl. 79, fig. F).

It belongs in *Streptopinna* von Martens, 1880, and is the genotype, by monotypy. It is distinguished from all other species in Pinnidae by the peculiar shape of the adult shell. It is so extremely distorted that it is difficult, at first glance, to recognize its affinity with the other Pinnidae. It may be as broad as it is long or be lengthened out so that it becomes strap-like and undulating. Whatever the shape it ultimately assumes, it is always twisted and gives the impression of a diseased or monstrous specimen. Its sculpture consists of low, coarse ribs over the entire surface except the ventral margin.

Another feature of this unique species is that the shell is apparently stronger at its apical extremity than in other Pinnidae. The anterior end persists as a beak throughout the life of the shell, and therefore no series of protective septa are laid down as in *Pinna* and *Atrina*, and the animal does not move periodically upward as in those species, in which the beaks are worn off by the act of burrowing.

It is an Indo-Pacific species, ranging from the Red Sea to the Philippines and Japan. Conrad described a *Pinna nuttalli* in 1837 from the Hawaiian Islands, which has been considered a synonym of *saccata*. Dall, Bartsch, and Rehder (1938, p. 78), who cite *nuttalli* as a good species, comment as follows: "The scant material from a little south of this area [Hawaiian Islands] leads us to question this dictum. At all events, *Atrina* (*Streptopinna*) *nuttalli* Conrad was applied to the Hawaiian shell. We therefore feel safe in our choice of this name."

The present species is figured in Reeve (1843-1878, vol. 11, *Pinna*, pl. 4, sp. 6a, b). The Chemnitz figure of *saccata* (1780-1795, vol. 8, pl. 90, fig. 779) is completely uncharacteristic. It shows a symmetrical, undistorted, triangular shell with a squarely truncate posterior margin, with numerous narrow yet prominent ribs. It is sparsely spinose. It is gray-blue instead of the orange-red of *saccata*. It seems obvious that it was a pure error in making up the plate. It does not even resemble the young of *saccata*.

**Pinna digitiformis**

1758, *Systema naturae*, ed. 10, p. 708, no. 228.

1767, *Systema naturae*, ed. 12, p. 1160, no. 269.

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

"P. testa laevi tubulosa digitiformi incurva, margine summo membranacea."

Linnaeus did not own this species, and therefore his collection gives us no help in its identification. The description in the "*Museum Ulricae*" merely makes it clear that it was not even a bivalve. The words "testae saepius utraque sutura coadunatae, ut univalvis appareat" made Hanley (1855, p. 153) suspect that Linnaeus had a pteropod before him. To Winckworth the language suggested a *Lingula*. The species remains unidentified and should be dropped from the nomenclature.

**Pinna lobata**

1758, *Systema naturae*, ed. 10, p. 708, no. 229.

1767, *Systema naturae*, ed. 12, p. 1160, no. 270.

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

"P. testa nuda lobata . . . Testa membranacea, dum valvulae explicantur obcordata: lobis lateralibus rotundatis latioribus; a cardine ad lobos nervus; a nervo lineae laterales ductae."

This is another unidentified species. Linnaeus did not own it and must have based his

description on a borrowed specimen. The language of the description seems to repel the idea that it is a bivalve, although Winckworth said (1929b, p. 293) that it suggested a *Pteria*. Hanley (1855, p. 153) doubted that it was even a pteropod, although in some particulars it reminded him of a *Cavolina*.

**Pinna pennacea**

1758, *Systema naturae*, ed. 10, p. 708, no. 230.

LOCALITY: Not stated.

"P. testa pellucida patula pennam referente. . . . Constat haec unica valvula aperta ex canali obtuso utrinque latius marginato praeterquam basi. Dubia mihi ob structuram, pelluciditatem, flexibilitatem etc.; asservata in Museo Ser. Reginae LUDOVICAE UDALRICAE, illustrissimique Senatoris Com. Tessin."

This name did not appear in *Pinna* in the twelfth edition of the "*Systema*" but was moved to *Sepia* in the section "*Vermes Mollusca*." Linnaeus' doubts as to its identity in 1758 are clearly set forth in the description of that year, but he later discovered that it was merely the pen of a *Loligo* and referred it to *Sepia loligo* in 1767 (p. 1090) with a reference to the *Pinna pennacea* of the tenth edition and the comment "Ex haec specie defumta [*sic*], nec propria testa est."

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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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LOCATOR INDEX OF THE LINNAEAN SPECIES OF VERMES TESTACEA  
DESCRIBED IN THE "SYSTEMA NATURAE" (TENTH AND TWELFTH  
EDITIONS) AND THE "MANTISSA," 1771

Initial capital letters of adjectival specific names are used where they were used in original, even though carelessly, by Linnaeus or the printer, e.g., *Conus Minimus*.

The elision of a final letter of a specific name follows the original. This may have possibly been owing to the printer's having been pressed for space, e.g., *Albume (sic)*.

Questionable spelling is indicated by *sic*, e.g., *Patella chinensis (sic)* for *sinensis*.

Species not numbered by Linnaeus can be located by the next preceding numbered species, e.g., *Buccinum costatum* "c," by "seq.

400."

References to "Emendanda" indicate misspellings or other typographical errors corrected at the end of the tenth edition, e.g., *Cardium aculeatum*.

Fossil species, the inclusion of species of other groups (Cirripedia, Annelida, etc.), and other necessary notes will be found under Remarks.

"Rev. 12th ed." refers to Linnaeus' notes for a proposed revised twelfth edition found in his annotated copy of the twelfth edition of the "Systema."

SPECIES	NAME AND NUMBER IN TENTH EDITION, 1758	NAME AND NUMBER IN TWELFTH EDITION, 1767	REMARKS
<i>achatina</i>	<i>Bulla achatina</i> , 343	Same, 391	
<i>aculeatum</i>	<i>Cardium aculeatum</i> , 62	Same, 78	See Emendanda, 10th
<i>aculeatus</i>	<i>Chiton aculeatus</i> , 3	Same, 3	
<i>acutangulus</i>	<i>Turbo acutangulus</i> , 559	Same, 642	
<i>aethiopica</i>	<i>Voluta aethiopica</i> , 373	Same, 435	
<i>Albella</i>	<i>Helix Albella</i> , 574	Same, 658	
<i>Albicilla</i>	<i>Nerita Albicilla</i> , 640	Same, 733	
<i>albida</i>	<i>Tellina albida</i> , 38	Same, 50	
<i>Albume (sic)</i>	<i>Nerita Albumen</i> , 626	Same, 718	
<i>albus</i>		<i>Chiton albus</i> , 8	
<i>algira</i>	<i>Helix algira</i> , 576	Same, 660	
<i>Aluco</i>	<i>Murex Aluco</i> , 497	Same, 572	
<i>alveolata</i>	<i>(Tubipora arenosa, "o")</i>	<i>Sabella alveolata</i> , 812	In Lithophyta, 10th ed., Annelida
<i>Amarula</i>	<i>Helix Amarula</i> , 611	Same, 702	
<i>ambigua</i>	<i>Helix ambigua</i> , 622	Same, 714	
<i>ambiguus</i>		<i>Turbo ambiguus</i> , 632	
<i>amethystea</i>	<i>Cypraea amethystea</i> , 293	Same, 334	
<i>Ammiralis</i>	<i>Conus Ammiralis</i> , 257	Same, 298	See subsp. <i>summus</i> , <i>ordi-</i> <i>narius</i> , <i>occidentalis</i> , and <i>cedo-nulli</i>
<i>Amplustre</i>	<i>Bulla Amplustre</i> , 337	Same, 381	
<i>Ampulla</i>	<i>Bulla Ampulla</i> , 334	Same, 378	
<i>ampullacea</i>	<i>Helix ampullacea</i> , 592	Same, 676	
<i>anatifera</i>	<i>Lepas anatifera</i> , 9	Same, 18	Cirripedia
<i>anatinus</i>	<i>Mytilus anatinus</i> , 219	Same, 258	
<i>anatinus</i>	<i>Solen anatinus</i> , 30	Same, 40	
<i>anguina</i>	<i>Serpula anguina</i> , 700	Same, 804	
<i>angulata</i>	<i>Anomia angulata</i> , 202	Same, 238	Fossil Brachiopoda
<i>angulata</i>		<i>Tellina angulata</i> , 47	
<i>annulatus</i>	<i>Turbo annulatus</i> , 565	Same, 648	
<i>Annulus</i>	<i>Cypraea Annulus</i> , 314	Same, 355	
<i>anserifera</i>		<i>Lepas anserifera</i> , 17	Cirripedia
<i>antiquata</i>		<i>Patella antiquata</i> , 762	
<i>antiquata</i>	<i>Arca antiquata</i> , 144	Same, 174	
<i>antiquata</i>	<i>Chama antiquata</i> , 132	Same, 157	

SPECIES	NAME AND NUMBER IN TENTH EDITION, 1758	NAME AND NUMBER IN TWELFTH EDITION, 1767	REMARKS
<i>antiquatus</i>			<i>Spondylus</i> , Mantissa, 547
<i>antiquus</i>	<i>Murex antiquus</i> , 486	Same, 558	
<i>Anus</i>	<i>Murex Anus</i> , 463	Same, 539	
<i>aperta</i>		<i>Bulla aperta</i> , 376	
<i>aprinum</i>		<i>Dentalium aprinum</i> , 784	
<i>arabica</i>	<i>Cypraea arabica</i> , 286	Same, 327	
<i>arbustorum</i>	<i>Helix arbustorum</i> , 596	Same, 680	
<i>Arcinella</i>		<i>Chama Arcinella</i> , 167	
<i>arctica</i>		<i>Mya arctica</i> , 32	
<i>Arcularia</i>	<i>Buccinum Arcularia</i> , 395	Same, 457	
<i>arenaria</i>	<i>Mya arenaria</i> , 17	Same, 27	
<i>arenaria</i>	<i>Serpula arenaria</i> , 699	Same, 803	Annelida
<i>Areola</i>	<i>Buccinum Areola</i> , 389	Same, 451	
<i>Argo</i>	<i>Argonauta Argo</i> , 231	Same, 271	
<i>Argus</i>	<i>Cypraea Argus</i> , 287	Same, 328	
<i>Argyrostomus</i>	<i>Turbo Argyrostomus</i> , 544	Same, 624	
<i>aruanus</i>	<i>Murex aruanus</i> , 484	Same, 556	
<i>Asellus</i>	<i>Cypraea Asellus</i> , 309	Same, 351	
<i>asinina</i>	<i>Haliotis asinina</i> , 652	Same, 745	
<i>asper</i>	<i>Murex asper</i> , 500	Same, 576	
<i>ater</i>	<i>Strombus ater</i> , 441	Same, 516	
<i>aulicus</i>	<i>Conus aulicus</i> , 279	Same, 320	
<i>Auricularia</i>	<i>Helix Auricularia</i> , 617	Same, 708	
<i>auriscalpium</i>	<i>Turbo auriscalpium</i> , 569	Same, 652	
<i>Auris-dianae</i>	<i>Strombus Auris dianae</i> , 429	Same, 497	
<i>Auris-judae</i>	<i>Bulla Auris judae</i> , 345	<i>Voluta Auris judae</i> , 393	
<i>Auris-midae</i>	<i>Bulla Auris midae</i> , 344	<i>Voluta Auris midae</i> , 392	
<i>Aurisiacus</i>	<i>Conus Aurisiacus</i> , 275	Same, 316	
<i>aurita</i>	<i>Anomia aurita</i> , 190	Same, 224	Brachiopoda
<i>aurita</i>		<i>Lepas aurita</i> , 19	Cirripedia
<i>babylonius</i>	<i>Murex babylonius</i> , 479	Same, 549	
<i>Balanoides</i>		<i>Lepas balanoides</i> , 11	Cirripedia
<i>Balanus</i>	<i>Lepas Balanus</i> , 5	Same, 10	Cirripedia
<i>balaustina</i>	<i>Tellina balaustina</i> , 47	Same, 61	
<i>balthica</i>	<i>Helix balthica</i> , 618	Same, 710	
<i>balthica</i>	<i>Tellina balthica</i> , 53	Same, 68	
<i>barbara</i>	<i>Helix barbara</i> , 610	Same, 701	
<i>barbara</i>	<i>Patella barbara</i> , 661	Same, 755	
<i>barbata</i>	<i>Arca barbata</i> , 141	Same, 170	
<i>barbatus</i>	<i>Mytilus barbatus</i> , 214	Same, 252	
<i>Beccarii</i>	<i>Nautilus Beccarii</i> , 237	Same, 276	Foraminifera
<i>betulinus</i>	<i>Conus betulinus</i> , 266	Same, 308	
<i>Bezoar</i>		<i>Buccinum Bezoar</i> , 473	
<i>bicornis</i>	<i>Chama bicornis</i> , 138	Same, 166	
<i>bidens</i>		<i>Mytilus bidens</i> , 255	
<i>bidens</i>	<i>Nerita bidens</i> , 635	Same, 728	
<i>bidens</i>	<i>Turbo bidens</i> , 566	Same, 649	
<i>biloba</i>	<i>Anomia biloba</i> , 204	Same, 240	Fossil Brachiopoda
<i>bilocularis</i>	<i>Mytilus bilocularis</i> , 212	Same, 250	
<i>bimaculata</i>	<i>Tellina bimaculata</i> , 52	Same, 67	
<i>birostris</i>		<i>Bulla birostris</i> , 371	
<i>borealis</i>		<i>Venus borealis</i> , 143	
<i>Brandaris</i>	<i>Murex Brandaris</i> , 446	Same, 521	
<i>Bubo</i>	β subsp. of <i>Murex Rana</i> , 452	β subsp. of <i>Murex lampas</i> , 529	
<i>bullatus</i>	<i>Conus bullatus</i> , 281	Same, 322	

SPECIES	NAME AND NUMBER IN TENTH EDITION, 1758	NAME AND NUMBER IN TWELFTH EDITION, 1767	REMARKS
<i>bullatus</i>	<i>Solen bullatus</i> , 31	Same, 41	
<i>caerulea</i>	<i>Paiella caerulea</i> , 665	Same, 759	
<i>Caffra</i>	<i>Voluta Caffra</i> , 363	Same, 420	
<i>Calcar</i>	<i>Nautilus Calcar</i> , 235	Same, 274	Foraminifera
<i>Calcar</i>	<i>Turbo Calcar</i> , 538	Same, 617	
<i>calyculata</i>	<i>Chama calyculata</i> , 134	Same, 160	
<i>canaliculata</i>	<i>Bulla canaliculata</i> , 339	Same, 384	
<i>canaliculatus</i>	<i>Murex canaliculatus</i> , 483	Same, 555	
<i>Canariu (sic)</i>	<i>Strombus Canarium</i> , 438	Same, 507	
<i>cancellata</i>	<i>Murex scabriculus</i> , 473 (q.v.)	<i>Voluta cancellata</i> , 413	Referred to in 12th ed. as <i>M. scabriusculus</i>
<i>cancellata</i>	<i>Venus Ziczac</i> , 119 (q.v.)	<i>Venus cancellata</i> , 118 (?)	
<i>candidus</i>	<i>Pholas candidus</i> , 13	Same, 23	
<i>Canrena</i>	<i>Nerita Canrena</i> , 623	Same, 715	
<i>Capitaneus</i>	<i>Conus Capitaneus</i> , 254	Same, 295	
<i>Capitellum</i>	<i>Murex Capitellum</i> , 465	<i>Voluta Capitellum</i> , 431	
<i>Caput-serpentis</i>	<i>Anomia Caput serpentis</i> , 200	Same, 236	Brachiopoda
<i>Caput-serpentis</i>	<i>Cypraea Caput serpentis</i> , 298	Same, 339	
<i>Cardissa</i>	<i>Cardium Cardissa</i> , 59	Same, 74	
<i>cariosus</i>		<i>Murex cariosus</i> , 548	
<i>carnaria</i>	<i>Tellina carnaria</i> , 51	Same, 66	
<i>Carneola</i>	<i>Cypraea Carneola</i> , 290	Same, 331	
<i>Carocolla</i>	<i>Helix Carocolla</i> , 581	Same, 665	
<i>Casina</i>	<i>Venus Casina</i> , 95	Same, 117	
<i>castrensis</i>	<i>Venus castrensis</i> , 105	Same, 129	
<i>Caurica</i>	<i>Cypraea Caurica</i> , 313	Same, 356	
<i>Cedo-nulli</i>		ε subsp. of <i>Conus Ammiralis</i> , 298	
<i>Cepa</i>	<i>Anomia Cepa</i> , 186	Same, 219	
<i>Ceramicus</i>	<i>Murex Ceramicus</i> , 470	<i>Voluta Ceramicus</i> , 432	
<i>Cervus</i>			<i>Cypraea</i> , Mantissa, 548
<i>Chamaeleon</i>	<i>Nerita Chamaeleon</i> , 644	Same, 737	
<i>chinensis (sic)</i>	<i>Patella chinensis</i> , 656	Same, 749	
<i>Chione</i>	<i>Venus Chione</i> , 100	Same, 125	
<i>Chiragra</i>	<i>Strombus Chiragra</i> , 423	Same, 491	
<i>Chrysodon</i>		<i>Sabella Chrysodon</i> , 813	Annelida
<i>Chrysostomus</i>	<i>Turbo Chrysostomus</i> , 535	Same, 614	
<i>Cicercula</i>	<i>Cypraea Cicercula</i> , 325	Same, 367	
<i>ciliare</i>	<i>Cardium ciliare</i> , 64	Same, 80	
<i>Cimex</i>	<i>Turbo Cimex</i> , 530	Same, 609	
<i>cinerarius</i>	<i>Trochus cinerarius</i> , 512	Same, 590	
<i>cinerea</i>		<i>Chiton cinerea</i> , 9	<i>Buccinum</i> , Mantissa, 550
<i>cingulatum</i>			
<i>Citrina</i>	<i>Helix Citrina</i> , 595	Same, 679	
<i>clandestina</i>		<i>Cypraea clandestina</i> , 347	
<i>clathratus</i>		<i>Murex clathratus</i> , 563	
<i>Clathrus</i>	<i>Turbo Clathrus</i> , 549	Same, 631	
<i>clavus</i>	<i>Conus clavus</i> , 272	Same, 313	<i>Strombus</i> , Mantissa, 548
<i>clavus</i>			
<i>Cochlidium</i>	<i>Murex Cochlidium</i> , 482	Same, 553	
<i>Cochlus</i>	<i>Turbo Cochlus</i> , 534	Same, 613	
<i>coffea</i>	<i>Bulla coffea</i> , 348	<i>Voluta coffea</i> , 397	
<i>Colus</i>	<i>Murex Colus</i> , 480	Same, 551	
<i>complanata</i>	<i>Helix complanata</i> , 579	Same, 663	

SPECIES	NAME AND NUMBER IN TENTH EDITION, 1758	NAME AND NUMBER IN TWELFTH EDITION, 1767	REMARKS
<i>compressa</i>	<i>Patella compressa</i> , 675	Same, 772	
<i>compressa conoidea</i>		<i>Bulla conoidea</i> , 385	Venus, Mantissa, 546
<i>contorta</i>	<i>Helix contorta</i> , 589	Same, 673	
<i>contortuplicata</i>	<i>Serpula contortuplicata</i> , 696	Same, 799	Annelida
<i>contrarius</i>			<i>Murex</i> , Mantissa, 551
<i>Conulus</i>	<i>Trochus Conulus</i> , 519	Same, 598	
<i>cor</i>	<i>Cardium humanum</i> , 82	<i>Chama cor</i> , 154	
<i>corallinum</i>	<i>Cardium corallinum</i> , 75	<i>Mactra corallina</i> , 98	
<i>cordata</i>	<i>Chama cordata</i> , 135	Same, 161	
<i>cornea</i>	<i>Helix cornea</i> , 587	Same, 671	
<i>cornea</i>	<i>Nerita cornea</i> , 631	Same, 722	
<i>cornea</i>	<i>Tellina cornea</i> , 57	Same, 72	
<i>corneum</i>		<i>Dentalium corneum</i> , 787	
<i>corneus</i>	<i>Murex corneus</i> , 491	Same, 565	
<i>corneus</i>	<i>Turbo corneus</i> , 554	Same, 637	
<i>Cornicula</i>	<i>Voluta cornicula</i> , 362	Same, 415	
<i>Cornu-arietis</i>	<i>Helix Cornu arietis</i> , 590	Same, 674	
<i>Cornu-militare</i>	<i>Helix Cornu militare</i> , 582	Same, 666	
<i>cornutum</i>	<i>Buccinum cornutum</i> , 384	Same, 445	
<i>cornutus</i>	<i>Murex cornutus</i> , 445	Same, 520	
<i>Corona</i>	<i>Nerita Corona</i> , 629	Same, 720	
<i>costatum</i>	<i>Buccinum costatum</i> , "o"	Same, 463	Seq. 400, in 10th ed.
<i>costatum</i>	<i>Cardium costatum</i> , 58	Same, 73	
<i>costatus</i>	<i>Pholas costatus</i> , 11	Same, 21	
<i>craniolaris</i>	<i>Anomia craniolaris</i> , 183	Same, 216	Brachiopoda, fossil
<i>craticulatus</i>	<i>Murex craticulatus</i> , 495	Same, 569	
<i>crenatus</i>	<i>Turbo crenatus</i> , 550	Same, 633	
<i>crenellus</i>		<i>Turbo crenellus</i> , 628	
<i>crenulatum</i>	<i>Buccinum crenulatum</i> , 416	Same, 481	
<i>Crepidula</i>		<i>Patella Crepidula</i> , 752	
<i>cribraria</i>	<i>Cypraea cribraria</i> , 310	Same, 353	
<i>crispa</i>	<i>Anomia crispa</i> , 197	Same, 232	Brachiopoda, fossil
<i>crispata</i>	<i>Mya crispata</i> , 15	<i>Pholas crispata</i> , 25	
<i>crispus</i>	<i>Nautilus crispus</i> , 236	Same, 275	Foraminifera
<i>Crista</i>	<i>Nautilus Crista</i> , 234	<i>Turbo nautilus</i> , 654	
<i>Crista-galli</i>	<i>Mytilus Crista galli</i> , 206	Same, 243 (as <i>Crista-galli</i> )	
<i>cristata</i>		<i>Patella cristata</i> , 768	
<i>cruciata</i>	<i>Patella cruciata</i> , 679	Same, 776	
<i>cruciatus</i>	<i>Trochus cruciatus</i> , 505	Same, 583	
<i>Cutellus</i>	<i>Solen Cutellus</i> , 27	Same, 37	
<i>cuneata</i>	<i>Donax cuneata</i> , 87	Same, 108	
<i>cutaceus</i>		<i>Murex cutaceus</i> , 532	
<i>cygneus</i>	<i>Mytilus cygneus</i> , 218	Same, 257	
<i>Cymbiu (sic)</i>	<i>Argonauta Cymbium</i> , 232	Same, 272	
<i>Cymbiu (sic)</i>	<i>Voluta Cymbium</i> , 374	Same, 436	
<i>Cypraea</i>	<i>Bulla Cypraea</i> , "o"	Same, 389	In 12th ed. recognized as immature <i>Cypraea spurca</i> , q.v. seq. 341, 10th ed.
<i>Dactylus</i>	<i>Pholas Dactylus</i> , 10	Same, 20	
<i>Dactylus</i>		<i>Voluta Dactylus</i> , 401	
<i>decollata</i>	<i>Helix decollata</i> , 608	Same, 695	
<i>decollatus</i>		<i>Murex decollatus</i> , 578	
<i>decussata</i>	<i>Arca decussata</i> , 147	Same, 177	

SPECIES	NAME AND NUMBER IN TENTH EDITION, 1758	NAME AND NUMBER IN TWELFTH EDITION, 1767	REMARKS
<i>decussata</i>	<i>Venus decussata</i> , 126	Same, 149	
<i>decussatum</i>	<i>Buccinum decussatum</i> , 388	Same, 450	
<i>deflorata</i>	<i>Venus deflorata</i> , 108	Same, 132	
<i>Delphinus</i>	<i>Turbo Delphinus</i> , 546	Same, 626	
<i>Dentalis</i>	<i>Dentalium Dentalis</i> , 687	Same, 785	
<i>dentatus</i>	<i>Strombus dentatus</i> , "o"	Same, 513	Seq. 440, 10th ed.
<i>denticulata</i>	<i>Donax denticulata</i> , 86	Same, 107	
<i>despectus</i>	<i>Murex despectus</i> , 487	Same, 559	
<i>Diadema</i>		<i>Lepas Diadema</i> , 13	Cirripedia, <i>Lepas</i> , Mantissa, 544
<i>Diadema</i>		Same sp. described twice	
<i>digitaria</i>	<i>Tellina digitaria</i> , 56	Same, 71	
<i>digitiformis</i>	<i>Pinna digitiformis</i> , 228	Same, 269	
<i>diluviana</i>		<i>Ostrea diluviana</i> , 208	Fossil, Cretaceous
<i>dimidiatum</i>	<i>Buccinum dimidiatum</i> , 420	Same, 487	
<i>Dione</i>	<i>Venus Dione</i> , 91	Same, 112	
<i>diphos</i>			<i>Solen</i> , Mantissa, 544
<i>discors</i>		<i>Mytilus discors</i> , 261	
<i>distortus</i>	<i>Turbo distortus</i> , 547	Same, 627	
<i>divaricata</i>	<i>Tellina divaricata</i> , 55	Same, 70	
<i>divaricatus</i>	<i>Trochus divaricatus</i> , 513	Same, 591	
<i>dolarium</i>		<i>Murex dolarium</i> , 564	
<i>dolobratus</i>	<i>Trochus dolobratus</i> , 522	Same, 601	
<i>Dolium</i>	<i>Buccinum Dolium</i> , 380	Same, 442	
<i>donacina</i>	<i>Tellina donacina</i> , 46	Same, 59	
<i>duplicatum</i>	<i>Buccinum duplicatum</i> , 419	Same, 485	
<i>duplicatus</i>	<i>Turbo duplicatus</i> , 560	Same, 643	
<i>Dysera</i>	<i>Venus Dysera</i> , 93	Same, 115	Var. $\beta$ of 10th ed. omitted, see <i>V. Paphia</i>
	vars. $\beta$ , $\gamma$ , $\delta$	vars. $\gamma$ , $\delta$	
<i>ebraea</i>	<i>Voluta ebraea</i> , 372	Same, 429	
<i>ebraeus</i>	<i>Conus ebraeus</i> , 268	Same, 310	
<i>eburneum</i>		<i>Dentalium eburneum</i> , 789	
<i>echinatum</i>	<i>Cardium echinatum</i> , 63	Same, 79	
<i>Echinophorum</i>	<i>Buccinum Echinophorum</i> , 381	Same, 443	
<i>edentula</i>	<i>Venus edentula</i> , 122	Same, 146	
<i>edule</i>	<i>Cardium edule</i> , 77	Same, 90	
<i>edulis</i>	<i>Mytilus edulis</i> , 215	Same, 253	
<i>edulis</i>	<i>Ostrea edulis</i> , 180	Same, 211	
<i>electrica</i>	<i>Anomia electrica</i> , 187	Same, 220	
<i>Elephantinum</i>	<i>Dentalium Elephantinum</i> , 686	Same, 783	
<i>Ensis</i>	<i>Solen Ensis</i> , 25	Same, 35	
<i>Entalis</i>	<i>Dentalium Entalis</i> , 688	Same, 786	
<i>Ephippiu (sic)</i>	<i>Ostrea Ephippium</i> , 182	Same, 215	In <i>Perna</i> , new genus, in rev. 12th ed.
<i>Ephippium</i>	<i>Anomia Ephippium</i> , 185	Same, 218	
<i>Epidromis</i>	<i>Strombus Epidromis</i> , 437	Same, 506	
<i>episcopalis</i>	<i>Voluta episcopalis</i> , 368	<i>V. (Mitra) episcopalis</i> , 425	Unnumbered in 12th ed.
<i>equestris</i>	<i>Patella equestris</i> , 654	Same, 747	
<i>Erinaceus</i>	<i>Buccinum Erinaceus</i> , 390	Same, 452	
<i>Erinaceus</i>	<i>Murex Erinaceus</i> , 451	Same, 526	
<i>erosa</i>	<i>Cypraea erosa</i> , 315	Same, 357	
<i>errones</i>	<i>Cypraea errones</i> , 311	Same, 352	
<i>Erycina</i>	<i>Venus Erycina</i> , 98	Same, 122	

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<i>Exanthea exoleta</i>	<i>Venus exoleta</i> , 117	<i>Cypraea Exanthea</i> , 325 Same, 142 (B. subsp. is <i>V. lupinus</i> )	= <i>C. zebra</i> , 1758, 291 Cf. <i>V. Lupinus</i>
<i>exoletus</i>	<i>Turbo exoletus</i> , 561	Same, 644	
<i>exustus</i>	<i>Mytilus exustus</i> , 213	Same, 251	
<i>Exuvia</i>	<i>Nerita Exuvia</i> , 646	Same, 739	
<i>Faba farcta</i>	<i>Voluta Faba</i> , 355 <i>Anomia farcta</i> , 199	Same, 406 Same, 235	See Emendanda, Fossil Brachiopoda Foraminifera
<i>fascia fasciata fascicularis</i>	<i>Nautilus fascia</i> , 246 <i>Ostrea fasciata</i> , 174	Same, 286 Same, 205 <i>Chiton fascicularis</i> , 4	
<i>Femorale</i>	<i>Murex Femorale</i> , 456	Same, 531	
<i>Ficus</i>	<i>Murex Ficus</i> , 475	<i>Bulla Ficus</i> , 382	
<i>figulinus filaris</i>	<i>Conus figulinus</i> , 267	Same, 309	<i>Voluta</i> , Mantissa, 548 Annelida
<i>filograna fimbriata</i>	<i>Venus fimbriata</i> , 109	<i>Serpula filograna</i> , 797 Same, 133	
<i>Fissura Fissurella</i>	<i>Patella fissura</i> , 681	Same, 778 <i>Strombus Fissurella</i> , 511	
<i>flammeu (sic) flaveola flavicans flavum flexuosa fluviatilis foliacea Folium Fontinalis fornicata fragilis fragilis fragilis Fragum Frons fusca fuscatus Fusus Gaederopus galatea Galea Gallina Gallus Gargadia gari gemicum Generalis</i>	<i>Buccinum flammeum</i> , 386 <i>Cypraea flaveola</i> , 320 <i>Ostrea flavicans</i> , 173 <i>Cardium flavum</i> , 71 <i>Nerita fluviatilis</i> , 632 <i>Tellum foliacea</i> , 39 <i>Ostrea Folium</i> , 178 <i>Bulla Fontinalis</i> , 340 <i>Patella fornicata</i> , 658 <i>Cypraea fragilis</i> , 297 <i>Helix fragilis</i> , 613 <i>Tellina fragilis</i> , 37 <i>Cardium Fragum</i> , 67 <i>Mytilus Frons</i> 208 <i>Patella fusca</i> , 677 <i>Murex fuscatus</i> , 498 <i>Murex Fusus</i> , 478 <i>Spondylus Gaederopus</i> , 127	Same, 448 Same, 358 Same, 204 Same, 87 <i>Venus flexuosa</i> , 121 Same, 723 Same, 51 Same, 209 Same, 386 Same, 751 Same, 338 Same, 704 Same, 49 Same 83 Same, 245 Same, 774 Same, 573 <i>Strombus Fusus</i> , 489 Same, 151	
<i>Galea</i>	<i>Buccinum Galea</i> , 377	Same, 439	<i>Lepas</i> , Mantissa, 544
<i>Gallina</i>	<i>Venus Gallina</i> , 96	Same, 119	
<i>Gallus</i>	<i>Strombus Gallus</i> , 428	Same, 496	
<i>Gargadia gari</i>	<i>Tellina Gargadia</i> , 33 <i>Tellina gari</i> , 36	Same, 44 Same, 48	
<i>gemicum</i>			
<i>Generalis</i>	? subsp. $\gamma$ or $\delta$ of <i>Conus Capitanus</i> , 254	<i>Conus Generalis</i> , 293	<i>Buccinum</i> , Mantissa, 550
<i>genuanus</i>	<i>Conus genuanus</i> , 260	Same, 302	
<i>Geographus</i>	<i>Conus Geographus</i> , 283	Same, 324	
<i>gibba</i>	<i>Ostrea gibba</i> , 172	Same, 203	
<i>gibberulus</i>	<i>Strombus gibberulus</i> , 433	Same, 501	
<i>gibbosa</i>	<i>Bulla gibbosa</i> , 331	Same, 374	
<i>gibbosulum</i>	<i>Buccinum gibbosulum</i> , 397	Same, 459	
<i>Gigas</i>	<i>Chama Gigas</i> , 130	Same, 155	
<i>Gigas</i>	<i>Strombus Gigas</i> , 435	Same, 504	



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<i>glabella</i>	<i>Voluta glabella</i> , 356	Same, 407	
<i>glabra</i>	<i>Ostrea glabra</i> , 170	Same, 201	
<i>glabrata</i>		<i>Mactra glabrata</i> , 97	<i>Cardium triste</i> of 10th ed. may have been identical, <i>vide</i> Hanley, 1855
<i>glabratum</i>	<i>Buccinum glabratum</i> , 406	Same, 470	
<i>glaciale</i>		<i>Buccinum glaciale</i> , 474	
<i>Glans</i>	<i>Buccinum Glans</i> , 394	Same, 456	
<i>glauca</i>	<i>Helix glauca</i> , 594	Same, 678	
<i>glaucina</i>	<i>Nerita glaucina</i> , 624	Same, 716	
<i>glaucum</i>	<i>Buccinum glaucum</i> , 391	Same, 453	
<i>glaucus</i>	<i>Conus glaucus</i> , 261	Same, 303	
<i>Globulus</i>	<i>Cypraea Globulus</i> , 326	Same, 368	
<i>glomerata</i>	<i>Serpula glomerata</i> , 697	Same, 800	Annelida
<i>Glycymeris</i>	<i>Arca Glycymeris</i> , 151	Same, 181	
<i>gothica</i>	<i>Helix gothica</i> , 585	Same, 669	
<i>graeca</i>	<i>Patella graeca</i> , 683	Same, 780	
<i>granatina</i>	<i>Patella granatina</i> , 663	Same, 757	
<i>granosa</i>	<i>Arca granosa</i> , 146	Same, 176	
<i>granularis</i>	<i>Patella granularis</i> , 662	Same, 756	
<i>granulata</i>		<i>Sabella granulata</i> , 809	Annelida
<i>granulata</i>		<i>Serpula granulata</i> , 798	Annelida
<i>granulatus</i>	<i>Conus granulatus</i> , 274	Same, 315	
<i>granulatus</i>	<i>Murex granulatus</i> , 501	Same, 577	
<i>Granum</i>	<i>Murex Granum</i> , 477	$\beta$ subsp. of <i>M. canaliculatus</i> , 555	
<i>Granum</i>	<i>Nautilus Granum</i> , 244	Same, 284	Foraminifera
<i>grisea</i>	<i>Helix grisea</i> , 606	Same, 693	
<i>grossa</i>	<i>Nerita grossa</i> , 643	Same, 736	
<i>gryphica</i>			<i>Chama</i> , Mantissa, 546, fossil
<i>gryphoides</i>	<i>Chama gryphoides</i> , 137	Same, 165	
<i>Gryphus</i>	<i>Anomia gryphus</i> , 192	Same, 226	
<i>Gualtierana</i>	<i>Helix Gualtierana</i> , 586	Same, 670	
<i>Gyrinus</i>	<i>Murex Gyrinus</i> , 453	Same, 528	
<i>haemastoma</i>		<i>Buccinum haemastoma</i> , 466	
<i>Haemastoma</i>	<i>Helix Haemastoma</i> , 607	Same, 694	
<i>Haliotoidea</i>	<i>Helix Haliotoidea</i> , 621	Same, 713	
<i>Harpa</i>	<i>Buccinum Harpa</i> , 400	Same, 462	
<i>Haustellum</i>	<i>Murex Haustellum</i> , 443	Same, 518	
<i>hecticu (sic)</i>	<i>Buccinum hecticum</i> , 417	Same, 482	
<i>helvola</i>	<i>Cypraea helvola</i> , 316	Same, 361	
<i>hemicardium</i>	<i>Cardium hemicardium</i> , 60	Same, 76	
<i>Hippocastanum</i>	<i>Murex Hippocastanum</i> , 471	Same, 545	
<i>Hippopus</i>	<i>Chama Hippopus</i> , 131	Same, 156	
<i>Hirundo</i>	<i>Cypraea Hirundo</i> , 308	Same, 350	
<i>Hirundo</i>	<i>Mytilus Hirundo</i> , 222	Same, 262	
<i>hispana</i>	<i>Helix hispana</i> , 599	Same, 686	
<i>hispida</i>	<i>Helix hispida</i> , 591	Same, 675	
<i>hispidus</i>	<i>Chiton hispidus</i> , 1	Same, 1	
<i>Histrion</i>	<i>Nerita Histrion</i> , 641	Same, 734	
<i>humanum</i>	<i>Cardium humanum</i> , 82	<i>Chama cor</i> , 154	
<i>hybridus</i>	<i>Trochus hybridus</i> , 504	Same, 582	
<i>Hydatis</i>	<i>Bulla Hydatis</i> , 333	Same, 377	
<i>Hyotis</i>	<i>Mytilus Hyotis</i> , 207	Same, 244	
<i>Hypnorum</i>	<i>Bulla Hypnorum</i> , 341	Same, 387	

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<i>Hysterita</i>	<i>Anomia Hysterita</i> , 203	Same, 239	Brachiopoda, fossil
<i>Hystrix</i>	<i>Murex Hystrix</i> , 468	Same, 543	
<i>imbricatus</i>	<i>Turbo imbricatus</i> , 557	Same, 640	
<i>imperialis</i>	<i>Conus imperialis</i> , 251	Same, 291	
<i>inaequivalvis</i>	<i>Solen inaequivalvis</i> , 32	<i>Tellina inaequivalvis</i> , 56	
<i>incarnata</i>	<i>Tellina incarnata</i> , 45	Same, 58	
<i>incrustata</i>	<i>Venus incrustata</i> , 115	Same, 139	
<i>intricata</i>	<i>Serpula intricata</i> , 695	Same, 796	Annelida
<i>Irus</i>	<i>Donax Irus</i> , 90	Same, 111	
<i>Isabella</i>	<i>Cypraea Isabella</i> , 304	Same, 345	
<i>islandica</i>		<i>Venus islandica</i> , 124	
<i>Isocardia</i>	<i>Cardium Isocardia</i> , 66	Same, 82	
<i>Isognomum</i>	<i>Ostrea Isognomum</i> , 176	<i>Ostrea Isogonum</i> , 214	In <i>Perna</i> , new genus, in rev. 12th ed.
<i>Ispidula</i>	<i>Voluta Ispidula</i> , 351	Same, 400	
<i>itala</i>	<i>Helix itala</i> , 598	Same, 683	
<i>Jacobaea</i>	<i>Ostrea Jacobaea</i> , 155	Same, 186	
<i>janthina</i>	<i>Helix janthina</i> , 602	Same, 689	
<i>javanus</i>		<i>Murex javanus</i> , 550	
<i>Labio</i>	<i>Trochus Labio</i> , 516	Same, 595	
<i>laciniosa</i>	<i>Patella laciniosa</i> , 659	Same, 753	
<i>lactaria</i>			<i>Nerita</i> , Mantissa, 551
<i>lactea</i>	<i>Arca lactea</i> , 143	Same, 173	
<i>lactea</i>	<i>Tellina lactea</i> , 50	Same, 65	
<i>lacteus</i>	<i>Turbo lacteus</i> , 551	Same, 634	
<i>lacunosa</i>	<i>Anomia lacunosa</i> , 198	Same, 233	Brachiopoda, fossil
<i>lacustris</i>	<i>Nerita lacustris</i> , 634	Same, 725	
<i>lacustris</i>	<i>Patella lacustris</i> , 672	Same, 769	
<i>laeta</i>	<i>Venus laeta</i> , 104	Same, 128	
<i>laevigata</i>	<i>Tellina laevigata</i> , 41	Same, 53	
<i>laevigata</i>		<i>Helix laevigata</i> , 709	
<i>laevigatum</i>	<i>Buccinum laevigatum</i> , 414	Same, 478	
<i>laevigatum</i>	<i>Cardium laevigatum</i> , 72	Same, 88	
<i>Lambis</i>	<i>Strombus Lambis</i> , 425	Same, 493	
<i>Lampas</i>	<i>Murex Lampas</i> , 454	Same, 529	
<i>lanceatum</i>		<i>Buccinum lanceatum</i> , 486	
<i>Lapicida</i>	<i>Helix lapicida</i> , 572	Same, 656	
<i>lapillus</i>	<i>Buccinum lapillus</i> , 403	Same, 467	
<i>lapponica</i>		<i>Voluta lapponica</i> , 434	
<i>latissimus</i>	<i>Strombus latissimus</i> , 436	Same, 505	
<i>Lazarus</i>	<i>Chama Lazarus</i> , 129	Same, 164	
<i>Legumen</i>	<i>Nautilus Legumen</i> , 248	Same, 288	Foraminifera
<i>Legumen</i>	<i>Solen Legumen</i> , 26		
<i>Lentiginosus</i>	<i>Strombus Lentiginosus</i> , 427	Same, 495	
<i>Leucas</i>	<i>Helix Leucas</i> , 577	Same, 661	
<i>lignaria</i>	<i>Bulla lignaria</i> , 335	Same, 379	
<i>lignarius</i>	<i>Murex lignarius</i> , 492	Same, 566 ( <i>lignarius</i> )	
<i>Lima</i>	<i>Ostrea Lima</i> , 175	Same, 206	
<i>limosa</i>	<i>Helix limosa</i> , 615	Same, 706	
<i>Lincina</i>	<i>Turbo Lincina</i> , 556	Same, 639	
<i>Lingua-felis</i>	<i>Tellina Lingua felis</i> , 34	Same, 45	
<i>literata</i>	<i>Venus literata</i> , 124	Same, 147	
<i>lithocardium</i>			<i>Cardium</i> , Mantissa, 544
<i>lithophagus</i>	<i>Mytilus lithophagus</i> , 211	Same, 248	
<i>litteratus</i>	<i>Conus litteratus</i> , 252	Same, 292	
<i>littoralis</i>	<i>Nerita littoralis</i> , 633	Same, 724	

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<i>littoreus</i>	<i>Turbo littoreus</i> , 528	Same, 607	
<i>livida</i>	<i>Bulla livida</i> , 347	<i>Voluta livida</i> , 396	
<i>lividus</i>	<i>Strombus lividus</i> , 442	Same, 517	
<i>lobata</i>	<i>Pinna lobata</i> , 229	Same, 270	
<i>Lota</i>	<i>Cypraea Lota</i> , 296	Same, 337	
<i>Lotoriu (sic)</i>	<i>Murex Lotorium</i> , 457	Same, 533	
<i>Lucifer</i>	<i>Strombus Lucifer</i> , 434	Same, 503	
<i>lucorum</i>	<i>Helix lucorum</i> , 605	Same, 692	
<i>Luhuanus</i>	<i>Strombus Luhuanus</i> , 432	Same, 500	
<i>lumbricalis</i>	<i>Serpula lumbricalis</i> , 698	Same, 801	Phylum undet.
<i>Lupinus</i>	<i>Venus Lupinus</i> , 123	$\beta$ subsp. of <i>Venus exoleia</i> , 142	
<i>lurida</i>	<i>Cypraea lurida</i> , 294	Same, 335	
<i>lusitanica</i>		<i>Helix lusitanica</i> , 684	
<i>lutaria</i>	<i>Helix lutaria</i> , 600	Same, 687	
<i>lutea</i>	<i>Patella lutea</i> , 670	Same, 766	
<i>lutraria</i>	<i>Mya lutraria</i> , 18	<i>Mactra lutraria</i> , 101	
<i>Lynx</i>	<i>Cypraea Lynx</i> , 303	Same, 344	
<i>maculata</i>	<i>Venus maculata</i> , 101	Same, 126	
<i>maculatum</i>	<i>Buccinum maculatum</i> , 415	Same, 479	
<i>maculatus</i>	<i>Trochus maculatus</i> , 502	Same, 580	
<i>magnum</i>	<i>Cardium magnum</i> , 70	Same, 86	
<i>Magus</i>	<i>Conus Magus</i> , 276	Same, 317	
<i>Magus</i>	<i>Trochus Magus</i> , 507	Same, 585	
<i>Malleus</i>	<i>Ostrea Malleus</i> , 177	Same, 207	
<i>Mammilla</i>	<i>Nerita Mammilla</i> , 627	Same, 719	
<i>mammillaris</i>	<i>Patella mammillaris</i> , 668	Same, 763	
<i>Mappa</i>	<i>Cypraea Mappa</i> , 285	<i>Helix mammillaris</i> , 685	
<i>Mancinella</i>	<i>Murex Mancinella</i> , 469	Same, 326	
<i>margaritaceus</i>	<i>Turbo margaritaceus</i> , 545	Same, 544	
<i>margaritifera</i>	<i>Mya margaritifera</i> , 20	Same, 625	
<i>margaritifera</i>	<i>Mytilus margaritifera</i> , 209	Same, 29	
<i>marginatus</i>	<i>Strombus marginatus</i> , 431	Same, 246	
<i>Marica</i>	<i>Venus Marica</i> , 92	Same, 499	
<i>marmorata</i>	<i>Haliotis marmorata</i> , 651	Same, 114	
<i>marmoratus</i>	<i>Turbo marmoratus</i> , 539	Same, 744	
<i>marmoreus</i>	<i>Conus marmoreus</i> , 250	Same, 619	
<i>mauritaniana</i>	<i>Cypraea mauritaniana</i> , 299	Same, 290	
<i>maxima</i>	<i>Ostrea maxima</i> , 154	Same, 340	
<i>medium</i>	<i>Cardium medium</i> , 61	Same, 185	
<i>Melongena</i>	<i>Murex Melongena</i> , 472	Same, 77	
<i>mendicaria</i>	<i>Voluta mendicaria</i> , 360	Same, 547	
<i>Mercator</i>	<i>Conus Mercator</i> , 265	Same, 412	
<i>mercatoria</i>	<i>Voluta mercatoria</i> , 357	Same, 307	
<i>mercenaria</i>	<i>Venus mercenaria</i> , 99	Same, 409	
<i>Meretrix</i>	<i>Venus Meretrix</i> , 102	Same, 123	
<i>Meroe</i>	<i>Venus Meroe</i> , 107	Same, 127	
<i>Midae</i>	<i>Haliotis Midae</i> , 647	Same, 131	
<i>Miles</i>	<i>Conus Miles</i> , 255	Same, 740	
<i>miliaria</i>	<i>Voluta miliaria</i> , 354	Same, 296	
<i>militaris</i>		Same, 402	<i>Patella</i> , Mantissa, 552
<i>Millepeda</i>	<i>Strombus Millepeda</i> , 426	Same 494	
<i>Minimus</i>	<i>Conus Minimus</i> , 263	Same, 305	<i>Strombus</i> , Mantissa, 549
<i>minimus</i>			
<i>minuta</i>	<i>Ostrea minuta</i> , 158	Same, 189	

SPECIES	NAME AND NUMBER IN TENTH EDITION, 1758	NAME AND NUMBER IN TWELFTH EDITION, 1767	REMARKS
<i>minutu (sic)</i>	<i>Dentalium minutum</i> , 689	Same, 790	
<i>minutus</i>		<i>Solen minutus</i> , 42	
<i>Mitella</i>	<i>Lepas Mitella</i> , 8	Same, 15	Cirripedia
( <i>Mitra</i> )	<i>Voluta episcopalis</i> , 368	Subsp. of <i>Voluta Mitra</i> , 425	Subsp. unnumbered
<i>episcopalis</i>			
( <i>Mitra</i> ) <i>papalis</i>	<i>Voluta papalis</i> , 369	Subsp. of <i>Voluta Mitra</i> , 425	Subsp. numbered 426
<i>modiolus</i>		<i>Arca modiolus</i> , 171	
<i>Modiolus</i>	<i>Mytilus Modiolus</i> , 217	Same, 256	
<i>Modulus</i>	<i>Trochus Modulus</i> , 508	Same, 586	
<i>Monachus</i>	<i>Conus Monachus</i> , 262	Same, 304	
<i>Moneta</i>	<i>Cypraea moneta</i> , 312	Same, 354	
<i>monile</i>			<i>Buccinum</i> , Mantissa, 550
<i>monilis</i>	<i>Voluta monilis</i> , 353	Same, 403	
<i>Morio</i>	<i>Murex Morio</i> , 481	Same, 552	
<i>Morio</i>		<i>Voluta Morio</i> , 421	
<i>muricata</i>	<i>Donax muricata</i> , 89	Same, 110	
<i>muricata</i>	<i>Pinna muricata</i> , 225	Same, 266	
<i>muricatum</i>	<i>Cardium muricatum</i> , 69	Same, 85	
<i>muricatus</i>	<i>Trochus muricatus</i> , 509	Same, 587	
<i>muricatus</i>	<i>Turbo muricatus</i> , 529	Same, 608	
<i>murinu (sic)</i>	<i>Buccinum murinum</i> , 421	Same, 488	
<i>Mus</i>	<i>Cypraea Mus</i> , 301	Same, 342	
<i>muscorum</i>	<i>Turbo muscorum</i> , 568	Same, 651	
<i>Musica</i>	<i>Voluta Musica</i> , 370	Same, 427	
<i>mutabile</i>	<i>Buccinum mutabile</i> , 398	Same, 460	
<i>Naucum</i>	<i>Bulla Naucum</i> , 332	Same, 375	
<i>navalis</i>	<i>Teredo navalis</i> (Vermes In-testina, pg. 651)	Same (Vermes Testacea, 807)	
<i>Nautilus</i>	<i>Nautilus crista</i> , 234	<i>Turbo Nautilus</i> , 654	
<i>nemoralis</i>	<i>Helix nemoralis</i> , 604	Same, 691	
<i>Neriteu (sic)</i>	<i>Buccinum Neriteum</i> , 399	Same, 461	
<i>Neritoidea</i>	<i>Helix Neritoidea</i> , 619	Same, 711	
<i>Neritoidea</i>	<i>Patella Neritoidea</i> , 655	Same, 748	
<i>Neritoides</i>	<i>Turbo Neritoides</i> , 527	Same, 606	
<i>neritoideus</i>	<i>Nerita nodosa</i> , 628	<i>Murex neritoideus</i> , 542	
<i>niloticus</i>		<i>Trochus niloticus</i> , 579	
<i>nimbosa</i>	<i>Patella nimbosa</i> , 684	Same, 781	
<i>nitidulum</i>	<i>Buccinum nitidulum</i> , 413	Same, 477	
<i>noachina</i>			<i>Patella</i> , Mantissa, 551
<i>Noae</i>	<i>Arca Noae</i> , 140	Same, 169	
<i>nobilis</i>	<i>Conus nobilis</i> , 259	Same, 301	
<i>nobilis</i>	<i>Pinna nobilis</i> , 224	Same, 265	
<i>nodosa</i>	<i>Nerita nodosa</i> , 628	<i>Murex neritoideus</i> , 542	
<i>nodosa</i>	<i>Ostrea nodosa</i> , 164	Same, 194	
<i>Nodus</i>	<i>Murex Nodus</i> , 467	Same, 541	
<i>notata</i>	<i>Patella notata</i> , 678	Same, 775	
<i>Nubecula</i>	<i>Patella Nubecula</i> , 685	Same, 782	
<i>Nucleus</i>	<i>Arca Nucleus</i> , 153	Same, 184	
<i>Nucleus</i>	<i>Cypraea Nucleus</i> , 323	Same, 365	
<i>nummaria</i>	<i>Arca nummaria</i> , 152	Same, 183	
<i>Nussatella</i>	<i>Conus Nussatella</i> , 273	Same, 314	
<i>obliquus</i>	<i>Nautilus obliquus</i> , 241	Same, 281	
<i>obliterata</i>	<i>Ostrea obliterata</i> , 160	Same, 197	Foraminifera
<i>oblonga</i>	<i>Chama oblonga</i> , 136	Same, 163	

SPECIES	NAME AND NUMBER IN TENTH EDITION, 1758	NAME AND NUMBER IN TWELFTH EDITION, 1767	REMARKS
<i>obtusatus</i>	<i>Turbo obtusatus</i> , 526	Same, 605	
<i>occidentalis</i>	♂ supsp. of <i>Conus Ammivalis</i> , 257	Same, 298	
<i>ocellata</i>	<i>Cypraea ocellata</i> , 319	Same, 362	
<i>octona</i>		<i>Helix octona</i> , 698	
<i>Oculus-capri</i>	<i>Helix Oculus capri</i> , 573	Same, 657	
<i>Oleariu (sic)</i>	<i>Buccinum Olearium</i> , 376	Same, 438	
<i>Oleariu (sic)</i>	<i>Murex Olearium</i> , 455	Same, 530	
<i>Olearius</i>	<i>Turbo Olearius</i> , 541	Same, 621	
<i>Oliva</i>	<i>Voluta Oliva</i> , 350	Same, 399	
<i>Olla</i>	<i>Voluta Olla</i> , 375	Same, 437	
<i>Oniscus</i>		<i>Strombus Oniscus</i> , 502	
<i>Onyx</i>	<i>Cypraea onyx</i> , 305	Same, 346	
<i>opercularis</i>	<i>Ostrea opercularis</i> , 171	Same, 202	
<i>orbicularis</i>	<i>Ostrea orbicularis</i> , 179	Same, 210	
<i>orbicularis</i>	<i>Venus orbicularis</i> , 118	B subsp. of <i>Venus tigerina</i> , 141	
<i>ordinarius</i>	γ subsp. of <i>Conus Ammivalis</i> , 257	Same, 298	
<i>Orthocera</i>	<i>Nautilus Orthocera</i> , 249	Same, 289	Foraminifera, fossil
<i>Ovum</i>	<i>Bulla Ovum</i> , 327	Same, 369	
<i>Pagodus</i>	<i>Turbo Pagodus</i> , 537	Same, 616	
<i>pallens</i>	<i>Arca pallens</i> , 148	Same, 178	
<i>pallida</i>	<i>Bulla pallida</i> , 338	<i>Voluta pallida</i> , 405	<i>B. pallida</i> of 10th ed. unrecognizable unless Linnaeus thought it an immature <i>V. pallida</i> (fide Hanley)
<i>Pallium</i>	<i>Ostrea Pallium</i> , 163	Same, 193	
<i>palmipes</i>			<i>Lepas, Mantissa</i> , 544
<i>palustris</i>		<i>Strombus palustris</i> , 515	
<i>papalis</i>	<i>Voluta papalis</i> , 369	<i>V. (Mitra) papalis</i> , 426	So numbered in 12th ed.
<i>Paphia</i>	β subsp. of <i>Venus Dysera</i> , 93	<i>Venus Paphia</i> , 113	
<i>Papilio</i>		β subsp. of <i>Conus genus</i> , 302	
<i>papillosum</i>	<i>Buccinum papillosum</i> , 393	Same, 455	
<i>parva</i>	<i>Haliotis parva</i> , 653	Same, 746	
<i>patelliformis</i>		<i>Anomia patelliformis</i> , 222	
<i>patulum</i>	<i>Buccinum patulum</i> , 402	Same, 465	
<i>paupercula</i>	<i>Voluta paupercula</i> , 359	Same, 411	
<i>Pecten</i>	<i>Anomia Pecten</i> , 193	Same, 227	Fossil Brachiopoda
<i>pectinata</i>	<i>Anomia pectinata</i> , 184	Same, 217	Fossil Brachiopoda
<i>pectinata</i>	<i>Patella pectinata</i> , 669	Same, 765	
<i>pectinata</i>		<i>Pinna pectinata</i> , 264	
<i>pectinata</i>	<i>Venus pectinata</i> , 120	Same, 144	
<i>pectinatum</i>	<i>Cardium pectinatum</i> , 79	Same, 92	
<i>Pectunculus</i>	<i>Arca Pectunculus</i> , 150	Same, 180	
<i>Pediculus</i>	<i>Cypraea Pediculus</i> , 322	Same, 364	
<i>Pella</i>	<i>Arca Pella</i> , 142	Same, 172	
<i>pella</i>		<i>Helix pella</i> , 699	
<i>pellucens</i>	<i>Ostrea pellucens</i> , 166	Same, 196	
<i>pellucida</i>	<i>Patella pellucida</i> , 673	Same, 770	
<i>Peloronta</i>	<i>Nerita Peloronta</i> , 639	Same, 732	
<i>Penicillus</i>	<i>Serpula Penicillus</i> , 702	<i>Sabella Penicillus</i> , 814	Annelida

SPECIES	NAME AND NUMBER IN TENTH EDITION, 1758	NAME AND NUMBER IN TWELFTH EDITION, 1767	REMARKS
<i>Penis</i> ♀ <i>pennacea</i>	<i>Serpula Penis</i> , 701 <i>Pinna pennacea</i> , 230	Same, 806 <i>Sepia Loligo</i> , p. 1096; 4	Linnaeus recognized identity with <i>S. Loligo</i> in 12th ed.
<i>pennsylvanica</i> (sic)	<i>Venus Pennsylvanica</i> , 114	Same, 138	
<i>Perdix</i>	<i>Buccinum Perdix</i> , 378	Same, 440	
<i>Perna</i>	<i>Mya Perna</i> , 21	Same, 30	In <i>Perna</i> , new genus, rev. 12th ed.
<i>Perna</i>		<i>Ostrea Perna</i> , 213	
<i>Persicula</i>	<i>Voluta Persicula</i> , 352	Same, 404	
<i>persicum</i>	<i>Buccinum persicum</i> , 401	Same, 464	
<i>personatus</i>	<i>Turbo personatus</i> , 532	Same, 611	
<i>perspectivus</i>	<i>Trochus perspectivus</i> , 503	Same, 581	
<i>perspicua</i>	<i>Helix perspicua</i> , 620	Same, 712	
<i>pertusa</i>	<i>Voluta pertusa</i> , 367	Same, 424	
<i>perversa</i>	<i>Helix perversa</i> , 601	Same, 688	
<i>perversus</i>	<i>Murex perversus</i> , 485	Same, 557	
<i>perversus</i>	<i>Trochus perversus</i> , 523	Same, 602	
<i>perversus</i>	<i>Turbo perversus</i> , 567	Same, 650	
<i>Pes-felis</i>	<i>Ostrea Pes felis</i> , 165	Same, 195	
<i>Pes-lutrae</i>			<i>Ostrea</i> , Mantissa, 547
<i>Pes-pellicani</i>	<i>Strombus Pes pellicani</i> , 422	Same, 490	
<i>Petholatus</i>	<i>Turbo Petholatus</i> , 533	Same, 612	
<i>petulca</i>	<i>Venus petulca</i> , 97	Same, 120	
<i>pharaonius</i>	<i>Trochus pharaonius</i> , 506	Same, 584	
<i>pholadis</i>			<i>Mytilus</i> , Mantissa, 548
<i>Phryne</i>	<i>Venus Phryne</i> , 106	Same, 130	
<i>Physis</i>	<i>Bulla Physis</i> , 336	Same, 380	
<i>Pica</i>	<i>Turbo Pica</i> , 542	Same, 622	
<i>pictorum</i>	<i>Mya pictorum</i> , 19	Same, 28	
<i>Pileare</i>	<i>Murex Pileare</i> , 458	Same, 534	
<i>pilosa</i>		<i>Arca pilosa</i> , 182	
<i>pisiformis</i>	<i>Tellina pisiformis</i> , 54	Same, 69	
<i>Placenta</i>	<i>Anomia Placenta</i> , 205	Same, 241	
<i>planata</i>	<i>Tellina planata</i> , 40	Same, 52	
<i>Planorbis</i>	<i>Helix Planorbis</i> , 578	Same, 662	Phylum undet.
<i>planorbis</i>	<i>Serpula planorbis</i> , 691	Same, 792	
<i>Pleuronectes</i>	<i>Ostrea Pleuronectes</i> , 159	Same, 190	
<i>Plica</i>	<i>Ostrea Plica</i> , 162	Same, 192	
<i>plicaria</i>	<i>Voluta plicaria</i> , 366	Same, 423	
<i>plicata</i>	<i>Nerita plicata</i> , 642	Same, 735	
<i>plicataria</i>		<i>Mactra plicataria</i> , 95	
<i>plicatus</i>		<i>Spondylus plicatus</i> , 153	
<i>Plicatella</i>	<i>Anomia Plicatella</i> , 196	Same, 231	Fossil Brachiopoda
<i>plicatum</i>	<i>Buccinum plicatum</i> , 383	Same, 444	
<i>polita</i>	<i>Nerita polita</i> , 638	Same, 731	
<i>politum</i>		<i>Dentalium politum</i> , 788	
<i>politus</i>	<i>Turbo politus</i> , 570	Same, 653	
<i>Polythalamia</i>		<i>Serpula Polythalamia</i> , 802	
<i>Pomatia</i>	<i>Helix Pomatia</i> , 593	Same, 677	
<i>Pompilius</i>	<i>Nautilus Pompilius</i> , 233	Same, 273	One of 3 mollusks in <i>Nautilus</i> Linné; see <i>N. Crista</i> , <i>N. spirula</i>
<i>Pomum</i>	<i>Buccinum Pomum</i> , 379	Same, 441	
<i>poraria</i>	<i>Cypraea poraria</i> , 321	Same, 363	
<i>porcellana</i>	<i>Patella porcellana</i> , 657	Same, 750	

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<i>porphyria</i>	<i>Voluta porphyria</i> , 349	Same, 398	
<i>praemorsum</i>	<i>Buccinum praemorsum</i> , 408	<i>Buccinum praerosum</i> , 471	Name changed in 12th ed., no change of meaning
<i>praerosum</i>	<i>Buccinum praemorsum</i> , 408	<i>Buccinum praerosum</i> , 471	
<i>Princeps</i>	<i>Conus Princeps</i> , 256	Same, 297	
<i>prostrata</i>	<i>Venus prostrata</i> , 113	Same, 137	
<i>proximatum</i>			<i>Buccinum</i> , Mantissa, 550
<i>pubescens</i>		<i>Anomia pubescens</i> 234	Brachiopoda
<i>pubescens</i>	<i>Donax pubescens</i> , 83	Same, 103	
<i>puerpera</i>			<i>Venus</i> , Mantissa, 545
<i>Pugilis</i>	<i>Strombus Pugilis</i> , 430	Same, 498	
<i>pulligera</i>		<i>Nerita pulligera</i> , 726	
<i>Pullus</i>	<i>Buccinum Pullus</i> , 396	Same, 458	
<i>Pullus</i>	<i>Turbo Pullus</i> , 531	Same, 610	
<i>punctata</i>			<i>Cypraea</i> , Mantissa, 548
<i>punctata</i>	<i>Venus punctata</i> , 116	Same, 140	
<i>punctatus</i>	<i>Chiton punctatus</i> , 4	Same, 6	
<i>punctatus</i>	<i>Trochus punctatus</i> , 524	Same, 603	
<i>Pupa</i>	<i>Helix Pupa</i> , 609	Same, 700	
<i>Pupa</i>		<i>Nerita Pupa</i> , 727	
<i>pusillus</i>	<i>Pholas pusillus</i> , 14	Same, 24	
<i>Pusio</i>	<i>Murex Pusio</i> , 490	Same, 561	
<i>Pusio</i>	<i>Ostrea Pusio</i> , 169	Same, 200	
<i>Pustula</i>	<i>Patella Pustula</i> , 682	Same, 779	
<i>putris</i>	<i>Helix putris</i> , 614	Same, 705	
<i>Pyrum</i>	<i>Murex Pyrum</i> , 462	Same, 535	
<i>Pyrum</i>		<i>Voluta Pyrum</i> , 433	
<i>radiata</i>	<i>Tellina radiata</i> , 42	Same, 54	
<i>radiatus</i>	<i>Solen radiatus</i> , 28	Same, 38	
<i>Radicula</i>	<i>Nautilus Radicula</i> , 245	Same, 285	Foraminifera
<i>Radula</i>	<i>Murex Radula</i> , 499	Same, 575	
<i>Radula</i>	<i>Nerita Radula</i> , 630	Same, 721	
<i>Radula</i>	<i>Ostrea Radula</i> , 161	Same, 191	
<i>ramosus</i>	<i>Murex ramosus</i> , 448	Same, 523	
<i>Rana</i>	<i>Murex Rana</i> , 452	Same, 537	Cf. <i>Bubo</i> and <i>Rubeta</i>
<i>Rapa</i>	<i>Murex Rapa</i> , 476	<i>Bulla Rapa</i> , 383	
<i>Raphanistrum</i>	<i>Nautilus Raphanistrum</i> , 242	Same, 282	Foraminifera
<i>Raphanus</i>	<i>Nautilus Raphanus</i> , 243	Same, 283	Foraminifera
<i>reflexus</i>	<i>Turbo reflexus</i> , 555	Same, 638	
<i>regius</i>	<i>Spondylus regius</i> , 128	Same, 152	
<i>Remies</i>	<i>Tellina Remies</i> , 48	Same, 62	
<i>replicatus</i>	<i>Turbo replicatus</i> , 558	Same, 641	
<i>reticularis</i>	<i>Anomia reticularis</i> , 195	Same, 230	Brachiopoda, fossil
<i>reticularis</i>	<i>Murex reticularis</i> , 461	Same, 538	
<i>reticulata</i>	<i>Patella reticulata</i> , 680	Same, 777	
<i>reticulata</i>		<i>Tellina reticulata</i> , 63	
<i>reticulata</i>	<i>Venus reticulata</i> , 110	Same, 134	
<i>reticulata</i>		<i>Voluta reticulata</i> , 408	
<i>reticulatum</i>	<i>Buccinum reticulatum</i> , 411	Same, 476	Brachiopoda
<i>retusa</i>	<i>Anomia retusa</i> , 191	Same, 225	
<i>retusum</i>		<i>Cardium retusum</i> , 75	
<i>Ricinus</i>	<i>Murex Ricinus</i> , 464	Same, 540	
<i>ringens</i>	<i>Helix ringens</i> , 580	Same, 664	
<i>ringens</i>	<i>Serpula ringens</i> , 703	<i>Sabella ringens</i> , 811	Phylum undet.

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<i>rostrata</i>	<i>Tellina rostrata</i> , 43	Same, 55	
<i>rotundata</i>	<i>Pinna rotundata</i> , 226	Same, 267	
<i>rotundata</i>	<i>Venus rotundata</i> , 125	Same, 148	
<i>Rubecula</i>	<i>Murex Rubecula</i> , 459	Same, 536	
<i>ruber</i>		<i>Chiton ruber</i> , 7	
<i>ruber</i>	<i>Mytilus ruber</i> , 221	Same, 260	
<i>Rubeta</i>	$\gamma$ subsp. of <i>Murex Rana</i> , 452	$\gamma$ subsp. of <i>Murex Lampas</i> , 529	
<i>rudis</i>	<i>Pinna rudis</i> , 223	Same, 263	
<i>ruffina</i>		<i>Voluta ruffina</i> , 418	
<i>rufum</i>	<i>Buccinum rufum</i> , 385	Same, 446	
<i>rugosa</i>			<i>Chama</i> , Mantissa, 546
<i>rugosa</i>	<i>Donax rugosa</i> , 84	Same, 104	
<i>rugosa</i>			<i>Venus</i> , Mantissa, 545
<i>rugosum</i>			<i>Buccinum</i> , Mantissa, 549
<i>rugosus</i>		<i>Mytilus rugosus</i> , 249	
<i>rugosus</i>		<i>Nautilus rugosus</i> , 277	
<i>rugosus</i>		<i>Turbo rugosus</i> , 618	Foraminifera
<i>rustica</i>	<i>Patella rustica</i> , 676	Same, 773	
<i>rustica</i>	<i>Voluta rustica</i> , 358	Same, 410	
<i>rusticum</i>	<i>Cardium rusticum</i> , 78	Same, 91	
<i>Rusticus</i>	<i>Conus Rusticus</i> , 264	Same, 306	
<i>saccata</i>	<i>Pinna saccata</i> , 227	Same, 268	
<i>saccharina</i>	<i>Patella saccharina</i> , 660	Same, 754	
<i>Sandalinum</i>			<i>Anomia</i> , Mantissa, 547, fossil coral
<i>sanguinea</i>	<i>Ostrea sanguinea</i> , 167	Same, 198	
<i>sanguineus</i>	<i>Turbo sanguineus</i> , 543	Same, 623	
<i>Sanguisuga</i>	<i>Voluta Sanguisuga</i> , 364	Same, 419	
<i>sarmaticus</i>	<i>Turbo sarmaticus</i> , 540	Same, 620	
<i>satjata</i>		<i>Chama satjata</i> , 162	
<i>saxatilis</i>	<i>Murex saxatilis</i> , 450	Same, 525	
<i>scaber</i>	<i>Trochus scaber</i> , 510	Same, 588	
<i>scabra</i>	<i>Helix scabra</i> , 584	Same, 668	
<i>scabra</i>		<i>Sabella scabra</i> , 810	
<i>scabriculum</i>	<i>Buccinum scabriculum</i> , 412	<i>Voluta scabricula</i> , 417	
<i>scabriculus</i>	<i>Murex scabriculus</i> , 473	<i>Voluta cancellata</i> , 413 (q.v.)	
<i>Scalaris</i>	<i>Turbo Scalaris</i> , 548	Same, 630	
<i>Scalpellum</i>		<i>Lepas Scalpellum</i> , 16	Cirripedia
<i>Scarabaeus</i>	<i>Helix Scarabaeus</i> , 571	Same, 655	
<i>scobinata</i>	<i>Anomia scobinata</i> , 189	Same, 223	Brachiopoda
<i>scobinata</i>	<i>Tellina scobinata</i> , 49	Same, 64	
<i>Scorpio</i>	<i>Murex Scorpio</i> , 449	Same, 524	
<i>Scorpius</i>	<i>Strombus Scorpius</i> , 424	Same, 492	
<i>Scortum</i>	<i>Venus Scortum</i> , 103	<i>Donax Scortum</i> , 102	
<i>scripta</i>	<i>Donax scripta</i> , 88	Same, 109	
<i>scripta</i>	<i>Venus scripta</i> , 121	Same, 145	
<i>scriptus</i>	<i>Murex scriptus</i> , 496	Same, 570	
<i>Scrobilator</i>	<i>Murex Scrobilator</i> , 460	Same, 537	
<i>scruposa</i>		<i>Sabella scruposa</i> , 808	Phylum undet.
<i>semiaurita</i>	<i>Ostrea semiaurita</i> , 181	Same, 212	In <i>Perna</i> , new genus, in rev. 12th ed.
<i>Semi-lituus</i>	<i>Nautilus Semi-Lituus</i> , 240	Same, 280 ( <i>Semi lituus</i> )	Foraminifera
<i>Seminulum</i>	<i>Serpula Seminulum</i> , 690	Same, 791	Foraminifera
<i>semiorbiculata</i>	<i>Chama semiorbiculata</i> , 133	Same, 159	



SPECIES	NAME AND NUMBER IN TENTH EDITION, 1758	NAME AND NUMBER IN TWELFTH EDITION, 1767	REMARKS
<i>Senator</i>	<i>Conus Senator</i> , 258	Same, 300	
<i>senilis</i>	<i>Arca senilis</i> , 145	Same, 175	
<i>senticosus</i>	<i>Murex senticosus</i> , 474	Same, 546	
<i>serratum</i>	<i>Cardium serratum</i> , 73	Same, 89	
<i>siliqua</i>	<i>Solen Siliqua</i> , 24	Same, 34	
<i>Sipunculus</i>	<i>Nautilus Sipunculus</i> , 247	Same, 287	Foraminifera
<i>Smaragdulus</i>	<i>Buccinum Smaragdulus</i> , 404	Same, 468	
<i>Solaris</i>		<i>Trochus Solaris</i> , 593	
<i>solidula</i>	<i>Bulla solidula</i> , 346	<i>Voluta solidula</i> , 395	
<i>solidum</i>	<i>Cardium solidum</i> , 76	<i>Mactra solida</i> , 100	
<i>Spectru (sic)</i>	<i>Conus spectrum</i> , 280	Same, 321	
<i>Spelta</i>	<i>Bulla Spelta</i> , 329	Same, 372	
<i>Sprengheri</i>		<i>Mactra Sprengheri</i> , 94	Misspelling for <i>Spengleri</i>
<i>spinosa</i>		<i>Anomia spinosa</i> , 242	Brachiopoda, fossil
<i>spinosus</i>	<i>Conus spinosus</i> , 271	<i>Strombus spinosus</i> , 510	
<i>spiratum</i>	<i>Buccinum spiratum</i> , 405	Same, 469	
<i>spirillum</i>	<i>Serpula spirillum</i> , 692	Same, 793	Annelida
<i>spirillus</i>		<i>Murex spirillus</i> , 554	
<i>spirorbis</i>	<i>Helix spirorbis</i> , 588	Same, 672	
<i>spirorbis</i>	<i>Serpula spirorbis</i> , 693	Same, 794	Annelida
<i>Spirula</i>	<i>Nautilus Spirula</i> , 239	Same, 279	One of 3 mollusks in <i>Nautilus</i> Linné; see <i>N. crista</i> , <i>N. Pompilius</i> See <i>Bulla Cypraea</i>
<i>spurca</i>	<i>Cypraea spurca</i> , 317	Same, 359	
<i>squamosa</i>	<i>Venus squamosa</i> , 111	Same, 135	
<i>squamosus</i>		<i>Chiton squamosus</i> , 5	
<i>Squamula</i>	<i>Anomia Squamula</i> , 188	Same, 221	
<i>stagnalis</i>	<i>Helix stagnalis</i> , 612	Same, 703	
<i>stagnalis</i>		<i>Helix stagnalis</i> , 697	New in 12th ed. Repetition of name probably oversight
<i>staphylaea</i>	<i>Cypraea staphylaea</i> , 324	Same, 366	
<i>stercoraria</i>	<i>Cypraea stercoraria</i> , 289	Same, 330	
<i>Stercus-muscarum</i>	<i>Conus Stercus muscarum</i> , 269	Same, 311	
<i>stolida</i>	<i>Cypraea stolida</i> , 318	Same, 360	
<i>striata</i>		<i>Donax striata</i> , 106	
<i>striata</i>	<i>Haliotis striata</i> , 649	Same, 742	
<i>striatellus</i>	<i>Trochus striatellus</i> , 525	Same, 604	
<i>striatula</i>	<i>Anomia striatula</i> , 194	Same, 228	Brachiopoda, fossil
<i>striatula</i>	<i>Helix striatula</i> , 575	Same, 659	
<i>striatula</i>		<i>Mactra striatula</i> , 96	
<i>striatula</i>	<i>Ostrea striatula</i> , 157	Same, 188	
<i>striatulus</i>			<i>Mytilus</i> , Mantissa, 548
<i>striatulus</i>	<i>Turbo striatulus</i> , 552	Same, 635	
<i>striatus</i>	<i>Conus striatus</i> , 277	Same, 318	
<i>striatus</i>	<i>Pholas striatus</i> , 12	Same, 22	
<i>striatus</i>	<i>Trochus striatus</i> , 518	Same, 597	
<i>strigilatum</i>	<i>Buccinum strigilatum</i> , 418	Same, 484	
<i>strigilatus</i>	<i>Solen strigilatus</i> , 29	Same, 39	
<i>stultorum</i>	<i>Cardium stultorum</i> , 80	<i>Mactra stultorum</i> , 99	
<i>subcylindrica</i>		<i>Helix subcylindrica</i> , 696	
<i>subulatum</i>		<i>Buccinum subulatum</i> , 480	
<i>succincta</i>	<i>Cypraea succincta</i> , 306	Same, 348	<i>Venus</i> , Mantissa, 546

SPECIES	NAME AND NUMBER IN TENTH EDITION, 1758	NAME AND NUMBER IN TWELFTH EDITION, 1767	REMARKS
<i>succinctus</i>		<i>Strombus succinctus</i> , 509	
<i>succinctus</i>			<i>Murex</i> , Mantissa, 551
<i>summus</i>	β subsp. of <i>Conus Ammivalis</i> , 257	Same, 298	
<i>syracusanus</i>	<i>Murex syracusanus</i> , 494	Same, 568	
<i>Talpa</i>	<i>Cypraea Talpa</i> , 292	Same, 333	
<i>Tectum-persicum</i>	<i>Turbo Tectum persicum</i> , 536	Same, 615	
<i>Telescopium</i>	<i>Trochus Telescopium</i> , 521	Same, 600	
<i>tentaculata</i>	<i>Helix tentaculata</i> , 616	Same, 707	
<i>Terebellum</i>	<i>Conus Terebellum</i> , 284	<i>Bulla Terebellum</i> , 388	
<i>Terebra</i>	<i>Turbo Terebra</i> , 562	Same, 645	
<i>Terebratula</i>	<i>Anomia Terebratula</i> , 201	Same, 237	Brachiopoda
<i>Testiculus</i>	<i>Buccinum Testiculus</i> , 387	Same, 449	
<i>testudinaria</i>	<i>Cypraea testudinaria</i> , 288	Same, 329	
<i>Testudinaria</i>	<i>Lepas Testudinaria</i> , 7	Same, 14	Cirripedia
<i>testudinaria</i>	<i>Patella testudinaria</i> , 674	Same, 771	
<i>Textile</i>	<i>Conus Textile</i> , 278	Same, 319	
<i>Thermalis</i>		<i>Turbo Thermalis</i> , 629	
<i>tigerina</i>	<i>Venus tigerina</i> , 112	Same, 136	
<i>tigerina</i>	<i>Venus orbicularis</i> , 118	β subsp. of <i>V. tigerina</i> , 141	
<i>tigerina</i>		<i>Venus tigerina</i> , 141	
<i>Tigris</i>	<i>Cypraea tigris</i> , 302	Same, 343	
<i>Tintinabulum</i>	<i>Lepas Tintinabulum</i> , 6	Same, 12 ( <i>Tintinn-</i> )	Cirripedia
<i>tornatilis</i>	<i>Bulla tornatilis</i> , 342	<i>Voluta tornatilis</i> , 394	
<i>tortuosa</i>	<i>Arca tortuosa</i> , 139	Same, 168	
<i>torulosa</i>		<i>Murex torulosa</i> , 574	
<i>trapezia</i>		<i>Chama trapezia</i> , 158	
<i>Trapezium</i>	<i>Murex Trapezium</i> , 493	Same, 567	
<i>Tribulus</i>	<i>Murex Tribulus</i> , 444	Same, 519	
<i>tricarinata</i>		<i>Patella tricarinata</i> , 764	
<i>trifasciata</i>	<i>Tellina trifasciata</i> , 44	Same, 57	
<i>Tringa</i>	<i>Voluta Tringa</i> , 361	Same, 414	
<i>tripia</i>			
<i>triquetra</i>	<i>Serpula triquetra</i> , 694	Same, 795	<i>Venus</i> , Mantissa, 545
<i>triste</i>	<i>Cardium triste</i> , 74		Annelida
<i>Tritonis</i>	<i>Murex Tritonis</i> , 488	Same, 560	See <i>Mactra glabrata</i>
<i>truncata</i>		<i>Anomia truncata</i> , 229	Brachiopoda
<i>truncata</i>	<i>Mya truncata</i> , 16	Same, 26	
<i>truncata</i>		<i>Tellina truncata</i> , 60	
<i>Trunculus</i>	<i>Donax Trunculus</i> , 85	Same, 105	
<i>Trunculus</i>	<i>Murex Trunculus</i> , 447	Same, 522	
<i>Tuber</i>	<i>Trochus Tuber</i> , 517	Same, 596	
<i>tuberculata</i>	<i>Haliotis tuberculata</i> , 648	Same, 741	
<i>tuberculata</i>	<i>Patella tuberculata</i> , 666	Same, 760	
<i>tuberculatum</i>	<i>Cardium tuberculatum</i> , 65	Same, 81	
<i>tuberculatus</i>	<i>Chiton tuberculatus</i> , 2	Same, 2	
<i>tuberculatus</i>		<i>Strombus tuberculatus</i> , 514	
<i>tuberosum</i>	<i>Buccinum tuberosum</i> , 382	Same, 447	
<i>Tulipa</i>	<i>Conus Tulipa</i> , 282	Same, 323	
<i>Tulipa</i>	<i>Murex Tulipa</i> , 489	Same, 562	
<i>tumidula</i>			<i>Venus</i> , Mantissa, 546
<i>Turbinellus</i>	<i>Murex Turbinellus</i> , 466	<i>Voluta Turbinellus</i> , 430	
<i>umbilicaris</i>	<i>Trochus umbilicaris</i> , 514	Same, 592	
<i>umbilicatus</i>	<i>Nautilus umbilicatus</i> , 238	Same, 278	Foraminifera
<i>undata</i>	<i>Arca undata</i> , 149	Same, 179	

SPECIES	NAME AND NUMBER IN TENTH EDITION, 1758	NAME AND NUMBER IN TWELFTH EDITION, 1767	REMARKS
<i>undata</i>	<i>Nerita undata</i> , 645	Same, 738	
<i>undatum</i>	<i>Buccinum undatum</i> , 410	Same, 475	
<i>undosum</i>	<i>Buccinum undosum</i> , 409	Same, 472	
<i>Unedo</i>	<i>Cardium Unedo</i> , 68	Same, 84	
<i>ungarica</i>	<i>Patella ungarica</i> , 667	Same, 761	
<i>Unguis</i>	<i>Mytilus Unguis</i> , 210	Same, 247	
<i>unguis</i>	<i>Patella unguis</i> , 671	Same, 767	
<i>ungulatus</i>	<i>Mytilus ungulatus</i> , 216	Same, 254	
<i>ungulina</i>	<i>Helix unguлина</i> , 597	Same, 682	
<i>ungulinus</i>	<i>Turbo unguinus</i> , 564	Same, 647	
<i>urceus</i>	<i>Strombus urceus</i> , 440	Same, 512	
<i>Uva</i>	<i>Turbo Uva</i> , 553	Same, 636	
<i>Vagina</i>	<i>Solen Vagina</i> , 23	Same, 33	
<i>Vanelli</i>	<i>Cypraea Vanelli</i> , 295	Same, 336	
<i>varia</i>	<i>Haliotis varia</i> , 650	Same, 743	
<i>varia</i>	<i>Ostrea varia</i> , 168	Same, 199	
<i>variegatus</i>	<i>Turbo variegatus</i> , 563	Same, 646	
<i>varius</i>	<i>Conus varius</i> , 270	Same, 312	
<i>varius</i>	<i>Trochus varius</i> , 511	Same, 589	
<i>vermicularis</i>		<i>Serpula vermicularis</i> , 805	Probably Annelida
<i>verrucosa</i>	<i>Bulla verrucosa</i> , 330	Same, 373	
<i>verrucosa</i>	<i>Venus verrucosa</i> , 94	Same, 116	
<i>Vertagus</i>		<i>Murex Vertagus</i> , 571	
<i>Vespertilio</i>	<i>Voluta Vespertilio</i> , 371	Same, 428	
<i>vestiarius</i>	<i>Trochus vestiarius</i> , 515	Same, 594	
<i>Vibex</i>	<i>Buccinum Vibex</i> , 392	Same, 454	
<i>vicarius</i>		<i>Conus vicarius</i> , 299	
<i>virens</i>		<i>Solen virens</i> , 43	
<i>virgata</i>	<i>Tellina virgata</i> , 35	Same, 46	
<i>virginea</i>	<i>Nerita virginea</i> , 637	Same, 730	
<i>virginea</i>		<i>Venus virginea</i> , 150	
<i>virgineu (sic)</i>	<i>Buccinum virgineum</i> , 407	<i>Bulla virginea</i> , 390	
<i>virgineum</i>	<i>Cardium virgineum</i> , 81	Same, 93	
<i>Virgo</i>	<i>Conus Virgo</i> , 253	Same, 294	
<i>Virgo</i>		<i>Voluta Virgo</i> , 416	
<i>viridis</i>	<i>Mytilus viridis</i> , 220	Same, 259	
<i>viridis</i>	<i>Nerita viridis</i> , 636	Same, 729	
<i>Vitellus</i>	<i>Cypraea Vitellus</i> , 300	Same, 341	
<i>Vitellus</i>	<i>Nerita Vitellus</i> , 625	Same, 717	
<i>vittatum</i>		<i>Buccinum vittatum</i> , 483	
<i>vittatus</i>	<i>Strombus vittatus</i> , 439	Same, 508	
<i>Vivipara</i>	<i>Helix Vivipara</i> , 603	Same, 690	
<i>Volva</i>	<i>Bulla Volva</i> , 328	Same, 370	
<i>Vortex</i>	<i>Helix Vortex</i> , 583	Same, 667	
<i>vulgata</i>	<i>Patella vulgata</i> , 664	Same, 758	
<i>Vulpecula</i>	<i>Voluta Vulpecula</i> , 365	Same, 422	
<i>Vulsella</i>	<i>Mya Vulsella</i> , 22	Same, 31	
<i>Zebra</i>	<i>Cypraea Zebra</i> , 291	Same, 332	Identical with <i>C. Exanthema</i> , 1767, 325
<i>Ziczac</i>	<i>Cypraea Ziczac</i> , 307	Same, 349	
<i>Ziczac</i>	<i>Ostrea Ziczac</i> , 156	Same, 187	
<i>Ziczac</i>	<i>Venus Ziczac</i> , 119	Omitted in 12th ed.	Probably <i>V. cancellata</i> , 1767, 413
<i>Zizyphinus</i>	<i>Trochus Zizyphinus</i> , 520	Same, 599	
<i>zonaria</i>		<i>Helix zonaria</i> , 681	

APPENDIX A: SPECIES PLACED IN DIFFERENT GENUS IN TWELFTH EDITION (INCLUDING THOSE OF WHICH SPECIFIC NAMES ALSO CHANGED)

TENTH EDITION

*Mya crispata*, 15  
*Mya lutraria*, 18  
*Solen inaequivalvis*, 32  
*Cardium triste*,<sup>1</sup> 74  
*Cardium corallinum*, 75  
*Cardium solidum*, 76  
*Cardium stultorum*, 80  
*Cardium humanum*, 82  
*Venus scortum*, 76  
*Pinna pennacea*, 230  
*Nautilus crista*, 234  
*Conus spinosus*, 271  
*Conus terebellum*, 284  
*Bulla pallida*, 338  
*Bulla Auris judae*, 345  
*Bulla Auris midae*, 344  
*Bulla coffea*, 348  
*Bulla livida*, 347  
*Bulla solidula*, 346  
*Bulla tornatilis*, 342  
*Buccinum virgineum*, 407  
*Buccinum scabriculum*, 412  
*Murex Capitellum*, 465  
*Murex Ceramicus*, 470  
*Murex scabriculus*, 473  
*Murex Turbinellus*, 466  
*Murex Ficus*, 475  
*Murex Rapa*, 476  
*Murex Fusus*, 478  
*Nerita nodosa*, 628  
*Serpula Penicillus*, 702  
*Serpula ringens*, 703

TWELFTH EDITION

*Pholas crispata*, 25  
*Mactra lutraria*, 101  
*Tellina inaequivalvis*, 56  
*Mactra glabrata*, 97 (questionable)  
*Mactra corallina*, 98  
*Mactra solida*, 100  
*Mactra stultorum*, 99  
*Chama cor*, 154  
*Donax scortum*, 102  
*Sepia Loligo*, p. 1096, 4 (Vermees Mollusca)  
*Turbo nautilus*, 654  
*Strombus spinosus*, 510  
*Bulla terebellum*, 388  
*Voluta pallida*, 405 (?)  
*Voluta Auris judae*, 393  
*Voluta Auris midae*, 392  
*Boluta coffea*, 397  
*Voluta livida*, 396  
*Voluta solidula*, 395  
*Boluta tornatilis*, 394  
*Bulla virginea*, 390  
*Voluta scabricula*, 417  
*Voluta Capitellum*, 431  
*Voluta Ceramica*, 432  
*Voluta cancellata*, 413  
*Voluta Turbinellus*, 430  
*Bulla Ficus*, 382  
*Bulla Rapa*, 383  
*Strombus Fusus*, 489  
*Murex neritoideus*, 542  
*Sabella Penicillus*, 814  
*Sabella ringens*, 811

APPENDIX B: CHANGES OF SPECIFIC NAMES IN TWELFTH EDITION (INCLUDING CHANGES IN SPELLING)

TENTH EDITION

*Cardium triste*, 74  
*Cardium humanum*, 82  
 $\beta$  subsp. of *Venus Dysera*, 93  
*Venus orbicularis*, 118  
*Venus Ziczac*,<sup>2</sup> 119  
*Venus Lupinus*, 123  
*Ostrea Isognomum*, 176  
*Pinna pennacea*, 230  
*Nautilus crista*, 234  
 $\gamma$  or  $\delta$  subsp. of *Conus Capitaneus*, 254  
*Buccinum praemorsum*, 408  
*Murex scabriculus*, 473  
*Murex Granum*, 477  
*Murex lignarius*, 492  
*Nerita nodosa*, 628

TWELFTH EDITION

*Mactra glabrata*, 97 (?)  
*Chama cor*, 154  
*Venus Paphia*, 113  
 $\beta$  subsp. of *Venus tigerina*, 141  
*Venus cancellata*, 118 (?)  
 $\beta$  subsp. of *Venus exoleta*, 142  
*Ostrea Isognomum*, 214  
*Sepia Loligo*, p. 1096, 4 (Vermees Mollusca)  
*Turbo nautilus*, 654  
*Conus Generalis*, 293 (?)  
*Buccinum praerosum*, 471  
*Voluta cancellata*, 413  
 $\beta$  subsp. of *Murex canaliculatus*, 555  
*Murex lignarius*, 566  
*Murex neritoideus*, 542

<sup>1</sup> The identity of *Cardium triste* with *Mactra glabrata* is merely a guess on the part of some conchologists. If they are wrong, we must consider *Cardium triste* to

have been discarded by Linnaeus.

<sup>2</sup> The identity of *Venus Ziczac* with *Venus cancellata* is, in the same way, also questionable.

## INDEX TO SPECIES

The generic name, in parentheses, which follows each specific name, refers to the genus in which the species was placed in the twelfth edition of the "Systema naturae" (1767), or in the tenth edition (1758) in the cases where the specific name was abandoned in the twelfth, or in the "Mantissa" (1771).

- aculeatum (Cardium), 56
- aculeatus (Chiton), 20
- albida (Tellina), 43
- albus (Chiton), 22
- anatinus (Solen), 36
- anatinus (Mytilus), 217
- angulata (Tellina), 41
- antiquata (Arca), 149
- antiquata (Chama), 132
- antiquatus (Spondylus), 128
- arcinella (Chama), 140
- arctica (Mya), 31
- arenaria (Mya), 28
- balaustina (Tellina), 49
- balthica (Tellina), 51
- barbata (Arca), 144
- barbatus (Mytilus), 212
- bicornis (Chama), 139
- bidens (Mytilus), 215
- bilocularis (Mytilus), 210
- bimaculata (Tellina), 51
- borealis (Venus), 113
- bullatus (Solen), 37
- calyculata (Chama), 134
- cancellata (Venus), 93
- candidus (Pholas), 26
- cardissa (Cardium), 55
- carnaria (Tellina), 51
- casina (Venus), 93
- castrensis (Venus), 102
- cepa (Anomia), 200
- chione (Venus), 99
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